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S.C. SUPREME COURT

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF SOUTH CAROLINA
COLUMBIA DIVISION

Clyde Marcus, II; on behalf of himself and all others similarly situated,

Plaintiffs,

v.

Duke Energy Corporation and Duke Energy Carolinas, LLC,

Defendants.

Civil Action No.: 3:24-cv-1281-MGL

PLAINTIFFS' MEMORANDUM IN OPPOSITION TO DEFENDANT'S MOTION FOR SUMMARY JUDGMENT

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Plaintiff Clyde Marcus Jones, II, on behalf of himself and all those similarly situated, respectfully responds in opposition to Defendants Duke Energy Corporation, Inc. and Duke Energy Carolinas, LLC's (referred to collectively as "Defendant," or "Duke Energy") joint Motion for Summary Judgment. Because Defendant has not met its burden under Fed. R. Civ. P. 56 to demonstrate that no question of material fact exists, summary judgment must be denied.

I. Introduction

On August 9, 1997, *The State* published an article quoting a former Duke Energy employee who recalled that, as a teenager working mosquito control on Lake Wateree in the 1940s, he sprayed hundreds of barrels of highly toxic transformer oil as a larvicide. (EX 1, DUK_00104376). According to the article, since the 1940s, oil from electric company transformers routinely contained Polychlorinated Biphenyls ("PCBs"), carcinogenic toxic contaminants known to bioaccumulate in the environment. *Id.* The article warned of an imminent investigation by the South Carolina Department of Health and Environmental Control ("SCDHEC") regarding Defendant's use of contaminated oil as a larvicide in Lake Wateree. Defendant Duke Energy denied any such use and claimed it could not determine what substances it used in its mosquito control program in the 1940s because no records were available.

Despite Duke's denial, on August 13, 1997, Defendant sent employees Tim Hunsucker and Ron Santini to the shores of Lake Wateree to test the soil at the Lake Wateree Mosquito Control Facility, used by Defendant for decades to store chemicals**,** larvicides and other mosquito-control materials. Hunsucker and Santini collected soil samples from four locations on the property from the surface to a depth of eight feet. (EX 2, DUK_00104704 at 722). They field-tested the samples for two things: total petroleum hydrocarbons and PCBs. Starting at three feet below the surface,

three of the four samples tested positive for PCBs. The samples were then sent to an analytical laboratory, which confirmed the PCB contamination. (*Id.* at DUK_00104711-104722).

On September 8, 1997, Hunsucker returned to the Lake Wateree Mosquito Control Facility, this time with DHEC, for the agency's investigation into the allegations reported in *The State*. DHEC collected samples, but from depths of *less* than three feet below the surface. Defendant did not disclose to DHEC its August 1997 sampling conducted less than a month prior or the results of that testing, nor did Defendant ask DHEC to sample below three feet. (EX 3, Zachary Hall 30(b)(6) Dep., at p. 52:2-53:17). Defendant knew the soil above three feet would not test positive for PCBs.

Based on DHEC's September 8, 1997 test results, PCBs were excluded as contaminants of concern from the remediation plan approved by the agency. (*Id*. at 43:16-44:5). That plan called for the removal of hundreds of tons of soil, which was excavated and transferred to an independent third party. (EX 4, DUK_00104581). But neither DHEC nor the removal company knew the soil likely contained toxic PCBs. Had Defendant disclosed its earlier testing, those PCBs would have been required to be treated as contaminants.

The PCBs found on the shore of Lake Wateree resulted from Duke Energy's decades-long disposal of waste transformer oil as a larvicide in its mosquito control program. In 1997, Duke's mosquito control director Ken Manuel drafted a commemorative speech acknowledging use of transformer oil in the program. (EX 5, DUK_00000027). But after Duke Energy's August 1997 testing, the speech was never delivered, and the company never again acknowledged using toxic waste transformer oil in mosquito control.

Defendant Duke Energy has repeatedly denied that it used transformer oil as a mosquito larvicide across the reservoirs of the Catawba-Wateree Hydroelectric Project, including Lake

Wateree. Those denials are irreconcilable with Defendant's own internal records, communications, and correspondence.

In this litigation, Lake Wateree waterfront property owners seek to hold Defendant accountable for this toxic contamination and its resultant harm.

II. Factual Background

a. Duke Power Waste Disposal and Mosquito Control

Defendant began its Mosquito Control Program in 1923 in response to legal claims by lakefront homeowners who contracted malaria after Defendant built its hydroelectric dams. What began with water-level manipulation and vegetation management expanded by the 1930s to chemical larvicides, including Paris Green and DDT.

Defendant initially used No. 2 diesel fuel as a larvicide. In 1942, Defendant added waste oils—including crankcase oil, gas house oil, and transformer oil—to the program. (EX 6, DUK_00000185). Transported in 55-gallon drums, every year Defendant applied thousands of gallons of these oils along its reservoir shorelines, including Lake Wateree.

The use of transformer oil continued over the next several decades. In 1961—nearly two decades after being introduced—program director F.M. Boldridge requested thousands of gallons of transformer oil for Wateree Pond. (EX 7, DUK_00000643). That same year, consultant parasitologist Harold Brown reported that Defendant's spraying extended beyond obvious breeding areas, in part to assure nearby residents that Duke was actively controlling mosquitoes. (EX 8, DUK_00000530). Brown returned in 1968 and reported Defendant's oiling schedule called for application of a diesel, crankcase oil, and transformer oil mixture every eight days. (EX 9, DUK_00000536 at 540).

George Swearingen became program director in 1966. (EX 10, Jeff Lineberger 30(b)(6) Dep., 97:5-7). He held a Master of Science, was a registered sanitarian, and, by Defendant's own account, would have been able to identify environmental conditions presenting public-health concerns. *Id.* at p. 97:22-98:15. In August 1969, Duke representative W.T. Gill confirmed that he was transporting transformer oil for pond sanitation, and Swearingen thanked him for his continued cooperation in "assisting us in the removal of the used transformer oil in your area." (EX 11, DUK_00000170-171).

On May 4, 1970, at a mosquito-control workshop in North Carolina, Swearingen stated that Duke was then using a mixture of diesel fuel and transformer oil for mosquito control on its reservoirs. (EX 12, DUK_00000797-949). He further confirmed that the program operated consistently across North and South Carolina, where Duke's crews surveyed and treated 2,500 miles of shoreline. *Id.* at DUK_00000838. Before 1970, Duke's records did not distinguish between PCB-containing transformer oil and petroleum-based mineral oil. What the records do show is straightforward: from 1942 through at least 1970, Defendant knowingly used waste transformer oil as a mosquito larvicide.

b. PCBS in the Utility Industry

Monsanto introduced PCB-based dielectric fluid in 1930 as a nonflammable alternative to mineral oil. Because transformers and pole-top capacitors required dielectric fluid, PCBs quickly became common in the utility industry. (EX 13, Gann, R.G. "Development of Flammability Criteria for Transformer Dielectric Fluids," National Bureau of Standards, U.S. Dep't of Commerce, (1980). at pp. 2-4). Defendant adopted PCBs in the 1930s and eventually owned hundreds of PCB-filled transformers and nearly 100,000 PCB capacitors, together containing

hundreds of thousands of gallons of PCBs. Over time, those PCBs contaminated even non-PCB equipment and waste petroleum oils.

By the 1960s, public concern had shifted from pesticides like DDT to other persistent chemicals. In 1966, Sören Jensen identified PCBs as a worldwide contaminant of concern and described their persistence and toxicity in living organisms. (EX 14, Report of Robert Workman at p. 13); (*see also* EX 15 Jensen, S. New Scientist, "Report of A New Chemical Hazard," p. 612, Dec. 15 1966). In 1968, in the journal *Nature*, R.W. Riseborough further documented that PCBs were already widespread in the global ecosystem, accumulating in animal tissue, and threatening fish and bird populations. (EX 14 at p. 13); (*see also* EX 16, R.W. Riseborough, Nature, "Polychlorinated Biphenyls in the Global Ecosystem," Vol. 220, Dec. 14, 1968 at p. 1).

R.W. Riseborough's article, "Polychlorinated Biphenyls in the Global Ecosystem," marked a major turning point in the understanding of PCB persistence. *Id.* By the mid-1960s, the impact of PCBs on fish and birds was well understood. By 1968, PCBs were among the most abundant synthetic pollutants in the global environment, with the potential to decimate natural populations of birds and fish, as well as to accumulate in the fatty tissues of living creatures. *See, e.g.*, EX 16.

The toxicity of PCB exposure was well-documented in occupational settings as early as the 1930s and 1940s. Beginning in 1968, however, Monsanto publicly acknowledged broader environmental implications of PCBs. In February 1970, after reports that Aroclors 1254 and 1260[1] had been found in marine, aquatic, and wildlife environments, Monsanto warned customers that "all possible care should be taken in the application, processing, and effluent disposal of these products to prevent them becoming environmental contaminants." (EX 17, Monsanto Ltr. to

[1] Aroclors 1254 and 1260 were revealed in Defendant's August 13, 1997 test results from the Lake Wateree Mosquito Control Facility, and were consistent with the Aroclors used in Defendant's operations.

Customers, Feb. 8, 1970). Monsanto also highlighted emerging water-pollution standards requiring that industrial products containing PCBs should not reach waterways.

In July 1970, Monsanto limited PCB[2] sales to "closed systems" including transformers, continuing to supply the electric utility industry because of its dependence on PCBs. At the same time, Monsanto announced a disposal program for customers who could not otherwise destroy or regenerate used PCB fluids. (EX 18, Monsanto Ltr. to Customers, Jul. 1970). Thus, by 1970, both the manufacturer and its utility customers understood that waste PCBs required controlled disposal—not release into the environment.

Beginning in 1972, Defendant sent thousands of gallons of waste PCBs to Monsanto for incineration. (EX 19, DUK_00023353). Those records, together with Defendant's ownership of hundreds of PCB transformers and nearly 100,000 PCB capacitors, show that by the early 1970s Duke possessed substantial quantities of waste PCBs and understood they required specialized disposal. *Id.*; *see also* EX 10, Lineberger 30(b)(6) Depo. at 128:21-130:15. Yet before 1972, Defendant has no record of disposing of used transformer oil anywhere other than the lakes of the Catawba-Wateree Hydroelectric Project. Defendant's own documents, along with the testimony of Henry Beckham and William Beckham, support the inference that while Duke knew PCBs were environmentally toxic, it continued applying used transformer oil in mosquito control during the late 1960s and early 1970s.

c. PCB Contamination within Defendant's Utility System

[2] Industry members used PCB as vernacular for askarel. "PCB-filled" and "askarel-filled" thus refers to the same equipment. However, as Duke and other utilities realized, equipment and stores of oil that were not manufactured with PCBs were nevertheless considered "PCB" due to contamination and required specialized disposal. By 1978, the default in the utility industry was to treat all equipment and oil as PCB unless testing confirmed otherwise. Defendant's argument that it possessed comparatively few askarel-filled transformers is therefore a red herring.

By 1968, Defendant knew or should have known that PCBs in dielectric fluid were persistent toxic contaminants and that Defendant's waste transformer oil was likely PCB-contaminated. The utility industry routinely used the same pumps, hoses, filtration units, and storage tanks for both mineral oil and PCB-filled equipment, and Defendant has no record of any different practice or any separation of waste oils before 1974. (EX 14 , Workman Report, at ¶ 104).

By the late 1960s, the utility industry knew legislation restricting PCBs was imminent. (*Id.* at ¶ 92). In 1972, Congress enacted the Clean Water Act, 33 U.S.C. § 1251, *et seq*, and strengthened pesticide regulation through amendments to the Federal Insecticide Fungicide and Rodenticide Act, 7 U.S.C. § 136 ("FIFRA"). Meanwhile, Defendant's operations used hundreds of thousands of gallons of PCB-contaminated oil, as its later disposal records confirm, generating PCB waste on a massive scale. (*See e.g.* EX 20, DUK_00024009; EX 21 DUK_00024022, EX 22, DUK_00015348; EX 23, DUK_00015357). Duke did not come to possess this waste oil overnight. Rather, Duke generated these massive quantities of toxic waste oil over its 30-plus year use of PCBs.

In 1974, Defendant created an ad hoc committee to address its PCB problem, with George Swearingen as an original member. (EX 24, DUK_0099969-100104). After Congress enacted the Toxic Substances Control Act, 15 U.S.C. § 2601, ("TSCA") in 1976, Defendant adopted its first PCB disposal and prevention plan in 1978. (EX 25, DUK_00016374). That plan defined a spill as any accidental discharge of PCBs on land or in water and recognized that any spill of dielectric fluid from transformers and capacitors was a "PCB spill." *Id.* at DUK_00016381. It further instructed that spills into water be contained with an oil boom until the visible sheen disappeared. *Id.* Those instructions are inconsistent with Defendant's contention in this case that PCB-contaminated dielectric fluid used in mosquito control would have sunk immediately. *See* EX. 10

at 131:1-133:13. This also belies Defendant's argument that the only PCBs it possessed were pure and unadulterated. Rather, waste oil, including oil from leaks, spills, maintenance, and when equipment was put out of service were amalgamated.

Later versions of Defendant's PCB prevention plan expressly acknowledged its stores of PCB-contaminated mineral oil. Before those plans, Defendant's records largely used "transformer oil" to refer broadly to both petroleum-based mineral oil and askarel insulating fluid. (EX 14, Workman Report at ¶ 22). By 1968, however, Defendant was on notice that its mineral oil and mineral-oil-filled transformers were cross-contaminated with PCBs. Nevertheless, Defendant continued applying used transformer oil as a larvicide for at least two more years.

Defendant's PCB contamination problem persisted for decades. In 1992, Defendant still possessed hundreds of thousands of gallons of PCB-contaminated mineral oil. (EX 26, DUK_00030133) (of 203,900 gallons of waste mineral oil sent to Riverbend Steam Station for disposal, more than 150,000 gallons were PCB-contaminated). Defendant's only pre-1978 reference to "mineral oil" being used in its mosquito control program appears in George Swearingen's handwritten notes for his May 4, 1970 presentation confirming Duke's use of transformer oil for mosquito control. There, he noted that the mixture was "really about 99% mineral oil," although his presentation acknowledged that transformer oil was used (EX 27, DUK_00000295 at 297). By then, Duke personnel in Swearingen's position and maintenance staff would have understood that Duke kept no separate waste streams for PCB-oil and mineral oil and that the liquids were mixed. (EX 14, Workman Report ¶ 107). Once PCBs became recognized as a dangerous environmental contaminant, Duke personnel also understood the significance of that remaining 1%.

By 1974, the American National Standard Institute ("ANSI") had issued standards for handling PCB-containing insulating fluids. (*Id.* at ¶ 71). By 1978, EPA had adopted a presumption that mineral-oil-filled equipment was PCB-contaminated unless testing proved otherwise. (*Id.* at¶ 111). That regulatory presumption reflected the industry's widespread recognition that ordinary utility maintenance practices had rendered "transformer oil" inseparable from PCB waste.

Defendant's own 1978 testing confirmed widespread PCB contamination in its waste oil and equipment. (EX 10, Lineberger 30(b)(6) Dep., 64:11-66:7). Defendant also concedes that the utility industry knew mineral oil was cross-contaminated with PCBs before passage of the TSCA. (*Id.* at 79:23-80:2).

In a draft 1977 speech to the Middle Atlantic Mosquito Control Association, Swearingen acknowledged that Duke had been criticized in recent years for using the wrong insecticides, applying them poorly, and upsetting the ecosystem. (EX 28, DUK_00000289). He also recognized that Duke's mosquito-control program covered the 11 dams along the Catawba-Wateree basin. In contrast to his 1970 presentation, he omitted any mention of Duke's prior use of waste transformer oil.

After 1970, Swearingen never again publicly acknowledged Duke's use of waste transformer oil in mosquito control. At the same time, Duke's ad hoc PCB committee assigned him responsibility for reporting PCB spills across the system. (EX 24 at DUK_00100092). At a November 13, 1978 committee meeting, Swearingen warned that he and his assistant alone could not manage spill reporting for all of Duke Power and urged that additional personnel be trained. *Id.*

Defendant's PCB committee did more than respond operationally to contamination; it also sought to reduce the new regulatory burden. In 1983, Duke representatives met with EPA Region

IV to discuss the "practical problems" posed by existing and proposed PCB regulations. (*Id.*at DUK_00099991). Duke also worked through the Utility Solid Waste Activities Group ("USWAG") to influence EPA guidance on PCB spills and definitions. (*Id.* at DUK_00099978-79). Swearingen participated in those efforts from the committee's inception until the mid-1980s.

Taken together, the evidence demonstrates that while Defendant knew its transformer oil and mineral-oil waste streams were contaminated with PCBs, it continued applying that oil by the thousands of gallons along the shorelines of the Catawba-Wateree reservoirs, including Lake Wateree. Those applications placed PCB-contaminated oil directly into the reservoir environment for decades. There is more than enough evidence from Defendant's own records, later disposal practices, and the expert testimony in this case, for a reasonable jury to conclude that contamination of the reservoir was not accidental or unavoidable, but the foreseeable and singular result of Defendant's long-running mosquito-control practices.

d. Defendant Denies its Widespread Use of PCBs

In 2001, an EPA National Screening Study detected high levels of PCBs in fish tissues in reservoirs in the Catawba Basin, including South Carolina's Lake Wylie and Lake Wateree. (EX 29, DUK_00012433). In 2010, DHEC found PCBs in species of fish in Lake Wateree, Lake Wylie, Lake Norman, and Mountain Island—all lakes treated for mosquitos by Duke Energy. (EX 10, Lineberger 30(b)(6), 46:14-48:1); *see also* (EX 30, James Glover Dep., 148:7-150:19). Shortly thereafter, DHEC recommended fish consumption advisories for these reservoirs, noting that the reservoirs themselves, not the tributaries feeding the reservoirs, were contaminated.

In 2009, news stories reported widespread PCB contamination in the Catawba-Wateree Basin resulting in fish consumption advisories. (EX 29, DUK_00012433). In response, Ken Manuel, then-directors of mosquito control, disclaimed Defendant's former use of transformer oil.

(EX 31, DUK_00012445). In a 2010 email, Manuel stated that he had reviewed old company mosquito control documents, and that "there is nothing to indicate PCBs were ever used nor has DDT, which had been suggested by some." (EX 32, DUK_00012099). Manuel's statements directly contradict Defendant's historical record, as well as Manuel's own 1997 written history. *See* EX 5, DUK_00000027.

In 2011, Defendant prepared internal talking points to respond to inquiries about PCBs in Defendant's reservoirs. (EX 33, DUK_00023136). Per these talking points: "Duke Energy does not monitor for PCBs since it has never generated or manufactured PCBs, as they are not associated with power plant operations." *Id.* But Defendant's own documents demonstrate that Defendant possessed hundreds of thousands of gallons of waste PCBs and that Defendant historically owned and operated hundreds of PCB transformers and nearly 100,000 PCB capacitors. (*See e.g.* EX 26, DUK_00030133).

In 2022, Dr. James Glover and Dr. Deke Gundersen published a peer-reviewed article identifying Defendant's mosquito control program as the source of widespread PCB contamination in Lake Wateree. Dr. Glover affirmed this conclusion in his deposition, and further addressed and dispelled Defendant's hypotheses about alternative sources. (EX 30, James Glover Dep., 139:3-143:4). To date, Defendant has never acknowledged its role in contaminating these waters, or in harming the flora, fauna and biological resources of the lake, nor has Defendant acknowledged the impact this contamination has had on shoreline property owners. Defendant has leaned on these same shoreline owners, identifying them as crucial "stakeholders" in extending the life of Defendant's license to operate the Catawba Hydro-Electric Project issued by the Federal Energy Regulatory Commission ("FERC"). (*See* EX 34, 2006 Pamphlet Regarding FERC re-licensure).

Defendant should not be allowed to use these homeowners when convenient while simultaneously ignoring the impact of its conduct on homeowner rights.

Dr. Glover is a testifying expert in this case, alongside an additional liability expert, certified industrial hygienist Robert Workman, and two damages experts, economist Gretchen Greene, and licensed appraiser, Michael Tachovsky. The testimony of these expert witnesses, lay witnesses, and the documentary evidence have created questions of fact as to liability and damages for the jury to decide. As such, Defendant's motion for summary judgment must be denied.

III. Standard

Rule 56 of the Federal Rules of Civil Procedure provides that summary judgment will be granted only where the movant "shows there is no genuine dispute as to any material fact[.]" "[S]ummary judgment will not lie if the dispute about a material fact is 'genuine,' that is if the evidence is such that a reasonable jury could return a verdict for the nonmoving party." *Anderson v. Liberty Lobby, Inc.,* 477 U.S. 242, 248 (1986).

At summary judgment, "'the judge's function is not [herself] to weigh the evidence and determine the truth of the matter but to determine whether there is a genuine issue for trial.'" *Cricket Store 17, LLC v. City of Columbia*¸ 97 F.Supp.3d 737 (D.S.C. 2015) (quoting *Anderson*, 477 U.S. at 249). "In determining whether a genuine issue of material fact exists," a court must "view the facts and draw all reasonable inferences in the light most favorable to the non-moving party." *Hoschar v. Appalachian Power Co.*, 739 F.3d 163, 169 (4th Cir. 2014); *see also, e.g.*, *Wannamaker-Amos v. Purem Novi, Inc.*, 126 F.4th 244, 250 (4th Cir. 2025) ("At the summary judgment stage, a court must view the evidence in the light most favorable to the non-moving party and assume that the factfinder would resolve all genuinely disputed issues in her favor"); *Cricket*

Store 17, LLC, 97 F.Supp.3d 737, 744 (noting that factual disputes affecting the outcome of the suit under the governing law will properly preclude summary judgment).

The evidence in this case, including Defendant's own internal records and communications, and the testimony of its witnesses, supports a finding that genuine issues of material fact exist for a jury to decide. Therefore, Defendant's request for summary judgment must be denied.

IV. Argument and Citation to Authority

a. Defendant is Equitably Estopped from Asserting the Statute of Limitations.

As Duke Energy acknowledges in its motion for summary judgment, "[i]n South Carolina, a defendant may be estopped from claiming the statute of limitation as a defense if some conduct or representation by the defendant has induced the plaintiff to delay in filing suit." *Hedgepath v. AT&T*, 559 S.E.2d 327, 328 (S.C. 2001). "An inducement for delay may consist either of an express representation that the claim will be settled without litigation or *other conduct that suggests a lawsuit is not necessary*." *Id*. (emphasis added). Application of equitable estoppel is appropriate "if the plaintiff reasonably relied upon the words or conduct of the defendant in allowing the limitations period to expire." *Id.*

In this case, Defendant is equitably estopped from asserting the statute of limitations as a defense because, as explained below, it engaged in a decades-long campaign to conceal its contamination from putative class members. Duke Energy asks this Court, however, to rule on and reject Plaintiff's equitable estoppel argument *as a matter of law*. As this Court explained in its Order Granting in Part and Denying in part Defendant's Motion to Dismiss, ECF No. 55 at 7, "[w]hether the defendant's actions lulled the plaintiff into 'a false sense of security' is usually a question of fact." *Id*. at 339 (quoting *Dillon Cnty. Sch. Dist. No. Two v. Lewis Sheet Metal Works, Inc.*, 332 S.E.2d 555, 561 (S.C. Ct. App. 1985)); *see also, e.g.*, *Black v. Lexington Sch. Dist. No.*

Two, 488 S.E.2d 327, 330 (S.C. 1997) (explaining that "the issue whether a defendant is estopped from claiming the statute of limitations is ordinarily a question of fact" (citation omitted)). Summary judgment on the issue of whether a defendant is equitably estopped from asserting the statute of limitations is appropriate only "where there is no evidence of conduct on the defendant's part warranting estoppel." *Black*, 488 S.E.2d at 330 (citation omitted).

Here, there is ample evidence that Defendant concealed the harmful effects of its mosquito control program, leading putative class members to believe the program was safe and that no claim existed. Crucially, Defendant hid the results of its August 13, 1997 soil samples from the Lake Wateree Mosquito Control facility that were positive for PCBs. In a December 2006 pamphlet issued during relicensing of the Catawba-Wateree Hydroelectric Project, Defendant touted its stewardship of Lake Wateree—stating that "[m]ore than 30 studies addressed fish and other aquatic species . . . and how to better protect them[.]" *See* EX 34 at 3. The pamphlet also promoted expanded recreation opportunities and contributions to "support, protect and enhance fish and wildlife habitat[.]" *Id.* at 4-5. It omitted any mention of contamination, Duke's historic mosquito-control practices, or Duke's prior use of toxic transformer oil. Overall, the brochure conveyed that Duke was a responsible steward and that Lake Wateree faced no environmental problems traceable to Duke.

For years, Duke also assured putative class members and the public that its mosquito control program used only "safe and government-approved larvicide." (*See, e.g.*, EX 35, DUK_00004371; EX 36, Jones_001167; EX 37, DUK_0002434). Duke's internal talking points for the program's 85th anniversary similarly stated that the program used "a safe and government approved larvicide (Bti) that attacks only mosquito larvae." (EX 38, DUK_00004409). Missing from these public statements was any acknowledgment that Duke had historically used toxic, PCB-

contaminated transformer oil in the same program. Defendant prepared those talking points knowing media representatives would attend. *See id.* The omission was not incidental; it concealed a material part of the program's history.

After DHEC issued the first Lake Wateree fish-consumption advisory because of PCB contamination, Defendant prepared internal talking points for its public response. *See* EXs 39 and 36, (DUK_0014122, 0023136). Those talking points misrepresented Defendant's role in the contamination and omitted a critical fact: Duke possessed large volumes of PCB-contaminated transformer oil and used that oil in its mosquito control program. (*See* EX 10, Lineberger 30(b)(6) Dep. at 59:24-61:18); (EX 25, Duke Energy's Procedure for Marking, Storage and Disposal of PCB Materials and Pollution Prevention Plan). One set of talking points stated, "Duke Energy does not monitor for PCBs since it has never generated or manufactured PCBs, as they are not associated with power plant operations." *See* EX 33. That statement was materially misleading because it omitted Defendant's documented use of toxic transformer oil in mosquito control and further omitted Defendant's possession of hundreds of thousands of gallons of PCB-contaminated waste transformer oil used in its operations.

Another set of Duke talking points stated that Defendant investigated possible PCB contamination in 1993 and "found PCBs below detectable limits based on our study methodology and indicated no areas of gross PCB contamination." (EX 39). But Defendant conceded in its Rule 30(b)(6) deposition that its 1993 testing used a higher detection limit than that used for a fish-consumption advisory and "wasn't intended to determine if a fish consumption advisory was needed or not." (EX 10, Lineberger 30(b)(6) Dep. at 184:3-19). The "below detectable limits" public statement concealed the actual testing limits from class members. Defendant's internal response emphasizes this point. As media attention grew, one representative wrote: "This thing is

picking up steam in the media in both SC and NC . . . . **We need to mash the gas as much as possible** to get our Q&A document out . . . .” EX 40 (emphasis added), DUK_00014157. In short, Duke rushed out a reassuring – and false - public narrative to deflect responsibility for the fish advisory.

In 2013 Defendant issued a press release for the MCP’s 90th anniversary. (*See* EX 41, DUK_00011550). The press release specifically targeted shoreline homeowners, noting that Defendant used only a “safe and government-approved larvicide” for the program and failed to mention Defendant’s past use of toxic waste transformer oil. *See id.* Duke’s media contact confirmed in an email that these press releases were intended to pacify Lake Wateree homeowners (putative class members) about Duke’s mosquito control practices, stating: “I’m sure the people who live and play at these lakes are eternally grateful (and far less itchy).” *Id.*

Thus, Defendant systematically represented that its mosquito control program was safe and beneficial while concealing its use of toxic waste transformer oil as a larvicide. Those representations reasonably led Plaintiffs to believe a lawsuit was unnecessary. Contrary to Defendant’s assertion, the fish-consumption advisory would not have put homeowners on notice of a claim against Duke, particularly given Defendant’s longstanding misrepresentations about the contamination, its role in causing it, and its effects. As evidenced by Duke’s concealment of positive test results, and its internal talking points, Defendant continued disseminating information even after the first fish advisory to persuade the public that it was not responsible and that Lake Wateree was safe.

Furthermore, Defendant has continued its pattern of concealment *in this litigation*. After removal to this Court, Plaintiff issued his first set of requests for production on September 15, 2025. Under the Court’s operative scheduling order, discovery ended on April 3, 2026. ECF No.

103. On April 6, 2026, after the close of discovery, Defendant produced, for the first time, the positive test results from Defendant's August 1997 soil testing at the Lake Wateree Mosquito Control facility that confirmed PCB contamination. (*See* EX 2, Positive Test Results), and (EX 42, April 6, 2026 Service Email). The results were responsive to Plaintiff's first requests to produce, served in September, 2025, and constitute crucial evidence in this case. Yet Defendant failed to disclose them until after the discovery deadline. Defendant admitted that these positive results were never shared with DHEC – yet another willful concealment. (EX 3, Hall 30(b)(6) Dep. at 52:11-53:17).

There is more than sufficient evidence that Defendant's past and continuing misrepresentations about the safety of its mosquito control program preclude it from asserting the statute of limitations as a defense to Plaintiff's claims, and Duke is not entitled to summary judgment based on the statute of limitations.

b. South Carolina Law is Well Established that Physical Impact is not Required[3] for Plaintiff's Claims.

Defendant asks the Court to dismiss each of Plaintiff's claims by urging the Court to adopt a new rule requiring a physical invasion of property for *all* environmental torts. Duke Energy, however, acknowledges in its Motion to Certify that this is not the law in South Carolina. *See* ECF No. 115-1 at 7-9. This Court should decline Duke's invitation to adopt a sweeping new rule.[4]

[3] Though not required, a jury could nevertheless find evidence to support physical contamination. *See e.g.* EX 49, Butler Dep. at 122:17-123:3, where Defendant's liability expert, Dr. Eric Butler noted that PCBs sprayed in the water abutting lakeshore properties could constitute circumstantial evidence of property contamination based upon the physical propensities of PCBs.

[4] For the reasons set forth in Plaintiff's response in opposition to Defendant's Motion to Certify, this Court should also decline to certify the question of whether a physical invasion of property is required for all environmental torts to the South Carolina Supreme Court. For the sake of efficiency, Plaintiff incorporates its response in opposition to Defendant's Motion to Certify herein by reference.

The lake is the key feature and asset of lakefront properties on Lake Wateree. Duke Energy's own expert, Christina Brunk, acknowledged that "the lake is a huge draw[]" for the properties on Lake Wateree and that at least the majority of houses built on Lake Wateree were built there because of the lake. (EX 43, Christina Brunk Dep. at 143:10-21). Ms. Brunk further conceded Lake Wateree is known as a fishing destination. *Id.* at 61:5-13. Defendant's longstanding mosquito control practices contaminated Lake Wateree, causing harmful levels of PCBs to accumulate in the lake's fish and its aquatic environment. Plaintiff alleges that this contamination has resulted in loss of use and enjoyment of class members' properties and diminution in the value of these properties. Plaintiff's expert Dr. Gretchen Greene, a well-respected environmental economist, has explained and calculated Plaintiffs' damages for diminution in value and loss of use and enjoyment. (*See* EX 44, Dr. Gretchen Greene Expert Report). Further, Plaintiff's expert appraiser, Dr. Michael Tachovsky, has testified that physical contamination of a property is not necessary for the value of the property to be adversely affected by a nearby contaminant. (EX 45, Michael Tachovsky Dep. at 184:6-20).

Defendant concedes that physical contamination is not required under South Carolina law. *See* ECF No. 115-1 at 15. The case relied upon by Defendant in support of its contention that physical invasion *ought* to be required, *Chestnut v. AVX Corp.*, No. 2007-CP-26-7459, 2012 WL 10646711 (S.C. Comm. Pl. Mar. 9, 2012), does not support establishing such a sweeping new rule. As an initial matter, it is a trial court case with no precedential value in this Court or in South Carolina state court. More importantly, on appeal, the South Carolina Supreme Court upheld dismissal of the appellants' claims for nuisance and strict liability under South Carolina Appellate

Court Rule 220(c)[5] because those claims were not pled on behalf of the appellants, not because the appellants had failed to present evidence of physical contamination as Defendant represents. *Chestnut v. AVX Corp.*, 776 S.E.2d 82, 84 (S.C. 2015) ("Since each of these claims [nuisance and strict liability] was pled only on behalf of the Subclass A plaintiffs and not on behalf of appellants, we uphold the circuit court's dismissal of these two causes of action pursuant to Rule 220(c), SCACR."). The Court then reversed dismissal of the appellants' negligence claim on the ground that appellants had alleged diminution in value due to the proximity of their properties to contamination. *Id.*

South Carolina's strict liability framework for ultrahazardous activities also does not require physical impact. Rather, a plaintiff must demonstrate three elements: (1) that the defendant engaged in an ultrahazardous activity, (2) causation, and (3) damages. *See Wallace v. A. H. Guion & Co.*, 117 S.E.2d 359, 361 (S.C. 1960). As to the first element, "[w]hether an activity is abnormally dangerous must be determined on a case by case basis." *Ravan v. Greenville Cnty*, 434 S.E.2d 296, 305 (Ct. App. 1993). The inquiry turns on the inherent dangerousness of the activity—not on whether it produces a physical impact. *Id*. In *Wallace*, the Supreme Court rejected the argument that strict liability for blasting requires a physical invasion such as rocks or debris being thrown onto the plaintiff's property, holding instead that liability attaches for "consequential injuries occasioned by concussion or vibration to property . . . without the actual casting of material . . . ." 117 S.E.2d at 361.

[5] Rule 220(c), SCACR, provides: "The appellate court may affirm any ruling, order, decision or judgment upon any ground(s) appearing in the Record on Appeal." In relying on this rule to uphold dismissal of the appellants' claims for nuisance and strict liability, the Court was indicating that it was *not* affirming the dismissal for the reasons provided by the lower court.

Thus, Plaintiff's claims for negligence, nuisance, and strict liability[6] do not require proof of physical invasion under South Carolina law, and Defendant's argument that it is entitled to summary judgment on these claims for failure to show physical invasion should be rejected.

c. Defendant's Conduct Constitutes a Private Nuisance Impacting the Use and Value of Plaintiff and Class Members' Water-Front Properties

Defendant contends that Plaintiff's nuisance claim fails because, at best, Plaintiff alleges a public nuisance without any evidence of particularized harm. Plaintiff's claim, however, is for private nuisance, and, in any event, Plaintiff has presented evidence of specific and personalized harm caused by Defendant's contamination of Lake Wateree. Accordingly, summary judgment must be denied.

South Carolina law recognizes both private and public nuisance. To establish a private nuisance, a plaintiff must demonstrate that the defendant made unreasonable, unwarrantable, or unlawful use of his own property that substantially interfered with the plaintiff's use and enjoyment of his land. *O'Cain v. O'Cain*, 473 S.E.2d 460 (S.C. Ct. App. 1996); *Blanks v. Rawson*, 370 S.E.2d 890, 892 (S.C. Ct. App. 1988) (noting that a nuisance is anything which works hurt, inconvenience, or damages "and further that a nuisance can be any conduct…which interferes with the enjoyment of life or property"). The degree of inconvenience or interference is usually a question of fact for the jury to decide. *Shaw v. Coleman*, 645 S.E.2d 252 (S.C. Ct. App. 2007). For private nuisance, the question is whether the defendant's conduct has injured or interfered with the plaintiff's legal rights as a property owner. *Id.*, 645 S.E.2d at 258 (quoting *Lefurgy v. Long Cove Club Owners Ass'n, Inc.*, 443 S.E.2d 577, 579 (S.C. Ct. App. 1994) (noting that the lawful operation of a business may nevertheless constitute a private nuisance by the way it is conducted)).

[6] Plaintiff is no longer pursuing a cause of action for trespass.

Defendant argues that Plaintiff's claims arise solely from the fish-consumption advisories issued by DHEC and that those advisories affect Plaintiff no differently than the public at large. That argument ignores the critical fact that Plaintiff and the putative class members own waterfront property on Lake Wateree, which Defendant contaminated by discharging thousands of gallons of waste transformer oil into the lake over three decades. South Carolina law recognizes that waterfront property owners "possess a property right incident to their ownership of the bank and bed of a watercourse that is distinct from those rights that may be enjoyed by the public at large." *White's Mill Colony, Inc. v. Williams*, 609 S.E.2d 811 (S.C. Ct. App. 2005); *see also* ECF No. 55 at 9. Plaintiff therefore alleges a concrete, particularized injury tied to his unique property rights—not a generalized grievance shared equally by the public.

The record confirms this particularized injury. Plaintiff testified he can no longer use his waterfront property as intended, that his wife fears swimming in the water, and that he no longer eats fish from the lake. (EX 46, Marc Jones Dep, at 113:12–14). He further testified that PCB contamination has reduced his property's value and has depressed the value of lakefront properties on Lake Wateree. (*Id.* at 69:14–25; 73:14–20). Defendant's own witness, Jeff Lineberger, acknowledged that Defendant would be responsible for harm to waterfront homeowners if Plaintiff proves Defendant caused the contamination in Lake Wateree. (EX 47, Jeff Lineberger Individual Dep., 98:7–40). Defendant also publicly identified Lake Wateree waterfront homeowners as "stakeholders" who have input on Defendant's actions affecting the lake—an acknowledgment that these owners hold interests distinct from those of the general public. (EX 10, 30(b)(6) Jeff Lineberger Dep., 29:22–32:10). That distinction is further reflected in the very purpose of Defendant's mosquito-control practices on Lake Wateree, which were undertaken to address nuisance mosquitos affecting lakefront homeowners. Plaintiff also offers expert testimony from

Dr. Gretchen Greene and Dr. Michael Tachovsky that Defendant's conduct has diminished, and will continue to diminish, the value of Plaintiff's and the putative class members' properties. Dr. Greene has quantified both the percentage diminution in property value and the monetary value of the loss of use of the reservoir.

In short, Plaintiff has presented evidence that Defendant's contamination of Lake Wateree has directly impaired his distinct property rights, diminished the value of his waterfront property, and deprived him of the full use and enjoyment of that property. Those are concrete, particularized injuries sufficient to support Plaintiff's nuisance claim and to defeat summary judgment.

Moreover, South Carolina law permits a private plaintiff to sue for public nuisance when he suffers a "special injury" to his real or personal property—meaning "individual or specific damage in addition to that suffered by the public." *Carnival Corp. v. Historic Ansonborough Ass'n*, 753 S.E.2d 846 (S.C. 2014).

In *Carnival,* neighborhood associations and preservation societies sought injunctive relief based upon alleged harm to neighborhood character, traffic, congestion, noise, and air quality arising out of a cruise ship's operation at Charleston's Union Pier Terminal. *Id.* 753 S.E.2d at 849. The South Carolina Supreme Court held the associations lacked standing because they did not allege those harms in any "personal, individual way," but only as injuries shared with the public at large. *Id.* at 77, 753 S.E.2d at 851. That is precisely where *Carnival* differs from this case.

Plaintiff has shown exactly the kind of particularized injury missing in *Carnival*. He and the putative class members own waterfront property on Lake Wateree and have presented evidence that Defendant's dumping of toxic waste oil diminished the value of those properties and impaired the owners' use and enjoyment. Defendant's expert Christina Brunk likewise agreed that lakefront property derives substantial value from the lake itself. (EX 44, Christina Brunk Dep., 143:10–21).

This loss of use and diminution in value is not a generalized grievance shared equally by the public; it is a direct, property-based injury unique to waterfront owners. Plaintiff has therefore demonstrated a special injury sufficient to support standing and defeat summary judgment.

d. Causation is Clear: There is Ample Evidence Confirming that Duke Knowingly Contaminated Lake Wateree with PCBs.

Defendant asks the Court to grant summary judgment as to Plaintiff's negligence, nuisance and strict liability claims because, as Defendant argues, Plaintiff has "failed to produce evidence that Defendant caused the contamination in Lake Wateree." Consistent with its pattern throughout this motion, Defendant ignores the evidence of record (many of which are attached as exhibits) including documents verifying that Defendant used waste transformer oil as a larvicide, that Defendant knew its transformer oil was contaminated with PCBs, and that Defendant hid soil testing results from the Lake Wateree Mosquito Control Facility. Defendant's argument also completely disregards the opinions of Plaintiff's experts, Dr. James Glover and certified industrial hygienist Robert Workman. Finally, Defendant ignores the concessions of its own witnesses, including Jeff Lineberger, Zach Hall, and expert Dr. Eric Butler. In sum, the balance of the testimony, and evidence of record in this case, supports, a finding that Defendant is the source of PCB contamination in Lake Wateree, and it is actually Defendant who has failed to provide a viable alternative source.

1. There is ample evidence in the record that Duke's MCP was the proximate cause of PCB Contamination.

As Defendant notes, for both nuisance and negligence claims, South Carolina law requires the Plaintiff to demonstrate that Defendant's conduct was a proximate cause of the harm. *See, e.g.*, *Oliver v. S.C. Dep't of Highways & Pub. Transp.*, 422 S.E.2d 128 (S.C. 1992) (noting that proximate cause requires proof of causation in fact and legal cause). Causation in fact is proved by "establishing the injury would not have occurred 'but for' the defendant's negligence." *Id*. 422

S.E.2d at 130 (quoting *Whitlaw v. Kroger Co.*, 410 S.E.2d 251, 253 (S.C. 1991)). Meanwhile, "[l]egal cause is proved by establishing foreseeability…looking to the 'natural and probable consequences' of the complained of act." *Oliver*, 422 S.E.2d at 131.

Defendant argues that Plaintiff has no evidence that Defendant's conduct was the source of Lake Wateree's PCB-contamination or that Defendant was unreasonable in causing that contamination. To the contrary, ample evidence exists on which a reasonable jury could find that Defendant's spraying of contaminated oil is the source of PCB contamination in Lake Wateree.

Plaintiff identified biologist James Glover has a liability expert in this case. Dr. Glover's career has focused on aquatic ecology and environmental and public health. (*See* EX 48, Report of Dr. James Glover at p. 1). Dr. Glover began his work with DHEC in the early 1990s, eventually managing the agency's Water Monitoring and Aquatic Biology sections until his retirement in 2017. *Id*. Glover was involved in environmental contamination and source investigations including several involving PCB-contamination. *Id.* He has served as an adjunct professor at Clemson University's Department of Toxicology. *Id.* Dr. Glover focused his career on environmental monitoring of wetlands, freshwater, streams, rivers, reservoirs, estuaries, and other marine ecosystems, including conducting fish tissue monitoring and analysis, namely for mercury and PCBs. *Id*. at p. 2.

In 2022, Dr. Glover published a peer reviewed article related to widespread PCB contamination in Catawba-Wateree basin reservoirs. *Id.* Using spatial analysis, historic fish tissue PCB data, additional fish tissue samples, and historic literature, Dr. Glover determined: "the widespread contamination found in Lake Wateree was the result of past mosquito control activities which were carried out by Duke Energy." *Id.* at 3. Dr. Glover's publication and report in this case also address the improbability of other sources, finding that fish in Catawba reservoirs upriver of

past industrial activities also had elevated levels of PCBs in their tissues, eliminating these past industrial sites as potential sources. *Id*. at 8. During his deposition, Dr. Glover considered and dispelled each of Defendant's alternative source proposals, set forth in the report of Dr. Eric Butler. (EX 30, James Glover Dep., 139:3-143:4). Dr. Glover's 2022 publication was subject to peer review, which is the gold standard for ensuring the credibility of scientific scholarly work. EX 48, Glover Report at p. 9.

Defendant's own expert, Dr. Eric Butler, conceded that Defendant's operations could be the source of PCB-contamination in Lake Wateree. (EX 49, Dr. Eric Butler Dep., 65:8-18). In fact, Butler admitted that Defendant sprayed "substantial amounts" of oil on Lake Wateree in the name of mosquito control, including waste transformer oil, and that the oil sprayed in Defendant's mosquito control program could have been contaminated with PCBs. (*Id*. at 129:6-20; 134:5-15). Defendant's motion wholly ignores the concessions of its own liability expert.

Plaintiff also identified as an expert certified industrial hygienist Robert Workman, who opined that Defendant knew by 1968 that PCBs were toxic and had pervaded Defendant's petroleum-based mineral oil and non-PCB equipment. (EX 14, Workman Report at ¶¶ 103-112). Workman also opined that from 1968 until 1972, Defendant knew that its waste transformer oil, applied as a larvicide, contained PCBs. *Id.* at ¶ 115. Defendant's knowledge resulted in a critical overlap between 1968 and 1972 when Defendant knew its waste transformer oil contained toxic PCBs but continued to use this waste transformer oil as a mosquito larvicide in the Catawba-Basin reservoirs. *Id*. at ¶¶ 115-125.

Correspondence from Monsanto to customers (including Duke Power) regarding PCB bioaccumulation confirms that by the late 1960s, companies such as Duke Power who relied on PCB-containing oil for their operations knew of its toxicity. (*See e.g.* EXs 17 and 18). As a rule,

utilities utilized a shared infrastructure and did not have separate waste streams for their transformer oil waste. (EX 14, Workman Report at ¶¶ 28, 46, 104). By 1970, the electric utility industry's PCB problem, including mineral oil cross-contamination, was public knowledge. (*Id.* at ¶ 28). Defendant has no records of what was done with PCB-containing waste oil prior to passage of the TSCA, or whether any testing was performed of the oils to eliminate concern for PCB-contamination. (EX 10, Lineberger 30(b)(6) Dep., p. 69:19 – 71: 15, 109:5-116:17). Defendant has admitted, however, that it used waste transformer oil in its mosquito control program during a time when that oil contained PCBs. Defendant has also admitted that the industry would have been aware of the PCB problem prior to passage of the TSCA. (*Id.* at p. 79:11-80:2). PCB-waste disposal logs post-dating the Act confirm that Defendant possessed hundreds of thousands of gallons of PCB-waste oil. *See e.g.* EXs, 19 through 23. Finally, Defendant hid the results of its 1997 soil testing from the Lake Wateree Mosquito Control Facility positive for PCBs and never re-tested the soil to the same depths again.

As reflected above, Plaintiff has presented evidence and expert testimony that Defendant's use of PCB-contaminated waste oils is the source of PCB contamination in Lake Wateree, and that Defendant knowingly disposed of contaminated waste transformer oil into its reservoirs, including Lake Wateree. A reasonable jury could therefore find Defendant is responsible for the resulting harm. Based upon the evidence, summary judgment regarding Plaintiff's nuisance, negligence, and strict liability claims must be denied.

2. Dr. Butler's alternative source hypothesis is speculative and misleading.

Defendant leans heavily on its causation expert, Dr. Butler, claiming that his report and deposition testimony show "*undisputed* evidence of *numerous* third-party sources of PCBs potentially impacting Lake Wateree," which include "well characterized sites in both Brownfield and Superfund programs." ECF No. 112-1 at 15 (emphasis in original). Respectfully, Defendant is

intentionally misleading the Court. As Dr. Butler admitted in his deposition, many of the "known and potential sources of PCB contamination" identified in his expert report are not sources at all. Stated simply, Butler presents no evidence that Lake Wateree's PCB contamination came from any source other than Defendant's mosquito control practices, and a reasonable jury could conclude that Duke is not only a source of PCB contamination, but *the* source.

In Table 3.1 of Dr. Butler's report, he lists what he calls "known and potential sources of PCBs in the Catawba-Wateree Basin" claiming that they, and not Duke Energy, likely caused the contamination. ECF No. 90-11 at 10. The alternative sources include two EPA Superfund sites, Rock Hill Chemical and Carolawn. *Id.* What Dr. Butler's report omits is that PCBs *are not contaminants of concern at either site*. *See* EX. 49-1 at 4 (9/14/21 EPA Report for Rock Hill Chemical Co. Superfund Site identifying 1,2-Dichloroethene, Trichloroethene, Vinyl Chloride, and Manganese as Contaminants of Concern); EX. 49-2 at (9/2023 EPA Report for Carolawn Superfund site identifying lead and other Contaminants of Concern). During his deposition, Dr. Butler admitted this reality. Ex. 49, Butler Dep., 111-14; *see also id.* at 116:11-14 (Q. "No, but the EPA considered the Carolawn Superfund site to not have PCBs as a contaminant of concern, correct? A. That's true."); *id.* at 77:7-14 (same for the Rock Hill Chemical Co. site).[7]

[7] In his deposition, Dr, Butler admitted that he had not reviewed the EPA Records of Decision for either of the two Superfund Sites he listed. Ex. 49, Butler Dep. 68:18-22 ("Q. Have you reviewed the Records of Decision for the Rock Hill Chemical site and the Carolawn site? A. I have not."). Dr. Butler also admitted that the research on the "potential" sources was conducted by his staff at Gradient Consulting. *Id.* at 204:21-25. An extensive review of EPA records shows that while PCBs were first detected in some tests on the two sites, after the initial waste removal, the EPA did not consider PCBs to be contaminants of concern. Dr. Butler's report intentionally omits this key detail, creating the misleading impression that these two Superfund sites are massive PCB toxic waste dumps contributing to Lake Wateree's contamination even today.

Dr. Butler also lists the Catawba Paper Mill and the "Charlotte metropolitan area" as potential sources of PCBs in Lake Wateree. Dkt. 90-11 at 10-11. But Dr. Butler admitted in his deposition that he was unaware of any PCB tests or spill events from either of these "potential sources." As Dr. Butler testified:

> Q. And you list Catawba Paper Mill, but you don't have any reason to believe that -- or you've not seen any studies that show that the Catawba Paper Mill caused PCB contamination of the Catawba-Wateree Basin.
>
> A. Well, I don't have any data specific to Catawba Paper Mill to inform that decision. But there have been numerous paper mills in the United States that have been studied, and most of them, or many of them, have been associated with PCB contamination.

Ex. 49, Butler Dep. 59:12-17.[8] Similarly, Dr. Butler speculated that "being downstream from a major metropolitan area like Charlotte is likely to receive inputs of PCBs from the region," *id.* 105:13-22, but also admitted that he was unaware of any PCB spills coming from Charlotte. *See id.* at 105:23-25 ("Q. But you don't have any examples of large PCB spills coming from the city of Charlotte. A. I don't.").[9]

In sum, Dr. Butler's alternative source explanations are misleading, at best speculative, and certainly not "undisputed." The Court should not credit them when deciding whether a reasonable

[8] It is ironic that Dr. Butler claimed his knowledge of the paper industry as "associated with PCB contamination" informs his belief that a former paper mill is a potential source of PCBs in Lake Wateree, yet he hesitates to make the same logical leap as to Duke Energy. This is despite Duke's widespread use of PCBs in electrical transformers and capacitors, and its corporate documents reflecting the junking of equipment and spraying of "transformer oil" in the Mosquito Control Program in its own reservoir. *See, e.g.,* EX 11, DUK_00000170-171 (1969 letters discussing "equipment to be junked" and "old transformer oil to be used for pond sanitation in various places on the system"). A reasonable jury would not be so inclined to ignore these obvious facts.

[9] The three brownfield sites cited by Dr. Butler are similarly speculative, as they are all located at least 30 miles from Lake Wateree, with the Spring Mill site in Lancaster being the closest. And none are located on the water.

jury could conclude, based on the extensive direct and circumstantial evidence, that Duke Energy proximately caused the PCB contamination of its own reservoir.

e. Defendant's Claim That There is No Evidence of Damages Lacks Merit Because Plaintiff Has Produced Two Expert Reports on Damages.

Duke Energy represents that the "record is bereft of any evidence of damages" and seeks summary judgment on this ground. ECF No. 112-1 at 36. That is simply untrue. Plaintiff has produced expert reports of two highly-qualified experts to support the damages in this case.

Plaintiff has produced an expert report of Dr. Michael Tachovsky, a certified appraiser with extensive experience in matters involving environmental contamination, including in the class action context and PCBs specifically. Dr. Tachovsky's report sets forth an analysis of the unimpaired value of the properties in the proposed class. *See* EX 50, Report of Dr. Michael Tachovsky. Dr. Tachovsky calculates the total unimpaired value of the class properties to be $1,207,55,412.

Plaintiff has also produced the expert report of Dr. Gretchen Greene. *See* EX 44. Dr. Greene is an environmental economist who specializes in natural resource damage assessments. In her report, Dr. Greene concludes that the fish consumption advisory linked to PCB contamination in Lake Wateree has diminished the value of the class properties by an average of twelve percent from the unimpaired values calculated by Dr. Tachvosky. Dr. Greene opines the total amount of diminution in value of the class properties resulting from the fish consumption advisory is approximately $144 million. *Id.* at 3-6. Dr. Greene also calculates damages for loss of use and enjoyment, which she determines to be $2.7 million. *Id.* at 6-8. Plaintiff has also testified under oath as to how the contamination impacted his property use and that of his family. (*See* EX 46, Jones Depo. Excerpt). In addition, fact witness Deborah Phillips testified that she disclosed the fish-consumption advisory when she and her husband sold their Lake Wateree waterfront home

because it materially affected the property's value. (*Id*., 57:15-58:4). The expert opinions of Dr. Tachovsky and Dr. Greene, as well as the testimony of fact witnesses, constitute competent and sufficient evidence of Plaintiff's damages; the record is certainly not "bereft" of evidence as Defendant contends. In contrast, Defendant has failed to present any expert opinion in this case regarding the value of the class properties or the amount of impairment caused by the fish consumption advisory.

Defendant claims that damages in this case are limited to lost rental value or usable value of the properties because, according to Defendant, Plaintiff is alleging a temporary injury to property. In support of this contention, Defendant relies on a paragraph in Plaintiff's prayer for relief in the First Amended Complaint that requests damages for remediation costs, but the First Amended Complaint repeatedly alleges the permanent nature of the contamination and injury, *see* ECF No. 38 ¶¶ 16, 33, 94, 125, 138, 148, 151, 168. Although Plaintiff pled remediation costs in the First Amended Complaint in the alternative, Plaintiff is no longer seeking remediation costs and is in fact alleging permanent injury to the class properties. *See* Fed. R. Civ. P. 8(a)(3) (providing that a pleading must contain "a demand for the relief sought, which may include relief in the alternative of different types of relief"); *see also, e.g.*, *Hayes v. Prudential Ins. Co. of Am.*, 60 F.4th 848, 855 (4th Cir. 2023) ("But Federal Rule of Civil Procedure 8(a)(3) specifically permits pleading 'in the alternative[.]'").

The fish consumption advisory at issue in this case was issued due to the presence of PCBs in the fish of Lake Wateree. As explained in the First Amended Complaint and in the expert report of Certified Industrial Hygienist Robert Workman, PCBs are "forever chemicals" that persist in the environment and bioaccumulate in organisms, including fish and humans. *See* EX 14, at ¶¶ 30-34. If remediation were even possible at all, which Plaintiff doubts, it would be cost prohibitive,

exceedingly difficult, and, to say the least, impractical. Distinguishing between a temporary and permanent injury to property might sometimes be difficult, but not in this case. Wherever the line might be, contamination from a "forever chemical" certainly qualifies as a permanent injury to property. Because Plaintiff is alleging a permanent injury to property, the damages in this case are not limited to lost rental value or usable value as Defendant posits.

Defendant also argues it is entitled to summary judgment because Plaintiff is seeking "stigma damages" that Defendant believes should be unrecoverable under South Carolina law. Defendant fails to define stigma damages, so it is unclear whether Plaintiff is even seeking what Defendant considers "stigma damages." But regardless of the definition, as stated above, Plaintiff seeks damages for diminution in value and loss of use of enjoyment of property caused by Defendant's conduct. Plaintiff has presented competent expert evidence of these damages, and summary judgment is, therefore, inappropriate.

Furthermore, in seeking certification to the South Carolina Supreme Court of the question whether stigma damages are compensable, Defendant admits there is no controlling South Carolina precedent holding stigma damages may not be recovered, however they may be defined. *See* ECF No. 115-1 at 12-13. For the reasons set forth in Plaintiff's opposition to Defendant's Motion to Certify, which is herein incorporated by reference, this Court should decline to adopt a rule regarding stigma damages and should decline to certify a question on stigma damages to the Supreme Court.

Lastly, Defendant avers it is entitled to summary judgment because Plaintiff's damages calculations provided by Dr. Greene are speculative (even though Defendant also claims Plaintiff has failed to provide any evidence on damages). Defendant's argument goes to the weight and credibility of Plaintiff's expert's damages opinion, which may not be decided by the court on

summary judgment. *See, e.g.*, *Sedar v. Reston Town Center Prop., LLC*, 988 F.3d 756, 761 (4th Cir. 2021) ("[C]ourts must view the evidence in the light most favorable to the nonmoving party and refrain from weighing the evidence or making credibility determinations." (quotations omitted) (citation omitted)).

Because Plaintiff has presented expert opinions on the damages in this case, Defendant's argument that it is entitled to summary judgment due to the lack of any evidence regarding damages lacks merit and should be rejected.

V. Conclusion

The record in this case, including the testimony, documents, and reports, contains more than sufficient evidence to create questions of fact as to Defendant's culpability in knowingly contaminating Lake Wateree. Based upon these questions of fact, a reasonable jury could find Defendant responsible for this contamination and the resultant harm. Accordingly, Defendant's motion for summary judgment must be denied.

Respectfully submitted,

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Dated: June 5, 2026

Exhibit 1
DUK_00104376 – DUK_00104377
1997 Article: The State

Newspapers by ancestry
https://www.newspapers.com/image/753088141/
The State (Columbia, South Carolina) · Sat, Aug 9, 1997 · Page 15
Downloaded on Feb 11, 2026

1940s tales, risk of PCBs spur probe at Wateree

By SAMMY FRETWELL
Staff Writer

During hot, sticky summers 50 years ago, college students sprayed an oily substance on Lake Wateree that today is creating a stir.

One of those men says he and several partners emptied hundreds of barrels of highly toxic transformer oil into the water while working a summer job controlling mosquitoes for Duke Power Co.

His partners that summer say they only pumped motor oil on the lake, a common method at the time for killing mosquito larvae. Duke Power says it has no records to show what material was put on the water in the 1940s.

State health regulators don't know what to think. But for the past several weeks, the Department of Health and Environmental Control has spent time sifting through the stories.

A DHEC criminal investigator interviewed three former students, now long-since retired from full-time jobs, and a Lake Wateree recreation shop manager last week.

Friday morning, the investigator visited a spot on Lake Wateree where the dumping is said to have happened most often. That spot is in Kershaw County just west of the S.C. 97 bridge in an arm of Lake Wateree known as Beaver Creek.

"The only thing I can tell you officially is we are conducting an investigation based on information we have received from a citizen," DHEC spokesman Thom Berry said. "They are allegations of improprieties and some possible dumping issues in Kershaw County."

DHEC launched its probe after hearing the story of Bruce McIsaac, a retired plant worker who says he distinctly remembers applying transformer oil to the lake. McIsaac had mentioned it to local merchant Rock Savage, who,

PLEASE SEE **WATEREE** PAGE **B2**

PCB facts

State environmental investigators are checking into a man's claim — disputed by co-workers — that he sprayed PCB-laden waste into Lake Wateree in the late 1940s.

- Polychlorinated biphenyls, or PCBs, were used widely for decades to help cool electrical transformers.
- Congress banned the manufacture of PCBs in the late 1970s, citing evidence that they cause liver and stomach cancer, skin lesions and nervous disorders.
- PCBs are a threat if ingested over time. That often occurs by eating fish tainted with sufficient amounts of the material.
- PCBs have been found in Lake Wateree fish, but not in amounts considered harmful.

Clipped By:
Plauditus
Feb 22, 2024

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The State (Columbia, South Carolina) · Sat, Aug 9, 1997 · Page 16
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WATEREE

FROM PAGE B1

along with a free-lance reporter, started asking questions of DHEC.

In the 1940s, oil from electric-company transformers routinely contained PCBs, a carcinogenic substance not produced in the United States since 1976. PCBs cooled transformers that converted power supplies for homes.

"We put out 50 55-gallon drums of transformer oil a day," said McIsaac, 70, who says he worked the summer job in 1947 and 1948. "Most of it occurred right before the mouth of Beaver Creek."

The Lancaster County resident said he knows Duke's mosquito-control program used transformer oil because a company supervisor told him what the material was. The supervisor has since died.

PCBs are suspected of causing cancer. They can persist in the environment for 50 years or more, experts say. At Lake Hartwell, near Anderson, DHEC discourages people from eating some fish species because of PCB contamination that occurred decades ago.

PCBs have also been found in some species of Lake Wateree fish, but the amount has not been high enough to prompt health warnings, DHEC records show.

Though the levels aren't unsafe, there are few places in South Carolina where any amount of PCBs have been found in fish, DHEC researcher Butch Younginer said.

At Lake Wateree, the agency hasn't found PCB contamination in the water itself. But DHEC did find it in sediments at two spots, according to a 1993 survey. One was at mid-lake, just west of Beaver Creek.

PCBs can accumulate in fish over time if the material exists anywhere in a lake system, even if the water itself is clean.

Despite McIsaac's statements, his partners in the summer program call the story a fanciful tale.

Shannon Catoe, who worked with McIsaac when both were students, said his old friend is dead wrong about what they applied on Lake Wateree in the 1940s. He also said in an interview with The State that McIsaac worked with him only one summer.

"Out of the whole three years, I don't believe I saw one drum of transformer oil," Catoe said of his time on the job. "It was motor oil."

Duke's summer program involved spraying oil from a barge that moved around the lake, looking for mosquito nests in coves.

"As far as PCBs, you're barking up the wrong tree," Catoe said. "Bruce was a good friend of mine, but he didn't know or care what was going on. All we were doing was a job. This PCB business is way out. I'm a registered engineer, and I think I've got a little sense."

Another worker that summer, Archie Catoe (no relation to Shannon Catoe), echoed those sentiments.

"I don't think it was anything like that," he said when asked if they dumped PCBs in the lake. "Bruce tends to exaggerate."

Duke spokesman Joe Maher said it's hard to tell what happened in the 1940s because the firm has no records of what was applied.

Maher also said companies and environmental regulators have learned a lot about toxic materials since the 1940s. At the time, the impact of PCBs on the environment wasn't known, and the federal Clean Water Act was years from being passed.

"Our sensitivity to environmental consequences is not something that started in the 1960s with Earth Day," he said. "It goes back into the '20s. In the '40s on Lake Wateree, our environmental sensitivity was such that we would treat the lake in the appropriate way with the best available technology."

Staff Writer Bob Kudelka contributed to this story. Free-lance reporter Mary Helen Yarborough also contributed to this report. Sammy Fretwell covers the environment. Reach him at 771-8537.

Clipped By:
maryhyarborough
Feb 16, 2024

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Exhibit 2

DUK_00104704 – DUK_00104722

1997.08.13 Testing at Lake Wateree Mosquito Control Facility

INITIAL
INVESTIGATION

IF FOUND PLEASE RETURN TO:

NAME _____

COMPANY _____

STREET _____

CITY _____ STATE ____ ZIP ____

PHONE _____ _____

PP CONFIDENTIAL

JOB BOOK

FROM PENINSULAR PUBLISHING

"ATTORNEY - CLIENT PRIVILEGED"

PROJECT NAME L.WATEREE MOSQUITO CONTROL

PROJECT NUMBER _____

CREW T.HONSUCKER/R.SANTINI

DATE 8.13.97 BOOK # 1 OF 1

WEATHER CLEAR, HOT, HUMID

FIELD BOOK
16 PAGE
8 LEAVES
50% RAG

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CURVE FORMULAS

$T = R \tan \frac{1}{2} I$

$T = \frac{50 \tan \frac{1}{2} I}{\text{Sin. } \frac{1}{2} D}$

$\text{Sin. } \frac{1}{2} D = \frac{50}{R}$

$\text{Sin. } \frac{1}{2} D = \frac{50 \tan \frac{1}{2} I}{T}$

$R = T \text{ cot. } \frac{1}{2} I$

$R = \frac{50}{\text{Sin. } \frac{1}{2} D}$

$E = R \text{ ex. sec } \frac{1}{2} I$

$E = T \tan \frac{1}{4} I$

$\text{Chord def.} = \frac{\text{chord}^2}{R}$

$\text{No. chords} = \frac{I}{D}$

Tan. def. = ½ chord def.

The square of any distance, divided by twice the radius, will equal the distance from tangent to curve, very nearly.

To find angle for a given distance and deflection.

Rule 1. Multiply the given distance by .01745 (def. for 1° for 1 ft.) and divide given deflection by the product.

Rule 2. Multiply given deflection by 57.3, and divide the product by the given distance.

To find deflection for a given angle and distance. Multiply the angle by .01745, and the product by the distance.

GENERAL DATA

RIGHT ANGLE TRIANGLES. Square the altitude, divide by twice the base. Add quotient to base for hypotenuse.

Given Base 100, Alt. $10.10^2 \div 200 = .5$. $100 + .5 = 100.5$ hyp.

Given Hyp. 100, Alt. $25.25^2 \div 200 = 3.125$; $100 - 3.125 = 96.875$ = Base.

Error in first example, .002; in last, .045.

To find Tons of Rail in one mile of track: multiply weight per yard by 11, and divide by 7.

LEVELING. The correction for curvature and refraction, in feet and decimals of feet is equal to $0.574\,d^2$, where d is the distance in miles. The correction for curvature alone is closely, $\frac{2}{3}d^2$. The combined correction is negative.

PROBABLE ERROR. If d_1, d_2, d_3, etc. are the discrepancies of various results from the mean, and if Σd^2 = the sum of the squares of these differences and n = the number of observations, then the probable error of the mean = $\pm 0.6745 \sqrt{\frac{\Sigma d^2}{n(n-1)}}$

MINUTES IN DECIMALS OF A DEGREE

1′	.0167	11′	.1833	21′	.3500	31′	.5167	41′	.6833	51′	.8500
2	.0333	12	.2000	22	.3667	32	.5333	42	.7000	52	.8667
3	.0500	13	.2167	23	.3833	33	.5500	43	.7167	53	.8833
4	.0667	14	.2333	24	.4000	34	.5667	44	.7333	54	.9000
5	.0833	15	.2500	25	.4167	35	.5833	45	.7500	55	.9167
6	.1000	16	.2667	26	.4333	36	.6000	46	.7667	56	.9333
7	.1167	17	.2833	27	.4500	37	.6167	47	.7833	57	.9500
8	.1333	18	.3000	28	.4667	38	.6333	48	.8000	58	.9667
9	.1500	19	.3167	29	.4833	39	.6500	49	.8167	59	.9833
10	.1667	20	.3333	30	.5000	40	.6667	50	.8333	60	1.0000

INCHES IN DECIMALS OF A FOOT

1-16	3-32	⅛	3-16	¼	5-16	⅜	½	⅝	¾	⅞
.0052	.0078	.0104	.0156	.0208	.0260	.0313	.0417	.0521	.0625	.0729

1	2	3	4	5	6	7	8	9	10	11
.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167

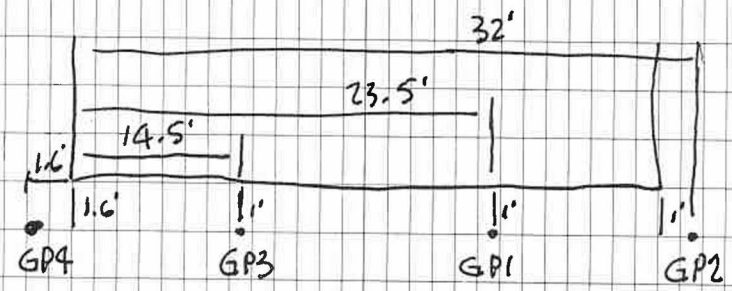
ATTORNEY-CLIENT PRIVILEGED.

1/3

- OBSERVATIONS

- SECONDARY CONTAINMENT MADE OF CEMENT BLOCKS WITH POURED CONCRETE BASE APPEARS TO BE IN GOOD CONDITIONS. DISCHARGE FITTING FROM TANK TO BOAT DOCK STILL PRESENT IN CONTAINMENT FLOOR DRAIN W/OUTSIDE VALVE STILL PRESENT.

SAMPLES (SOIL) COLLECTED AT FOUR LOCATIONS:



GP1-GP3: SAMPLES COLLECTED FROM 0'-4 and 4'-8'. DIESEL ODOR at 4' BUT GONE AT 6'

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DUK_00104706

GP4: SAMPLED FROM 0'-4' ONLY. NO ODORS PRESENT.

GP1-GP4 FIELD SCREENS FOR PCB's ONLY: USING DTECH PCB TEST KIT.

PCB SCREENED AT 3'-4' INTERVAL ONLY.

		RESULTS	
GP1	3'-4'	12%	0.5-1.0 PPM
GP2	3'-4'	LO	<0.5 PPM
GP3	3'-4'	52%	4.1-15 PPM
GP4	3'-4'	6%	<0.5 PPM

- THE AREA IS MAINTAINED ON A REGULAR BASIS - GRASS CUT, NO SIGN OF TRASH, ETC.
- PESTICIDE BLDG IS WOOD FRAME CONSTRUCTION & it is LABELED AS A PESTICIDE STORAGE AREA WITH PROPER HAZARD PLACARDS.
- BOAT DOCK/RAMP ARE IN GOOD

CONDITION.

- NO VISIBLE SIGNS OF disturbed OR distressed VEGETATION IN and AROUND SECONDARY CONTAINMENT OR OTHER AREAS ADJACENT TO SITE.
- PHOTOGRAPHS TAKEN W/DIGITAL CAMERA.
- TPH FIELD SCREEN DONE ON SOIL SAMPLES:

LOC	DEPTH	RESULT	
GP3	3'-4'	1090 ppm	1440 ppm
		TOTAL TPH:	1530 ppm.

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DUK_00104707

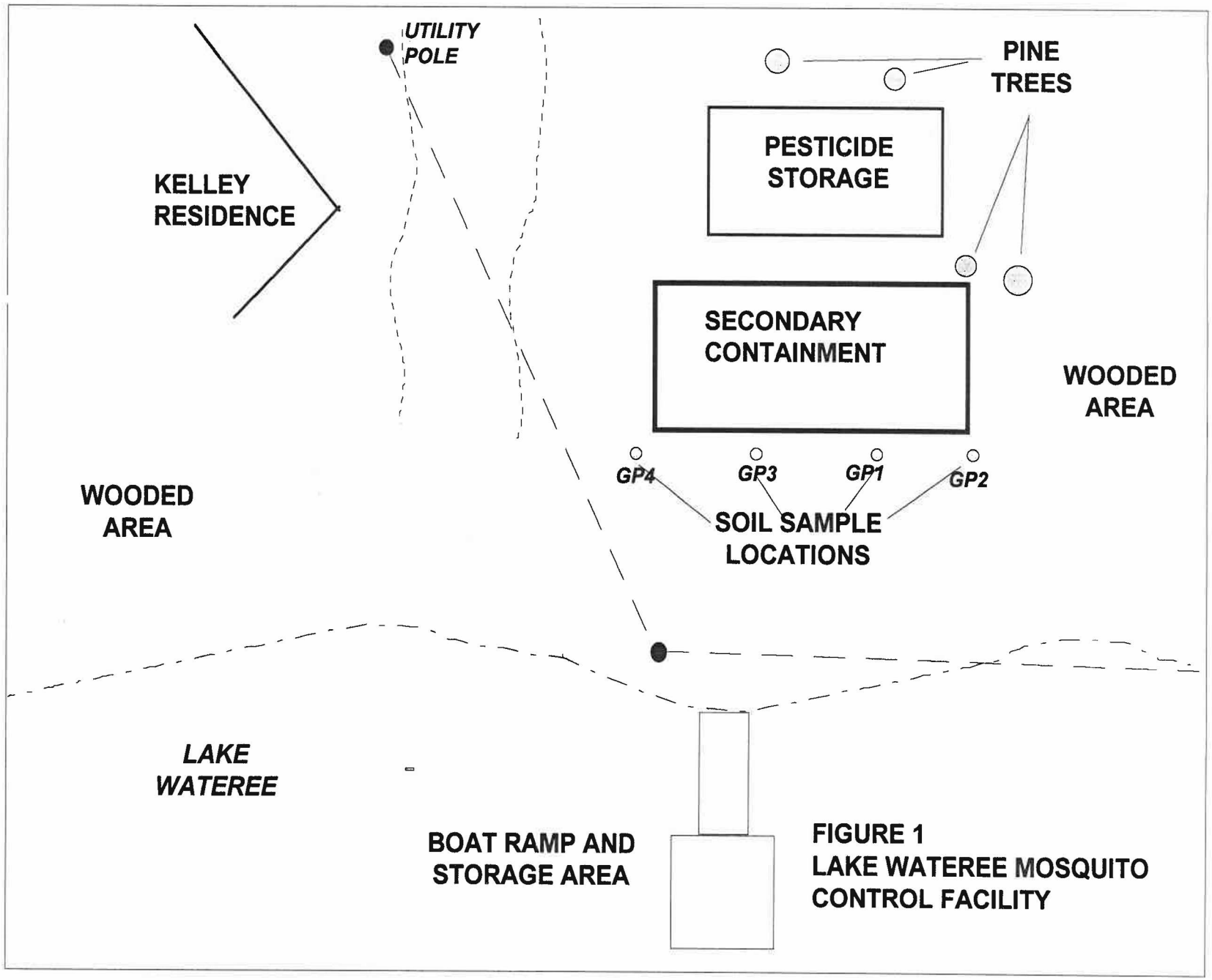


FIGURE 1
LAKE WATEREE MOSQUITO CONTROL FACILITY

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TABLE 2. RESULTS OF PCB/DIESEL FIELD/LAB ANALYSIS

SAMPLE ID	PCB'S						TPH DIESEL	
	FIELD SCREEN (PPM)	LAB ANALYSIS (PPM)	AROCLORS 1248 (PPM)	1254 (PPM)	1260 (PPM)	1262 (PPM)	FIELD SCREEN (PPM)	LAB ANALYSIS (PPM)
WMS-GP1-3'-4'	0.5-1.0	0.1			0.1		NA	NA
WMS-GP2-3'-4'	<0.5	1.5		1.5			NA	NA
WMS-GP3-3'-4'	4.1-15	120		120			1,530	17000
WMS-GP4-3'-4'	<0.5	ND					NA	NA
WMS-GP1-7'-8'	NA	NA					NA	ND
WMS-GP2-7'-8'	NA	NA					NA	ND
WMS-GP3-7'-8'	NA	NA					NA	ND

NA = NOT ANALYZED
ND = NOT DETECTED

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CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST FORM *

Form 35226 (R10-93)

DUKE POWER COMPANY
Laboratory Services
MNS Bldg. # 7405 (MG03A1)
13339 Hagers Ferry Road
Huntersville, NC 28078

LS CLIENT CONTACT/PHONE[1]:
CLIENT[2]: TIM HUNSUCKER
Project Name[3]: WMS - SITE (SOUTH CAROLINA)
Results to/Phone[4]: TIM HUNSUCKER / RON SANTINI
Address and/or PROFS[5]: MG03A
Matrix (type of samples)/QC Level[6]: SOIL / I
SAM No.[7]: 97-AUG-0158

FRAC[8]	CHEMPLOT Number[9]	Sample Description or ID[10]	Collected using sampling instructions[11] Date	Time	Name	RCB	TPH DIESEL (3550)
		WMS-GP1-3'-4'	8/13/97	1030	TSH/RAS	1	
		WMS-GP2-3'-4'		1045		1	
		WMS-GP3-3'-4'		1105		1	1
		WMS-GP4-3'-4'		1116		1	
		WMS-GP1-7'-8'		1036			1
		WMS-GP2-7'-8'		1049			1
		WMS-GP3-7'-8'	8/13/97	1109	TSH/RAS		1

Pace Analytical

Pace Analytical Services, Inc.
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Huntersville, NC 28078
Tel: 704-875-9092
Fax: 704-875-9091

August 21, 1997

Ms. Penny Franklin
Duke Power Company
13339 Hagers Ferry Road
MNS Bldg #7504 MG03A1
Huntersville, NC 28078

RE: PACE Project No. 670814.510
Client Reference: WMS-Site

Dear Ms. Franklin:

Enclosed is the report of laboratory analyses for samples received August 14, 1997.

Footnotes are given at the end of the report.

If you have any questions concerning this report, please feel free to contact us.

Sincerely,

Ashley Nitong
Project Manager

Enclosures

REPORT OF LABORATORY ANALYSIS

Pace Analytical

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Duke Power Company
13339 Hagers Ferry Road
MNS Bldg #7504 MG03A1
Huntersville, NC 28078

August 21, 1997
PACE Project Number: 670814510

NC Wastewater Lab Cert. #12
NC Drinkingwater Lab Cert. #37706
SC Lab Cert. #99006

Attn: Ms. Penny Franklin

Client Reference: WMS-Site

PACE Sample Number:			92 0162676		
Date Collected:			08/13/97		
Date Received:			08/14/97		
Client Sample ID:			WMS-GP1		
Parameter	Units	PRL	3'-4'	METHOD	DATE ANALYZED
INORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Percent Solids	%		80		08/15/97
ORGANIC ANALYSIS					
PCBS				8080	
Aroclor-1016	ug/kg	41	ND		08/19/97
Aroclor-1221	ug/kg	41	ND		08/19/97
Aroclor-1232	ug/kg	41	ND		08/19/97
Aroclor-1242	ug/kg	41	ND		08/19/97
Aroclor-1248	ug/kg	41	ND		08/19/97
Aroclor-1254	ug/kg	41	ND		08/19/97
Aroclor-1260	ug/kg	41	100 CO		08/19/97
Date Extracted, PCBs	Date		081897		08/18/97

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Ms. Penny Franklin
Page 2

August 21, 1997
PACE Project Number: 670814510

Client Reference: WMS-Site

PACE Sample Number:			92 0162684		
Date Collected:			08/13/97		
Date Received:			08/14/97		
Client Sample ID:			WMS-GP2		
Parameter	Units	PRL	3'-4'	METHOD	DATE ANALYZED
INORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Percent Solids	%		80		08/15/97
ORGANIC ANALYSIS					
PCBS				8080	
Aroclor-1016	ug/kg	33	ND		08/20/97
Aroclor-1221	ug/kg	33	ND		08/20/97
Aroclor-1232	ug/kg	33	ND		08/20/97
Aroclor-1242	ug/kg	33	ND		08/20/97
Aroclor-1248	ug/kg	33	ND		08/20/97
Aroclor-1254	ug/kg	410	1500 CO		08/20/97
Aroclor-1260	ug/kg	33	ND		08/20/97
Date Extracted, PCBs	Date		081897		08/18/97

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Ms. Penny Franklin
Page 3

August 21, 1997
PACE Project Number: 670814510

Client Reference: WMS-Site

Parameter	Units	PRL	92 0162692 08/13/97 08/14/97 WMS-GP3 3'-4'	METHOD	DATE ANALYZED
INORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Percent Solids	%		78		08/15/97
ORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Extraction - Hydrocarbons as Diesel			081897	3550	08/18/97
Petroleum Hydrocarbons as Diesel	mg/kg	640	17000	3550/8015	08/19/97
PCBS				8080	
Aroclor-1016	ug/kg	33	ND		08/20/97
Aroclor-1221	ug/kg	33	ND		08/20/97
Aroclor-1232	ug/kg	33	ND		08/20/97
Aroclor-1242	ug/kg	33	ND		08/20/97
Aroclor-1248	ug/kg	33	ND		08/20/97
Aroclor-1254	ug/kg	21000	120000 CO		08/20/97
Aroclor-1260	ug/kg	33	ND		08/20/97
Date Extracted, PCBs	Date		081897		08/18/97

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Ms. Penny Franklin
Page 4

August 21, 1997
PACE Project Number: 670814510

Client Reference: WMS-Site

PACE Sample Number:			92 0162706		
Date Collected:			08/13/97		
Date Received:			08/14/97		
Client Sample ID:			WMS-GP4		
Parameter	Units	PRL	3'-4'	METHOD	DATE ANALYZED
INORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Percent Solids	%		82		08/15/97
ORGANIC ANALYSIS					
PCBS				8080	
Aroclor-1016	ug/kg	40	ND		08/19/97
Aroclor-1221	ug/kg	40	ND		08/19/97
Aroclor-1232	ug/kg	40	ND		08/19/97
Aroclor-1242	ug/kg	40	ND		08/19/97
Aroclor-1248	ug/kg	40	ND		08/19/97
Aroclor-1254	ug/kg	40	ND		08/19/97
Aroclor-1260	ug/kg	40	ND		08/19/97
Date Extracted, PCBs	Date		081897		08/18/97

REPORT OF LABORATORY ANALYSIS

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Ms. Penny Franklin
Page 5

August 21, 1997
PACE Project Number: 670814510

Client Reference: WMS-Site

Parameter	Units	PRL	92 0162714 08/13/97 08/14/97 WMS-GP1 7'-8'	METHOD	DATE ANALYZED
INORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Percent Solids	%		82		08/15/97
ORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Extraction - Hydrocarbons as Diesel			081897	3550	08/18/97
Petroleum Hydrocarbons as Diesel	mg/kg	6.1	ND	3550/8015	08/19/97

Parameter	Units	PRL	92 0162722 08/13/97 08/14/97 WMS-GP2 7'-8'	METHOD	DATE ANALYZED
INORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Percent Solids	%		81		08/15/97
ORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Extraction - Hydrocarbons as Diesel			081897	3550	08/18/97
Petroleum Hydrocarbons as Diesel	mg/kg	6.2	ND	3550/8015	08/19/97

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August 21, 1997
PACE Project Number: 670814510

Client Reference: WMS-Site

Parameter	Units	PRL	92 0162730 08/13/97 08/14/97 WMS-GP3 7'-8'	METHOD	DATE ANALYZED
PACE Sample Number:					
Date Collected:					
Date Received:					
Client Sample ID:					
INORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Percent Solids	%		87		08/15/97
ORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Extraction - Hydrocarbons as Diesel			081897	3550	08/18/97
Petroleum Hydrocarbons as Diesel	mg/kg	5.7	ND	3550/8015	08/19/97

These data have been reviewed and are approved for release.

Margaret S. Harding
Manager, Laboratory Operations

REPORT OF LABORATORY ANALYSIS

Pace Analytical

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Ms. Penny Franklin FOOTNOTES August 21, 1997
Page 7 for pages 1 through 6 PACE Project Number: 670814510

Client Reference: WMS-Site

CO	Compound confirmed by secondary column.
ND	Not detected at or above the PRL.
PRL	PACE Reporting Limit

REPORT OF LABORATORY ANALYSIS

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Ms. Penny Franklin
Page 8

QUALITY CONTROL DATA

August 21, 1997
PACE Project Number: 670814510

Client Reference: WMS-Site

Percent Solids
Batch: 92 62720
Samples: 92 0162676, 92 0162684, 92 0162692, 92 0162706, 92 0162714
92 0162722, 92 0162730

SAMPLE DUPLICATE:

Parameter	Units	PRL	920161955	Duplicate of 92 0161955	RPD
Percent Solids	%		84	84	0%

REPORT OF LABORATORY ANALYSIS

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Ms. Penny Franklin
Page 9

QUALITY CONTROL DATA

August 21, 1997
PACE Project Number: 670814510

Client Reference: WMS-Site

Petroleum Hydrocarbons as Diesel
Batch: 92 62854
Samples: 92 0162692, 92 0162714, 92 0162722, 92 0162730

METHOD BLANK:

Parameter	Units	PRL	Method Blank
Petroleum Hydrocarbons as Diesel	mg/kg	5.0	ND

SPIKE AND SPIKE DUPLICATE:

Parameter	Units	PRL	920162722 WMS-GP2 7'-8'	Spike	Spike Recv	Spike Dupl Recv	RPD
Petroleum Hydrocarbons as Diesel	mg/kg	6.2	ND	212	83%	75%	10%

LABORATORY CONTROL SAMPLE:

Parameter	Units	PRL	Reference Value	Recv
Petroleum Hydrocarbons as Diesel	mg/kg	5.0	172	84%

REPORT OF LABORATORY ANALYSIS

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Fax: 704-875-9091

Ms. Penny Franklin QUALITY CONTROL DATA August 21, 1997
Page 10 PACE Project Number: 670814510

Client Reference: WMS-Site

PCBS
Batch: 92 62856
Samples: 92 0162676, 92 0162684, 92 0162692, 92 0162706

METHOD BLANK:

Parameter	Units	PRL	Method Blank
Aroclor-1016	ug/kg	33	ND
Aroclor-1221	ug/kg	33	ND
Aroclor-1232	ug/kg	33	ND
Aroclor-1242	ug/kg	33	ND
Aroclor-1248	ug/kg	33	ND
Aroclor-1254	ug/kg	33	ND
Aroclor-1260	ug/kg	33	ND

SPIKE AND SPIKE DUPLICATE:

Parameter	Units	PRL	920162706 WMS-GP4 3'-4'	Spike	Spike Recv	Spike Dupl Recv	RPD
Aroclor-1016	ug/kg	33.057	ND DS				
Aroclor-1016	ug/kg	40		204	81%	91%	12%
Aroclor-1260	ug/kg	33.057	ND DS				
Aroclor-1260	ug/kg	40		204	83%	90%	8%

LABORATORY CONTROL SAMPLE:

Parameter	Units	PRL	Reference Value	Recv
Aroclor-1016	ug/kg	33	167	72%
Aroclor-1260	ug/kg	33	167	75%

REPORT OF LABORATORY ANALYSIS

Pace Analytical

Pace Analytical Services, Inc.
9800 Kincey Avenue, Suite 100
Huntersville, NC 28078
Tel: 704-875-9092
Fax: 704-875-9091

Ms. Penny Franklin
Page 11

FOOTNOTES
for pages 8 through 10

August 21, 1997
PACE Project Number: 670814510

Client Reference: WMS-Site

DS	Concentration found on diluted sample.
ND	Not detected at or above the PRL.
PRL	PACE Reporting Limit
RPD	Relative Percent Difference

REPORT OF LABORATORY ANALYSIS

Exhibit 3

Zachary Hall 30(b)(6) Deposition Excerpts

A. That is correct.

Q. And again, you have seen no documentation to suggest that DHEC was ever made aware of the testing that was performed by Duke on August 13th of 1997; is that correct?

A. Yes. That is correct, counselor.

Q. But Tim Hunsucker was present at the secondary testing was that performed in September of 1997; is that right?

A. Yes, counselor. That is correct.

Q. Sitting here today, do you know if DHEC was ever made aware that Duke had tested the soil at the Lake Wateree mosquito control facility and had received test results that were positive for PCBs?

MR. LONG: Object to the form.

THE WITNESS: No, counselor. I don't know that they were informed of the August '97 event.

BY MS. FICKLING:

Q. And do you know if Duke was ever provided with access to the samples from that August of 1997 event?

I'm so sorry. Do you know if DHEC was ever provided access to the samples from August of 1997 event?

A. No, counselor. I know, again, that they did their own sampling -- subsequent sampling in September of '97.

Q. Do you know if Mr. Hunsucker ever told the representatives from DHEC that were at the site in September of 1997 if you go to 3 feet, you might find PCBs?

A. No, counselor. I -- I don't -- I don't know that. But I don't think that -- that Tim Hunsucker thought there were PCBs there, quite honestly.

Q. Despite the fact that Duke had in its possession field results that were positive for PCBs?

MR. LONG: Object to the form.

BY MS. FICKLING:

Q. Is that a yes?

A. That is a yes.

Q. And despite the fact that Duke had in its possession laboratory results that were positive for PCBs?

MR. LONG: Object to the form.

BY MS. FICKLING:

Q. Is that right?

A. Counselor, they knew at the time that they had hits for PCBs from the August '97 event. But,

DHEC and had they seen PCBs at the levels that were -- you just referred to from the August of '97 event, there would have been some additional work that would have had to be done at this site, and the record just -- just doesn't support that. That was an independent assessment by -- by DHEC with their own bottles in their own lab, which verified that the presence of PCBs were not there.

BY MS. FICKLING:

Q. So the testimony of Duke is that the August sampling has to have been a false positive. That is the testimony, correct?

A. That is correct, counselor.

Q. The June 1998 testing did not test for PCBs, did it?

A. It tested for compound specific 8260. I think it was 8260. I know it was 8270, which is -- that has the mass spec confirmation that we were just talking about. And they look for what are called TICs, or tentatively identified compounds.

Had PCBs been present, they certainly would have shown up in that list of tentatively identified compounds. That is the way you detect PCBs, by a GC

mass spec when you run 8270.

Q. But at that point in time, PCBs had already been eliminated as contaminants of concern, vis- -vis, the September 1997 testing; is that right?

A. Yes. That is correct.

Q. Okay.

A. 8270 is a common method to identify diesel contamination, so that was the focus of what they were looking for.

But in addition to the 8270 run, they also ran tentatively identified compounds, so if PCBs had been present, they would have shown in that report.

Q. Now, I think you mentioned just a moment ago, that if PCBs had been present, you would have needed to do something to identify the vertical and the horizontal spread of those contaminants; is that correct?

A. Well, that was what was done in June of '98. In order to better define the spatial kind of dimensions of the diesel contamination, that was the purpose of that June of '98 event.

Q. But that would not have been to determine spatial dimensions of PCB contamination, correct?

A. Well, counselor, the -- it was the same soil. So the soil that we are talking about with the

Exhibit 4
DUK_00104581
Certificate of Third-Party Removal

Soil Recycling Certificate

TPS Technologies Inc. does hereby certify that 436.01 tons of petroleum - contaminated soil received from

Duke Power Company
Wateree Mosquite Control Fac.
Derby Road
Liberty Hill, SC

Under Manifest/authorization number 05-01429 have been properly recycled to approved regulatory standards at our Soil Recycling Facility in Greenville, South Carolina

Dated this 20th day of October , 19 98

Sworn and Attested by:
TPS Technologies Inc.

By: _____

Exhibit 5
DUK_00000027
(Confidential)
Draft 1997 Manuel Commemorative Presentation

A BRIEF SUMMARY OF DUKE POWER COMPANY'S WWII (1942-1943) MOSQUITO CONTROL FILES

During the early years of WWII, Dr. F. M. Boldridge the Director of Duke Power's Health and Sanitation Department was fighting his second major war in a way different from his participation in WWI as a young army doctor with the American Expeditionary Force in France. Doc Boldridge or Doc as he was known by all who knew him at Duke Power, was struggling to maintain an effective malarial mosquito control program on Catawba River reservoirs in the face a massive national defense mobilization of men and essential war materials.

Hired by James B. Duke in 1923 to establish and direct a Duke Power response to the transmission of malaria that might be associated with Duke reservoirs, Boldridge was a leading US malaria expert who at that time was with the US Public Health Service. Malaria transmission was common along the river valleys of the southern US as well as the Catawba River during the first half of the Twentieth Century [1]. This debilitating and deadly disease was associated with the presence of indigenous anophelene mosquitoes species especially *Anopheles quadrimaculatus*.

The mosquito control program Boldridge developed for Duke Power, focused on the reduction of mosquito breeding habitat and the control of mosquito larvae [2]. This approach became a model for TVA and other later mosquito control programs in the southern states during the years of the Great Depression preceding WWII [3].

By 1941, many of the reservoirs in the Duke Power system were receiving mosquito larvae control activities called "oiling" either on a routine basis or as determined by mosquito surveys. During this time Boldridge was dealing with several malaria court cases against DPC as malaria continued to be a problem in the area especially by anophelene mosquito breeding in farm ponds, ditches, swampy lowland streams, etc. It is interesting to note that due to Duke Power's aggressive mosquito control campaign on its reservoirs, no court case against DPC concerning malaria transmission because of mosquito breeding on company property has been upheld.

Following the US entry into WWII and the massive mobilization of labor and critical material resources for the war effort, the typically used larvicid oil (diesel fuel) was no longer available for mosquito control. Challenged with providing an effective mosquito control program on DPC reservoirs to prevent the increase of malaria in the Catawba River basin, Boldridge scoured the Carolinas for substitute oils for use in the DPC mosquito control program. These substitute oils included used auto crankcase motor oil from service stations, gashouse oil (a possible by-product oil from coal gasification plants), pump drip oil (oil type unknown) and transformer oil. Other oil products may have also been used, but the vast majority of the material used in the program during 1942 and 1943 (based on records reviewed) was used crankcase oil from numerous service stations receiving a regular used oil pick-up service from Duke Power provided by a drayage contract with Cox Transfer [trucking] Co [4].

Exhibit 6

DUK_00000185

(Confidential)

Disbursement Vouchers for Materials in Mosquito Control

FORM NO. 12-80M-1-41-W.P.CO.

DUKE POWER COMPANY

DISBURSEMENT VOUCHER

Health Dept. (BRANCH OR PLANT) May 12, 1942 (DATE)

PAYABLE TO

NAME Cox's Transfer Co.

ADDRESS 3700 Rozzell Ferry Rd.,

Charlotte, N. C.

PAID STAMP
GENERAL OFFICE USE ONLY

AUDITED VOUCHER NO.

APPROVED BY DEPT. HEAD OR MANAGER

EXTENSIONS AND ADDITIONS CHECKED OK BY

CHECKED OK WITH ATTACHED PAPERS BY

APPROVED FOR PAYMENT BY

CODE NO.

DATE	DESCRIPTION OF ITEM	AMOUNT	DISTRIBUTION (FOR GENERAL OFFICE ONLY)						
			LOCATION	ACCOUNT PRIMARY	ACCOUNT SEC.	JOB ORDER	CLOSING PRIMARY	CLOSING SEC.	AMOUNT
	BROUGHT FORWARD								
5/12/42	To Attached Bills As Follows:								
	Bridgewater Pond:								
	43 Bbls. Transformer Oil; Drayage @ 1.85								
	Per Bbl.	79 55							
	Oxford Pond:								
	50 Bbls. Transformer Oil; Drayage @ 1.85								
	Per Bbl.	92 50							
	Tumbling Shoals:								
	50 Bbls. Transformer Oil; Drayage @ 1.85								
	Per Bbl.	92 50							
	Rhodhiss Pond:								
	50 Bbls. Crankcase Oil; Drayage @ 1.85								
	Per Bbl.	92 50							
	2,500 Gals. Crankcase Oil @ 2¢ Per Gal.	50 00							

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Exhibit 7
DUK_00000643
(Confidential)
1961 Request for Transformer Oil for Wateree Pond

DUKE POWER COMPANY

GENERAL OFFICE

CHARLOTTE, N.C.

Health Department

July 5, 1961

Lefler Concrete Block Co.
646 State Street
Charlotte 8, N. C.

Attention: Mr. George Lefler

Dear Sir:

In approximately 10 days we will have 60 empty barrels in which no mixed oil has been placed delivered to our oil dump at Bridgewater Pond and 60 empty barrels delivered to our oil dump at Wateree Pond. We want you to have these particular barrels filled with clean transformer oil only. Mixed oil is not to be placed in these barrels under any condition whatsoever.

You may contact Mr. E. C. Smith, Duke Power Company, Albemarle, North Carolina as to directions and information on the location of the oil to be secured by your truck.

Very truly yours,

F. M. Boldridge,
Health Director

CC: Mr. John A. Lyon ll

Exhibit 8
DUK_00000530 - DUK_00000532
(Confidential)
1961 Report of Parasitologist Harold Brown

SURVEY OF THE DUKE POWER COMPANY MOSQUITO CONTROL PROGRAM
ON LAKES JAMES, WYLIE, WATEREE AND LAKE NORMAN BASIN
1961

On September 7th through 11th I accompanied Dr. F. M. Boldridge and J. A. Lyon on a tour of inspection of three lakes and the site of the proposed Lake Norman. Lakes James, Wylie and Wateree are all now of sufficient age to have become relatively well stablized. Due to the size of these lakes extensive wave action is present on many miles of shore line and this effectively prevents mosquito breeding. There remain, however, in each of these lakes a number of shallow coves which are protected from wave action and in which the growth of aquatic plants makes a favorable site for mosquito breeding. These isolated areas of mosquito breeding are often considerable distances apart. They are all sprayed with an anti-larvacide at regular intervals during the mosquito breeding season; and as I observed the operations of several of the crews, it is obvious that they are doing a thorough job. I noticed the the spray crews also sprayed long areas of shore line which were quite bare and exposed to wave action and therefore probably not the source of mosquito breeding. This extra spraying is done to a large extent to impress the residents of near-by cottages that Duke Power Company is actively engaged in mosquito control. In view of the slow speed of the oiling barges, I believe that some thought should be given to the use of smaller, faster boats with smaller crews to spot-spray the places on the lakes that actually breed mosquitoes. This should greatly reduce the time consumed traveling among the various areas that really need spraying. The presence of this boat actively engaged should impress the local residents.

There is extensive evidence on all of the three lakes of the effectiveness of the spraying program against growths of willow. The new chemicals for killing willow and other aquatic plants are most effective and eliminate much tedious hand clearing. I was

especially impressed with the elimination of extensive mosquito breeding areas among willow growths on Lake James. Some 20 years ago I spent considerable time on this lake and there were extensive areas of mosquito breeding many of which had to be hand cleaned of willows, a time-consuming, laborous, and expensive procedure.

The new Lake Norman with its shore line of 520 miles is somewhat smaller than the three lakes noted above with their total shore line of 717 miles. This new lake for the first several years will present a real problem in mosquito control for in spite of careful cleaning of the basin site, there will be a tremendous amount of floatage which will serve admirably for mosquito breeding purposes. Surveys this year and last year indicate that Culicine and to a less extent Anopheline mosquitoes are breeding in ponds around this lake and in seepage pools within the lake basin. There are, therefore, mosquitoes in the area which will serve as a source of supply at Lake Norman as it rises. Fortunately, this lake is being developed at a time when there is literally no malaria in the United States and the control of mosquitoes in North and South Carolina is no longer necessary for the control of malaria. Mosquito control at present is largely to make life somewhat more comfortable and pleasant. Unquestionably, many miles of shore line on Lake Norman will require spraying for several years until floatage sinks or is stranded and areas of the shore line become bare and exposed to wave action. To maintain mosquito control on Lake Norman will be a considerable task the first several years and it might be worthwhile to consider summer employment of a college student who is studying biology or entomology to assist in the mosquito surveys.

We made a search for mosquito breeding on the premises of Mr. Wilhelm on Lake Norman. The area in which he lives has been plagued

with mosquitoes this summer and the local residents have been complaining about it. We found that there was very extensive Culicine breeding in the water trough of Mr. Wilhelm's pig pen. He was shown these developing larvae and pupae and was amazed that mosquitoes lived in water. A survey of his garage revealed hundreds of Culicine and a few Anopheline mosquitoes. By disturbing the leaves of the sweet potato plants in a garden near his home thousands of mosquitoes swarmed out from their day-time resting place. There had been rain several weeks before and Mr. Lyon found that there was extensive breeding of mosquitoes in pools in the potato patch. At a nearby garage mosquitoes breeding in water held in discarded automobile tires was also noted. The local people, however, blame Duke Power Company's clearing operations for all of the mosquitoes and they do not realize that they are breeding them in great numbers in their own household area. I feel, therefore, that now is the time to cooperate with the several county health departments which operate in the Lake Norman area to develop an education program on mosquitoes and to stimulate the health department to participate in the control of mosquitoes breeding in household areas. I see no reason why Duke Power Company must be held responsible for mosquitoes which their lake does not produce.

Lake Norman offers an excellent opportunity to follow the natural history of mosquito breeding in a newly formed lake, and careful records of mosquitocatches, changes in the shore line of the lake and other pertinent data will be most useful. Inasmuch as Mr. Lyon is entering the service of Duke Power Company at the time of the development of Lake Norman, he has a fine opportunity to develop a control program using the latest methods and chemicals and to evaluate their effect.

H. W. Brown.

Harold W. Brown, M.D.
September 13, 1961

Exhibit 9
DUK_00000536 - DUK_00000541
(Confidential)
1968 Report of Parasitologist Harold Brow

Aug. 14, 1968

Mr. Blades,

This is Dr. Brown's report.
Please read at your convenience
and return to me for filing.

George

3:24-cv-01281-MGL Date Filed 06/05/26 Entry Number 121-9 Page 2 of 7

COLUMBIA UNIVERSITY School of Public Health and Administrative Medicine

THE FACULTY OF MEDICINE
DIVISION OF PARASITOLOGY

630 West 168th Street
New York, N. Y. 10032

August 12, 1968

George T. Swearingen
Manager
Environmental Health
Duke Power Company
P.O. Box 2178
Charlotte, North Carolina 28201

Dear Mr. Swearingen:

Enclosed find my report on our recent Duke Power Company lake area survey. You seem to have everything well under control.

With best wishes,
Sincerely,

Harold W. Brown

Harold W. Brown, M.D.

HWB/bg

Conference and Survey of Duke Power Company's Lake Sanitation Program

MR. C. J. BLADES
MR. G. T. SWEARINGEN
DR. F. M. BOLDRIDGE
MR. D. GUDGER

July 26-31, 1968

Harold W. Brown.
Harold W. Brown, M.D.

The meeting of the informal association of the local and state health officials from North and South Carolina and the Duke Power Company workers on July 26-28th at Lake James afforded all an opportunity to exchange ideas in an informal atmosphere. There were the usual discussions on general sanitation, solid waste problems and mosquito control throughout the 3-day session. Friday evening Mr. C. J. Blades, after welcoming the guests, asked several of the Duke Power Company Staff to discuss future plans of the company. Mr. Don Voyles, Manager, Chemical and Environmental Services, outlined the studies that were being made by the Company to ascertain the relationships and the effect of the production of electrical power to the total environment. Methods of controlling any deleterious effects will be developed as part of this program. It was brought out that the Company has in progress a 6-million-dollar smoke and fly ash abatement program. I noted in a recent report that fly ash was quite effective in clarifying and purifying natural waters. Mr. C. A. Dewey, Jr., Principal Environmental Engineer, outlined some of the problems and studies his group are making on the environment with special emphasis on nuclear power plants. He made the point that when we have the facts we can then begin to solve the problems.

The question arose as to the availability of Duke property for the disposing of solid wastes. Mr. Blades assured the group that land would be made available if the local governments would provide the manpower and equipment to develop approved sanitary land fills. Otherwise the unsanitary dumping grounds would be attributed to the Company. This point of view was well accepted by the group.

A trip by boat around some of the shore line of Lake James indicated that wave action along with fluctuation of water level was producing shore conditions that prevented mosquito breeding. One spray team is able to adequately cover the areas of the shoreline that could produce mosquitoes. Although several areas of solid waste dumping, mostly beer cans, are present on the lake,this situation in general appears to be gradually improving. The campsites and launching areas are kept relatively clean of waste.

We spent some time on Keowee Lake, which is gradually filling with water. The clearing which is nearly complete has been excellent and litttle remains after several burnings of the debris. The shoreline is clean and fairly steep in many areas which will prevent mosquito breeding. We found, after a long search, one early anopheline and 2 culicine larvae in a quiet area in a slough and 2 culicine larvae in 30 dips in a marshy area, which will later be covered by many feet of water. There is a small amount of flotage and a few brush piles that require burning. Some 7 thousand applications for cottage sites on this lake have been made; and, fortunately, the shoreline at the cottage sites is so well maintained that mosquito breeding cannot exist.

Cane Creek produces extensive marsh areas and examination

of it on the outskirts of Seneca revealed anopheline and culicine larvae breeding areas 1/3 of a mile from a group of houses. However, in a dump in this area, in tin cans partially filled with water, and numerous culicine eggs, larvae and pupae were found. This whole area will be flooded by the lake and eliminated as a mosquito breeder.

The farm of Mr. C.R. McAllister (K464 on map) adjoins Keowee Lake. Anopheline and culicine larvae were present in pot holes in a "dry" stream on his property. Adjacent to his house there was a considerable amount of mosquito breeding in partially filled tins. These conditions are characteristic of the Company lake areas and although the lakes are accused of producing all of the mosquitoes, many of the old and new residents in the area are breeding their own mosquitoes so close to home that they are a nuisance. Education is the only way to control these small areas of home breeding of mosquitoes.

We visited the atomic energy power plant and were impressed by its size and the type of construction required for reasons of safety.

Mr. Blades drove us through the Jocassee area and outlined the development program for the "upper" lake. The 24-hour fluctuation of this lake of several feet will be helpful in the control of mosquito breeding. In this area, unpopulated by man or his domestic animals the conditions for active mosquito breeding should be kept at a minimum and present breeding areas will be submerged under many feet of lake water.

Considerable time was spent examining the potential mosquito breeding areas of Lake Norman. The oiling schedule which calls for an application of diesel-crankcase-transformer oil every 8 days is apparently well maintained, for there was evidence of oil in all of the potential mosquito breeding areas that we examined. No mosquito larvae were found in several areas which appeared to be favorable breeding areas. We examined in detail an old farm pond at the end of a cove. The pond dike had been broken allowing lake water to flow in and out of the partially dried pond. No mosquito breeding was found and there was considerable evidence of oil. Mr. Swearingen had some time previously found culicine larvae in cow tracks in this area which is a potential hazard as it has 1) shallow water, 2) cow's blood for mosquito food, 3) cottages within 1/8 to 1/4 miles.

Fortunately the number of cottages on Lake Norman is increasing which results in additional shoreline maintainence by the owners. The original clearing work was excellent,

the shoreline benefits from wave action and some fluctuation in water level.

We visited two potential mosquito breeding areas near Cornelius on which Mr. Swearingen had recently improved the drainage by extensive drag line and bull dozer operations. This was important as there is a considerable population nearby.

So far this year there have been only several complaints about mosquitoes. There is little solid waste problem due to the type of person using the lake and the excellent control by the marina owners. Sanitary facilities of the cottages must meet the local county requirements.

In general it appears that the Duke Power Company is maintaining its high standards of lake basin clearing. The lake shores are adequately oiled,where this is indicated to prevent mosquito breeding. Although indiginous malaria is not present in North and South Carolina, it is estimated that 2500 cases will be imported into the United States in 1968, most of them from Viet Nam, and they represent a potential danger, hence the need for anopheline control. The ever present danger of encephalitis indicates the need for culicine control. Although much is said about unsightly solid waste, the lake properties are relatively free of it.

Exhibit 10

Jeff Lineberger 30(b)(6) Deposition Excerpts

appears to be a pamphlet in December of 2006 on that first page.

Do you see that?

A. Yes, ma'am.

Q. And it appears to be a pamphlet about highlights of the comprehensive or licensing agreement for the Catawba-Wateree hydroproject.

Do you see that?

A. Yes, ma'am.

Q. Okay. And if we turn just briefly to the second page, there appears to be a map which goes over the territory of the project on the left-hand side.

Do you see that?

A. I see the map. That's not -- the boundary is not the territory of the project, though. That is the river basin boundary. The licensed project boundary is much, much smaller than this.

Q. But this reflects the river basin boundary. Is that your understanding?

A. This reflects the Catawba-Wateree river basin boundary, down to the dam at Lake Wateree.

Q. And if we're looking at the text on the page, it's the second page of the pamphlet, a partnership with the Catawba-Wateree River, and it's the last full paragraph that begins: Duke Energy

elected to involve stakeholders.

Do you see that text?

A. Yes, ma'am.

Q. It says: Duke Energy elected to involve stakeholders in developing proposed terms of its new license for the project. What emerged was a new and invigorated partnership going beyond relicensing, a partnership that will serve both the region and the river for generations.

That is what you just spoke about a moment ago; is that right?

A. Yes, ma'am, it is.

Q. And on the next page, top of the page, it states: To strengthen and continue its partnership with the community, Duke Energy committed to work with stakeholders in a basin-wide collaborative process to obtain its new operating license for the project with Federal Energy Regulatory Commission. The goal was to strike a balance among the project's power generation uses while benefitting fish and wildlife and providing other beneficial public use such as water supply and recreation.

Do you see that?

A. Yes, ma'am.

Q. And then if we turn to the very -- or the

second to last page, where it talks about the partners, and it seams to list out the partners with the river.

Do you see that?

A. Oh, this page. Partners with the river of the comprehensive relicensing agreement?

Q. Yes, sir. Do you see that?

A. Yes, I see that.

Q. If you will go to the section of this that lists out the partners, beginning with the letter L.

Do you see the Lake Wateree Association there?

A. Yes, ma'am.

Q. And so given this document and its context, is it fair to say that the Lake Wateree Association was identified by Duke as a partner with the river for the comprehensive relicensing agreement?

A. For the hydroproject operation, yes.

Q. And do you know what or who the membership of the Lake Wateree Association -- who is included within that, are you aware?

A. I don't know. All the people that are included or I guess really what their criteria are for being a member of the Lake Wateree Association, this is also a little bit -- it's a little bit different

now.

You also notice now over there, there is Wateree Homeowner's Association, and it says Fairfield County underneath it. The Lake Wateree Association was primarily residence of the Kershaw County I think. Those two have since merged into one that is called the Lake Wateree Association.

But it was primarily people that owned residential properties that adjoined Duke Energy's property at the hydroproject.

Q. Understood. And those were partners that Duke Electric elected to include in the relicensing process; is that correct?

A. Yes. And the way you became -- the way you got on this list was you signed a comprehensive relicensing agreement. We had other folks that were involved stakeholders that, frankly, were partners in other aspects, but they, for various reasons, chose not to sign the relicensing agreement.

As -- as I recall, I believe we had 85 different organizations involved on one of the six stakeholder teams that were working through all of the studies and eventually negotiating towards a relicensing agreement, and 70 of those 85 signed the relicensing agreement. There were 15 that chose not

have been fine for either.

(Court Reporter clarification.)

THE WITNESS: It would have been fine for either.

BY MS. FICKLING:

Q. All right. And turning back to the first page, the page ending in 27, and I believe we just had a discussion about the genesis of the mosquito control program, and it being a voluntary program.

The fourth full paragraph that starts "by 1941."

Do you see that?

A. Yes, ma'am.

Q. And it states: Many of the reservoirs in the Duke Power system were receiving mosquito larva control activities called oiling, either on a routine basis or as determined by mosquito surveys.

Did I read that correctly?

A. Yes, you did.

Q. So first of all, it talks about many of the reservoirs in the Duke Power system. Which reservoirs, is it your understanding that Duke was conducting mosquito control activities on around that time frame?

A. On a routine basis in 1941. So in 1941,

Lake James would have been one, Lake Wiley would have been one, Lake Wateree would have been one.

On a routine basis, Lake Norman was not constructed at that time. Lake Keowee was not constructed at that time. And Lake Greenwood -- we never owned Lake Greenwood, but Lake Greenwood was not leased by Duke Energy at that time.

So the -- primarily, the three that we would have been doing it on a routine basis would have been those I listed.

Q. And about Fishing Creek?

A. Fishing Creek, I don't believe we did routine mosquito control there. I think we did it from time to time. And I would say the same about Ox -- well, Oxford is the name of the hydro station, but it's Lake Hickory. I would say the same about that, that it was done from time to time. But we didn't have a -- really a routine mosquito control program at those locations.

Q. And this speaks to mosquito control that was performed either on a routine basis or as determined by the mosquito survey. So would Hickory and Fishing Creek have been encompassed within that sentence?

A. They probably would have. They would have

been in the as determined by mosquito surveys part.

Q. And the manner in which that would have been conducted would still have been oiling in some instances; is that correct?

A. We were using number 2 fuel and diesel fuel for larviciding. So, yes, that is what they are referring to as oiling.

Q. When you say larvicide, is it your understanding that larvicide is another way of saying pesticiding?

A. Well, larvicide is killing the larvae of mosquitos. So a pesticides kills pests. So in regard, they are similar.

Q. They are similar or they are the same?

MR. LONG: Object to the form. Asked and answered.

You can answer again.

THE WITNESS: Larviciding is just that. It's killing the larvae of something, and in this case, it's mosquitos. So it's killing a pest larvae. So I believe that, you know, larviciding is pesticides for mosquito larvae.

BY MS. FICKLING:

Q. Thank you. And it says, during this time,

Q. And what is a polychlorinated biphenyl?
A. It's a man-made product that is put into dielectric fluid to provide insulating capabilities.
Q. What is dielectric fluid?
A. It's fluid that is put inside of transformers and capacitors to insulate the internals and to help with help with -- help dissipate heat that is created when energy is passing through it.
Q. And this plan that was prepared in 1978, does it recognize that Duke had a certain quantity of PCB-containing dielectric fluid that required proper disposal as a hazardous waste?
MR. LONG: Object to the form. You can answer.
THE WITNESS: Can you repeat that question?
BY MS. FICKLING:
Q. Sure. Let me see if I can simplify it. This PCB plan from June 15th of 1978, that is marked DUK 00016374, first, I believe you said that this was the first plan that Duke had put together, the first PCB plan; is that correct?
A. Yes, ma'am.
Q. And in this plan, is it fair to say that by 1978, Duke knew that it had certain amounts of

dielectric fluid, for example, that had quantities of PCBs?

A. It -- I believe it did -- that that we did know that, as you would note on page 2 of that plan, the following were PCB trade names probably to be found on the Duke Power company system. And askarel is a generic term. And then it lists by company, what those manufacturers called their as askarel.

Q. Correct. And then if you move to 1.3, Section 1.3 which states, "PCB items which may be found on Duke's system are as follows."

Do you see that?

A. Yes, ma'am.

Q. And it includes, capacitors; is that right?

A. Capacitors. Yes.

Q. I am sorry. You're correct. Transformers; is that right?

A. Yes, ma'am.

Q. And then other items, there's a designation for other items. Do you see that?

A. Yes, I do.

Q. And those other items could include fluids; is that right?

A. Yes.

Q. Fluid mixtures?

A. Yes.
Q. Drums?
A. Drums, yes.
Q. Tanks?
A. Tanks.
Q. Or any material contaminated with PCBs by spillage or leakage, correct?
A. That is correct.
Q. And so by the time of this plan, had Duke identified certain materials in its possession that it determined were contaminated by PCBs?
A. I believe we had identified at least some of the equipment listed here, capacitors and transformers, I think we identified some of those that were -- that had PCBs in them.
Q. And other items, correct?
A. I expect, yes, that we had identified at least some other items.
Q. Well, in fact, if you move forward to Section 5 of this document, this first PCB plan, and it's going to be on page the last numbers are 381.
A. Okay.
Q. Do you see Section 5, "Spill reporting and clean up"?
A. Spill reporting and clean up, yes.

began manufacturing PCBs?

A. I read that. I believe it was in the 1930s.

Q. And you do know if, when Monsanto first began manufacturing PCBs and when manufacturers first began to assemble askarel transformers or PCB-filled transformer, did Duke purchase those transformers?

A. I don't know if Duke purchased the -- if your question is, did Duke purchase some of the first askarel-filled transformers, I do not know the answer.

Q. You do not dispute that between 1930 and 1976, Duke possessed PCB-filled transformers, do you?

A. Duke Energy had askarel-filled transformers, at least during that time. So no, I do not dispute that.

Q. And there is no dispute in your mind that those particular transformers would have contained PCB; is that right?

A. Askarel-filled transformers would have contained PCBs.

Q. Now, Duke also possessed transformers whose insulating fluid was supposed to be mineral oil; is that right?

A. That is correct.

Q. But ultimately, many of those transformers

were deemed PCB transformers, based upon the amount of PCB fluid contained within those transformers.

Is that your understanding, from your review of the documents in this case?

MR. LONG: Object to the form.

You can answer.

THE WITNESS: Once we implemented our PCB plan and -- and started sampling the dielectric fluid, we did find some transformers that had being contaminated PCB.

BY MS. FICKLING:

Q. Once the PCB plan had been implemented. So is it your understanding that there was no testing that was performed to determine if there was contamination prior to 1978?

A. I have not seen a record of that.

Q. And when we say -- you have not seen a record of that. And this is -- my question was poor. It's not you. I want to make sure I understand.

Prior to 1978, you have not seen any records that reflect testing of PCB -- or strike that. I'm sorry.

Prior to 1978, you have not seen a record of testing performed of transformers to determine if

those transformers were contaminated with PCBs. Is that your testimony?

A. I -- I have not seen a record of testing of transformer fluid for PCBs prior to the PCB plan, which was implemented in response to the Toxic Substances Control Act, and that plan was implemented in 1978.

Q. And so was Duke Power not performing any sort of testing prior to that time to determine whether its stores of oil had been contaminated by PCBs?

MR. LONG: Object to the form.

You can answer.

THE WITNESS: We had no reason to believe prior to implementation of our testing, that other transformers -- other -- transformers other than the askarel-filled transformers that we ordered were contaminated PCBs.

BY MS. FICKLING:

Q. And, again, your testimony is that the testing began in 1978; is that right?

A. Our testing first began as part of the implementation of that first PCB plan in 1978.

Q. Are you aware when the first studies were

Q. And --
A. I don't know how many gallons.
Q. On those two types of equipment capacitors and transformers, would Duke have been performing some routine maintenance and inspection of those pieces of equipment?
A. We would have been doing some inspections, but we didn't do maintenance on capacitors, not maintenance that would involve opening up the capacitor. We also didn't do maintenance on askarel-filled transformers.
Q. And I just want to make sure I understand. It was not needed or Duke didn't perform it?
A. We did not perform it.
Q. Who did?
A. We would have sent those back to the manufacturer.
Q. Did Duke ever have any leaks in its transformers?
A. Transformers have leaks from time to time.
Q. What about capacitors?
A. They may have leaked.
Q. Does Duke have any records of what happened with any of the spillage or leakage from transformers

and capacitors prior to 1976?

A. I -- I think -- I have not seen any of those records. I expect they have been lost to time.

Q. What makes you expect that?

A. It was 50 years ago, and there was -- at that -- before TSCA, before TSCA was passed in 1976, before that, there would have been no requirement to maintain records about such things.

Q. Do you think it is, as a general rule, a best practice to maintain records of regular inspections of equipment to determine that its operational?

MR. LONG: Object to the form.

You can answer.

THE WITNESS: Records maintenance for inspecting equipment, it is something you should do within limitations. I mean, it -- most -- most all the equipment that we are talking about here no longer exists. It's not there anymore. It's been replaced by other things.

So you -- you don't maintain every single record for every inspection you have ever done on a piece of equipment.

BY MS. FICKLING:

Q. But we don't --
A. It's not required.
Q. We don't have any records. I just want to make sure that that's accurate, that there are no records of any maintenance or inspection performed on the pieces of equipment prior to 1976 that you are aware of?
A. Not that I'm aware.
Q. And there are no records of where any waste or byproduct oil from these pieces of equipment went prior to 1976; is that right?
MR. LONG: Object to the form.
You can answer.
THE WITNESS: We don't know where specifically, any of those byproducts went.
(Plaintiff's Exhibit 4 was marked for identification.)
BY MS. FICKLING:
Q. I'm going to hand you a document -- sorry. I don't mean to throw paper at you. And this has been marked as Plaintiff's 4. For the record, it is DUK 00000643.
Did you review this document in preparation for your deposition, Mr. Lineberger?
A. It looks like three -- did you intend to

BY MS. FICKLING:

Q. Nothing prevented you from reviewing those depositions; is that correct?

A. Other than time.

Q. George Swearingen took over for Mr. Lyon in 1966; is that right?

A. Yes.

Q. When did he first began with Duke Power company?

A. I think in 1966, he was hired from South Carolina. He was a South Carolina public health worker. He was hired to lead the program in 1966.

Q. Does he have any familiarity with the generating operations side of Duke Power, to your knowledge?

A. When you say "familiarity" what do you -- I mean, was he a -- he didn't -- I don't believe he managed generating assets themselves, if that is what you mean by familiarity. He would have been as familiar as most other managers would have been about how we produced power.

Q. And because he was hired in a public health role, is it your understanding that he would have been informed and trained on the scientific and available industry information about the substances that he was

using in mosquito control?

MR. LONG: Object to the form.

THE WITNESS: I believe he would have had -- had some training. He did have a masters of science. He is also a registered sanitarian. So I -- he had qualifications, if that is the question.

BY MS. FICKLING:

Q. What does it mean to be a registered sanitarian?

A. I don't know exactly what the requirements are of that, but it's -- it's a registration that is relative to public health and he would be able to identify things that were going on in the environment that could have had a public health concern.

Q. Have you ever heard the term the long 60s?

A. Say that again.

Q. Have you heard of term the long 60s? Do you know what I'm referring to when I say that?

A. No, ma'am, I don't.

(Court Reporter Clarification.)

BY MS. FICKLING:

Q. The long 60s.

(Plaintiff's Exhibit 6 was marked for identification.)

waste lubricating oils for PCBs. PCBs would not had a purpose in waste lubricating oils.

BY MS. FICKLING:

Q. I see. Well, this states: Disposal of waste lubricating oils continues to be a problem. Past methods include spilling on coil mine, along fence lines, access roads, etc. We now dump waste oils on the ground near the ash basin. Employees use a small quantity for oiling roads near their homes.

Are you familiar with whether Duke has ever had any kind of citations or violations against it for using PCBs in oiling roadways?

A. No, ma'am.

Q. Okay. The last paragraph states: Please determine if there is a market for waste oils.

And then are some handwritten notes on this document; is that right?

A. Yes, I see that. Handwritten notes.

Q. Right. And the bottom note is: Barney, George Swearingen may be able to use this oil and mosquito control if there is enough volume to make it worthwhile to pick up. I've talked with George and sent a xeroxed copy of letter to him. He will contact Ralph and check it out.

Did I read that correctly?

A. Yes.

Q. And then in the upper left-hand corner, there is a reference to approximately 1,000 gallons once a year when changing oil annually.

Do you see that?

A. Yes, I see that. It's hard to read the cursive writing.

Q. Sure. Where are the records of those annual oil changes that this refers to that would produce a thousand gallons a year of waste?

A. I -- I expect if there were records created, they have been lost to time.

Q. So you don't know whether there were ever any records reflecting this once annual oil change that would have produced a thousand gallons of waste a year, correct?

A. I don't know that those records ever existed.

Q. And you don't have any documentation to indicate where that thousand gallons a year of waste would have gone, do you, at this time frame in 1969?

A. I do not.

Q. Do you know, sitting here today, whether that thousand gallons of waste lubricating oil was

worth Mr. Swearingen's time?

A. I do not.

(Plaintiff's Exhibit 8 was marked for identification.)

BY MS. FICKLING:

Q. I'm going to hand you what we will mark as Plaintiff's 8. And for the record, this is DUK 00000170 through 171.

Do you see that?

A. 170, 171. Yes.

Q. Okay. And this appears to be a series of letters between August of 19th of 1969 and August 25th of 1969; is that right?

A. 17th. August 25th, '69.

Q. And you reviewed this document as part of your preparation for this deposition; did you not?

A. Yes.

Q. So the first of the letter is the August 19th of 1969, which is from Hickory, North Carolina, and is written by a W.T. Gill to Mr. C.J. Blades, correct?

A. Yes.

Q. And do you know who Mr. Gill is?

A. I do not know who he is.

Q. Well, this states: Dear sir, a Mr.

Mosteller from Charlotte was by today getting some old transformer oil to be used for pond sanitation in various places on the system.

Do you see that?

A. Yes.

Q. How did Mr. Blades make this connection with Mr. Gill for a supply of old transformer oil to be used in pond sanitation?

A. I don't know.

Q. He goes on: He mentioned that your department had some big tanks in some places but was using drums at Bridgewater, and that you were going to get tanks here at some future date. I would like to suggest that we have an old water tank at Bridgewater that holds approximately 7500 gallons that could be moved at a reasonable cost for this purpose.

Do you see that?

A. Yes.

Q. All right. And then at the end of this letter, last paragraph, it says, "We have a good bit of oil at Marion main station that we would like for Mr. Mosteller to get while he is in this area."

Do you see that?

A. Yes.

Q. And again, he is referring to transformer

oil, old transformer oil, to be used for pond sanitation in various places on the system. Pond sanitation is another part of mosquito control, isn't it?

MR. LONG: Object to the form.

THE WITNESS: I would say mosquito control is part of pond sanitation. I think pond sanitation does additional things besides just mosquito control.

BY MS. FICKLING:

Q. I see. But the clear purpose for this old transformer oil was pond sanitation in various places on the system, correct?

MR. LONG: Object to the form.

THE WITNESS: Yes. It's talking about use for pond sanitation in various places on the system.

BY MS. FICKLING:

Q. And then the next page, page 171, is a response letter on August the 25th of 1969 from Mr. Swearingen. Do you see that?

A. Yes.

Q. It's directed at Mr. Gill?

A. Yes.

Q. And it has a copy to Mr. Blades; is that

right?

A. It does.

Q. And he says, "Mr. Blades referred your letter dated August 19th, 1969 concerning the old water tank at Bridgewater to me, and if the tank is in good condition I would be interested in the possibility of moving to it Lake James to be used for oil storage."

The next paragraph, "I appreciate your interest in this situation and your continued cooperation in assisting us in the removal of the used transformer oil in your area."

Do you see that?

A. Yes. I see that.

Q. Who does Mr. Swearingen refer to when he refers to us?

A. I appreciate your answer -- I am sorry, I am just reading it again.

I believe he is talking about Duke Power.

Q. How did Duke determine that a solution for old transformer oil was to use it in pond sanitation?

MR. LONG: Object to the form.

THE WITNESS: Well, there was one curious thing here. The first letter was signed. This George Swearingen letter is

not signed. So we are making assumptions that it was actually sent. I'm not sure we can assume that.

BY MS. FICKLING:

Q. So it your testimony that you do not believe this letter was ever sent?

MR. LONG: Object to the form. Asked and answered.

THE WITNESS: I -- I can't be sure that it was sent. I mean, we draft letters all the time and sometimes don't send them. Any need letter that has been signed would have been sent. So I don't know that this letter was sent.

BY MS. FICKLING:

Q. But you would agree with me that the letter from August 19th of 1969, which is directed to a Duke Power company representative, states that some old transformer oil was being picked up to be used for pond sanitation in various place on the system. That is what the letter says; is that right?

A. That is what the August 19th letter says.

MR. LONG: Thank you.

(Plaintiff's Exhibit 9 was marked for identification.)

BY MS. FICKLING:

Q. And to your knowledge, in 1969, whether sent or not, is this an acknowledgement that Duke Power is still using used transformer oil in its mosquito control?

MR. LONG: Object to the form. You can answer.

THE WITNESS: In pond sanitation, is what this is talking about, in pond sanitation. I don't see the words mosquito control on here anywhere, but it's in pond sanitation.

BY MS. FICKLING:

Q. And I think your testimony earlier was that mosquito control is a part of pond sanitation; is that right?

A. Subset pond sanitation.

Q. Thank you.

A. There are other things that are included in pond sanitation.

Q. I have handed you what is marked as Exhibit 9 to your deposition, and I will submit to you that this was a batch of documents that was used in another deposition in this case and it was introduced by Duke. You may not have had an opportunity to review this so

of Monsanto.

Q. And I'm sorry, when you say you were a customer of Monsanto to that extent, what products specifically, are you referring to?

A. It -- it would be askarel-containing products.

Q. Which were in Duke's possession; is that correct?

A. Transformers.

Q. And Duke understood that it had those products; is that right?

A. Yes. We had askarel-filled transformers.

Q. But there was no testing performed until 1978. Is that your testimony?

MR. LONG: Object to the form.

THE WITNESS: I don't believe we did testing until we had that first PCB plan.

(Plaintiff's Exhibit 10 was marked for identification.)

BY MS. FICKLING:

Q. I will hand you what we marked as Plaintiff's 10.

And is this the set of documents that you were referring to correspondence between Duke and Monsanto, relating to the disposal of some of its

waste to PCB oils?

A. Yes. Yes.

Q. And in particular, if you could, Mr. Lineberger, move into the document to -- and for the record, this is DUK 00023353.

And if you would for me, please, move in the document to -- the numbers are 23362. And it's a letter from May the 28th of 1975 from Monsanto to Duke Power Company. And you see it's a letter from Monsanto to Duke, addressing a letter that Duke had sent on May the 13th concerning incineration of Pyranol fluids.

Do you see that?

A. Uh-huh (affirmative).

Q. And the letter at the end is signed by C.R. Field, who is the supervisor of their customer service center; is that right?

A. Monsanto's, yes. I assume that's who he worked for.

Q. From this signature, does it appear that Duke was a customer of Monsanto?

A. Yes. This were providing us the labels and instructions on how to return fluids.

Q. My question was whether Duke was a customer of Monsanto as reflected in this letter.

MR. LONG: Object to the form.

THE WITNESS: For -- for this interaction, let's see. Incineration charges are 5 cents per pound. So we would be sending them the materials back to be properly incinerated, and they were charging us.

So yes, for this interaction, we were a customer.

BY MS. FICKLING:

Q. And when you say "materials, "you mean the used fluids, correct?

A. Used fluids. It also talks about solids here, but I think these -- these other attachments were talking about fluids. So yes.

Q. And so from the interaction we see here, Duke possessed used Pyranol fluids, which were used fluids containing PCBs; is that right?

A. That -- Pyranol was, I think, a brand name of askarel, of an askarel fluid. So yes.

Q. And prior to this back and forth with Monsanto, what did Duke do with its used Pyranol fluids?

A. I don't know that there was a record to that.

is the agency that has responsibility in South Carolina for fish consumption advisors.

Q. Okay. Do you know whether the Coughlan study was something that could actually be used to determine whether the fish had sufficient enough levels of PCBs such that they would be hazardous to health?

A. The Coughlan study was a -- it was an initial screen and -- because this was a voluntary study and he was doing so many locations and he was looking for so many different contaminants, he used an approved EPA technique that had a -- a detection level that would have been above that for fish consumption advisory. But it would have been a good sound study for an initial screening, and that's what this was intended for.

Q. And so --

A. This wasn't intended to determine if a fish consumptions advisory was needed or not.

Q. Okay. And, again, I want to make sure that we are looking at the same things.

(Plaintiff's Exhibit 17 was marked for identification.)

BY MS. FICKLING:

Q. I am going to hand you what has been marked

Exhibit 11

DUK_00000170 - DUK_00000171

(Confidential)

1969 Letter - Waste Transformer Oil for Pond Sanitation

Hickory, N.C.
August 19, 1969

Mr. C. J. Blades
Duke Power Company
Charlotte, N.C.

Dear Sir:

A Mr. Mosteller from Charlotte was by to day getting some old transformer oil to be used for pond sanitation in various places on the system, he mentioned that your department had some big tanks in some places but was using drums at Bridgewater and that you were going to get tanks here at some future date.

I would like to suggest that we have an old water tank at Bridgewater that holds approx. 7500 gallons that could be moved at a reasonable cost for this purpose, The P & T Maintenance Dept, have long boom cranes that could let this tank down in tact and transport it to the site in one piece. The legs could be cut off to a proper length so that you could load trucks or drums as you wish. I believe that a crane could be connected to the tank and hold it up while the legs were cut off at proper length, the tank could be lowered to a truck and set up on suitable bases at the new site. Concrete caps could be poured around the legs and avoid having to make elaborate metal "feet" on the legs when erecting at the new site.

The old water tank is still at Lookout Shoals village, it is a good bit smaller but could be moved in a like manner to some other location.

We have a good bit of oil at Marion Main station that we would like for Mr. Mosteller to get while he is in this area, Mr. Joe Sherrill of Maint. Dept. has a list of equiptment to be junked, I also have this list and will be glad to help Mr. Mosteller locate the oil to be moved.

Yours very truly,

W. T. Gill
Hickory, N.C.

Copy-C.H.Lackey

Geo — will you answer
CJB

DUKE POWER COMPANY
GENERAL OFFICE
CHARLOTTE, N. C. 28201

August 25, 1969

Mr. W. T. Gill
P. O. Box 1690
Hickory, N. C. 28601

Dear Mr. Gill:

Mr. Blades referred your letter dated August 19, 1969 concerning the old water tank at Bridgewater to me.

If the tank is in good condition I would be interested in the possibility of moving it to Lake James to be used for oil storage. We believe the storage tank to be used on Lake James should be placed underground for safety reasons, therefore, the tank we use will have to have an asphalt coating to protect it against rust.

I appreciate your interest in this situation and your continued cooperation in assisting us in the removal of the used transformer oil in your area.

I will call you in the next few days so that we may take a look at this tank.

Thanks again for your interest.

Sincerely yours,

George T. Swearingen
Manager
Environmental Health

Copy to: Mr. C. J. Blades
Mr. C. H. Lackey

COPY

Exhibit 12
DUK_00000797 - DUK_00000949
1970 North Carolina Proceedings Workshop

REPORT NO. 36

PROCEEDINGS WORKSHOP ON MOSQUITO CONTROL IN NORTH CAROLINA

SPONSORED BY

DEPARTMENT OF ENTOMOLOGY,
N. C. STATE UNIVERSITY
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WATER RESOURCES RESEARCH INSTITUTE

QUAIL ROOST CONFERENCE CENTER
ROUGEMONT, NORTH CAROLINA

MAY 4, 1970

Water Resources Research Institute
OF THE UNIVERSITY OF NORTH CAROLINA

North Carolina State University at Raleigh • University of North Carolina at Chapel Hill

PROCEEDINGS

WORKSHOP

ON

MOSQUITO CONTROL

IN

NORTH CAROLINA

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Department of Entomology, N. C. State University

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Quail Roost Conference Center

Rougemont, North Carolina

May 4, 1970

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Agreement Number 14-31-0001-3033

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Dr. Henry R. Thacker, Director, Research and Development, Federal Water Pollution Control Administration, U.S. Department of the Interior

Mr. S. Leigh Wilson, Assistant Executive Director, North Carolina League of Municipalities

Dr. James Worth, Director, Geophysics Laboratory, Research Triangle Institute

Mr. W. M. Zillgitt, Director, Southeastern Forest Experiment Station, Forest Service, U.S. Department of Agriculture

PROGRAM

May 4, 1970

8:30 a.m. Registration

9:00 a.m. Welcome ..... Dr. J. Lawrence Apple
Director
Institute of Biological Sciences
North Carolina State University

9:10 a.m. Preliminary Remarks ..... Professor David H. Howells
Director
Water Resources Research Institute

9:20 a.m. Overview of Mosquito Control Problems ..... Dr. Kenneth L. Knight
Head
Department of Entomology
North Carolina State University

10:00 a.m. Present Approaches to Mosquito Control in North Carolina

North Carolina State Board of Health:

Salt Marsh Mosquito Control ..... Mr. N. K. Oates
Sanitary Engineer

Fresh Water Mosquito Control ..... Mr. Don F. Ashton
Entomologist

Duke Power Company ..... Mr. George T. Swearingen
Manager
Environmental Health

Carolina Power & Light Company ..... Mr. A. C. Harris
Superintendent
Blewett Tillery Hydroelectric Plant

U.S. Army ..... Captain Darwin Palmer
MSC, USA, Entomologist
Fort Bragg, North Carolina

U.S. Navy ..... Captain John M. Hirst
MSC, USN, Entomologist
Naval Medical Field Research Lab
Camp Lejeune, North Carolina

Local Interests in Mosquito Control ..... Mr. Charles J. McCotter
Administrative Officer
Pamlico County Health Department
Bayboro, North Carolina

12:00 noon LUNCH

1:00 p.m. State of the Art Report
Present & Potential Control
Techniques ..... Dr. Herbert F. Schoof
Assistant Chief
Technical Development Laboratories
National Communicable Disease Center
Public Health Service
Savannah, Georgia

2:00 p.m. Implications of Mosquito Control to Other Facets of Water Resource Management

Corps of Engineers ..... Mr. James W. Midkiff
Wilmington District
Corps of Engineers

Soil Conservation Service ..... Mr. John E. Layden, Jr.
Planning Coordinator
River Basin & Watershed Planning Staff

Division of Commercial & Sports
Fisheries ..... Dr. Thomas L. Linton
Commissioner

Wildlife Resources Commission:

Division of Wildlife ..... Mr. T. Stuart Critcher
Assistant Chief

3:30 p.m. COFFEE BREAK

3:45 p.m. Review and Discussion of Pending Research Projects

Effects of Mosquito Control Ditching on
High Salt Marshes in North Carolina

Phase I ..... Dr. Edward Kuenzler
University of North Carolina
Chapel Hill

Phase II ..... Dr. Kenneth L. Knight
North Carolina State University
Raleigh

May 5, 1970

8:00 a.m.-
8:30 a.m. How Mosquito Control Works in
Virginia .....Mr. R. E. Dorer
Director
Bureau of Solid Waste & Vector Control
Virginia State Department of Health

8:30 a.m.- 9:00 a.m.	Florida Mosquito Control Program	Mr. John Mulrennan Director Bureau of Entomology Florida State Board of Health
9:00 a.m.- 11:00 a.m.	Work Groups	
11:00 a.m.- 11:45 a.m.	Work Group Reporting and Discussion	
11:45 a.m.- 12:00 noon	Workshop Evaluation	
12:00 noon	LUNCH	
1:00 p.m.	Adjournment	

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INTRODUCTION

The objectives of this workshop were to explore present mosquito control practice, transition away from persistent pesticides, minimization of ecological impact, integration of mosquito control with water resource management, program coordination, and develop recommendations concerning changes in the program together with research and educational needs.

Participants included representatives of federal and state agencies and electric utilities concerned with mosquito control and its implications to water resource management.

This is the fourth in a series of research workshops sponsored by the Institute to increase communication between research users and researchers on water resource problems and research needs.

David H. Howells
Director

WELCOME

Dr. J. Lawrence Apple
Director
Institute of Biological Sciences
School of Agriculture and Life Sciences
North Carolina State University

I am pleased to have this opportunity, although I am afraid I have little in the way of experience or expertise to contribute to this subject. Having been to the coast very many times, however, I am very much concerned about the total problem. It is gratifying to see so many participants here representing so many different agencies and institutions. The workshop does address a topic that is of extreme importance to the State of North Carolina in its efforts to manage its natural resources for the maximum benefit of its citizens and its visitors. I doubt if man has ever gone through a period of more critical self-examination of human values than the 1970's promise us. I think whether we agree or disagree with the trend of events at the present time, it is unmistakably clear that man's inherent rights are being idealized as never before. Does each individual have the right to a clean, undisturbed, natural--yet healthful--environment; an adequate food supply, a guaranteed level of income with which he might purchase the necessities of life? All of us, I think, would hope that utopia is possible. However, the Seventeenth Century writers have said, and I quote, "Man is an embodied paradox, a bundle of contradictions." They could have been referring to the idealist or our idealism as expressed in the seventies. Man, himself, in his present numbers and surely in the numbers predicted for the year 2000, contradicts nature. Perhaps this recognition prompted Sir William Gilbert to write many years ago that, "Man is nature's sole mistake."

The subject of this workshop is involved in that paradox. We do not like the discomforts and the diseases that mosquitoes might bring, but in effecting mosquito control other conditions may be created which are also undesirable. I am happy to see this workshop bring together the many points of view represented here in order that you might wrestle with a common problem. I do hope, and I'm sure you will, have free expression in a critical examination of the issues involved so that we might achieve the best possible balance in a program that will achieve our objectives. The communication of the type afforded by this workshop is extremely important. We must have understanding. We must

talk the same language, because if we do not understand each other, then our communication breaks down and the chances for success is greatly jeopardized. I do hope that you have a successful conference today and tomorrow, and that it shall be not only a pleasant experience but a very gratifying one in terms of subject matter.

PRELIMINARY REMARKS

Professor David H. Howells
Director
Water Resources Research Institute

This is the fourth workshop that the Water Resources Research Institute has either sponsored or co-sponsored during the past year. The others have dealt with agricultural water use, flood plain management and municipal water and sewer charges. Our next is scheduled for September 17. Some of you might be interested in this since it deals with the highly charged question of stream channelization that the conservationists and construction agencies haven't always seen eye to eye on. This has been encouraged by the State Department of Water and Air Resources.

The Water Resources Research Institute is a unit of the Consolidated University of North Carolina and is located at North Carolina State University. It is charged with developing a strong water resources research program and an increasingly effective information dissemination program dealing with the water resources problems of the state. We're convinced there has been far too little interchange between the university community and the public agencies in this field. Whether we're successful or not, we have been devoting a lot of effort toward a better characterization of water resource problems and a clearer definition of what our research needs really are.

One of the things we're concerned about, and I think this is a problem of national scope, is the matter of getting new information into practice. All you've got to do is go out and talk to consulting engineers or others who are having to use research information, and it's very clear that we have many barriers. Mr. James Stewart--Jim, would you stand up so they can see you--is a graduate student who has been a county extension chairman and understands extension. He's working with the Institute now on his dissertation in the area of information exchange including the conceptualization of problems, research needs and transfer of information back to the user. At the end of this workshop, he will pass out evaluation questionnaires which we hope you'll take the time to fill out.

The objectives of the workshop are to consider the following topics:

Evaluation of present practice--techniques and emphasis - advantages and disadvantages.

Transition away from persistent pesticides and minimization of other forms of ecological impact.

Integration of mosquito control with other facets of water-land resource management.

Effectiveness of state-wide coordination of operating programs, including local government.

Recommendations for changes in North Carolina mosquito control programs.

Research, educational and extension needs.

We hope this will be a very productive experience for everyone.

OVERVIEW OF MOSQUITO CONTROL PROBLEMS

Dr. Kenneth L. Knight, Head
Department of Entomology
North Carolina State University

Man's remarkable domination of the earth began, perhaps one-half million years ago, when he first used a stick or a stone to improve his food-collecting capabilities. Now in itself this is not a unique biological phenomenon, since we know of other animals that have a tool-using capability (for example, there is a wasp which tamps shut the entrance to its burrow with a pebble held by its mouthparts). However, through the ensuing millenia, man steadily improved his tool-making ability. A logical outgrowth of this was the development of techniques for modifying the environment--modifications designed to protect him from the elements and from his enemies and to make possible the more efficient production of food. For long years progress was slow; but as technological hurdles were cleared one by one, the rate of development increased until within just the last half century we have gone from horse and buggy transportation to trans-lunar rocketry. Our mastery of the total environment is equally great, and we now have the unfortunate capability of making it completely unsuitable for man's survival.

Our concern with mosquitoes and our ability for their control has followed closely the picture just described. For long ages, man patiently endured the attacks of mosquitoes. Then technology began to give him some weapons against mosquito attack--clothing and protective shelters, among others. However, tolerance for mosquitoes remained great until at the end of the nineteenth century it was confirmed that mosquitoes are the sole transmitters of several deadly human diseases. In the seventy years since that time the number of man years annually applied to the control of mosquitoes has been fantastically great, as has been the number of pages written on the subject.

With all of this effort, just where are we? We have mastered all of the techniques necessary to place men on the moon; yet, a capability for adequate management of mosquitoes and the diseases and discomforts they cause continues to elude us. In some respects, we have even lost ground. For example, it was reported late in 1969 that Culex tarsalis in the Central Valley of California is now resistant to all seven of the insecticides on which its control had previously depended. As if it isn't enough that nature is resisting our efforts, man continues to create new mosquito problems at an alarming rate.

I have been charged with the responsibility for giving an overview of mosquito control problems. Up to this point an effort has been made to emphasize that mosquitoes have been a health and comfort problem to man throughout history and that this problem remains with us in spite of our rich technological capabilities. Next, let us consider the components that enter into mosquito control.

There are many ways to cut a pie, and I choose to divide this one into two parts: The sociological aspects and the technological aspects.

Sociological aspects are those concerned with the impact of man and his activities. Their importance in the solution of any problem can be tremendous. We may have the ultimate in technological capabilities and be completely unable to make use of them because of human frailties and obstinancies. Perhaps man's biggest problem today is the population bomb. Man now has in his hands all of the technological tools needed to control both the quality and size of the human population, but it is unlikely that these will ever be efficiently applied because of chauvinistic, political, economical and religious considerations. In other words, technological capabilities are in themselves not enough. Equal attention must be given to the sociological aspects of a problem if it is to be successfully attacked.

Although certainly not all inconclusive, a list of the sociological aspects of the problem of mosquito control should at least include the following items: Organization, politics, economics and public relations.

In the major area of pest management, mosquito control has long been unique because of the extent of its reliance for success on organization. This situation came into being principally because adult mosquitoes can and frequently do fly long distances. Consequently, all too often the mosquitoes biting a man relaxing in his back yard were produced on the property of someone else. Obviously, if permanent control of mosquitoes is to be obtained, there must be a capability for destroying them at their source. This need in the case of mosquito control very early gave rise to mosquito control commissions, mosquito abatement districts or some similar form of legally organized control area. Financial support was obtained by taxing the inhabitants of a district and a mosquito control staff and facilities were created with both the responsibility and authority to carry out their activities on the private and public lands of the district. Invariably, state legislation was passed which provided the legal basis needed for district formation and usually also provided matching state funds.

To support the local mosquito control efforts, an organization of one sort or another has developed at state level. Also, perhaps most often, authority for mosquito control is invested with the State Board of Health. In New Jersey, where organized mosquito control originated in the United States, a State Mosquito Control Commission regulates mosquito control through county mosquito control commissions. Every county except one has such a commission. Technological support for the program is provided by the State Experiment Station. Florida, with one of the most extensive organizations in the United States, not only has the administrative program under the Health Department but also the research phase (through the Florida Entomological Research Laboratory at Vero Beach).

Organizational-wise, the most difficult problem is to maintain liaison between the state organization charged with mosquito control responsibilities and the other state organizations who are charged with responsibilities for overseeing the management of the water resources of the state. Unless an effective coordination of all such agencies within a political unit can be effected, some disasterous happenings are bound to occur. A common example of this is where an agency is dredging a channel and pumping the fill into an area to be reclaimed. Eventually, this fill dries, settles and cracks form across all of its surface. Rains fill these cracks and mosquito breeding areas are created.

Top-level liaison between all agencies with responsibilities for water resource management is very important. For example, wildlife people can greatly increase the area of their refuge and public lands by taking over the management of impoundments. Dredging and ditching should never be permitted without the coordinated approval of those charged with responsibilities for public health, real estate development, and waterway maintenance. In this connection it is rather amazing to note that the eight-man Estuarine Study Committee of Governor Moore's Interagency Council on natural Resources had no representative of the State Board of Health--a group carrying out more work on estuarine-adjoining lands than all of the member agencies of the Estuarine Study Committee combined. A primary purpose of this workshop is to bring together individuals from all of the agencies in the state with water management responsibilities and to discuss mosquito control in all of its aspects against such a backdrop.

Politics was the second sociological aspect mentioned. I am sure that no one would underestimate the importance of this item in the development of an adequate mosquito control program. It takes political know-how to get an abatement district into being, not to mention the original creation of the state-level enabling legislation and the annual provision of the necessary matching funds. Furthermore, it is not infrequent that political pressure is brought to bear in an effort to force decisions which, while economically favorable to one group, would create serious mosquito problems for the public at large.

Economics has been added to the list of sociological aspects important to mosquito control for reasons that have already been explained. There are other reasons also. For example, it would be ideal if every mosquito abatement district could own and maintain a helicopter. Such a machine makes possible the ready surveillance of all areas within a district as well as permitting spot applications of insecticides into otherwise unreachable areas.

Public relations is the last of the sociological apsects enumerated. Public misunderstanding of the technical aspects of mosquito control and of work being undertaken can seriously undermine acceptance and support of control programs. At all times, it is essential to keep the public adequately and correctly informed. Extensive use of the regular communicative media will be necessary, as well as the use of extension-type educational programs.

Much earlier I spoke of dividing the mosquito control problem into two parts: the sociological and technological aspects. Having briefly considered the sociological side, let us move on to the technological phases of mosquito control.

Essentially, the technology of mosquito control consists of the following three major elements: biological and ecological, surveillance, and population management.

Essential to the control of any pest is possession of a detailed knowledge of the biology or life cycle and habits of the pest and an equally full knowledge of its ecology of interrelationships with the other biological and physical elements of the environment in which it lives. With all of the thousands of hours of research that have been done on mosquitoes, we are still woefully weak in this area of knowledge. The present trend towards decreasing the use of pesticides has made it even more necessary to have an extensive knowledge of the biology and ecology of the pest which is under consideration.

Since not everyone here is probably equally informed on mosquitoes, I propose to tell in a most generalized way something about the life of mosquitoes.

The Culicidae, or mosquitoes, constitute a large and widely distributed family of medically important insects. The blood-sucking habits of the females, coupled with the ability of some to transmit disease organisms, make them extremely serious pests of man and domestic animals. There are nearly 3000 species known to occur in the world, and previously unknown additional species are being found every year. About fifty different species occur in North Carolina.

According to the presently accepted classification, the family Culicidae (belonging to the order Diptera or the two-winged flies) is divided into three subfamilies--Anophelinae, Toxorhynchitinae, and Culicinae. The first subfamily contains all of the species which transmit human malaria. The second has only one species in the United States, a very large metallic blue and green mosquito which, oddly enough, is incapable of taking blood, instead feeding only on nectar. The third subfamily contains all of the remaining mosquito species that are important pests of man.

Species of mosquitoes are widely distributed throughout the world, being absent only from Antarctica (however, they occur up to within 150 miles of the North Pole) and from some isolated oceanic islands. Mosquitoes occur everywhere on the continents except in areas of permanent snow or ice, but the largest number of species are found in the tropics.

Mosquitoes are best known because of the blood-sucking habits of the females. Not all mosquitoes, however, suck blood. The females of many kinds also utilize plant and animal nectar secretions, some largely so, and males exclusively so. Much variation exists as to host specificity for the blood meal; but evidently, only terrestrial vertebrates are normally used, although fish and even insects have been reported as occasional hosts.

Mosquitoes are usually active at twilight crepuscular and nocturnal, but there are some NIGHT distinctly diurnal species. Flight habits are extremely variable among the family as a whole. Some species undergo compulsive dispersal flights of many miles, whereas others seldom ever move far from their larval habitats. Mating takes place in a great variety of situations, although occurring in flight in almost all species. Crepuscular male swarms are a common phenomenon.

In general, female mosquitoes require a blood meal before they can mature eggs. Some individuals of many species, however, are capable of utilizing

food reserves carried over from the larval stage to mature a somewhat smaller-than-normal first batch of eggs. These "autogenous" females must then take a blood meal if they are to lay eggs again. It has been established that autogenous individuals inherit the ability to secrete a gonadotrophic hormone after emergence, which triggers ovarian development without the prior stimulus of a blood meal.

The gravid or egg-filled female shows a considerable amount of specificity in selecting sites for egg laying. Stimuli used in this process are principally visual, olfactory, and tactile and operate in varying combinations, depending on the species.

Egg-laying habits of mosquitoes vary widely among the different genera. The malaria-carrying Anopheles deposit their eggs singly on the water, either while standing on the surface or hovering over it. The salt marsh Aedes mosquitoes and many others common to this region deposit their eggs in crevices in moist ground litter and soil at the retreating water line of water-holding depressions or in natural water-holding containers such as tree holes that will again be flooded during rains. Females of the Culex mosquitoes (the common Southern house mosquito belongs here) and related types generally glue their eggs together in raftlike masses that float on the water. In these instances, the females stand on the water's surface or very close to it while egg laying.

Mosquito eggs of species that lay directly on water surfaces hatch very shortly after the completion of embryonic development, provided that the temperature is satisfactory. The eggs of species that lay on moist surfaces other than water, however, must undergo an appropriate "conditioning process" before they will hatch. With some species of Aedes, this even includes the necessity of first overwintering. With all such species, hatching requires that embryonic development be completed before the eggs are flooded. Furthermore, when flooding is finally accomplished. it must occur at or above the threshold developmental temperature for the species.

As pointed out, mosquito larval habitats reflect distinct selective processes on the part of the ovipositing female. Some mosquito species show a high degree of specificity in this regard, but others are much more indiscriminate. Very broadly, mosquito larval habitats can be classified as:

1. Ground water sites
    a. temporary water
    b. permanent water

2. Specialized water sites (container habitats)
   a. natural habitats
   b. artificial habitats

In general, Aedes and Psorophora larvae are found in temporary ground waters such as winter seepage ponds, floodplain ponds, summer rain ponds, and marsh edges. The mosquitoes that use the permanent ground water sites are those that lay their eggs directly on the surface of the water. The category of specialized water sites encompasses such natural habitats as tree holes, rock holes, pitcher plants, and such semidomestic habitats as fish ponds, tin cans, piles of rubber tires, stopped-up eaves troughs, drains, and cisterns.

All mosquito larvae, except members of the Mansonia group, must come to the surface at frequent intervals to obtain oxygen. Mansonia larvae and pupae, however, insert their respiratory siphons and trumpets into the submerged roots and stems of aquatic plants and obtain their oxygen directly from the plant tissue.

The food of mosquito larvae consists chiefly of organic detritus, but extremely small plants and animals are also swept up and used. The larva of Anopheles rotates its head 180° and with its mouth brushes upward, sweeps the surface film for food; in contrast, the culicine larva sweeps in particles either suspended or resting on underwater surfaces and rarely feeds from the surface. It can feed from the surface, however, by twisting its body until the mouth brushes are uppermost. The larvae of some mosquitoes are predacious and feed on small aquatic organisms, including other mosquito larvae. The length of the larval stage varies with the species and with the availability of food.

The pupal or "tumbler" stage appears with the fourth larval molt. Because it is lighter than water, the pupa rests at the surface. Movement is accomplished with a jerking tumbling motion. Except for Mansonia species, pupae obtain air from the surface through the pair of respiratory trumpets borne dorsally on the cephalothorax. The pupal stage lasts only a few days (usually two to four) for most mosquito species.

Male mosquitoes emerge from the pupae slightly earlier than do females. This results in males having a shorter aquatic existence than do the females. Because the pupal stages of the two sexes are of about the same length, the shortening in development of males takes place primarily in the larval stages; pupal and adult males are, therefore, of a correspondingly smaller size.

Male swarms are a common feature of many mosquito species. These swarms are initiated by a changing low-level light intensity and, accordingly, can occur at both twilight and dawn. The precise level of light intensity necessary to initiate swarming varies with the species but is mostly in the range of 0.2 to 10.0 ft-c. Almost invariably, females happening to pass near a swarm is primarily a mating mechanism. As a rule, mating probably takes place soon after emergence because females taken near the larval habitat and shortly after a general emergence period are almost invariably found to be inseminated.

In the northern United States, mosquitoes normally overwinter either as eggs or as adults, depending on the species involved. However, there are a few kinds which are reported to overwinter as larvae, presumably frozen in the ice.

Mosquitoes are of great economic importance for at least two reasons: The effects of their bites and their capacity to serve as vectors or transmitters of disease agents. The nature and appearance of mosquito bites are too well known to require extensive description. The bites tend to be irregularly distributed over exposed parts of the body, especially the face, hands, legs, and ankles. Mosquitoes can also bite through thin and loosely woven clothing. On some people these bites cause much discomfort which does often lead to scratching and even to secondary infection.

Because of their biting, mosquitoes often cause serious economic loss to farmers by interfering with planting, cultivating, and harvesting of crops. They may also lower milk production, cause weight loss in beef cattle, and reduce egg production in poultry. In extreme cases mosquitoes have caused the death of domestic animals, apparently due to blood loss or as a result of anaphylatic shock. Additionally, the presence of biting mosquitoes restricts real estate development and the use of recreation areas or, on the other hand, requires time, effort, and money for control measures.

Mosquitoes serve as vectors of a number of pathogenic microorganisms, including the malarias, certain filarial worm diseases (including heartworm of dogs), and numerous viruses (yellow fever. dengue, encephalitis, etc.).

Earlier I mentioned that the technology of mosquito control consisted of three major elements. The first of these dealt with the biological and ecological aspects of mosquitoes which have just been described in a general way. Surveillance, determining what kinds of mosquitoes are present (necessary since not all mosquitoes are disease carriers or pests of man and domestic

animals), where they are being produced and how abundant they are is a very important aspect of any mosquito control program. Without it great sums of money and many hours of labor can be wasted and major mosquito problems left unchecked. Actual population management or the mosquito control process itself is the third of the major aspects making up the technology of mosquito control. Modern needs and concepts of mosquito surveillance and of mosquito population management will be considered later today by a long-time expert in the field, Dr. H. F. Schoof.

Question: Will mosquito larvae grow in an environment without dissolved oxygen?
Answer: I think a few kinds of mosquitoes probably can do this since we find their larvae living in heavily polluted waters; normally, one would expect such aquatic sites to have little or no dissolved oxygen. At any rate the larvae of most mosquito species depend upon atmospheric air for their primary oxygen source. For this purpose they rise regularly to the water surface and take in air through an opening at the tip of their abdomen. Mosquito larvae have thin-walled terminal sac-like gills, and it used to be thought that these served to remove dissolved oxygen from the surrounding water. It is now known that these are pressure regulators in most species and are not primary respiratory organs. However, there are a few species which possess tracheae or air-transporting ducts in their gills, and these species probably do utilize dissolved oxygen.

PRESENT APPROACHES TO MOSQUITO CONTROL IN NORTH CAROLINA

STATE BOARD OF HEALTH
Salt Marsh Mosquito Control Program
Mr. N. K. Oates
Sanitary Engineer

I'd like to show you a few slides on the permanent mosquito control program in the eastern part of the state. I would appreciate any questions you may have as we go along.

We have three types of marshes in the coastal area. The first is the regularly flooded marsh such as you see in this slide. Primary vegetation here is Spartina alterniflora. This marsh is flooded twice daily with each high tide. It provides nursery area for fish, shrimp, plants and other marine life. There is no mosquito problem in the regularly flooded marshes.

The second type is the irregularly flooded marsh. They're flooded only during heavy rainfall or abnormally high tides. The primary vegatation is Juncus roemerianus, and this is interspersed with Distichlis spicata with patches of Distichlis scattered throughout these marsh areas.

Here we have a salt-kill area. This was caused after the hurricanes in 1954-55 by intrusion of salt water into the pine forest areas. Salt water was trapped, left a salt deposit and killed the trees as you can see.

Most of the irregularly flooded marshes have a natural dike along the shoreline that was created by wave action along the shore. When you have an abnormally high tide such as we have during hurricanes, the water in these areas rises up over the natural dike into the irregularly flooded marsh and is trapped. This slide shows a natural dike along the shoreline. The salt-marsh female mosquito deposits her eggs on the moist ground in the irregularly flooded marshes. When the eggs are flooded and conditions are right--the temperature of the water, etc.--the eggs will hatch and the adult mosquito will emerge within five to ten days, depending upon the temperature of the water. We go out into the marshes and make a survey to determine where the breeding areas are. Patches of Distichlis spicata are usually a pretty good indicator of where you will find the salt-marsh mosquito eggs laid. Salt marshes are very prolific mosquito breeding areas. We have dipped as high as 1500 mosquito larvae per dipper of water in the marsh areas. Two methods of salt marsh water management are used. One is ditching, and the idea is to put enough ditches or canals in the marsh to get the water off within a five-day period after the

marsh is flooded. These ditches are constructed about five feet wide and about four feet deep. This is deep enough to keep water in the ditches at all times, even at low tide, so that it will support the marine life. The marine life can move throughout the canal system. When the marsh is flooded by high tide, the water can find its way back through the spoil mounds to the canal. Once the surface water runs off, you will have some subsurface drainage from the depressions in the marsh. The canals are constructed deep enough to support marine life and boating.

This is a typical layout of a marsh area. A rim ditch runs along the contour of the land to catch the water as it runs off the high ground to the marsh. We also have lateral ditches which drain the water out of the depressions after the marsh is flooded.

This is another typical layout. The soil was rather tight here so you have to put the ditches much closer together. Where you have a high organic subsoil, you can space your ditches much further apart.

This picture was taken soon after construction of the ditches, and the spoil piles haven't had a chance to grow vegetation. However, after about a year or two we do get vegetation growing on the spoil piles, and they aren't quite so bad to look at. One of our biggest kicks from some of the marine biologists down in the coastal area is they say we're destroying the aesthetic value of the marsh, and I'll certainly have to agree with them. Once you go out and dig a canal, the bare spoil piles are rather hard to look at. However, they will grass over in a short period of time.

Question: How long before you have to perform maintenance work on the ditches?
Answer: Well, that is one reason for the size of the canals. We could get by with a smaller ditch. However, because of maintenance, we try to dig them large enough so they will last almost indefinitely. You will notice also that the ditches are all tied together where we can get a circulating action of the water. We have ditches now that are ten years old and are still holding up very well.
Question: Have you had to do any maintenance on any of the dragline ditching?
Answer: Not so far. However, you will notice here that I did not run these ditches out into the adjacent water. Anytime you have a beach area exposed on one side, you can expect the wave action to fill the ditches up almost immediately. What we have tried to do is tie into natural canals such as these.

The outlet is right here, and I have found that if the natural outlets are excavated, chances are they will fill up also.

The next slide is one I took on the ground in this area here. This ditch here is about five years old. You will notice here that the spoil piles have grassed over. This was a very prolific mosquito breeding area. The natural dike is along the shoreline with a swale area between the dike and hammock. As I said, this is a prolific mosquito breeding area. The mosquitoes swarmed us when we surveyed the area.

These ditches are about five years old. You will notice that the spoil piles have grassed over. We do have myrtle bushes coming in on the spoil piles. Any other chance in vegetation is not apparent.

This marsh has been ditched about five years. You will notice that the spoil piles are grassed over. I judge just from observation that there is no change in vegetation in the marsh. There might be a little change in the higher ground where the rim ditch is. We have some salt-kill areas that are returning to the natural state they were in before the intrusion of salt water.

Question: You do not put in ditches on regularly flooded marshes?
Answer: That's correct. The only ditches that we dig are in the irregularly flooded marshes, and these are all privately owned or at least they are claimed to be. Sometimes we have to go through a regularly flooded marsh to get to an outlet, but not always. We get easements or permission from the property owner before any mosquito control work is performed.
Comment: It seems to me we ought to get a definition right now on this word drainage. Everytime we hear the word ditching, somebody immediately thinks that means we drain dry. I think that definition is a problem every place we go. We talk about ditching, and they say, "Are you going to drain the marsh?" It has been a problem for some wildlife people in particular, because if ditching meant drying the marsh completely, it would be disastrous. But here drainage removes the excess water from the marsh after abnormally high tides and abnormal amounts of rainfall.
Answer: We call this water management rather than drainage because it is a little different than upland drainage where the ditches are normally dry.
Comment: The ditches provide access for marine life into the irregularly flooded marsh where they can get food. Ordinarily, the only way they can get

the food is when there's a lot of rainfall, and it's washed into the adjacent water.

Question: Have you developed any means of getting drainage through to the beach other than using natural outlets? Have you developed any of these arrowheads?

Answer: We usually use a natural outlet, and we find very few areas where we have to cut through the natural dike.

Question: Did you say that you get legal easements for all of your ditching?

Answer: Yes, sir, from the property owners.

Question: Do you get legal easements or do you get written permission?

Answer: Well, we get written permission. In some areas we get verbal permission. It depends on where we think we might run into a problem later. Normally, we get signed easements from all property owners.

Comment: Written easements are legal. It depends on how the county rules. Dare County requires these to be notarized. We have had some easements recorded; but normally, we just get signed easements. We don't normally record it.

Question: You said you got 95 percent reduction of mosquitoes in the marsh?

Answer: Yes, sir, in the areas that have been ditched.

Question: Is the mosquito population any different in the county than it was five years ago?

Answer: In Carteret we have about 70,000 acres of marshland, and I would say that we presently have control on 15,000 acres. As far as the total reduction, it is not too significant at the present time. However, in the areas that we have water management the mosquito population is very low until the mosquitoes fly in from the untreated areas.

Question: Will all the marshes have to be ditched?

Answer: Well, all the marshlands will have to be altered somewhat, either by impoundments or ditching for effective control; that is, the irregularly flooded marshes. Now in the regularly flooded marshes, there is no mosquito problem.

Question: Does this just control one kind of mosquito?

Answer: This controls primarily two kinds--Aedes sollicitan and the Aedes taeniorhynchus, which is the primary mosquito problem in the coastal area. We do have other species of mosquitoes there, but I'd say the vast majority of them--maybe 90 percent--are salt-marsh mosquitoes.

Question: Isn't it a very small percent of those marshes that are producing mosquitoes after the area is flooded?

Answer: The percentage is higher in the irregularly flooded marshes than in the regularly flooded marshes.

Comment: This is the type of marsh in most counties in the northeastern part of the state.

Comment: I noticed the marshes from Onslow County south, the characteristic change. I'd say even in Onslow County the amount of irregularly flooded marsh, mosquito breeding marsh, is a much lower percentage than it is in Carteret County, for example.

Comment: The farther south you go--from the North Carolina-Virginia line toward the South Carolina--the more regularly flooded marshes you find. In fact, Brunswick County has almost 100 percent regularly flooded marshes, and the salt-marsh mosquito problem there would come from the tributaries leading into the marsh areas. It is the same in New Hanover County. They have very little salt-marsh mosquito problem there. It's normally around hammocks that were created when the Corps of Engineers dredged the inland waterway. Pamlico County would have almost 100 percent irregularly flooded marsh.

Comment: Well, just like in Pamlico we have no inward tides at all. The wind blows right directly across the sound so Pamlico Sound is just like a big wash basin.

Comment: We have another method of mosquito control in the coastal area, also. This is by impoundment. This was done at the encouragement of the Wildlife Commission, primarily Mr. Otto Florschutz, waterfowl biologist. We have found that impoundments provide excellent mosquito control as well as providing habitats for waterfowl. One reason we went into impounding was to try to replace some of the waterfowl habitats that we may have inadvertently taken out of production with our ditching program.

On the construction of impoundments we construct a dike, put in floodgates, and pumping station. This slide shows the dike under construction. We take the material from the inside of the impoundment to construct the dike. The spoil ditch inside the impoundment creates deep water areas for marine life in the winter and summer months. The deep water is necessary to support marine life in the summer because the water warms up pretty much in the impoundment at that time. We try to maintain twelve inches of water in the impoundment.

This just shows another dike under construction.

This is a pumping station here. We're pumping tide water over into the impoundment. It doesn't show the supply canal, but when we're pumping these impoundments, we pump fish, crabs, shrimp and all the marine life in the adjacent waters over into the impoundment.

This shows a culvert with a slide gate valve. This is so we can maintain the water level. If the water gets too high, we can let some of the water out.

Question: Do crabs grow in the impoundments?
Answer: I have some slides on some crabs that were harvested on the impoundment at Otway.

This is an impoundment on the White Oak River which was constructed in cooperation with the North Carolina Wildlife Resources Commission.

We have over 3000 acres of impoundments completed in the coastal area. I would say we probably have a thousand acres under construction, and there's no estimate on the number planned in the future.

This is a hunter check station so that the Wildlife Commission can get sufficient data on hours hunted, kind and number of waterfowl harvested.

This is a pumping station on the White Oak River Impoundment.

This shows an aerial view of it. This particular impoundment is one hundred acres. This is the perimeter of the impoundment. You will notice here the mounds that were thrown up for resting areas and nesting sites inside the impoundment.

This is juncus that hasn't died from being flooded. The vegetation was primarily Juncus and distichlis similar to that seen outside the impoundment.

This is another impoundment of two hundred acres. Normally, after the impounded area is flooded, the water kills the Juncus and you have your Widgeon grass and other desirable duck foods replacing it.

These are wood duck boxes that were put up inside the impoundment. The wood ducks make good use of these boxes. Seven wood duck boxes out of eleven were used the first year they were put up on the White Oak River Impoundment.

This shows some more ducks going into the pond.

The local wildlife club sponsors many bird walks, and the Carolina Bird Watchers Association or club has been down to tour the impoundment in Carteret County. We have an ornithologist who lives in the area that has identified over eighty different species of waterfowl on this impoundment.

This shows a couple of swans on the Topsail Island Impoundment. A bald eagle visited the Huntley Impoundment in Carteret County last year. We haven't spotted him this year. I hope no one killed him. There's no white on the neck. I understand they have to be about four years old before the feathers up around the head and neck turn white. This was taken by the president of the local wildlife club.

This shows some crabs that were harvested inside the impoundment.

I think there is a great marine potential in these impoundments. There are some studies being made in South Carolina on shrimp farming in impoundments.

If I could take about five more minutes, I'd like to show just a few slides on our fresh-water drainage program in the eastern part of the state. Mr. McCotter and Mr. Ashton said they would relinquish a few minutes of their time.

This is a green tree reservoir. We have very little mosquito problem in these green tree reservoirs. This is one in New Hanover County, and we would certainly like to see green tree reservoirs preserved. I think quite a few people have the misconception that we're trying to drain these green tree reservoirs, but this is not true. What we're trying to do with the drainage program in the eastern part of the state is to eliminate conditions such as you see in this slide. It's very flat in the coastal area; and when you back the water up a foot, you may back it up a half mile and may spread out half a mile wide. The drainage phenomena in the eastern part of the state is quite different from what it is in the Piedmont and the western part of the state.

This shows a septic tank and without a satisfactory location for a drain field. The water table is right on top of the ground. The water is highly polluted here. There's a tremendous number of Culex mosquitoes bred, and you have a very unhealthy environment.

This logging operation helped create the conditions you will see in the next slide. When I first started to work, I was under the impression that the hurricanes had done the greatest portion of damage to the drainage system in the coastal area. However, I found after much investigation that the logging industry is to blame for most of the damage to the streams, and this started back in the twenties. Roper Lumber Company came through the eastern part of the state, and we can see much evidence of debris being thrown in the streams from the very first logging operation.

Question: Are there any kind of restrictions on that now?

Answer: Yes, there are laws on the books that prohibit anyone from throwing anything in a drainage ditch. I think the breakdown is that there's no one charged specifically with the enforcement of this law. We would certainly like to see more participation from the wildlife protectors. Certainly, the mosquito control workers are doing all they can. In fact, we have gone through and cleaned out the streams and gone back at the end of the month to measure up the previous month's work and found logging operations had already dumped debris into the streams. We have sent all the logging industries--loggers, pulp wooders, etc.--a copy of this law printed on sheriff department stationery instructing them that we are planning to enforce this law.

The drainage slide you saw just a few slides back helped create this condition here. As you can see, the privy is inundated, and this water is highly polluted. When runoff from these areas is flushed out into the estuarine areas, we're continually having to close shellfish areas due to pollution.

Here, you can see the top of the culvert is two feet under the surface of the water. Raw sewage is running out on top of the ground. The conditions are not limited to the low-income housing areas. You see the water ponded up behind this house. The water table is right on top of the ground, and drainage to lower the water table is necessary so the septic tanks will function properly.

Question: Why do people build on this low land?
Answer: Actually, this area here is some of the highest land in the county, about thirty feet above sea level. However, it's right in a plateau area, and the drainage ditch has been filled up due to logging operations, etc. and there's just no drainage.
Question: Why do people build in these areas?
Answer: Maybe they shouldn't have.

I'll run through these hurriedly. You see here flooding of the farmlands. Flood conditions are eliminated after we put in the ditch. Now we're trying to lower the water table in these areas. I don't think we'll have a change of vegetation because all evidence indicates the ditches are as deep as they were twenty-five or thirty years ago before the logging operations. Septic tanks cannot work properly when they have water standing on top of the drain field.

Question: I've heard Dr. McCracken, head of the Soils Department at State, say that in Carteret County--I don't even come close to remembering the exact figure--but I think it's less than 20 or 25 percent of the area in Carteret County is suitable for septic tanks.
Answer: He's probably correct. It isn't too high.

This is Neuse River right near Kinston. The tree tops were thrown into the stream. It hasn't filled up the Neuse, but it's causing a drainage problem on some of the smaller streams. You will notice here that the logger cut off the butt portion of this log. It was hollow, and he just left it lying in the stream. There's twenty-five miles of watershed on this particular stream, and farther upstream there's an airport under construction right on the top of the watershed. This is going to aggravate the flood conditions that already exist.

Question: How is it determined if a septic tank will work in an area?
Answer: Normally, they go out and run a percolation test with the land in the natural state. If the test shows good results, they go in and start building houses, paving streets and sidewalks, etc. taking this area out of absorption and doubling the runoff from rain on the exposed area. The ground becomes saturated, and the septic tanks will not work properly. There is a deterioration of the drainage system as the area is developed, and loose silt from landscaping is washed into the ditches.
Question: Is approval policy pretty much based on just looking at the perk test?
Answer: Well, I think it is from the Health Department standpoint. However, there's more study being made to coordinate the interest of the Health Department with the Planning Commission in areas where they have planning. That's another thing. In some areas you don't have county planning, and it's needed in all of the counties.
Comment: I believe one of the biggest problems, too, Keith, is the lack of a statewide planning use concept or law in North Carolina. I believe if we had land and water use planning that we'd correct more problems caused by septic tanks than any other one law that could be enacted in the state so far as the problem of sewage pollution is concerned.

Let me show one more slide, and I'll stop. There's twenty-five miles of watershed on this little stream here, and I have some slides that haven't been developed showing some logs completely blocking the canal passage. This is right below where the draglines are working. What we're trying to do here is cut the canal about twenty-five to thirty feet wide and about six feet deep. One of the reasons we're cutting it as deep as we are is to provide a place to catch what little silt we may lose during construction and also provide a fresh-water fishing area. You will notice in the other slide up above the dragline the stream is filled up with silt and debris. The stream is not deep enough to support fish life, and we are going to have to go about four miles before we can pick up five feet of elevation. So we hope to create about four miles of new fishing area on this stream.

STATE BOARD OF HEALTH
Fresh Water Mosquito Control Program
Mr. Don F. Ashton
Entomologist

I started in mosquito control in 1937. At that time we were primarily interested in malaria control; and therefore, we confined our work to the control of the malaria mosquito, Anopheles quadrimaculatus. As we reduced the numbers of malaria mosquitoes--we'll take credit for it--the number of deaths dropped from 150 in 1936 to zero in 1948. Dr. Ken Knight was saying a while back the mosquito population does not have to be reduced to zero to stop transmission. We had thirty-six cases of malaria reported in 1950.

Mosquito control prior to and during World War II was accomplished by oiling of ditches and drainage in the upland areas. We were not concerned at that time with salt-marsh mosquito control.

After the war DDT became available--DDT is a dirty word now, I know--but within two years we were having no deaths at all from malaria and only a few reported cases. At this time there was a shift from malaria control to general mosquito control, and we at the State Board of Health are now attempting to control the pest mosquitoes in the state. We have fifty known species of mosquitoes in North Carolina. Of these fifty species only seven or eight fresh water mosquitoes and three salt marsh mosquitoes are pests.

My topic was directed toward inland or fresh water mosquitoes which would normally exclude the salt marsh species except for one very interesting case. Near Charlotte we had an outbreak of salt marsh mosquitoes, Aedes sollicitans, not too many years ago. Breeding was taking place in ponds that received waste from a dye manufacturing plant. and this waste had a high concentration of sodium sulfate. The sodium (salt) ion in the soil was probably attracting the females to these ponds and stimulating egg laying. Every time it rained during the summer we experienced a flight of salt marsh mosquitoes. These flights were often as great as would be experienced along the coast. The ponds have been filled with sand; and as far as I know. the breeding areas are eliminated.

Knowing the species is extremely important in the control of mosquitoes. Of the fifty-odd species of mosquitoes in North Carolina, I doubt if there are more than two or three that will breed in exactly the same conditions. There is the time (season) element, the acidity of the water, the pollution factor, and many other conditions which determine the suitability of the water as a breeding media for a particular mosquito species.

In our cities and towns the principal mosquitoes are Culex quinquefasciatus, Culex restuans, Anopheles punctipennis, and possibly Anopheles quadrimaculatus. The two culex mosquitoes breed primarily in polluted water and in water-holding containers. Anopheles punctipennis will be found breeding in the cool running streams in town and may be succeeded by Anopheles quadrimaculatus as the water warms up in the summer. A. quadrimaculatus prefer neutral to slightly basic waters but may, at times, be found breeding in acid waters. Culex restuans and Anopheles punctipennis would usually be found in the spring and C. quinquefasciatus and A. quadrimaculatus in the summer.

The Psorophors and Aedes mosquitoes breed primarily in temporary waters which are collected in ruts in the road, depressions in a pasture or woodland or even between the rows in a field.

Psorophora confinnis is one of our most annoying mosquitoes, following heavy rains, in our coastal plains. It is a fierce biter; and because it breeds in such enormous numbers, it may be compared with the salt marsh mosquito.

In early spring Aedes canadensis is the most abundant temporary pool mosquito. Larvae of this species may be found in pools which are covered with ice following a cold night.

The most annoying mosquito in our inland towns is Culex quinquefasciatus. Since this mosquito will breed in artificial containers (tires, tin cans, bird baths, etc.) or polluted streams, it will do little good to only apply larvicides to the streams. We at the State Board of Health feel that a general environmental sanitation program--that is, removal of all discarded water-holding containers from the premises--is a necessary adjunct to a larviciding program. Stream clearance and maintenance is also advantageous. Grading and filling will serve to control mosquitoes under certain conditions. Most of the streams in our cities are highly polluted and support large numbers of mosquito and midge larvae.

Two types of mosquito control are generally recognized: Permanent control--that is, ditching, filling, or environmental clean-up--and temporary control--applying mists or fogs for adult control and larvicides for larval control.

Many types of chemicals can be used as larvicides, but we feel that unless the chemicals are applied under close supervision, No. 2 fuel oil is the larvicide or choice. Usually, the person applying the larvicide is a day laborer with very little interest in his work; and as often happens, the larvicide is applied too heavily or may actually be dumped to lighten the load. When highly toxic materials are used, an over application can be dangerous.

Question: What chemicals are used on hydro lakes?
Answer: One of the better chemicals is "Abate." This is used on several lakes at the present time. DDT at the rate of 0.1 pounds per acre was used at one time, but this has been discontinued. A mixture of No. 2 fuel oil and used transformer oil is used by two electric companies. The oil is applied at the rate of ten to fifteen gallons per acre.
Question: Are any of our people using the Humble Oil product?
Answer: Yes, they are using it.
Question: Is Flit "MLO" being used by any of our counties?
Answer: Yes, Mr. Howie is using Flit-MLO in Mecklenburg County. This is a well-organized program.
Question: What is the nature of the material that has been referred to here?
Answer: Flit-MLO is one of the fractions of fuel oil. The various petroleum fractions were tested, and the most larvicidal fraction is sold as Flit-MLO. I believe that this material also contains a spreading agent which will allow the use of 2-3 gal./A. for control rather than 10-15 gal./A.
Question: It's better than $2 a gallon, isn't it?
Answer: I don't know the exact price.
Question: In Virginia it's 90¢ a gallon in 55-gallon drums, but it's about 60¢ a gallon if you buy 6000 gallons at a time.
Answer: But compared with 15¢ or 20¢, that is considerable.
Question: But if you put on five times as much as you need, you are going to break the bank.
Answer: That is what you have to watch when working with a one-man project.

Water management is the first approach that we take. This involves either ditching or filling to remove the water that might puddle.

In the control of Aedes and Psorophora mosquitoes which lay their eggs in depressions which would fill after a rain, the removal of this water within five days is essential to prevent breeding.

The eggs of mosquitoes that are deposited on the ground usually require a period of several days in which to "ripen." If these eggs are flooded before the eggs become mature, they are usually killed. In the case of Aedes canadensis it appears that the eggs must also pass through a winter or prolonged cold spell. Aedes canadensis may be found in the same depression after several fillings and dryings which gives the impression that there may be several

broods a year. In most mosquitoes of this type, not all eggs will hatch at the first flooding or the second or third. This is probably a survival mechanism.

Culex quinquefasciatus, the Southern house mosquito, as was stated previously, breeds in polluted water and that contained in artificial containers. Old tires that are lying around in the yards or are covered by a honeysuckle patch appear to be the principal offender. (Environmental sanitation to control mosquitoes started our section in the garbage business.) Mr. Oates showed you some slides of drainage in subdivisions which is primarily aimed at Culex mosquito control.

In the mountains around several of the TVA lakes, we have Aedes vexans. These lakes are holding lakes which may be drained during part of the year. The mosquitoes lay their eggs on the floodplain. When the eggs are flooded during the summer, the mosquitoes may become a problem.

The species, Aedes sticticus, a floodplain mosquito is very annoying in some areas of the state in the spring. These mosquitoes emerge from eggs that were laid the previous year in the river and stream bottoms. The first flood in the spring usually produces the greatest numbers of this mosquito. It is a vicious biter and will fly as much as ten miles.

Question: I know very little about the disease-transmitting species. How many species are important disease transmitters?
Answer: Mosquitoes probably transmit more diseases than any other insect because of their blood-sucking habits.

Anopheles quadrimaculatus is the malaria mosquito in the eastern United States. Aedes aegypti is the transmitter of yellow fever and dengue. The Aedes mosquitoes are probably responsible for the transmission of California encephalitis. Culex quinquefasciatus is probably the principal transmitter of St. Louis encephalitis, although this disease has not been found in North Carolina. Western encephalitis has been found in North Carolina, but what species is responsible for transmission is questionable. Culiseta melanura is probably responsible for most of the transmission of eastern encephalitis in North Carolina.

Comment: Culex quinquefasciatus was responsible for the transmission of St. Louis encephalitis in Houston and Dallas.

Comment: Heartworm of dogs is also transmitted by mosquitoes.

Culiseta melanura is very abundant in our Coastal Plains following prolonged wet spells which fill our swamps, bays, and pocosins. Most of our encephalitis has occurred in those counties adjacent to the coast. Most of the water that falls into these fresh water bays and pocosins must go either up or down; there is little surface drainage. We have been attempting to provide drainage for some of these fresh water bays. In the 1956 encephalitis epidemic about 900 horses contracted the disease with one possible human case. During the last epidemic there was one known human case and an untold number of horse deaths.

It was during the last epidemic of eastern encephalitis, in 1965, that it was established that Culiseta melanura is a transmitter of the disease to horses. Prior to this time it was thought that C. melanura only infected birds. This mosquito is easily disturbed and will seldom attack an animal that is moving around. A horse will sleep in the field and will probably be attacked at that time. One C. melanura was captured while feeding on a mule. This mosquito was proven to be infected and to also contain mule blood. The mule contracted the disease.

Comment: It was two or three o'clock in the morning before you got those that bit the horse.

Answer: Yes, it was late; that is correct.

Question: Don, you mentioned the Charlotte Aedes sollicitans. I know that they are found in Kentucky and other inland places, but I just wondered how you figure he got there or she got there in the first place. I mean, what is it--about 250 or 300 miles from the coastal area?

Answer: Well, I traveled from the coast to Raleigh and swatted them in the car in Raleigh, so I think that is probably the way it happened. Someone living in the area had been to the coast. They were probably South Carolina mosquitoes. Most people in that area go to Myrtle Beach, South Carolina.

The interesting part of the story to me is the presence of the Sodium ion. In Kentucky I believe it is salt from slag piles. The female mosquito is stimulated to lay her eggs by the presence of this ion. Once the eggs have been laid and have ripened, they will hatch in fresh water. On our coast we

seem to have more mosquitoes following heavy rains during the summer than we have following storm tides. There is enough salt in the soil to stimulate egg laying so that all that is needed is the rain water.

Comment: I did a paper a while back on the distribution of Aedes sollicitans and A. taeniorhynchus in the United States, and there are many inland records in addition to Kentucky. In Illinois where oil wells are dug, the salt water comes up with the oil. A. sollicitans must travel sufficiently far so that if a likely place occurs, eventually the females will find it. There are records in South Dakota and Nebraska; for example, at Lincoln they have several salt wells that are drained into the marshes, and they have a good crop of A. sollicitans in those places. So wherever the chemical conditions can be created they will find it. They have tremendous dispersal abilities.

Question: You named half a dozen fresh-water mosquitoes. I assume these are disease carriers. Are there primary disease carriers among the salt marsh types of mosquitoes?

Answer: Indications are that A. sollicitans is a good transmitter of eastern encephalitis. To emphasize this, at Ocracoke during the 1956 encephalitis epidemic many of the banker ponies died. More than 900 horses were lost in North Carolina that year. Aedes sollicitans and Culex salinarius are the principal mosquitoes at Ocracoke, although Culiseta inornata was recently found. Other mosquitoes may be present but not in numbers.

Comment: Just across the inlet there are a variety of conditions among the dunes.

Answer: A few other mosquitoes may be present but have not been reported.

Question: How conclusive is yours or anyone else's published evidence that A. sollicitans is a carrier? Have you actually found it to be a definite carrier?

Answer: It has been demonstrated in the laboratory that A. sollicitans is a good carrier. As I remember, there have been only one or two cases where wild A. sollicitans have been found to be infected.

Question: Is that human encephalitis or animal encephalitis?

Answer: The encephalitides referred to here are the Arboviruses which are eastern encephalitis, western encephalitis, St. Louis encephalitis, California encephalitis, and possibly others. Eastern and western may be transmitted to either horses or man.

The bird is the primary host for eastern, western, and St. Louis encepha-litis and is transmitted by mosquitoes. There is brain damage in the animals; and if they are not killed, they are usually a dummy.

DUKE POWER COMPANY

Mr. George T. Swearingen
Manager
Environmental Health

After listening to what you said and what Don Ashton said, I don't know if Duke Power Company didn't have the first organized mosquito control program in the state.

Approximately fifty years ago Duke recognized the importance of pond sanitation and mosquito control on its impoundments and founded a Health and Sanitation Department. We try to stay abreast of the change in times and titles in this department, and today this department is known as the Environmental Health Department. In this department we are primarily concerned with pond sanitation as well as mosquito control along with water supplies and waste disposal systems around our construction and plant sites which is both the hydro and steam stations. With the breeding of the Anopheles quadrimaculatus on the hydroelectric impoundments during the "malaria years," control measures were introduced and have continued each year during the mosquito-breeding season. This activity has continued to increase for the past fifty years through development of the Catawba River Basin. The size of our program is still increasing with the acquisition of Lake Greenwood in South Carolina a few years ago. We also have a tremendous development down there known as the Keowee-Toxaway Project in Northwestern South Carolina in which we are building two impoundments. Actually, there are three lakes. There's a canal, very similar to the situation we have at Lake James, that connects several rivers and makes two impoundments into one. Then we are also involved in the Belews Creek project between Winston-Salem and Greensboro.

At the present time I guess we're carrying out survey work and larviciding programs on approximately twenty-five hundred miles of shoreline in North and South Carolina. I don't want to differentiate between the two. I want to put this in as South Carolina because this is as much a part of my program as what I have in North Carolina. Practically all of our mosquito control measures are accomplished by larvicide crews using boats equipped with power sprayers. We also have mobile truck mounted units. We use some hand sprayers and occasionally small mist blowers. Incidentally, we are following the recommendations of the two State Medical Entomologists in our program. I like to have our larviciding crews work the same area, if at all possible, because they are more familiar

with potential problems in those areas. The knowledge of sloughs, shoals, rocks, creek runs and shallow areas is very necessary for an efficient operation in addition to protecting men and equipment. We have daily worksheets for all crews to prevent overlapping. They also furnish us an accurate volume record of the larvicide applied, the area covered, the time the work was done, and the crew involved. We try to operate on an eight-day cycle--larviciding every eight days--but occasionally, we'll vary a day or two according to rainy weather or other situations that come up to prevent us from getting around normally. We are using transformer oil and No. 2 diesel fuel at the present. We begin to start these larviciding operations in early April and continue throughout the breeding season which usually ends sometime in October or the first frost.

We have some twenty-two cities which draw their raw water supplies from our reservoirs so we must be very careful what we use in the way of insecticides and herbicides. We bypass the water intakes by approximately a quarter of a mile, depending upon wind direction at time of larvicide application. We are not using any of the chlorinated hydrocarbons or stomach poisons. We do use some herbicides to a limited extent following cutting operations on our shoreline maintenance. If you cut willows, sweet gum, or some of the others, and you do not poison the stump, you may expect the density of the growth of the sprouts to be ten times the original problem. Now we're doing some work down in South Carolina on Lake Greenwood at the present time. I think we've counted eighty-six sprouts on one sweet gum stump which was about eighteen or twenty inches in diameter. Well, this goes to show the density and how fast this stuff will grow--six, eight or ten feet in a year. It will come back on you that fast if you don't poison the stumps.

We're even trying a different method of permanent control. The first thing I saw on it, I believe, came from TVA. We have a flat bottom that has silted in for many years in the headwaters of one of our reservoirs. This bottom is only flooded during periods of high water or very heavy rainfall. Since most of the deposited soil is topsoil from the surrounding mountains, this bottom supports a very dense growth of weeds, briars, vines and other undesirable plants during the growing season. Last year I talked to my boss and the forestry people in the company, and we decided that we would try to plant bald cypress on this. So we put out about 600 seedlings per acre. In a few years we'll be able to tell whether this will help us any or not. I hope it will.

I sincerely believe that the solid waste problem on our properties, created by people who live in close proximity to our lakes, is responsible for more mosquito nuisance situations than our lakes have created for many, many years. I would certainly listen to any suggestions that any of you may have concerning this problem.

The Duke Power Company owns some 300,000 acres of land and the watershed area surrounding our reservoirs. The majority of this land is in improved forests that are managed and controlled by graduate foresters. This forest management program not only makes money on the timber operations, but the quality of the water in our reservoirs is greatly improved. In fact, a few years ago the lakes were red before we started this program, approximately fifteen or twenty years ago, and today most of them are blue unless we have extremely high rainfall at certain periods.

I'd also like to mention that we have an environmental test section. I'm proud of my department. They used to be combined, but they've moved this to the Steam Department now. This section monitors our reservoirs on a standard frequency for such things as temperature, dissolved oxygen, pH, total Fe, total manganese, turbidity and BOD. I don't want to steal any of Mr. Cornell's department's thunder, but Duke Power Company is one of the participants in a joint study on thermal effects; in other words, heated water disturbance in the steam section. The Division of Inland Fisheries of the North Carolina Wildlife Resources Commission is also participating.

Much of our effort on mosquito control at Duke Power is put into source reduction if it is at all feasible. If there is a good permanent solution, we prefer this method over continuous temporary operations any time. We are also aided in our mosquito control efforts by the drawdown on our impoundments and the heavy boat traffic created by fishermen and other pleasure seekers. The shoreline development of cottage sites is one of the most permanent and economical means available to inhibit mosquito breeding.

I believe if I had to take my choice of all the things that make my job easy I would say that it is shoreline development by cottages--leasing these lots to individuals at a very nominal fee to establish some recreational family aspects of the thing. That keeps the shoreline clean. It's funny, but people will litter anywhere but their own front yard. So consequently, we have pretty clean shorelines where we've leased these lots.

In closing I would like to say that world travel being what it is today, we are only a few hours away by air from many malarial areas of the world. Returning servicemen from Vietnam and Peace Corps volunteers may also harbor the malaria parasite. With these potential threats and the ever-present potential threat of the arbor-virus diseases, we see the need for a continuation of an active and intensive mosquito control program by Duke Power.

If any of you have any questions, I'll be glad to try to answer them.

Question: George, I wish you'd elaborate about the planting of the seedlings and the effects you're hoping to receive.

Answer: This bottom has about forty acres in it. It's at the head of Lake James, and there's two or three natural drainage sloughs that come up in this thing. Well, they flood; and when the lake's right at the full pond level, the only thing that's flooded is these sloughs. If we then have a heavy rainfall in the mountains and the pond is full at that time, it floods this basin. That's when you have trouble from the Aedes and Psorophora. John knows this. I'll bet he's very familiar with that bottom I'm talking about. On the briars and canes and honeysuckle, blackberry vines and things of that nature, they get up to five, six, or maybe eight feet tall in this bottom in the summertime. It's hard to get in there to control it. The only way I see to do it is to apply herbicides by airplane. It's fairly boggy out there when the lake is full because the water table is so near the surface. We thought that maybe we could plant these cypress and shade this growth out; then we could control the growth and also lower the water table a few inches. We decided to try it. We may regret it, but I hope not.

Question: How is the cypress doing?

Answer: They're doing just fine. I think we've got a 90 percent survival, Dr. Knight, and they were tremendous seedlings when we got them. I think they came from somewhere in Georgia, and they were about that high when we planted them. I guess some of them look like that now.

Question: Are they growing fast enough to outgrow the brambles?

Answer: Well, we've disced part of it this year, and we're going to cut some of this out later in the wintertime when the ground's frozen. That would probably be the best time to get in there.

Question: To what extent do you get Aedes vexans?

Answer: At times I guess we're just popular. I guess I have as many complaints from vexans as any other mosquito.

Question: Do you have any other pest?

Answer: Well, yes. Some of the older reservoirs where you have a tremendous amount of organic matter on the bottom.

Question: You don't practice water elevation management?

Answer: Well, it's kind of difficult. If all of our reservoirs were the same size, it would be much simpler. They figure it's cheaper to maintain a control program over all the lakes like we're doing than to try to do it with water management. The flow of the power is small, and we don't have the water they have in TVA.

Question: You began the Anopheles quadrimaculatus when?

Answer: Last summer--last fall, in fact it was in October--on the new lake down in South Carolina. We larvicided the entire summer and had pretty good success. About the 20th of October we had about two weeks of warm weather. Frank Arnold from South Carolina called me and said, "George, you've got a little trouble up on that new lake." I said, "You've got to be kidding." He said, "No, go down and take a look." So I went down and took a look, and we actually had the biggest hatch of "quads" I've ever seen since I've been with the company. That was about the 20th of October. It just shows you that if you have a late fall what kind of problem you can get into.

Are there any other questions? Thank you.

CAROLINA POWER AND LIGHT COMPANY

Mr. A. C. Harris
Superintendent
Blewett Tillery Hydroelectric Plant

Our program at the Tillery plant was laid out by Mr. Don Ashton several years ago, and it's been a planned program since 1940. Before that, we used a little oil on the trouble spots. When the shoreline began developing, we started a program to try to do away with the larvae before the mosquitoes got there. At the present time we are doing this by contracts with the Wilson Tree Company, and it's patrolling the area on a seven-day basis. They now work four days a week, ten hours a day and cover 125 miles of shoreline on patrol. For spraying we're only covering about ninety-two miles because the shoreline is real steep, and we've got water activity. Another thing, the lake's water elevation fluctuated in the year and a half I've been there about ten inches, so we haven't had too much of a problem with it. We're using hand sprayers in the areas that are developed to work around the cottages. In the canals and in what marshland we have, we use boats. Our biggest problem and the most expense has been controlling the vegetation. We start cutting rights-of-way about the last of January through the time we start seeing signs of mosquitoes, usually around April 1 to April 15. Then we start spraying. This continues through October 15 and sometimes up to November 1. We continue spraying and go back to work on the rights-of-way until the weather gets so bad you can't work in there.

We've built a lot of the cooling lakes at our steam plants. One of the most effective things we've found to control erosion of the dikes has been asphalting the banks. This has worked very well. The mosquito is really a rarity. At the Lee Plant in Goldsboro, we have around 300 acres in the cooling lake. Of course, the water level is constant, and we have asphalt ten feet, I believe, up the bank and have no vegetation problem. We have to lower the water about every three years and patch some asphalt, but that pretty well takes care of the mosquitoes.

On the Tillery lake we have a two-man crew working out of a boat. It costs us about $500 a week to keep this crew going which we don't think has been excessive for the program Mr. Ashton has laid out. The fellows don't know the names of the mosquitoes. All they know is that they can see them

fly, and they have been able to identify the larvae. We have a daily report they fill out. Out biggest problem is beer cans and tires around the undeveloped areas, and we even clean those up as we go along. We have some pasture land that runs down to the shoreline, and the animal tracks have made a breeding ground. We watch that real close and have been able to take care of it.

We have one cooling lake up at our Skyland plant near Asheville. The City of Asheville has leased that lake for recreation and is taking care of the mosquito control up there. They are using--what I was able to find out--a smoke generator in there.

I wasn't able to find out about our Roxboro plant, which is near here. The lake is leased by the county for recreation, and to my knowledge there's no control there at the present time.

Question: The smoke generator you just referred to, what chemical do you use?
Answer: We don't use any chemical, just the fuel oil injected for the machine. We tried DDT after the war at Tillery, but according to reports that I've been reading, it was dropped after two or three years, wasn't it?
Comment: I believe it was dropped the first year. The reason was that in order to put DDT out you had to use a very fine mist from a nozzle. To get the spots in your lake you had to shoot the oil four or five feet; and if that's against the wind, you've lost.
Question: Are you going to be limited in using the smoke generator by concern over air pollution?
Answer: That's a good question. We don't know what we're going to do about air pollution. That's going to be a big thing, and there's a question of whether a lot of the electric companies are going to be able to stay in business if they comply with all the regulations.
Question: What chemicals are you using as larvicides?
Answer: Not anything. We're using No. 2 fuel oil and motor oil. When we have transformer oil, we use it because it doesn't cost us anything. The reason that burned cylinder oil and transformer oil were used in the beginning was that it leaves a beautiful film on the water, and the men could see where they had gone. If you use nothing but No. 2 fuel oil, you can hardly see it. If you add a small amount of used cylinder oil, it gives a beautiful rainbow appearance; and you can see it as you're moving along. That's the reason.

Question: Does this conflict at all with your recreation?

Answer: Not at the rate that we put it out because it evaporates very quickly. The motor oil actually is about 20 percent of the volume. Some places don't like to put it in at all because it has to be strained, and it clogs the nozzle. I think we're mixing it fifteen gallons to 135. I believe that's our mix, and we put out about 150 gallons a day. I had only one complaint last summer with 25 percent of the shoreline developed with cottages. I took the mosquito man and went up there, and we found a trash pile sixty feet from the cottage. It was full of larvae. We sprayed it out and just showed it to the lady and convinced her. That was the best publicity we ever had.

Comment: The biggest complaint we've had at Tillery is the dairy farms where the animal tracks go down to the creek. When the cattle water, there's always a nest of mosquitoes between those tracks. This has caused the most trouble in the beginning. He was always complaining of mosquitoes, I guess, to get you folks to go in and spray.

Comment: Well, I think he was complaining about something else and just used the mosquitoes.

Question: Where cooling lakes are concerned, is there a temperature cut-off point where mosquitoes no longer will breed and you can ignore it?

Answer: I don't know.

UNITED STATES ARMY

Captain Darwin Palmer, MSC
Entomologist
Fort Bragg, North Carolina

It's been a pleasure for me to come up here today and learn some things rather than to tell you any earth-shattering things you don't know. I was surprised to come before the Navy. I figured they'd just put the Army first because it started with an A, and they didn't realize that a Captain in the Army is not quite as high as a Captain in the Navy. Probably, the secretary didn't realize that.

Comment by Dr. Knight: Captain Palmer, I'll tell you why we did it. I'm an ex-Navy man; and if we had put the Navy first, it would look like a little favoritism there.

I'd like to tell you a little bit about my background. I went to the University of Delaware and have a B.S. from there in Entomology. I was fortunate enough to get a direct commission as an entomologist in the Army, and I've been in for several years now. I'm planning to have them send me to graduate school. I'm keeping my fingers crossed to see what happens with the fiscal year appropriations. They're supposed to have a meeting sometime before July 1. You never know when it's going to be. Then they'll let me know what the story is.

This is the way things look at Fort Bragg. We have the Post Surgeon who just happens to be the hospital commander at this time and has a number of people on his staff, one of which is the preventive medicine officer. I work for the preventive medicine officer in the preventive medicine activity, and we're responsible for surveying the post for arthropods, vectors of disease, and informing the Post Surgeon of any problems. Then, he informs us to take care of them. The Post Engineer has all the equipment and all of the personnel for this insect and rodent control, as he has the Entomology Services under his direction. There are two supervisors and about ten men in the Entomology Services Shop. These are the men who do all of the spraying and the work; these are the low-paid individuals. You never know exactly what they're going to do--you know this from personal experience in your own activities. When we find an area that we believe needs attention, we get together with the people

at Entomology Services, work with them, show them where the trouble spot is, and they treat it. Other than our recommendations, they have pretty good systems already in effect. They have trails throughout the woodlands where they go with a mist machine for adult mosquito control. They also have men who are responsible for larviciding any particular spots. They use malathion for both of these purposes, and they have fogging each evening from about eight to ten o'clock starting about May 15, and they use dibrom for this purpose. It's better than anything else we have available. Fogging might work, as you know, for a few hours, but other than that everybody just thinks it's helping out, "the psychological effect." Well, I can't really see any long-lasting effects, and I don't think anybody else has been able to show any long-lasting effects. Once in a while we get areas we can recommend to have filled or drained, but other than that I think it's more of a future item of interest to stop using pesticides and start using some good long-range sense in that respect.

If there are not any questions, that's about it in a nutshell--what we do at Fort Bragg.

Question: What type of surveillance work do you do?
Answer: We have mosquito light traps. In these we use dry ice about once a week trying to increase our catches with the carbon dioxide produced. We have a regular "route," you might say, which we do larval collections all along. Once in a while we have adult resting collections and adult biting collections. We used to run a Black Jar Oviposition Study for the Aedes aegypti. In fact, we did last year. We've never found an adult, A. aegypti; however, two years in a row we found some aegypti eggs. Other than A. aegypti we find Aedes triseriatus in these artificial containers. We work on a complaint basis also. If someone complains, we get to the area and see what we can find. We have a lot of problems with the Psorophora species and Aedes vexans. Other than that, we don't have any problem mosquitoes.

One thing I left out that I'd like to add--for instance, in 1968 we had 402 people--Vietnam returnees-- come down with malaria while they were at Fort Bragg. It was what you might call a relapse, and these people were in the hospital for a certain period of treatment, and it's just amazing to me and some other people that we haven't had introduced malaria crop up on us at Fort

Bragg. A lot of the conditions are good, but I guess all of them didn't fit together properly. We have many areas that people go on training exercises just routinely, and it would be no problem at all to introduce malaria parasites into the mosquito population and have mosquitoes introduce it back into the troop population. We've just been very fortunate to avoid it. They've had it right near Fort Benning--they've had some cases--and down at Fort Campbell or Fort Knox they've had introduced malaria, and at Fort Stewart in Georgia so we've just been very lucky. Our Anopheles population is quite small at Fort Bragg.

Question: Do you usually spray in the areas where the patients are kept and are the patients kept in one single location?
Answer: These people are in the hospital and are on the eighth floor, and it's all air conditioned. We don't have any problems with those. Where I consider a problem is when they're out on these field exercises when the fever starts.
Question: Mr. Palmer, do you see very much of a potential for these people who have had malaria after they are discharged from the Army? Possibly, they come back into civilian life and get off the medication; then, a relapse may occur. We've been very concerned about this in the State Board of Health about getting introduced malaria.
Answer: Yes, sir. I think there probably is a likelihood for that to happen. The big problem that we've had with people who get out of the service right after they returned from Vietnam, they probably wouldn't take the pills. The big problem we had for a while all through the Army was that people would come back after being evacuated with some type of injury or wounds, come back to the hospital, and after a couple of weeks they come down with malaria. The reason was they stopped using the pills. In fact, when you leave the country, they usually give you a little bottle and tell you to take them for eight weeks, and what happened, they got evacuated through different channels, and they never got the pills. The hospital just neglected to start them on chloroquine-primiquine, and they had a very serious problem because nobody thought about it until they started looking back at the situation. These people are just neglected. I think it's going to continue to be a problem. I don't know if there's really anything you can do about personnel who get discharged and don't take their malaria pills.

Comment: We think the best thing we can do is to keep the mosquitoes away from them.

Answer: That's right.

Comment: A few years ago when I was down at Bragg talking to a medical officer there, they were letting the ambulatory malaria patients go around as they pleased. They had to report to the hospital each day or whenever it was time, and they were watched taking the pills. I think that probably helped in that respect. Another thing I heard down in Atlanta a while back was that if a man does get out of the Army and does come down with malaria, they say he'd better go back to a VA hospital or to an Army hospital rather than to a civilian hospital because they (VA and Army) can recognize the malaria. If you don't recognize the malaria, you don't know to treat the patient for malaria.

Answer: The civilian hospitals in the United States don't know what malaria is. You almost have to twist an arm to get them to run a blood test.

Comment: After World War II they put a hospital up near Asheville in order to take care of all those people who had malaria. There aren't too many who know, but they proceeded in selecting a site right next to a quarry with all the pits in there, and I think it was about six or eight hundred feet from the breeding site of the Anopheles quadrimaculatus and another place up there where they had quads was the recreation area, the lakes--that was the place where they let the patients go! So I tell you, there's a lot of luck in it. The classic example heard about after the Korean Conflict was in California where all these campfire girls got malaria, and they traced it back to one veteran who came back and camped out in the open. He had malaria and transmitted it to these mosquitoes, and California couldn't understand why cases kept popping up in different parts of the state. Then they found out their own campfire girls had all been in this one place.

Answer: I'm sure in the future we're going to have some introduced malaria in North Carolina; you'd think it would be the military personnel bringing it back, but there's a lot of Peace Corps people and with the way international business is now, the business people are the ones going out and not taking any chemophrophylaxis at all and being in a malarious area and coming back with malaria. We have people, for instance, those who have been in Africa, and they just didn't know they were supposed to be taking malaria pills!

Comment: I've heard a lot of people comment about the malaria problem in the military, and I think that it is really wonderful that the level has been held

as low as it has. I think you've done a splendid job and really deserve a pat on the back. The people that I've talked to know more about this than I do. But I've talked to a few people who have treated a few malaria cases, and they think the military has done a splendid job.

Answer: One interesting thing that the Army tried was testing the chloroquine residual in urine. Just arbitrarily they'd grab fifty or a hundred people out of the mess line and test urine samples to see if there was any residual or what you would call a trace of chloroquine, and they found out that the next time they went back to test the same people the number of negatives were cut in half just because these people know there was a way to see if they did not take the pill. That's pretty good, you know; you didn't have to do anything more than test the people, and they realized there's a way you could find out if they had taken their pills. One interesting thing you might think about is that these people who are getting malaria are always the field troops that are out without any screens or anything else, and they don't want to spray; they don't want to wear any repellant because they think the NVA Army can smell the repellant. There's all kinds of stories going around, plus these guys that know that it is nicer in the hospital or where they send them for treatment. When you get malaria, you get a month off, you know, at a hospital right next to the ocean, and it's a lot better than being out and getting rained on every day. But you can get a lot of people who are willing volunteers to come down with malaria. In fact, they probably pray for it every day. You know, when night comes along you're supposed to roll down your sleeves; well, they probably would take their shirts off if it would do any good. I'm not kidding you. But that's the way the situation is. Of the people who get malaria, half of them want to get it. So that's a big problem there.

UNITED STATES NAVY

Captain John M. Hirst, MSC
Entomologist
Naval Medical Field Research Laboratory
Camp Lejeune, North Carolina

Thank you, Ken, I'm not an expert on mosquitoes. I'm only an expert in getting elected to office. With all due respect to the person who preceded me, most of the comments were directed toward Army personnel. The Marines would never volunteer for malaria. With the amount of equipment we make them carry here, they don't mind getting rained on a little bit. I think our Marines learned early about this chloroquine test, and they always carried a few extra pills with them so that only the first four or five urine samples showed an abstinence and by that time knew the purpose of the test and had their pills with about four cups of coffee. Most of our mosquito control program in North Carolina is controlled by the same regulations. I wanted to bring this up because there are many people here who have not been with the military for a while, and what has changed our program and almost every military activity is based on regulations that have been developed by the Department of Agriculture and HEW since about last July. Although there are still points of difference between those two agencies, I think that we in the military have recently published what we think they will require of us in a short period of time. We have not had DDT and some of the hard chemicals taken away from our arsenal of products, but the uses for these will be in keeping with the Department of Agriculture's laws. As a result, however, at some of our bases--not the North Carolina ones--but on some of the bases where they never knew anything ever but DDT, they'll probably go to plain oil which will be a great boom for these programs. At any rate the bases in North Carolina are all Marine except for some small Navy facilities; so some of my comments will concern large activities like the Marine Corps Base at Camp Lejeune which houses the Base personnel, the Second Marine Division, Force Troops and their related military activities. On that base is also the Naval Medical Field Research Laboratory to which I'm attached and the Naval Hospital so at the moment we're boasting a population of about 80,000 people. This is a population bulge, and it makes us agree with the definition that a "pest is anything that is too numerous." I mean, now we have become our own pests there; we have created problems. I suppose now we'll have some even greater ones

since if you've read the papers recently, that whole area will be a participating factor in a project which started this week and will last for the entire month of May. Although it takes place all through the Atlantic, in the Carribbean, its headquarters and its center of operation is there. It's called Exotic Dancer III to give it a nice, friendly title; but as a result of that we'll have even more people. From there they will go back to all parts of the world from which they have come for this test. This will be an exercise including Army, Navy, Air Force and Marine Corps--great numbers of people. I'm sure that there are mixed with them many people who have had Vietnam duty.

Our problems will be really magnified during this next month period. Cherry Point is no exception from this, then, although it doesn't lie immediately adjacent; it has its own complex of problems. Cherry Point houses all people of the Marine Corps Air Station, but even a larger contingent there is made up of almost all military, the Second Marine Air Wing. The Base may have, as you read in the papers, some 3000 civilians which might be cut to half that number soon. The Wing, being nearly all military, may suffer small losses at least at this time. These are the two large concentrations of military people related to the Navy and the Marine Corps.

The many acres that they cover for a long time were considered temporary since nobody up the ladder had ever said, "This is going to be a Marine Corps air station now and next week and ten years from now," so as long as it's called temporary in the military, it's very difficult to get an appropriation to do a permanent type of mosquito control. You can dig a temporary ditch to drain the water from the parade ground, but to dig the ditch for mosquito control requires an appropriation. You can't get an appropriation for permanent mosquito control on any military base if it's called temporary activity.

Well, that is not a military ruling. It is a ruling made by our civilian administration. I think we'd better remember one of the finest things about the military in the United States is that it isn't run by the military. So it's the civilians that tell us that "you can't have an appropriation to do that." If we want to do a big permanent mosquito job that might cost $20,000, it's doubtful if we could get it approved in two years. In the two-year time it takes to get it approved the cost has increased at least 50 percent so when we do get the money, we can only do two-thirds of the job. Now these are things we would have to face. I always thought, "Gee, the military can do anything. They have all kinds of equipment, all kinds of money and all kinds of people,"

and they do. But what they do and when is dictated by the civilians. I'm glad it is that way, but I'm sometimes embarrassed to explain it because people just can't understand.

So at the moment we are faced with two words. Only one of them has been used here so far when George mentioned "permanent" control by the planting of the trees. We are now able to do permanent control measures on bases which are considered permanent bases provided we can justify the work in relation to everything else that has to be done.

For "temporary" control there is still too much of that in effect, and I'm sorry that it is so. We have the same experience as you mentioned where we are using thermal fog machines. Several years ago that technique was declared obsolete for military use except for certain purposes for which it is now being restricted. Instead, we developed what is called a non-thermal aerosol generator which to the average military man is still called the "fogger." It puts out a very fine mist. There's no heat involved, and in North Carolina we are now using dibrom both at Cherry Point and at Camp Lejeune for more or less poorly scheduled programs, where if we have a man who is supposed to get forty hours' work this week and it comes Thursday night and he doesn't have it all in, we bring him back on Friday, and at ten o'clock in the morning he'll be fogging with 91 degrees of temperature and a wind of twenty-five knots. We have to get him out to get him his pay and let him get his hours. So there are problems with this type of control, too. Some of the temporary control, however, I think must be mentioned.

Recently, we were able to encourage our Naval Preventive Medicine Unit at Norfolk to have a course called Mosquito Surveillance. This program will be in May. We are encouraging people from Cherry Point and from Camp Lejeune to be sent there, but we have the problem again, "Do we have enough money?" It looks now like we might send just one from each of those two activities and hope that those two can come back and teach some people under them to do mosquito surveillance.

Then, we have the little activities like the one that someone mentioned in Dare County out at Buxton which has very few acres. In fact, they've been getting less and less number of acres every year as the ocean eroded away part of the land. They do fogging on the nights when mosquitoes are real bad. We have a little radio station out on Cedar Island. It is a very neat and compact radio station. I don't think there's any land on it that's really

important for breeding, but we can find breeding right where the air conditioning units drip outside the buildings. They have mosquito problems from the 20,000 acres that surround the base and the breeding is right outside the windows where the air conditioning units drip.

These are the activities that you're interested in here. What they can contribute is based on perhaps this type of thinking. Instead of looking to the military, for an example, we must remember that money is not appropriated to them to set the example. The problems will be the same as in the surrounding civilian communities. The answers are going to be the same. I believe that in most cases, as the surrounding area develops its mosquito control program--permanent or temporary as it may be--so will military be given money to equal that situation. The temporary controls that were started twenty-five years ago or more in the Camp Lejeune and Cherry Point area are still being continued probably in the same manner. The permanent controls have been slow to develop. The last part is that when a permanent control is built, there must be a maintenance of some kind. In civilian life when you build anything permanent and you want to keep it over a long period of time, you appropriate for management or maintenance. In the military we cannot appropriate beyond next year. So you can build a ditch and say, "This is going to require so much maintenance," and everybody up topside will agree, "Yes, yes." You say, "Okay, it cost me $12,000 to put in this little program. I'd like to have $1,500 to check it two years from now." "Oh, well you can't appropriate for it now." So it's more a money problem, I believe, than anything else. But in order for us to sell it, it must be sold to our civilian overseers, and I believe this is a proper way to do it. I'd love to go up and have to justify some of our projects. They use us because in the research lab we support their problems in every manner which we possibly can; and frequently, it is through our lab that we can sell support for certain programs beyond the base level.

My commanding officer asked me to extend an invitation to all of you to visit the laboratory. Our present commanding officer wants to have the doors open at all times, and we like to have visitors and encourage you to come and see how the research laboratory is spending your money in the studies that are related to amphibious warfare, not only in mosquito control.

Now, last, we are teaching personal control where we know our Marines are working with Marines who have had malaria and some have malaria. We're teaching more and more the use of repellents. Protect yourself! This is

the system within the Marines anyhow. Protect yourself! As the repellents become more available and are better understood, their use is being taught not only to the young enlisted Marines but to their young officers. I believe we'll be able to see benefits from this. It's a very difficult thing to go to a front area, I'll say like a guard post out on the periphery of the base at Guantanamo Bay and say to a marine on guard, "Do you use repellent?" and he says, "Yes, sir." "Can you show me?" and he says. "Yes, sir." He knows right where the bottle is, and he screws the top off and puts a little glob in his hand and goes like this and says, "I do that every night, but it's no damn good." "Well, how long has that bottle been there?" "Oh, it's about a month. We're only allowed one bottle every month out here." Now we expect a Marine to have four of those bottles with him at all times, full; but locally they make certain exceptions. Marines are not always in an area that's mosquito controlled--area controlled. Frequently, there are patrols that are in uncontrolled areas. Then Marines need to know how to protect themselves.

LOCAL INTERESTS IN MOSQUITO CONTROL

Mr. Charles J. McCotter
Administrative Officer
Pamlico County Health Department
Bayboro, North Carolina

One day I had the occasion to stop at a dock where a number of crabbers had just recently come in from their day's work; and as customary when a public official is in a crowd, numerous leading questions are always asked. On this particular date, a crabber by the name of Elie Sadler said to me, "Charlie, you got a Health Department running in the county now; why don't you really do something for the people--that is, get rid of these darn mosquitoes?" I in turn gave him the stock answer, that being, "Gee, I wish we could, and maybe we will look into it."

Weeks went by and I thought very often about what Elie had to say not only from his personal opinion but from the overall health and economic aspects. We in Pamlico County had a very serious problem with the mosquitoes, and it was even more difficult for me to overlook this problem; therefore, I felt it incumbent to start talking to individuals and groups to survey the general feeling which, as you know, can be extremely varied. I took it upon myself to go to the tax rolls and take every tenth name and send them a questionnaire which asked their feelings on mosquito control and the all-important question, were they willing to pay for this project in cold, hard cash; namely, local taxes. I was very much surprised that a little over 80 percent of the questionnaires returned were willing to have a tax increase, and the average amount that they recommended was twenty-three cents on the $100 valuation. Upon a complete analysis of this astonishing result, I conferred with our local Board of Health and Board of Commissioners both of whom were very pleased to hear of this great response from the citizens.

In talking with a number of the coastal legislators, the general opinion was, "Let's get going," and asked a very pointed question, "Where do we go?" The answer for this I did not have, but in conferring with numerous other state and federal authorities and particularly representatives of the North Carolina State Board of Health, it was recommended that the 1955 General Assembly establish a Mosquito Study Commission which was done, and a report was made outlining the problems and needs for coastal North Carolina.

During 1954 and particularly the fall of 1955, coastal North Carolina was ravished by a series of hurricanes that produced mosquitoes in great abundance, and emergency spray programs were inaugurated by the state in the several counties which produced excellent results. These same spraying programs were continued in succeeding years also with good results, but it was our opinion that spraying was of such a temporary nature that we needed to consider a more permanent program, and after conferring with numerous authorities in this state and other states, we were able to secure some draglines through Hurricane Disaster Relief Programs for special hurricane relief projects.

In 1959 we inaugurated a general marsh water management program whereby we could eliminate or to better paraphrase same to retard the breeding of mosquitoes on our vast marshlands. With 416,000 acres of salt marsh and salt-killed areas, we had a vast job to perform in the state. In Pamlico County there are 37,000 acres which was enough to scare the average official because of the finances involved; therefore, we attempted a long-range program which at this time we have completed approximately 80 percent of the total project.

Our local interest remained extremely high, and everyone was requesting that the draglines come to their area first; therefore, we had to establish a master plan of going to the general areas that the mosquito breeding was the greatest and following a general pattern to those areas with less breeding given the lowest priorities. After a couple of years of this water management program, I had numerous conferences with Mr. Otto Florschutz, Biologist with the North Carolina Wildlife Resources Commission, who suggested that we inaugurate impoundments into our program, the first of which was a test impoundment constructed for his agency and which proved extremely effective not only for mosquito control but for wildlife habitat. After that the request for impoundments started pouring into our office. These had to be evaluated very closely in view of the fact that our cost data indicated that the average impoundment would cost approximately 49 percent more than the ditching. This cost factor was not the overriding question, however, as we realized the great benefits would in the future far exceed the increased cost.

As of March 31, we in Pamlico County had constructed 430 miles of ditches and 2873 acres of dikes at a cost of $823,000. In January 1968 we realized a number of our mosquitoes were not respecters of county boundaries; thereby we entered into a contract with adjoining Beaufort County, and through March 1970 we had completed some fifty-seven miles of ditches and 400 acres of

impoundment. The Beaufort County project would have been stymied from the beginning had there not been exceedingly great local interest because as a number of their citizens stated, "Little Pamlico is getting rid of their mosquitoes, why can't we?" Even though the local interest was there to prepare contracts between two counties and two state agencies and to secure the necessary appropriations will give you many headaches trying to cut the necessary red tape.

As of this time our interest in mosquito control is probably at its lowest ebb not only due to the fact that our mosquitoes are much less numerous, but in this day of aquarius when so very few citizens have a proper interest in public affairs, it is getting extremely hard to carry out the necessary public programs such as mosquito control where a person on one hand desires such a program and with the other hand is banging the gavel so hard for reduced taxes. How we can reactivate our interest in such matters to me is of the greatest concern not only in the field of public health but in all facets of government. I thank you.

Question: What's the relative cost of upkeep of impoundments and ditches?
Answer: Under the contracts that we have on impoundments the Health Department does not maintain the dikes except in the case of a hurricane as defined by the U.S. Weather Bureau, where the winds exceed seventy-five miles per hour. Otherwise, it's the property owners' responsibility to keep up the impoundments. There's been very little upkeep that's had to be done to the impoundments. Some of them are in the position of needing a little bit more. As far as the ditches are concerned, the major problem we have is not filling the ditches, but areas where the myrtle bushes lean over. We still have good drainage underneath it. Quite a few years ago we tried to design a mowing machine that would go along and mow these banks, and that's one of the most fantastic things you've ever seen. It wouldn't even touch it. We are hoping to get a program started on that. Our funds are limited now. We did do, oh, maybe ten or twelve miles of it last summer, and if we can get anymore funds, we're going to start that as a permanent major.
Question: Will these come back on you once you mow them down?
Answer: Well, you know a myrtle bush is a very unusual thing. You find that normally in your high marshlands, but if you have a ditch cut through a piece of marshland, they would normally grow right out the side of it because in

Pamlico the general marshlands are some six inches above normal tide. Now the tide goes and comes everytime the wind shifts, but they will sort of grow out of the side of that and hang over the ditch.

Question: Could these be controlled by herbicides or not?

Answer: Well, it would be mighty expensive to go up and down them all the time because you can cut them one year, and they're right back the next. The only thing you could do really is pull the roots out. That does a real good job, but it's a very awkward situation.

Question: How many people do you have on your tax rolls in Pamlico?

Answer: Taxpayers? Gee, I don't know. There're only 9250 people in the whole county.

Question: Any of them you don't know?

Answer: Yes, sir. There's somebody that was moving in yesterday when I was on the way out. Incidentally, we are getting the most complaints right now than we have had in a number of years. Somebody must have changed the wind cycle. The predominant wind in North Carolina at this time of the year is supposed to be from the Southwest. For the last couple of years it's been shifting around to the East and Northeast. That gives us a high tide. I assume that's where they are coming from. I mentioned Beaufort County a few minutes ago about the mosquitoes coming over--of course, Beaufort and Pamlico are adjacent to each other. We have some other counties in North Carolina that have not even come into a mosquito control program. At Pamlico Point where your wildlife impoundments are you can stand on Pamlico Point and just a few miles across the river all of them are coming in from Hyde County where they've never had any control. They will eat you slam up. But the individuals don't know where they are coming from. However, just as soon as they come across regardless of how much work we've done, the phone starts ringing--not the Hyde County phone, it's still our phone.

Question: What about educational programs, Charlie?

Answer: Well, there are some people that are not amenable to education. I happen to be one of them, and all of my cohorts down there are about the same way.

Question: Can you comment on the amount of chemicals being purchased now by the counties or by the municipalities? Do you have any insight on that?

Answer: No, sir, I can't. As for Pamlico County, we haven't bought a gallon of insecticide in eight years. We consider that it is much better to buy

shingles than to buy pans and set in the livingroom to catch the drip. Now, notwithstanding the fact that occasionally we don't need some chemicals and need some spraying, but to run one smoke machine for four hours, I can run two draglines for eight hours. Now Sid and Don can give you some figures on the statewide basis, but that is our opinion in Pamlico. Fortunately, we have been able to live with it. Who knows, if they get much worse, we are probably going to have to start spraying. We have said that every year for some years. We hope we don't and can get by because that is such a temporary measure plus the fact that the first time it rains you've got to do it all over again.

Question: You said something about 40,000 or 60,000 acres of marsh in Pamlico County?

Answer: Thirty-seven thousand and ,that is with the salt-killed area as well as the normal marsh. Those figures are taken from our 1955 study report, a copy of which I think you have.

Question: But it does include the salt-killed upland type of mosquito breeding areas--not just the true marsh?

Answer: That's right.

Question: Not just the true marshes?

Answer: That's correct.

Comment: The important thing is the percentage here--of breeding--is much, much higher than it is in, as was said this morning, in some of the counties.

Answer: All who saw the slides earlier that Keith had, where you saw all the pine trees and a marsh underneath that. Frankly, if we had started this program a few years before we had all of those hurricanes back in the middle fifties, a lot of this would not have been salt-killed, but the tides came in, they deposited, the water eventually got out and all the salt left. If they'd had some ditches in there, maybe it would have been neutralized to the point that we wouldn't have had half the kill that we actually had.

PRESENT AND POTENTIAL TECHNIQUES FOR THE CONTROL OF MOSQUITOES[1/]

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Much progress has been made in the development and evaluation of new insecticides for mosquito control, but the controversy revolving around the "persistent compounds," particularly DDT and its related organochlorine insecticides, has in large part overshadowed the advancements. Considerable testimony both pro and con has been offered on this topic, much of which has been scientifically unsound and representative of the extremist type of reaction.

DDT has been banned in certain states; in other states the use of DDT or other organochlorine compounds is allowed under certain circumstances. The Department of Agriculture has cancelled the registration of DDT for use in and around homes and in aquatic environments, marshes, wetlands and adjacent areas except where its application is deemed essential for the control of disease vectors as determined by public health officials.

The Commission set up by the Secretary of the Department of Health, Education, and Welfare recommended in its report (Anon., 1969) that all uses of DDT and DDD in the United States be eliminated within two years except those uses essential to preserving human health and welfare and approved unanimously by the Secretaries of the Departments of Health, Education, and Welfare; Agriculture and Interior.

Fortunately, from the domestic standpoint, DDT no longer represents a frontline pesticide in mosquito control. Most abatement districts discontinued DDT applications five to ten years ago. However, DDT has been used for the control of Culiseta melanura in New Jersey, as a preventive measure against encephalitis vectors in and around farmhouses in the western United States, and as a preflood treatment, chiefly in northern United States.

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Despite the fact that DDT has been used with safety to man, its further use in the United States must now be limited to the prevention and control of human diseases and other essential vector control uses for which no alternative pesticide exists. The evidence that DDT has caused injury to non-target organisms justified the view that non-essential or indiscriminate applications of it are unwarranted.

Although the current use of DDT against all disease vectors is limited in the United States, the same is not true in other countries, particularly those that have disease problems of yellow fever, malaria, plague, epidemic typhus, onchocerciasis or sleeping sickness. Some countries, such as Sweden, Italy and Canada, have issued a general ban against DDT, although it can still be used for specific purposes. Of interest is the recent information that Sweden has allowed DDT to be imported for use against forest insects. The importance of DDT in international public health problems is keynoted by the recent statement of the Director General of the World Health Organization: "DDT has been instrumental in controlling some of the most important vector-borne diseases of man; the concept of malaria eradication rests completely on its continued use. The record of safety of DDT to man has been outstanding during the past twenty years, and its low cost makes it irreplaceable in public health at the present time."

Action continues on this entire matter of pesticide environmental contamination, and anyone involved in vector control must make a consistent effort to keep abreast of changes in regulatory practices (both federal and state) that could affect his use of these materials.

Chemicals have been a major weapon in man's effort to combat mosquitoes. The role that insecticides play in such control received a major stimulation with the advent of DDT during the closing year of World War II. Following this, a great host of insecticides were developed by research and development personnel in the chemical industry. Initially, the materials produced were primarily organochlorine in nature; they included compounds such as DDT, methoxychlor, chlordane, heptachlor, dieldrin and aldrin. However, the appearance in many insect populations of resistance to one or more of these compounds led to the development of the organophosphorus materials, such as parathion and malathion. Subsequently, the carbonate insecticides were produced, and at the present time these represent our latest tools in the chemical control of mosquitoes. In mosquito control, insecticides are used in a variety

of ways, not only in regard to the methods of formulation but also as to the techniques of application. The formulations include emulsifiable concentrates, wettable powders, solutions and granules. Treatment extends from the use of hand equipment, power sprayers, and ground fogging units to aerial application.

In this review chemical approaches have been classified according to the stage of the insect at which they are directed and the type of application involved. The relative toxicities of the various compounds are given in Table 1[2/].

Table 1. Acute oral LD-50's of selected pesticides to female rats (mg/kg).

DDT	118
methoxychlor	6,000
Abate	13,000
dichlorvos (DDVP)	56
naled (Dibrom)	250
Dursban	82
fenthion	245
parathion-ethyl	3.6
propoxur (Baygon)	86
carbaryl (Sevin)	500
paris green	100
pyrethrum	263

Adulticides. Applications applied for the control of adult mosquitoes are residual treatments, residual fumigants and space applications. Following World War II, the residual type of treatment was used a great deal in this country to control the malaria vector in the southeastern United States. It is still a major weapon against malaria vectors in countries other than the United States. The principal chemical employed is DDT, although other compounds, such as propoxur (Baygon), malathion, and carbaryl (Sevin), have

2/ Use of trade names is for identification purposes only and does not constitute endorsement by the Public Health Service or U.S. Department of Health, Education, and Welfare.

been considered substitutes for DDT in areas where the vector no longer is susceptible to that chemical. In the United States DDT is not considered essential as a disease control agent even against malaria, since malathion is considered equally effective as a household treatment. Although malathion does not give a long-lasting deposit on the house construction materials (mud, cement plaster) found in tropical areas, it is extremely persistent when applied to wood, the principal material used in this country.

One point about residual treatment is that many of the organophosphorus or carbamate compounds not only are effective as surface residues but also produce a fumigant action (Table 2). These compounds were applied to the mud-lined walls of experimental huts at our laboratory at Savannah, Georgia, and cages of anopheline mosquitoes were suspended from the ceilings at various time intervals after treatment. The data also show that some pesticides (Mobam and BAY 78182) have no fumigant type action whatsoever.

Table 2. Fumigant action of insecticidal residues (2 g/m^2).

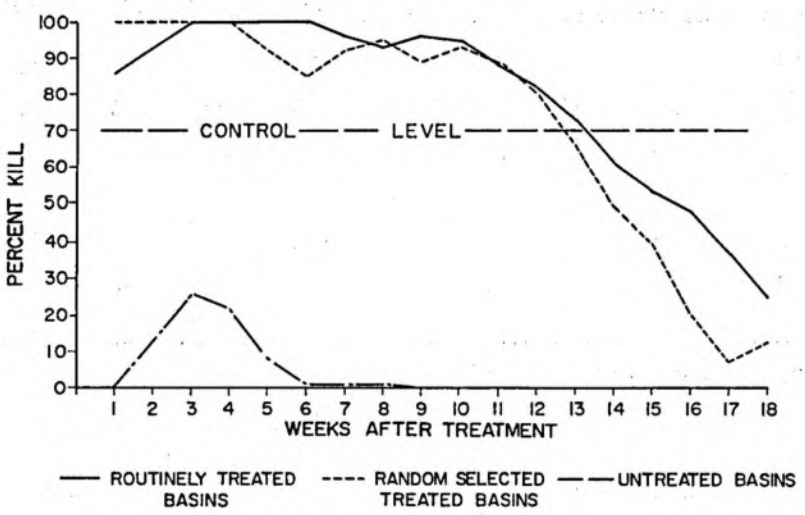
	Weeks of 90% or higher kill
propoxur	>20
Dursban	>18
Landrin	13
bromophos	13
Mobam	0
BAY 78182	0
BAY 38799	2
phoxim	8

The residual fumigants are limited to one formulation which incorporates dichlorvos (DDVP) into resin. One resin strip per 1000 cubic feet a room or similar enclosed area will produce adequate vapor to cause death of adult mosquitoes therein for periods of two to three months. Obviously, the room or space treated cannot be subject to excessive ventilation; otherwise, the threshold concentration adequate to cause the death of the mosquitoes will not be attained. In mosquito abatement programs, DDVP resin strips have been

shown to be suitable for controlling the production of Culex mosquitoes from catch basins which in many cities are a principal source of this mosquito. The effectiveness of this type of treatment is shown in Figure 1.

FIGURE I

PERCENT MORTALITY OF ADULT FEMALE *CULEX PIPIENS QUINQUEFASCIATUS* IN CATCH BASINS.
SAVANNAH, GEORGIA-1963



The major adulticiding practice followed in mosquito abatement work is space application. Machines, such as the TIFA, Dynafog and Leco[2/], produce thermal aerosols that are used to reduce mosquito prevalence when other methods have failed to curtail mosquito breeding. Numerous insecticides have been employed for this purpose, and one commonly used at present is malathion. Other compounds approved for such usage are fenthion (Baytex) and naled (Dibrom). Space treatments are designed to discharge insecticidal particles that contact the insect in flight. They do not apply a treatment of lasting effect; the chief effect is to kill mosquitoes present at the time of treatment. When mosquito breeding is heavy, it may be necessary to apply fog treatments three to five or more times a week. If the breeding potential is light, a single treatment may be sufficient to reduce adult annoyance to an acceptable level for a period of two to ten days or more. Data from some of the studies with different compounds are given in Table 3. These results point out the fact that the dosage applied may need to be varied depending upon the species involved, since certain mosquitoes are more difficult to kill than others (e.g., Gardona versus Aedes aegypti and Culex pipiens

quinquefasciatus). In addition to the thermal aerosol fog, non-thermal fogs also can be applied and studies have shown that from an effectiveness standpoint each is equivalent (Table 4).

Table 3. Percent mortality of caged adult female mosquitoes in thermal fog tests, 1967.

Insecticide	Oz./ gal.	Test runs	Ae. aeg. 150'	Ae. aeg. 300'	Ae. taen. 150'	Ae. taen. 300'	A. alb. 150'	A. alb. 300'	Cu. quin. 150'	Cu. quin. 300'
malathion	6	26	94	84	90	52	96	93	61	38
Gardona	4	10	98	87	80	25	71	51	30	7
bromophos	6	16	85	70	44	40	66	61	62	45
Abate	6	8	46	9	7	1	15	9	31	1
BAY 77488	2	6	66	45	58	41	93	76	24	14
BAY 78182	2	8	98	88	78	67	98	94	95	82

Adapted from Taylor and Schoof, 1969.

Table 4. Effectiveness of thermal(T) versus nonthermal(NT) fogs against Culex quinquefasciatus.

	T	NT
malathion	94/82*	86/79*
Dursban	95/70	91/80
naled	71/28	75/31
propoxur	43/22	61/22

*First figure represents % kills of caged adults at 150 feet. Second figure represents % kills of caged adults at 300 feet.

In the general concept of space treatments, one of the new developments in the last couple of years has been the interest shown in ultra low volume (ULV) treatments applied at ground levels. Before discussing ground ULV equipment, however, it would be well to consider the aerial aspect since this

phase was the initial method of treatment with ultra low volume quantities (i.e., less than 1/2 gallon of insecticide per acre)[3/] of insecticide. Pesticides have been aerially applied for many years, but during the past several years the application of extremely small quantities of technical grade insecticide has come into the picture. When we speak of small amounts, reference is to three fl. oz. of malathion or 0.5 to 1.0 fl. oz. of naled per acre.

The first extensive use of ULV applications from the air against mosquitoes came in 1966 in Dallas, Texas, during an outbreak of St. Louis encephalitis (Kilpatrick and Adams, 1967). The work demonstrated that ULV treatments were extremely effective in reducing the number of infected mosquitoes present in the area. Initially, one out of every 160 specimens was infected. Subsequently, only two infected mosquitoes were found in about 58,000 specimens. Since that time, the ULV method has been tried successfully in experimental studies against Ae. aegypti in Bangkok, Thailand, and against A. simpsoni in Ethiopia (Brooks et al., 1970). However, it was not successful against Ae. aegypti during an outbreak of dengue in Puerto Rico in 1969 (Brooks et al., unpublished manuscript) because the treatments, although effective against the outdoor populations of the mosquito, unfortunately did not penetrate the houses. Thus, the mosquitoes resting and/or breeding therein were not affected. ULV treatments are not a common tool in mosquito abatement districts; their chief value lies in epidemic or disaster situations where rapid coverage of the area is essential.

The fact that technical grade malathion could be used effectively in aerial applications has led to interest in the use of ULV as a ground-applied treatment. Recent studies by Mount et al. (1970) in Florida have shown that a commercial ULV cold aerosol nozzle was capable of dispensing technical malathion in droplet sizes averaging from eleven to sixteen microns mass median diameter, the size depending upon the flow rate of the material per minute. The higher the flow rate, the greater the average diameter as well as the mass median diameter. The nozzle was mounted on a Curtis cold fogger, and the unit was operated with a pressure of 3.5 p.s.i. A flow meter and a small needle

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3/ ULV, "ultra low volume," as used for labeling purposes is defined as: application of a volume of 1/2 gallon or less of undiluted concentrate per acre.

valve regulated the flow of the technical grade material from the source container. The insecticide was moved from the tank by air pressure of 3.5 p.s.i., and no insecticide pump was necessary. Comparative tests were made between the aerosols produced by the ULV apparatus and one of the standard machines used for high volume thermal aerosol production. As shown in Table 5, higher kills of caged mosquitoes were obtained with the ULV cold aerosols.

Table 5. ULV versus thermal fogs of malathion against caged Ae. taeniorhynchus.

	Lb./A.	Fl. oz./A	Avg. Kill
ULV*			
	0.009	0.12	69
	0.018	0.24	93
	0.036	0.48	92
Thermal**			
	0.009	14	65
	0.018	14	59
	0.036	14	85

*Vehicle speed 10 m.p.h.
**Vehicle speed 5 m.p.h.
Adapted from Mount et al., 1970.

The number of fluid ounces used per acre indicates that the amount of material or payload required was far less with the ULV method than with the thermal fog treatment. Furthermore, the rate of speed of the vehicle with the ULV applicator was twice that of the vehicle dispensing the thermal aerosol. The effectiveness of ULV treatments at vehicle speeds of 10 versus 20 m.p.h. indicated no appreciable differences (Mount et al., 1970).

Ground-applied ULV applications thus appear equal to or more effective than thermal fogs and, in addition, permit a much greater latitude in the speed of the vehicle as well as providing an increased coverage because of the much smaller payload required. The absence of fuel oil in ULV applications reduces cost and essentially eliminates the traffic hazard frequently associated with thermal fogs. Nonetheless, the white cloud produced by

thermal fogs often has been considered of value because it demonstrates to the public that abatement efforts are being made. At present, the ULV type of ground application is still in the experimental phase, since questions remain on the toxicological considerations and on the possible damage to automobile paints. In addition malathion, as yet, has not been registered or labelled for use as a ground treatment.

Much interest has been developed in the particle size produced by fog machines, particularly in reference to the distance at which the insecticide treatment can produce effective kills. In work on an island off the coast of California, Stains et al., (1969) have reported that low volumes of either naled or Dursban, when dispensed in droplet sizes on the order of ten mass median diameter (MMD), gave kills of adult caged mosquitoes and house flies at distances of two miles from the release point. Mount (1970) recently summarized the findings on optimum droplet size for adult mosquito control and stated that a droplet size range of five to ten microns is considered optimum for ground treatments, whereas with aerial treatments the optimum droplet size probably is in the range of ten to twenty-five microns MMD. With ground application, droplets larger than the ten microns are more susceptible to fallout and to impingement on surfaces in their path of movement. Mount (1970) indicated that droplets less than five microns do not impinge on the adult mosquitoes too well. They also are more likely to be moved upward by convection currents and thus will not move through the area normally inhabited by adult mosquitoes. The importance of the size of the droplet, particularly in relation to the droplets above twenty-five microns, is emphasized by the findings of Weidhaas et al. (1970) that a twenty-five-micron droplet of technical grade malathion contained sufficient toxicant to kill the mosquito. Thus, droplets larger than twenty-five microns are quite wasteful of the insecticide. Mount (1970) reported that at a dosage of 0.009 lb./A. the kill of caged Ae. taeniorhynchus was 20 percent or greater with droplets of 9.7 and 6.4 microns versus that with droplets of twelve to seventeen microns.

The importance of droplet spectrum cannot be overemphasized. Our ignorance along this line is largely due to the fact that too little attention has been paid to it and suitable devices to detect the different size droplets have been limited. One example of much importance is the finding in aerial spray research conducted against forest insects (Himel and Moore,

1967) in which it was shown that 93 percent of the spruce bud worms collected had not been contacted by any particles that were in excess of fifty microns in diameter even though droplet size ranged from three microns to 400 microns. Apparently, no droplet over 100 microns ever contacted the target insect.

Larvicides. Mosquito larvicides have long been a standby in mosquito control, but the degree to which they are used varies considerably in the different parts of the country, the species involved and individual operator's preference. Most measures directed against C. p. quinquefasciatus are larvicidal, and the same also applies to Culex tarsalis in California. Although there are a number of effective organophosphorus materials for this purpose, concern exists where the same type of insecticide is applied as a larvicide and as an adulticide because larviciding generally is considered to exert a higher selection pressure upon the mosquito population. Therefore, if resistance develops, it means that the adulticiding technique of fogging also may fail, thereby leaving no immediate chemical weapons with which to combat the mosquito.

Table 6 lists the LC-95 levels of different insecticides used as larvicides (Taylor and Schoof (a), unpublished manuscript). The lower the parts per million (ppm) figure, the greater the toxicity of the compound to the insect. Such figures represent laboratory data and show only the relative potency of the different materials. The two compounds, Dursban and Abate, are uniformly toxic to the three species of mosquitoes listed. Other compounds vary considerably with the species involved. For example, methoxychlor requires more than five times as much material to kill Ae. aegypti as it does to kill Anopheles quadrimaculatus or C. quinquefasciatus. Two of the materials, propoxur (Baygon) and carbaryl (Sevin), are carbamate compounds, and these generally are considered to be relatively poor as larvicides in comparison to the organophosphorus materials. Nonetheless, they are toxic to the mosquito larvae, provided sufficient material is applied. Currently, the two outstanding larvicidal compounds are Dursban and Abate. Dursban is a more effective chemical under conditions where the water contains a high amount of organic matter; in contrast, Abate can be used with a far higher degree of safety to man and non-target organisms than is true for Dursban. Actually, the safety level of Abate is such as to permit it to be used in drinking water for the control of the yellow fever mosquito.

Table 6. LC-95 levels in parts per million of selected pesticides for three species of mosquito larvae.

Insecticide	A. quad.	C. quin.	A. aeg.
Abate	0.004	0.004	0.004
propoxur	0.5	0.5	2.5
carbaryl	2.5	2.5	2.5
Dursban	0.004	0.004	0.004
fenthion	0.02	0.005	0.02
Gardona	>2.5	0.5	0.5
methoxychlor	0.5	0.5	>2.5
naled	0.5	0.1	0.2
parathion(e)	0.01	0.01	0.02
parathion(m)	0.025	0.005	0.01

From Taylor and Schoof (a), unpublished manuscript.

Although DDT has been of considerable value as a preflood treatment and has been used widely for this purpose against Aedes vexans, particularly in northeastern and western United States, a number of organophosphorus and carbamate materials can serve to provide the same type of efficacy, provided the dosage per acre is in the range of two to four pounds. Table 7 gives a resume of such data from experimental studies conducted at Savannah, Georgia (Taylor and Schoof (b), unpublished manuscript). Dursban, without a doubt, has been the best material against the four species of larvae involved. Although these data refer to a dosage of 2 lb./A., Dursban has been equally effective at 0.5 lb./A. when applied to grassy spots exposed to normal rainfall and outdoor weathering conditions. Abate requires four pounds per acre to give six weeks' effectiveness against Ae. taeniorhynchus and is even less effective than propoxur (Baygon), which requires only two pounds per acre. A second carbamate, carbaryl (Sevin), at four pounds per acre gave more than ten weeks of kill of Ae. taeniorhynchus. In other studies, Dursban treatment has been shown to be effective for as long as fourteen weeks at 0.5 ppm, whereas Abate at 1 ppm was inactive after three weeks (Anon., 1970). In areas where DDT is no longer acceptable for use, consideration now is being given to

methoxychlor. This insecticide, although closely related to DDT, is biodegradable and, because of this fact, is acceptable to fish and wildlife groups. Studies with these two compounds against Ae. aegypti illustrate that the compound is equal to or even more effective than DDT. However, workers in the northern United States have indicated that methoxychlor is not as good as DDT from a biological standpoint, but from the standpoint of calming the emotional upheavals that the word DDT sometimes invokes in the public, the abatement district may lean toward a less effective insecticide which is fully acceptable to the layman.

Table 7. Weeks of 90% mortalities of three species of mosquito larvae obtained from preflood application of nine insecticides

	#/A	Ae. taen.	A. alb.	C. quin.
Abate	4	12*	12*	12*
Mobam	4	8†	12†	6†
Akton	2	>12†,*	>12†,*	<2†,*
Cidial	2	6*	2*	6*
bromophos	2	<2*	6*	6*
Dursban	1	>12**	>12**	>12**
propoxur	2	6†	12†	-
carbaryl	4	>12††	12†	-
fenitrothion	2	2**	8†	-

Effective formulation: *Emulsifiable concentrate; †granular formulation; ††wettable powder; and ** all formulations.

Before finishing the section on larvicides, there are two other compounds that should be mentioned, since both materials have long been used in the control of certain mosquitoes. Before DDT appeared, paris green served for many years as a treatment against anopheline larvae but was not used against culicine species. However, the Florida State Board of Health research laboratory (Rogers and Rathburn, 1958) developed a paris green granule that has been and is still being used as a successful means of controlling salt marsh

mosquito larvae. Despite its use for many years, there has not been any indication of any harmful effects from this chemical upon the wildlife of these areas. In addition, the mosquitoes have shown no indication as yet of developing resistance to it.

The second compound is ordinary fuel oil. Special commercial formulations of oils (e.g., Flit M.L.O.) have been developed for larviciding purposes; their chief advantage is that they can be used at dosage rates of two to four gallons per acre as contrasted to the use of fuel oil at ten to fifteen gallons per acre. However, it is of much interest to note that the addition of a surfactant, such as T-Det MC or Triton X45, at a level of 0.5 percent in the fuel oil also allows fuel oil to be used at dosage rates similar to these special larvicidal oils. The surfactant-fuel oil preparation is now being used extensively by the Chatham County Mosquito Control Commission at Savannah, Georgia, and the Commission Director reports that its cost per acre is less than that for the special oils and about one-third the cost of the paris green pellet application.

Among the non-insecticidal means of mosquito control are drainage, filling, impoundment and other familiar means of source reduction. Consequently, let us look at techniques other than these types, such as the biological control and genetic control of mosquitoes. The recent emphasis on insecticide pollution in both air and water has generated tremendous interest in and emphasis on such approaches. A point of view frequently held by laymen is that such means are simple, and all one has to do is to apply fungi, viruses, or protozoa that are harmful to the insect, and this approach will do away with the need for chemicals. Such an interpretation indicates that the proponent is quite unacquainted with the role and feasibility of non-chemical procedures. These measures are highly refined methods of treatment. Considerable scientific knowledge about both the organism and the mosquito is required before one can even begin to think about them in terms of a practical control procedure. Many of the organisms that are detrimental to mosquitoes are already present in the environment; obviously, they have not been doing the job necessary for human comfort and freedom from disease.

In addition, the misconception exists that any biological control measure, whether a fungus or any other type of parasite, is harmless to non-target organisms including man. An Expert Committee of the World Health Organization on the Safe Use of Pesticides states in its 1967 meeting: "It is important to

bear in mind, however, that a biological agent or the toxic product of an organism will not necessarily present either a greater or lesser health hazard than a synthetic material. Although there is a popular belief that 'natural' substances are harmless, all the most poisonous materials so far known are, in fact, of natural origin. Therefore, any material--living or dead--which it is proposed to introduce as a pest control agent should be subjected to the same searching examination for potential toxicity to man as is applied to the synthetic pesticides. Furthermore, it may be very difficult to lay down satisfactory criteria for testing the safety of such agents as novel viruses or bacteria. Microbial toxins could be submitted to a conventional pharmacological and toxicological examination, but a precise assessment of hazard could only follow a detailed study of the mode of action, which might take a very long time. Such considerations apply only to non-viable biological materials that come into intimate contact with man.

"Particular attention to hazards may be needed in the case of fungi. These can not only produce a variety of potentially toxic metabolites, including carcinogens, but at least some of them can become established in mammalian tissues and give rise to granulomata. Others appear able to induce hypersensitivity reactions leading, for example, to progressive tissue damage in the lungs, which may be fatal."

Turning to the opposite viewpoint is the argument that such techniques can never be as effective as chemicals; hence, they can largely be ignored. This viewpoint is as extreme as the one mentioned earlier, since it is quite obvious to anyone involved in the field of vector and insect control that each tool in itself should not be considered as a single weapon to the exclusion of all other types of control measures. The whole approach to successful vector control emphasizes an integrated approach, and it involves not only a wide variety of chemicals and application techniques but also envisions the inclusion of biological and genetic methods as components in the arsenal of weapons for mosquito control.

Biological control of mosquitoes has not met with a great deal of success up to the present time even though numerous organisms, particularly among fungi and protozoa, are lethal to mosquito larvae. Several years ago the field discovery was made that many Ae. aegypti larvae were dying even though apparently no chemical control measures were being applied (Barrett, 1968). The emphasis on this finding by operational personnel led to detailed research

on the subject. The dead larvae contained a protozoan parasite, Lankesteria culicis. Unfortunately, data from laboratory studies showed that L. culicis was not harmful to the larvae even when the latter were heavily infested. Nonetheless, the fact remained that in one area in Texas far fewer parasites caused the death of the mosquito larvae. Field investigation led to the suspicion that other factors were operating, one of which may have been the use of DDT in certain areas where kills of the larvae were being obtained. Laboratory tests in which DDT and the parasite were combined showed excellent kills even of larvae resistant to DDT. At this time it appeared that a discovery of great potential had been made but, unfortunately, the initial test data could not be replicated. Apparently, unknown factors operating in the initial tests were absent in subsequent tests. Later, an intensive survey was made for the parasite and for larvae of mosquito host in Texas, Florida, Louisiana and Mississippi. However, the final conclusion was that this particular organism offered no promise for controlling Ae. aegypti larvae.

Other organisms are now under study at our laboratory. One organism is highly toxic to culicine larvae but not to anopheline larvae. Work is also being conducted in cooperation with Dr. John Couch of the University of North Carolina on the fungus Coelomomyces, since it is detrimental to anopheline larvae. Unfortunately, the species of fungus involved is specific for the A. quadrimaculatus and is not of value against malaria vectors in the tropics.

The genetic control of mosquitoes encompasses not only the actual genetical manipulation within a species but also involves the use of sterilizing agents, such as chemosterilants or gamma irradiation. Most of us are familiar with the fact that the screwworm fly in Florida and lower Georgia was eliminated by the use of sterilized screwworm males, but the success of this effort has not spilled over into similar accomplishments with mosquitoes. Studies have been conducted with both Ae. aegypti and A. quadrimaculatus in the United States, but in each case successful results were not achieved. A part of the failure can be attributed to infiltration of mosquitoes from outlying areas, part to lack of knowledge in the biology and ecology of the species, and part to the fact that the study was not donducted over a long enough period to achieve conclusive findings. In most studies with the chemosterilants or cobalt irradiation, it is a relatively simple matter to sterilize the male and/or female mosquito. It is likewise easy to introduce large numbers of sterilized males into cages with normal males and to show that the number of

viable eggs can be reduced to extremely low levels. However, to put the same tool to work in the field may create many problems. First, the sterilized males may not be as competitive as the wild males. Second, the dispersal of the sterilized males may occur too slowly to have any effect on the matings of field males and females. In cage population studies, you have the sterilized and fertile insects confined in small space. In a field trial, many more sterilized males may be present in a block than normal males, but if at the breeding site the fertile males are there at the time the females emerge, the females have frequently already mated before the sterile male puts in an appearance. Consequently, the fact emerges that we have relatively little information on the normal behavior and ecology of mosquitoes, particularly the male sex, under field conditions. Therefore, until we know more about these factors, the use of these sophisticated tools of genetic control must be delayed. However, certain promising developments during the past few years have given hope that such tools may be effective against at least one species of mosquito, C. p. quinquefasciatus. In his laboratory studies, Dr. Hans Laven found that among the different populations of C. p. quinquefasciatus the males and females are not always compatible (i.e., mating does not produce viable eggs). With this knowledge, he developed a strain of male C. p. quinquefasciatus that were incompatible with the female mosquitoes occurring in a small isolated Burmese village where the species was breeding only in artificial water containers during the dry season. By the daily introduction of 5000 incompatible males at the breeding sites complete elimination of all viable egg rafts was achieved within a three-month period (Laven, 1967). No other means of control were used. However, it must be emphasized that the males were released in the jugs in which the mosquitoes bred so that the factor of distribution or dispersal was artificially handled. Nonetheless, the work did show that the use of these incompatible males could cause a tremendous reduction in the reproductive capacity of the local mosquito population. These findings are one of the chief reasons for a large-scale study of the same type that is now underway in Delhi, India, under the sponsorship of the Public Health Service and the World Health Organization.

More recent information on C. p. quinquefasciatus has been obtained by the U.S. Department of Agriculture in studies conducted with chemically sterilized males on Sea Horse Key off the east Florida coast (Patterson et al., in press). In these studies the pupae were sterilized by placing them in an

aqueous solution of 0.75 percent thiotepa. Subsequently, the sterilized pupae were transported to the island and released. The island involved was approximately one mile long and one-eighth mile wide, and the primary breeding site for the mosquito was an open septic tank. Limited breeding occurred in various types of containers that were scattered over the island and held water. The number of males released daily ranged from 8400 in the beginning to 18,000 over six generations.

The ratio of sterile males to fertile males was 3:1 at the second generation and 100:1 by the sixth generation. The results indicated a steady increase in the percentage of sterile egg rafts combined with a decrease in the average number of egg rafts laid per day. These workers concluded that the indigenous Culex population was suppressed and eliminated from the island within a twelve-week period by the release of the sterile males.

In the previous discussion, a number of different methods used to suppress and control mosquito populations have been covered. However, it is the judicious use of these methods in an integrated control operation that leads to success in an area-type mosquito control program. Thus, the successful mosquito abatement program is based on the use of numerous approaches that can be listed as:

1. Surveillance (inspection)
2. Source reduction (drainage, impoundment, filling)
3. Chemical control
4. Education and public relations

Surveillance has been listed as the first of the four approaches because in any control program one must know where the mosquitoes are breeding, the types involved and the densities present. With inspection, you have the information needed to guide the control operations and measure their effectiveness. Both of these aspects are of basic importance to the control operator. Without proper guidance from inspection, the chemical measures may be applied to the wrong areas and thus result in ineffective control as well as a needless expenditure of manpower and money. This same logic would apply to the permanent type of control measures, since such measures should obviously be directed toward the most prolific breeding sites during the initial phase of control operations. Inspection also is critical in determining the efficacy of source reduction and chemical control measures. Records should be kept of mosquito densities on a periodic basis so that such

information can serve as a basis for keeping the public adequately advised on the status of the program. An informed public will greatly enhance a continuance of as well as additional financial support from the community. Inspection can involve various types of procedures including the use of mosquito light traps, determining larval infestation by dipping, spotting the locations of public complaints on the project area maps, and establishing a network of rainfall gauges to determine where breeding is most likely to occur whenever precipitation takes place in the area. Without records on the mosquito densities, the program manager is left without factual data to support his problems and achievements in the public eye.

Source reduction procedures include any technique--drainage, impoundment or filling--that decreases the mosquito breeding in an area. Such procedures are long-term in scope and may have to be carried on for a number of years. In south Georgia, drainage work has been going on for the past nine years and has eliminated considerable acreage of breeding areas without adverse effect on the marshes per se.

Chemical measures supplement source reduction procedures and include such operations as adulticiding with ground equipment and the larviciding of breeding areas that are temporary or cannot be eliminated by source reduction measures. Such work can be done with ground equipment or may involve the use of aircraft whenever extensive areas must be larvicided. As a general practice, such treatment is usually restricted to larvicides, such as paris green or oil, to minimize the chance of the mosquito becoming resistant to the chemical employed.

The fourth element, education and public relations, is of utmost importance to the success of the mosquito control program. The aims and objectives of the operation must be clearly outlined to the public, and the public should be kept advised on the status of the work. Many of the difficulties that frequently arise between mosquito control programs and the public stem from a lack of communication. Individuals may not know what insecticides are being used; they may feel the marshes are being destroyed by the drainage ditches or that the chemical portion of the program is adverse to birds, fish and other non-target organisms. Such misunderstandings arise not only with the lay public but also with agencies concerned with the conservation of wildlife or the natural occurrence of birds and fish. Frequent consultation between the control supervisor and these agencies will do much to lessen the misunderstandings

and friction that occur between mosquito control operations and these other agencies. Wildlife groups should be consulted to be certain that the control measures to be applied are not adverse to their interests. In some cases it may be advantageous although more costly to the abatement group to solve a mosquito problem and yet preserve the wildlife. A wise supervisor recognizes that in the long run his entire program may benefit considerably from a little more money well spent in such cooperative liaison because of the goodwill and harmony created between his activities and wildlife groups, bird enthusiasts and the public in general.

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IMPLICATIONS OF MOSQUITO CONTROL TO OTHER FACETS OF WATER RESOURCE MANAGEMENT

CORPS OF ENGINEERS

Mr. James W. Midkiff
Wilmington District

It's certainly nice to be here. I won't try to explain for the Corps or anything, but this is really--something was said about the program arrangement before--going from the sublime to ridiculous. Anyway, I'll do what I can to share some of our experiences with you. Certainly, as far as knowing about mosquitoes, on the one end we have what the previous speaker was saying, Dr. Knight, etc. On the other, there are those who if the mosquito gets on them and stays long enough, they know they'll bite them. They shoo them off; well, I don't shoo them off. I try to kill them in place. So I'm at that end of the spectrum on the knowledge of mosquitoes.

In the Corps, contrary to what some late popular writers would lead you to believe, most Corps projects begin with a resolution from Congress, not from some dream in the military's mind or some other source. Congress sends the request to the Corps to study a basin or a particular project. One of the first acts that the Corps does when they get this request is go to the Public Health Service and ask them, the experts, what are the possibilities of a mosquito problem in this particular study area. When we come up with a definite project, we go to the Public Health Service again. Usually, they are working with the State Board of Health, and we get again their comment and recommendations on planning and operation of the project so that there will not be a mosquito problem. We get comments from both agencies, and they are submitted to Congress along with the other recommendations and evaluated along the line and by Congress to know whether or not we can have the project.

Of course, you can balance two extremes. You can do nothing in the planning of the project and hope in operation to spend a fortune and maybe control the mosquito problems; or you can properly plan and construct your project, spend some money here, and cut down a tremendous amount on what is required in the actual operation of the project.

To begin with, proper clearing of an area for a reservoir is essential. If your clearing is completed too soon, you have to go back and do a lot of rebrushing, so timing is important in fitting your clearing plan into your

other plan of construction. You should, if possible, clear your reservoir during the winter; but of course, if you take two or three years to build, this is impossible. We know what is generally best, but we cannot always follow that. Other things you have to consider in construction is the control of drift and its removal, the draining and all permanent filling of burrow and spoil areas, and marginal drainage which has been mentioned before.

Once the project is built, water level fluctuation for mosquito control is critical; drift removal and shoreline maintenance are important. As a last resort, if the other systems don't work, we larvicide. Dr. Knight mentioned surveillance. Certainly, this is also important.

Now, I'd like to take a typical Corps project and tell you about our plan of operation and then go back and show you how this either fits or conflicts with malaria control without mentioning malaria control initially. I would like to use the plan of operation for the John H. Kerr Reservoir which is located in Virginia and North Carolina, just a little bit northeast of here on the Roanoke River.

The Kerr Reservoir is operated for flood control, hydroelectric power generation, recreation, water quality control, and fish and wildlife enhancement. In order to best serve these purposes and to take advantage of the seasonal flow in the basin, we operate in accordance with the rule curve which I have roughly sketched on the board here. This ordinate is the reservoir elevation with reference to mean sea level and this is months of the year. What we do is have a pool as low as possible in January. In February and March, we fill to the top of the power pool and then as an add-on, since we have been in operation during April, we fill two feet above the normal pool. When the striped bass begin spawning in the Weldon area, we release this extra water to supplement the normal flows in the river to make proper habitat for the spawning striped bass.

During the primary recreation season we operate with a relatively level pool. This meets the needs of recreation. It also gives us a fairly high head for power generation. A little bit early, earlier than the recreationists would like, we begin to pool down our reservoir gradually to the low winter elevation. We do this to use water from storage to supplement the low flows which normally occur in the river during this time and also to get a little bit of additional flood control storage so that we can store rare floods that

do occasionally occur during this season from tropical storms. It gives us a little bit of extra flood control storage that we may need for this purpose.

Now how does this rule curve compare with operation for what I understand would be the ideal mosquito control problems? Well, first, before you begin your growing season you inhibit growth along the shoreline, and this is good because it doesn't give you the growth in which the water will stand and cause you a lot of mosquito problems. It lessens the area's suitability for mosquito growth. Actually, we keep it up here until the beginning of June, but normally, the water requirements are greater than the inflow so this actually comes down gradually during this period. This is good because it keeps the water coming out of the area at a gradual flow and does not have the conditions ideal for the mosquito breeding.

The level period here is not good for mosquito control, but the recreationists demand it; and this is a compromise in the other direction. The gradual pull down for the remainder of the year certainly includes a considerable amount of this mosquito breeding season, and this is good. So you can see that for the most part, operations for other purposes also fit right into an ideal pattern for mosquito control. Nature does not always permit us to operate according to this rule curve. This would be ideal, but we're seldom on it. We're always above or below. There's a possibility we may not be able to fill during the spring. Ninety percent of the time we are able to fill, but if we were not able to fill, you would get tremendous regrowth in this span. It would take quite a bit of rebrushing and shoreline maintenance to overcome this problem. Quite often the water inflow is such--we do have minimum power demands, we have to let so much water downstream, and also water quality flows--these will exceed the inflow during our normal level reservoir period. The recreationists scream, but there's nothing we can do. Sometimes nature makes it even better than we planned, insofar as mosquito control is applied. Quite frequently, I'd say, if the rain were a little harder or lasted a little longer, we would be on schedule.

I think Don Ashton does follow us quite closely, and he does know that we do have problems at times. Sometimes we go a little bit overboard if the recreation people ride us a little bit too hard or something. We tend to drift a little bit away from what we know is best, and the mosquitoes know; they just take advantage of these laxes on our part, and they let us have it so we do have to keep an eye on all the purposes and try to hit a happy medium so that no one suffers too much for the advantage of the others.

We are constantly reviewing our plan of operation for this and all projects. We're always looking for suggestions; and hopefully, we are operating in such a way that we do meet--as well as possible--the needs of all the interests.

Question: What kind of larvicide do you use?
Answer: Right now we're using Abate in the granular form.
Question: How is it applied?
Answer: By airplane for the most part.
Question: Isn't there some agreement to maintain Lake Gaston at some level? How does that affect your program?
Answer: Gaston was built subsequent to John H. Kerr. The latter is a storage project, and Gaston is more a run-of-river, but it's built so that just what we release from Kerr is just what they need to release from Gaston. So we don't release it to fill Gaston. It just so happens that what we release for our power requirements keeps Gaston full. So VEPCO for the most part controls the releases of both so far as power is concerned. It's not planned to keep Gaston full. Gaston was just built so that it would stay full. It's not a storage project at all.
Question: Where they've made these three impoundment surveys because of the mosquito population, do they still do that?
Answer: No, we started when I was at Bugs Island. I just wonder what the results were after they impounded.
Comment: The peak for the past few years fluctuated between the middle of July and the first week in August. For several years there has been a peak of "quads." The only thing that they haven't been doing down there that I would like to see done is more shoreline clearance. Some of that place is really coming in.
Answer: Well, we would like to do more, but someone has mentioned the funds limitation. We do what we can with what we have and hope to get by.
Comment: I think Kerr and VEPCO have done a very good job.
Question: Do we need to know anything about the grade on the edge of a reservoir? Is that important?
Answer: Yes, it is, and at Kerr you have--take your choice, you've got some practically vertical banks and some broad, flat areas. In your broad, flat areas you pretty much have to count on some ditching. We did do marginal

drainage; I believe it was just after they filled. Certainly, if you have a steep bank and get some wave action, you've got no problem. But if you've got broad flat areas, you're more apt to get some lush growth. You will get some weed growth even with this early flooding and then a pull down. That's not like your woody growths that you get if you do not get the water up there at the beginning of the growing season. Incidentally, at Kerr we are planting some cypress and doing some other forestation hoping to take advantage of the help that might be in some of these flat areas that was mentioned this morning.

Question: How does that compare with Gaston?

Answer: I know they also use Abate, and I think a lot more of it than we have used. It does show that the constant level does have some good advantages.

Question: Have you ever had any evidence that Abate causes any problems to the fish and other non-target organisms?

Answer: I've never heard of anything.

Question: Well, I haven't ever, either, but I just wondered.

Answer: No, sir, I know of no problems. I think they use it pretty heavy at Gaston.

Comment: It takes it. The flow stays pretty much the same. Roanoke Rapids Lake fluctuates as much as three feet in a day, but Gaston fluctuates maybe a foot a year.

Comment: It's almost a complete larviciding control there.

Question: Have they ever used any DDT around there? What do they use primarily to abate this?

Answer: Malathion. I don't know about DDT.

Comment: VEPCO used some DDT for a short while, but they didn't have a real going program at that time.

Comment: The reason I asked is that we spent two years trying to develop a resistant strain of quadrimaculatus to DDT. In spite of everything we did, we couldn't get them resistant to this. Up at Clark Hill they've been using DDT in the reservoir, and they've got also the "quads." After six years of use, they're just as resistant as the devil to DDT. Then they switched to malathion and haven't had any problem since. It just shows that an engineer can develop a resistant strain better than an entomologist.

SOIL CONSERVATION SERVICE

Mr. John E. Layden, Jr.
Planning Coordinator
River Basin and Watershed Planning Staff

I'm very pleased to be here, and I've enjoyed myself very much up to this point. I've been a little confused as to what I'm doing here. I don't know whether I was invited to inform people or to be informed. I hope it's the latter. I'm not in a very good position, I think, to inform you very much, particularly in mosquito control. I have been finding myself in rather serious difficulty trying to get on some common ground with the people here. I'm very impressed with the relatively large number of excellent specialists of one sort or another. You see, my working title is Planning Coordinator, but my classification title is Soil Conservationist, and this is a generalist's job. So I went down several tracks of this sort to try and find common ground. Frankly, you and I, Dr. Knight, have one thing in common; it's the only thing I can find. We've both been in North Carolina about two years. In fact, this week is my second anniversary in North Carolina.

Let me make some general comments about the Soil Conservation Service and what we do and what we don't do. The Soil Conservation Service is the action and implementation agency of the Department of Agriculture in this whole broad field of conservation, development, and management of soil and water resources. This assignment to the agency along with our very direct and highly developed working relations with soil and water conservation districts in the state provide for a broad and rather active program affecting soil and water resources. We have personnel assigned in each of these local units, soil and water conservation districts; these people are trained and, we hope, highly competent in the field of soil and water resources planning and application of the various measures.

We do all kinds of planning, and we involve all kinds of people. We can deal with and plan with local owners of land, and this is true particularly of farmers. We work with various and sundry groups; we can work with planning commissions, get in the broad area of planning of parts of counties or counties or several counties, and we get involved with local units of government--cities, townships, counties--and are involved in various ways with many state and other federal agencies. We can assist in planning for an individual owner, an individual tract of land, or we can be involved in very broad planning.

I'd like to mention, too--I suspect this is as good a place as any--that within the various things we do in the Soil Conservation Service, we have no authority for decisions. Someone else owns the land, and the landowner is the guy that does make decisions, whether it's an individual farm or whether it's owned by a county, a city, or someone else. So if you want to talk to somebody in authority, why come see us? I have as little authority as anybody you've ever seen in your whole life.

Within this framework then, we had to develop a considerable amount of expertise in convincing people that it's a good idea to do something. We then get deeply involved after working on the basis of planning various things that would be good for soil and water resources. We get involved in assisting and helping to build or install. I'll not get into a great big long-winded dissertation on this subject. I'm very pleased with the fact that you are specialists so I'll not try to get you trained as soil conservationists and slip you over into the generalist's field. You'd better stay a specialist because from what I've heard, we're going to need you and your competence for a long time in the future, particularly as this applies to mosquito control. We are involved in a relatively large number of practices or measures outside of mosquito control, particularly in control of soil erosion, water runoff, and this sort of thing. We are involved in construction of ponds and lakes and reservoirs, over and above erosion control, that are runoff control measures. We do get into channel construction, ditch construction, etc. from small ditches up to at least fairly good sized streams. I suspect that the ponds, lakes, reservoirs, and the channels would be the things where we'd be primarily involved in this matter of effects upon mosquito control--good, bad or indifferent. I thought maybe this is where I should speak a little more specifically.

When we talk about ponds, dams, reservoirs, lakes, etc., we are always involved in this kind of planning for a specific purpose. If we are interested in one purpose, then it is planned and designed in a particular manner. If we're involved with more than one purpose, then you may get into conflicts of how do you do this thing and satisfy more than one specific need or more than one specific purpose. I would use reservoir planning as an example. If the only thing involved is temporary storage of flood water, then there is a relatively small permanent pool, if you want to use that term, but this pool is involved only with sediment storage--we put water in this area because it is a more efficient trap of sediment. That; then, is the purpose of this small

pool of water being there. We plan the reservoirs so there is sufficient capacity to store this sediment that will accumulate. We think it's more efficient to put it there than to let it go down the stream and have someone else worry about getting it out downstream somewhere. If we have reservoirs in which there is a permanent pool or additional permanent pool storage for some beneficial use, then you can get into quite a variety of considerations. If we're interested in waterfowl, for instance, I think the major criteria is you want as much shallow water as possible. I suspect a maximum of two feet; that would be real good if we could get a large area of water at this depth. On the other hand, if you're planning this beneficial pool for fishing, then you need as much water as you can get in excess of six to eight feet deep. If recreation is the purpose, then you want the maximum amount of surface area. If water supply is the purpose, then you want maximum volume with minimum surface area so that you have as little problem as possible with the loss of water through evaporation.

I think that from these few very simple illustrations that when you get into multiple-purpose planning, you can have some highly incompatible purposes, uses, and design criteria. You can't accomplish them all. Sometimes, I suspect, we go a little too far in talking about the tremendously fine advantages of multiple-purpose planning of reservoirs. I've about convinced myself that maybe this is not even a good way to talk about it. I think maybe we ought to--if somebody could come up with another term, I would appreciate it--but I think we should really get into the business of planning for some primary purpose and then secondary purposes. Many, many things can be considered. You can get sufficient storage for flood water, which in our operations are only temporary storage. We do not get into gated structures or manually controlled structures except in very rare instances. We can have a reservoir with the maximum amount of shallow water so that it's very good for waterfowl and there will be some left over where there's enough depth there can be some fishing. This sounds real good on paper. Then we have a triple-purpose reservoir, flood water, waterfowl, fishing, and I think that some of these must suffer. You cannot plan ideally for all of these kinds of things.

We get into the same kind of consideration when you're talking about planning, designing, and constructing channels. If the only purpose to be served, the only thing we're trying to accomplish is flood prevention, then the most efficient and economical design is a straight channel with a uniform bottom

grade; depth is not an important consideration or criterion. When we add drainage as a purpose, we're going to be efficient in discharging floodwaters and also provide for drainage. We use the same general criteria except that we add depth to it. We have to use the minimum depth of five feet, so that you can remove excess water from the soil profile, and you can do an efficient job of farming. As you add or plan for other purposes, you get into different kinds of design criteria. You may put in extra depth just to provide water for fish; or we'll construct from one side only and leave the cover of trees if water temperature is a critical point so you have shade and the water doesn't get as hot. It's a little on the difficult side again when you get into channels to accomplish all of these purposes in an ideal manner. We can do a pretty decent job if we don't get too many purposes and if these purposes don't conflict with one another.

In general, all of these things can be considered, and we do consider them. As we get into additional purposes--now we're talking about mosquito control--I think that we have two things going for us there, particularly in the lakes, reservoirs, or ponds we're planning. Except in very few instances, our basic design criteria here provide for a fluctuating water level. It's never steady. We were talking about Lake Gaston varying, what did you say, a foot per year or something? I don't think we've ever been involved with a reservoir that had fluctuation as low as that. The other thing is a matter of not having shallow water around the edge even in small farm ponds. In these situations we try to cut out around the edge where it otherwise is shallow, and we like for it to be at least two feet deep as quickly as possible around the edge. This sort of thing, then, does provide for a considerable degree of fluctuation in the water surface which works in pretty well with mosquito control.

I'd say, then, that in general terms the things that we do could have, under some conditions, a negative effect on mosquito control. We have high hopes that this is not so. If we know about this and it becomes a specific need, then we can plan and design for it; or at least in the past, we have been able to respond to different needs and different purposes. I hope that we can continue to be at least as smart as we need to be to consider other needs and purposes in the future.

Other than this, Dr. Knight, I don't know what else we can say about the operation and activities of the Soil Conservation Service as it relates to mosquito control. If there are questions, I'd be happy to try to answer them.

Comment: When I was in Iowa, I had a student run a study of farm ponds just for a research problem, and I've forgotten now how many he had, but twenty-five or thirty, I suppose, and the amount of mosquito breeding we found was disappointing to me. I thought there'd be more of a problem than there was. Essentially, out there we found maybe a few culicadae inornada breeding where weed and emergence vegetation was growing in shallow areas. By and large, apparently, you folks do build the feature of rather rapid drop-off and essentially we found no problems. I don't know whether that's true in North Carolina or not.

Question: What provisions are made for water regulation?

Answer: Our basic design criteria for the use of vegetative emergency spillway provides for a certain amount of storage between the level of the pond and the emergency spillway to protect the spillway. With a vegetative spillway, if you have water flowing through it every year, it kills the vegetation, and you have difficulty getting vegetation to grow. So our criteria call for larger than one-year frequency storage. An emergency isn't used in any design more often than once in ten years, and most reservoirs of any size are provided with more than ten-year frequency storage. In watershed projects we have no emergency spillway planned to operate more than once in fifty years--fifty-year storms is a better way of saying it. The hydrologists like to talk about a two percent chance. Sometimes that'll happen twice in one year.

Question: You do operate as an extension service in a way?

Answer: Well, yes, to a degree because we are in contact with a tremendous number of landowners, operators, and users. We're forced into it, generally speaking. The Agricultural Extension Service is assigned the responsibility of a formal program of information and education. We have nobody on the payroll who was hired because he had ability in this area. We're all hired because of some technical specialty which does cause complications. We're not too good in public relations, really. At least I don't think we are.

Question: Most of your programs do have motivation in the way of subsidies, don't they?

Answer: Yes. I'm not sure how we define subsidy, but as far as I'm concerned, the technical assistance we're providing is made available through public funds so this is a subsidy of a sort; that's correct. This is a big advantage. I worked for years in Indiana, and for reasons I've never been able to understand drainage of farmland in Indiana is absolutely critical and important. To find

a private consultant firm working in this field is impossible. In fact, the few that are there now are people who worked for us and then either retired or quit or something. This has been true there ever since the word go. A county surveyor gets into drainage work up there; that's a pretty common thing. So they're just plain and simply accustomed to some public funds being available to serve this purpose. Frankly, I think it's a pretty lousy way to operate, but I don't propose to change habits something over a hundred years old. I'm not that ambitious. But you're right; there's a tremendous amount of subsidies involved. We hope that it's good. We get all kinds of studies made as a result of work that's being done; somebody makes more income and has to pay more income tax and then they claim, "Okay, how about that, we came out ahead." Don't ask me if that's right or not.

Question: Do you make surveys anywhere other than where you have a program?

Answer: Well, yes, we would not be involved in anything unless there had been a formal request of some type made. Primarily, individual tracts of land would be primarily the request of the soil and water conservation district. And then we are providing assistance to this local unit of the government.

Question: To the district office?

Answer: That is correct. With very rare exceptions we have no authority to provide direct federal assistance to a landowner. The district and their program for how they're going to handle soil and water resources activities within their jurisdiction guides our program. One way of saying it is we don't really have a program; we're operating from someone else's program, in this case the soil and water conservation district.

Question: Then, after you've made the survey and prepared a survey report, will these reports be available to anybody?

Answer: Anything that we do ends up being done with public funds, so it is public information.

Comment: Well, I've used your reports in three different areas and have found many answers in those reports that made very much sense.

Answer: If we have the information, it is available. We try to manage this a little bit. We have tremendous numbers of people who do not have an interest coming in and asking for this, that, and the next thing on the basis of just seeing what it looks like. Basically, the work we do is done with public funds so it is public information. Anybody who has a real interest, we're happy to respond. That's what we're in business for.

DIVISION OF COMMERCIAL AND SPORTS FISHERIES
NORTH CAROLINA DEPARTMENT OF CONSERVATION AND DEVELOPMENT

Dr. Thomas L. Linton
Commissioner

This panel discussion began with the statement that the interests represented on this panel would keep in mind their relationship to mosquito control activities. I assure you that the Division of Commercial and Sports Fisheries does. Our relationship is that of two similar dislikes; one to be chewed upon by mosquitoes, the second to be chewed upon by people. In the course of both our activities we sometimes get chewed on by both groups. With this thought in mind I would like to briefly outline to you some of the things this Division is involved in which relate to the activities of mosquito control, problems resulting from mosquito control work, and other problems that may come up in the future.

A statute passed by the 1965 legislature required registration of claims of ownership to submerged lands in the state. A strict interpretation of this law would require registration of all mosquito ditches, as well as all drainage canals. It is obvious that this was very unpopular with those faced with the task of filing these claims for drainage ditches and mosquito control ditches, especially when the intent of the statute was to receive claims of ownership to oyster beds. This implication to future mosquito control work is plain. I know Mr. McCotter has had some inquiries in this regard and probably Mr. Oates also.

Based on the statutes that we now have on the books, I think it is very necessary that we get together and work toward better communication. Concerning this matter, there is something that we need to do now before the next session of the legislature. I would certainly hate to see any legislation come forth on this matter without the affected state and local agencies being involved in its planning.

In the same regard I think it will be very interesting, since the state does claim ownership to all the marshlands, the outcome of ownership of impoundments in marshlands. This is a very good technique to get mutual benefit out of your activities where you have wildlife enhancement, duck habitat enhancement, and mosquito control in one package. However, if a person has made a contract with you to impound this area in good faith,

thinking that this is going to provide him duck hunting while it gets rid of mosquitoes in the neighborhood and then the state comes in and says we own that impoundment, this might cause a little controversy.

It's very interesting what one can run into in some of these matters, but I throw that out to you just as a thing that hopefully will not come about. This looks like a problem that looms on the horizon for us in the very near future.

The Division of Commercial and Sports Fisheries, as directed by the 1969 legislature, is developing a comprehensive estuarine zone use plan. This is one of the most important things in which the Division has become involved. A concentrated effort is being made in the use plan study to get all of the state agencies, federal agencies, the boards of county commissioners in the coastal counties and representatives in the academic community together to jointly develop this land-use plan for the coastal area. What areas do we need to preserve through outright purchase of these estuarine areas; what types of activities can be conducted near the marshes, near the rivers and sounds, that will be of economic benefit to the community without having an adverse effect on the fish and wildlife resources. We have gotten pretty deeply involved in this study. We have met with the liaison officers in the federal and the state and the county commissioners in twenty-five coastal counties and with the representatives of academic communities. We have contracted with a private consulting firm in North Carolina, the president of the firm being the former commissioner of the Division of Commercial and Sports Fisheries. Dr. David A. Adams was with the President's Council on Marine Science and Engineering in Washington for a year and a half. Dave has put together a preliminary plan that has been submitted to all of the groups I have mentioned so that we can all take pot shots at it and see where it needs to be changed, through deletion or addition. We are in the process of putting together a comprehensive coastal zone use plan with everybody who has an interest in this being able to contribute to it. In addition to the people mentioned, we have compiled a list of the major industries in the coastal zone. Since any regulations or changes in the law that applies to the coastal area certainly could help or harm the industry people directly, they must be involved. We are attempting to take into account all of those who do have a piece of the action and get their insight. This plan will give us that communication that is lacking in many cases. We must have this communication to produce the proper planning

for the future. Even with planning we're going to have a tremendous number of controversies coming up but without planning, I am sure that these controversies would be increased many fold.

The relationship of mosquito control work to the interest that the Division of Commercial and Sports Fisheries is not clearly understood. Some think it is the best thing that ever happened to the shrimp industry. There's a commercial fisherman over near Atlantic who swears by the mosquito ditches, stating that they provide a greater area for shrimp nursery grounds. Others say this is ruining the marsh, and it should be stopped. So we could probably get a pile of letters several feet in height endorsing the program and a pile of letters of equal height condemning the program.

I think one important thing that has happened lately which will probably give us the information and data needed to base our future activities in this area and give us a shield to fend off those who complain about the program, is the research program funded by the Water Resources Research Institute. This cooperative study involves Dr. Knight, Dr. Kuenzler, and Mr. Howard Marshall. The study will be a partial evaluation of certain aspects of the mosquito control program. I say partial meaning that it takes in only the high marsh. It will be a step in the right direction. It promises to give us the data that we need to make proper evaluation of this program and make any changes that might be necessary or point out the good points so that in the future we'll have a better basis for program design.

In this brief summary and sketch I have attempted to explain our involvement in the mosquito control program. If you have any questions, I'll be happy to answer them.

Question: Dr. Linton, you mentioned a state draining marshes. Does this include the Juncus marshes?

Answer: The regularly flooded marshes. That is a legal question which I cannot answer, where we're going and where the state will stop in this planned watershed. I suppose this is a potential problem, this impoundment. Am I correct, your impoundments are primarily in the Juncus marsh? Our definition on marshland is about like our definition on navigable waters, and that's why I prefaced it with a potential problem.

Question: Did I understand you to say that your department or one of the departments is doing research in these impoundments for the production of shell fish, crabs and oysters and what effect it has on them?
Answer: No.
Comment: You'll hear about it a little bit later on in the program.
Question: Dr. Linton, is there anything we can do in the meantime? Can you do anything at all?
Answer: I don't believe we can do anything as a temporary measure. However, before the legislature convenes for the 1971 session we need to get together and see what we want to go to the legislature to get this thing squared away. We are not interested in laying claim to all of the mosquito ditches. However, by the broad nature of that statute that required registration of submerged land, we get claims filed on farm ponds up in Ashe County and around Asheville and little things like that, so we need to clarify this matter through the legislature. This is the only way to get matters right.
Question: What's the time schedule on this? Will this report be ready for submission at the opening of the General Assembly?
Answer: A portion of it will. In this regard we are trying to do what we can. We have some tentative ideas that will be tried out on the committee this week to see if it is possible to go to the legislature with some proposals during the coming session. The law requires an interim report to be filed with the 1971 legislature and a completion report with the 1973 legislature. Due to the good reception from all these groups that I have mentioned, we are thinking about the proposed legislation for the 1971 session.
Question: Is this report available to other people?
Answer: We have a limited number of copies.
Question: I know you have many uses for them. I'd be interested in seeing one.
Answer: Art Cooper has one.
Question: Well, that would be good. He was supposed to be here. I never did find out. Regarding this report, who is editing the report?
Answer: The contract with Dave Adams was just to prepare a tentative report. There are approximately nine bills in the Congress that would require the states to do exactly what we're trying to do here, and if one of them is enacted, North Carolina will be in a very advanced position in this matter. We contracted with Dave to prepare a preliminary plan; that's all it is, just to be looked at and hashed around and shot back and forth. So this is what we've done; we've submitted it to all the groups that I've mentioned.

Question: I believe you mentioned that copies have been submitted to the involved state agencies.

Answer: Yes. We're not near the final draft yet. We had a problem that we ran into and then some agencies sent four or five people, and we wrote back and asked for one person to be the liaison officer from that agency. Dr. Kooman has designated one person, and the report has gone again to this person. I can't remember off hand just who it is. If you have not had an opportunity to see this report, it is the fault of your liaison officer. I can go back to that original list and send you a copy. You were there, too, weren't you, Keith? And we had one other person from the local level, I believe. I'll get the name and send you one for you to look at. We're not attempting to pull a fast one on anybody. We want everybody who is involved in this thing to have an opportunity to look at it and to comment on it and get your thoughts into the pot so that we won't go to the legislature with something and be sandbagged by some who feel they've been slighted. You know well what I'm talking about. We're trying to cover everyone who is interested so that we will have their thoughts put into this and hope that we can get better than 50 percent agreement on this. This may be wishful thinking, but I don't think so. Thank you.

Question: Is it too early to ask how the comprehensive study looks to the State Board of Health?

Answer: Well, so far I'm waiting for the agencies to come back with the information they want to have included. We didn't have too much to contribute, but you have a great deal. The Department of Water and Air Resources has a great deal to submit as a result of the last meeting. Dr. Adams was merely assigning certain responsibilities to the various agencies to supply him with material they wish to have included. Then, he will put it in order in the preliminary plan.

Comment: Well, I find this very reassuring to know that planning of this type is going on. I've seen that bill and had planned to ask somebody what was happening, but I think it's very reassuring to know that planning of this broad type, and I'm including all possibly interested agencies, is a very reassuring thing. I think I, like everybody else, would like to see that coastal North Carolina is kept in a desirable condition for future generations. I mean allow a man to live and use it, but also to be kept in such a way that a few years from now it will have some of the same values that are there right

now. I'm sure everybody's interested, but at times economic pressures get pretty intense.

NORTH CAROLINA WILDLIFE RESOURCES COMMISSION

Mr. T. Stuart Critcher
Assistant Chief
Division of Game

When I began a review of the literature and reports on mosquito control, marshlands, ecology, pesticides and other topics which, in my opinion, relate to the subject of this conference, the sheer volume was in itself somewhat confusing. Generally, however, I was able to clarify, in my own mind at least, that there do exist many cause and effect relationships between mosquito control techniques and wildlife populations which depend upon wetlands habitat. Many of these relationships have been intensively researched and a relatively clear understanding is available to us; for example, the effects of the persistent chlorinated-hydrocarbon insecticides on certain invertebrates, fish, and birds. Other cause and effect relationships, however, are somewhat unclear at this time, and further study is urgently needed; for example, the effect of ditching on the quantity and rate of nutrient production of salt marshes and on the exchange of these nutrients with adjacent estuarine waters; also, the effects of ditching on the salt marsh plant communities and the rate and characteristics of plant succession.

The North Carolina Wildlife Resources Commission is responsible, by statutory decree, for the management and wise use of all of the wildlife resources in our state. It is very understandable that the Commission has sincere interest in any land-use program or any program which may have either a beneficial or an adverse effect on wildlife or wildlife habitat; wildlife as used here meaning and including fish, birds, and mammals.

There have been some remarks made today about mosquito control in inland fresh waters; however, I would like to address most of my remarks to mosquito control work in the estuarine areas as this appears to be the area in which we have the greatest common interest.

In the estuarine zone, there are two types of salt marshes in which we are particularly interested as wildlife habitat. These are: irregularly flooded and regularly flooded salt marshes. In a survey of the wetland areas in North Carolina, conducted by the U.S. Fish and Wildlife Service and the Wildlife Resources Commission, it was determined that all marshlands in North Carolina aggregate only 206,350 acres. These are tabulated as follows:

Marsh Type	National Wetlands Classification Number	Acreage	Percent Alteration
Inland Fresh Marsh	12 and 13	47,500	1.0
Irregularly Flooded Salt marsh	17	100,450	26.7
Regularly Flooded Salt marsh	18	58,400	31.9
Total and Average		206,350	22.2

The combined acreage of all marshlands in the state constitutes only 0.66 percent of the land area of North Carolina (206,350 divided by 31,398,630).

These marshlands are unique ecological types. They (1) occur in very limited quantity, (2) are extremely valuable as habitat for certain species of wildlife, (3) are an essential part of the complex estuarine ecosystem, and (4) can be easily altered, damaged, or destroyed by the activities of man.

In a survey conducted by the Wildlife Resources Commission in 1969, in association with a study of the estuarine areas sponsored by the Governor's Interagency Council on Natural Resources, it was determined that 22.2 percent of North Carolina's marshlands had been altered by one or another of man's activities. See above table. These activities included such operations as dredging, spoiling, ditching, diking, urban development, etc.

As wildlife habitat, these marshlands support the entire population of clapper, king, and sora rails and are essential for the survival of these marsh birds. Marshes are an essential part of most of the waterfowl habitat in the state. The marsh vegetation directly produces a significant quantity of waterfowl foods, but equally as important the nutrients produced in the marsh contribute to the growth of submerged aquatic plants which grow in the adjacent estuarine waters. These marshes and waters, therefore, contribute to the support of an estimated 90 percent of the state's population of ducks and geese.

The ecologists and nutritional authorities have stated that marshlands are the most productive and most fertile land areas in existence. The amount of energy that can be captured and cycled back into the ecosystem is greater in a marsh environment than in any other. In turn, the associated waters are enriched with nutrients that accelerate the production of plankton, one-celled plants, and animals, which are the beginning of the animal food

chain. From nutrients to plankton, to macrofauna, to snails and fiddler crabs, to clapper rails; so goes one very simplified example of a very complex food chain. A similar example with nutrients, the submerged aquatic plant--sago pondweed--and the canvasback could be cited; or so could shrimp or spotted weakfish. This entire cycle, from energy capture, to nutrient evolvement, to food production, all of which begins in the marsh, is vital to shrimp and oyster, finfish and crab, clapper rail, and canvasback.

One cannot but conclude that these marshlands are essential and basic to the welfare of many forms of recreational pursuit and to many commercial enterprises that are important to the economy of the state and to the health and well-being of the people.

Earlier it was mentioned that over 22 percent of these marshes had been altered by activities of man, including dredging, filling, housing development, etc., as well as by ditching. The survey data indicated that the amount of alteration attributable to mosquito ditching was significant. Following is a tabulation which shows the extent of this marsh alteration in four of the coastal counties which have had active mosquito ditching programs:

County	Altered Marsh Acreage		Total	Total Salt-Marsh Acreage	Percent Altered
	Irregularly Flooded	Regularly Flooded			
Carteret	3,978	1,000	4,978	48,600	10.2
Dare	7,000	-	7,000	16,000	43.8
Onslow	-	10,500	10,500	12,350	85.0
Pamlico	11,423	-	11,423	15,000	76.2
	Total and Average		33,900	91,500	36.9

These data indicate alteration ranging from 10 to 85 percent for these four counties, and averaging about 37 percent, as compared to an average of about 22 percent for all coastal counties. It would seem, therefore, that mosquito ditching has contributed significantly to salt marsh alteration.

What exactly are the effects of ditching on a salt marsh? There is quite a divergence of opinion. Some speculate that the nutrient exchange rate is accelerated due to the improved access for tidal flows. Other workers have stated that the water table is lowered, that the rate of plant succession is speeded up and that encroachment by brushy perennials soon changes the marsh

to a brushy area. I am not qualified to say what the effects have been or what ecological changes have occurred in our marshes as a result of mosquito ditching. It can be stated, however, as a matter of general knowledge that when a marsh becomes drier and as plant succession advances toward perennial woody species, the value of the marsh decreases as habitat for muskrat, other furbearers, rails and waterfowl. Surely, we agree that the effects of ditching should be more thoroughly evaluated.

The transactions of the 1959 symposium on "The Coordination of Mosquito Control and Wildlife Management," Washington, D. C., concluded that there were a considerable number of benefits to be gained from impounding salt marshes over other methods of mosquito control. Our observations in Pamlico and Onslow Counties confirm this conclusion. Recent records for the 800-acre Pamlico Point Impoundment show about 400 man-days of duck hunter use or one-half man-day per acre. These hunters averaged 2.5 ducks per trip. Initial construction and development costs for Pamlico Point were determined to be $34 per acre. When this cost is amortized over twenty years, the average annual cost is $1.70 per acre.

The most recent national economic survey of hunting activities shows that one day of duck hunting costs an average of $6.44. If we use this expenditure as the "value" of this form of recreation, then one-half man-day is worth $3.22. By comparing this value of $3.22 with the average annual per acre cost of $1.70, a benefit-to-cost ratio of 1.9 to 1.0 can be derived. The engineers and economists of the Corps of Engineers and the Soil Conservation Service find a construction project to be highly feasible when they determine that the B-C ratio is about two to one.

Question: What is this $6.44?
Answer: This is the average value that the national economic survey of fishing and hunting resources done by the Bureau of Sports Fisheries and Wildlife in 1965 said that one day of waterfowl hunting was worth.
Question: To whom? How do you arrive at that?
Answer: This is the national average.
Question: To whom is it worth that?
Answer: To the hunter.
Question: Is he willing to pay that? Is that how they arrived at it?

Answer: This is an average of license cost and expenses. Not being an economist, I'm not sure that I can answer your question, but this was what he spent.
Question: This is not value to the society?
Answer: No. This is something else.
Question: When you speak of a two-to-one benefit-cost ratio, you need to specify.
Answer: That's right. This was just duck hunting alone. Now if you want to throw another 500 man-days of fishing onto this 800-acre impoundment, you'll come out with in excess of three-to-one B-C ratio. They caught, in this impoundment, pumpkin seed and other fish as well as crabs that were shown on a slide this morning and other things in there that I've left out entirely. There were as many as fifty or sixty fishermen down there that were catching forty, fifty, and sixty half-pound to three-quarter-pound pumpkin seed all during the year. I didn't see it, but it was reported to us. At $3.25 for one day's fishing value you can come up with a three-to-one B-C ratio, leaving out the crabs and any other things. So we felt really very proud of this impounded area. You saw it on a slide this morning.

From a wildlife point of view we can state that a salt marsh impoundment is one of the most highly productive types of wetland habitat. The mosquito control authorities state that impoundments will all but eliminate the salt marsh mosquito. Here, then, are two interests which could endorse the impoundment technique. But what are the other effects on the ecology of this type of environment? Even by use of this technique, which at least has the advantage of more than a single purpose objective, further evaluation is indicated.

I would like to close by saying that the marsh areas in North Carolina, although limited in acreage, are vital to many forms of wildlife. The North Carolina Wildlife Resources Commission is both interested and concerned with any form of land use that may detract from their value or serve to enhance their productivity. We will cooperate to the fullest possible extent to achieve the wisest and best uses of these wetlands.

Question: What are the arguments against impounding?
Answer: Well, the mosquito control people say that they are 100 percent effective for A. sollicitans. They have dipped in some animal tracks and some hunter boot tracks and found some larvae in depressions.

Question: There has been a good deal of study of the value of spartina marshes to the rest of the estuary. How much fixed energy food value goes out into the estuary for the shrimp, crabs, and the fish? I don't believe data are available. Until you know this, you don't know what your real cost is.
Answer: This is certainly true. The most highly productive, I think, is the regularly flooded; but undoubtedly, these upper or high marshes contribute to this energy flow into the estuarine waters. I haven't seen any breakdown of this contribution. I'm not saying that all of the Juncus marsh should be impounded for waterfowl. I don't think the commercial fisheries people would agree to this. I would hate to see a particular type of habitat of this sort completely impounded and turned into an entirely different type of habitat. I don't think this would be wise use.
Comment: That would be complete destruction of it.
Answer: That's right.
Comment: You might as well fill in as flood it if you're going to completely destroy it anyway.
Question: There is a study being conducted on value of the Juncus marsh, the energy or amount of energy. Dick Williams down at Harker's Island in Carteret County has been doing some research on that. He describes the Juncus marsh more or less as a desert. I know nothing about this except he is doing some research on the amount of energy in the Juncus marsh. One of the things I tried to point out is there's been very little exchange of energy between your Juncus marsh and estuarine area because of this natural dike.
Question: Is there any evidence of subsurface flow of nitrate down through the marshes into the estuaries?
Answer: As far as subsurface drainage, it has been our experience that there's not too much lateral flow because of elevational differences.
Comment: Agricultural people involved with draining lands for agriculture, etc. in the lowlands on the coast tell me that the principal movement would be through the ground water.
Comment: Some work has shown there's actually a loss of nitrogen from the water going into the high marsh.
Question: I don't have any figures; but if you take your counties that have all high or Juncus marshes and not any regularly flooded marsh, the fact that they don't release these nutrients as often as our lower marsh does not say they release less. If you go to a county that has entirely Juncus marsh, specifically

I'm thinking of Currituck and Pamlico, the fisheries in those counties are every bit as high as in the counties where they do have a daily release.

Comment: Well, I think that the answer to this point will be forthcoming from the people who are going to do the energy exchange studies in this particular thing. I don't think any of us can deny that both types of marsh are very, very important to the estuarine waters.

Question: Have impoundments been limited to the high marshes?

Answer: They have been, yes. From several practical considerations, they have been limited to the high marsh, irregularly flooded marshes. There are other factors to consider, too, that are less direct. Pollution, siltation, and soil disposal from permits, ditching, pesticides, and all other things are having an effect on this type of habitat. I think all I can do is to state that it is an important type of habitat to the wildlife resources of the state. Not only waterfowl and clapper rails, but the herons, egrets, the shore birds and the wading birds, the eagles and all the others that are associated with aesthetic type wildlife. Even though we don't hunt some of these, we recognize this as being a very important type. We have a very vital interest in it and anything that is done to it. I've heard the word water management used here this morning. Hopefully, this is true water management and not just surface water removal without any evaluation of it. There is a difference in turning the water off and dropping the water table and truly managing one facet of this very important thing.

Question: I'd like to ask one more question, if I may. You made several references to ditching in Delaware and New Jersey that had changed the marshlands to more wooded vegetation. I wonder if you found that true in this state?

Answer: No.

Question: Some drainage has existed for about twelve years or more, and we have had a chance to observe it pretty closely. I wonder what your findings have been?

Answer: We haven't made any studies on it, and it would be very worthwhile to see what the rate of successional change is. You do know that when you get up into high elevation, you get into the brushy type and then eventually into the pond type. If there is a corresponding drop in the water table either now or in the future, I think you'll find this same rate of succession. This is just a biological principle. But other than the myrtle growing on the spoil banks

that was very obvious from Keith's photographs this morning, which is a step in this direction, I didn't observe any other vast successional changes out in the marsh. I think this may be five or ten years in coming. I don't know; investigators in the Northeast were very conclusive that this was the result end effect of ditching.

Question: But that is all spartina?

Answer: No, he had some Juncus, too. A lot of the New Jersey marshes are Juncus.

Question: Is that right?

Answer: Yes.

Comment: He says there's quite a change in the fauna involved.

REVIEW AND DISCUSSION OF PENDING RESEARCH PROJECTS

Effects of Mosquito Control Ditching on Estuarine Ecosystems

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I was going to come mostly to learn, and I have learned a lot. The study, "The Effects of Mosquito Control Ditching on Estuarine Ecosystems," deals primarily or entirely with the high marsh, the Juncus type marsh. Mr. Howard Marshall who is over here will be doing most of the work. He has experience in the coastal areas. He's a graduate student now in the curriculum in Marine Sciences at the University of North Carolina and is doing this as a Ph.D. dissertation.

The main question that we are all going to be looking at is whether the hazard to productivity in these marshes is compensated for by release from health and nuisance problems of mosquitoes. We don't know the answers yet, and we hope to get some data to bear on this. Much of what I was going to say has already been covered. You know what high marshes are now, the Juncus marshes, and the low marshes, the regularly flooded spartina marsh. These are temperate type systems. They are not found in the tropics, but they are very widespread in temperate regions. Water is brackish by and large, but it may be quite fresh or quite salty. The physiography of the land is very flat. Elevations are measured off in inches per mile essentially and drainage is normally very poor except through tidal creeks. The marshes are very productive. The spartina marshes may be ten times or more as productive as the open water of an estuary. They are comparable to or even more productive than much of our farmland. This productivity is funneled down to many other organisms that don't live in the salt marsh itself; e.g., fish, shrimp, crabs, that live in the water of the estuaries all the time. The spartina, and we presume the Juncus, is decomposed. The detritus particles wash down into the water and feed the filter feeders and the deposit feeders in the estuaries. So the marshes themselves, the grassy part of the marsh is the producer and is an energy exporter into the rest of the system.

The aspects which are to be studied in this project are the unditched marshes which will, in effect, be the control of some areas which have not been touched yet by mosquito drainage ditches. Ditched marshes will also be studied

in comparable areas to see the effect of ditches on the Juncus community and the productivity, etc. The third aspect will be the new systems that are produced by the ditches themselves. Several problems will be investigated. The first question is does the ditching provide a significant addition to the total subtidal area? You look at a cross section of a marsh. It may look like this with the high water here, low water here (illustrated on blackboard) and the tidal zone which is a regularly flooded marsh which may be spartina and Juncus which is irregularly flooded at slightly higher levels. There are intertidal zones here below the tidal marsh which are often muddy in nature. If you cut a channel into the Juncus marsh, this drops it down into the intertidal zone; the walls of this ditch are then in the intertidal zone. If you have miles and miles of these ditches, is the intertidal zone in the ditch then comparable to the intertidal zone in the normal tributary of the estuary?

What kind of ecosystems develop in these ditches? Up here in the Juncus marshes that have water in them all the time, will it be autotrophic or heterotrophic? In other words, are they going to be spawning our nursery areas for commercial or sports fisheries organisms? Will oysters, crabs, and shrimp, etc. be there? I suspect they will. Will they be important channels to transport detritus and other organic matter out of the marsh? Will they speed up the transport of organic matter? We often see in these marshes big mats of Juncus or spartina areas that have blown down and persist for a year or so. Sometimes the spartina material floats up and goes out on the high tide. Will the new ditches speed up this transport and make the Juncus marsh a better producer of organic matter and funnel it out into the estuary?

There will be sampling in the new ditches for the animals that live there, dredging and seining, plankton nets, etc. to see what the standing crop of the organisms is--to learn something about their growth measurements, temperature, salinity, oxygen, and productivity.

The third question is the flux of nutrients between the ditched and the unditched marsh versus the water. What is the direction and what is the rate of flow of the nitrates and the phosphates? Are these plant nutrients going to move out of the marsh faster and make the marsh less productive or will the nutrients move up these ditches and into the marshes better and faster and increase their production rate or organic matter? One way to do this is to look at some nutrients such as phosphate in estuarine waters before the flood tide, say before a storm comes to blow the water up into the Juncus

marsh, measure the phosphate level in the water before, during and after the water has come down out of the marsh to see whether there's more phosphate in the water or less phosphate in the water after this flooding.

The fourth problem that will be investigated will be that of potential aquaculture. Can commercially imported species be grown in the ditches? Can shrimp, oysters or crabs be grown in there on an aquaculture-type basis, holding the animals there, protecting them perhaps from predators, getting them to grow fast and collecting them for the market? The growth rate of oysters, for example, will be studied in the ditches as compared to the growth rates of oysters out here in some normal tidal creek of the estuary.

Finally, what are the effects of the ditches on marsh plant communities? Changes in plant species and plant biomass will be studied in the ditched marshes and especially on the spoil piles. Perhaps the changes in vegetation along the ditches may add some diversity to the marsh. Diversity is supposed to give you, if not more productivity, more stability, more niches for animals to live in. Maybe there are some good points to having a little diversity inside the marsh. We don't know. Perhaps there is a reduction in productivity which more than balances the increase in stability. Diurnal productivity measurements will be made in ditched marshes and in unditched marshes to see whether the daily production of organic matter is increased or decreased by these ditches. You can do that by putting a big plastic bag over the vegetation and pumping atmospheric air through the bag, comparing the carbon dioxide in the air which has gone through with what it was before it went through the bag. If a lot of CO_2 is being taken out of the air when it goes through the bag, then there's a high rate of production in the daylight. If the CO_2 is not being taken out of the air very fast, then productivity is low. In addition to these productivity measurements, the amount of organic matter being transported out of the marsh will be measured as well as it can by measuring the amount of detritus coming out through the ditches and through the tidal creeks from these ditched areas.

That's about all I wanted to say. Ditching has been going on for a number of years now. As usually happens, a program is started. People don't foresee how far it's going to go, how many ditches you're going to need in an area, whether you're going to have to ditch only a few acres of marsh or ditch every marsh in North Carolina to assure good control. Maybe ditching is the best way to control the insects. Maybe there are better ways, cheaper

ways. I already commented on the benefit-cost ratio. I think we have to consider these other costs. If you convert some one type of productive system to another type of productive system, is the loss or gain in productivity important for everyone?

Question: What time interval do you have on this? Are you going to study the unditched versus the two-year-old ditches, four years, etc?
Answer: (Not intelligible). Note: This is a two-year study.
Question: Are there any WPA ditches left in the high marsh?
Answer: Yes, there're a few of them on Newport River, and there's some down east. However, it appears that the water level has risen some since these ditches were dug. Many of them now stay pretty much submerged, and there's no mosquito problem now where apparently there was thirty or forty years ago about the time they were dug. I can understand from talking to some of the people who live in the area that while they have shown me places where Juncus marsh is now growing, they used to have gardens when they were children, and showed me areas where they used to have a house, where it's now Juncus marsh. So apparently, the water table is rising in the area or the land is settling.
Comment: I would also say that you have different conditions in different counties. In Pamlico County, the wind tides are dominant whereas in Carteret County and the other coastal counties fluctuation is by lunar tides.
Comment: It's rather hard to compare what happened up in New Jersey marshes or in Florida marshes with what happens in North Carolina marshes.

REVIEW AND DISCUSSION OF PENDING RESEARCH PROJECTS

Effectiveness of Ditching in Estuarine Marshes for Mosquito Control

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North Carolina State University at Raleigh

The objective of Phase II of this project is to evaluate comparatively the mosquito production of ditched and unditched Juncus marshes. Mr. Richard LaSalle, a graduate student in the Department of Entomology at North Carolina State University, will undertake this study as a Ph.D. thesis problem, beginning in July of this year.

Our evaluation of mosquito production will be based largely upon weekly egg and larval sampling throughout the warm weather period. Additionally, several light traps will be operated as adult sampling devices to keep track of the size of the biting populations. Since salt marsh mosquitoes routinely fly long distances, adult figures in themselves will not give an accurate measure of mosquito breeding occurring in the study areas.

Records will be kept of tide levels and of rainfall in the study areas, and these data will be correlated with the rate of surface water drainage in the experimental and control plots. In turn the rate of drainage on newly ditched marshes will be compared with that of older ditching.

During the course of the project, efforts will be made to learn whether or not ditched Juncus marshes produce other biting flies, such as Culicoides (no-see-ums) and tabanids (deerflies and horseflies).

HOW MOSQUITO CONTROL WORKS IN VIRGINIA

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One might divide the mosquito problem in Virginia into four categories; namely, salt marsh, freshwater, temporary rainpool breeders, and house mosquitoes.

In eastern Virginia bordering on the ocean and the Chesapeake Bay and its tributaries, there are many acres of salt marshes. Certain portions of these marshes breed great numbers of mosquitoes. These mosquitoes are primarily Aedes sollicitans, with a goodly number of Aedes taeniorhynchus, and they have a long flight range. Mosquitoes of this species frequently fly into controlled areas from distant uncontrolled marshes.

Virginia has an average of about forty-five to fifty inches of rainfall; this results in many freshwater swamps and ponds. Such places breed Aedes vexans, Culex erraticus, Aedes atlanticus, Anopheles quadrimaculatus, Culiseta melanura, and, in some limited areas, Mansonia perturbans.

In late summer it is common to experience heavy rain which in eastern Virginia floods many places which normally do not hold water. Such places breed hordes of Psorophora mosquitoes.

In backyards in man-made places and in polluted water Culex mosquitoes breed in great numbers. Hence, it can be seen that any complete mosquito control program must take into account all of the various bothersome species which breed in a variety of habitats.

Methods of control used consist of filling low places, excavating shallow shorelines to make them steep and deep, ditching the salt marshes to allow circulation, drainage of the uplands, larviciding, and adulticiding.

On the salt marshes, ditches are installed in such a manner so as the tides can freely ebb and flow, thus not allowing water to stand in one place long enough to breed mosquitoes. In highly developed areas sometimes marshes are excavated so as to make highland and deep water. Larvicide is not applied to salt marshes in Virginia.

In permanent bodies of water where shallow shorelines provide breeding places for mosquitoes, sometimes the edges are deepened making a shoreline that is deep and steep. This allows fish access to control the mosquito breeding.

Ditches are cleaned and graded to reduce standing water. This is perhaps the most important mosquito control effort and consumes most of the money spent.

Larviciding is practiced during the mosquito breeding season from mid-April to mid-October. Each known mosquito breeding place is recorded on a map. Once each week during the season a crew inspects the place; and if found breeding, it is treated with a suitable larvicide. Larvicide being used in Virginia consists of Abate if the season is relatively dry and the crews are covering their routes within the week. When the season becomes wet and pupae begin to show, the larvicide used is No. 2 fuel oil with a spreader or Flit MLO.

Adulticiding is practiced to supplement all other control measures when mosquitoes become bothersome either from local mosquito breeding that has been missed or from migrating mosquitoes. Ground equipment is used mounted on trucks. In the larger mosquito control districts, Dibrom is the chemical used, while in the smaller districts Malathion and Lethane is used. The reason for this is because it is more complicated to mix Dibrom, but Dibrom is less expensive. The larger districts are better equipped to accomplish the mixing chore; and because they use large quantities, the saving is significant. It is the tendency to minimize fogging operations as much as possible because it is temporary, expensive, and creates a traffic hazard.

The area around Langley Field and Fort Eustis is sprayed by airplanes operated by the Air Force with the local governments cooperating. The local governments furnish insecticide and carry insurance which holds the Federal Government free of any liability. This spray is directed against adult salt marsh mosquitoes. The time for spraying is determined by entomological inspection. Dibrom at the rate of one-half ounce per acre is used.

There is a law in Virginia which provides for the establishment of mosquito control districts. Any city, town, or county may create a district by action of the local governing body. A district may include all of a city, town, or county, or any portion or combination thereof. The local government creating the district appoints two members to a mosquito control commission. The third member and ex officio chairman is the State Health Commissioner or his deputy. Commissioners serve without pay. They are charged with operating mosquito control in the designated boundaries of the district.

Funds with which to operate may come from a special tax which can be as much as 35¢ per $100 valuation, from direct appropriations, or from private contributions. The State Board of Health is empowered to contribute to any

duly constituted district a financial contribution equal to 25 percent of the funds collected locally, not to exceed $10,000 annually.

At the present time there are twenty-six mosquito control districts in Virginia. They are spending over $1,000,000 annually. The first was established in 1940. In addition, several cities operate mosquito control programs independently.

Of the twenty-six established mosquito control districts, ten are classified as large, full-time operations with budgets ranging from $50,000 to $200,000. There are five districts which spend between $15,000 and $50,000, and there are eleven small, seasonally operated districts which operate on less than $15,000 per year.

All of the organized mosquito control work is carried on in eastern Virginia. The mosquito problems in the western section of the state are generally local problems caused by Culex mosquitoes associated with polluted water. Most of the areas where there is sufficient population to justify spending the funds it takes to do a reasonable job of controlling mosquitoes are now under control in Virginia. This does not mean that mosquitoes are under control all over Virginia. There are plenty of areas where mosquitoes abound in great numbers, but it is just not economically feasible at the present time to spend the money it would take to control them. As these areas develop and more people move in, it is conceivable the demand will be forthcoming.

Twenty-three years ago the Virginia Mosquito Control Association was organized. Membership is open to anyone who has an interest in mosquitoes and their control. The Association is performing a very useful service in promoting and maintaining public interest. The Association performs other services to the mosquito control districts, such as joint purchase of insecticides, operation of mosquito light traps, joint printing of educational material, all of which saves money for the districts over what they would spend if they operated separately. Each year an annual meeting is held. Perhaps the most beneficial service furnished by the Association is the bimonthly publication of "The Skeeter." Approximately 500 Skeeters are mailed to all corners of the country, and this has been going on for over twenty years.

The first English settlement in the new world was established in Virginia in 1607 at Jamestown Island. The settlement moved from Jamestown to Williamsburg because of malaria. So it can be seen that Virginia's interest in mosquitoes outdates any other part of the United States. Mosquitoes need blood

to reproduce their kind. It can be said that today's mosquitoes found around Jamestown and Williamsburg are descendants from some of the best blood of this country, such as George Washington, Thomas Jefferson, and, because of their aggressiveness, perhaps Patrick Henry.

Question: I'm very much interested in the things you are. We are faced with a problem now. Some of our equipment is on the main highway. What action do you propose to take, if any, about this equipment on these main arteries?
Answer: I wish I had brought one of the forms we made out but we say no fogging on a main highway. I think any highway that has a speed limit of over 45 mph, there'll be no fogging. I think that's it; it may be 35 mph. I'm not sure.
Question: What would be the consequences in a court case if you had specific instructions for these people and they violated them? That would put you in a pretty bad situation, wouldn't it?
Answer: You sound like one of those shyster lawyers. I think you're better off than you would be if he said, "Well, what instructions did you give them men?" and the only thing you could say would be, "Well, we've told them about this." I think you'd be better off if you had written instructions. If the man didn't follow the written instructions, then I think the man himself may be liable.
Comment: I might add that in the State of North Carolina the counties themselves are immune from liability, and it is the driver who is responsible. So counties do not have liability insurance on any of their equipment.
Question: What happens to the poor driver if he has an accident? Does he have to carry five million dollars' worth of liability?
Answer: He's the one that's liable, not the county. Now in our case each one of our employees has to have their insurance company sign a paper to the effect that their insurance covers this liability.
Question: You made some interesting remarks that I made notes on. For example, no larviciding in salt marshes and you alluded to zoning in relation to population as guidelines for your mosquito control program and other basic principles that I'm sure you as an individual have in guiding the administrative functions of your agency. My question is, is there a written policy or written modus operandi for the program in Virginia?

Answer: No, I don't believe so. I serve on all of the commissions, and I think I can mold most of the commissioners into the same sort of thinking. So I would say that most of the commissions are behind this type of thinking.

Question: Do you see any advantage to a prepared guideline--a documented policy statement?

Answer: Maybe the Virginia Mosquito Control Association could do that. Another thing that I didn't say about the Virginia Mosquito Control Association is that we are free to say things that maybe a government agency couldn't say; but as an Association, we have been going to get additional money from the legislature. We've acted through the Association. As an employer of the state, I couldn't say anything; but I can put that hat on and write an editorial on it. I think we might work something through them.

Question: Is there any larviciding on the salt marsh?

Answer: We haven't done it. Incidentally, we have a garbage can on each route with paris green granules, and they are used in such places as boats. People have boats in their yards, and they let them fill with water. If you spray a boat with oil, somebody's going to give you hell; but if you take a handful of this and shove it in there, they don't fuss. When it floods on the lawn if you spray with oil on a lawn, you're going to get in trouble; but you can take this paris green and put it on.

Question: You said that "Abate" was cheap. What did you mean?

Answer: Well, 5¢ a gallon.

Question: What's the concentration?

Answer: This is where I have trouble with you fellows. You're always talking about so many gallons per acre. An acre can be 207 feet square. That's an acre. Or an acre can be a little pool here, a little pool there or 150 different places which in total make up an acre. Now when you try to apply a figure of so much per acre to one and the other, you're all mixed up. This is the reason why even with oil it'll run from fifteen to fifty gallons an acre. So I don't know; I can't give you a figure. Most of our domestic mosquito control is broken up into many little places and not very many big extensive areas.

Question: What do you apply? Five percent, two percent?

Answer: I forget.

Question: Did you have a lot of mosquito problems from the recent hurricane?

Answer: No. That stuff came down those mountains and went away. Now, it did wash away a warehouse that had insecticides, endrin, parathion, and some other

insecticides. Then, there was a lot of other insecticides that were in farms; and as a result of this, they went down--I didn't get this assignment, and I'm glad--and searched the river bottom and recovered all of the containers. Many of them were unmarked. Some were never recovered. In fact, there were thirty-some bodies that were never recovered in that flood.

Question: You've already talked about concentrates. Who is allowed to handle this concentrate?

Answer: We usually have a man trained at each commission office who is in charge of mixing insecticides. Nobody else. This is another thing, that the fogger merely checks his truck in. It's already loaded and everything, and they keep account of what they use. At night that truck is brought in, and the next day it's serviced by one man who is trained to do the mixing and everything else. We don't allow everybody to touch it.

Question: Where does he get his training?

Answer: Well, we train him.

FLORIDA'S MOSQUITO CONTROL SYSTEM

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Subtropical Florida, with its 1221 miles of coastline, heavy rainfall, warm climate, and flat topography, gives rise to an abundant and unique fauna. Included in this unusual fauna is a number of arthropods which are greatly annoying and which carry diseases of humans.

The extensive beaches of the state are sometimes laden with seaweed, the larval habitat for dog flies or stable flies (Stomoxys calcitrans). The adjoining flat land mass is pocked with tremendous salt marshes, swales, swamps, fresh water marshes, ponds, lakes, or streams which afford an environment conducive to the heavy production of sixty-seven species and subspecies of mosquitoes, twenty-two species of sandflies (Culicoides spp.), several species of yellow-flies (Chrysops spp.), as well as many other species of arthropods annoying or dangerous to man.

Florida citizens have been swatting mosquitoes for many generations. It wasn't their fault that nature chose to endow Florida with a beautiful setting, a wonderful climate--and mosquitoes. The bitter came with the sweet. It wasn't their fault either that for years the guns and ammunition available were just not enough to wage a winning war on the blood-thirsty hordes. And so they suffered crippling losses to malaria, yellow fever, and dengue; and to top it off, they were continually annoyed by the mosquitoes which did not happen to carry diseases. Florida Crackers have paid a heavy tribute of lives, blood, and money to the pesky mosquito.

Today, real relief from the costly bites is available. The Division of Health in 1953 prepared to take the leadership in chasing these unwanted residents out of Florida. In doing this it did its level best to make Florida a healthier, more comfortable, and more prosperous land for both the "Crackers" and their many welcomed guests.

First Organized Control Effort

A great forward step in the control of mosquitoes in the state was the organization of the Florida Anti-Mosquito Association in 1922. The first meeting was called by Dr. J. Y. Porter who, although no longer State Health Officer,

retained a deep interest in the work. This organization has been primarily responsible for the promotion of legislation for the creation of mosquito control districts and of legislation making state aid possible to mosquito control districts and counties.

Mosquito Control Legislation

The first state law on mosquito control was passed in 1925 making it possible for a county to vote for a mosquito control district and for the residents to tax themselves for the work. Another state law was enacted in 1929, and in 1941 the legislature provided for three alternate methods for establishing mosquito control districts in the state.

The first state law providing for state aid to counties and mosquito control districts was passed in 1949. This law provided that aid be given by the State Board of Health to mosquito control districts and county health departments in the form of insecticides, materials, equipment, personnel, and trucks in amounts not to exceed $15,000 annually to any one county. This law, for the first time, recognized pest mosquitoes and other non-disease-bearing arthropods as being of public health and economic importance. A total of $350,000 was made available each year under this law by the State Legislature for the control of mosquitoes and human-biting flies.

In 1953 upon the recommendation of the Florida State Board of Health, the State Legislature passed a second state aid law whereby any board of county commissioners or a mosquito control district that places funds in its budget for the control of "arthropods of public health importance," would receive funds directly from the state upon proper certification by the State Board or district. This law stipulated that state funds are to be used exclusively for permanent eliminative measures such as sanitary landfills, filling and draining of breeding areas, the purchase of all types of equipment, the hiring of personnel, and the operation of equipment to be used in carrying out permanent measures of arthropod control. The legislature appropriated $1,250,000 annually for this program in addition to the annual appropriation of $350,000 for both permanent and temporary control measures. In addition to the direct aid to counties and mosquito control districts, this law provided an additional appropriation of $250,000 a year to be used by the State Board of Health for administration, consultation, and for the construction and operation of a research laboratory. The State of Florida is, therefore, at present appropriating a total of $1,650,000 annually for the control of mosquitoes and other

arthropods of public health importance. Local appropriations for 1969-70 amounted to $8,292,795.

In 1955 all three Mosquito Control Acts that had to do with the creation of mosquito control districts and the two State Aid Mosquito Control Acts were combined into one act which is now known as the Mosquito Control Act, Chapter 388, Florida Statutes.

The tourist industry is the largest industry in Florida, and in 1969 brought in 5.5 billion dollars as compared to $950,000,000 in 1953 when the overall program was started. It is, therefore, important at all times that the state do all in its power to protect the health as well as the comfort of its visitors. Furthermore, the permanent residents of the state are not unappreciative of the benefits to themselves of a vigorous program against mosquitoes and other pestiferous arthropods.

Mosquito Control Districts

The first mosquito control district was established by vote in Indian River County in 1925. At the end of 1953 there were twenty-three mosquito control districts in twenty-one of Florida's sixty-seven counties. In addition to the twenty-one counties having organized mosquito control districts, arthropod control was carried on by twenty-three additional counties. In 1970 the program had been expanded to fifty-five counties.

At one time a small county, Brevard, with a population of 25,570 in 1950, appropriated $208,649 for mosquito control for the fiscal year 1953-54. The county now has a population of over two hundred thousand and is the site of Cape Kennedy. Indian River County, a small county, had a per capita tax for mosquito control of $9.11 and Dade County (Miami), the wealthiest and most populous, had the lowest per capita tax of 17¢.

All mosquito and arthropod control is directed at the local level by an individual under the supervision of the mosquito control board or the board of county commissioners elected by the people.

All boards are required by law to submit a plan of operation to the Division of Health annually before expending their own funds or before receiving aid from the state. In order to assist the local boards with their administrative and technical problems, the state is divided into four operational districts. Stationed in each district is an entomologist who is responsible for arthropod control in an assigned number of counties.

Each board is also required by law to report each month on all county and state expenditures for mosquito control as well as reporting at the end of each month on all of their operational activities.

Division of Responsibilities in Mosquito Control

The distinction between matters of public sanitation and matters of personal sanitation is recognized by everyone. Yet, in the field of insect pests, the distinction between public and individual responsibilities has seldom been appreciated. The most annoying mosquitoes in Florida are public pests. Many insect pests are so restricted in their breeding and wandering that they are, essentially, a premise problem. This applies, in a measure, to domestic mosquitoes, Aedes aegypti and Culex p. quinquefasciatus. But salt-marsh, glades, and Mansonia mosquitoes are in no sense such individual property-owner's worries. They are, by their very nature, a public liability. They originate on land at large and are as public as the sunshine or the breeze. They reflect public sanitation just as lice reflect personal sanitation and roaches reflect household sanitation.

Individual Responsibility. The mosquito-control responsibilities of individual premise occupants are simple--leave no water standing on the premise in a condition to breed mosquitoes. The flight range of Aedes aegypti is so short that were it not for its disease relationship the control of this mosquito would be of no more public concern than the control of ants. Whatever species is involved, the individual has the duty, nevertheless, of preventing the breeding of mosquitoes on property he occupies.

In rural or undeveloped areas the problem of responsibility is more complex, and there will always be a broad area of overlap between the duty of the private land-owner to minimize mosquito breeding through proper land and water management practices and the responsibility of the mosquito control district to control the mosquitoes leaving that private land. Mutual help and collaboration is obviously indicated, founded best on mutual respect and shared concern for the people of the district.

Community Responsibility. Regardless of size, communities are responsible for mosquitoes originating within their confines. The control of mosquitoes originating in publicly contaminated waters or in misdrained public installations of any kind is a community responsibility. The duties in this respect of such community services as street departments, sanitations departments, engineering departments, waste-disposal departments, as well as the

various public utilities, are often sadly underemphasized. The result has been that responsibilities clearly resting on these public services have been passed on to mosquito control agencies when these exist or have been completely ignored.

The Division of Health believes that agencies created specifically for mosquito control should not be forced to assume the responsibility for the neglect or improper operation of other departments of community service. It goes without saying that mosquito control directors should volunteer all possible advice to these other departments and guide their efforts to avoid the production of mosquitoes.

County or District Responsibilities. The above responsibilities in mosquito abatement apply equally, though on a geographically wider scale, to county governments or specially oriented taxing districts (e.g., drainage districts, soil-conservation districts, port authorities, etc.) which might include several unincorporated communities or rural areas. Here, under the sponsorship of health departments or as specifically established mosquito control districts, there rests the responsibility for controlling those far-flying mosquitoes--those public pests--which invade communities from beyond their boundaries and which plague residents of rural areas. While it is true that these mosquitoes often transgress county lines, this is not so much an argument for the need of control at the state level as it is of the need for coordination at the state level. Experience throughout the United States has demonstrated that actual control, even of far-ranging mosquitoes, is most expeditiously directed at the county or district level.

State Responsibility. Because (1) mosquitoes pose public health problems, (2) the mosquito problems are statewide, and (3) the chief mosquito offenders are so far-ranging, the state has the responsibility for promoting and coordinating mosquito control programs operated at the county or district level. In Florida this responsibility is discharged with vigor and integrity by the Division of Health's Bureau of Entomology. This Bureau administers the state-aid programs to mosquito control districts which were initiated in 1951 and 1953, and in this capacity has the responsibility of overseeing the use of state funds to the extent that they are utilized efficiently. It has the further responsibility of supporting the research which alone can maintain efficiency in mosquito control. The Entomological Research Center in Vero Beach has for its mission the uncovering of all biological data possible which can be utilized in developing better mosquito control methods or which can contribute

to a better understanding of the mechanisms behind the transmission of diseases by mosquitoes. The West Florida Arthropod Research Laboratory in Panama City has, among responsibilities involving other insects, the mission of improving current methodology in mosquito control and developing new methods when called for. Between these two research institutions, the Division of Health feels that the state has the kind of excellent developmental support it needs to keep current with the ever-changing strategies of mosquito control required by a fast-growing state.

In the area of public health involvement, other bureaus of the Division of Health join the Bureau of Entomology in maintaining constant surveillance over mosquito-borne diseases. The Division of Health maintains and revises as needed an elaborate plan of operation for the surveillance, prevention, and control of encephalitis due to arbovirus. This plan (last revision February 1, 1970) covers all possible contingencies from normal surveillance through epidemic prevention to maximal epidemic control. Not only mosquito control agencies but several county, state and federal agencies with normally unrelated missions are coordinated in this plan for smooth cooperation and division of responsibilities in the event of any serious threat from arbovirus transmission. The Division of Health prayerfully hopes that the plan will never need to be implemented by another epidemic as manifested itself in 1962.

Operational Objectives. The major objective of mosquito control, stated earlier, can be abbreviated to operating an efficient program with minimum disturbance of the environment. The last phrase is incorporated because injudicious control operations, whether environmental or chemical, can do great damage to land and life. The efficiency of a mosquito control program will normally depend on the strategy exercised by the director in deploying his funds, his men, his equipment, and his materials. For this reason a mosquito control program is usually only as good as its director. A good director need not be an entomologist or engineer, but he must be knowledgeable and educable in addition to possessing the expected administrative qualifications.

Knowledge and Inspection. It should be obvious that no control program can be efficient unless the following biological facts about the mosquitoes involved are known: (1) Choice of breeding sites, (2) conditions for hatching and emergence, (3) dispersal habits, (4) resting habits and locations, and (5) responses to weather. Research is unearthing these and many other facets of mosquito biology. It is furthermore obvious that no control program can be

efficient unless the following control information is at the command of the director: (1) Disposition of breeding areas of annoyance, (2) the precise role of terrain, weather, and tides in producing and affecting the behavior of mosquitoes in his district, (3) the techniques available, for permanent or temporary ends, for combatting mosquitoes, (4) the tools and materials available, and (5) the programming, or selection of techniques, tools, materials and times best adapted for the problem at hand.

However much research may help the director, it cannot serve him to the full unless he institutes and maintains constant surveillance of the mosquito situation in his district. Twenty years ago an inspection program was considered a sort of luxury. But control directors gradually resigned themselves to the inevitable--for every new advance in control technology put a greater demand on inspection. Now many of the state's districts have truly excellent inspection programs. It is the stand of the Division of Health that no control district should be without the best inspection system it can support to guide its operations.

Strategy of Control

Control by Insecticides. Where feasible, permanent or semi-permanent elimination of mosquito sources is the most effective method of mosquito control. However, this method, called source reduction, frequently requires months and even years to accomplish. During the interim period it is necessary and desirable to apply insecticides or other measures, if available, to bring about temporary relief from pest mosquitoes and to protect the population from mosquito-borne diseases. In fact, the only effective method of epidemic disease control available at this time is by use of insecticides.

Both source reduction and insecticidal treatments can have adverse effects on the environment if not employed judiciously. Therefore, the Division of Health urges all who are responsible for application of mosquito control measures to select methods, materials, and procedures that will accomplish the objectives of control with the least adverse effect on the environment. Further, the Division feels that this can best be done by first making a careful study of all aspects of a project before selecting a control procedure.

Widespread use of DDT over the state's mosquito breeding marshes in the middle and late 1940's killed a large percentage of susceptible mosquitoes and left those that had a natural resistance to this insecticide to breed future generations which, like their parents, were resistant to DDT and

related chemicals. As a result of this costly lesson, the State Board of Health (now Division of Health) recommended that snythetic organic insecticides not be used as mosquito larvicides in the state. This was nearly twenty years ago, and this policy has paid tremendous dividends to the counties and the state.

Undisputable proof of the soundness of this policy is in the almost total absence of resistance of Florida mosquitoes to the organophosphate insecticides after approximately fifteen years of extensive use only as adulticides. The few spots where resistance to these compounds is known to occur is where they have been applied frequently to large areas, including breeding marshes, by aircraft. Selection of resistant populations is expected where this procedure is practiced.

The best approach to mosquito control by use of insecticides is to kill mosquitoes in the larval stage for the obvious reason that this will prevent development of the adults. In keeping with the policy outlined in the preceding paragraph, only granular Paris green and oil larvicides are used in Florida. Moreover, these should be applied only where and when an adequate inspection program shows that they are needed.

Realizing that source reduction and/or larviciding will not be adequate to fully accomplish the objective of most mosquito control programs, the Division recognizes the necessity of using adulticides in order to achieve the ultimate level of control required to protect the tourist industry and the public health of the state. It is in the adulticiding program that synthetic organic insecticides are properly utilized in the mosquito control programs of Florida.

These valuable chemical tools should be used primarily in populated areas and nearby fringes. There is little justification for applying adulticides to remote breeding areas except under unusual circumstances. Also, like larvicides, they should be applied only where and when adequate inspection shows that this kind of treatment is needed. The only circumstance that justifies routine fogging or spraying for control of adult mosquitoes is in mosquito-borne epidemic disease control or prevention.

It is the policy of the Division of Health to employ for mosquito control only those approved, effective insecticides that scientific data show are the safest for humans and wildlife.

Finally, these guidelines for mosquito control by insecticides in Florida are based upon presently available, effective procedures and materials; however,

if and when biological or other methods and/or materials that are both effective and safer for man and the environment become available, then it will be the policy of this Division to reconsider its recommendations accordingly.

Source Reduction

The elimination of mosquito breeding by improved premise sanitation should be the first step considered in any mosquito control program. Constant motivation of the public is required for this type of program to be successful. In this connection public information is of the greatest importance to enable the populous at all times to understand the objectives of all aspects of the mosquito control program.

It must be constantly driven home that the efficiency of a mosquito control program is proportional to the rate of permanent elimination of the problem. Today, as of old, source reduction can be accomplished by the flooding of areas where flood-water mosquitoes breed, drainage of certain areas, construction of large minnow access ditches, deepening and filling, complete filling, and complete vegetation removal. These are methods of mosquito control that should be constantly pursued until such time as the mosquito problem can be eliminated by some biological means, which appears to be in the far distant future.

Cooperation. The keystone of good public relations is always cooperation. In mosquito control this is especially important because (1) work is always being done on someone else's land, and (2) the director is a public servant.

The land where work is done is most often privately owned. When the land is undeveloped, a short visit to the owner explaining the need to trespass, cut a ditch, build a dike, or whatever, is nothing more than a matter of courtesy. However, when the land is in use, whether in pasture, grove, field crops or in public ownership and devoted to recreation, wildlife management, and so on, the matter of cooperation takes on another dimension. It then becomes incumbent on the director to explain in considerable detail to the manager of that land how the problem mosquitoes are produced, what he could do to alleviate or eliminate the problem, or what the mosquito control district can do to eliminate the problem, either cooperatively or unilaterally. Obtaining the cooperation of the land owner or manager is far better than having to invoke laws.

Like many other public servants, mosquito control directors may be devoted to their particular mission to the point of forgetting that there are

many other public servants equally devoted to other missions. This overlooks the most important mission each has which is jointly serving the public in a worthy cause. An example can be taken from troubles with conservation interests. The man who wants more ducks at any cost will never get along on the same ground with the man who wants to get rid of mosquitoes, regardless of consequences. The deadlock is a public disservice, the very opposite of the antagonists' duties. The public is served only when extremists abandon their stubborn positions and compromise as all civilized human beings must in all walks of life. The beauty of compromise in the case of mosquito control and conservation is that it can so often be achieved to the benefit of both parties. In probably no other state has this been so often demonstrated as in Florida, which has an enviable record of cooperation in this particular area.

The Division of Health is fully aware of the increasing value of the state's waters, surface or ground, and of the concurrently increasing demand of them in the face of growing threats to their quality and quantity. Realizing, as well, that permanent mosquito control operations necessarily affect waters, the Division of Health advises all mosquito control directors to proceed most cautiously with any alteration of natural water situations. Advance consultations with any agency concerned with natural waters and their uses is more necessary now than ever. However, this should never be exaggerated to mean that mosquito control should utilize its funds for the development of water uses. Marshes and swamps canalled or impounded for mosquito control are now so treated at the lowest cost possible, which is as it should be. In many cases, however, additional treatment and management could and should be instituted to maximize the fish, wildlife, or other resource values of the areas. The Division of Health encourages this and urges all possible cooperation to achieve it but not at the cost of mosquito control funds nor at the hazard of mosquito production.

An Old Summing-Up

To many who may think that environmental concern is something new on the American or Florida scene, it may come as a surprise that the Division of Health finds it hard to sum up its policies on objectives in 1970 better than by reiterating a statement printed twenty-two years ago (Florida Health Notes, ibid., pp. 105-106) following the query "What Price Mosquito Control?"

"We are told that this is a great country and that Florida is a great state. Promotionists may tell us and tell everybody that mosquito control will make Florida an even greater state. But there's an old, old story about a certain goose having laid a golden egg which apparently recent generations of Americans have never heard. These words may sound caustic to those for whom they were admittedly meant to be so, but to the majority of Floridians they are solely words of warning. One of the reasons why America is great is that this is one country where almost anything can be done--for a price. But the real price is too often something far more valuable than money: the natural resources which are the one and only God-given, material inheritance of generations unborn. The price of too many industrial and community expansions in Florida has been pollution of waters of great importance to industries and communities. Here is the goose and here is the egg. In like manner, the price of mosquito control can be the pollution of both land and water, for insecticides used excessively are, in every sense of the word, pollution. Thinking people, while granting that mosquitoes are undesirable, will also see beyond the mosquitoes. They will realize that the infinitely intricate pattern of soil, water, plant, and animal, which is man's non-man environment on earth, has values which dwarf on a grandiose scale the mere elimination of mosquitoes. Therefore, they can adopt but one logical attitude towards mosquito control; it is desirable, and yet in the perspective of value and time, it must be practiced with utmost care."

Question: How many facilities do you have for the bulk handling of pesticides?
Answer: Most of the big operations have these facilities--all mosquito control districts.
Question: How about the composting plants?
Answer: They have been a complete failure.
Question: Was that because of economics?
Answer: The main problem, as you know, is getting rid of the compost. People are afraid to use it because of all the chemicals going into the refuse cans.
Question: How do they dispose of pesticide containers in Florida?

Answer: In sanitary landfills.

Comment: I wondered, the water table being what it is, what your problems are?

Answer: We don't bury in the water. We cut off the water with a dike and pump out of cells adjacent to where we are burying. The water is polluted and is discharged to a "polishing pond."

Comment: I want to mention that John also trains mosquito control directors for the states.

Question: What about use of pesticides in the marshes?

Answer: We don't allow any phosphatic insecticides to be used in any marshes in the State of Florida--period! We know that if you use these as a larvicide, the mosquitoes are going to build up resistance.

WORK GROUP REPORTING AND DISCUSSION

GROUP I

Mr. Charles J. McCotter, Chairman
Dr. Richard C. Axtell, Reporter

Who's got the questions? I've got the answers here, but I don't know what the questions are.

No. 1: Evaluation of present practice, techniques and emphasis, advantages and disadvantages. That was easily covered with the following statement that there is not sufficient data for evaluation of effects of present practices on the total environment. We cannot use one method everywhere, obviously. Question is how extensive use of a particular method is to be allowed. How much ditching is needed to alleviate the mosquito problem in an area? Impounding seems effective for mosquito control and for encouraging wildlife, but is there any problem of cutting off nutrient flow? What larviciding and adulticiding practices and chemicals should be allowed and under what conditions? It would be helpful and good public education to have a state level policy statement and guidelines covering all present mosquito control practices.

No. 2: Transition away from persistent pesticides and minimization of other forms of ecological impact. The group strongly favored transition away from persistent pesticides. Again, the group suggested that there is need for research and evaluation of practices that in any way may have some impact upon the ecology and the environment.

No. 3: Integration of mosquito control with other facets of water-land resource management. The group concurred that it is essential to have integration of mosquito control practices with other water-land resource uses. The point was brought up that the basic problem here is communication between all the different public and private agencies and the mosquito control personnel. Improved communication would be the essential step in getting proper integration of these practices. It was suggested that some sort of better review process for integrating mosquito control practices with other land-water management practices would be helpful. Again, it was suggested that we very often are lacking the data that we ought to have in trying to reach a decision on what method or combination of methods are appropriate to use in order to reach our overall objectives.

No. 4: Effectiveness of statewide coordination of operating programs including local government. There was considerable overlapping here in discussion. It was felt that the present-day requirements for mosquito control are so complex that this dictates that coordination be much more sophisticated than has been necessary in the past. In addition to this rather high-level coordination, it was pointed out that workshops would provide coordination more at the working level, the sort of coordination at the grass roots that you do not always get when you have high-level agency coordination councils, etc. In other words, it was brought out that this workshop should not be the end, but this should be a first step and many more workshops would provide the coordination. Some of these workshops probably should be very narrow and specific in their topic and involve primarily technical people and people who are out in the field actually doing the work. As a personal thing, I think the coordination achieved by some high-level committee is meaningless or wonder if there really is a coordination of people doing the work.

No. 5: Recommendations for changes in North Carolina mosquito control programs. The first point was that we presently have only one state entomologist and two engineers. A major change is to have more state-level technical assistance. We learned that South Carolina has two entomologists, and we could probably pick other states as examples that even have more. As was mentioned by Mr. Mulrennan, there's great advantage to having a continuous survey of the mosquito problem so that we will have some index of what is happening when you make various changes in control practices over many, many years so that you can show this to the taxpayers. North Carolina desperately needs some sort of uniform continuous survey program, particularly in the coastal area. There was opinion expressed that in view of the fact that there is a research project under the auspices of the Water Resources Research Institute on the effects of ditching that we ought to hold up on any further ditching until such time as the information is available from the research project.

No. 6: Research, education and extension needs was the sixth point, and you know that fragments of this have already been covered. To summarize, again, the group concurred that mosquito control is a very complex technical program. With such complexity there is a need for a much greater manpower input at the state level. There is a need for much more research, survey, education, and extension. It was suggested that it might be to mutual

benefit for all concerned if you do not try to mix up all these various needs and put them onto the back of one person or one organization. It was suggested that the most mutually advantageous arrangement might be to push for additional educational extension programs by the State Board of Health and to encourage more research and survey type of research program by the University. There's practically none right now--maybe I should say some. There's a combination of more contact with the people with information from the state government and a backup of more long-term research to provide some answers for some of the anticipated problems through an expanded university program.

Comment: I have a comment to make on the discontinuation of all ditching until the research projects are completed. Some projects never get completed. We have learned in an embarrassing way that certain thoughts sometimes lead to instantaneous bans with embarrassing results; for example, cyclamates. Why not allow the present program of ditching to be continued only to the point that it is now on the planning board and not extended beyond that? You can pull a dragline out of a swamp and leave a breeding hole.

Comment: The research may or may not provide the kind of information that you need. It seems to me that it might be better to simply encourage a minimization of ditching until we have more information.

Comment: The group didn't include curtailment of impoundments along with the ditching. We know that for every impoundment constructed that much productive salt marsh is lost. We do not know if any damage is being done by ditching.

Comment: I disagree with the Captain's statement to the point that this planning, as I see it now, includes ditching all the marsh. That is planned. So to follow your suggestion would mean that there would be no checking of ditching at all.

Comment: All marsh is not planned to be ditched unless it is a mosquito breeder. We have marshes that do not breed mosquitoes, and we do not go in and ditch these marshes. How about the high marshes? If it breeds mosquitoes, it will be ditched.

Comment: I still say, then, that it's all inclusive of the high marsh.

Question: Why was impoundment not included along with ditching?

Answer: We do know of some beneficial aspects of impoundments. We're not quite sure what the disadvantages might be. You're right; we don't know the complete story on ditching. We don't know good or bad. We're completely in the dark.

We're sure of one thing--on impoundments you lose that much marsh. I'm sure we lose that much marsh on ditching.

Comment: You're sure of one thing on ditching--it eliminates mosquito breeding about 90 percent.

Question: You're sure?

Answer: I'm positive.

Question: You're not sure of what the impact is on the aquatic environment?

Answer: No, but I'm sure of that as one positive thing.

Comment: No one's convinced me yet that remaining marsh, if you don't get every bit of that remaining marsh, can't produce enough mosquitoes to make that county miserable.

Comment: We requested the research. We want the research, but we still want reduction of mosquitoes. If we relax to any great degree, our program is completed, and we would have failed 100 percent on the initial purpose with the reduction of mosquitoes to make a better environment for the people to live in, to advance, promote and protect the public health besides other things.

Comment: I would have recommended that equipment for a moratorium period would go into cleaning up sanitary landfills. A fantastic number of mosquitoes breed in trash piles, trash on the highways, and in sanitary landfills. So you'd still be controlling mosquitoes, and you might be getting a bigger part of the population that's affecting the cities where the trash is located.

Comment: One of the purposes of the workshop is to encourage all points of view.

GROUP II

Captain John M. Hirst, Chairman
Mr. George T. Swearingen, Reporter

Group II started with Question No. 6 and discussed only the last four subjects.

No. 3: Integration of mosquito control with other facets of water-land management:

a. There is an urgent need for a state land use and water use law in order to define by law terms necessary to good water-land use planning.

b. A workshop covering land and water-use resources would be of great benefit to control agencies of state government and mosquito control workers and agencies.

No. 4: Effectiveness of statewide coordination of operating programs, including local government:

a. Need for legislation to support coordination of state and local programs and to guide the public support of these related programs.

b. Better publicity on public participation to improve our environment by desire and not just because of law.

No. 5: Recommendation for changes in North Carolina mosquito control programs:

a. Changes in North Carolina mosquito control programs need more coordination between state and federal agencies to promote mosquito control in North Carolina.

b. Research programs related to mosquito control be concentrated in the State Board of Health, such research to be conducted through the Consolidated University System.

No. 6: Research, educational and extension needs:

a. Research:

1. On ecological impact of mosquito control in fresh-water wetlands.

2. Ecological impact of expansion of salt-marsh mosquito control by ditching and impoundments.

3. Research leading to publication of what is true versus hysteria in mosquito control and related environmental situations.
4. Basic and applied research of pest management in relation to water.

b. Educational needs:

1. Educational programs to relieve misunderstandings in political and social thinking about the general subject of mosquito control.

GROUP III

Mr. S. H. Usry, Chairman
Mr. N. K. Oates, Reporter

No. 1: Evaluation of present practices, techniques and emphasis, advantages and disadvantages. One of the first questions brought out was what is the influence of larviciding on other crustacea in the marshes. North Carolina has done no larviciding in the marshes since the inception of the mosquito program. The North Carolina program has been leaning towards source reduction. It was brought out that there was a need for more long-term records such as light trap counts, etc., and to continue to press for effective evaluation on mosquito abundance and environmental conditions.

No. 2: The transition away from persistent pesticides and minimization of other forms of ecological impact. North Carolina has patterned its control program after other states based on their experience. At the present time we're using no persistent insecticides; also, no phosphatic larvicides would be used in the marshes. We need more studies on the ecological impact and establishment of better facilities when handling an insecticide such as they have in Florida. Also, we should get out more public information on use of insecticides and how they're being used. I think we're being credited for using a lot of the persistent insecticides that are being used for agricultural purposes.

No. 3: Integration of mosquito control with other facets of water-land resource management. We recommended that we press for other water-land resource management besides the Wildlife Commission. I think we've been working fairly close with the Wildlife Commission for the last several years. We need better liaison between the various agencies that are concerned with the wetlands.

No. 4: The effectiveness of statewide coordination of operating programs including local governments. North Carolina will only have one district, and that's out at Ocracoke. It is very small, and most of the programs are operated through the Board of Health directly with the County Commissioners. We need an expanded public relations and educational program.

No. 5: Recommendations for changes in North Carolina mosquito control programs. It was recommended that there's a need for a liaison committee represented by all interested agencies, starting with the agencies represented

at this meeting and to expand with other agencies that may be interested. It was recommended that this liaison committee meet every six months to discuss the problems.

No. 6: Research, educational and extension needs. A request for research for control of mosquitoes be made through North Carolina State University and to expand the ecological study such as that be made on the ditching program. I think adequate research on insecticides is being done in other areas, and we can obtain that information.

Question: Was your group willing to accept impoundments without question? Your emphasis here seemed to be on ditching?
Answer: I don't believe impoundment was mentioned.
Comment: Impoundments are not a total solution. If you impound all of the salt marshes, you're going to lose all the high marshes.
Answer: I think that would come through proper planning and land-use study. I think there is a definite need for impoundments and also for the marshes being left for nursery areas. Some kind of a land-use study for the marshes should be made. I don't know who would be in a position to determine what percent should be put into impoundments, but there is a need for a land-use study.
Comment: Presumably, zoning would mean that some would go for industrial development, some would go for ditching, and some degree of alteration through impoundment. It is conceivable that some would even be retained so that future generations could see it as it once was.

Dr. Knight: I notice in these reports that a surprising amount of different things have been taken up. No group has treated the subjects in quite the same way as any other group. This is very interesting and shows what happens when you do break up into sessions of this type. I suspect that it won't be possible to give a consensus for each question, but I think that the other comments made are equally valuable; and I believe that all of this material will simply serve as a guide in one respect to the State Board of Health which has the primary charge here. One thing that hasn't been made clear is that the State Board of Health did not dictate in any way in the planning as to what was to be covered. They asked for no special protection or no special considerations. I would like, then, to thank them for taking part in the initial planning of this work-shop. You know when you do that and it's going to be in part toward your

operation, that's a rather magnanimous and broadminded consideration. I, for one, appreciate it very greatly. I hope that you all do. It's in a way opened up their whole operation for our considerations, and this is not always done by people. At the same time they provided the cooperation needed in accomplishing this task, as well as having four people here.

Mr. Staton: We (the State Board of Health) would be pleased to provide tours of salt-marsh areas to any of the people participating in this workshop so that you will have a better opportunity to see the program and understand what is being attempted.

Comment: I think the record should show that the group feels very proud that the State Board of Health and gentlemen from the University have given us the opportunity to meet and make these comments. I think the record ought to show that this is real progressive. We're appreciative of the opportunity.

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Exhibit 13

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Gann, R.G. "Development of Flammability Criteria for Transformer Dielectric Fluids," National Bureau of Standards, U.S. Dept. of Commerce (1980)

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Development of Flammability Criteria for Transformer Dielectric Fluids

Richard G. Gann

Center for Fire Research
National Engineering Laboratory
National Bureau of Standards
U.S. Department of Commerce
Washington, D.C. 20234

Final Report

February 1980

Issued March 1980

Prepared for:

U.S. Department of Energy
Electric Energy Systems Division
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Washington, D.C. 20545

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NBSIR 80-1992

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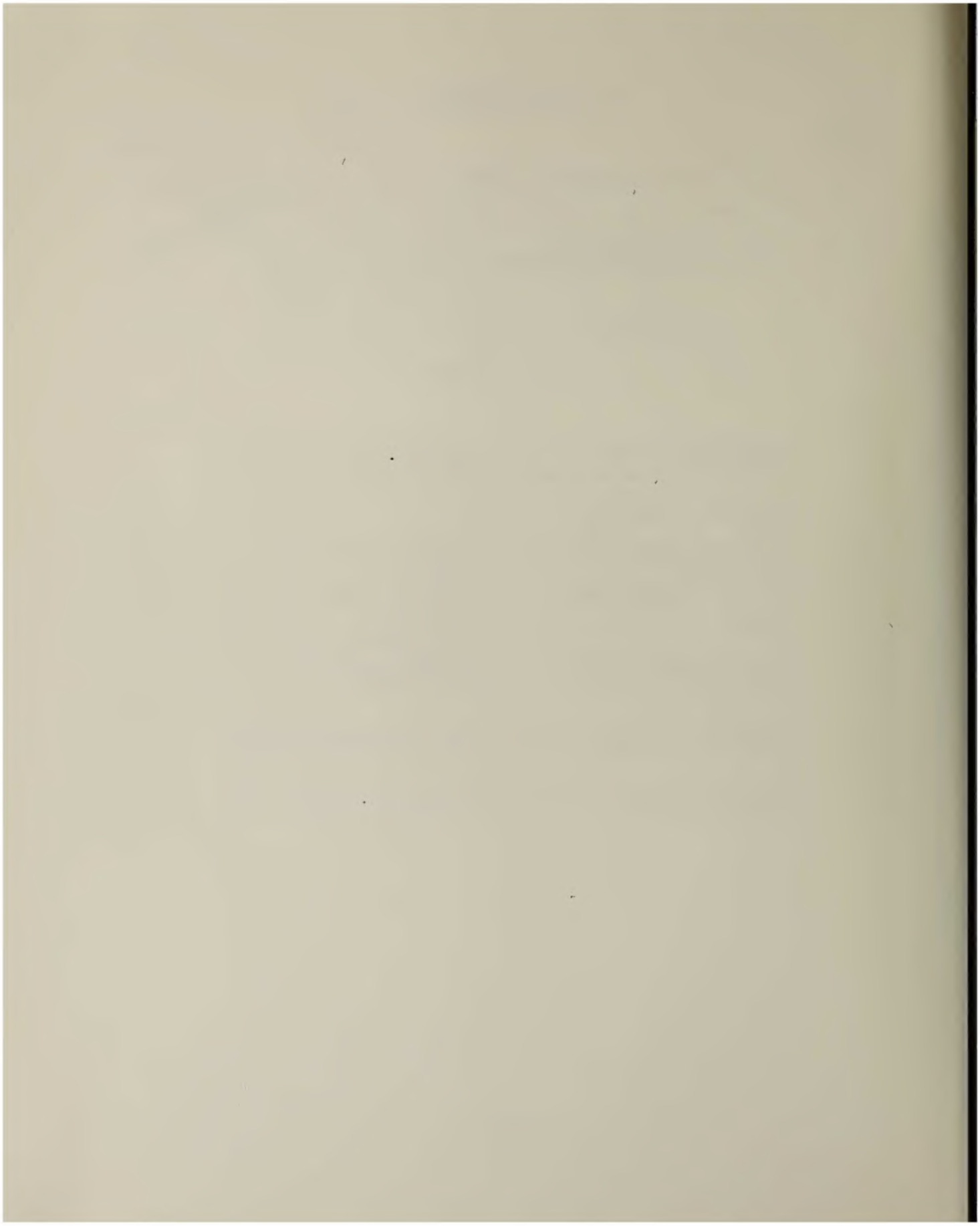
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DEVELOPMENT OF FLAMMABILITY CRITERIA FOR TRANSFORMER DIELECTRIC FLUIDS

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Abstract

With the recent ban on the use of polychlorinated biphenyls, it has become necessary to examine the fire safety requirements for electrical insulating fluids. The hazards are delineated and the magnitude of the transformer fire problem assessed. The current fire code and standard test methods are shown to be inadequate. Approaches to fluid fire performance testing are presented, as is a basis for evaluating the economic impact of alternative fire safety strategies. The report concludes with recommendations for further work.

Key words: Fire; fluids; pool fires; transformers.

1. INTRODUCTION

1.1 Background

The routine availability of electrical power has become an essential facet of our life style. With the exception of an occasional shock or blown fuse, we assume total safety and reliability of the power transmission network. However, this has only evolved because each element in the system has been itself engineered to be safe and reliable. We have responded to changes in technology in the past and maintained or improved the system. Rubber cable insulation has given way to polyvinyl chloride, circuit breakers are replacing fuses, and grounded outlets are becoming commonplace.

Due to certain recent events, we now need to reexamine one of the basic elements--the transformer. These devices convert an available input voltage to that needed by the device at hand. There are millions of indoor transformers in use, ranging from the small step-up transformers in televisions to the large step-down power transformers in apartment complexes and shopping centers.

Inside a transformer case are two coils of wire, each consisting of a number of turns wound on a single iron core. The coils are insulated from each other and from the core. Each turn is insulated from its neighbor as well. The power is transformed and transmitted as the current flow in the incoming, or primary, coil induces a current flow in the outgoing, or secondary, coil.

Ideally, the ratio of the number of turns in the two coils is also the ratio of the primary to secondary voltage. In practice, the power output of a transformer is somewhat less than the power input due to impedance heat losses in the windings and the core. While the efficiency of large transformers approaches unity, even a small heat loss poses a cooling problem. Thus an insulating, or dielectric, medium is required to also transfer heat from the source to the case. From there, energy is radiated and convected to the surroundings.

For many transformers, liquids of appropriate dielectric strength and viscosity are being used to meet the insulation and heat transfer objectives. The fluids have had admirable in-service histories. Nevertheless, they pose a potential hazard in that under sufficiently strenuous conditions, virtually all liquids will burn. Transformer fires fall into two classes, those resulting from slow fluid leaks and those resulting in violent rupture of the transformer case. The former are far more prevalent; the latter are potentially more hazardous. Nonetheless, fires of either origin can ruin the transformer, delay the return of electrical service, damage the room or building, and injure or kill occupants or firefighters. Thus, a third constraint is placed

on the transformer, and specifically the fluid--it must operate within an acceptable degree of fire risk.

Heretofore, two classes of fluids, mineral oils and polychlorinated biphenyls, have found wide usage. The former are the more prevalent. These petroleum distillate fractions are relatively inexpensive and meet conventional electrical and environmental requirements, at least to the extent the latter have been formulated. Since they are deemed to present an unacceptable flammability hazard, their use is constrained by the National Electrical Code [1][1] to outdoor transformers or indoor units enclosed in a fire resistant vault. By contrast, the polychlorinated biphenyls, also referred to as PCBs or askarels, not only have excellent electrical properties, but have also been considered nonflammable. Thus they represent the dielectric of choice in a large number of indoor uses where their high cost is more than offset by the savings in the cost of supplemental fire protection. However, over the past decade, evidence has accumulated that these compounds present a significant biological hazard. They are thus considered unacceptable for manufacture and use.

Industry has not been idle during this dilemma. A variety of candidate substitute fluids have been developed to "replace" the PCBs. These fall into three classes: high performance hydrocarbons, polydimethylsiloxane (silicone), and chlorinated aromatics. However, no operational fire safety criteria had been developed. As a result, we are now faced with a desire to use a substitute fluid for askarels without having a basis to determine acceptability.

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[1] Numbers in brackets refer to the literature references listed at the end of this report.

1.2 Magnitude of the Problem

Our prime source of fire data is the National Fire Incident Reporting System (NFIRS) which is operated by the U.S. Fire Administration [2]. In a survey of their data for 1976, 1977 and early 1978, including nearly one million fires in the data base and eight states reporting, 209 cases involved indoor transformers. Four of these fires resulted in an injury, none in any deaths. A more recent sampling of 1978 fires revealed that in a data base of about 230,000 fires, only seven began with indoor transformers. There were no injuries or deaths. The maximum reported damage in these seven fires was $2000.

The difference between the two data sets is due to the small number of incidents. Generally injuries and deaths in this type of fire correlate with the fire spreading beyond the room of origin. Once a fire spreads outside the room, it is unimportant how it started. Thus it is fair to use the number of transformer fires that spread beyond the room of origin, the total number of fires that did so, and the total number of resulting injuries and deaths to estimate a total annual transformer fire picture for the nation. With this approach, and using the 1976-78 NFIRS data, we calculate there are about 6000 indoor transformer fires per year, resulting in about 300 injuries and seven deaths, as well as 40 million dollars of damage. These are extrapolated figures, and it should especially be noted that no fire deaths appear in the raw data.

To help put this in perspective, we experience some three million reported fires per year (30 million unreported), and the average death rate is about three per thousand fires [3]. The numbers here are 6000 fires and about one death per thousand fires. Clearly product quality and current codes and practices have resulted in a quite low fire-loss profile. The question we now address is: With askarels removed, can a (similarly) reasonable degree of fire safety be achieved with replacement fluids?

1.3 Objectives of This Effort

In 1975, the Energy Research and Development Administration (ERDA) requested the National Bureau of Standards to appraise the existing flammability test methodology relevant to transformer fluids standards and to elucidate the test-related research and development need to evaluate new fluids. The final report on that project [4] noted that while there were several standard flammability tests for fluids, they are not sufficient to evaluate in-use performance. It was thus recommended that research be directed at developing flammability performance criteria. The authors also recommended the development of tests that would be a realistic indicator of fire hazard.

Following that report, ERDA (now DOE) then requested the NBS Center for Fire Research to proceed toward a comprehensive evaluation of recommendations for test procedures for transformer fluid flammability. During this project, we have performed in-house research, funded extramural research, and worked with other active committees and organizations. Specific areas of effort have included:

1. Accumulation and evaluation of fire incidence data.
2. Detailing of the fire scenarios and the resulting fire hazard.
3. Development of performance tests for the slow leak scenario.
4. Establishment of the radiation characteristics of fires of different fluids.
5. Development of test concepts for future study of the violent rupture scenario.
6. Model for ignition of other materials by flaming fluid droplets (violent rupture scenario).
7. Formalism for evaluating the relative merits of various fire protection alternatives.
8. Development of an approach for evaluating the effect of electrical aging on fluid flammability.

The remainder of this report is a description of the current status of fluid flammability evaluation and test methods with details of the NBS-CFR effort. Much supplementary background material is contained in a prior report [4] which should be considered prerequisite reading. In addressing the problem, we have confined ourselves to indoor transformers. In the conclusion are recommendations for extension of the current work and identification of further needs.

2. THE CURRENT STANDARD

The National Electrical Code [1] is the reference used by local officials as a basis for approval of a transformer installation. This is a frequently changing document, with further revisions under consideration now. Regarding indoor, liquid-filled transformers, the most recent (1978) version reads as follows:

"450-23. High Fire Point Liquid-Insulated Transformers. Transformers insulated with a nonpropagating liquid approved for the purpose, having a fire point not less than 300°C, shall be permitted to be installed indoors or outdoors. Such transformers installed indoors and rated over 35,000 volts shall be installed in a vault.

For the purposes of this article, a nonpropagating liquid shall be one which, when subjected to a source of ignition, may burn but the flame will not spread from the source of ignition.

450-24. Askarel-Insulated Transformers Installed Indoors. Askarel-insulated transformers installed indoors and rated over 25 kVA shall be furnished with a pressure-relief vent. When installed in a poorly ventilated place, they shall be furnished with a means for absorbing any gases generated by arcing inside the case, or the pressure-relief vent shall be connected to a chimney or flue that will carry such gases outside the building. Askarel-insulated transformers rated over 35,000 volts shall be installed in a vault.

450-25. Oil-Insulated Transformers Installed Indoors. Oil-insulated transformers installed indoors shall be installed in a vault constructed as specified in Part C of this article.

Exception No. 2: Where the voltage does not exceed 600, a vault shall not be required if suitable arrangements are made to prevent a transformer oil fire from igniting other materials; and the total capacity in one location does not exceed 10 kVA in a section of the building classified as combustible, or 75 kVA where the surrounding structure is classified as fire-resistant construction."

From the viewpoint of the consumer this is a simple procedure to follow. Either the fluid supplier certifies certain properties and test results or the transformer must be contained in a vault. A typical vault with 3-hour fire resistance is of 6-inch thick reinforced concrete. It is thus expensive, bulky and heavy. It is certain to force design perturbations in a new construction and be most difficult to incorporate when retrofitting transformers.

To be excepted from vault containment, the transformer must be under 35 kV and filled with one of the pending PCB substitutes. This in itself poses two problems. The first is that no test method or geometry is defined to establish the fluid as non propagating. Pool tests of one geometry will give different results from another geometry. All are likely to differ from a spray test. "Non propagating" is too absolute a term; virtually all fluids can be made to undergo flame spread under sufficiently severe conditions. The second difficulty is the phrase "approved for the purpose." There is no definition of the source(s) of authoritative approval. Thus, from the viewpoint of the supplier's liability, this is an untenable situation. To alleviate this, we must define the fire hazards, quantify the risks, devise appropriate test methods, verify their applicability, and identify and obtain recognition from an appropriate organization.

3. THE SLOW LEAK SCENARIO

3.1 Description of Hazard

The sequence of events below generally results from external damage to the transformer case. This may be due to a flaw in manufacture,

rough handling, perforation by a fork-lift truck, etc. The dielectric fluid drains from the case, forming a puddle on the floor. Escaped fluid can then be ignited by a remote source as the fluid flows to it, or contained fluid can be ignited by the now overheated transformer core. The result is a flaming pool of liquid which may or may not be physically bounded. For reasons which will become obvious soon, we will deal with bounded pools in this section and the unbounded case in section 4. Even when the fluid itself is confined, the radiation from the flames can pyrolyze and ignite remote fuel, while the radiative and convective heat weakens the structural strength of the room or building. Thus, the fire phenomena of concern are ignitability, flame spread across the pool surface, and heat release rate.

3.2 Characteristics of Pool Fires

More than one hundred papers have been published on the burning behavior of bounded liquids, i.e., pool fires. Beginning in the post-World War II era, the modern effort continues with the classic, comprehensive study of Blinov and Khudiakov [5] and a fine review paper by Hall [6].

3.2.1 Ignition

The minimum temperature at which a fuel bursts into flames depends on whether the stimulus is merely thermal or also includes a discrete free radical source such as a flame, arc or spark. In the former case, this is referred to as the autoignition temperature. In the latter, the pertinent temperatures are the flash point, at which the first flames appear, and the fire point, a slightly higher temperature at which the flames are sustained. The lowest of the three is the flash point, the temperature at which the lean flammability limit is reached in the vapor above the liquid. The fire point is slightly higher since the flames must feed back enough energy to the liquid surface to vaporize more fuel and maintain at least a lean limit mixture in the vapor phase. The

autoignition temperature is much higher. Since no pilot is present with a source of free radicals, the gases must be hot enough for thermal breakdown of the fuel to free radicals to occur or for the rate of fuel-oxygen reaction to be fast enough for oxidative pyrolysis of the fuel.

The standard test methods to determine these temperatures are described in the previous NBS report. (No new tests have appeared in the interim.) Small cups of fuel are used in a nominally isothermal apparatus. An actual fuel spill is far from this. Most likely the initial pool temperature will approach ambient. Since the fluid has a finite thermal conductivity and a significant viscosity, an ignition source applied at one end of the pool may raise the temperature locally. Heat losses to the rest of the pool and to the floor could well balance the heat input at a temperature below the fire point, thus preventing a sustained ignition. Clearly, then, it is not sufficient to know the fire point of the fluid; one must also know its thermal properties and those of the surroundings. To be sure, a fire point of 1000°C could be required and would undoubtedly reduce the pool fire damages to nearly zero. However, this criterion would not be met by any currently known fluid of appropriate electrical properties. The current 300°C minimum fire point required by the National Electrical Code is a compromise value, imposing a burden on the ignition source to substantially heat the fluid yet keeping within the constraints of industrial capability, fluid cost, and transformer compatibility. The value is not unreasonable from a safety record viewpoint. However, it still remains for us to ascertain the necessity of so high a value.

3.2.2 Flame Spread Over the Pool Surface

The magnitude of the heat release rate and the longevity of the fire itself will be in large part determined by the rate at which the flames engulf the entire fuel surface. In assessing this process, much the same points are involved as in the previous section. Once the initial,

localized flame is established, both subsurface convection [7] and flame plume radiation [8] heat the adjacent fluid. When the surface temperature reaches the fire point for a given incremental area, the vapor above it is ignited by the adjacent flame and the plume expands to cover this new area as well. This will continue until the full surface is involved or (rarely) until some location is reached where the heat losses to the surroundings exceed the incident energy. The rate of flame spread will depend on fluid properties (thermal conductivity, viscosity), flame characteristics (height, breadth, opacity), pool container properties (surface area, aspect ratio, container thermal conductivity), pool properties (pool depth, lip height above fluid), and surroundings (degree and geometry of confinement, thermal conduction losses and radiative reinforcement).

At present there is no standard test method for flame spread over liquids. Even if there were, with this complexity of variables, its applicability to any given situation would be fortuitous. Fortunately, for the fluids currently involved here and the geometries under consideration (see section 3.3), the flame spread time to cover the entire fuel surface is well under the total burning time even for fairly shallow pools (~5 cm). Thus, in this scenario, the rate of flame spread upon sustained ignition is a secondary issue.

3.2.3 Ignition of Surrounding Fuels

The mechanism here is similar to that involved in flame spread, except that it is now the lean limit of the vapors from the remote fuel which must be reached. Unless the fuel is directly over the pool, energy transfer is purely radiative in nature. A limited amount of work has been directed at determining minimum irradiances for ignition of materials. For instance, canvas ignites at about 2.1 W/cm^2, pine at 3.3 W/cm^2, black rubber at 6.2 W/cm^2, all for 3-minute exposures [9]. Knowing this, we also need to obtain the incident radiance from the pool fire plume. Such measurements are dependent on the opacity and

temperature of the flames, their spatial extent and the view factor from the remote fuel. Pioneering studies underway at the Factory Mutual Research Corporation [8] are beginning to yield such information. However, at this date we are unable to quantify this hazard.

An implicit assumption here is that the effective flame radiation is alike for all fuels, i.e., it is continuum, gray-body emission with little contribution from discrete bands [8]. This is reasonable since, in this configuration, much soot is generated, and the hot soot dominates the emitted energy. However, while these flames appear to be orange on a black soot background, the flames from silicone fluids appear more yellow and the "soot" white. Different radiant spectra could lead to different absorptivities by remote fuels. We therefore investigated the applicability of the gray-body assumption for a typical silicone fluid and found that the emission spectrum and temperature are similar to those for hydrocarbons. Details of this study are presented in appendix A.

3.2.4 Dependence of Pool Burning Rate on Prevailing Atmospheric Conditions

For the large, turbulent fires of concern here, breezes affect the burning rate and thus the heat release rate [5]. Even drafts as small as 0.5 m/s increase the oxygen availability, increasing the otherwise diffusion-limited transport to the flame front. This increases the completeness of reaction, and thus the flame temperature. Since the flame radiation is proportional to the fourth power of the temperature [10], more energy is incident on the fuel surface, increasing the evaporation rate. This increase in burning rate is tempered somewhat by the fact that as the air velocity increases, the flames are displaced from the fuel pool, which reduces the radiative feedback. Eventually, this leads to the flames being blown off the pool and being extinguished. For hydrocarbon fuels this occurs at relatively high air velocities which are not likely to be encountered around indoor transformers [11].

Moreover, for pool diameters of the order of one meter or larger, there is evidence that the natural turbulent entrainment of oxygen reduces the importance of even strong wind effects to less than 20 percent [12].

A second necessary consideration is vitiation or oxygen depletion of the incoming air supply. A one square meter pool fire can theoretically consume all the oxygen in about one cubic meter of air in one second. Thus the pool can be its own vitiation source, certainly so in small rooms. Under reduced oxygen concentrations, the burning rate is also reduced, and at some level the fire is extinguished. For small, diffusion-controlled fires of hydrocarbons where heat losses to the pan are important, this occurs at 15-16 percent oxygen [13]. For large, turbulent fires, limits closer to 10 percent have been observed [14].

3.3 Pool Fire Performance Tests

It is abundantly clear from the earlier discussion that the available standard tests which might be used to assess fluid flammability cannot represent the actual situation. Realizing this, the involved community has continued to address the problem and is arriving at credible, if partial, solutions.

3.3.1 The Factory Mutual Approval Scheme

During the past several years, the Factory Mutual Research Corporation (FMRC), with the assistance of industry and government, has constructed a philosophy for hazard reduction, performed experimental and theoretical research, and now has issued a test sequence for recognition of less flammable transformer fluids [15]. The demands placed on the fluid are intended to reduce the likelihood of structural damage to the roof of a noncombustible building with noncombustible occupancy. Situations in which either the building or the fluid fail to qualify must be dealt with by a selection of containment or suppression devices.

The first requirement is that the fluid have a fire point of at least 300°C, consistent with the current National Elecrical Code. This temperature is sufficiently high to afford resistance to small ignition sources, such as matches, but is still low enough to be met by the several classes of commercial fluids discussed earlier. There appears to be no technical basis for selecting this particular value.

Next, the transformer must be located within a dam that is at least four times the area of the transformer tank and is deep enough to contain all the fluid in the event of a spill. Should the fluid be ignited, and it is assumed that it will be and become fully involved in flames, this insures that the flames will not spread along the floor. It assures a fixed flame geometry.

This leads to the third requirement--a maximum allowable rate of convective heat release. In a nonflammable building with nonflammable contents, the risk of extensive fire loss is mainly to the structure itself. If the ceiling over the fire is overheated, collapse of the roof could ensue. Plume theory was used to develop curves which provide a maximum allowable heat release rate for a given ceiling height, ceiling material and pool area. The accuracy of these curves has been experimentally verified [16]. The heat release rates are to be measured by FMRC using a procedure described below. This approval scheme is already active.

With the assumptions involved and the limited applicability, this is indeed a conservative approach. However, it is the first of its kind to combine performance tests with theoretically-derived, operationally-verified performance limits and apply them to the reduction of fire risk. Hopefully it will serve as a model for future test development.

3.3.2 Rate of Heat Release Determinations

The FMRC approach to measuring convective heat release rates is to burn large pans of the fluid in a building of very high ceiling and measure the temperature rise of an array of thermocouples suspended above the plume [17]. A radiative component is also determined, using a single radiometer, for fluid use in outdoor transformers located near a vulnerable wall. The pan was selected to be 1.73 m in diameter and 7.6 cm deep. As Hottel noted [18], for fires above one meter in diameter, the mass burning rate per unit surface area is independent of that surface area. Thus the one measurement should be characteristic of the fluid for the range of dike areas expected. The fluid is ignited by an outer, concentric, ring-shaped pan which is filled with n-heptane floating on water. The heat release measurements are taken after the entire surface of the candidate fluid has ignited and the ignition trough has burned out.

Tests have been run with samples of most commercial candidate fluids [17]. The hydrocarbon fuels all had similar convective and radiative heat release rates of approximately 700 kW per square meter of pan area and 400 kW/m^2, respectively. The silicone fluid values were about 50 kW/m^2 and 30 kW/m^2, and were less precisely determined since the fluid crusts during burning and this gives non-steady values.

The RTE Corporation also ran a series of 12 tests. They used a similar pan, but ignited the fluid with a propane burner. A conceptually similar, but dimensionally different thermocouple array was used for the convective measurements. A different radiometer and view factor was used. As of this date, only a preliminary report [19] has been issued. It presents the results for one hydrocarbon test and one silicone test. The hydrocarbon fluid convective and radiative components were 400 kW/m^2 and 330 kW/m^2, respectively. The silicone fluid values were 150 kW/m^2 and 340 kW/m^2.

Under contract from Dow-Corning, the Southwest Research Institute (SwRI) burned pool fires of high performance hydrocarbon and silicone fluids [20]. These were similar to those burned in the other two sets of tests. Pan sizes differed somewhat from the prior studies, and a propane burner was the ignition source. The total hydrocarbon heat release rates were about 1200 kW/m^2; the silicone was about 150 kW/m^2.

Although multiple tests were run by both FMRC and SwRI, no indicator of reproducibility was provided in either report. Clearly, secondary changes in ignition and measurement techniques have a sizable effect on the reported heat release rates, indicating a need for standardization, if not refinement, of the procedures. Factory Mutual has since performed more tests and is establishing such limits of uncertainty [16].

3.4 Aging of Fluids

In the preceding discussion, it has been tacitly assumed that the appropriate fluid to be studied, and eventually tested, is the fresh fluid. Since transformers have lifetimes of decades, some consideration must be given to the likelihood that the fluid will undergo some partial metamorphosis during this period. Changes in chemical structure could lead to variations in the fluid's flammable limits and thus its fire point.

The thermal degradation of gaseous organic molecules is well-studied [21] and in the high pressure limit is similar to the degradation of liquids [22]. The process is, in its early stages, unimolecular, and the buildup of decay products is linear with time. The reaction rate rises exponentially with increasing temperature. Thus laboratory scaling of these processes to shorter lifetimes is a relatively easy process. The complexities of the transformer interior negate such a simple approach. While the fluid temperature may reach 150°C near the core, it may be nearly 100°C lower near the case. In addition, the

fluid is perturbed by intentional additives, such as antioxidants, and unintentional components, such as extracts from paper insulation or metal atoms from the case and coils. Their effects on the fluid decay rate are neither kinetically simple nor spatially uniform. This is an area that needs attention.

In this section, the major topic of concern is electrical aging. During its lifetime, a fluid is subjected to strong electrical fields and perhaps partial discharges. As these occur, there are formed low molecular weight gases, which may dissolve in the fluid or occupy the ullage above, lower molecular weight fluid components, and higher molecular weight fluid components. Since we are concerned with the ignitability of the fluid, it is the former two sets of products that matter. The lower molecular weight fluid molecules volatilize at lower temperatures. By Raoult's Law, an increase in their concentration in the liquid will produce a richer vapor above, thus lowering the fire point. The electrical generation of gaseous products produces the same result. A lower fire point increases the likelihood of ignition by smaller pilot sources.

We are performing preliminary experiments to establish the means for evaluating the enhanced flammability of electrically degraded fluids. Our approach is to measure the change in vapor pressure of a fluid induced by the electrical stress. Full details will appear in a later report. A conceptual description follows.

The insulating fluids under investigation were found to contain dissolved air. Thus the fluid was gently heated, pumped to a stable vapor pressure, about 10 m torr (1.3 pa), and the vapor pressure measured as a function of temperature. The sample was then transferred to a ~150 cm^3 high voltage cell and subjected to a voltage of 25 kV for six hours. The vapor above the fluid was then collected and analyzed with a mass spectrometer by direct injection. Following removal of this vapor, the vapor pressure of the fluid was again measured.

Three experiments with silicone fluid resulted in vapors consisting of water, nitrogen and oxygen. These were probably the result of further outgassing. In one case, several electrical breakdowns occurred and some hydrogen was produced. This is consistent with a prior study on arc-decomposed fluids [23]. A mineral oil sample also experienced arcing with the resulting generation of hydrogen. The comparative vapor pressure measurements are still in progress.

4. THE VIOLENT RUPTURE SCENARIO

4.1 Description of Hazard

In this type of transformer failure, the potential for damage is far greater than that discussed earlier. Here, a typical fault often begins as turn-to-turn current leakage, gradually involving more turns and progressing to coil-to-coil or coil-to-ground discharge [24]. This suddenly releases a large pulse of energy, generally in about one ac cycle. This in turn thermally expands the fluid, forcing it against the case, which yields. Upon contact with the air, the now hot combustible gases dissolved in the fluid or in the ullage autoignite and then ignite the escaping fluid. A violent emission of liquid blobs ranging in size from microns to centimeters in diameter occurs. Depending on the fluid and conditions, all or some of the droplets may be flaming. Thus they may ignite other fuels by aerial impact. In addition, upon settling to the ground they may form ignited pools which may flow to other fuels or may cause structural damage as noted in section 3.

We have assumed that we are not in a position to reduce the frequency of electrical transformer failures. Thus the discussion that follows deals only with ameliorating the impact of such explosions.

4.2 Applicability of Standard Test Methods

Because of the highly specialized nature and lack of detailed study of this type of event, and the track record of askarels, no test methods have been developed specifically for it. The standard ignition temperature measurements do not apply since the arc energy is so large. In addition, combustible gases from arc-decayed fluid and paper insulation provide an intense piloted ignition. The fluid is blown out in a pulse, not with a sustained backing pressure, so steady state spray ignition tests are difficult to relate. In a nutshell, there is no premise for assessing the fire safety of a fluid in this mode. There is no voluntary standards committee work in this area at present.

4.3 Explosion Tests

If one has available a source of high current ($\geq$ 5000 amperes) at high voltage ($\geq$ 5000 volts), it is possible to simulate the sudden electrical failure of a transformer. Such high power laboratories are few in number and expensive to operate. Nonetheless, both General Electric and RTE have performed tests of this type [25]. Faults were induced in containers of potential and current dielectric fluids. The outcomes were filmed, yielding mainly qualitative data. Mineral oil produced a huge, black and orange fireball. Silicone fluids generally produced large white clouds with far less extensive flames. The high performance hydrocarbons similarly outperformed the mineral oil. Surprisingly, a PCB explosion yielded a large black cloud with some orange flames. Thus, even the "nonflammable" fluid could be ignited. These pioneering tests, as crude as they were, have provided a "feel" for further studies. However, because of the perceived cost-benefit ratio, an extensive research program was not pursued.

Recently, the National Electrical Manufacturers Association (NEMA) proposed and was awarded a contract to study explosions in a less expensive, more controllable manner. Using a model by Barkan [22],

black powder charges would be designed to simulate the rate of energy release from electrical failures. Various-sized transformer cases and complete transformers are to be exploded, and the reproducibility determined. The result will be an assessment of whether this approach can be used in further studies of this scenario. In addition, several combustible materials, such as fiberboard, polystyrene, and plywood, will be placed at discrete locations about the explosion site. Their ignitability by ejected fluid will be determined visually, and the results used to test the model described in the next section of this report. The project has begun, and completion is scheduled for early 1980.

4.4 Model for the Ignition of Remote Fuels by Flaming Droplets

In the event of a violent transformer explosion, the major fire hazard results from secondary ignition by ejected, flaming fluid. The burning globules impact some combustible material, locally heat it above its fire point, and ignite it. This hazard is clearly reduced if the fluid droplets lose too much heat to the contacted surface and are themselves extinguished. This would result in the need for the target material to be raised to its (much higher) autoignition temperature for flaming to ensue. Our purpose, then, is to identify the ignition-determining fluid and target material properties and ascertain whether control of them is feasible.

The simplified physical model is as follows. A flaming liquid droplet impinges on a horizontal surface, forming a thin, hot layer with flames above it. Prior to impact, the liquid has reached a steady-state temperature with endothermic evaporation balancing the radiant heating from the flames. Upon impact, the liquid is initially isothermal at T_L, which is above the liquid's fire point. Since the liquid is thin, it is assumed to remain isochermal. However, the value of T_L will approach the fire point as heat is removed by the solid. The solid surface itself is non-porous, thermally thick, and initially at T_o, the room temperature. As time progresses, the temperature profile of the system behaves as shown in figure 1.

The problem is one of one-dimensional heat transfer to a semi-infinite slab. We assume that heat is lost from the liquid only to the solid. Within the solid, the spatial and temporal temperature profiles are described by the Fourier equation [26]:

$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}$$

with boundary conditions on the solid of $T=T_o$ at $t=o$ for all values of x, $T=T_L$ at $x=o$ for all t (T_L will vary with time), and $T=T_o$ at $x = \infty$ for all t. The solution for this is

$$\frac{T-T_o}{T_L-T_o} = 1 - \text{erf}\left(\frac{x}{2\sqrt{\alpha t}}\right) \qquad (1)$$

where α is the thermal diffusivity of the solid. This expression assumes T_L is a constant, whereas in this model, T_L will decrease from its initial value, $T_L(O)$, to the fire point of the fluid, T_{FP}. At T_{FP}, extinction occurs. The equation is valid when $T_L \tilde{} T_{FP}$, and T_L-T_{FP} generally will be much less than T_L-T_o for high fire point fluids. Hence, we will assume the validity of the solution, subject to later examination.

The next expression needed is for the energy loss rate per unit area transferred from the fluid to the solid, $\dot{q}''$ [26].

$$\dot{q}'' = -\int_o^\infty (T-T_o)\, c_s \rho_s \, dx \qquad (2)$$

where c_s and ρ_s are the specific heat and density of the solid, respectively.

Substituting equation (1) into (2),

$$\dot{q}'' = -\int_o^\infty (T_L - T_o)\left[1-\text{erf}\quad \frac{x}{2\sqrt{\alpha t}}\right] c_s\rho_s\, dx \qquad (3)$$

Assuming the heat capacity and density of the solid change little as a function of temperature,

$$\dot{q}'' = -(T_L - T_o)\, c_s\rho_s \int_o^\infty \left[1-\text{erf}\quad \left(\frac{x}{2\sqrt{\alpha t}}\right)\right] dx \qquad (4)$$

which integrates to:

$$\dot{q}'' = -(T_L - T_o)c_s\rho_s \quad \sqrt{\frac{\alpha}{\pi}}\ t^{-1/2} \qquad (5)$$

Integrating with respect to time, and withdrawing the lost energy evenly throughout the liquid ($q'' = dC_L\rho_L\Delta T_L$), we obtain an expression for the temperature decrease of the fluid:

$$\Delta T_L = \frac{2c_s\rho_s}{c_L\rho_L}\ \frac{T_L - T_o}{d}\sqrt{\frac{\alpha}{\pi}}\ t^{1/2} \qquad (6)$$

where the subscript L refers to the fluid and d is the thickness of the fluid layer. We can rearrange this equation to get the contact time in which the fluid temperature would be reduced from its starting temperature to its fire point, ΔT_L.

$$t = \left[\frac{\Delta T_L [c\cdot\rho]_L\ d}{2\sqrt{\frac{\alpha}{\pi}}\ [c\cdot\rho]_s\ (T_L - T_o)}\right]^2 \qquad (7)$$

Before proceeding further with this quite approximate model, it is valuable to calculate a typical magnitude of a flame quenching time. For silicone fluid, mineral oil and several high performance hydrocarbons, the specific heat is about 1.5 J/g-K and the specific gravity is about 0.9 g/cm^3. The thermal diffusivity is the thermal conductivity (3×10^{-3} J/s-cm-K for wood) divided by the product of the density (0.8 g/cm^3 for wood) and specific heat (2.4 J/g-K for wood). For the moment, we will assume the liquid layer is about 0.3 cm thick. The fluids of interest will have fire points in the range of 300°C, and T_o will generally be about 25°C. We will use a value of 50°C for ΔT_L. For wood, then, t is about one half of a second. This is far less than the ignition time for the wood [27].

With this in mind, it is now important to ascertain whether there are any critical fluid properties that can be used to evaluate this ignition risk in realistic cases where far more fluid might land on the solid and where large flames might cause radiative heating of the solid. As already mentioned, the thermal properties of the wide range of currently-known dielectric fluids do not vary much. Furthermore, the liquid temperatures during flaming and the fire points are relatively uniform. By contrast, fluid surface properties offer some hope. Fluids that preferentially form small droplets upon expulsion have a lower probability of delivering large quantities of fluid to any one surface. Fluids that wet the impacted surface well will form thin, readily cooled layers. These aspects need further investigation.

From this crude model, we can also begin to refine the coarse terms "combustible" and "noncombustible" used in the National Electrical Code. Some differentiation can be made on the basis of thermal properties. In terms of this scenario, solids with higher values of heat capacity, density and thermal conductivity will be less ignitable. In addition, solids whose surfaces resist droplet adhesion or, at the other extreme, promote good thermal contact will also perform favorably. This is also a line of study which would be worth pursuing.

5. EVALUATING ALTERNATIVE FIRE SAFETY STRATEGIES

As with any issue concerning public safety, the dielectric fluid flammability problem has two aspects. Heretofore, this report has dealt with scientific characterization of the fire phenomena. In this section, we address the equally important question of how to select approaches to achieve a desired degree of fire safety.

There are inherent difficulties in regulating the safety level of transformer installations. There is a lack of available, detailed case data on past transformer fires. The fire ignition and spread phenomena are only qualitatively understood. The pertinence of available test methods is questionable. Experts disagree on technical issues and may be biased by disciplinary or commercial interests, and above all there are serious value judgments to be made regarding the degrees of property loss, accidental injuries and deaths that are acceptable.

The methodology of decision analysis [28] provides a structuring of this problem. By creating a formalism of non-exclusive alternatives, we are able to reduce a complex problem to a series of specific issues. Probabilistic methods can then be used to address the uncertainties. Existing expertise can answer the purely technical aspects, and explicit value judgments can be introduced to facilitate comparisons. In the end, we have a dollar value for the costs and losses associated with each possible regulatory decision. These can then be examined in view of the degree and type of fire safety desired. This approach has recently been successfully applied to the equally complex reduction of upholstered furniture fire loss [24].

In the present study [30], a decision tree was constructed to estimate the losses from transformer fires in terms of property damage, injuries and deaths. Branches on the tree included the probability of a fluid leak, probability of ensuing transformer failure, location of tank rupture, fraction and volume of fluid emitted, likelihood of ignition,

degree of fire protective construction present, fuel load in the room, and extent of fire spread. Using NFIRS data, average losses were calculated for contemporary transformer failures under historically-evolved regulations (defined as the "base case"). Since essentially no PCB-filled transformers have caused fire damage and since relatively few transformers were filled with other high performance fluids at the time interval counted, it was assumed that all fires involved mineral oil.

Seven intervention strategies were then evaluated by calculating their cost of implementation and using the decision tree to estimate their effectiveness:

1. Requirement of a periodic, in-use fluid testing program consisting of acidity level, dielectric strength, interfacial tension, color, and combustible gas analysis.

2. Requirement of a 300°C fire point.

3. Requirement of a "fire-proof" fluid, with a performance-related standard yet to be developed.

4. Requirement that the transformer be contained in a room of 3-hour fire resistant construction.

5. Requirement that the transformer be contained in a room of 1-hour fire resistant construction.

6. Requirement of a dike around the transformer to contain any spilled fluid and a metal sheet around the transformer to eliminate spreading of sprayed fluid.

7. No protection at all.

These were then compared with each other and with the aforementioned base case (which includes partial use of some of the above protection measures). In doing so, dollar values were assigned to human losses. Sensitivity analyses were performed to determine the dependence of the outcome on the values of the various input parameters.

The expected annual losses after implementing any or none of these strategies are listed in table 1. The cost-plus-loss figures over the transformer lifetime are shown in table 2. Note that the effect of each strategy on deaths, injuries, and property loss is calculated independently, thus the fractional reductions in the three types of losses are not necessarily equal. As one would have guessed, the data show that safety costs money.

The concept of risk attitude now becomes pivotal. The regulator must decide what the public will not tolerate and what costs are acceptable. This decision is inevitable. The improvement lies in the existence of concrete data to base his judgment. For instance, if over one thousand injuries and thirty deaths a year are considered small compared to some other pressing demand on his resources, the "no protection" alternative might be selected. If the regulator anticipates a public outcry over even one fire death, there are three possible approaches, and their relative merits can be considered.

It is important to note that the conclusions are based on the best data available and consider only a few representative strategies. While these cover the three basic approaches (inspection, fluid upgrading, and physical barrier), clearly further thought and commercial progress should suggest further ideas. The model itself can also be made more sophisticated as needed.

6. RECOMMENDATIONS FOR FURTHER WORK

6.1 Assessment of the Current Status

At this time, no new PCB-filled transformers are being supplied, and there is mounting pressure to retrofill or replace the existing units. The former alternative is problematic [31]; both alternatives are costly. Nonetheless, existent PCB-filled units will disappear for two reasons. First, many transformers eventually leak, and there will be no PCBs to top them off. Second, the leaked fluid poses potential health problems as noted in the recent case cited in appendix B. Both the hazard and the outcry are intolerable.

The NFIRS data indicate that the current variety of transformer installations and environments pose relatively little fire risk. It is assumed that this record will be sustained. This will be complicated by the fact that older buildings may not be able to support fire-resistant enclosures, and the only currently-allowed exceptions are situations approved by the Factory Mutual standard, i.e., noncombustible occupancy in a noncombustible structure. New buildings will have to be designed with the strength and space for vaults, an expensive consideration beyond the cost of the vault itself.

At present, there is no pending relief, in the form of enlightened recommended practices, from the expense or even impossibility of rigid adherence to current standards.

6.2 Needed Test Development

There are three components necessary to advance the possibility of lower cost fire safety. The first is to model the specific fire hazards of the fluids and identify which fluid properties determine them. Our current study has performed much of this. The second is to characterize the surroundings in terms of their contribution to a fire initiated

by the transformer. After these, the third step is to use this knowledge to create germane test methods to identify fluid and occupancy combinations that are compatible with the desired degree of fire safety. We have learned enough to project what these might look like. In reading the ensuing discussion, it should be remembered that it is still necessary to identify parties or agencies that will endorse such tests and concepts upon their development.

6.2.1 Fluid Ignitability

Should the fluid escape from the transformer case and form a puddle, there will be a minimum energy input rate if flames are to ensue. The current assumption is that this will be available. Rather, for any given installation, the surrounding energy sources and the ignition potential of the transformer itself should be quantified. The fluid should be physically bounded, as noted in the Factory Mutual scheme. A heat balance model should be constructed involving the heat transfer mode (radiative, convective or conductive) from the ignition source and the heat dispersion capability of the fluid and its container. These loss terms would rely mainly on the thermal properties of the fluid and the container. The criterion for acceptability would be whether the eventual maximum fluid temperature reached the fire point or autoignition temperature, the choice depending on the nature of the igniter at hand. A fluid that can resist all available ignition sources should be relatively fire-safe.

The test method for verification should involve a thermally thick pool of the fluid, the depth being determined using such studies as reported in references [6] and [7]. The pool should be large enough to simulate actual usage and to reduce the edge effects, which create excessive heat loss. A diameter of one meter and a depth of ten centimeters is a reasonable *a priori* estimate. Thermal sources would be simulated by an immersed electrical coil, flaming sources by an impinging propane torch. Each fluid would be given a rating based on

the magnitude of ignition sources it could withstand. If the rating level exceeds the ignition sources in a given usage, it would no longer be necessary to require the building or surroundings to be noncombustible under the slow leak scenario.

6.2.2 Radiant Ignition of Surrounding Materials

Should a fluid be found ignitable under the above criteria, it still may be relatively safe. Since it is geometrically contained by a dam, its means of igniting further fuels is mainly radiative. The radiation may arise from the fire plume itself or from the layer of hot gases which would accumulate in the upper portion of the room [32]. There are solid efforts to characterize the plume radiation [8] and the radiative ignition of fuels [33]. There is already some data on the minimum irradiances or minimum time exposures for ignition of various fuels [9,34]. More such data are sorely needed. Ideally, simple comparison of the fire radiances with fuel susceptibilities would provide an indicator of compatibility. For verification, at least a few full-scale room fire tests should be conducted.

Successful ignition resistance is the most convenient outcome for establishing a degree of fire safety. Ignition delay times that are long compared to, perhaps, halon extinguisher or sprinkler activation times could also be accommodated.

6.2.3 Contact Ignition of Surrounding Materials

In the event of already flaming fluid escaping from the case, we need to know if surrounding materials can be ignited by impacting fluid before the fluid extinguishes. This situation is most likely to occur under the violent rupture scenario. The model presented in section 4.4, a first attempt at understanding this, will be tested in the current NEMA project. Extension of the model, in directions indicated earlier, and further experiments will probably be necessary. The important

characteristic is whether all the ejected fluid is flaming. If the radius of the fireball from the explosion is significantly smaller than the throw radius of the fluid or if the falling globules are no longer flaming, the fluid possesses a reduced potential for further ignition.

One possible approach to a correlative laboratory test method involves the currently-discarded spray test. As noted by Factory Mutual [17b], all the current candidate fluids will ignite under certain spray conditions. Some set of such conditions should be selected, and spray fires established. Samples of various materials would then be introduced into the spray at appropriate locations for appropriate time intervals. Selection of values of these parameters would require some further study. The fluids which failed to ignite all appropriate samples would be designated acceptable for use under this scenario. Conversely, materials which resisted ignition from a given fluid spray could be designated "compatible" with that fluid. This would provide a basis for defining an occupancy as "noncombustible".

6.2.4 Damage to the Building

Some aspects of this have been discussed above: the building's exposed construction and interior finish materials would be treated the same as its contents. If these materials are noncombustible, the Factory Mutual scheme addresses the avoidance of structural damage. Thus this consideration is moderately well in hand. The only further instance of concern is when the building materials are not ignitable by the fluid, yet are not steel or concrete. Extension of the Factory Mutual calculations to include structural loss of such materials, e.g., wood, would complete the picture.

6.3 Epilogue

The most serious need is for more detail on any transformer-initiated fires that do occur. This will ensure the thoroughness of the fire

safety analysis. While qualification of fluids for general usages could be based on a general series of criteria, it would be operationally and economically more feasible for the selected fluid to meet the specific flammability constraints of its specific usage. Lest this be considered as impractical, such a system is currently used for portable fire extinguishers [35]. The formalism of decision analysis provides a means for evaluating such an approach.

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Table 1. Expected annual national losses [30]

Strategy	Property damage	Injuries	Deaths
Base case	$40.6M	299	7
Fluid testing	$26.7M	197	4
High fire point	$146.4M	1040	33
"Fire proof" fluid	$1.5M	10	0
3-hour vault	$14.7M	118	0
1-hour vault	$15.1M	120	0
Dike and sheet	$25.9M	199	3
No protection	$148.2M	1053	34

Table 2. Cost plus loss per transformer over transformer lifetime [30]

Strategy	Cost	Property damage	Injuries	Deaths	Value of injuries	Value of deaths	Cost plus loss
Base case	$1786	$32	5.4×10^{-4}	1.2×10^{-5}	$2	$1	$1820
Fluid testing	2650	20	3.6×10^{-4}	7.8×10^{-6}	2	0	2672
High fire point	822	114	1.9×10^{-3}	6.0×10^{-5}	8	3	946
"Fire proof" fluid	2731	11	1.9×10^{-5}	6.0×10^{-7}	0	0	2742
3-hour vault	3511	11	2.2×10^{-4}	1.3×10^{-8}	1	0	3523
1-hour vault	1795	12	2.2×10^{-4}	1.8×10^{-7}	1	0	1806
Dike and sheet	2786	20	3.6×10^{-4}	5.0×10^{-6}	2	0	2008
No protection	0	115	1.9×10^{-3}	6.0×10^{-5}	8	3	131

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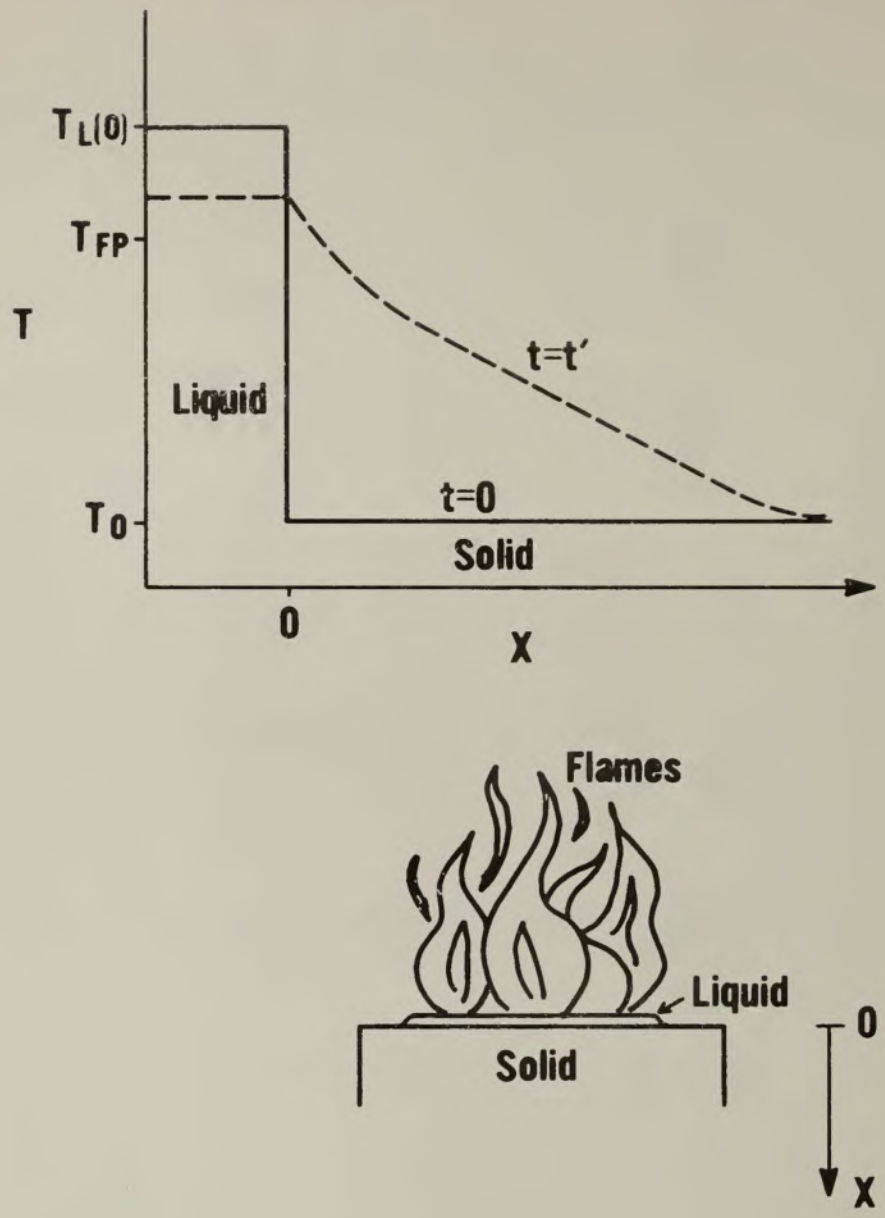


Figure 1. Temperature profiles of solid-liquid system at droplet impact (t=0) and at some later time (t=t')

APPENDIX A. COMPARISON OF RADIATION CHARACTERISTICS OF SILICONE AND HYDROCARBON FLUID POOL FIRES

The purpose of this study was to resolve whether the emission spectra from fires of different fuels (hydrocarbon vs silicone) are different. To investigate this possiblility we burned small pool fires of typical hydrocarbon and silicone fluids and monitored their emission spectra with identical equipment.

A.1 Experimental Procedure

The hydrocarbon fluid used was NBS #10 pump oil, and the silicone fluid was a commercial 50 cs sample. The pan employed for the pool fires measured 15 cm x 13 cm x 2 cm. In this configuration there were two problems which arose in measuring emission spectra: (1) The flames were relatively small (15-25 cm in height) and somewhat turbulent. This led to considerable flame flicker, so that any emission signal exhibited large fluctuations at low frequency. (2) The amount of fuel burned was small, with the result that reasonably steady flames were obtained for only about 10 minutes. Thus, extensive signal averaging could not be utilized to reduce the low-frequency noise arising from flame flicker.

These experimental limitations dictated the optical equipment which could be used successfully. A careful monochromator scan of the emission would require a more steady light source and longer times than were available. Therefore, a simpler experimental setup was devised and is shown in fig. A-1. The emission was detected directly with an RCA 4840 photomultiplier tube. This tube is very sensitive at wavelengths down to the vacuum ultraviolet (~200 nm) and has good response throughout the visible region (400-700 nm). A series of long-wavelength pass filters was used to isolate spectral regions 30 nm to 85 nm wide. Table A-1 presents the spectral characteristics of the specific filters used in this investigation. To avoid the photomultiplier tube "seeing" background and scattered light, a narrow

viewing angle was defined by using two irises and a length of blackened pipe. This detection equipment was positioned to monitor emission from an area approximately 5 cm above the pan in which the pool fires were burned.

A data run proceeded as follows:

(1) The unfiltered light from the pool fire was allowed to irradiate the photomultiplier tube.

(2) The first long-wavelength pass filter was then inserted (50% transmission at 670 nm), thus attenuating the light reaching the photomultiplier tube.

(3) The filter was then removed, again allowing unfiltered light to reach the photomultiplier tube.

(4) The second long-wavelength pass filter was next inserted (50% transmission at 640 nm), which attenuated the light somewhat less than the first filter.

(5) The second filter was then removed, and this procedure was repeated for the total of nine long-wavelength pass filters, listed in Table A-1.

A.2 Results and Data Analysis

The raw data obtained using the procedure outlined above are shown in fig. A-2(a) for the hydrocarbon fluid and fig. A-2(b) for the silicone fluid. At least five similar runs were made for each fluid. Fig. A-2(c) presents the results of monitoring the emission from a 100W tungsten light bulb. This light source is much more stable than the pool fires, and its emission spectrum is included to show the optical response of the detection equipment.

The series of nine long-wavelength pass filters defines eight spectral regions between successive filters. These spectral regions are 30 nm to 85 nm in width. Thus, the net signal change between two successive filters indicates the amount of light reaching the photomultiplier tube in a specific spectral region. This net signal change must then be normalized for the photomultiplier sensitivity and the width of the spectral region. For example, consider filters #1 and #2 in table A-1. The net signal change obtained using these two filters is a measure of the light emitted in the 640-670 nm region. The raw net signal change obtained from data such as those in figs. A-2 is then normalized by the photomultiplier sensitivity at 644 nm (the mean wavelength) and by the width of the spectral region (30 nm).

The results of analysis of the data in figs. A-2 are presented in fig. A-3(a) for the hydrocarbon fluid and fig. A-3(b) for the silicone fluid. Each data point represents the emission in a spectral region defined by two successive long-wavelength pass filters. Also indicated in figs. A-3 is the relative error in these determinations caused by the low-frequency flame flicker. The relative error is largest at shorter wavelengths where successive filters made little or no change in the detected light for both fluids (i.e., the relative error is largest where the net signal change is smallest).

Figs. A-2 and A-3 show immediately that there is little emission below 500 nm from either the hydrocarbon or the silicone fluid. For the hydrocarbon fluid it is difficult to measure net signal changes for filters beyond #5 (50% transmission at 530 nm). The data for the silicone fluid are more noisy (fig. A-2(b)), with the result that no signal change at all was reproducibly detected for filters #6, #7, #8, or #9.

Figs. A-3 also includes calculated gray-body (constant emissivity) spectral distribution curves. The temperatures chosen for comparison with the filter data were obtained from one-line, optical pyrometer measurements. A number of pyrometer measurements were made, giving

1370 ± 30K for the hydrocarbon fluid and 1470 ± 50K for the silicone fluid. The data from the long-wavelength pass filter results and from the pyrometer measurements are consistent within the error limits of the filter data. These error limits are sufficiently large that the filter data are compatible with gray-body spectral distribution curves spanning several hundred degrees. However, the same determinations made for the emission from the tungsten light bulb result in more narrow error estimates, and show that the pyrometer temperature value of 1790K is significantly lower than the results from the filter data (fig. A-3(c)).

A.3 Conclusions

(1) The spectral distribution of the emission from typical hydrocarbon and silicone fluids is similar, in that there is little emission from either fluid below 500 nm relative to the emission at longer wavelengths.

(2) The spectral distribution of the emission from these fluids is consistent with that expected for gray-body soot radiating at temperatures determined from pyrometer measurements. These temperatures are similar for the two fluids.

Table A-1. Long-wavelength pass filters

Filter	50% transmission wavelength (nm)	Mean wavelength between filters (nm)	Photomultiplier tube sensitivity
(1) Corning 2-64	670		
		655	30
(2) Corning 2-59	640		
		615	40
(3) Corning 2-73	590		
		575	55
(4) Corning 3-67	560		
		545	70
(5) Schott OG530	530		
		513	85
(6) Schott GG495	495		
		475	95
(7) Schott GG455	455		
		413	100
(8) Schott GG395	370		
		340	90
(9) Corning 0-53	310		

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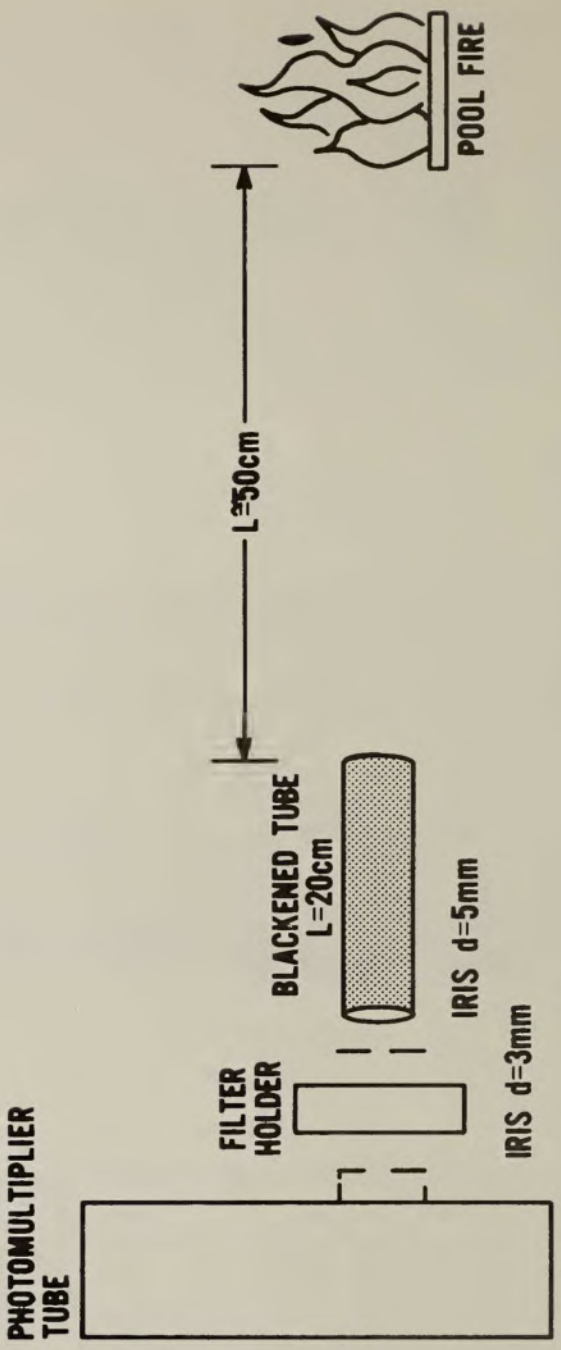


Figure A-1. Apparatus schematic

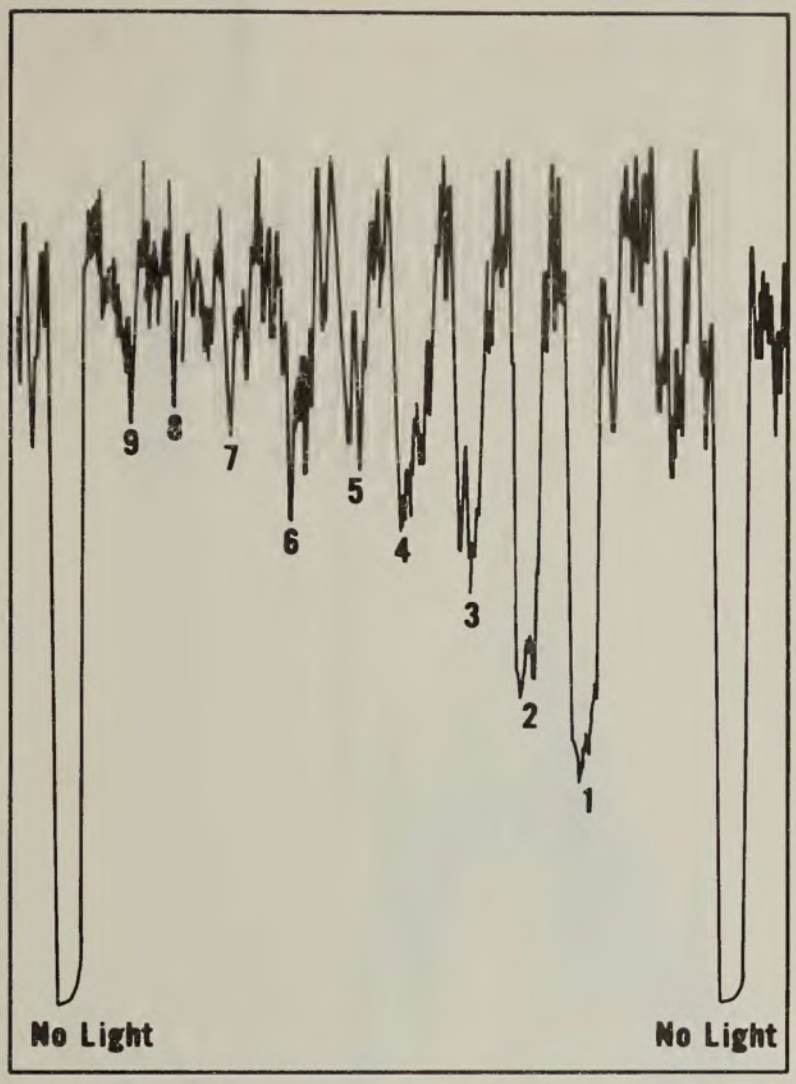


Figure A-2(a). Photomultiplier response data from pump oil fire (Numbers of inserted filters are indicated.)

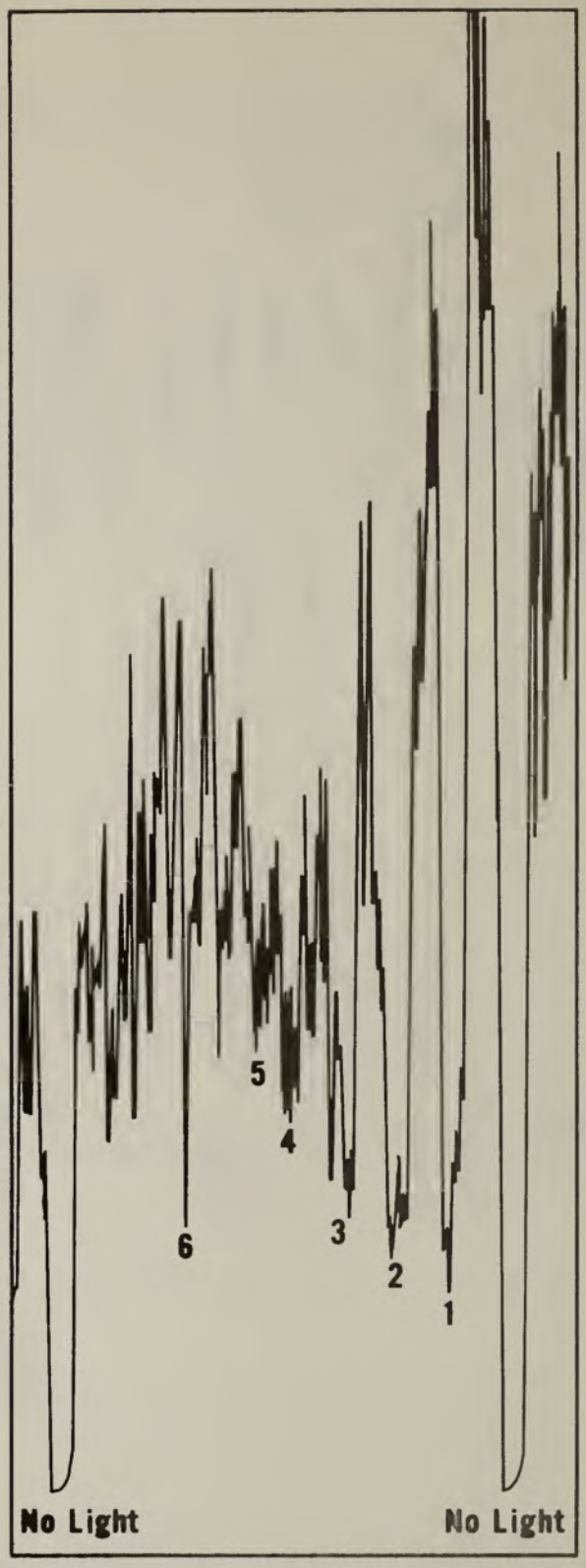


Figure A-2(b). Photomultiplier response data from silicone fluid fire (Numbers of inserted filters are indicated.)

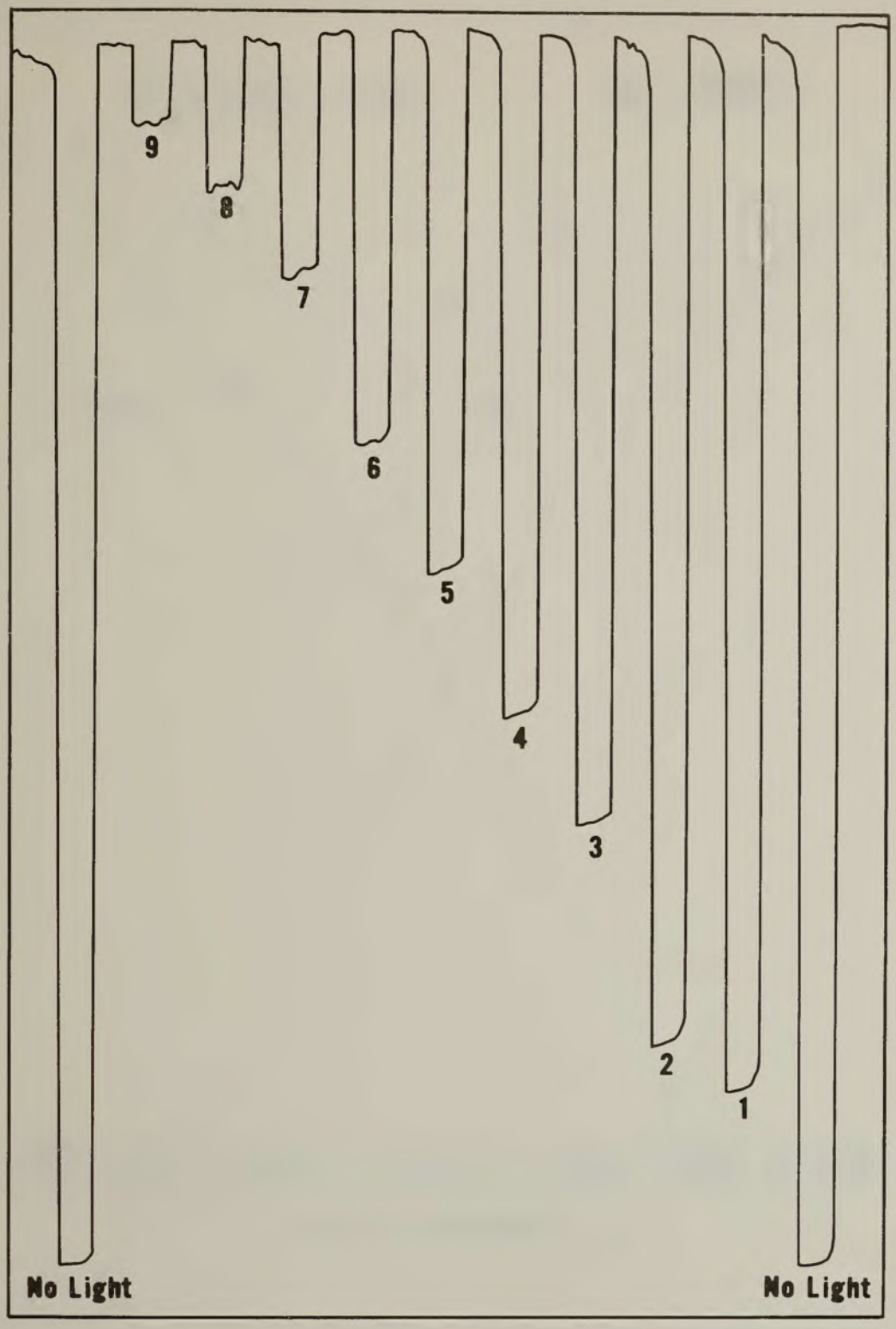


Figure A-2(c). Photomultiplier response data from tungsten bulb (Numbers of inserted filters are indicated.)

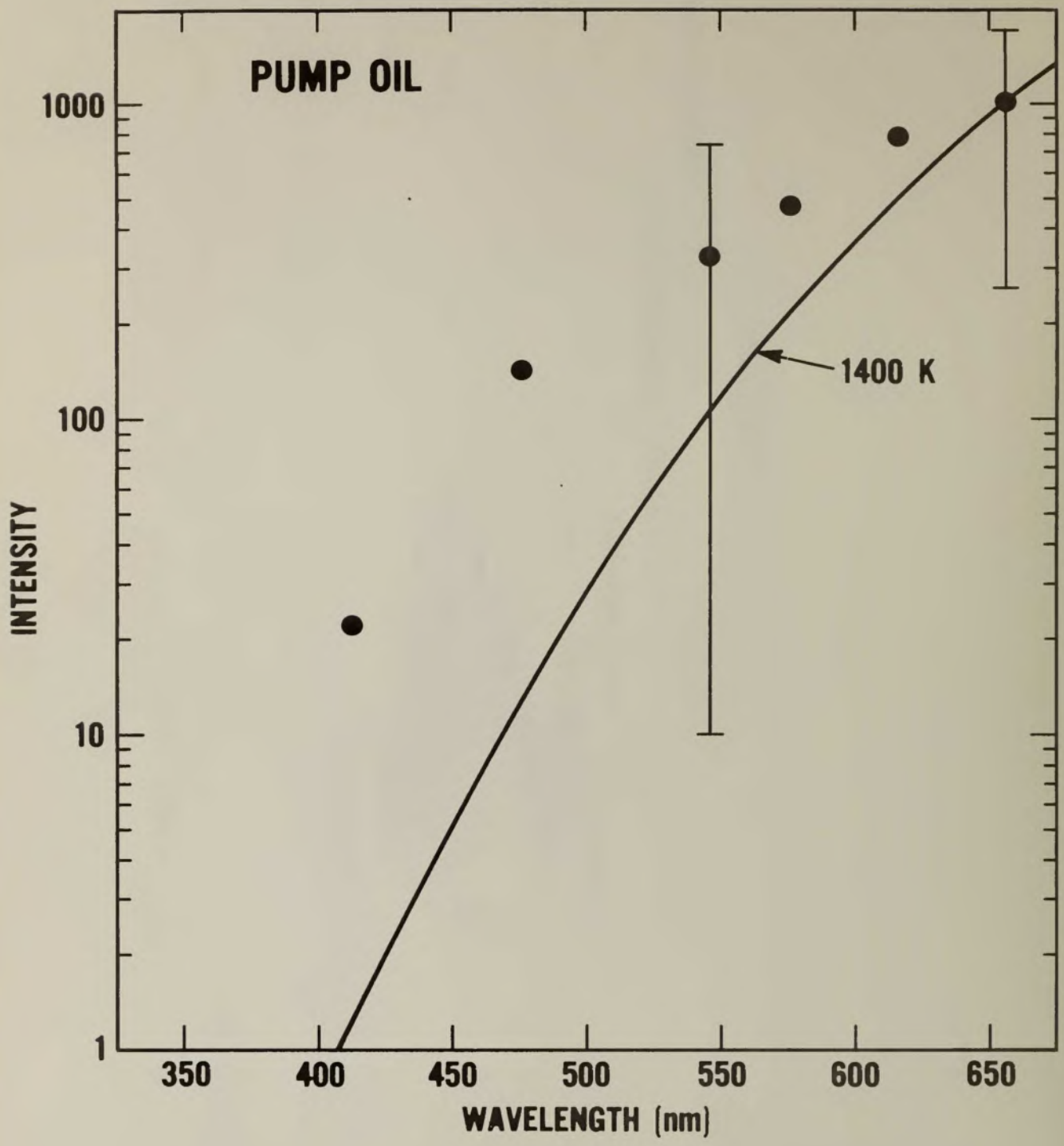


Figure A-3(a). Spectral data from pump oil fires (intensity in arbitrary units) The curve represents the blackbody emission at the optical pyrometer temperature.

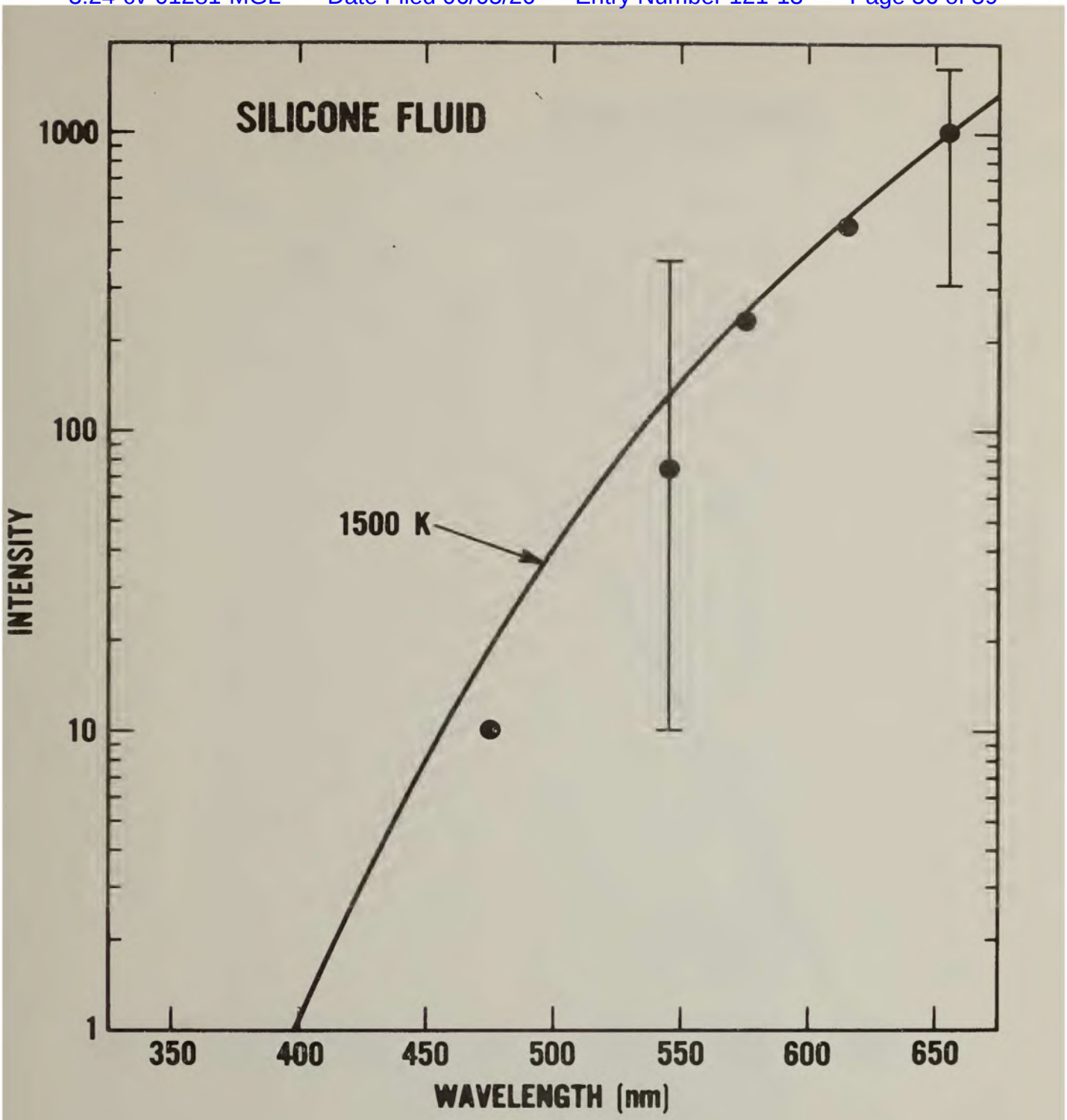


Figure A-3(b). Spectral data from silicone fluid fires (intensity in arbitrary units) The curve represents the blackbody emission at the optical pyrometer temperature.

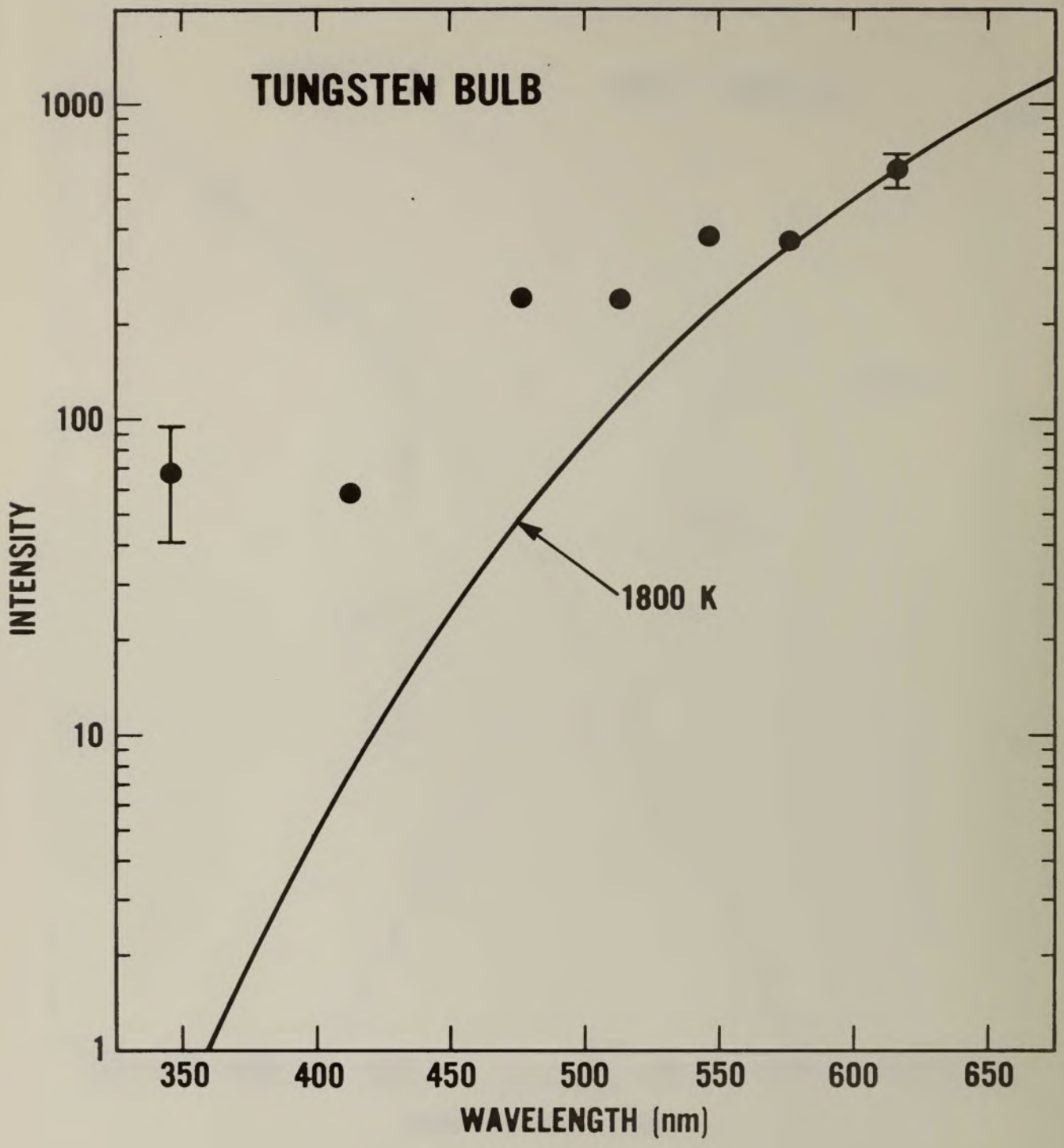


Figure A-3(c). Spectral data from tungsten bulb fires (intensity in arbitrary units) The curve represents the blackbody emission at the optical pyrometer temperature.

APPENDIX B. A RECENT CASE OF PCB LEAKAGE AND POLLUTION
from The Washington Post, September 29, 1979

Pollutant PCB Discovered In Food Products 'By Chance'

By Joanne Omang
Washington Post Staff Writer

The spread of the chemical pollutant PCB to human and animal food in 17 states was spotted "just by chance" and could have gone unnoticed under current government procedures, a Department of Agriculture official said yesterday.

Assistant Secretary Carol Tucker Foreman told a House hearing that bureaucratic routine and slipups accounted for the six-week delay between the taking of a food sample that proved to be PCB-loaded and the day that the Food and Drug Administration was notified of the contamination. But "even under the best of circumstances" it would have taken three to four weeks, she said.

The FDA is still tracking down shipments nationwide of cake mixes, waffle mixes and other products made with eggs that might have contained PCB from a Montana animal feed plant, according to acting FDA commissioner Sherwin Gardner. He said he was "reasonably certain" that none had escaped the FDA net but would not know for sure until all the reports are in and cerified in another 30 days.

PCB is polychlorinated biphenyl, a possibly cancer-causing chemical that has been linked to skin and liver disease, bone problems and other ailments. Banned in 1977, it previously was used as a lubricant and high-temperature coolant and continues to exist in older electrical transformers and industrial machinery.

It was such a transformer, apparently damaged by some kind of farm machinery or loading vehicle as it sat in a machine storage shed, that leaked about 200 gallons of oil containing PCB at the Pierce Packing Co. of Billings, Mont., according to the FDA.

The oil went into a drainage system that was routinely cleansed of fats for inclusion in animal feed. Foreman told the hearing that 399,000 pounds of affected poultry and 16,000 pounds of fresh pork have been located and held off the market. The FDA and USDA have also tracked the chemical to 73,000 pounds of egg products, about 52,000 pounds of which have been withheld. The rest is being traced.

The Agriculture Department monitoring system spot checks animal carcasses and is designed to catch trends over a year-long period, Foreman said. "It was just by chance that we picked up this single incident relatively quickly," she added. "It is also possible that a single incident of this size could go entirely undetected."

She said there are 120 million head of livestock and 3.5 billion poultry marketed each year. "The cost of testing all of them for [dangerous chemical] residues would be about $100 billion," she continued. Further, she said there are some dangerous chemicals, like the cancer-causing nitrofuranes, for which no residue-detecting test exists.

The PCB in this incident was found first in a chicken taken routinely from a processing plant in Provo, Utah, on July 6, Foreman related. But the USDA veterinarian who would have mailed the sample to be tested was on vacation and his replacement did not know a sample was waiting, so the mailing was delayed for a week.

On Aug. 3, the USDA inspection office in Alameda, Calif., was told the sample contained PCB, but waited until receiving written confirmation Aug. 8 before notifying the Utah office. That office traced the hen to the Pierce plant by the 10th but did not notify the FDA until Aug. 16, six weeks from the day the sample was taken.

"We should have far more sensitivity," Foreman said. "There should have been earlier and more compelling notification." She said corrective measures are being taken at the Department of Agriculture, but warned, "We have to realize that as long as we use chemicals in agriculture . . . accidents will occur."

Idaho Gov. John V. Evans objected in his testimony to "lapses . . . slipshod procedures . . . inexcusable delays" in government agency performance in the case. He recommended improved communication, technical and laboratory facilities and called for some sort of indemnification program for citizens damaged by future pollution problems.

"We've got to eliminate PCBs completely," he said. But the subcommittee chairman, Rep. Bob Eckhardt (D-Tex.), said that would be "a massive and extremely difficult, costly thing." An Environmental Defense Fund witness, Jacqueline Warren, told the hearing there are still 275 million gallons of PCB oils in transformers in use.

Rep. Andrew Maguire (D-N.J.) asked whether it would be possible to ban PCB at least in the nation's 125,000 food processing plants. Foreman and Gardner said they thought that would be "feasible."

NBS-114A (REV. 9-78)

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DEVELOPMENT OF FLAMMABILITY CRITERIA FOR TRANSFORMER DIELECTRIC FLUIDS

5. Publication Date: February 1980

6. Performing Organization Code

7. AUTHOR(S): Richard G. Gann

8. Performing Organ. Report No.

9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
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WASHINGTON, DC 20234

10. Project/Task/Work Unit No.

11. Contract/Grant No.

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U.S. Department of Energy
Electric Energy Systems Division
Power Delivery Branch
Washington, D.C. 20545

13. Type of Report & Period Covered: Final

14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

16. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)

With the recent ban on the use of polychlorinated biphenyls, it has become necessary to examine the fire safety requirements for electrical insulating fluids. The hazards are delineated and the magnitude of the transformer fire problem assessed. The current fire code and standard test methods are shown to be inadequate. Approaches to fluid fire performance testing are presented, as is a basis for evaluating the economic impact of alternative fire safety strategies. The report concludes with recommendations for further work.

17. KEY WORDS (six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)

Fire; fluids; pool fires; transformers.

18. AVAILABILITY

☒ Unlimited

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UNCLASSIFIED	53
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UNCLASSIFIED	$7.00

USCOMM-DC

Exhibit 14

Report of Plaintiff's Expert Robert Workman (Confidential)

EXPERT REPORT: DUKE POWER COMPANY HISTORICAL AWARENESS OF PCBS AND DISPOSAL PRACTICES

I. EXECUTIVE SUMMARY

INTRODUCTION AND PURPOSE

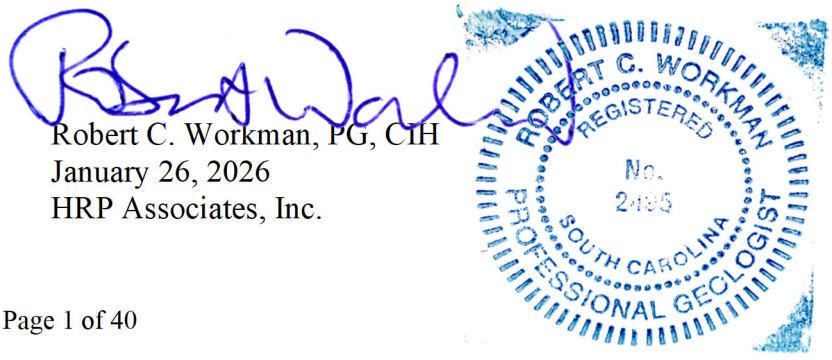
1. This expert opinion report addresses the actions and knowledge of Duke Power Company, now Duke Energy Corporation ("Duke"), concerning polychlorinated biphenyls (PCBs) and, specifically, Duke's historical practice of mosquito larvicide spray that involved discharging waste electrical transformer oil into Lake Wateree, South Carolina.

2. The report is organized into four (4) sections.
   - Section I: Executive Summary and Expert Qualifications.
   - Section II: Background Information and Technical Definitions.
   - Section III: Detailed Opinion Narratives and Knowledge Milestones.
   - Section IV: Works Cited

EXPERT CERTIFICATION

3. I, Robert C. Workman, prepared this report and have professional expertise in the subject of PCBs regarding environmental regulations, contamination assessment, source identification, remediation, and industrial hygiene. I am a Registered Professional Geologist (PG) in South Carolina, and a Certified Industrial Hygienist (CIH) through the Board for Global Credentialing.

4. HRP was retained by Wyche, P.A., to provide expert opinions on Duke's historical knowledge, environmental management standards, and regulations relevant to past handling and disposal of PCB-contaminated waste transformer oil through a mosquito control program performed at Lake Wateree, South Carolina.



Robert C. Workman, PG, CIH
January 26, 2026
HRP Associates, Inc.

SUMMARY OF OPINION

5. The opinions set forth below are held to a reasonable degree of professional certainty, based upon a review of available documents, applicable regulatory and industry standards, and my professional experience. The technical foundations for these opinions are established in the background and definitions presented in Section II, and the narrative of the opinions included in Section III.

6. *Opinion I: Duke's Awareness of the Hazards of PCBs.* It is my opinion that by 1968, at the latest, Duke was likely aware, or should have been aware, that the PCBs in electric insulating liquids were persistent, toxic contaminants.

7. *Opinion III: Duke's Awareness of PCB-Contaminated Electric Insulating Liquids*. It is my opinion that by 1968, Duke was likely aware, or should have been aware, that virtually all waste transformer oil generated during its operation was contaminated with PCBs.

8. Opinion II: *Duke's Irresponsible Handling of Waste Transformer Oil*. It is my opinion that from the 1940's until at least 1972, Duke likely knew, or should have known, that PCBs were present in the waste transformer oil being disposed through its reginal mosquito control program. Furthermore, during the period from 1968 until at least 1972, an overlap occurred wherein 1.) Duke had knowledge that the PCBs present in waste transformer oil, and 2.) Duke had knowledge that the PCBs present in the waste transformer oil were toxic, persistent pollutants that contributed to worldwide environmental contamination.

DATA RELIED UPON

9. In forming the opinions expressed in this report, I relied on a body of authoritative materials and discovery documents that are presented as the works cited, in Section IV. The materials include federal environmental regulations and guidance; scientific and technical literature; industry standards, engineering manuals; manufacturer correspondence, electric utility records; historical news media; judicial records and decisions. Discovery documents include

attorney-provided historical correspondence and reports from Duke. Collectively, these sources provide the historical, technical, and regulatory foundation supporting the opinions presented in this report.

EXPERT QUALIFICATIONS

10. I graduated with a Bachelor of Arts in Biology from Covenant College in 1993, and a Master of Science in Hydrogeology from Clemson University in 2007. Since 1994, I have worked as an environmental consulting professional under the framework of federal and state regulations including TSCA, CERCLA, RCRA, EPCRA, and OSHA.

11. My professional experience from 1994 through 2025 was with CRB Geological & Environmental Services, Inc., in Miami, Florida, and until 2025, managing the Greenville, South Carolina office as a Senior Project Manager and Industrial Hygienist. My responsibilities included performing environmental site assessments; designing and performing site remediation of subsurface contamination; and providing consulting services for industrial hygiene matters.

12. Beginning in April 2025, my professional experience has been with HRP Associates, Inc. (HRP), as the South Regional Manager, located at 701 Easley Bridge Highway, Suite 4130, Greenville, South Carolina. HRP operates as a professional services consulting firm providing expert services for environmental matters, including environmental site assessments; site remediation; environmental health and safety consulting; and hazardous materials management.

13. My experience as a Registered Professional Geologist is relevant to the PCB contamination reported at Lake Wateree. I prepare and review reports evaluating contaminant toxicity, contaminant distribution, historical source area migration, and the fate and transport of contaminants, including PCBs and chlorinated industrial compounds. I am proficient in evaluating the contamination models of dense non-aqueous phase liquids (DNAPL), such as PCBs, and their interaction with soil, water and sediments.

14. I have directed, performed and evaluated many hundreds of environmental site assessments that include sampling and analysis of soil, groundwater, surface water and building materials for PCBs and other organic and inorganic contaminants.

15. Since 1994, I have directed and performed numerous of site corrective action and remediation nationally for federal and state programs including programs based in regulations under CERCLA, RCRA and TSCA.

16. My experience reviewing and directing environmental assessing industrial sites provides familiarity with the site conditions, equipment, contaminant release patterns, and regulations applicable to electrical equipment installation. I have investigated numerous sites for PCB contamination, been involved in PCB remediation, and source area assessment addressed by federal regulations under the Toxic Substances Control Act (TSCA)

17. My credentials as a Certified Industrial Hygienist (CIH) are relevant to interpreting toxicological data, including ATSDR profiles and EPA regulations discussed in this report. I routinely evaluate site conditions, industrial operations and commercial property for comparison with federal, state and ACGIH exposure limits as part of industrial environmental management and human health exposure assessment.

18. I have not published any works or papers in the past ten (10) years.

19. I have not provided court testimony in the past four (4) years.

20. HRP is being compensated for my services in this matter at the rate of $375/hour for document preparation; $463/hour for deposition labor; and $500/hour for court testimony.

II. BACKGROUND AND DEFINITIONS

ELECTRIC INSULATING LIQUIDS

21. Electric Insulating Liquids (EILs), also known as dielectric fluid, is associated with certain electrical equipment including the transformers and capacitors operated by Duke and referenced in this report. The types of EILs are categorized as either petroleum-based mineral

oil or non-petroleum synthetic liquids. In the early 1970's petroleum based naphthenic mineral oil comprised approximately 80% of the total volume of EIL in use, and polybutene products comprised approximately 10%, both with low-risk health effects. The remaining volume of EIL in the early 1970s were non-petroleum liquids, including askarels that comprised approximately 6% of the total volume. Askarels were formulated with Aroclor products, which were formerly manufactured by Monsanto Chemical Company and were 100% PCB content (NIPCC, 1971).

22. Historically, terms "transformer oil" and "insulating oil" were used interchangeably in reference to the fluids contained in transformers and capacitors. Furthermore, the term "transformer oil" was vernacular applied to both refined petroleum-based mineral oils that were manufactured without PCBs, as well as the askarel synthetic insulating fluids that contained PCBs. The interchangeable nomenclature obscured the chemical compositions and environmental risks associated with different dielectric fluids (NTIS, 1972; Water Resources Research Institute, 1970; EPRI, 2016).

23. Mineral Oil, or Mineral Insulating Oil (MIO), is highly refined petroleum-based liquid used as dielectric (insulator) and coolant in transformers. Historically, mineral oil was much less expensive than askarel, so it was preferred for general transformer use. Mineral oil is susceptible to explosions, and accordingly transformers in critical locations could not be filled with mineral oil where fire or explosion was an unacceptable risk. Mineral oil does not contain PCBs when produced; but while in use, the oil can become contaminated by PCBs from inadvertent or intentional mixing with askarel. Mineral oil is characterized by low viscosity and high dielectric strength with a specific gravity typically between 0.85 and 0.90, meaning it is lighter than water and will remain on the surface if released into an aquatic environment (IEEE, 1984; NTIS, 1972).

24. Askarel is a generic trade name for a group of synthetic, fire-resistant insulating liquids. These fluids contain high concentrations of PCBs of up to 100% by weight in some formulations. Askarel was used in a small percentage of transformers and in most capacitors to ensure fire and explosion safety and long-term dielectric resilience (ATSDR, 2000; U.S. EPA, 2016; EPRI 2016).

25. Aroclor™ was the trade name for PCB mixtures manufactured by the Monsanto Company between 1930 and 1979. Aroclors are identified by a four-digit numbering system (e.g., Aroclor 1242, 1254, 1260), where the first two digits ("12") indicate a 12-carbon biphenyl structure and the last two digits represent the approximate percentage of chlorine by weight in the formulation (Monsanto Sales Manual, 1944).

26. Askarel was a premium dielectric fluid that cost much more than standard transformer grade mineral oil. The 1972 NTIS report *PCBs and the Environment* document reported that askarel cost almost eight times what mineral oil cost. This consistent cost differential reflects the utility sector's treatment of askarel as an asset to be conserved rather than a routine consumable. Askarel was valued for its stability and longevity, with expected service life over thirty years (NTIS, 1972).

27. Pyranol™ was the specific brand name for askarel manufactured and utilized by the General Electric Company (GE). GE was a primary customer that purchased bulk Aroclor mixtures and rebranded them as Pyranol for use in their electrical apparatus (GE Technical Manuals). Inerteen™ held an identical trade status as the brand name for askarel utilized by the Westinghouse Electric Corporation (Westinghouse Service Bulletins). Duke operated electrical equipment from GE and Westinghouse, and used both Pyranol and Inerteen (GE, 1972; Duke, 1982).

28. By 1970, the industry's recognition of the PCB problem was public and associated with mishandling askarel, specifically allowing discharges to the environment. The problem was magnified when it became apparent that widespread contamination of mineral oil with PCBs had resulted from decades of uncontrolled mixing of askarel into mineral oil during manufacturing, maintenance and disposal practices. The contamination of mineral oil with PCBs is thought to have commenced in the 1940's or earlier, in correlation to the widespread use of PCBs in the electrical industry. Once electrical equipment was placed into service, fluid mixing of askarel into mineral oil occurred during incidental events like fluid level topping off transformers, using common pipes, pumps, storage tanks, and equipment, so that was inevitable that PCBs were introduced into non-PCB equipment. There would be no reason to expect that discarded volumes of waste insulating liquid from mineral oil and

askarel would be segregated. It follows that prior to 1979, any waste electric insulating liquid generated by Duke or other electric utilities would be contaminated with concentrations of PCBs (NIPCC, 1971; Weinstein U.S. EPA, 1974; EPRI, 1986).

29. In 1971 an alternative, less-persistent askarel was introduced as Aroclor PCB 1016 for use in capacitors that was followed by a shift in the industry usage. The alternative product was produced specifically in response to growing environmental concern (NIST, 1972)

POLYCHLORINATED BIPHENYLS

30. PCBs are a class of man-made organic chemicals known as chlorinated hydrocarbons. Their chemical stability and fire-resistant properties made them ideal for high-heat and energy industrial applications, but these same traits resulted in environmental persistence (Jensen, 1966).

31. PCBs were manufactured exclusively in the United States by Monsanto. Foreign producers of PCBs existed with minor importation of PCBs recorded in trade documents. As the sole manufacturer, Monsanto documentation of the risks of PCBs are essential milestones of the industry knowledge and response to PCB environmental contamination in the 1960's and 1970's (U.S. EPA, 1979; NIOH, 1977).

32. PCBs and askarel are characterized by high specific gravity (greater than 1.1). Because the fluid is more dense than water, it does not float like oil or dissipate when released into aquatic environments. Instead, it migrates through the water column and binds to bottom sediments, creating persistent reservoirs of contamination (ATSDR, 2000; U.S. EPA, 2016).

33. PCBs are lipophilic (fat-soluble), leading to bioaccumulation in the fatty tissues of organisms. Through bio-amplification, contaminant concentrations increase as they move up the food chain, resulting in Fish Consumption Advisories which are currently in effect for regional waterways throughout South Carolina (Stalling & Mayer, 1972; U.S EPA, 2016).

34. As established by the 1966 Jensen study and the 1972 Stalling and Mayer findings, PCBs do not readily break down. Once introduced into a watershed, they remain a "legacy" contaminant for decades. Early recognition of their persistence and widespread distribution

as ecological contaminants has been supported and confirmed by decades of intervening scientific studies and research (Jensen, 1966; Stalling & Mayer, 1972).

ELECTRIC UTILITY EQUIPMENT

35. The containment of EIL within the Duke system included electrical transformers and capacitors. The transformers and capacitors are built as metal containment shells over the internal components. The void space inside the metal walls is filled with EIL as an insulator and coolant. Fill ports and drain plugs allow access to the insulation liquid.

36. Dry-type transformers were investigated by Duke Power in 1970 in response to the growing environmental concern related to PCBs. This information appeared in a November 6, 1973 document titled *General Electric Group Manufacturing Support Operation, Task Force Pyranol Transformers*. The subject of the letter was the synthesis of market outlook in anticipation of the near future elimination of Aroclors and PCBs. The significance of dry-type transformers is that this type of equipment is not filled with liquid, requires no askarel or mineral oil, but have limited applications compared to the reliability and functionality of liquid filled transformers. (GE, 1973).

37. Transformers transfer electrical energy between circuits through electromagnetic induction. Most transformers utilized mineral oil, and askarel was reserved for units in "critical" areas where fire or explosion risks were unacceptable, such as indoor or high-density locations (IEEE, 1984; EPRI, 2016).

38. The volume of EIL in a transformer ranges from 40 to 100 gallons for small pole-top units to thousands of gallons in large power transformers (IEEE C57.106, 1991).

39. Capacitors store electrical energy and improve grid efficiency. Between the 1930s and 1977, capacitors were filled with askarel due to the high risk of internal arcing and catastrophic failure. Capacitors store lower individual volumes of fluid compared with transformers, and are frequently deployed in banks containing hundreds of gallons of pure or concentrated PCBs (EPRI, 1986; U.S. EPA, 2016; ANSI/IEEE Std 18-1980).

40. PCB Capacitor refers to any capacitor manufactured before the 1979 ban. In 1979 it was recognized that virtually every capacitor contained askarel, and this is documented in the rules and regulations described in the USEPA Final Ban Rule. Capacitors that were manufactured after the ban were labeled as non-PCB (U.S. EPA, 1979).

41. The TSCA regulations introduced determinations for managing transformers and insulating liquid depending on the content of PCBs in the insulation fluid. TSCA required that the term "PCB Transformer" apply for any transformer that contained insulating liquid with PCBs at a concentration of 500 ppm or greater. "PCB-Contaminated Transformers" contain insulating liquid with PCBs at a concentration between 50 and 500 ppm. As of 1979, USEPA estimated that there were thirty-five million transformers that contained insulating fluid with a PCB content of 50 to 500 ppm. The term "Non-PCB Transformer" was equipment that contained insulating liquid containing less than 50 ppm PCBs. As of 1979, the EPA estimated that 25% to 40% of all transformers contained oil with more than 50 ppm PCBs (USEPA TSCA, 1979).

SUPPLY CHAIN: MONSANTO AND GENERAL ELECTRIC

42. Monsanto Company was the near-exclusive manufacturer of PCBs in the United States from 1930 until 1977, developing the Aroclor brand used by the entire electric utility industry (Monsanto Chemical Co., 1957; EPRI, 2016).

43. In 1970 a crucial development occurred when Monsanto directly addressed all the buyers of PCBs as Aroclor in a letter dated February 18, 1970. The letter acknowledged the recent scientific findings that PCBs were reported to be a marine and wildlife pollutant. The letter was defensive and deflected some of the claims about PCBs in the public domain, and recommended alternative Aroclor products to the Aroclor 1254 and 1260 products. Monsanto advised the customers to exercise care that the disposal of Aroclors be prevented from becoming environmental contaminants. A follow up letter dated October 12, 1970, Monsanto instructed customers to no longer dump waste askarel or allow it to drain into the sewer, and instead to return waste Aroclor in drums to Monsanto for destruction (Monsanto Chemical Co., 1970).

44. General Electric (GE) served as a primary Original Equipment Manufacturer (OEM) for Duke, purchasing bulk Aroclor and rebranding it as Pyranol for use in their transformers and capacitors that were sold to Duke and other utilities. Duke and GE maintained first order communication regarding supply chain issues, including the development of PCB hazards and eventual elimination of askarel in electrical equipment (GE Task Force Pyranol Transformer, 1973; Markowitz, 2018).

45. GE's technical manuals dictated maintenance protocols for Duke. These protocols recommended periodic filtration, which unintentionally facilitated the contamination of clean mineral oil with PCB fluids during routine service cycles (IEEE 637, 1985; U.S. EPA, 2016).

46. Historical Context of Shared Infrastructure: Throughout the mid-20th century, electric utilities operated the same pumps, hoses, filtration units, and storage tanks to service both mineral oil and askarel (PCB) equipment. This shared infrastructure resulted in trace amounts of PCBs distributed throughout the entire oil inventory of a utility system, making contamination a physical inevitability of Duke's service protocols (EPRI, 2016; IEEE 637-1985; U.S. EPA, 2016).

DUKE POWER COMPANY

47. Duke Power Company is the primary electric utility in the North Carolina and South Carolina Piedmont region. Duke Power Company evolved into the modern corporate structure of Duke Energy (Duke Energy, various)

48. Duke was founded in 1905 as the Southern Power Company and renamed as Duke Power Company in 1924. Duke anchored its growth on an extensive hydroelectric network along the Catawba-Wateree River system (Duke Energy, various; Durden, 2002).

49. During the mid-20th century, Duke acquired numerous municipal and investor-owned utilities. These acquisitions inherited older transformers and capacitors frequently filled with askarel and mineral oils, as well as the legacy maintenance practices associated with those assets (Water Resources Research Institute, 1970; EPRI, 2016).

50. In 1997, Duke merged with PanEnergy Corp to form Duke Energy Corporation. Subsequent mergers with Cinergy Corp in 2006, and Progress Energy with Carolina Power and Light (CP&L) in 2012 transformed the Duke into one of the largest energy holding companies in the United States (Duke Energy Annual Reports, 1997, 2006, 2012).

THE CATAWBA-WATEREE WATERSHED BASIN

51. The Catawba-Wateree River Basin serves as the primary environmental context for Duke's historical hydroelectric operations. It is a large regional system beginning in the North Carolina Piedmont and flowing south into South Carolina, characterized by a chain of manmade lakes created by hydroelectric dams (SCDHEC, 2022).

52. Lake Wateree is the terminal reservoir in this chain that makes the lake a sediment trap for transported particles in the upstream watershed. Contaminants introduced upstream migrate and settle in the deep organic sediments of Lake Wateree (SCDHEC, 2022; U.S. EPA, 2016).

53. Duke's shoreline management of the 225-mile river basin is required under the 2015 FERC license and was required under the 1958 FERC license. Duke performed mosquito control under a public health program started in 1923 along with other shoreline maintenance projects as a crucial responsibility to maintain the lake system free from malaria and other mosquito borne illness. As of 2013, it was reported that Duke used an approved larvicide until the program ended in 2017 (Durden, 2002; US FERC, 2015; Duke, 2013; Duke 2017).

54. Duke operated multiple hydroelectric power generators on the Catawba-Wateree River Basin licensed by the Federal Energy Regulatory Commission (FERC). The original hydroelectric plant on Lake Wateree was built in 1919 by the Wateree Power Company as an operation of the Southern Power Company, and the predecessor company that was reorganized into Duke in 1924. Wateree was the first large hydroelectric reservoir in South Carolina. Duke bought Wateree Power and operated the entire river basin license beginning in 1958 and renewed in 2015 (Duke, 2019; US FERC, 2015).

OILING AS LARVACIDE FOR MOSQUITO CONTROL

55. Oiling has been a method of mosquito control in the Americas since the late 1800's. The practice involves the application of a thin oil film to the surface of standing water to suffocate mosquito larvae. (Glover, J. B., & Gundersen, D. T., 2021; US Department of Health, 1963; Herms & Gray, 1944).

56. By the 1960's, the practice of oiling recommended by the US Department of Health was to spray kerosene fuel oil on the water surface. The application of kerosene, diesel fuel oil was recommended because of the sheen film, dark color that made the oil easier to see, and the volatile portion increased the larvicide lethality There was no recommendation to use waste oil, or specifically waste transformer oil (CDC, 1963).

57. Duke's actions towards waste transformer oil historically categorized the application of waste transformer oil for mosquito control as a beneficial use of a readily available waste stream. Duke's public statements detailed the procedure to mix transformer oil with motor oil and diesel fuel to spray. Within the Catawba-Wateree River Basin, this practice would have introduced PCBs into the aquatic environment, where the chemicals became permanently sequestered in the bottom sediments (Duke Power Coordination Meeting Minutes, 1970; Markowitz, 2018; SCDHEC, 2022).

58. The practice of oiling evolved from unregulated recommendations and industry practices to a recognized pesticide activity regulated under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) as amended in 1972. With the 1972 amendment of FIFRA, an important regulatory revision was introduced to the definition of a pesticide that incorporated a user's intent to use a material as a pesticide determined the applicability of FIFRA. As of 1972, under FIFRA, the use of diesel fuel, transformer oil, or any other unregistered product as a larvicide (pesticide) was prohibited (U.S Congress, 1972; Yen & Esworthy, 2012).

59. Oiling, including the use of diesel fuel, waste transformer oil or other waste products would further be a violation of the Clean Water Act of 1972. The continued spray of petroleum after 1972 would be considered to be a discharge of a pollutant into navigable waters without a permit (U.S. Congress, 1972).

ENVIRONMENTAL AWARENESS 1960-1970

60. The decade preceding the 1970s saw a shift from passive acceptance of industrial pollution to active regulatory demand for protection. Any sophisticated corporation during the 1960's could not have been unaware of the publicity, hazards and concerns generated from PCB exposure and contamination during this time. Since PCBs were central to Duke's operation, the public environmental awareness would have been amplified in the environmental management, product engineering, and regulatory liaison staff within Duke's organization (Markowitz & Rosner, 2018)

61. Rachel Carson 1962 serial publication in *The New Yorker* and subsequent book *Silent Spring* introduced the public to bioaccumulation and environmental persistence, which resulted in immediate public outcry and forced government investigation. The concepts of industrial pollution presented in *Silent Spring* became central to the establishment of environmental regulations and the eventual ban of PCBs (Carson, 1962).

62. In 1966, Jensen published a widely circulated study of international conditions that established PCBs as a global contaminant, and is a milestone that the legacy nature of these chemicals was a recognized concern for society in general, and users of PCBs specifically. In addition to published industrial hygiene standards for acute hazards of PCBs as early as the 1940's the environmental chronic hazards were well known by the late 1960s (Jensen, 1966; Markowitz, 2018). Disasters such as the 1969 Cuyahoga River fire and the 1969 Santa Barbara oil spill galvanized public demand for federal intervention to prevent the discharge of industrial oils into navigable waters (Adler, 2002).

63. The 1968 landmark article in *Nature* by R.W. Risebrough has been identified as a turning point in the evolution of attitude and understanding of the global presence and persistence of PCBs. The article described PCBs found in birds and fish worldwide, and looked for sources of the contamination, including PCB-based electrical insulating liquids. The U.S. EPA reviewed the events leading to PCB regulations in the report *Polychlorinated Biphenyls 1929-1979, May 16, 1979*. The U.S. EPA referenced the Risebrough article as a major influence of the growing concern over PCBs stating, "*The discovery that PCBs were common in the environment in sufficient concentrations to affect the reproduction of wild birds was*

published in 1968 (Risebrough, 1968). This article was picked up in the press which started the widespread concern about possible human health effects from PCBs in the environment" (U.S. EPA, 1979).

64. The 1968 Japanese Yusho oil-disease public health crisis was not linked to PCBs until reported in 1969 following investigations. Yusho was a landmark event in occupational and environmental health demonstrating the dangers of PCB exposure. Yusho means "oil disease" and refers to a mass poisoning event where over 1,200 people were affected after consuming rice bran oil contaminated with PCBs Yusho influenced regulatory agencies to recommend stricter exposure limits and controls for PCBs. It provided critical evidence for the development of health-based standards, highlighted the need for comprehensive worker and public protection, and informed research and policy on persistent organic pollutants (NIOSH, 1977).

65. In 1969, internal records from Monsanto's PCB Abatement Plan documented the companies awareness and acknowledgement of the PCB crisis, and that the window of selling PCBs was closing. Monsanto and its customers prepared for the eventual elimination of PCB-based products by 1970 (Monsanto, 1969).

66. The first Earth Day in 1970 corresponded to the political mandate to create the EPA. It coincided with the U.S. government's overhaul of regulations that led to the powerful 1972 Clean Water Act (Gottlieb, 2005).

TECHNICAL AUTHORITIES AND INDUSTRY STANDARDS

67. The Electric Power Research Institute (EPRI), founded in 1972, is a cooperative research organization for the electric utility industry. EPRI documentation provides the definitive history of industry-wide knowledge regarding PCB testing, equipment decontamination, and the eventual phase-out of askarel (EPRI, 1981).

68. The Institute of Electrical and Electronics Engineers (IEEE) is the professional organization responsible for developing the consensus standards used by Duke engineers and utility operators nationwide. The IEEE C57 Series standards established the physical and chemical

requirements for electric insulation liquid and provided the technical procedures necessary to detect and manage PCB cross-contamination in mineral oil systems (IEEE C57 Standard Series; IEEE 799-1987).

69. The American Conference of Governmental Industrial Hygienists (ACGIH) is an association of industrial hygiene professional that establishes Threshold Limit Values (TLVs) for chemical exposure. The historical record of ACGIH recommendations demonstrates an increasing understanding of PCB toxicity and the necessity for exposure control. In 1946 the ACGIH set the first recommended limit at 1.0 mg/m³. Limits were refined to 0.5 mg/m³ for more potent 54% chlorine mixtures (e.g., Aroclor 1254). The ACGIH reinforced these limits as Threshold Limit Values in 1962 that provides a widely circulated public reference that even chronic, low-level exposure to PCBs was hazardous (ACGIH TLV Booklets, 1946, 1954, 1968).

70. The ACGIH criteria established the standard of care for protecting personnel from the systemic effects of PCB exposure during the maintenance and handling of electric insulating liquids. This documentation also establishes the timeline that the utility industry, including the environmental managers at Duke, had access to scientific data regarding the human health risks of PCBs decades before federal environmental regulations were enacted (ACGIH, 1946; Markowitz, 2018).

71. American National Standards Institute (ANSI) is the organization responsible for developing and maintaining voluntary consensus standards across industrial, engineering, and public-safety domains. The format of ANSI is to oversee and facilitate industry committees and experts to produce and publish standards. The standard ANSI C107.1 (1974, revised 1976) represents the earliest industry-wide national guidance warning utilities about the hazards and disposal requirements associated with PCB-containing insulating fluids. In developing standards for the electrical industry, several years of meetings and information sharing preceded the finalized ANSI C107.1 with proceedings and discussions that sophisticated electric utility such as Duke would be aware of. (ANSI C107.1, 1976).

72. National Electrical Manufacturers Association (NEMA) is the trade association representing U.S. manufacturers of electrical equipment—including GE, Westinghouse, transformer

makers, capacitor manufacturers, and related industrial sectors. Importantly, NEMA was an early proponent establishing the national standard for handling and disposal of PCB-containing insulating fluids in 1971. The involvement of NEMA, an organization with close ties to Duke, is an example that the industry was aware of the risks and routes of contamination of PCBs years prior to TSCA, and during the time that Duke was using waste transformer oil as part of its mosquito control program. Together with the established ANSI standards, the industry created a standard of practice (NEMA, 1971).

73. National Industrial Pollution Control Council (NIPCC) is a federal advisory council established to provide industry-specific guidance to the federal government on pollution control problems. NIPCC Sub-Council responsible for electrical equipment included leaders from Westinghouse Electric Corporation, General Electric Company, McGraw-Edison, Fairchild, and RCA. The foundational 1971 report *The Use and Disposal of Electrical Insulating Liquids, Sub-Council Report*, confirmed the national priority and attention that PCBs and electrical insulating oil received in 1971. The recommendation of the council report was total containment of askarel and incineration as the only acceptable disposal method (NIPCC, 1971).

74. National Technical Information Service (NTIS) is a federal office responsible for providing technical reports and federal research. The NTIS produced an interagency task force report on PCBs in 1972 that formally established the state of knowledge and industry related to the emerging crisis identified after PCBs were discovered in the environment in 1966 by Swedish researchers. The 1972 task force report sets a milestone that in 1971 the direction to prepare the report was finalized. The report stated that Monsanto voluntarily reduced PCB production in 1971 and provided insight into the electric utility industry, stating that the last "normal" year with respect to PCBs and electrical insulating fluid was 1968. The report documented the planning of the TSCA with the intent to restrict the use and distribution of PCBs. The implication of cross-contamination with PCBs is plain, and the 1972 report highlighted the importance of housekeeping in the use and disposal of PCBs, specifically with the electric utility sector as the largest users of PCBs and a duty of "special responsibility" to control and monitor PCB waste.(NTIS, 1972).

FEDERAL REGULATORY FRAMEWORK FOR PCBS 1970-1979

75. The United States Environmental Protection Agency (EPA) was established in 1970 to consolidate federal environmental research, monitoring, and enforcement. EPA established the 50 ppm threshold as the legal definition of "PCB-Contaminated" for dielectric fluids (USEPA, 2016).

76. The Clean Water Act (CWA), significantly expanded in 1972, established the National Pollutant Discharge Elimination System (NPDES). This legislation made it illegal to discharge any pollutant—including "waste" transformer oil—from a point source into navigable waters without a permit (CWA, 33 U.S.C. §1251 et seq.). The CWA superseded regulated authority that existed in the 1970s, but was not effective in eliminated PCB discharges to water, including the Refuse Act of 1899, and the Federal Water Pollution Control Act. (NTIS, 1972)

77. The Toxic Substances Control Act (TSCA) of 1976 gave the EPA the authority to regulate chemical substances. Congress mandated a ban on the manufacture and distribution of PCBs, leading to the definitive 1979 PCB Ban (TSCA Section 6(e), 1976; USEPA, 2016).

78. Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) as amended in 1972 addressed the discharge of diesel fuel, transformer oil, or any other unregistered product as a larvicide (pesticide) to navigable water. The original application of FIFRA to PCBSs resulted in the elimination of PCBs from formulations of pesticides in 1970 (NTIS, 1972).

79. Other federal regulations not discussed in this report addressed PCBs through the Food and Drug Administration and Department of Agriculture.

LAKE WATEREE FISH CONSUMPTION ADVISORIES 1997-2010

80. Public Health Warnings in the context of the Catawba-Wateree River Basin are primarily issued as Fish Consumption Advisories. These advisories are formal recommendations issued by state agencies to the public to limit or avoid eating certain species of fish caught in specific water bodies due to chemical contamination.

81. The primary contaminants triggering these warnings in the region are PCBs and Mercury. Because PCBs are lipophilic and do not biodegrade, they accumulate in the fatty tissues of fish. Predatory species, such as Largemouth Bass, and bottom-feeders, such as Blue Catfish, typically show the highest concentrations due to their position in the food chain and proximity to contaminated sediments (ATSDR, 2000; Stalling & Mayer, 1972).

82. In 1997, the South Carolina Department of Health and Environmental Control (SCDHEC) identified Lake Wateree as a primary area of concern for PCBs detected in fish tissue samples. The state agencies established action levels of specific concentrations of PCBs in fish tissue that, when exceeded, required the issuance of public health warnings (SCDHEC, 2022; NCDEQ, 2023).

83. A fish consumption advisory was first issued in 2010 and remains in effect through 2026 for Lake Wateree. Guidelines for certain species recommend a "Do Not Eat" policy for sensitive populations and "Limited Consumption" for the public. The fish consumption warnings serve as an ongoing record of the environmental legacy left by the historical management of dielectric fluids within the watershed (SCDHEC, 2022; USEPA, 2016).

III. DETAILED OPINION NARRATIVE

OPINION I: DUKE'S AWARENESS OF THE HAZARDS OF PCBS

84. Statement of Opinion: It is my opinion that by 1968, Duke was likely aware, or should have been aware, that the PCBs in electric insulating liquids were persistent, toxic contaminants.

85. 1944 - The Monsanto Sales Guide: In 1944, the Monsanto Chemical Company was the sole producer of PCBs in America and published a sales guide for Aroclor products that marketed the fluids as chemically stable, non-flammable, and suitable for a wide array of industrial applications. This early trade document also highlighted the health hazards including skin disorder, liver damage, and the need for ventilation, protective hygiene measures and minimizing exposure. This early marketing established the industry perception of PCB materials and insulating fluids as desirable products that reduced risk and maintenance requirements. For utilities like Duke, this period of use solidified the operational incorporation of PCBs into the functional equipment and maintenance operations (Monsanto Chemical Co., 1944).

86. 1946 to 1962 - ACGIH and the standard of care. The industrial hygiene community began establishing safety limits shortly after the use of askarel became widespread. The ACGIH set the first recommended PCB exposure limits in 1946, refined the limits in 1954. The ACGIH then published the Threshold Limit Values (TLVs) in 1962, and reinforced the TLVs in 1968 which correlated to the US Occupational Safety and Health Administration (OSHA) establishing the Time Weighted Average exposure limits. It is likely that a sophisticated public utility such as Duke employed competent health and safety professionals who knew that even chronic, low-level exposure to PCBs in electric insulating oil was a health hazard and dangerous in the environment. This data and working industry standard of care was established by health and safety professionals decades before federal environmental regulations were enacted (ACGIH TLV Booklets, 1946, 1954, 1968).

87. 1962 – Worldwide awakening to environmental awareness: The publication of Rachel Carson's *Silent Spring* essays in *The New Yorker* in 1962 resulted in the American societies instantaneous awareness of the dangers of pesticides. *Silent Spring* became a best-selling

book that focused on the effects of the pesticide DDT (dichlorodiphenyltrichloroethane) the attention shifted to recognize that other chlorinated hydrocarbons—specifically PCBs—posed an identical risk to the food chain and regional watersheds. Within months of publication, the facts presented in the book were investigated and confirmed by President Kennedy's Science Advisory Committee. By 1963 the environmental awareness from *Silent Spring* culminated in a senate hearing, public discourse and the awakening of America's environmental movement and mounting distrust of chemicals. The legislative genesis of the USEPA, Clean Water Act, TSCA and national environmental regulations can be traced to *Silent Spring* (Carson, 1962).

88. 1966 - Jensen study internationally established PCBs as a global contaminant after discovering them in the tissues of fish and eagles. This scientific breakthrough meant that by the late 1960s, the legacy nature of these chemicals was no longer an obscure theory, but a recognized international concern for utility operators managing large water bodies like the Catawba-Wateree Basin (Jensen, 1966).

89. By 1968, Risebrough's PCB investigation reported in *Nature* resulted in an important inflection point in the awareness of corporations, utilities, and government agencies regarding the global pollution concern. An internal Monsanto legal department memo dated August 24, 1971, summarized a lawsuit faced by the company and was titled *Date of Monsanto's Notice of Potentially Harmful Effects from PCB*. According to the memo, Monsanto was in direct communication with Risebrough prior to the release of the article and was aware that the growing PCB crisis now involved suspected human health effects. Monsanto's internal memo was a corporate legal trace of the timing of Monsanto's knowledge about PCBs as a pollutant. The first public awareness began with the Jensen's 1966 article, followed by debate of scientific consensus regarding PCBs in 1967. Earlier in 1968, the U.S. Department of Agriculture performed experiments furthering knowledge about PCBs in the environment, but Risebrough's article in 1968 was regarded by Monsanto as a clear indication of growing "alarm" about PCBs. Monsanto's communication with Risebrough in advance of the publication is consistent with other reports that the information presented in the article was originally discussed in a public scientific conference earlier in 1968. Monsanto's 1971 memo revealed that one of the responses to the article was in 1970

when a modification to Monsanto's Aroclor product labels included an additional warning to prevent leakage, disposal or vaporization that would result in a release to the environment. Monsanto's internal legal review determined that the company had credible knowledge about the risk of widespread environmental contamination from PCBs by October 1968, when the Risebrough article was published (Monsanto Chemical Co., 1971; Risebrough, 1968).

90. Risebrough's 1968 article not only solidified the discovery that PCBs were implicated in the severe global pollution matter, but also, in the search for sources of the pollution, the article stated that PCBs are used "*in industrial applications as plasticizers, in sealants, in hydraulic fluids, and in electrical transformers and condensers*". This statement meant that as of 1968 the global PCB pollution crisis was linked to releases of electrical insulating liquids. It is likely that the directors of a leading electrical utility company such as Duke, whose operation relied on PCBs, were immediately aware of this public implication.

91. The Yusho mass poisoning event of 1968 in Japan caused by PCB-contaminated rice oil provided undeniable medical evidence of the catastrophic results of human exposure. The resulting Yusho Disease characterized by chloracne and systemic failures transformed PCBs from a mere skin irritant into a recognized systemic toxin within the utility industry's safety and medical departments (ATSDR, 2000; Markowitz, 2018).

92. 1968 – The electrical utility industry experienced a major disruption in 1968 due to the publicized contamination from PCBs. This was documented in the March 1972 government document called *PCBs and the Environment* produced by NTIS. In evaluating the impending transition to alternative electrical insulating liquids, the authors stated that the last "normal" year for the electrical industry was 1968, implying uncertainty related to the continued use of PCBs. This statement from a government committee captured the electric utility sector's sentiment in 1968 regarding the PCB crisis, and Duke would have been aware of it based on industry-wide communications (NTIS, 1972).

93. In August 1969, Monsanto assembled an Aroclor Ad Hoc Committee and an internal committee admitted that PCBs were killing marine species and potentially driving bird species toward extinction. (Monsanto Chemical Co. Ad Hoc, 1969; Markowitz, 2018).

94. Later in 1969 Monsanto's PCB abatement plan resulted from the Ad Hoc Committee recommendations, that directly affected Duke and other electric utilities. Monsanto developed a strategy to limit PCB sales to closed-loop electrical systems. After decades of unrestricted sales, this policy shift was an implicit admission that PCBs were dangerous and must not be released into the environment. By 1970, when the restriction too effect, the manufacturer had effectively de-certified askarel for any application with the potential for environmental release (Monsanto Chemical Co., 1969).

95. 1970 Public disclosure of the PCB connection to electric utility use. The *New York Times* published an article called *Monsanto to Curb Use of PCB Compounds,* sealing the knowledge that PCBs were a threat to human health. The mainstream report highlights the change in attitude that the hazards were no longer confined to boardroom discussions; they were matters of public record. For a major electric utility like Duke, this served as formal notice that the PCB fluids they handled were a subject of intense national concern (New York Times, 1970).

96. The 1970 Interdepartmental Task Force on PCBs: The formation of this high-level federal body (including EPA, USDA, and FDA) signaled to industrial entities like Duke that PCBs were a primary target of federal environmental enforcement and public health scrutiny (USEPA, 1972; Markowitz, 2018).

97. 1970 - Technical Liability and IEEE Standards. By 1970, technical organizations like the IEEE began to fundamentally re-evaluate askarel. The industry began viewing it as a significant liability requiring absolute containment rather than a routine maintenance fluid. By this juncture, the Standard of Care was shifting toward ensuring that these chemicals were strictly isolated from the public and the environment (IEEE C57 Standard Series; EPRI, 2016).

98. 1972 National Technical Information Service (NTIS) Report on PCBs and the Environment. The federal government codified the scientific consensus on PCB toxicity through a comprehensive report issued by the NTIS, removing any ambiguity regarding the environmental risks of failing to contain dielectric fluid/insulating liquid waste streams (NTIS, 1972).

99. 1972 FDA Regulatory Milestone: In 1972, the FDA established Action Levels for PCBs in the edible portion of fish (5.0 ppm). For Duke, this would amplify concern of potential contamination from releasing waste electric insulation fluid into the watershed (USFDA, 1972).

100. The 1972 Monsanto-to-Duke Correspondence: Direct letters from Monsanto to Duke management recommended high-temperature incineration or the return of waste askarel. At this point Duke was warned that traditional disposal methods, such as surface application, were no longer acceptable for waste askarel (Monsanto-to-Duke Correspondence, 1972; Markowitz, 2018).

101. 1973 General Electric Task Force-Pyranol Transformers Letter: GE established a task force mandating total containment of PCBs, acknowledging the major environmental threat. The letter also states that GE knew that Duke was investigating dry-type transformers in 1970 as replacement equipment for askarel transformers. Not only does this confirm that Duke's primary equipment supplier transitioned to strict policy for PCB release, it discloses that Duke's actions indicated awareness of the impending transition away from askarel no later than 1970 (GE Internal Correspondence, 1973).

102. 1975 Monsanto Hygiene Guide. Monsanto published *A Guide for the Handling and Disposal of PCB's* and provided it to customers like Duke with an instruction manual for absolute containment and controlled disposal, further rendering improper disposal of waste electric insulating fluid out of line with safety mandates (Monsanto Chemical Co., 1975).

OPINION II: DUKE'S AWARENESS OF PCBS IN TRANSFORMER OIL

103. It is my opinion that by 1968, Duke was likely aware, or should have been aware, that practically all of the waste transformer oil generated in its operation was contaminated with PCBs.

104. Historical Context of Shared Infrastructure: Throughout the mid-20th century, electric utilities utilized the same pumps, hoses, filtration units, and storage tanks to service both mineral oil and askarel (PCB) equipment. General Electric's own service manuals often failed to mandate separate equipment for different fluid types. This shared infrastructure resulted in trace amounts of PCBs distributed throughout the entire oil inventory of a utility system, making contamination a physical inevitability of Duke's service protocols.

105. In 1968 the electric utility industry experienced a fundamental shift in its understanding of PCBs. This was documented by the 1972 NTIS report stating that 1968 was the last normal year in the industry following the acceptance that PCB pollution was indeed a crisis. The NTIS report specifically called for the implementation of good housekeeping in the electric utility operations, and the clear implication was that the historic of waste mineral oil with waste askarel resulted in a single stream of PCB contaminated waste oil. The focus on segregating PCB contaminated waste confirmed that the electric industry practice in 1968 was comingled waste mineral oil and waste askarels because up to that point, there was no impetus not to do so. This industry snapshot demonstrates that waste transformer oil in 1968 was known to contain mineral oil plus some smaller proportion of waste askarel.

106. A February 10, 1971 meeting of NEMA was assembled to plan a committee to develop standards for the use and disposal of askarels. The meeting documented a timeline of committee events within NEMA advancing the group through industry leaders from 1970 until 1971. The record of the NEMA meeting included other committee meetings that occurred during the same event with representatives from Duke Power in attendance (NEMA, 1971)

107. In 1970 while preparing for a public conference on mosquito control, Duke's environmental manager George Swearingen made handwritten edits to in advance of his

presentation that documented his intent to communicate that the transformer oil used in oiling was “really about 99% mineral oil” mixed with diesel fuel. Although the handwriting or subsequent presentation did not state that the 1% balance fluid in the transformer oil was askarel, that missing information can be presumed to be true. In 1968, 1960, or in 1950, Mr. Swearingen, along with any Duke maintenance technician would have been aware that there were no separate waste streams for askarel and mineral oil, and that the liquids were mixed. Up until 1968 there would not have been a reason to segregate the liquids during cleanup or maintenance work when waste fluid was generated. That PCBs had acute health effects was long known, but once the dangers of PCBs as a global pollutant became public, certain staff within Duke’s organization would have made the connection that the askarel waste liquid was disposed with the mineral oil waste in the waterways. Swearingen’s handwritten edit to his presentation in 1970 indicates his awareness of the importance of the 1% component in the waste transformer oil (DUK_00052088 Duke, Swearingen Notes 1970).

108. The 1974 ANSI C107.1 Standard: In 1974, the American National Standards Institute published the first edition of ANSI C107.1, *"Guidelines for Handling and Disposal of Capacitor- and Transformer-Grade Askarels Containing Polychlorinated Biphenyls."* This document was the first industry-wide consensus to formally identify PCB-laden waste as requiring "acceptable disposal" methods such as high-temperature incineration or controlled landfilling. Crucially, the 1974 standard warned against any disposal method that could lead to environmental release, effectively placing Duke on notice that using "waste transformer oil” as a surface-applied larvicide was inconsistent with professional engineering standards (ANSI C107.1, 1974; Markowitz, 2018).

109. The 1976 ANSI Revision: The 1976 update to ANSI C107.1 further refined these guidelines, reinforcing the mandate for "total containment." This revision served as a bridge between the initial industry awareness and the impending federal regulations. It confirmed that the technical community's stance was resolved, and that discharging these fluids into the environment was negligent. (ANSI C107.1, 1976; IEEE 637, 1985).

110. The Reality of Cross-Contamination (1978): By 1978, industry testing revealed the sheer scale of the legacy problem: as little as one gallon of residual askarel in a thousand-gallon

tank could contaminate an entire volume of mineral oil above the 50 ppm regulatory threshold that is compared to today. The EPRI and major utilities conducted extensive sampling of their fleets during this period, confirming that there was no such thing as a guaranteed PCB-free oil in an older utility system (EPRI, 1986; Markowitz, 2018).

111. The EPA Presumption of Contamination (1978): Following the enactment of TSCA, the EPA codified this awareness through the "Presumption of Contamination" rule. The EPA mandated that all mineral oil-filled equipment was presumed to be "PCB-Contaminated" (50–500 ppm) unless analytical documentation proved otherwise. This rule was a direct regulatory acknowledgment that the industry's own maintenance history had rendered all "transformer oil" potentially hazardous, effectively creating an evidentiary landscape where waste oil was legally and technically inseparable from PCB waste (US EPA, 1970; US EPA, 1979).

112. The article *"Mosquito Control Then, Now, and in the Future"* (Mulla, 1994) provides context that during the decades leading up to 1978, mosquito control programs relied on petroleum hydrocarbon oil for larvicide, but no mention of transformer oil was made. The article confirmed the timing of eliminating pesticides such as DDT and organochlorines in the 1960's in response to knowledge of widespread contamination (Mulla, 1994).

113. Modern Scientific Validation (2021): A 2021 study in the *Journal of South Carolina Water Resources* identifies the historical application of used transformer oil as a source of PCB loading in South Carolina reservoirs. It confirms that the PCB fingerprint in Lake Wateree sediment corresponds directly to the specific Aroclor mixtures (Aroclor 1254 and 1260) found in legacy utility fluids—mixtures consistent with the distribution of waste transformer oil contaminated with PCBs (Journal of South Carolina Water Resources, 2021; SCDHEC, 2022).

114. Forensic conclusions taken together: Duke's environmental manager's stated awareness that waste transformer oil used for mosquito control was 99% mineral oil and 1% something else; the 1974/1976 ANSI disposal standards describing PCB contamination of mineral oil; the NTIS 1972 report that recognized the long-standing problem of mixed waste streams; the 1978 EPA's presumption of contamination policy for transformer oil, and the 2021 sediment

sampling review from Lake Wateree connect the reality that by the 1970, Duke was operating in a professional environment where waste transformer oil was understood to be contaminated with PCBs.

OPINION III: DUKE'S IRRESPONSIBLE HANDLING OF WASTE TRANSFORMER OIL

115. It is my opinion that from the 1940's until at least 1972, Duke likely knew, or should have known, that PCBs were present in the waste transformer oil being disposed through its reginal mosquito control program. Furthermore, during the period from 1968 until at least 1972, an overlap occurred wherein 1.) Duke had knowledge that the PCBs present in waste transformer oil, and 2.) Duke had knowledge that the PCBs present in the waste transformer oil were toxic, persistent pollutants that contributed to worldwide environmental contamination.

116. Duke's disposal of waste transformer oil in the Catawba-Wateree river basin is well documented. Public documents and material produced by Duke in discovery establish the use of waste transformer oil for mosquito control from the 1940s until the 1970's.

117. The presence of PCBs in the waste transformer oil used by Duke for larvicide from the 1940's until at least 1972 is well documented.

118. The application of PCBs to a waterway resulting in lasting sediment contamination is well documented. From an environmental perspective, the application of waste transformer oil, and a proportion of dense PCB liquids therein, to the surface of stagnant or slow-moving water for decades, was an uncontrolled source of contamination from PCBs. Operationally, this involved spraying hundreds of gallons of liquid during daily operations so that the oil formed a lasting, thin film that would suffocate mosquito larvae along the shoreline. It is well known that dense PCBs sink and bind into the sediment, and then drift with sediment transport and becoming incorporated into the benthic ecosystem.

119. 1968 Duke Lake Sanitation Program. Discovery document DUK00000536 is an August 12, 1968 letter report prepared by Harold Brown, Harold Brown, MD, of Columbia University. This third party report summarized a *Conference and Survey of Duke Power Company's Lake Sanitation Program, July 26-31, 1968*, and was attended by George Swearingen. The report documented Duke's formula for larvicide oiling as a mixture of transformer oil, motor oil and diesel fuel to be applied every eight days in areas of stagnant water and mosquito breeding grounds. The notes also described that Duke used lake elevation fluctuations to control mosquito breeding grounds various lakes. (DUK_00000536 Duke, Lake Sanitation Report, 1968).

120. 1968 The PCB Disruption and the Electric Utility Industry's Special Responsibility. The 1972 NTIS report documented the influence exerted onto the electrical industry from the first scientific confirmation in 1966 of the global nature of the environmental crisis that was attributed to PCBs. The NTIS review by five federal agencies considered the sources of land and water contamination, and the electric utility sector was assigned "special responsibility" to maintain strict housekeeping conditions regarding use and disposal of PCBs, since the greatest volume of PCBs in use at the time was in electric insulating liquids. Specifically, the report summarized impending restrictions of liquid discharges of PCBs in contrast to the preceding uncontrolled release of PCB waste to waterways. The NTIS report set target an extremely conservative surface water quality standard of 0.01 parts per billion in receiving waters from industrial effluent (NTIS, 1972).

121. 1968 The Results of Careless Handling of PCB Waste. The NTIS report stated that the way to achieve strict water quality standards was through good housekeeping, and specifically by eliminating vague waste labels and terminology. The implication was that at least in part, the generic labelling of waste transformer oils, hydraulic oil and other waste had resulted in waste mineral oil being combined with waste askarel due to the widespread careless handling and improper disposal of askarel. The focus on segregating PCB contaminated waste confirmed the electric industry practice at the time was characterized by comingled waste mineral oil and waste askarels. The federal agencies called attention to the need to control even small quantities of PCB waste, that up until then were inconsequential. The picture in time provided by the 1972 NTIS report of the electric utility attitudes is

consistent with Duke's continued use of PCB contaminated waste transformer oil for mosquito larvicide after 1968.

122. 1968 Greenwood, SC Index-Journal. The mosquito control program was further articulated in a March 9, 1968 feature in *Index-Journal of Greenwood, SC*. The article detailed Duke's large-scale operations across its reservoir system, specifically quoting company officials regarding the scientific application of oil to eliminate mosquito larvae. This coverage is significant as it bridges the transition of the same program into 1971 and 1972, establishing that the program operating at a large scale in 1968 used a mixture of oil and diesel fuel. For Lake Greenwood a crew of six men worked for eight days from three boats to complete the mosquito control work along over 200-miles of shoreline, working continuously through the mosquito season. The article featuring Duke reinforced the perception that the oil used for mosquito control was a beneficial component of reservoir management and confirmed timing related to an eight-day cycle of application of larvicidal oil (The Index-Journal, 1968).

123. 1970 The Swearingen Statement. The report from a regional industry symposium called the *Proceedings of the Workshop on Mosquito Control in North Carolina was* sponsored by the University of North Carolina, Water Resources Research Institute. The 1970 meeting was a collaborative forum for major regional energy utilities to exchange mosquito abatement strategies. In addition to Duke, the meeting included representatives from Carolina Power & Light and South Carolina Electric & Gas. The disclosure of Duke's reliance on transformer oil to the cross-utility participation documents an opportunistic regional method for managing transformer waste oil. Duke's environmental health manager, George Swearingen, stated that Duke mixed waste transformer oil with diesel fuel in its mosquito control plan, and confirmed that statement in a documented question and answer session, stating that the oil added visibility and sheen that aided the workers in the spray application process (DUK_00052088 Duke, Water Resources Research Institute, 1970).

124. 1970 The Swearingen Statement Preparation Memo. Duke's preservation of the handwritten edits to Swearingen's May 1970 presentation documented that the transformer oil used in oiling was "really about 99% mineral oil" mixed with diesel fuel. Although the

handwriting or subsequent presentation did not state that the 1% balance fluid in the transformer oil was askarel, that missing information can be presumed to be true. Even without documenting the direct addition of waste askarel to the waste transformer oil, it is a well-established that the average waste mineral oil over the decades generated by Duke contained PCBs (DUK_00052088 Duke, Water Resources Research Institute, 1970).

125. 1971-1972 Public Outreach and the Harmless Oil Narrative. For at least two years during the summers of 1971 and 1972, Duke coordinated a publicity campaign in numerous local newspapers across the Catawba-Wateree River Basin service area, including the immediate vicinity of Lake Wateree, to maintain public acceptance of its larvicide program. These advertisements and press releases featured a photograph of George T. Swearingen, presented as Duke's Public Health Sanitarian, wading in shoreline water, collecting mosquito larva samples. The newspaper campaign contrasted to Duke's internal documents in that the newspaper ads consistently described the oil used for larvicide as "harmless oils" that provided a beneficial use by eradicating mosquito breeding ground, while the knowledge about the oil's PCB content remained within the utility's operational and environmental departments (The Chester News, 1971; Fort Mill Times, 1972)

126. Scale and Volume of Waste Transformer Oil: Historical records and depositional testimony, including the Swearingen Statement, describe scale of this waste disposal outlet. Duke's mosquito abatement program utilized a systematic application rate of approximately five gallons of used transformer oil per acre of surface water. The transformer oil was desirable in the mixture due to the bright and visible sheen produced on the water surface (Water Resources Research Institute, 1970; Journal of South Carolina Water Resources, 2021).

127. Sustained Larvicidal Efficacy. During the peak mosquito breeding season—extending from May through September—these applications were performed an eight-day frequency across the thousands of shoreline acres of the Catawba-Wateree Basin. The intent was to maintain a perpetual disruption to the rapid reproductive cycle of mosquitos. This high-frequency dosing corresponds with a substantial theoretical volume of oil that could be

continuously discharged, providing a persistent pathway for PCB contamination (Water Resources Research Institute, 1970).

128. Estimated Waste Oil Volume for Lake Wateree: To estimate the potential scale of the waste oil disposal on Lake Wateree, the annual load of waste transformer oil can be calculated by applying the documented operational parameters of the mosquito oiling program. The estimated annual volume of applied larvicide oil is calculated from Duke's statements and shoreline area documents.

- Acreage (A): Lake Wateree comprises approximately 242 miles of shoreline. Assuming a standard application swath of twenty feet from the shoreline into the water for effective larval control, the treated area is approximately 585 acres.

- Application Rate (R): Based on the Swearingen Statement and the 1970 Coordination Meeting, the standard rate was five gallons of waste transformer oil mixed into a proportion of fuel oil per acre.

- Frequency (F): Using a schedule of once per week during the 20-week peak season (May through September).

129. This calculation demonstrates that over 58,000 gallons of PCB contaminated waste transformer oil could theoretically be applied to the entire shoreline of Lake Wateree in a single season. Recognizing that the entire shoreline would not require treatment, the volume of waste oil applied could still be in the conservative estimated range of several thousand gallons per season, and consistent with a daily volume of 150-gallons of oil described in the references. When extrapolated across the decades of the program's operation, this volume represents loading of PCBs into the waterway sediment.

130. River Basin Volume Extrapolation: When the volume logic established for Lake Wateree is extrapolated across the entire Catawba-Wateree Basin, the scale of the possible disposal reaches an industrial magnitude. The basin consists of eleven major reservoirs covering approximately 1,745 miles of shoreline. Using the same conservative 20-foot treatment swath, the total treated area expands to approximately 4,230 acres. Applying the documented rate of five gallons per acre at a weekly frequency over a 20-week season, the estimated

annual basin-wide loading of waste transformer oil is in the range of 423,000 gallons. Using a conservative estimate that even ten percent of the shoreline required treatment, the annual volume of waste transformer oil would be near 50,000 gallons. This extrapolation illustrates that Duke's mosquito control program had the potential to distribute a large volume of waste transformer oil annually across the river system. (Water Resources Research Institute, 1970; Journal of South Carolina Water Resources, 2021).

131. Comparative Analysis of Waste Generation: To contextualize the scale of this potential disposal, the calculated application volumes can be compared to the total annual waste oil generated by a utility of Duke's size during the 1970s. Based on industry data from the Electric Power Research Institute (EPRI) and IEEE standards regarding transformer maintenance and oil replacement cycles, it can be estimated that a utility system with Duke's generating capacity and substation density would typically generate over 400,000 gallons of waste transformer oil annually through routine servicing, repairs, and decommissioning. The close alignment between this generation rate and the theoretical waste transformer oil volume of 50,000 gallons up to 423,000-gallons indicates that the disposal via the mosquito control program was an opportunistic cost offset to eliminate additional fuel oil purchase and an outlet for a significant portion of Duke's waste oil inventory (EPRI EL-4602, 1986; IEEE 637, 1985).

132. The 1972 Clean Water Act Paradigm Shift: The expansion of the 1948 Federal Water Pollution Control Act into the Clean Water Act in 1972 represented the definitive end of industrial dumping. By establishing the National Pollutant Discharge Elimination System (NPDES), the law made it a federal offense to discharge any pollutant into navigable waters without a permit. As a utility with deep institutional ties to the Catawba-Wateree River system, Duke was required to recognize that waste transformer oil was a pollutant, and its intentional application to the water's surface was not compliant with the emerging federal mandate for fishable and swimmable waters (CWA, 1972; Gottlieb, 2005).

133. The technical understanding of PCB density was well known in 1968, and when considering the waste transformer oil spray, although mineral oil would float on the surface of the water, the askarel components in Duke's waste oil were known to be sinkers. It would

have been apparent to certain scientific staff that the PCBs would sink in the water. Applying this waste stream as a mosquito larvicide was technically incompatible with environmental management principles that an environmental health professional would be aware of by 1968. The oil would not merely suffocate larvae on the surface, but the dense fluid portion would migrate to the reservoir floor, creating permanent sediment reservoirs. Continuing this practice through 1972 ignored the established physics of PCB's fate and transport and the known dangers of PCBs (ATSDR, 2000).

134. 1972 Industry Acknowledgement of Waste as Hazard: By the early 1970s, the utility industry began publicly reclassifying used oil from a reusable resource to a hazardous waste stream. The 1972 NTIS report and the formation of federal task forces provided the data necessary for Duke to understand that the beneficial use justification for mosquito control was no longer scientifically or legally defensible. Industry knowledge increasingly recognized that disposal by application was a failure of containment (Markowitz, 2018).

135. Verification of Improper Disposal The Agency for Toxic Substances and Disease Registry (ATSDR) confirms that the pre-1977 era was characterized by open-end applications of PCBs, including their use as pesticide extenders and the improper dumping of transformer fluids. The utility industry had the technical capacity to understand, as codified in the ATSDR's later findings, that intentional surface application was not a beneficial use for mosquito control but a primary pathway for the introduction of permanent sediment contamination. Duke's use of transformer oil as a mosquito larvicide represents a documented instance of the "careless disposal practices" identified by federal health authorities as the source of modern environmental liabilities (ATSDR, 2000; USEPA, 2016).

136. The 1972 Monsanto Special Undertaking (Indemnification): In a letter dated January 21, 1972, Monsanto implemented a "Special Undertaking" for its industrial purchasers of PCBs, including GE. This document required purchasers to acknowledge that PCBs "tend to persist in the environment" and that "care is required in their handling, possession, use and disposition." By signing this agreement, the purchasers agreed to "defend, indemnify and hold harmless Monsanto" against claims related to the contamination of humans, wildlife, and the environment. The significance of Monsanto's 1972 milestone indemnification for the

electric industry is that the environmental hazards of PCBs were not background concerns, but were priority liabilities of doing business in the industry (Monsanto Company "Special Undertaking" Agreement, 1972; Markowitz, 2018).

137. The 1972 GE Pyranol Disclosure Letter: Shortly following the January indemnity agreement, Monsanto issued a specific warning regarding Pyranol (GE's brand of askarel). The document stated that the PCBs in Pyranol were "not readily biodegradable," were identified as "contaminants" to the environment, and "may adversely affect some species of animal and marine life." This direct communication to Duke's primary OEM confirms that the technical circle in which Duke operated was fully apprised of the exact chemical mechanics (lack of biodegradability and environmental toxicity) that rendered surface application for mosquito control an act of environmental negligence (Friedman, 2024; GE Internal Correspondence, 1972).

138. In 1972 Duke was a major utility partner, GE customer, and primary stakeholder in the electric utility industry. Duke operated as a sophisticated industrial entity and the available evidence suggests that Duke's directors remained ignorant of the contractual and technical shifts within its own supply chain regarding the indemnification that Monsanto required as a condition of sale of Aroclor to GE.

139. Regional Accountability and Lake Wateree: As the owner and operator of the Lake Wateree hydroelectric project, Duke held a unique standard of care to protect the reservoir's water quality and organic sediments. By 1968, the widespread recognition that PCBs were bioaccumulative and that waste transformer oil was contaminated with PCBs meant that the waste oil applied to the lake posed a threat to the long-term health of the watershed. (SCDHEC, 2022; USEPA, 2016).

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Exhibit 15

Sören Jensen, "Report of a New Chemical Hazard," New Scientist, Dec. 15, 1966, p. 612



for various purposes such as hoeing. At the National Institute of Agricultural Engineering, Howden, Midlothian, some interesting new attitudes are developing, however. For one thing herbicides have eliminated the need for close manual procedures which means that it is no longer necessary to grow all crops in single rows. There would be distinct advantages in growing potatoes, for instance, in beds as wide as three or four rows. It would be more economical of land, earthing-up could be done quicker, and the soil would suffer less from the compressional damage done by agricultural machinery.

There is a drawback, however. Traditional tractor design does not permit the use of wide strips; and no one elsewhere seems to have given much thought to ways in which tractors could be improved. At NIAE engineers have had a hard look at what farmers are going to need in the future and have designed an impressive "self-propelled, multi-purpose toolframe", which could well come to dominate our rural landscapes in a few years' time. Essentially it consists of a large box frame, supported at chest-height on conventional tractor wheels—a large pair at the front and small pair at the rear corners. At the front of the frame in the centre is a powerful, 70-horsepower tractor engine coupled to the driving wheels by independent oil-driven hydrodynamic motors.

The driver sits high up on the rear member of the box frame in a seat that can be hydraulically shifted from side to side, or turned right round to face the reverse direction. He has two levers at his left hand: both forward gives a range of forward speeds; both backward, reverse speeds. By moving them independently the wheels will revolve at different rates and assist turning. The rear wheels are telescopically mounted and can be raised or lowered hydraulically. They are self-levelling over uneven ground. Agricultural implements are mounted—without the need for soil-damaging wheels—in the centre of the box frame. Implements, likewise, can be designed for hydraulic operation and the frame is equipped with two large oil tanks at each front corner and several hydraulic take-off valves. The whole contrivance is simplicity itself

potatoes in one operation. Work is also in progress on a lowly grow harvester.

That tractor wheels are indeed harmful to soil has emerged from a unique field study at the institute. Using a gamma-ray probe and detector, researchers there have been able to observe for the first time the actual local profiles of soil density across tractor ruts, plough furrows and the like. They have related these to the failure of plants such as raspberry canes to grow where the soil has become compacted. Clods are also typically the result of the passage of heavy machinery across the soil so that cutting down the extent to which tractors and wheeled vehicles run over the soil will undoubtedly improve production.

This is by no means the only application of modern methods of science to farm mechanization at NIAE. Novel work under way aims at automated singling of sugar beets. Again it is herbicides like paraquat that have made such advances possible. Manual thinning by hoe is tedious and expensive. The plan is to use a machine equipped with photoelectric detectors sensitive to the spectral absorption lines of the green chlorophyll pigment in leaves. Signals from this device, indicating the density of foliage, will control a paraquat spray which will squirt the excess plants, leaving only those required at specified intervals for optimum growth.

Engineering data during field trials on new equipment is about to be collected by radio telemetry, and modern data-processing methods are under development at NIAE.

REPORT OF A NEW CHEMICAL HAZARD

A Swedish research worker has expressed concern over the increased amounts of polychlorinated biphenyl (PCB) entering the air, presumably from industrial smoke and rubbish-dump smoke, and being absorbed by water and taken up by fish and later humans. PCB which is related to and as poisonous as DDT was detected by Mr Sören Jensen of the Institute for Analytical Chemistry, University of Stockholm, in some 200 pike taken from different parts of Sweden, fish and fish-spawn throughout the country, an eagle which was found dead in the Stockholm Archipelago, and in his own, his wife's and his baby daughter's hair. As the baby is only five months old her father concludes that she got her dose of PCB with her mother's milk.

It is not known at present how much of this substance is dangerous or even fatal. If it is comparable with DDT then the limit would be 0.5 mg per cubic metre of air—and, for comparison, the dead eagle had at least 10 times as high a concentration in its body. For purposes of elimina-

and has detected PCB first in an eagle from 1944.

In Sweden, PCB is known to be used in electrical insulations, hydraulic oils, high-temperature and high-pressure lubricating oils, paints, lacquers and varnishes, and as pigments in various plastics. It does not seem to be used as an insecticide. It is not destroyed by incineration and may enter the body directly through the skin, by breathing, or by way of food (especially fish). It is particularly harmful to the liver, and also the skin; this has been demonstrated by experiments on mice. PCB is much harder to break down than DDT and there is every reason to suppose that it is much more difficult to get it out of the system. The substance has also been detected in the air over London and Hamburg and also in seals caught off Scotland. It can therefore be presumed to be widespread throughout the world.

LOAVES AND FISHES

The famine which now threatens parts of India has tended to focus the attention of the developed countries on that sub-continent's chronic inability to feed its teeming people, but a warning note came last week from another less publicized area. Dr B. R. Sen the Indian Director General of the UN Food and Agriculture Organization was addressing a regional conference at Punta del Este, Uruguay. He lambasted the governments of Latin America for their unwillingness to face what could be "a very serious situation indeed". It would take, he said, an increase in food production of four per cent a year to stem "social and political unrest which still prevails", or even to prevent it from worsening.

Dr Sen's warning comes none too soon. Malnutrition if not actual hunger is widespread in Latin America, where per-capita food production has dropped by four per cent in the past six years. At the same time the population is expected to double itself (to 422 million) by 1985. Dr Sen believes the four-per-cent rise to be technically feasible, if an all-out effort is made now.

Apart from the struggle to increase food supplies to keep pace with population, however, efforts are also being made to overcome traditional prejudices against various foods which may be plentiful though neglected.

In the waters of Lake Victoria, for instance,—they cover an area about the size of Ireland—there are vast shoals of tilapia, a firm white fish, weighing about 8 oz and very tasty. European firms have already asked the Tanzanian government about the possibilities of sending frozen

Exhibit 16

R.W. Riseborough, "Polychlorinated Biphenyls in the Global Ecosystem," Nature, Vol. 220, Dec. 14, 1968

Polychlorinated Biphenyls in the Global Ecosystem

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Polychlorinated biphenyls are widely dispersed in the global ecosystem, and are powerful inducers of hepatic enzymes which degrade oestradiol. Together with other chlorinated biocides, such as DDT, they could account for a large part of the aberration in calcium metabolism which has been observed in many species of birds since the Second World War.

DECLINING populations of raptorial and fish-eating birds in Great Britain[1] and North America[2] have produced thin-shelled eggs since the period after the Second World War. A widespread change in the chemical environment which affected the calcium physiology of these species evidently occurred at that time. The chlorinated hydrocarbons, which came into general use in the 1940s, may now be the most abundant synthetic pollutants present in the global environment[3]. Thin eggshells have been found only in species which accumulate high concentrations of these compounds: relatively uncontaminated populations of these species continue to produce normal eggs[1,2].

Calcium metabolism in birds is intimately related to reproductive metabolism and is to a large extent regulated by steroids such as oestrogen and vitamin D[4]. The deposition of medullary bone, the chief source of calcium during egg and eggshell formation, is controlled by the steroid sex hormones[4–7], and hens deficient in vitamin D lay eggs with lower eggshell weights[8]. Steroids are hydroxylated and thereby degraded *in vivo* and *in vitro* by hepatic enzymes induced by exogenous, lipid-soluble substances, including the chlorinated hydrocarbons[9–14]. The relatively small amounts of chlorinated hydrocarbons required to produce this effect[9,11,15–18], and the discovery that small amounts of some of the DDT compounds are oestrogenic[9,19,20], have made irrelevant much of the parts per million approach to pollutant ecology based on toxicity data alone.

In both Great Britain[21–24] and North America[25] it was the decline of the peregrine falcon which initiated concern about the extent of the harmful effects of environmental contamination. In the United States the eastern population was extinct before competent observers were aware of a general, widespread decline[25]. Breeding peregrines persist in apparently normal numbers in British Columbia[26] and in the Arctic[27,28].

In 1967 we collected an unhatched, abandoned egg of a peregrine falcon in south-western North America, where a small remnant population remains (unpublished work of M. N. K., R. W. R. and S. G. H.). Analysis of this egg (Table 1) showed that it contained almost 5 mg of *p,p'*-DDE (dichloro-2,2-*bis*(*p*-chlorophenyl) ethylene). Unknown peaks present in the chromatograms of the extract of the egg were unidentified until polychlorinated biphenyls (PCB) were detected in European wildlife[29–31]. Positive confirmation of the identification was accomplished by mass spectrometry in Sweden[30]. The retention times of the unknown peaks in the peregrine extracts proved to be identical with those of several PCB compounds on *DC*-200 and *QF*-1 columns[3] and on a mixed *SE*-30:*QF*-1 column. Other species of birds and fish were subsequently analysed for PCB. The chlorine content of several extracts and standards was determined with a Dohrman microcoulometric detector and a method of quantification of the PCB compounds was devised based on peak heights produced in the electron capture detector related to standard *p,p'*-DDE[3]. The DDT compounds are destroyed by nitration[32] and *p,p'*-DDT (1,1,1-trichloro-2,2-*bis*(*p*-chlorophenyl)ethane), DDD (1,1-dichloro-2,2-*bis*(*p*-chlorophenyl)ethane) and toxaphene are dehydrochlorinated by saponification with alcoholic KOH. PCB is not degraded by either procedure.

Table 1. CHLORINATED HYDROCARBONS IN NORTH AMERICAN PEREGRINE FALCONS

Sample	Dieldrin	Total DDT*	Percentage DDE	PCB	DDT/PCB
1. Unhatched egg†					
Baja California (wet)	0·11	102	97	10·2	10
2. Second year‡ migrant from Arctic					
Breast muscle (wet)	NM	99	94	28	3·5
Breast muscle (dry)		296		84	
Brain (wet)	NM	85	98	21	4·7
Carcass (wet)	0·87	70	93	19·7	3·5
Carcass (lipid)	62·5	5,000		1,420	
3. Immature, California§					
Breast muscle (wet)	NM	14·4	90	9·4	1·5
Liver (wet)	NM	7·7	92	4·5	1·7
Brain (wet)	0·04	2·8	89	1·5	1·9
Brain (lipid)	0·50	36		19·3	
Carcass (wet)	0·11	20·2	92	10·8	1·9
Carcass (lipid)	1·6	300		160	
4. Adult, California‖					
Breast muscle (wet)	NM	127	87	98	1·3
Liver (wet)	NM	77	80	57	1·4
Brain (wet)	0·31	49·5	86	34·6	1·4
Brain (lipid)	3·7	595		415	
Carcass (wet)	1·7	85	87	65	1·3
Carcass (lipid)	50	2,600		1,980	
5. Immature¶ migrant from Arctic					
Breast muscle (wet)	NM	2·3	81	0·16	14
Breast muscle (dry)		7·8		0·54	
Liver (wet)	NM	1·0	92	0·10	10
Brain (wet)	NM	0·43	83	0·037	12
Body fat (wet)	NM	50·3	82	3·2	16
Carcass (wet)	0·07	9·3	82	0·80	12
Carcass (lipid)	0·44	63·7		5·5	
6. Immature Arctic migrant**					
Breast muscle (wet)	NM	1·9	89	0·6	3·4
Breast muscle (dry)		6·0		1·9	

Concentrations in parts per million wet weight, dry weight or lipid weight.

* DDT residues include: *p,p'*-DDT, *p,p'*-DDE, *p,p'*-DDD (*p,p'*-TDE), *p,p'*-DDMU, *o,p'*-DDT and *o,p'*-DDE. NM, Not measured.

† Chlorinated hydrocarbon contents of the egg were: 4,700 μg *p,p'*-DDE; 40 μg *o,p'*-DDE; 29 μg *p,p'*-DDT; 7·4 μg *p,p'*-DDD; 37 μg *p,p'*-DDMU; 5 μg dieldrin; 12 μg heptachlor epoxide. Concentrations were calculated by assuming a volume of 47·3 ml., the average value obtained by measuring eleven clutches of peregrine eggs from California in the Museum of Vertebrate Zoology, University of California, Berkeley, and by assuming a density of 1·0.

‡ Second year female, captured in October on the Texas coast during migration. Died in captivity shortly afterwards, no apparent cause of death. No body fat. Total body content of chlorinated hydrocarbons: 35 mg DDT, 10 mg PCB, 0·44 mg dieldrin, 0·18 mg heptachlor epoxide. Total body lipid, 7 g.

§ Plumage characteristics of both 3 and 4 were intermediate between those of typically resident California birds and the Arctic race *F.p. tundrius*, as described by White[33]. No. 3 was an immature female of the year trapped in the southern San Francisco Bay area in the winter of 1966. Observed feeding in the area for a week before capture. Died suddenly after eating a dead gull. Moderate body fat. Total body chlorinated hydrocarbon content: 13 mg DDT, 6·8 mg PCB, 0·07 mg dieldrin, 0·09 mg heptachlor epoxide. Total body lipid, 43 g.

‖ Adult female. Trapped in the southern San Francisco Bay area in the winter of 1966. Observed feeding in the area for a month before capture. Died shortly afterwards with no apparent cause of death and no body fat. Total body chlorinated hydrocarbon content: 52 mg DDT, 40 mg PCB, 1·0 mg dieldrin, 1·0 mg heptachlor epoxide. Total body lipid, 20 g.

¶ First year female trapped on the Texas coast in October. Lost at Pt Mugu, California, the following January and was shot by a sportsman 3 weeks later. Abundant body fat. Total body content: 7 mg DDT, 0·6 mg PCB, 0·05 mg dieldrin, 0·17 mg heptachlor epoxide. Total body lipid, 110 g.

** First year female trapped on the Texas coast in October. Died shortly afterwards of heat prostration.

In Table 1 are presented the results of analyses of peregrine falcons which died from a variety of causes

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shortly after being trapped for falconry. Significant amounts of PCB were present in Arctic peregrines only a few months old (Nos. 5 and 6), but higher residues were present in a second year Arctic bird (No. 2) and exceptionally high residues were present in an adult trapped in California (No. 4). In birds 2 and 4 the total lipid reserves were very low, and in both the brain concentrations of DDE and PCB were high, perhaps at toxic levels. Fat mobilization during reproduction or in times of starvation or stress could be expected to cause significant changes in the internal distribution of chlorinated hydrocarbons. Steroid hydroxylase activity in the liver might increase at this time. Dieldrin concentrations were lower than in the peregrines analysed in Britain, but DDE concentrations were approximately comparable[34].

Table 2 presents the results of analyses of peregrine prey species, remains of which were collected at eyries in Baja California, Mexico. With the exception of the remains of one mourning dove (*Zenaidura macroura*) and of three fish bats (*Pizonyx vivesi*), prey material found at four eyries consisted of sea birds. Of these, the eared grebe (*Podiceps caspicus*) and the black petrel (*Loomelania melania*) constituted 32 and 25 per cent, respectively, of the remains.

Black petrels, like other petrels and shearwaters (Table 3), contained especially high concentrations of both DDT and PCB. Reproductive success in this population of peregrines seems to be subnormal. In 1968 no pairs were observed to hatch or fledge more than a single young. In the past, two to four young, the number normally produced by healthy peregrines[25,27], were raised by each pair (L. W. Walker, personal communication). The thickness of fragments of a peregrine eggshell, with its membrane, collected in 1968 below an eyrie where one young hatched, was 0·24 mm, a decrease of 34 per cent from the mean thickness of 0·34 mm ± 0·015 mm (95 per cent confidence level) in twenty-three eggs collected in the area before 1947. The region is wilderness, with little or no human interference, and is remote from sources of pollution.

In California, numbers of breeding peregrines have been reduced by at least 80 per cent in recent years. The remaining few pairs, however, seem to be reproducing normally and rear, when undisturbed, between two and four young each year. They are found, like most of the surviving pairs in Great Britain[21–24], in a relatively uncontaminated region and seem to be feeding on birds which contain low concentrations of chlorinated hydrocarbons. A pair which fledged three young in 1968 fed chiefly on passerines and columbiformes during the breeding season. Both prey groups are relatively uncontaminated (M. N. K., R. W. R. and S. G. H., in preparation). A clutch of eggs collected in this region weighed as much as the eggs obtained in pre-war years, whereas other peregrine eggs from California collected since the Second World War have been thin-shelled (ref. 2, and D. W. Anderson, D. Hickey and R. F. Christensen, in preparation). Despite official protection the surviving birds are still subjected to shooting by sportsmen and to harassment at the eyries. If these could be effectively reduced the population might yet survive.

In Table 3 are presented the results of analyses of marine and terrestrial birds and of three species of freshwater fishes for PCB and DDT content and concentration. From the ratio of total DDT to PCB, it is apparent that regional fallout patterns exist. In most of the birds from San Francisco Bay which have been analysed, including peregrine falcons (Table 1) and eggs of the western gull, the Caspian tern and the black-crowned night heron (Table 3), the ratio was between one and two. Another black-crowned night heron egg had a typically "ocean" profile, suggesting that the adult female had wintered along the coast. In most of the birds from the Farallon Islands, which are 27 miles west of the Golden Gate Bridge, this ratio was between 2 and 5. In the Gulf of Panama, where PCB contamination might come from the Canal Zone and industrial areas in Panama City, the ratio is between 1 and 2 (Table 3).

In the Gulf of California, a region relatively remote from the sources of either DDT or PCB contamination, the ratio was in most cases approximately 9 or 10. This was true in the egg of the peregrine falcon (Table 1), in all of the black petrels and least petrels analysed, in the Craveri's murrelets (Table 2), in five of six osprey eggs and in six of seven western gull eggs (Table 3). Among the exceptions the fish bat, with low concentrations of both DDT and PCB, was the most divergent, with a ratio of 43 (Table 2). It is not clear whether this reflects differences between avian and mammalian physiology or a fundamental difference in feeding habits. The other exceptions include species which are present in the area only during the breeding season (Table 2).

In sea birds from the Pacific the ratio was usually between 5 and 10 (Table 3). PCB was not found in eggs of the Adelie penguin from Cape Crozier, Antarctica.

Table 2. PCB AND DDT IN PREY SPECIES OF PEREGRINE FALCONS IN THE GULF OF CALIFORNIA

Species*	N	DDT (μg)	DDT (p.p.m.)	Percentage DDE	PCB (μg)	PCB (p.p.m.)	DDT/PCB
Eared grebe (13)							
Whole body	3	—	0·28, 0·26, 12·1	97	NM†		—
Black petrel (10)							
Whole body	8	810 (685–1,344)	9·2 (W)	81	—	1·0 (W) (0·90–1·14)	9·2
Least petrel (6)							
Whole body	3	99	3·2 (W)	83	—	0·35 (W)	9·3
Eggs	2	30 (23–37)	—	84	3·1 (1·2–5·0)	—	10
Fish bat (3)							
Whole body	7	25 (15–31)	0·71 (W)	62	0·58 (0·45–1·06)	0·02 (W)	43
Craveri's murrelet (2)							
Eggs (one clutch)	2	230‡ (223–238)	39 (L)	80	—	4·5 (L)	8·7
Whole body, adult	1	37·1	0·31 (W)	85	—	0·039 (W)	7·9
Whole body, adult	1	295	2·4 (W)	85	—	0·26 (W)	9·2
Elegant tern (1)							
Eggs	8	15·5 (9·6–24·3)	5·0 (L)	90	—	1·5 (L) (0·8–3·6)	3·9
Heermann's gull (1)							
Eggs	3	195 (94–278)	48 (L)	95	—	8·1 (L) (3·5–11·3)	5·9

Content in μg of whole bodies and eggs; concentrations in p.p.m. wet weight (W) or lipid weight (L).

* All specimens were collected in the vicinity of four peregrine eyries in Baja California. Numbers in parentheses are the number of remains of each prey species which were found at the eyries. Also found were remains of one cormorant (*Phalacrocorax* sp), one red phalarope (*Phalaropus fulicarius*), one northern phalarope (*Lobipes lobatus*) and one mourning dove (*Zenaidura macroura*), but local specimens of these species were not analysed. Eggs of least petrels, elegant terns and Heermann's gulls were from different clutches. Eared grebe: *Podiceps caspicus*; black petrel: *Loomelania melania*; least petrel: *Halocyptena microsoma*; fish bat: *Pizonyx vivesi*; Craveri's murrelet: *Endomychura craveri*; elegant tern: *Thalasseus elegans*; Heermann's gull: *Larus heermanni*.

† Not measured. Interfering peaks on chromatograms.

‡ Both eggs also contained 0·08 p.p.m. dieldrin (lipid weight) and 0·17 p.p.m. endrin (lipid weight).

Table 3. PCB AND DDT IN THE GLOBAL ECOSYSTEM

Species	N	Total DDT (μg)	Total DDT (p.p.m.)	Percentage DDE	PCB (μg)	PCB (p.p.m.)	DDT/PCB
White crappie (1)	1	—	1·83 (W)	6	—	0·004 (W)	475
Black crappie (2)	1	—	2·10 (W)	6	—	0·003	660
Bluegill (3)	1	—	5·5 (W)	6	—	0·005	1,200
Adelie penguin (4)							
Eggs	5	0·78 (0·59–1·04)	0·128 (L)	74	< 0·044 μg/egg		> 18
Western grebe (5)							
Breast muscle	1	—	26·4 (W)	5	—	0·098 (W)	270
Fulmar (6)							
A	1	—	0·41 (W)	76	—	0·08 (W)	5
B	1	—	3·4 (W)	89	—	0·34 (W)	10
C	1	10,475	17·5 (W)	96	3,900	6·5 (W)	2·7
Pink-footed shearwater (7)	1	2,000	3·0 (W)	93	277	0·42 (W)	7·2
Sooty shearwater (8)							
A	1	—	12·3 (W)	94	—	1·2 (W)	10
B	1	—	10·3 (W)	86	—	0·9 (W)	12
C	1	1,265	2·3 (W)	85	NM		
Slender-billed shear-water (9)	1	—	32·0 (W)	92	—	2·1 (W)	15
Ashy petrel (10)	3	2,158 (1,644–2,826)	59·3 (W)	95	389 (298–482)	9·8 (W)	5·5
Brown pelican (11)							
Eggs, Panama	6	59 (18–183)	11·5 (L)	61 (47–78)	23·1 (18–30)		1·55 (0·97–3·2)
Eggs, Baja California	2	53 (47–59)	10·0 (L)	81	10·4 (9·0–11·7)	—	6·5, 4·0
Frigate-bird (12) eggs, Panama	3	9·6, 8·7, 30·0	—	88	8·4, 5·7, 84·0	—	1·1, 1·5, 0·4
Brown booby (13) eggs, Panama	4	20·8 (16·4–24·5)	8·2 (L)	89	12·2 (6·5–18·9)	4·8 (L)	1·7
Brandt's cormorant (14) eggs	17	326	—	91	113	—	2·9
Pelagic cormorant (15) eggs	2	128 (125–130)	—	90	62 (48–75)	—	2·1
Cinnamon teal (16)	1	4,340	10·9 (W)	70	—	0·91	12
White-tailed kite (17)							
Eggs, clutch *A*	4	11·4 (9·8–12·9)	0·76 (W)	77	6·4 (5·5–7·8)	—	1·8
Unhatched egg *B*	1	5·1	0·34 (W)	82	0·84	—	6·0
Unhatched egg *C*	1	5·3	0·35 (W)	73	3·6	—	1·5
Clutch *D*	2	8·3/egg	—	82	4·3/egg	—	2·0
Clutch *E*	3	10·2/egg	9·0 (L)	57	4·0/egg	—	2·6
Clutch *F*	4	31·9/egg	—	80	3·8/egg	—	8·5
Cooper's hawk (18)	1	8,500	25·2 (W)	90	—	6·3	4·0
Golden eagle (19) egg	1	150	2·0 (W)	98	17·5	0·23 (W)	8·5
Osprey (20), Baja California	6	127 (30–264)	55 (L)	85	(7·3, 3·0, 103) (24, 7·0, 19)	—	8·5, 10·1, 1·3, 11·2, 9·7, 11·1
Merlin (21)	1	435	2·9 (W)	94	55·4	0·39 (W)	12·7
American kestrel (22)							
Whole body, adult	1	5·1	0·044	39	3·7	0·031	1·4
Eggs, two clutches	6	2·4/egg	0·20 (W)	93	1·0/egg	0·09 (W)	2·3
Black-crowned night heron (23)							
Egg	1	541	—	89	330	—	1·6
Egg	1	869	—	99	23	—	36
Western gull (24)							
Eggs, San Francisco Bay, three clutches	4	803 (632–1,123)	—	85	805 (580–1,310)	—	1·0
Eggs, Farallon Is., ten clutches	10	412 ± 102	—	89	136 ± 55	—	3·0
Eggs, Baja Calif., seven clutches	7	385 ± 230	—	97	45 ± 30	—	9·1, 10·5, 5·0, 12·3, 10·6, 10·7, 10·5
Forster's tern (25) eggs	2	665 (598–732)	—	89	114 (91–137)	—	5·8
Caspian tern (26)							
Eggs, San Francisco Bay	2	1,269 (1,216–1,322)	—	89	805 (660–950)	—	1·7
Eggs, San Diego Bay	5	1,430 (991–2,430)	—	88	1,010 (550–1,600)	—	1·4
Red phalarope (27)	1	—	0·78 (W)	79	—	0·10	8
Common murre (28) eggs	6	1,945 (932–3,621)	151 (L)	90	558 (364–1,010)	45 (L)	3·5
Cassin's auklet (29)	1	—	5·8 (W)	98	—	0·16	36
Ancient murrelet (30)	1	—	0·75	90	—	0·15	5
Rhinoceros auklet (31)	1	—	2·7	97	—	0·36	8
Mourning dove (32)	2	12·0, 33·1	0·19 (W)	77, 93	Not detected	—	—
Barn owl (33)							
Eggs, one clutch	3	27·7/egg	1·25 (W)	95	10·4/egg	0·47 (W)	2·7
Eggs, one clutch	2	143/egg	6·6 (W)	96	14·4/egg	0·66 (W)	10
Meadowlark (34)	2	21·2, 448	0·18, 3·3 (W)	77, 93	2·5, 28·1	—	8·4, 15·9

Content in μg and concentrations in p.p.m. wet weight (W) or lipid weight (L).

Unless otherwise specified, analyses were of whole bodies. Endrin and dieldrin were identified on the basis of retention times on both *QF*-1 and *DC*-200 columns.

1. *Pomoxis annularis*, 284 g, Clear Lake, Lake Co., Calif., May 1968.
2. *Pomoxis nigromaculatus*, 212 g, Clear Lake, Lake Co., Calif., May 1968.
3. *Lepomis macrochirus*, 229 g, Clear Lake, Lake Co., Calif., May 1968.
4. *Pygoscelis adeliae*, Cape Crozier, Antarctica, October 1967.
5. *Aechmophorus occidentalis*, Clear Lake, Lake Co., Calif., May 1968.
6. *Fulmanus glacialis*. *A* and *B*: Monterey Bay, Calif., November 1, 1966. *C*: Point Reyes, Calif., December 1967. Fulmars breed in Alaska.
7. *Puffinus creatopus*. Breeds in Chile. Collected in May 1968, in the Gulf of California.
8. *Puffinus griseus*. Breeds in New Zealand and Chile. *A* and *B*: Monterey Bay, November 1, 1966. *C*: Gulf of California, May 1968. NM, Not measured, interfering peaks.
9. *Puffinus tenuirostris*. Breeds in Australia. Monterey Bay, December 1966.
10. *Oceanodroma homochroa*. Farallon Islands, Calif., May 1968.
11. *Pelecanus occidentalis*. Panama eggs were collected on Isla Pacheca and Isla Pachequilla, Gulf of Panama, February 1968. One egg contained 0·06 p.p.m. dieldrin and 0·06 p.p.m. endrin, another contained 0·16 p.p.m. dieldrin and 0·07 p.p.m. endrin (lipid weight). Baja California eggs were collected at Bahia de los Angeles, March 1968. One egg contained 0·24 p.p.m. dieldrin and 1·13 p.p.m. endrin (lipid weight).
12. *Fregata magnificens*. Isla Pacheca, Panama, February 1968.
13. *Sula leucogaster*. Isla Pacheca and Isla Pachequilla, Panama. February 1968. Two eggs were analysed for dieldrin and endrin. Dieldrin: 0·08, 0·18 p.p.m.; endrin: 0·06 and 0·011 p.p.m. (lipid weight).
14. *Phalacrocorax penicillatus*. Farallon Islands, May 1967.
15. *Phalacrocorax pelagicus*. San Mateo Co., Calif.
16. *Anas cyanoptera*. San Diego, April 1968. Adult male.
17. *Elanus leucurus*. *A*: Contra Costa Co., Calif., April 1968. *B* and *C*: Contra Costa Co., May 1968, two and three young raised, respectively. *D*: Abandoned, Contra Costa Co., May 1967. *E* and *F*: Destroyed nests, Contra Costa Co., March 1968.

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Table 3 (*continued*)

18. *Accipiter cooperii*. Balboa Park, San Diego, February 1968. First year female, died of trichomoniasis.
19. *Aquila chrysaetos*. San Luis Obispo Co., Calif., April 1968. Unhatched egg in nest where one young was raised. Egg also contained 4·7 μg of dieldrin, 1·9 μg of heptachlor epoxide, but no endrin.
20. *Pandion haliaetus*. Gulf of California, March 1968. One egg also contained 0·10 p.p.m. dieldrin and 0·25 p.p.m. endrin (L).
21. *Falco columbarius*. Immature, Utah, December 1967.
22. *Falco sparverius*. Adult was killed on road, Mendocino Co., Calif., December 1967. Eggs from Davis, California, 1968.
23. *Nycticorax nycticorax*. Eggs from different clutches, San Francisco Bay, May 1967.
24. *Larus occidentalis*. Standard errors, 95 per cent confidence limits.
25. *Sterna forsteri*. San Diego Bay, May 1967.
26. *Hydroprogne caspia*, 1967.
27. *Phalaropus fulicarius*. Monterey Bay, November 1, 1966.
28. *Uria aalge*. Farallon Islands, May 1967.
29. *Ptychoramphus aleuticua*. Farallon Islands, April 1966.
30. *Synthliboramphus antiquum*. Monterey Bay, November 1, 1966.
31. *Cerorhinca monocerata*. Monterey Bay, November 1, 1966.
32. *Zenaidura macroura*. San Diego, July 1968.
33. *Tyto alba*. Clutch *A* from Contra Costa Co., Calif., March 1968. Clutch *B* from Yolo Co., Calif., April 1968.
34. *Sturnella neglecta*. Davis, Calif., December 1967.

In these, however, the amount of DDT was very low; with a DDT: PCB ratio of 18, no PCB would have been detected. A larger amount of fat material from Antarctic organisms, which would contain more DDT, would therefore have to be analysed before concluding that PCB has not yet reached the Antarctic.

Individuals of species resident in industrial areas have, as expected, higher PCB levels than individuals of the same species from more remote regions. Analysis of ten eggs from ten clutches of the western gull from the Farallon Islands showed an average PCB content of 136 ± 55 μg (95 per cent confidence level). PCB content of four eggs from three clutches from an island in San Francisco Bay averaged 805 μg with a range from 580 to 1,310 (Table 3). Seven eggs from seven clutches in the Gulf of California contained 45 ± 30 μg of PCB. The DDT content of the eggs from the Farallons was not significantly different from that of the Baja California eggs.

Birds from the Gulf of California also contain dieldrin and endrin (Tables 2 and 3), but the number of analyse is as yet insufficient to compare their relative abundance with that of DDT and PCB. Despite the inability of the Shell Chemical Company to find any chlorinated hydrocarbons in the Gulf of California and at the mouth of the Colorado River[35], which drains into the Gulf, it is likely that some do enter from the Colorado River and from agricultural areas in western Mexico. A significant fraction, however, must come from the atmosphere[36], and air transport best explains the presence of PCB in remote areas. In extracts from the Gulf of California one PCB compound was present in relatively small concentrations. This compound is readily degraded by ultraviolet light irradiation in laboratory experiments, and may therefore be selectively degraded in the atmosphere. Although PCB is not soluble in water, it has a low but finite vapour pressure[37]. Incineration of materials containing PCB would greatly increase the rate of entry into the atmosphere. PCB is used in the manufacture of many industrial products, so the high amounts found in San Francisco Bay, Puget Sound[3] and San Diego Bay presumably result from direct discharge of industrial wastes into these waters and from local fallout.

The presence of PCB in the few land birds and freshwater fish analysed indicates that it is also distributed among continental ecosystems in North America. Peregrines could therefore acquire PCB, as well as the other chlorinated hydrocarbons, over all their global range. No PCB residue data are available for prey species from the Atlantic, but compounds which seem to be PCB have been isolated from seals[38]. A second year male peregrine spent the winter of 1967–68 on Isla Pacheca, Panama, where the pelican, booby and frigate-bird eggs of Table 3 were collected. The Cooper's hawk which was analysed, a species which also preys upon birds, contained high residues of both DDT and PCB (Table 3). Cooper's hawks have declined in eastern North America and in some regions have produced thin-shelled eggs[34]. Several species of raptors do not accumulate high amounts of the organo-chlorine compounds (Table 3), a result of the very low residue levels usually found in their prey. American kestrels and barn owls are common residents of California cities. The white-tailed kite, which was near extinction 40 years ago in California, is now abundant in areas where insecticide use is intense, yet because it preys primarily upon the short-lived and herbivorous vole, *Microtus*, the species accumulates very little DDT or PCB (Table 3).

Previous work[18] has shown that both DDT and dieldrin induce hepatic enzymes in the pigeon which, in an *in vitro* preparation, increase the metabolism of progesterone and testosterone. This work has now been extended to study the metabolism of oestradiol by enzymes induced by *p,p'*-DDE, technical DDT (Dupont) and PCB ('Aroclor 1262'). The experimental procedure previously described[18] was followed except that the chlorinated hydrocarbons were injected intramuscularly rather than given orally, and in the separation of oestradiol and its metabolites the solvent system used was the upper layer of a mixture of benzene: heptane: methanol: water 7:3:8:2. The strips were monitored with an autographic strip scanner. The profiles obtained for the various inducing agents are shown in Fig. 1. It will be noted that the profiles of the metabolites obtained after enzyme induction using DDE and DDT are identical, but that a different metabolite is produced by the enzyme induced by PCB. The amount of metabolites formed was calculated from the radioactivity of the peaks. The results obtained are given in Table 4.

Table 4. INCREASE OF OESTRADIOL METABOLISM BY PIGEON LIVER HOMOGENATES FROM BIRDS TREATED WITH VARIOUS CHLORINATED HYDROCARBONS

	Amount of polar metabolites formed in mμmoles
Control	29·3 ± 6·5
DDE (40 mg/kg)	76·2 ± 13·1
DDT (40 mg/kg)	93·1 ± 11·2
PCB (20 mg/kg)	160·0 ± 10·5

Each figure is the average with standard deviation of a group of four birds. In all cases 500 mμmoles of oestradiol-6,7-T (500 mCi/mmole) was present in the incubation mixture. Incubation time 30 min, weight of microsomal fraction used 300 mg. All chlorinated hydrocarbons were injected intramuscularly into the pectoral muscle 7 days before death.

Body concentrations of 40 p.p.m. of *p,p'*-DDE significantly increased the rate of oestradiol degradation by the induced enzymes in the experimental conditions. On a weight basis the PCB preparation had an oestradiol degrading potential approximately five times that of *p,p'*-DDE or technical DDT. Both DDE and PCB, which are apparently the most abundant of the chlorinated hydrocarbon pollutants in the global ecosystem, have therefore the capacity to produce sublethal physiological effects in birds.

Studies on the activity of induced enzymes in the rat at various times after a single injection of DDT or dieldrin have been made by Ghazal *et al.*[39]. He found that it took 70 days for the activity to fall to half its maximum value in the case of DDT and 15 days in the case of dieldrin. Experiments with dieldrin on pigeons

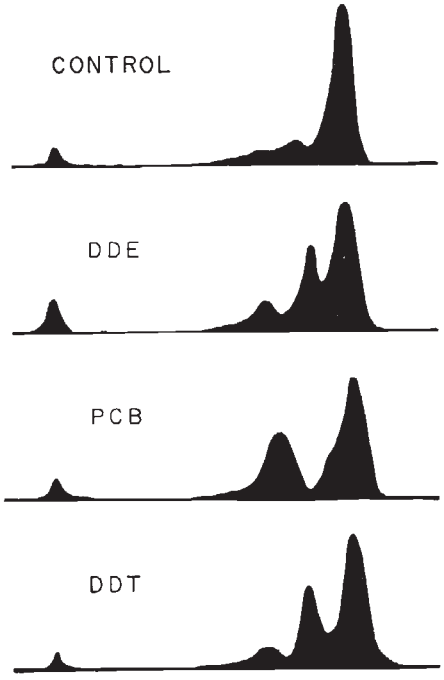


Fig. 1. Chromatographic separation of oestradiol and its metabolites. The large peak is unaltered oestradiol.

show that only a quarter of maximum activity remains after a month. Thus there is evidence that the effects of these induced enzymes can persist over a long period of time although more studies are needed to determine the steroid degrading potentials of livers of those species contaminated with chlorinated hydrocarbons. The profile of the metabolites should be some indication of the history of exposure to chlorinated hydrocarbons.

The reductions in eggshell thickness and eggshell weight increase the chances of egg breakage[21–24], and water retention, which affects hatching success[40–41], might be impaired. The environment in which birds now exist is therefore no longer the same as that in which they evolved; it is unlikely that any species has the genetic capacity to meet the selection pressures resulting from the abrupt environmental change which has produced the thin eggshells. The peregrine falcon is a species long highly revered and respected. G. H. Thayer[42] has described it as "the embodiment of noble rapacity and lonely freedom". An irony therefore exists in the fact that the peregrine may be the first species to be extirpated by global contamination.

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Tsunamis on the Moon?

by
W. G. VAN DORN
Scripps Institution of Oceanography,
University of California,
San Diego, California

The spacing of the five annular mountain rings around Mare Orientale fits a dispersion curve for gravity waves on a 50 km "liquid" layer overlying a rigid basement.

THE question whether the multiple ring-like mountain structures surrounding most of the lunar craters larger than 120 miles in diameter might be "frozen tsunamis", set in motion by the shock waves caused by impacting planetesimals, was first brought to my attention by R. B. Baldwin (personal communication). Baldwin points out that in several cases (including the giant Mare Imbrium) two or more rings can be made out

Exhibit 17

Monsanto Letter to Customers, Feb. 8, 1970

Monsanto

ORGANIC CHEMICALS DIVISION

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 694-1000

February 18, 1970

Dear Sir:

Recently several newspaper and magazine articles have been published indicating that Polychlorinated Biphenyls (PCBs) have been discovered at some points in some marine, aquatic and wildlife environments. The quantities detected are said to be in the parts per million and parts per billion categories.

It is claimed that the PCBs found strongly resemble chlorinated biphenyls containing 54% and 60% chlorine by weight. Products which are sold by Monsanto under the trade names of Aroclor® 1254 and 1260 do contain chlorinated biphenyls. In addition to Aroclor® 1254 and 1260, Monsanto sells certain functional fluids containing Aroclor® 1254. These include Pydraul® 625, Pydraul® AC, Pydraul® AC - Winter Grade, Pydraul® 540, Therminol® FR-3 and certain dielectric formulations. Several other companies around the world also produce products containing chlorinated biphenyls.

As your supplier of Aroclor® 1254 and 1260 and formulated products containing 1254, we wish to alert you to the potential problem of environmental contamination as referred to in the newspaper and magazine articles.

We would like to point out the following additional facts:

1. Products such as Pydraul® 90,135, 230, 312, A-200, F-9, 150, and 60, Turbinol® 153 and Therminol® FR-1 and FR-2 are not formulated with Aroclor® 1254 or 1260.

2. PCBs with a chlorine content of less than 54% have not been found in the environment and appear to present no potential problem to the environment.

DSW 009726

We have developed, and are now testing, new formulations to replace the Aroclor® 1254 and 1260 components in our Pydraul® products. The new products appear to be equal in performance and to have similar physical properties.

We feel that all possible care should be taken in the application, processing and effluent disposal of these products to prevent them becoming environmental contaminants. Of interest to you may be an article in Chemical Week, October 29, 1969, regarding water pollution standards set by each state in the Union. It is attached. This article reflects that good manufacturing practice in the future may require that no product used by any company should find their way into waterways.

We realize that you have marketed or may now market transformers and other electrical equipment containing dielectric fluids which include Aroclor® 1254 and 1260. Although these fluids are sealed into such equipment it is recognized that occasionally the fluid may be lost through leaks resulting from equipment misuse or equipment repair necessitating replacement of the fluid. Since the dielectric fluid contained in this equipment is only an incidental part of the over-all unit manufactured by you, we are not notifying the purchasers of such equipment of the potential environmental contamination problem described in this letter. We do recommend, however, that you notify such equipment users of this problem.

Sincerely yours,

Don Olson

Donald A. Olson
Director of Sales
Functional Fluids Group

lb

Attachment

DSW 009727

Exhibit 18

Monsanto Letter to Customers, July 17, 1970

NEWS

Monsanto

FOR RELEASE IMMEDIATELY 1970

E. V. John
(314) 694-2891
PUBLIC RELATIONS DEPARTMENT
Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166

MONSANTO CITES ACTIONS TAKEN ON ENVIRONMENTAL ISSUE

ST. LOUIS, July 16 -- Monsanto Company, sole U.S. producer of an industrial chemical called polychlorinated biphenyl (PCB), today said recent political charges and sensational headlines about the chemical causing "a major ecological crisis" completely ignore voluntary actions the company has taken to restrict use of the material.

"Our program began back in 1968 with the proper identification and measurement of PCB in the environment and will conclude this year by our unilateral action to restrict its use," Howard L. Minckler, company vice president and general manager of its Organic Chemicals Division, said.

He added that Monsanto had not been pressured into action by any legislation or organized group. "We have taken decisive action based on evidence that PCB is a persistent chemical which builds up in the environment."

-more-

DSW 009731

--2 MONSANTO: MINCKLER'S REPLY TO PCB CHARGES xxx environment."

"Commenting on a recent report that PCB can induce birth defects in animals, Minckler said, "Monsanto is not aware of any scientific data that indicates polychlorinated biphenyls may cause birth defects. The results of comprehensive toxicity studies, sponsored by Monsanto and using the usual species of laboratory animals, have failed to produce such effects.

"Scare tactics and sensational reporting do not serve the public interest nor solve ecological problems," he said. "Only a few reports have stated why PCBs were ever developed and why they are used today. Nor have the consequences of not using PCB been explained.

"What should be emphasized," Minckler continued, "is that PCB was developed over 40 years ago primarily for use as a coolant in electrical transformers and capacitors. It is also used in commercial heating and cooling systems. It is not a 'household' item.

"Anyone who lives in a large city is familiar with power failures. During periods of peak power needs, air conditioning and refrigeration fail, lights go out and commuters are stranded. If power companies were to remove PCB from equipment, we have been told that major blackouts would occur throughout the world.

-more-

DSW 009732

--3 MONSANTO: MINCKLER'S REPLY TO PCB CHARGES xxx world.

"PCB is used in electrical equipment as a safety fluid. It has replaced combustible oil products which have, on many occasions, exploded and burned, causing deaths and injury to human life. Today state and local laws all over the country require the use of non-flammable fluids in certain electrical equipment as a safety feature. At the moment, there are no substitutes available which equal the safety performance of PCB."

Monsanto said it intends to continue selling PCB for "closed-system" uses such as electrical components and heat-transfer systems. "With rigid control over where the product goes, how it is handled and disposed of, we believe the safety functions of the product can continue to serve society and the environment can be protected," Minckler said. "We are discontinuing sales into 'open systems' -- adhesives, sealants, chlorinated rubber, specialty paints, etc.

"For other uses, such as fire-resistant hydraulic fluids, where PCB cannot be strictly controlled, we have reformulated some fluids and they are on the market. The new products contain other fire-resistant ingredients. We will continue to develop alternate formulations which do not contain persistent PCB. We will not abandon hydraulic fluid users," Minckler commented, "as has been reported."

-more-

DSW 009733

--4 MONSANTO: MINCKLER'S REPLY TO PCB CHARGE xxx reported."

Monsanto has also established a new system for disposal or recycle of spent PCB. A special high-temperature incinerator will break down PCB into harmless materials. The company also regenerates spent fluids for reuse. The incinerator will be offered to customers who cannot otherwise destroy or regenerate their old fluids.

"Although loss of PCB from our manufacturing plants has been negligible, we have further tightened up our production techniques and installed new pollution abatement devices," the Monsanto executive said.

"I repeat," Minckler concluded, "our program was initiated and conducted by Monsanto alone. It will be concluded this year. We believe it is a position any responsible company would take."

-oOo-

FDA

Elmer P. Wheeler, Medical Dept.

July 24, 1970

H. S. Bergen, HEWDS
J. Mason, JNASO
W. B. Papageorge, WPAPA
J. E. Springgate, JSPRI

PDA Guideline for PCB's in Foods

P. S. Park
PPARK

Attached is a page from Food Chemical News of July 20, 1970, reference to the above subject.

This adoption of 'administration guideline levels' does not constitute a FDA regulation. It is, however, a basis for FDA regional offices and state food laboratories whether in departments of health or agriculture to seize and destroy (or declare unfit for human consumption) fish and milk which contain levels of PCB's above 5 ppm and 0.2 ppm respectively.

Elmer P. Wheeler

EPW:ju

Enclosure

DSW 009735

FOOD DATING legislation support from USDA was sought last week by Chairman Rosenthal (D-N.Y.) of the House Consumer Inquiry subcommittee. He wrote to USDA Secretary Hardin to request the Department to conduct a survey "to determine whether a statistically significant number of over-age perishable and semi-perishable food items are being sold by retail stores" and "whether the institution of expiration dates, or, in the alternative, the establishment of uniform codes known to consumers, would be effective in preventing the sale of old merchandise."

FATTY ACID labeling "statement of policy will issue shortly," FDA's M. J. Ryan, Director of Legislative Services, said in a letter to Rep. Yates (D-Ill.) (See FOOD CHEMICAL NEWS, July 13, Page 2). Ryan noted that FDA-ers have recently met with representatives of the National Heart and Lung Institute and of FTC to discuss the problem but said, "We are still not in a position to announce a formal policy." Yates had asked why "coconut oil could not be labeled as coconut oil rather than as vegetable oil."

THE CHEMICAL FEAST, James Turner's book criticizing FDA food regulation, has been published in paperbound, selling for 95 cents.

W. DONALD GRAY, who spearheaded many investigations of FDA as a member of the staff of Rep. Fountain's (D-N.C.) House Intergovernmental Relations subcommittee, is becoming an investigator for Sen. Magnuson's (D-Wash.) Senate Commerce Committee. For the past nine months, Gray has been a legislative assistant to Sen. McIntyre (D-N.H.

SAIB was formally cleared by Canada's Food and Drug Directorate for use as a density adjusting agent for citrus-flavored beverages up to 50 p.p.m., in a Trade Information Letter (No. 336). A food standard proposal was submitted to FDA last week to clear optional use of sucrose acetate isobutyrate, and a Food Additive Petition has been submitted (See story, Page 27). SAIB is being considered as a substitute for brominated vegetable oils, which FDD last week formally limited to 15 p.p.m. in citrus-flavored beverages.

POLYCHLORINATED biphenyls surveillance program of FDA is being directed towards support of State efforts on PCBs (See FOOD CHEMICAL NEWS, June 29, Page 29) The agency has adopted administrative guideline levels for PCBs of 5 p.p.m. in fish and 0.2 p.p.m. in whole milk. FDA's surveillance for PCBs actually started last year; before seizing Coho salmon the agency analyzed for PCBs to see if the residues were DDT or PCBs (See FOOD CHEMICAL NEWS, March 31, 1969, Page 18). Milk containing PCBs has been found in Ohio and in Maryland, but these have been isolated instances, and in one case the PCBs were traced to a silo paint.

FDA budget for fiscal year 1971 was reported by the House Appropriations Committee at $89.5 million, the amount of the Administration request.

FOOD ADDITIVE Petition filed by Geigy and noted July 17 would amend §121.2566 for antioxidants and/or stabilizers for polymers to clear use of 2-(3'-tert-butyl-5'-methyl 2'-hydroxyphenyl)-2H-5-chlorobenzotriazole in the manufacture of olefin polymers.

FDA'S Morton M. Schneider is switching from a Congressional relations post to the Office of Product Safety.

DSW 009736

FROM

SHIP TO

MONSANTO COMPANY
Department 246
SAUGET, ILLINOIS 62201

PRODUCT NAME

WEIGHT

RETURNED

for Reclamation or Disposal only

DSW 009737

Exhibit 19

DUK_00023353

Ltrs. Exchanged with Monsanto regarding PCB Waste Disposal

NOTE: EGH - SEND COPY OF INVOICE OF KAJ

FMN

PURCHASE ORDER

Mill-Power Supply Co.

6-16-75

No. C 32845

THIS ORDER NUMBER MUST APPEAR ON ALL THREE INVOICES AND ON ALL PACKAGES.

BUYER, WHOSE ADDRESS AND SIGNATURE APPEAR BELOW, AGREES TO PURCHASE FROM SELLER THE GOODS AND/OR SERVICES DESCRIBED BELOW UPON THE TERMS AND CONDITIONS SET FORTH ON BOTH THE FRONT AND REVERSE SIDES OF THIS PURCHASE ORDER. SELLER SHALL TRANSFER AND DELIVER TO BUYER, OR TO PERSON HEREIN DESIGNATED, AT THE LOCATION, AT THE TIME OR TIMES, AND BY THE MEANS HEREIN SPECIFIED, THE FOLLOWING GOODS AND/OR SERVICES:

MONSANTO INDUSTRIAL CHEMICALS CO.
800 N. LINDBERGH BLVD.
ST. LOUIS, MO. 63166

HEREIN DESIGNATED SELLER

MAKE INVOICE TO:
☒ DUKE POWER CO.
☐ MILL-POWER SUPPLY CO.

MAIL INVOICE AS DIRECTED BELOW UNDER NOTICE TO SELLER.

SHIP TO: DUKE POWER CO.
% E. B. HOWIE, SUPT. WHSING.
TODDVILLE WHSE.
CHARLOTTE, N. C. 28242

VIA SEE BELOW

PREPAID

QUANTITY	DESCRIPTION	LOT NUMBER
330	GALS. INTERTEEN OIL (6-55 GAL. DRUMS) FOR DISPOSAL - EST. 2050 LBS. ABOVE RETURNED ON SM 875-49 6/11/75 CENTRAL MOTOR LINES PREPAID PER LETTER 5/28/75 C.R. FIELD, IDENTIFICATION 83370-B.	

n/p K.M

NOTICE TO SELLER

1. Acknowledge order by acceptance and give date order will be shipped.
2. Acceptance is expressly limited to terms and conditions set forth herein and on reverse side.
3. If freight is prepaid and added to invoice, attach expense bill.
4. Show lot numbers on boxes and invoices if shown on this order.
5. Three Copies Of Invoice, with shipping papers attached, are to be mailed to:

MILL-POWER SUPPLY CO.
CHARLOTTE, N. C. 28232
P. O. BOX 1339 TEL. 704-373-4011
TELEX 57-2346

MILL-POWER SUPPLY COMPANY ("BUYER")

T. J. GARRETT, PRES.

ADDRESS REPLY TO: F. M. HAGSTAFF JB

REQUISITIONIST COPY

DUK_00023353

Exhibit 20
DUK_00024009
Duke Power PCB Waste Disposal Record

NEWCO CHEMICAL WASTE SYSTEMS INC.

Waste Shipment Manifest No. 9

THIS SECTION TO BE COMPLETED BY THE WASTE GENERATOR:

COMPANY NAME	SITE ADDRESS	PICK-UP DATE
Duke Power Co.	610 Toddville Rd Charlotte, N.C.	11-7-78
BUSINESS ADDRESS (IF DIFFERENT FROM SITE)	RESPONSIBLE INDIVIDUAL / PHONE NO. / EXT.	24 HOUR EMERGENCY NO.
—	J.P. Holland 704-373-4333	704-399-7550
NAME OR DESCRIPTION OF WASTE SHIPPED		TOXICITY
Capacitors Containing PCBs		☒ LOW ☐ MED. ☐ HIGH
QUANTITY SHIPPED	WORK ORDER NO. / PRODUCT CODE	DOT CLASSIFICATION
224 Cap 9 Drums	8259 / 48-A-N	

PHYSICAL STATE (CIRCLE APPROPRIATE BLOCKS): SOLID | LIQUID | SEMI-SOLID

SPECIFIC GRAVITY: .8 | .9 | ~~N/A~~ | 1.1 | 1.2 | 1.3 | 1.4

VISCOSITY: LOW | ~~MEDIUM~~ | HIGH

FLASH POINT (°F): <100 | 100-140 | ~~>140~~ | NONE

pH (CIRCLE RANGE): <1 | 2 | 3 | 5 | 7 ~~N/A~~ 9 | 11>

COMPOSITION (ACCOUNT FOR 100%): % CAPACITORS & 55 GAL. STEEL % DRUMS WITH 2% PCBs

CONTRACTED TO:	ADDRESS:	
NEWCO CHEMICAL WASTE SYSTEMS INC.	4626 ROYAL AVENUE, NIAGARA FALLS, NEWYORK 14303	
RESPONSIBLE INDIVIDUAL	PHONE NO. AND 24 HOUR EMERGENCY NO.	F.O.B. POINT
	(716) 285-6944	
HAULER	ADDRESS	
ZEIGLERS LIQUID WASTE	1020 N. HARTLEY ST YORK PA 17405	
RESPONSIBLE INDIVIDUAL	PHONE NO.	24 HOUR EMERGENCY NO.
		717-854-9181
HAZARDOUS WASTE FACILITY DESTINATION	ADDRESS	
RESPONSIBLE INDIVIDUAL	PHONE NO.	24 HOUR EMERGENCY NO.

I HEREBY CERTIFY THAT THE ABOVE DESCRIBED HAZARDOUS/TOXIC WASTES ARE PROPERLY CLASSIFIED, DESCRIBED, PACKAGED, MARKED AND LABELED AND ARE IN PROPER CONDITION FOR TRANSPORTATION COMPLYING WITH ALL DOT REGULATIONS.

AUTHORIZED SIGNATURE: Richard E Duncan — DATE: 11/7/78

THIS SECTION TO BE COMPLETED BY THE HAULER:

VEHICLE IDENTIFICATION NO.	HAULER'S PERMIT NO.	STATE	HAULER'S N.Y. STATE NO.
217	PA-013		
PICK-UP DATE	QUANTITY		OFF LOAD DATE
11/7/78	224 CAPACITORS & 9 55 GAL STEEL DRUMS		11/9/78

I HEREBY CERTIFY THAT THE ABOVE DESCRIBED WASTE WERE ACCEPTED FOR TRANSPORTATION AT THE PRODUCER'S SITE AND DELIVERED TO AND OFF LOADED AT THE HAZARDOUS WASTE FACILITY, BOTH AS LISTED HEREUPON.

AUTHORIZED SIGNATURE (DRIVER): Richard E Duncan — DATE: 11/7/78

AUTHORIZED SIGNATURE (RELAY DRIVER) — DATE

THIS SECTION TO BE COMPLETED BY THE RECEIVER:

I HEREBY CERTIFY THAT THE ABOVE DESCRIBED WASTES WERE DELIVERED TO THIS FACILITY, THAT THE FACILITY IS AUTHORIZED AND PERMITTED TO RECEIVE SUCH WASTES AND THAT THE FINAL DISPOSITION WAS AS SHOWN.

T. C. McGrath Jr
AUTHORIZED SIGNATURE

11-10-78
DATE

NAME AND LOCATION OF RECEIVING FACILITY: NEWCO

DISPOSITION:

_____ % INCINERATION _____ % TREATMENT/PROCESSING

_____ % RECOVERY 100 % LAND DISPOSAL _____ % STORAGE

_____ % TRANSSHIP TO _____

_____ % OTHER (SPECIFY) _____

HAULER'S COPY

Exhibit 21
DUK_00024022
Duke Power PCB Waste Disposal Record

Jon Yinger
District Manager
ZEIGLER'S REFUSE COLLECTORS
SCA SERVICES, INC.

700 N. Hartley Street
P.O. Box 1943
York, Pennsylvania 17405
(717) 845-8783

SCA SERVICES

R SUPPLY COMPANY
Equipment and Supplies
422 SOUTH CHURCH STREET
CHARLOTTE, N. C. 28232 TELEX 57 - 2346

3/11/81

No. 9421 -N-84
SHOW ON ALL CORRESPONDENCE

Zeigler's Refuse Collectors
Div. of S.C.A. Services
700 North Hartley St.
P. O. Box 1943
York, PA 17405

THIS IS A
REQUEST FOR QUOTATION
NOT AN ORDER

Gentlemen:
Please quote, subject to the terms and conditions on the back hereof, prices and shipping date for material listed below.

MILL-POWER SUPPLY COMPANY

F. O. B.	FOR DELIVERY BY	QUOTE NOT LATER THAN	DEPT.	REQ. NO.	REPLY TO:
Charlotte, NC		3/25/81			Mitch Ivey/gp

QUANTITY REQUIRED	DESCRIPTION	WEIGHT	LIST	DISCOUNT	NET
	PLEASE QUOTE BEST PRICE AND DELIVERY FOR DISPOSAL OF THE FOLLOWING MATERIAL IN ACCORDANCE WITH ATTACHED CONDITIONS AND REQUIREMENTS:				
1400 EA	Individual capacitors.....		NO BID		NO BID
20 EA	Transformer carcasses Largest - Approx. 10' X 5' X 5' Smallest - Approx. 3' X 2' X 2' Please give price/cubic ft. - Approx. 2200-2500 cubic ft.....		$12.00/Cu.Ft.		$12.00/CuFt
175 EA	55 gallon drums of liquid P.C.B.....		NO BID		NO BID
220 EA	55 gallon drums of dirt, rags, and debris.....		$92.50PER		$92.50PER

Includes Transportation

All quotations must show WEIGHT, TERMS OF PAYMENT, SHIPPING DATE, SHIPPING POINT, MANUFACTURING ADDRESS, (STREET, CITY)

Gentlemen: We submit the above prices and agree to make shipment FROM Charlotte, N.C.
within 10 Days days from receipt of order, F. O. B.
Terms of payment: per cent discount if paid within days after receipt of Invoice,
or 30 Days days NET. The conditions on reverse side hereof are part of this quotation.

SIGNED: Zeigler's SCA By Jon Yinger Date 3/17/81

Exhibit 22
DUK_0015348
Duke Power PCB Waste Disposal Record

Form 400820 (R12-95) Previously Form 21201

BULK OIL FOR DISPOSAL SHIPMENT SUMMARY

Section 1 — To be filled out by shipper and sent with bill of lading to Riverbend or with manifest to vendor disposal facility.

1. Name of Generating Facility: NACCO Materials Handling
2. Name of Facility Waste Disposal Specialist: Dave Roche 027RB/96
3. Shipment Number: 24-B
4. Date of Shipment: 7-8-96
5. Quantity Shipped: 2,400 (gals)
6. Weight of Shipment: 8,184 (kilograms) 8703
7. PCB Content: 120, 130, 140 (ppm)
   (Attach copy of Analysis Report)
8. Check One:
   Non-PCB (< 50 ppm) _____
   PCB-CONTAMINATED (≥ 50 ppm, but < 500 ppm) ✓
   OCT 0 2 ENTD
9. Earliest Date Oil Was Removed From Service For Disposal: 7-7-96
10. Date Oil Placed Into Transport For Off-Site Disposal: 7-7-96
11. Name Of Disposal Facility: Riverbend
12. Shipper Signature: Fredw Flowe Date: 7-8-96

Section 2 — To be filled out by disposal facility and sent back to Generating Facility, Waste Disposal Specialist.

1. Date Shipment Received: 7-8-96 RB027
2. Received By: Richard Bronowy
3. Date of Disposal: 7-8-96
4. Disposer Signature: EB Kane Date: 7-8-96

Burn # 13
7-8-96
4 unit

White — Disposer Returns to Facility Disposal Specialist Canary — Disposal Facility Pink — Generating Facility

Exhibit 23
DUK_00015357
Duke Power PCB Waste Disposal Record

Form 400820 (R12-95) Previously Form 21201

BULK OIL FOR DISPOSAL SHIPMENT SUMMARY

Section 1 — To be filled out by shipper and sent with bill of lading to Riverbend or with manifest to vendor disposal facility.

1. Name of Generating Facility: Indian Land Ret.
2. Name of Facility Waste Disposal Specialist: Dave Roche
3. Shipment Number: ~~34~~ 038 RB 196
4. Date of Shipment: 8-28-96
5. Quantity Shipped: 4400 (gals)
6. Weight of Shipment: 15,004 (kilograms)
7. PCB Content: 360 (ppm)
   (Attach copy of Analysis Report)

OCT 0 2

8. Check One:
   Non-PCB (< 50 ppm) ____
   PCB-CONTAMINATED (≥ 50 ppm, but < 500 ppm) ✓
9. Earliest Date Oil Was Removed From Service For Disposal: 8-28-96
10. Date Oil Placed Into Transport For Off-Site Disposal: 8-28-96
11. Name Of Disposal Facility: Riverbend
12. Shipper Signature: Fredrick Howe Date: 8-27-96

Section 2 — To be filled out by disposal facility and sent back to Generating Facility, Waste Disposal Specialist.

1. Date Shipment Received: 8-28-96 RB034
2. Received By: Manuel D. Mullis
3. Date of Disposal: 8-30-96
4. Disposer Signature: EB Moore Date: 8-28-96

Bern # 18
4 cmt

White — Disposer Returns to Facility Disposal Specialist Canary — Disposal Facility Pink — Generating Facility

Exhibit 24

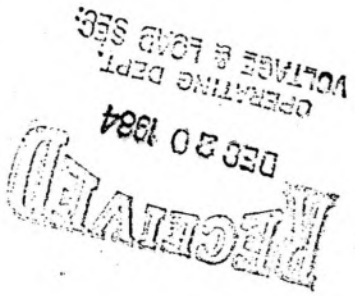
DUK_00099969 - DUK_00100104

(Confidential)

Duke ad hoc PCB Action Committee Meeting Minutes/Notes

December 19, 1984

D. W. Anderson
W. D. Baker
C. M. Bowers
H. B. Doggett, III
J. E. Harwood
R. E. Holmes, Jr.
P. W. Huntley
K. R. Jordan
J. E. Lansche
N. J. Melton
L. B. Morris
J. C. Painter
W. S. Price
D. P. Roche
C. T. Spry
G. T. Swearingen
S. Thompson
P. S. Wingo



Subject: **PCB Committee Meeting**

Nick Melton chaired a meeting of the PCB Committee on November 9, 1984. The purpose of the meeting was to establish Duke Power's position(s) on EPA's proposed PCB Transformer Rule and to update the Committee on other PCB matters of interest. Those present were:

Warren Baker
Charlie Bowers
Bill Breedlove
Trip Doggett
Pat Huntley
Ken Jordan
Nick Melton
Brian Morris
John Painter
Scott Price
Dave Roche
Charlie Spry
Pat Wingo

It was decided that the committee would review EEI/USWAG's Strategy and guideline for approaching the proposed rule, and establish the Company's position relative to USWAG's positions (refer to November 7, 1984 memo from Wald, Harkrader & Ross to the USWAG PCB Committee - item numbers below correspond to numbers in that memo).

Item No.	Comments
(1)	Ken Jordan urged that applicability of rule be limited to askarel transformers, not all PCB transformers.
(2)(a)	Expand the goal to exclude distribution vault transformers as well as power plants and substations. Restrict application to askarel transformers, fall back to 60,000 ppm PCB or some lower figure which would still exclude PCB contaminated transformers.
(2)(b)	Most of Duke's transformers are not network transformers.
(2)(c)	Restrict applicability to askarel transformers. Production stations should be excluded since local fire departments are not first responders. USWAG should secure technical data to support exclusion of transformers contaminated with low levels of PCB.
(2)(d)	Agree with USWAG - PCB label will unduly alarm public. Exclude power plants from marking requirements.

(2)(e) Agree with USWAG.

(2)(f) Agree with USWAG.

(2)(g)(1) Agree with USWAG. Ken Jordan will get input from Vance Martin
(2)(g)(2) regarding transformer protection.

(2)(h) Agree with USWAG. Comment on the Smoke Spread Reduction Plan.
(2)(h)(1)

(4)(a) Agree with USWAG.
(4)(b)
(4)(c)

(5) Agree with USWAG.

Ken Jordan made the general comment that Duke should try to have USWAG adopt its point of view as much as possible and to urge other utilities that share Duke's positions to speak out in favor of them.

Other matters of interest:

1. Dave Roche have a status report on the incineration of high level PCB-contaminated oil. ENCAS laboratories is preparing the test burn samples to send to the University of Nebraska laboratory for analysis.

2. Distribution PCB capacitors will be phased out by the end of 1986.

3. Distribution askarel transformers will be phased out by the end of 1985.

4. A corporate strategy for the phase-out of all PCB equipment is being developed now.

Bill Breedlove

W. N. Breedlove, Jr.

WNB/cww

November 1, 1984

TO: PCB Committee

FROM: N. J. Melton NJM

SUBJECT: Committee Meeting

Please plan to attend a meeting of the PCB Committee Friday, November 9, 1984 in Room 307, Woodlawn Center at 2:00 P.M.

It is necessary to discuss and prepare our position to the proposed rules on PCB use in Electrical Transformers. Please come prepared to hammer out our positions. If time permits, we will cover other reports.

1. Status of incineration of high level PCB contamination oil.
2. Phase out of PCB Capacitors
3. Phase out of PCB Transformers
4. Clean up policy
5. Other

NJM/wb

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February 1, 1984

W. D. Baker
T. J. Bowling
W. N. Breedlove, Jr.
H. B. Doggett, III
J. E. Harwood
R. E. Holmes, Jr.
P. W. Huntley
K. R. Jordan
J. E. Lansche
N. J. Melton
L. B. Morris
W. S. Price
D. P. Roche
C. T. Spry
G. T. Swearinger
R. R. Wylie

SUBJECT: PCB Committee Meeting

Nick Melton chaired a meeting of the Company PCB Committee on January 20, 1984. Those present were:

Warren Baker
Bill Breedlove
Trip Doggett
Pat Huntley
Ken Jordan
Nick Melton
Brian Morris
Scott Price
Dave Roche
Charlie Spry
Pat Wingo
Robert Wylie

1. Brian Morris and Bill Breedlove gave a brief report on the EPRI PCB Seminar held in Atlanta in December 1983. The hottest topic was PCB equipment fires.

2. Dave Roche opened a discussion of PCB equipment fires by referencing a brief page and a half "General Guidelines for Electrical Equipment Fires Involving PCB" that his subcommittee had put together some time ago. Nick mentioned that he had been contacted by Mr. Luther Fincher of the Charlotte Fire Department requesting the locations of Duke's PCB transformers in Charlotte. The Committee thinks that it is a good idea to give this information to fire departments across the system for their use. Ken Jordan will set up a meeting with Charlotte Division personnel to discuss the issue and determine a course of action.

3. Dave Roche reported on the proposed trial burn for up to 5% PCB at Riverbend. Oil with a concentration of 3.7% (37,000 ppm) PCB was accumulated at the plant and EPA's toxics office gave verbal okay to prepare for the burn. On the day before the burn was scheduled, EPA's hazardous waste incinerator group asked for more information and indicated the burn could not proceed as planned. Representatives from Duke plan to meet with EPA to agree on the details of the burn procedure. It appears that stack monitoring for polychlorinated dibenzofurans (PCDF's) and polychlorinated dibenzodioxins (PCDD's) will be required.

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4. Ken Jordan discussed USWAG's PCB Spill Clean-up Guidelines proposed by the Spill Clean-up Task Force. This is an attempt to develop and support a method of clean-up that EPA can use in developing its guidelines. Volunteer utilities are needed to test the proposed guidelines. A motion was made, seconded, and unanimously passed that Duke Power participate.

5. It was agreed that the USWAG PCB Questionnaire would continue to be answered and submitted quarterly. With detailed participation in spill clean-up, more data may be available for that part of the questionnaire.

6. Charlie Spry reported on storage and disposal of PCB's through Toddville. Duke is in good shape after some difficulties in 1983. Warren Baker reported that the repair of the floor in PCB Building No. 2 is holding up well.

7. Nick mentioned the EPA rulemaking on PCB equipment fires which will begin in March 1984. The Committee decided that Duke Power should participate through USWAG and individually if there is disagreement with USWAG's approach. All options should be kept open.

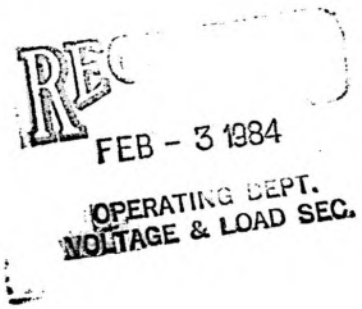
8. Scott Price mentioned that the Fire Suppression Task Force in Design Engineering might be helpful on the issue of PCB equipment fires.

9. **Redacted for Privilege**

Bill Breedlove

William N. Breedlove, Jr.
Transmission - Technical Services

WNB/fw


FEB - 3 1984
OPERATING DEPT.
VOLTAGE & LOAD SEC.

January 10, 1984

TO: PCB Committee

FROM: N. J. Melton

SUBJECT: PCB Committee Meeting
Change In Time

Due to conflict in time, our meeting scheduled for Friday, January 20, 1984 will be held at 2:00 P.M.

Please mark your records accordingly.

Thank you.

NJM/wb

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January 6, 1984

TO: PCB Committee

FROM: N. J. Melton

SUBJECT: PCB Committee Meeting

The PCB Committee will meet in Room 224B of the Woodlawn Center on Friday, January 20, 1984 at 9:00 A.M. The following items are proposed for discussion at that meeting.

1. Report on EPRI Seminar
2. Report on PCB Clean-up Guideline Task Force.
3. Report on burning of PCB fluid at Riverbend.
4. Report from Dave Roche on Guidelines for Electrical Equipment Fires Involving PCB.
5. Dukes' participation in proposed rule making on fire risks.
6. PCB Transformers in buildings on Duke System.
7. Continued participation in USWAG PCB quarterly questionnaire.
8. Toddville storage and disposal report.
9. Other

Attached for your information are:

1. PCBs: A Progress Report from Reddy Communications.
2. A Confidential Memorandum including the Minutes of the PCB Committee Meeting in Atlanta and a Meeting with the Equitable Life Assurance Society and USWAG representatives.
3. Proposed Amendments to PCB Rules ("Rule 3").

NJM/wb

Attachments

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JAN 10 1983
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March 30, 1984

W. D. Baker
T. J. Bowling
H. B. Doggett, III
J. E. Harwood
R. E. Holmes, Jr.
P. W. Huntley
K. R. Jordan
J. E. Lansche
N. J. Melton
L. B. Morris
W. S. Price
D. P. Roche
G. T. Swearingen
R. R. Wylie

SUBJECT: PCB Committee Meeting

Nick Melton chaired a meeting of the Company PCB Committee on March 29, 1984. Those present were:

Warren Baker
Bill Breedlove
Trip Doggett
Pat Huntley
Ken Jordan
Nick Melton
Dave Roche
Charlie Spry
Robert Wylie

GUESTS

G. L. Finley
C. J. Sherrill
E. B. Shuler

1. Nick began the meeting by showing a video tape of an "investigative report" by Detroit, Michigan's Channel 7 TV about Detroit Edison Company's PCB capacitor spill clean-ups. Messrs. Finley, Sherrill and Shuler were invited to see the tape with the Committee.

2. Nick and Ken Jordan advised the group of top management's decision to phase out Duke's askarel transformers in buildings. Distribution and Division Operations personnel are now evaluating the best way to achieve this (changeout, retrofill, vault modification, etc.) on an individual basis.

3. Ken Jordan mentioned that the Charlotte Fire Department had been given a list of Duke's askarel transformers in the city. No activity with other fire departments across the system is planned at this time.

4. Dave Roche reported that a revised plan for Duke's test burn of PCB-contaminated oil (up to 4+% PCB) had been given to EPA Region IV. Approval is expected from EPA within one month. The test burn is therefore scheduled for late April or early May.

5. The Committee discussed the Advanced Notice of Proposed Rulemaking (ANPR) from EPA on the risks posed by fires involving PCB transformers. It was decided to work through USWAG rather than as an individual company since Duke's data is lacking because no known fires involving PCB transformers have occurred.

6. Nick will be attending a USWAG PCB Committee Meeting next Wednesday, April 4, 1984 to discuss EPA's ANPR. Duke's Committee feels strongly that two "classes" of equipment should be fought for very hard by USWAG. They are:
   a) Non-askarel PCB transformers
   b) Askarel transformers in protected locations such as at power plants, in substation, etc.

Nick will reconvene the Duke PCB Committee sometime after next week's USWAG meeting.

Bill Breedlove

William N. Breedlove, Jr.
Technical Services-Transmission

WNB,Jr./mms

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October 19, 1983

W. D. Baker
T. J. Bowling
W. N. Breedlove, Jr.
H. B. Doggett, III
J. E. Harwood
R. E. Holmes, Jr.
P. W. Huntley
K. R. Jordan
J. E. Lansche
N. J. Melton
L. B. Morris
W. S. Price
D. P. Roche
C. T. Spry
G. T. Swearingen
R. R. Wylie

SUBJECT: PCB Committee Meeting

Nick Melton chaired a meeting of the Company PCB Committee on October 14, 1983. Those present were:

Warren Baker
Bill Breedlove
Trip Doggett
Joe Harwood
Roy Holmes
Pat Huntley
Mitch Ivey
Ken Jordan
Nick Melton
Brian Morris
Scott Price
Pat Wingo
Robert Wylie

1. Warren Baker briefed the Committee on some recent PCB disposal problems.

2. Nick mentioned Duke's recent visit to EPA Region IV in Atlanta, Ga. to discuss spill clean-up problems. A detailed memo about this has already been circulated to the Committee.

3. Redacted for Privilege

4. According to information from Dave Roche, Duke is almost ready to submit its plan for incineration of up to 50,000 ppm PCB-contaminated oil at Riverbend Steam Station.

5. Nick asked the group for its thoughts on the routine testing of voltage regulators in substations. There are pros and cons. No decision was made.

6. EPA's Questions and Answers information was mentioned briefly.

Mitch Ivey asked if Duke would be willing to drain and prepare for shipment items of equipment owned by customers. Nick referred Mitch to Roy Holmes for Roy's opinion on the matter.

Ken Jordan asked if Duke should spend more time providing information on the EEI/USWAG PCB Questionnaire. Nick agreed to ask Wald, Harkrader, and Ross and/or Resource Planning Corporation about the present usefulness of this data.

Joe Harwood mentioned an upcoming meeting to discuss an EPA waste oil questionnaire. The meeting is scheduled for October 19, 1983 at 2:00 p.m. in EC-1101.

A question was raised in the meeting about Duke's policy on burning PCB-contaminated oil for outside parties at Riverbend. Duke originally said no to this idea, but later allowed burning to be done. The Committee feels that there should be a consistent policy regarding burning for others. More discussion on this issue may be held at the next Committee meeting.

Information about Duke's position on certain PCB issues before EPA was given to Bill Lee for discussion with William Ruckleshaus, the present EPA Administrator.

Brian Morris brought up the subject of separating oil from transformers and reclosers at field locations. Unless a scheme can be developed to test the transformer oil for PCB concentration first, it cannot be placed in the same tank with recloser oil. EPA considers this dilution, but actually it is the same oil in both type of equipment.

Proposed changes in the federal Department of Transportation regulations regarding hazardous material transport were briefly discussed. USWAG is commenting.

W. N. Breedlove, Jr.

WNB,Jr./mms

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October 6, 1983

MEMO

TO: PCB Committee

FROM: N. J. Melton njm

SUBJECT: PCB Committee Meeting

There will be a meeting of the PCB Committee in Room 224B of the Woodlawn Center on Friday, October 14, 1983 at 9:00 A.M. The following agenda items are known at this time:

1. Report on visit to Region IV
2. USWAG & PCB regulatory activities CONTINUE LITIGATION ON 50 PPM + SIGNIFICANT EXPOSURE. ART ON USWAG TASK FORCE ON CLEANUP.
3. Report on shipments for disposal
4. Update on incineration project PLAN TO EPA BY END OF OCT FOR BURN UP TO 50,000 PPM - TEST BURN BY 12/83 POSSIBLE.
5. Discussion of testing of voltage regulators and other apparatus DELAY
6. Other items of interest

NJM/wb

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October 5, 1983

MEMORANDUM

TO: Mr. F. A. Jenkins

FROM: N. J. Melton njm

SUBJECT: PCB Activities

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[redacted]

Redacted for Privilege

NJM/wb

cc: PCB Committee
Mr. Bruce Shuler
Mr. C. J. Sherrill
Mr. D. L. Pearman

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September 29, 1983

TO: PCB Committee

FROM: N. J. Melton

SUBJECT: Recent Visit To EPA Region IV

Attached is a copy of the memo to file by Joe Harwood on our recent meeting in Atlanta with EPA Region IV. Also, he has attached pertinent documents which were presented to the representative of Region IV in Atlanta.

There is a USWAG PCB Committee meeting Tuesday, October 4, 1983 in Washington, and some other problems have arisen, which probably should be discussed at the committee meeting the following week. I will try to get a notice out as soon as we can confirm the date.

NJM/wb

September 16, 1983

Memo To File

Re: PCB Meeting with EPA Region IV
File No.: ENV-0106

On September 14, 1983, Messrs. N J Melton, K R Jordan, and J E Harwood met with EPA Region IV representatives Messrs. Roy Clark, Ralph Jennings, and Ms. Connie Jones of the Toxic Substances Branch in Atlanta. The purpose of our meeting was to share with EPA some concerns and practical problems with regard to existing and proposed spill clean-up regulations. Copies of the materials distributed at the meeting during our discussions are attached. In summary, Nick Melton explained our purpose for the meeting and our involvement in former PCB rule-makings via USWAG and comments and testimony generated by Duke. I then reviewed Duke's commitment to proper PCB management by reviewing the structures of our Hazardous Waste and PCB Committees. Further, indicating that Duke via activities of the PCB Committee has developed a comprehensive PCB Plan, held training sessions, developed a PCB management facility at Toddville, developed a computerized data base for management of selected PCB equipment, and has been assured of corporate management's support of such programs. Ken Jordan then proceeded to describe some practical problems with clean-up and some analytical problems we were encountering as a result of trying to comply with the literal interpretation of the regulations. Handouts per Ken's discussion are also attached (Examples 1, 2 and 3).

Our presentation was seemingly well received and Mr. Clark and Mr. Jennings had some interesting questions and comments. In general, they were seemingly pleased that we had come to Atlanta, and Mr. Jennings made notes as to our concerns. He also indicated he would submit our concerns to EPA-Washington on the appropriate issues. However, he indicated they would be comments earmarked as being from a concerned utility not from EPA Region IV.

Specifically, we had some interesting discussion about the concept of "background" and what was meant in the proposed regulations regarding PCB spill clean-up. To paraphrase Mr. Jennings, the intent of the term "background" means that clean-up to background would be to the concentration levels present before the incident presently being cleaned up. Consequently, "background" may vary from 0-1,000,000 ppm depending on previous spill activity at the site. Two points were brought out by Mr. Jennings during this discussion. First, in order to accurately determine background, it may be necessary to look at the species of PCB (Arochlor 1016, 1254, etc.) in order to determine if a spill was a recent event. His discussion centered around the fact that a spill of 1016 four or five years earlier would be easily differentiated between a recent spill of 1254. Mr. Jennings continued by indicating that those type of analytical results would be necessary in determining background. Second, Mr. Jennings further cautioned that fill replacement dirt (for areas excavated because of clean-up activities) should be checked for PCB concentrations. He indicated that some utilities have been known to replace PCB contaminated areas with fill material more contaminated

than the original area.

Mr. Clark had several questions per our inventory control program for Transmission and Distribution Departments. Ken and Nick answered Mr. Clark's concerns and he seemed favorably impressed with our efforts to keep up with our equipment, especially PCB transformers. In other discussions concerning clean-up, Mr. Clark repeatedly mentioned a "good faith effort" was important to Region IV and he felt regardless of how the final spill clean-up regulations read, a "good faith effort" was important and would be viewed favorably by his group.

In closing discussions, Mr. Jennings shared with us some of his experiences as an Analytical Chemist while working with PCB in the "early days" of formulating PCB regulations.

The meeting ended about 12:30 pm.

J E Harwood, Biologist

JEH/mdc/cwr

Attachments

DUKE POWER COMPAN
GENERAL OFFICES
422 SOUTH CHURCH STREET
CHARLOTTE, N. C. 28242

P. O. BOX 33189

TELEPHONE: AREA 704
373-4011

September 8, 1983

Mr. Ralph Jennings, Chief
Toxic Substances Branch
USEPA - Region IV
345 Courtland St, NE
Atlanta, GA 30365

Re: Meeting with EPA Personnel on PCB
File No.: ENV-0106

Dear Mr. Jennings:

As per our earlier discussions, please find attached an agenda for the subject meeting scheduled for September 14, 1983 at 10:30 AM in your offices. Representatives from Duke Power will be Mr. Nick Melton, Chairman Duke's Corporate PCB Committee; Mr. Ken Jordan, Distribution Department Representative to Duke's PCB and Hazardous Waste Committees and J E Harwood, Secretary, Duke's Corporate Hazardous Waste Committee. These gentlemen are prepared to discuss with you and your staff some of the practical problems with existing and proposed PCB regulations. I regret I will not be able to attend the meeting, but I trust this will be a mutually beneficial meeting for Duke and EPA.

If you have any questions or comments concerning the agenda please contact me at 704-373-4976 or J E Harwood at 704-373-8494.

Sincerely,

S B Hager, Chief Engineer
Civil-Environmental Division

D W Anderson

By: D W Anderson, Ecologist

DWA/cwr

Attachment

cc: C R Jeter
J R Hendricks
T W Devine
J E Harwood
K R Jordan
N J Melton

AGENDA

1. Introduction and Statement of Purpose
2. Background of Duke's Participation in Development of PCB Regulations
   a) USWAG Activities
   b) Company Comments
3. PCB's on the Duke System
   a) Compliance Program
   b) PCB Units on System
4. PCB's Regulations - Economic Impact
5. Practical Aspects Associated with Spill Clean-up and Testing

A Discussion of the Practical Aspects of PCB Regulations

Between

EPA Region IV

and

Duke Power Company

September 14, 1983

Atlanta, GA

Duke Power Company appreciates the opportunity to meet with the USEPA Region IV staff and discuss some of our experiences with the handling and disposal of PCB equipment and contaminated debris. The primary purpose of our meeting is to share some of the practical problems with existing and proposed spill clean-up regulations. Although Duke realizes EPA regional personnel are generally more oriented toward enforcement of regulations than in the rulemaking process, we are aware that often regional personnel are asked to review and comment on regulations being proposed by EPA-Washington. As a result of todays meeting, Duke is hopeful that when EPA-Washington does distribute for review and comment draft PCB Spill Clean-up Guidelines to the Regional offices that you will have had the benefit of some first hand, practical problems associated with compliance of certain aspects of the proposed regulations.

Duke Power Company is one of the ten largest electric utilities in the US, is one of the largest in the Southeastern US, and serves a 20,000 square mile area in the Piedmont sections of North and South Carolina. Duke presently serves over a million customers and has 480,000 transformers and over 100,000 capacitors operating in the service area. All of the units do not, however, contain PCB. There are 97,356 capacitors containing PCB's and 435 transformers contain PCB (Concentrations greater than 500 parts per million) systemwide.

Duke's commitment to proper PCB management is exemplified by the establishment of an inhouse corporate PCB Committee charged with following PCB regulations and establishing corporate policy with regard to compliance. Through the activities of the Committee Duke has:

1. a PCB (management) Plan which serves as a guidance document for field personnel,

2. a well publicized list of persons and phone numbers within the company who are knowledgable in the areas of environmental concerns and spill clean-up,

3. a computerized data base which allows for the tracking of PCB Transformers and the quarterly inspections required by the interim regulations,

4. a clearing house (Duke's Toddville Facility) for all company PCB equipment and debris destined for storage and/or disposal,

5. an EPA Region IV inspected and approved Annex III facility at the Toddville Facility,

6. an extensive training program for employees as to the proper handling of PCB items, and

7. a committment of manpower and other resources to the proper management of PCB (more than $311,000.00 in 1982).

In spite of the efforts by Duke and other utilities to comply with the intent and letter of the regulations, we do have some practical problems with regard to application. Duke feels that:

1. the level of clean-up required by the proposed regulations does not reflect a realistic approach to meaningful and workable regulations,

2. the sampling protocols are ambigious and do not reflect practical considerations,

3. our relationship to our customers will suffer because of the impact the proposed regulations will have on the forced destruction of the personal property of the customer.

Duke is optimistic that as a result of our meeting today that EPA-IV will have some understanding of the practical aspects of trying to enforce and/or comply with the PCB regulations. We hope this exchange of information will assist Region IV in making some meaningful comments to EPA-Washington on the proposed spill clean-up guidelines. We thank you again for the opportunity to discuss our concerns.

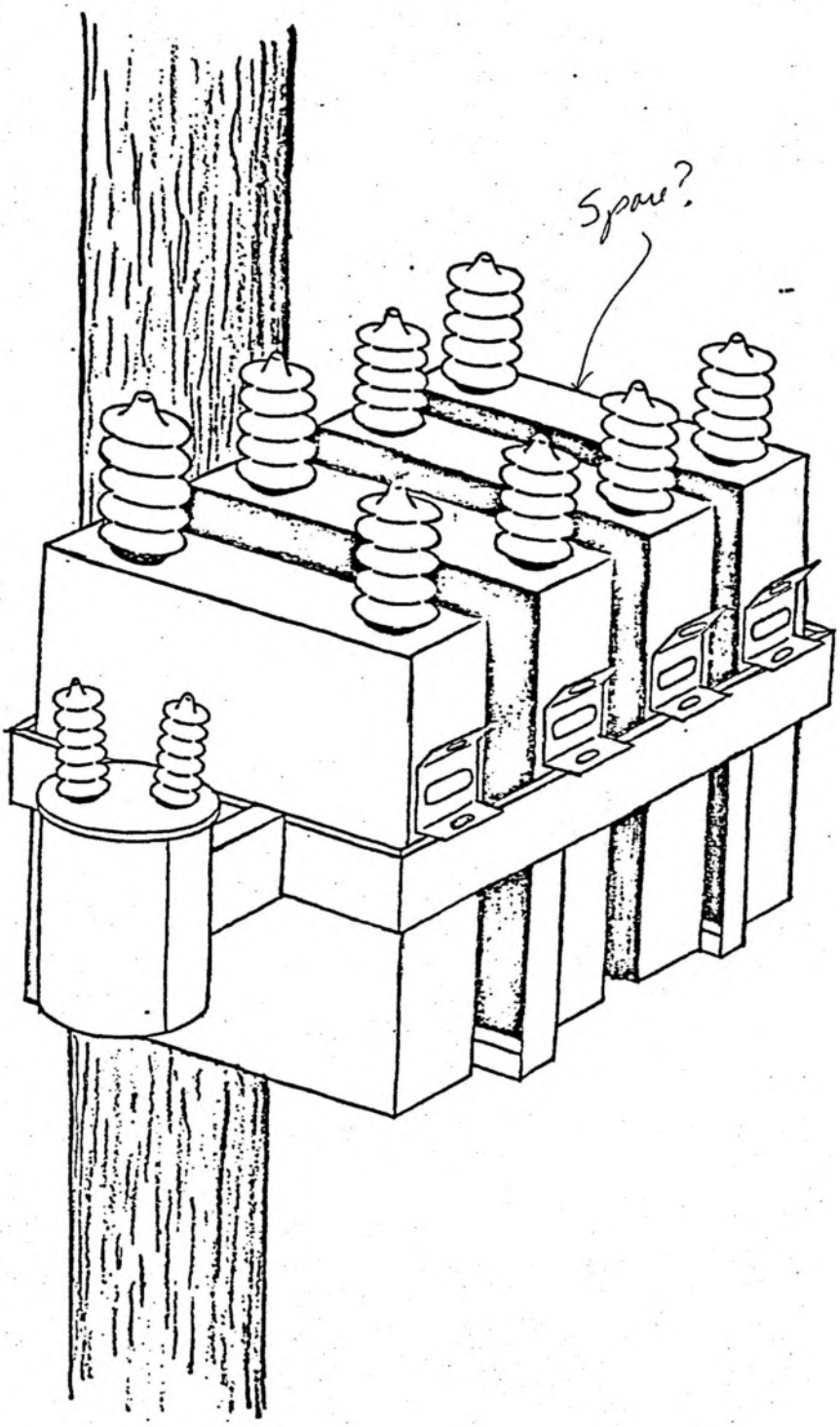


FIGURE 1. Typical capacitor bank with small transformer attached.

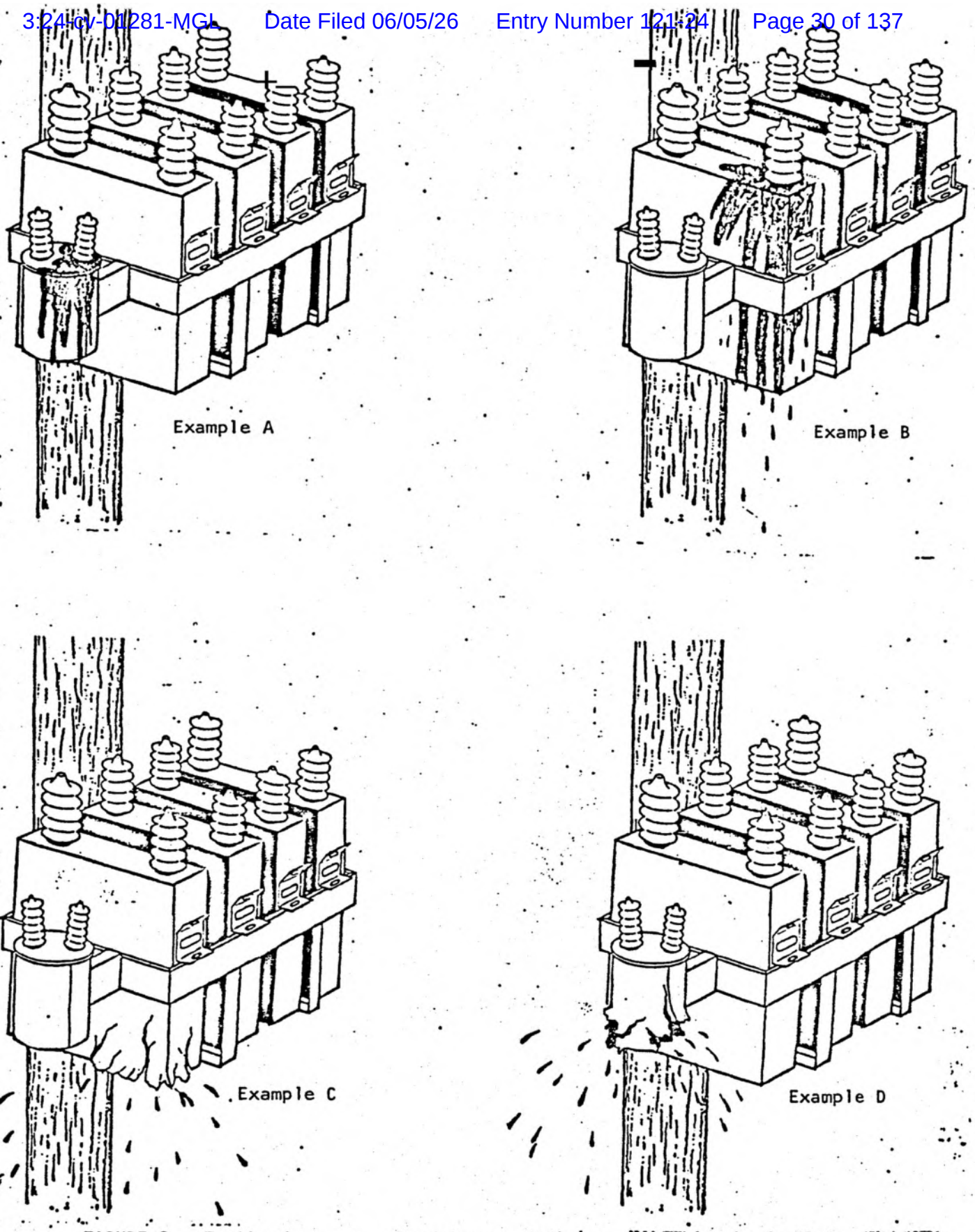


FIGURE 2. Two basic types of equipment failures. Examples A and B are representative of a leak from an insulator. Examples C and D are representative of rupture in the unit housing.

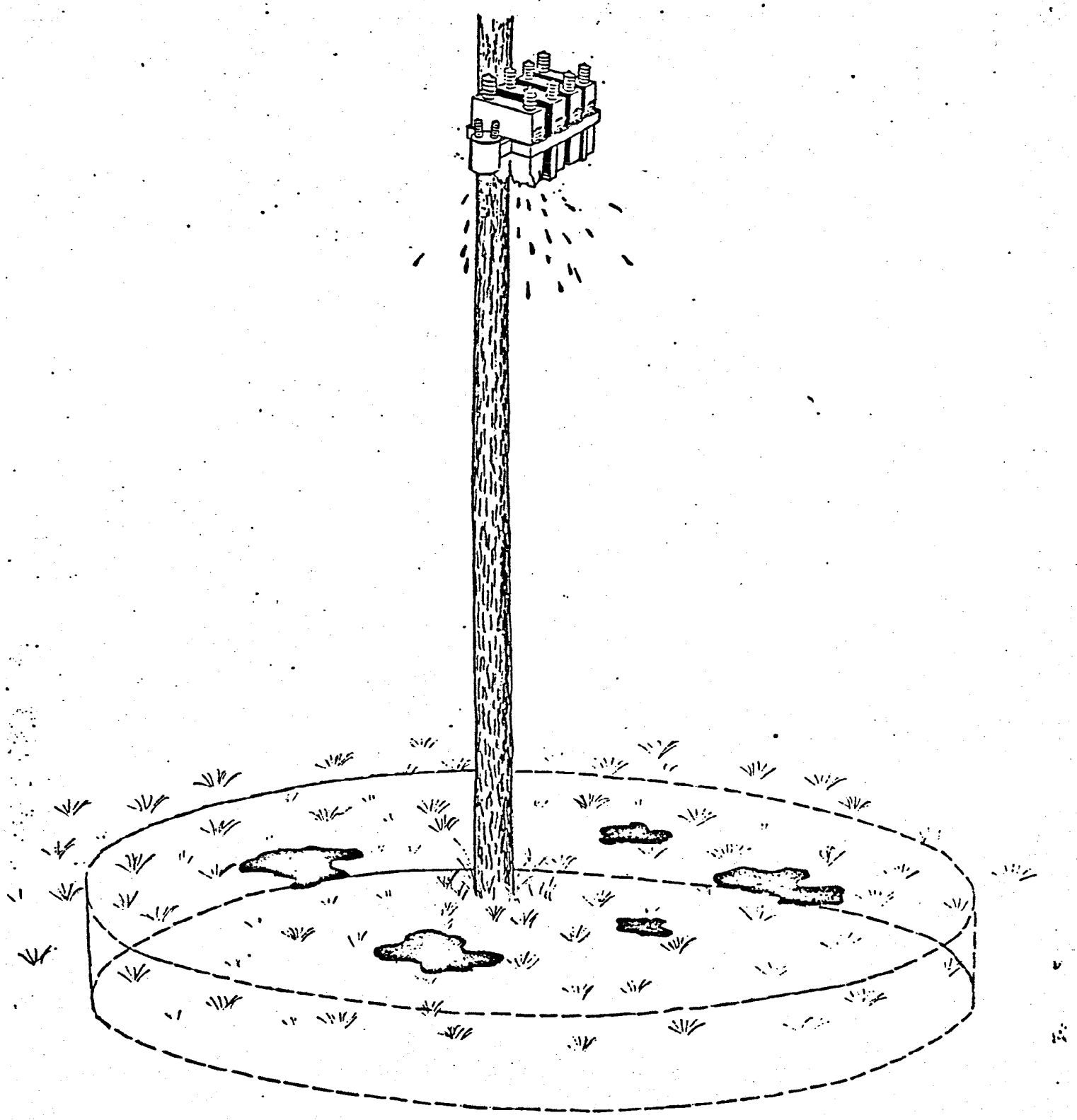
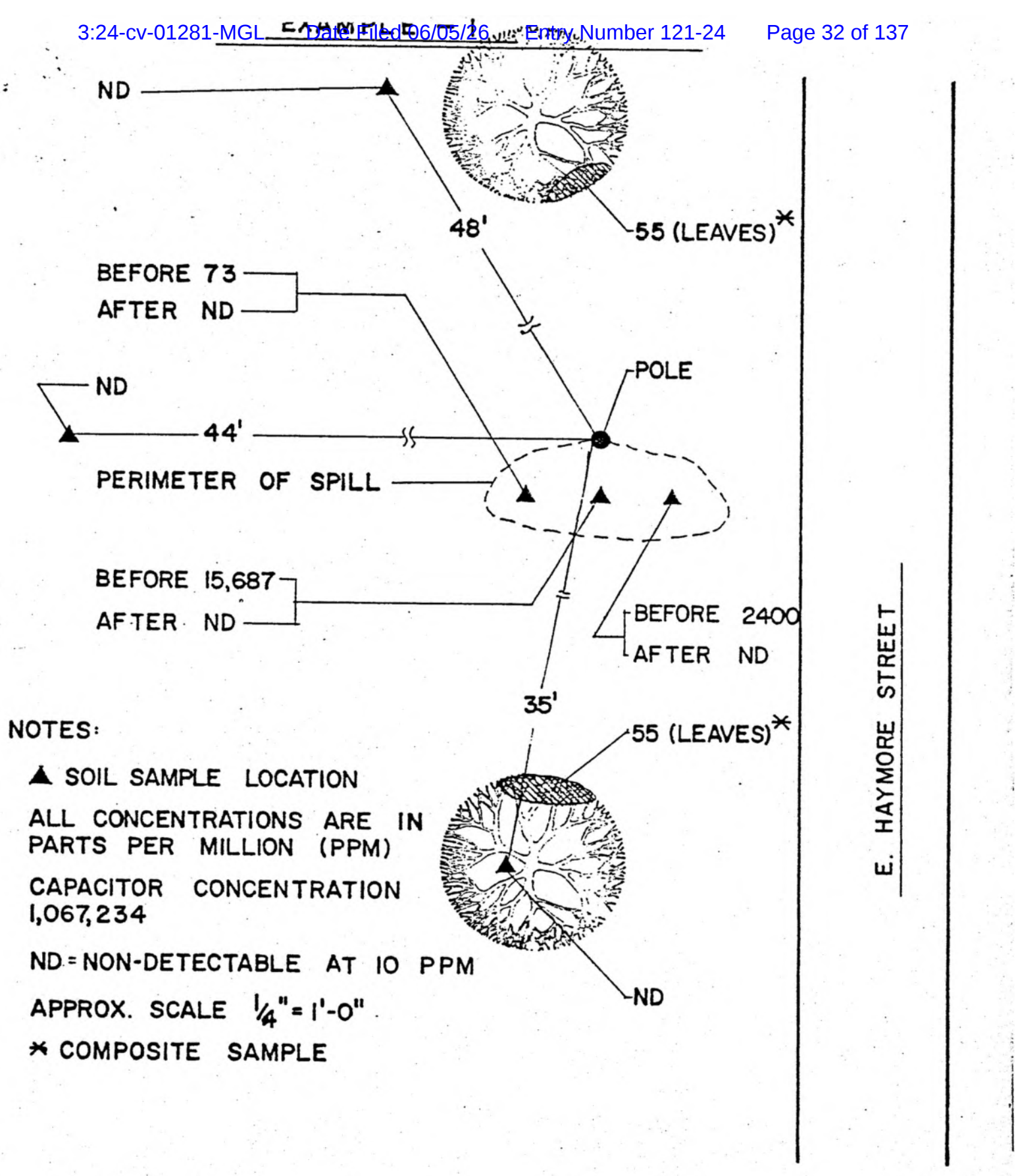


FIGURE 3. Typical distribution of unit contents as a result of a rupture type failure.



NOTES:

▲ SOIL SAMPLE LOCATION

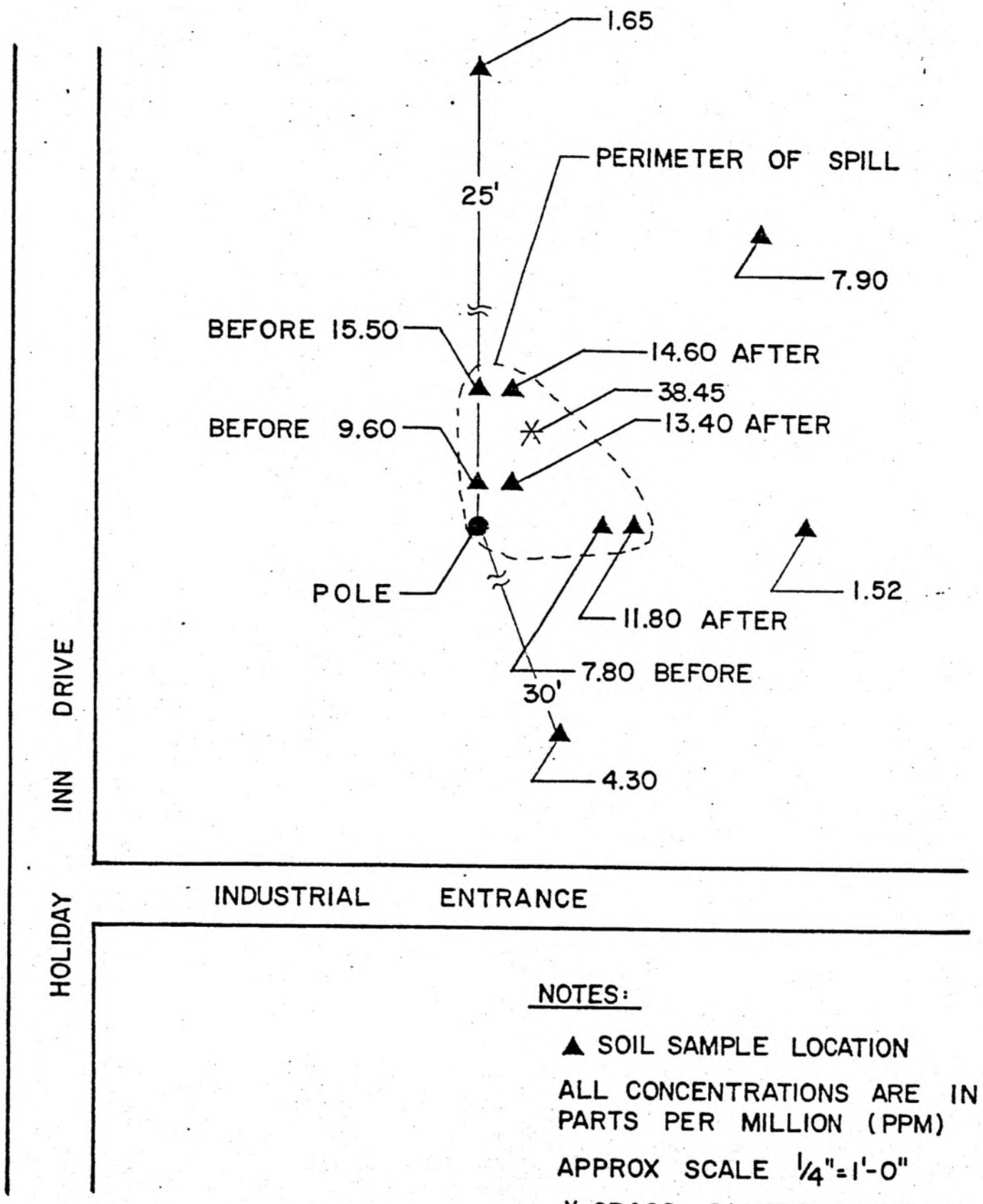
ALL CONCENTRATIONS ARE IN PARTS PER MILLION (PPM)

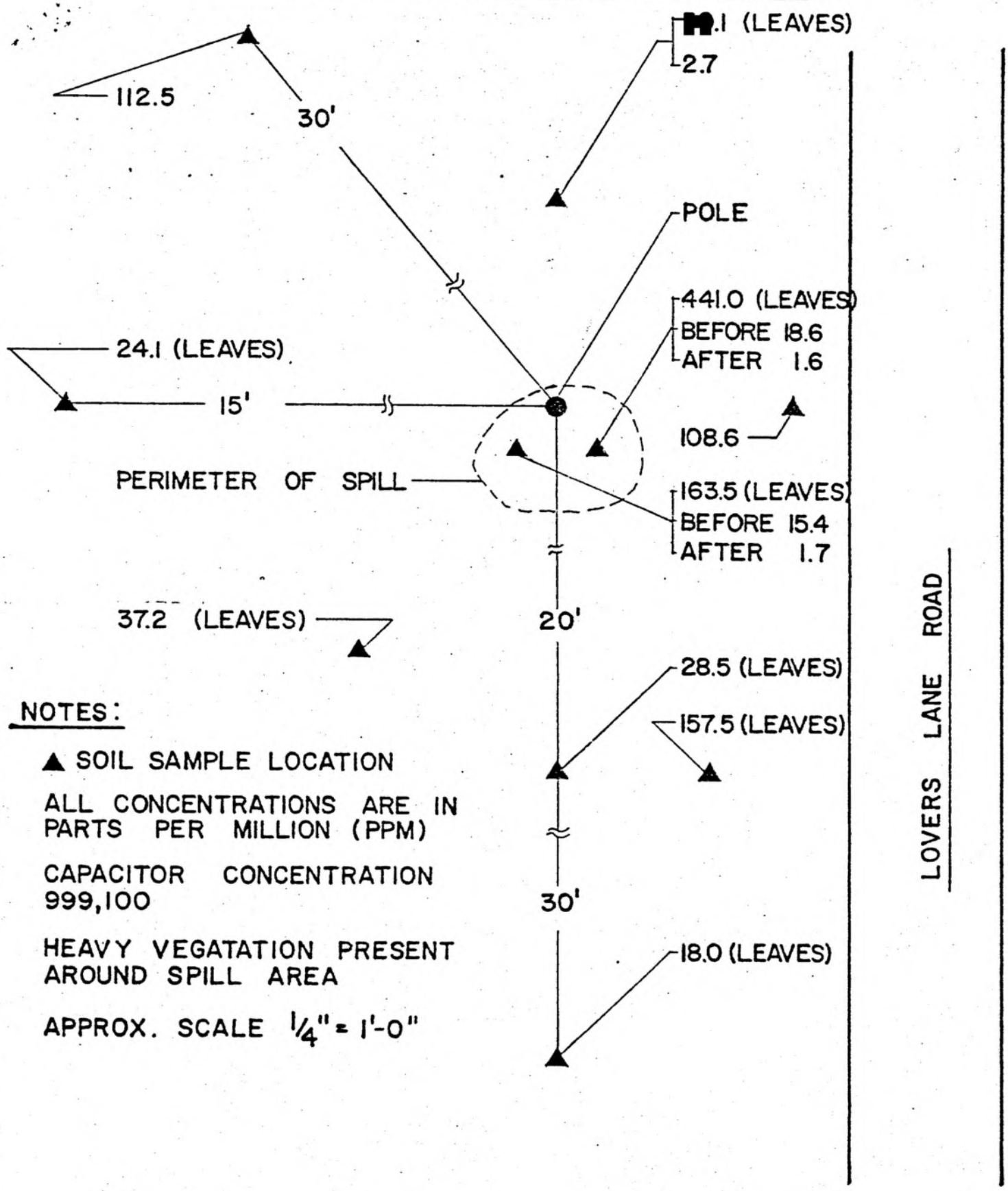
CAPACITOR CONCENTRATION 1,067,234

ND = NON-DETECTABLE AT 10 PPM

APPROX. SCALE 1/4" = 1'-0"

* COMPOSITE SAMPLE


1.65
PERIMETER OF SPILL
25'
7.90
BEFORE 15.50
14.60 AFTER
38.45
BEFORE 9.60
13.40 AFTER
POLE
1.52
11.80 AFTER
7.80 BEFORE
30'
4.30
HOLIDAY INN DRIVE
INDUSTRIAL ENTRANCE
NOTES:
▲ SOIL SAMPLE LOCATION
ALL CONCENTRATIONS ARE IN PARTS PER MILLION (PPM)
APPROX SCALE 1/4"=1'-0"
* GRASS SAMPLE LOCATION



NOTES:

▲ SOIL SAMPLE LOCATION

ALL CONCENTRATIONS ARE IN PARTS PER MILLION (PPM)

CAPACITOR CONCENTRATION 999,100

HEAVY VEGATATION PRESENT AROUND SPILL AREA

APPROX. SCALE 1/4" = 1'-0"

September 1, 1983

W. D. Baker
T. J. Bowling
W. N. Breedlove, Jr.
H. B. Doggett, III
J. E. Harwood
R. E. Holmes, Jr.
P. W. Huntley
K. R. Jordan
J. E. Lansche
N. J. Melton
L. B. Morris
W. S. Price
D. P. Roche
C. T. Spry
G. T. Swearingen
R. R. Wylie

SUBJECT: PCB COMMITTEE MEETING

Nick Melton chaired a meeting of the Company PCB Committee on August 26, 1983. Those present were:

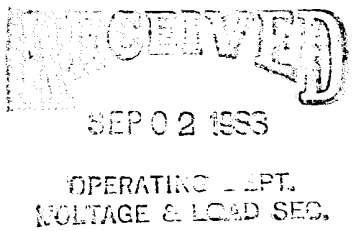
Ted Bowling
Pat Huntley
Robert Wylie
Ken Jordan
Brian Morris
Nick Melton
Scott Price
Trip Doggett
Warren Baker
Charlie Spry
Mitch Ivey
Bill Breedlove
Dave Roche
Joe Harwood

1. Redacted for Privilege

2. A visit to EPA Region IV (Atlanta) is scheduled next month regarding spill clean-up problems. This should help Duke's relations with Region IV and perhaps enlist their support for our position.

3. Scott Price asked if there were any questions from fire-fighters regarding PCB equipment fires. Are we in need of information for fire departments (professional and volunteer) about PCB fires? This will be explored for discussion at the next PCB meeting by a task force composed of:

Roche - Chairman
Harwood
Bowling
Price


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4. Warren Baker gave a PCB disposal report to the Committee.

   Contracts have been awarded to:

   ENSCO - Most liquids and transformers have been shipped
   SED - Capacitor shipments are set to begin Monday, 8-29
   Chemical Waste - Solid disposal

   Duke will receive statements of destruction when it has been accomplished by each vendor.

   Bill Breedlove was asked to check on disposal from Fairfax directly to SED in Greensboro.

5. Ken Jordan discussed spill clean-up. Two example clean-up sheets were presented to the group. These and one other spill will be used for talks with EPA Region IV in Atlanta.

6. Dave Roche reported on incineration. Outside interests want us to burn PCB-contaminated oil. A goal has been set in Fossil Production for commercial incineration of contaminated mineral oil.

   Union Electric has permission to burn up to 50,000 ppm PCB and can dilute to achieve this. Duke wants to do the same.

7. Ken Jordan discussed PCB Phase-Out. A capacitor replacement task force meets once a month to discuss plans. Full scale replacement is set to begin in 1985. Now Duke is replacing entire distribution capacitor banks with non-PCB units when one PCB capacitor in that bank fails.

William N. Breedlove, Jr.
William N. Breedlove, Jr.
Technical Services-Transmission

WNB,Jr./mms


RECEIVED
SEP 02 1983
OPERATING DEPT.
VOLTAGE & LOAD SEC.

8/26/83 MEETING

- IF NEG. BREAKDOWN – GO TO COURT SUE TO: 1. CHANGE PHASE OUT FROM 6 YR TO 10YR – DOUBTFUL CAN GET.
  2. DEFINATION OF SIGNIFICANT EXPOSURE
  3. 50 TO 500 PPM PRESUMPTION.

- WILL PREPARE GUIDE FOR [redacted] DIVISIONS ON [redacted] PCB FIRES.

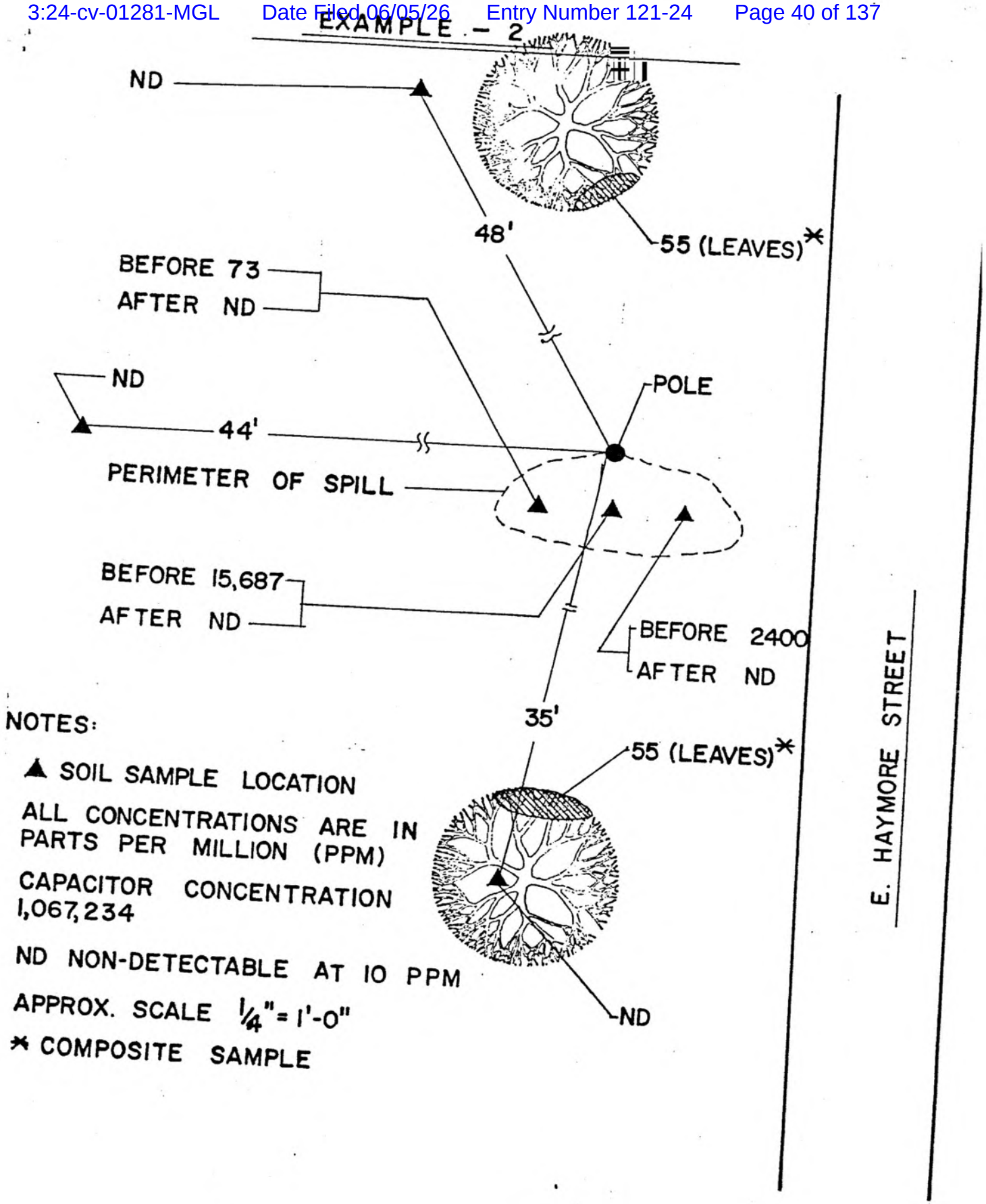
- HAVE DISPOSAL CONTRACTS WITH ENSLD (TRANS. LIQUIDS) + SEP (G'BORO) (CAPACITORS)
  - WORKING ON CONTRACTS FOR SOLIDS WITH CHEM. WASTE

- GOAL IN FOSSIL PROD TO COMMERCIAL BURN USED TRANS. OIL FOR OTHER UTILITIES BELOW 500 PPM.

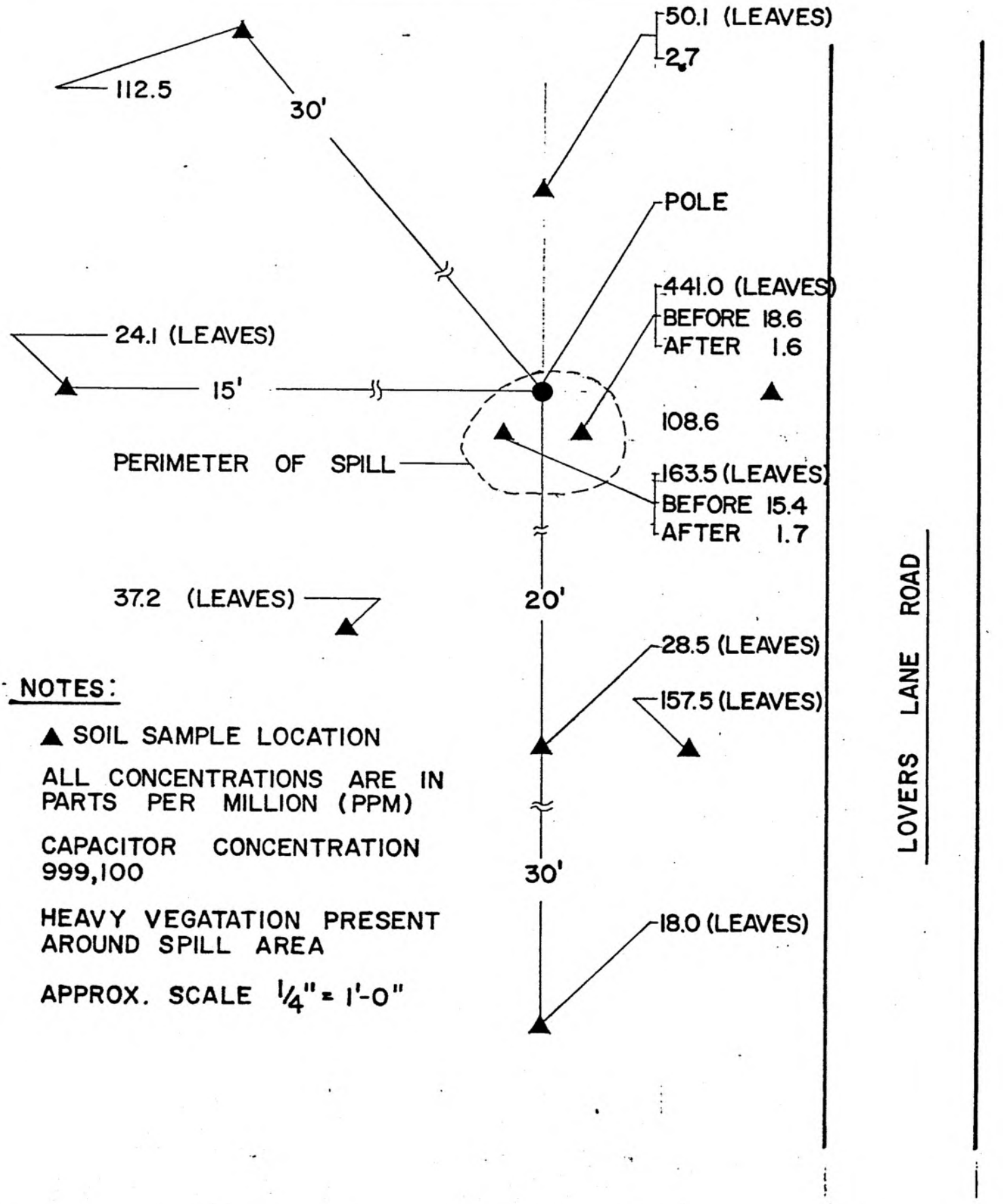
- ON CAP. PHASE OUT – BEGIN FULL SCALE REPLACEMENT IN 85, DOING SOME NOW AS UNITS FAIL. (BUDGET COST $5 MILLION.)

- Washington M. – check on reclassification.

9/12/83: PU JRH WAS SAMPLED ON 7/28/83 + TESTED LESS THAN 500PPM. JRH TO SEND MEMO ON THIS


EXAMPLE – 2
ND
48'
55 (LEAVES)*
BEFORE 73
AFTER ND
ND
44'
POLE
PERIMETER OF SPILL
BEFORE 15,687
AFTER ND
BEFORE 2400
AFTER ND
35'
55 (LEAVES)*
ND
E. HAYMORE STREET
NOTES:
▲ SOIL SAMPLE LOCATION
ALL CONCENTRATIONS ARE IN PARTS PER MILLION (PPM)
CAPACITOR CONCENTRATION 1,067,234
ND NON-DETECTABLE AT 10 PPM
APPROX. SCALE 1/4" = 1'-0"
* COMPOSITE SAMPLE

EXAMPLE – 1



NOTES:

▲ SOIL SAMPLE LOCATION

ALL CONCENTRATIONS ARE IN PARTS PER MILLION (PPM)

CAPACITOR CONCENTRATION 999,100

HEAVY VEGATATION PRESENT AROUND SPILL AREA

APPROX. SCALE 1/4" = 1'-0"

June 6, 1983

Mr. Brian Morris
Distribution Operations

SUBJECT: PCB Committee

Dear Brian:

We welcome you to the PCB Committee. You have been involved in the past and have been active in our recent discussions. If you need further briefing I will be glad to help you or Ken Jordan has complete files.

Your name is now on our list and you will receive copies of all future mailings. We look forward to your active participation in our work.

Very truly yours,

Nick

N. J. Melton, Manager
Apparatus Engineering

NJM/cgf

cc: PCB Committee
F. A. Jenkins
E. N. Hedgepeth, Jr.

RECEIVED
JUN 0 7 1983
OPERATING DEPT.
VOLTAGE & LOAD SEC.

3:24-cv-01281-MGL Date Filed 06/05/26 Entry Number 121-24 Page 43 of 137

June 1, 1983

Mr. N. J. Melton
Manager, Substation Apparatus Engineering
Woodlawn Center

SUBJECT: PCB Regulations

In preparation for the USWAG meeting later this week, I would like to suggest that we do two things. First of all, I believe we need a suggested "position statement" for consideration at the meeting. The attached draft is a starting point for such a statement. Secondly, we need to try to sell our proposed position statement to as many delegates as possible, before the meeting.

I realize that the time is short and a lot of work is involved, but I believe the possible benefits justify the effort. The final regulations on the five items yet to be settled will have a substantial economic and public relations effect on Duke Power Company.

In the light of new information on the Yusho incident and other health effects studies, and the interest at EPA and EDF to "move on to other things", I think we should make every effort to encourage USWAG to take a more aggressive position in the negotiations. Additional areas for their investigation could include 1) the studies by G. E., Monsanto, Sangamo and other manufacturers on employee health effects; 2) court cases (pending and resolved); 3) EPA's failure to consider pertinent testimony and data presented in the recent study; 4) current status on the alternate fluids; 5) the lack of justification for the 50 ppm and 500 ppm definitions of PCB's, and 6) the improper use of regulatory over-action, not environmental/health effects, at incidents such as occurred at Binghamton, N. Y. to justify the excessive regulations. I also think we should press for greater representation by operating personnel on the "negotiating team."

I will be glad to help support these positions.

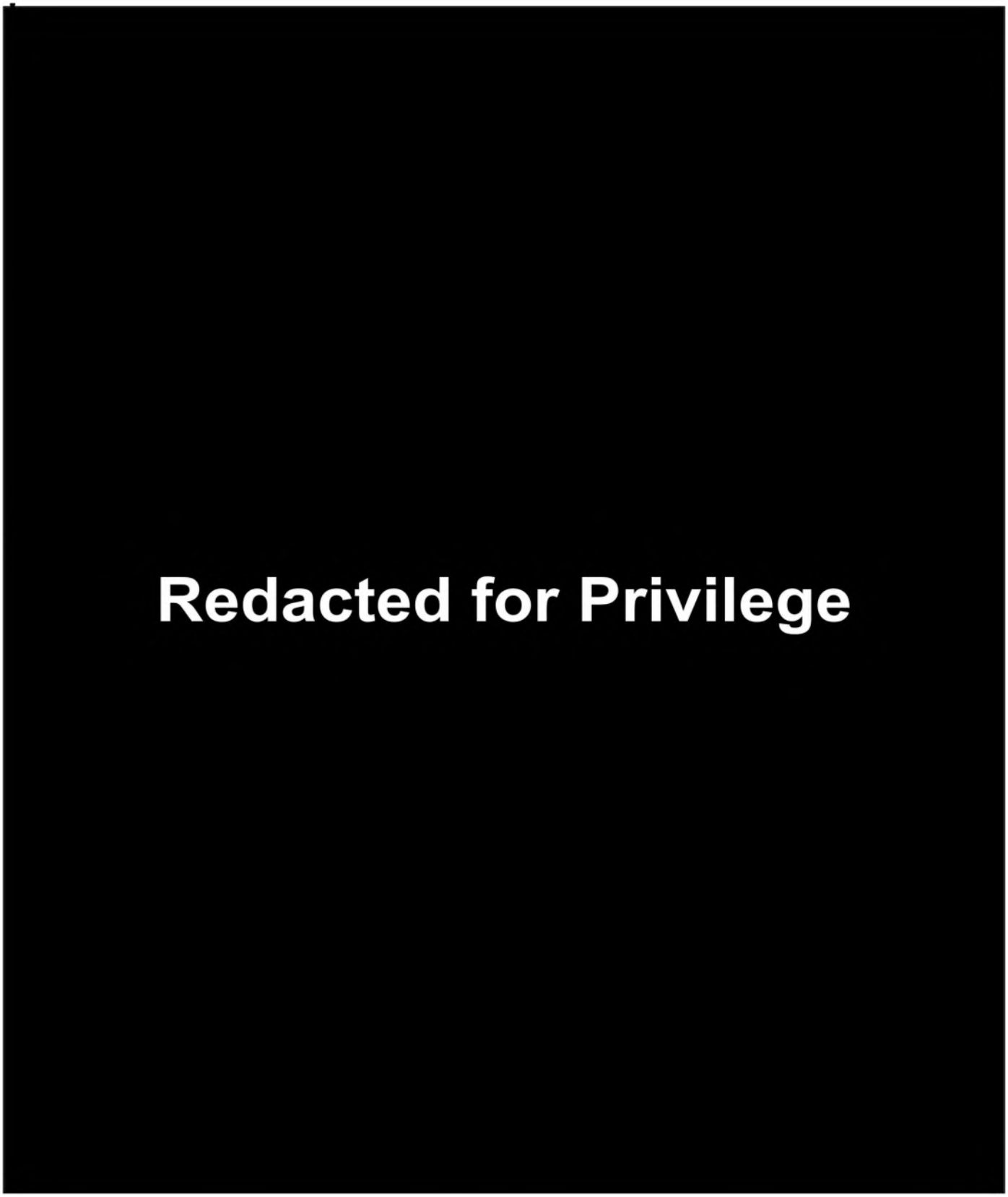
Ken Jordan
KENNETH R. JORDAN

KRJ/aw

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Redacted for Privilege

Continued



May 18, 1983

Mr. Robert Wylie
Nuclear Production Department

Dear Robert:

Bill Haller has requested that you serve as a member of the PCB Committee from the Nuclear Production Department. I am glad to have you as a member and look forward to working with you.

Attached are some documents which will give you a little information on the activities that are now progressing and of major concern at this time. I will be glad to brief you or answer any questions that you might have.

We do not have regularly scheduled meetings but call meetings when there appears to be a need to discuss matters or bring the committee up to date on actions which have been taken or are pending. You are now on our mailing list and will receive notices of all future meetings and mail out material.

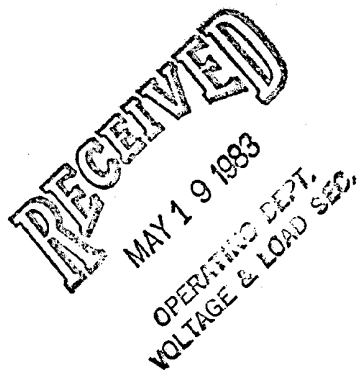
N. J. Melton

N. J. Melton, Chairman
PCB Committee

NJM/cgf

cc: W. A. Haller
F. A. Jenkins
PCB Committee

DUK_00100016



Confidential

April 25, 1983

MEMORANDUM

TO: PCB Committee

FROM: W. N. Breedlove, Jr. WNBJr

SUBJECT: PCB Committee Meeting Of April 19, 1983

Nick Melton chaired a meeting of the PCB Committee on April 19 to discuss several items of interest, particularly Duke Power's position on USWAG options to settle litigation with the Environmental Defense Fund.

Nick mentioned ongoing efforts by Dave Roche and others to enable Duke Power to dilute and burn at Riverbend PCB liquids in concentrations up to 50,000 ppm. More on this will be coming later.

Warren Baker gave a report to the Committee about a recent inspection trip to SED, Inc. in Greensboro. SED accepts capacitors for disposal and attempts to salvage materials for re-use through a solvent cleansing and separation process. PCB liquid and contaminated solvent is sent to a licensed incinerator just as Duke would send it.

Redacted for Privilege

Redacted for Privilege

Ken Jordan also briefed the Committee on Distribution's plans for phasing out capacitors. A committee including Ken is planning now to begin the replacement program in 1984 and complete it by 1987 (these are tentative dates).

George Swearingen asked Nick to question at the USWAG meeting whether EPA would give the utility industry any kind of committment on the acceptability of replacement fluids for PCB's.

Pat Huntley also asked if any of the phased out distribution capacitors could be used on the transmission system, possibly at customer substations. Nick indicated that this had been investigated before and that there were some problems involved. The idea will be re-examined.

WNB,Jr./mms

DUK_00100019



Confidential

4/19/83

- REQUESTING PERMISSION TO DILUTE UP TO 50,000 ppm & BURN IN RIVERBEND

- Cap Removal [redacted] committee, KRJ chairman.
  Land schedule - complete by 1987
  ≈500 tanks

- Locations where could not Dist app noted
  ≈400 & 7200 Volt cons.

3:24-cv-01281-MGL Date Filed 06/05/26 Entry Number 121-24 Page 54 of 137

QUARTERLY PCB TRANSFORMER INSPECTION REPORT
FEBRUARY 21, 1983

AREA .

1ST QUARTER 1983

STEAM UNITS HANDLED BY D. ROCHE THIS QUARTER ONLY.

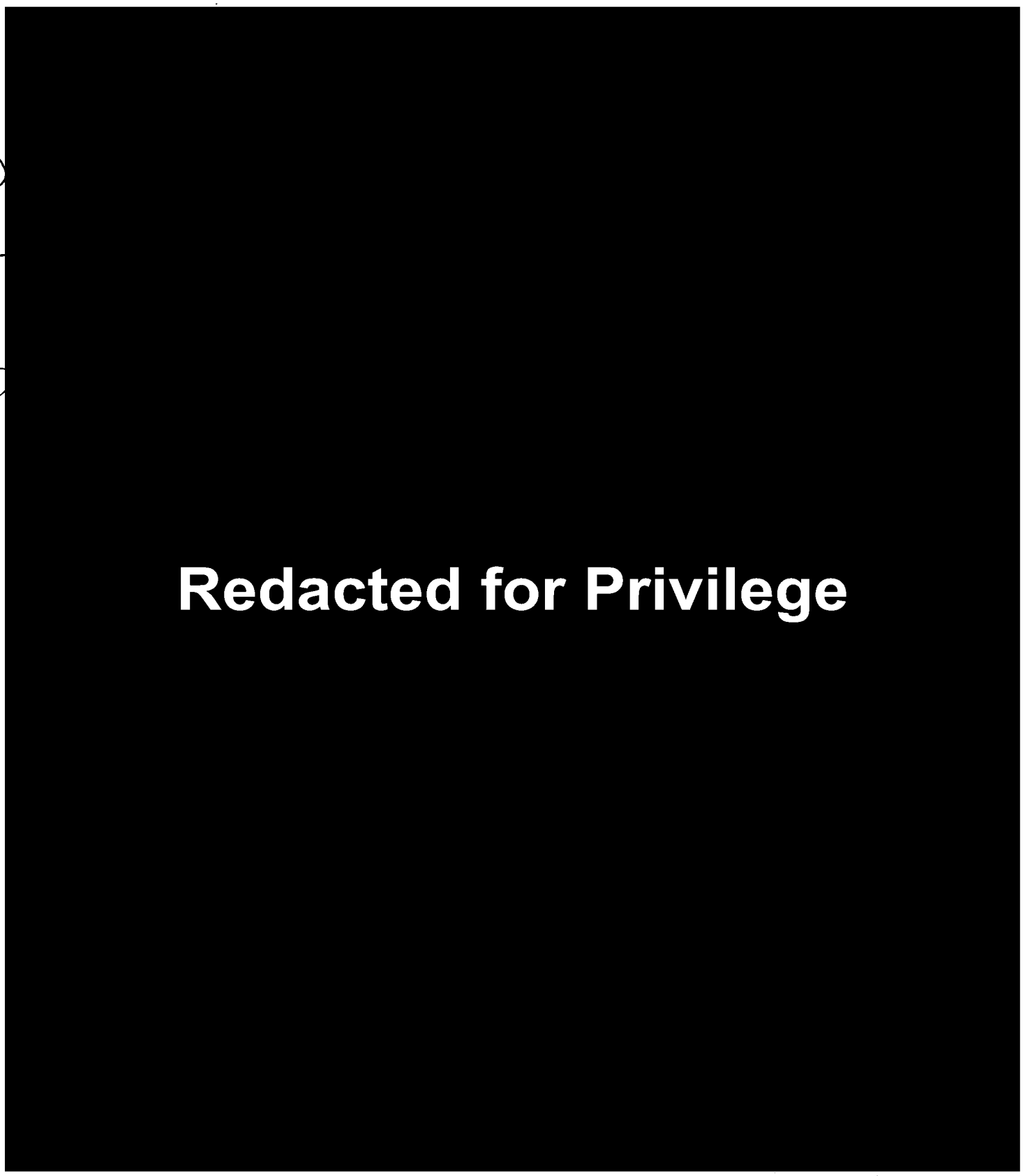
STATION	BANK ID	MFR/SN	PPM	DATE INSP
ALLEN STEAM PL	CHX2	MG9138855	99999	
ALLEN STEAM PL	CHX1	MG9128867	99999	
ALLEN STEAM PL PRECIPITATORS 2	35	WES3F3396	99999	
ALLEN STEAM PL PRECIPITATORS 2	31	WES3F3397	99999	
ALLEN STEAM PL PRECIPITATORS 2	32	WES3F3398	99999	
ALLEN STEAM PL PRECIPITATORS 2	44	WES3F3399	99999	
ALLEN STEAM PL PRECIPITATORS 2	33	WES3F3401	99999	
ALLEN STEAM PL PRECIPITATORS 2	41	WES3D172	99999	
ALLEN STEAM PL PRECIPITATORS 2	34	WES3D173	99999	
ALLEN STEAM PL PRECIPITATORS 2	43	WES3D174	99999	
ALLEN STEAM PL PRECIPITATORS 2	36	WES3D175	99999	
ALLEN STEAM PL PRECIPITATORS 2	46	WES3D176	99999	
ALLEN STEAM PL PRECIPITATORS 2	45	WES3D177	99999	
ALLEN STEAM PL PRECIPITATORS 2	52	WE6DE405	99999	
ALLEN STEAM PL PRECIPITATORS 2	51	WE6DE406	99999	
ALLEN STEAM PL PRECIPITATORS 2	53	WE6DE407	99999	
ALLEN STEAM PL PRECIPITATORS 2	54	WE6DE408	99999	
ALLEN STEAM PL PRECIPITATORS 2	55	WE6DE409	99999	
ALLEN STEAM PL PRECIPITATORS 2	56	WE6DE410	99999	
ALLEN STEAM PL PRECIPITATORS 2		WE7L2243	99999	
BELEWS CREEK STEAM STA UNIT 1		WEPXC03772	99999	
BELEWS CREEK STEAM STA UNIT 2		WEPXC03873	99999	
BELEWS CREEK SWITCHING STA	STA	IT21462A01	99999	
BUCK STEAM STA		IT19277	99999	
BUZZARD ROOST PL	03	GES355016	99999	
BUZZARD ROOST PL	03	GES355017	99999	
BUZZARD ROOST PL	03	GES355018	99999	
BUZZARD ROOST PL	04	GES355019	99999	
BUZZARD ROOST PL	02	GES355020	99999	
BUZZARD ROOST PL	02	GES355021	99999	
BUZZARD ROOST PL	01	GES355022	99999	
BUZZARD ROOST PL	01	GES355023	99999	
BUZZARD ROOST PL	04	GES355024	99999	
BUZZARD ROOST PL	02	GES355025	99999	
CLIFFSIDE STEAM STA	A05	GEC643723	99999	
CLIFFSIDE STEAM STA	A14	GEC643725	99999	
CLIFFSIDE STEAM STA		GE81726?9	99999	
CLIFFSIDE STEAM STA		GE83H49	99999	
COWANS FORD HYDRO	GU2	WE62E13954	99999	
COWANS FORD HYDRO	GU1	WE62E13955	99999	
COWANS FORD HYDRO	GU3	WE62E13956	99999	
COWANS FORD HYDRO	GU4	WE62PE2428	99999	
DAN RIVER STEAM STA	A1	WEY3P70991	99999	
DAN RIVER STEAM STA COMB TURB	A&C	WEYAR94051	99999	
DAN RIVER STEAM STA COMB TURB		WEY3896984	99999	
DAN RIVER STEAM STA COMB TURB		WEY3R329A5	99999	
JOCASSEE HYDRO	CX	IT21074A01	99999	
JOCASSEE HYDRO	CT	IT21074B01	99999	

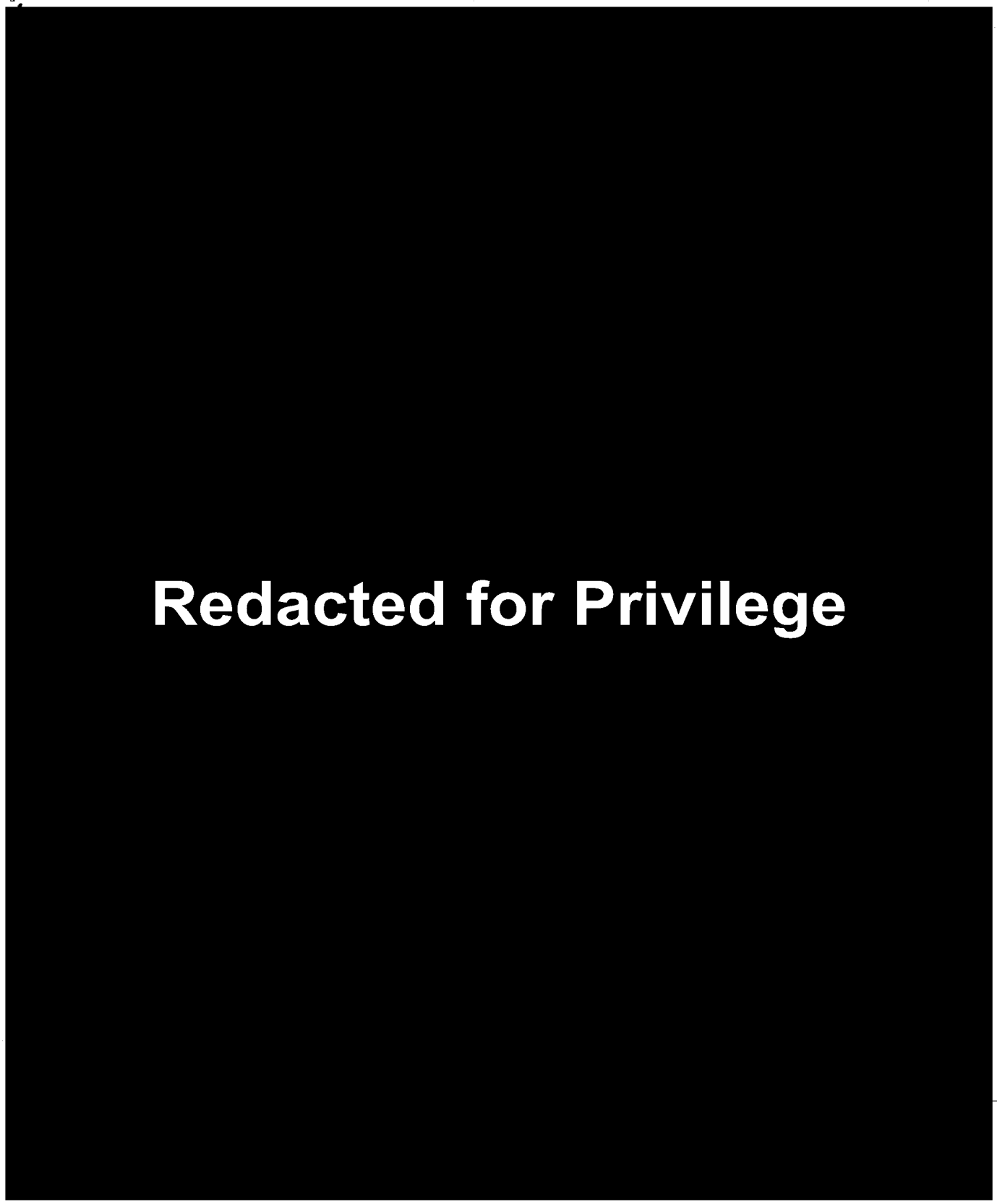
QUARTERLY PCB TRANSFORMER INSPECTION REPORT
FEBRUARY 21, 1983

AREA .

STATION	BANK ID	MFR/SN	PPM	DATE INSP
JOCASSEE HYDRO	XT	IT21074C01	99999	
JOCASSEE HYDRO	GU1	WE1PXC05372	99999	
JOCASSEE HYDRO	GU3	WE1PXC41773	99999	
JOCASSEE HYDRO	GU2	WE2PXC05372	99999	
JOCASSEE HYDRO	GU4	WE2PXC41773	99999	
JOCASSEE SW STA	STA	IT21291A01	99999	
JOCASSEE SW STA	ST8	IT21291B1	99999	
KEOWEE HYDRO	GU1	WE72PC9202	99999	
KEOWEE HYDRO	GU2	WE72PC9203	99999	
LEE STEAM STA	A4C	WEY3RA29A1	99999	
LEE STEAM STA	A5C	WEY3RA29A2	99999	
LEE STEAM STA		WEY3RA29A3	99999	
MARSHALL STEAM STA	AB	IT12446	99999	
MARSHALL STEAM STA	AA	IT12447	99999	
MARSHALL STEAM STA	CHX1	WE7221034	99999	
MARSHALL STEAM STA	CHX2	WE7221035	99999	
MCGUIRE NUC STA UNIT 1		GEH39723S74P	99999	
MCGUIRE NUC STA UNIT 2		GEH3S2L7S73P	99999	
MCGUIRE SWITCHING STA	03	IT18924	99999	
OCONEE 230KV SWITCHYARD	02	IT17994	99999	
OCONEE 230KV SWITCHYARD	01	IT17995	99999	
OCONEE 230KV SWITCHYARD	A1	IT19388	99999	
OCONEE 230KV SWITCHYARD	A1	IT19389	99999	
OCONEE 230KV SWITCHYARD	MST1	IT21066A01	99999	
OCONEE 230KV SWITCHYARD	MST2	IT21066B01	99999	
RIVERBEND STEAM STA		GEC643716	99999	
RIVERBEND STEAM STA		GEC778260	99999	
RIVERBEND STEAM STA		GEC778262	99999	
RIVERBEND STEAM STA		GEC778263	99999	
RIVERBEND STEAM STA		GEC778264	99999	
RIVERBEND STEAM STA		GEC778265	99999	
RIVERBEND STEAM STA		GEC778266	99999	
RIVERBEND STEAM STA		GEH3241796?P	99999	
RIVERBEND STEAM STA		GEH3247046?P	99999	
RIVERBEND STEAM STA		GEH3246166?P	99999	
RIVERBEND STEAM STA		GEH3248636?P	99999	
RIVERBEND STEAM STA (CONTINUED	4XPT	IT20884A01	99999	
RIVERBEND STEAM STA (CONTINUED	5XPT	IT20884B01	99999	
RIVERBEND STEAM STA (CONTINUED	C1	MG9198C9	99999	

87


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3)

1)

2)

Redacted for Privilege

DATE: April 14, 1983

TO: PCB Committee

FROM: N. J. Melton

Attached are many pages that I found in my basket this morning. I have not yet reviewed this information but have seen enough to conclude that we need to have a meeting in order to discuss and reach some preferred positions on the issues.

Please attend a meeting of the PCB Committee in room 224B of Woodlawn Center on Tuesday, April 19, 1983 at 8:30 a.m. Parking spaces unassigned are 90-121, 152-178, 209-233, 264-281, 311-356.

NJM/cgf

Attachments

Meeting of PCB Committee
January 15, 1982

Present: J. H. Francis, J. E. Harwood, R. E. Holmes, K. A. Jones, K. R. Jordan, G. T. Swearingen, H. B. Doggett, N. J. Melton, W. N. Breedlove

1. Joe Harwood gave a brief report of the recent EPA inspection of the PCB facilities at Riverbend and Toddville, and the PCB records. We know of no violations found. Dave Roche has requested a copy of the inspection report under the Freedom of Information Act.

   Joe Pointed out that the inspector found a drained and flushed PCB transformer outside the storage building. The position we have taken is that this situation is not addressed directly in the regulations and since no fluid is in the transformer, the outside storage is environmentally safe.

2. Bill Breedlove had no recommendation for any actions on the Toddville storage buildings. Joe Harwood was requested to secure an opinion from Design Engineering resources. Bill Breedlove is to brief the group from Design Engineering.

3. Bill Breedlove & H. B. Doggett are to indicate on the revised PCB plan all changes since the last revision. The Committee will then make a review for approval. Joe Harwood was to correct some telephone numbers on the Spill Report form and George Swearingen is to transmit a memo to use only the revised form for reporting.

4. Ken Jordan had transmitted some information regarding EPA rules on PCB levels in railroad transformers. Ken also requested that a strong position be taken by USWAG on oil filled equipment because of the clean-up problems.

NJM/cgf

DATE: January 4, 1982

TO: PCB Committee

FROM: N. J. Melton

SUBJECT: Committee Meeting
Friday - January 15 - 17th floor conference room 9:00 a.m.
Wachovia Center

PROPOSED AGENDA:

1. Reports of EPA on site inspections. Dave Roche & Joe Harwood.

2. Recommendations on PCB storage buildings at Toddville - Bill Breedlove

3. Approval of latest Duke Power PCB Plan.

4. Discussion of positions on PCBs to be taken by USWAG to EPA. (See minutes and documents previously mailed)

5. Other matters which members may wish to discuss.

NJM/cgf

DATE: December 9, 1981

TO: F. A. Jenkins

FROM: N. J. Melton

SUBJECT: PCB Committee Activities during 1981

During 1981, the PCB Committee members have been quite active. Listed below is a short description of some of the major activities and accomplishments.

1. The Riverbend Steam Station was set up and began to incinerate PCB contaminated transformer mineral oil under the guidelines established by EPA. D. P. Roche coordinated this effort which included meetings with all station personnel, notification of regulatory agencies and the media, and stack testing to confirm the effectiveness of PCB destruction. Toddville Stores personnel and Transmission Maintenance personnel were involved in setting up procedures and coordinating the delivery of waste oil to Riverbend.

2. A companywide response was made to EPA's Interim Measures Program. This program required Duke Power to screen approximately 20,000 industrial customers to identify food and feed facilities. Inspections and rulings had to be made on the exposure risks of all transformers at food and feed facilities which contained transformer oil contaminated above 500 parts per million with PCB. Weekly leak inspections, containment or replacement are required for units that do pose a risk of contaminating food or feed. Thirty-two Duke transformers were identified as posing a potential risk and were replaced. The coordination of inspection and identifying these units was made by K. R. Jordan of Distribution Engineering and P. W. Huntley of Operating Department. Quarterly leak inspections are required for transformers containing greater than 500 parts per million PCB that are not located at food and feed facilities. These inspections are being done companywide.

3. Duke Power was represented on the national PCB committee of the Utilities Solid Waste Activities Group, which addresses utility concern for the PCB regulations, by N. J. Melton. A study group was appointed by this committee to comply with a commitment made by EEI to the federal court to make an industrywide survey of PCB use. This study included an inventory of PCB equipment and a summary of health effects. EPA is to use the results of the study as a basis for reasonable regulations which are required by the court to be issued within six months after the completion of the study. D. P. Roche of Steam Production Department was one of seven members of the study group which advised the consultant and coordinated the study.

Duke Power was one of 100 utilities which was asked to participate in the study. Personnel of Duke Power Company spent approximately 910 manhours in gathering data for this study.

4. PCB compliance inspections by EPA at Greenville Main, Pine Knoll, and at Belews Creek Steam Station found no violations. Duke Power's PCB plan which was authored by this committee was being followed. J. E. Harwood and D. P. Roche conducted a practice inspection at Toddville.

5. The company's central records on PCB equipment in service and disposal of PCBs were kept and revised by W. N. Breedlove. The central records on PCB spills were kept and summarized by G. T. Swearingen.

6. The Transmission Substation Maintenance Section secured a second gas chromotograph and began an intensive program of PCB testing of transformers and other oil filled equipment on the system. Four outside laboratories were approved by the committee as a backup for Transmission's laboratory at Toddville.

7. Company personnel and committee members investigated new methods for treating or destroying PCBs including the de-chlorination processes of Sun Ohio and Franklin Institute and destruction by Plasma Torch Pyrolysis. H. B. Doggett, Transmission Department attended a three day seminar sponsored by EPRI on PCBs.

8. Programming was begun for computerizing the records of PCB capacitors on the system so that an up-to-date running inventory would be available to satisfy the regulatory requirements for location of all PCB apparatus. Also, computer systems were set up to store the PCB test data for distribution's transformers and transmission transformers and breakers.

9. Disposal of PCB waste at EPA-approved facilities was arranged through Mitch Ivey of Mill Power, by K. A. Jones, C. T. Spry, with legal advise from John Lanche. During 1981, 277 drums of debris and leaking capacitor, and ten transformer carcasses were shipped out to disposal sites at a cost of approximately $47,000. This group is now negotiating for disposal of liquid wastes as well as a new accumulation of capacitor, debris, etc. with estimated disposal costs in excess of $200,000.

NJM:cgf

MINUTES
PCB COMMITTEE MEETING
AUGUST 6, 1981

Present were H. B. Doggett, Dave Roche, George Swearingen, Pat Huntley, N. J. Melton.

1. Review of the Interim Measures Program activity was discussed. Ken Jordan reported that initially 17,323 customers were reviewed by their group. 438 oil samples were taken and 34 of these showed PCB levels exceeding 50 parts per million. All of these transformers have been removed or are in the process of being swapped out.

   Pat Huntley reported that six stations were requiring quarterly inspections. They have recently found two additional customers which were classified as food and feed processors.

   Dave Roche reported that inspections were in place at steam stations.

2. The questionnaire was reviewed to be sure that each person was active in their responsible areas. Partial reports of some statistics were distributed. It appeared that activity was going on and all the areas of the report should be completed by the week of August 16.

3. There was some discussion on clean up procedures and testing of oil spills from mineral oil filled transformers. Charlie Spry brought to our attention that two drums of soil were brought into Toddville from a clean up of mineral oil which was not tested. He pointed out it was quite expensive to bury drums in local landfills rather than shipping to a chemical waste landfill. It was agreed that we should go back and review with our associates this problem and come ready to make a decision at the next meeting whether we should change our policy.

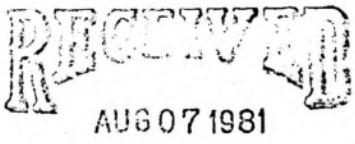
4. The next meeting will be August 24 and at that time we will review the results of the questionnaire.

5. A change in Section 4.4 of the PCB Plan was approved as worked out by Pat Huntley and Ken Jordan. Section 4.4 will read as follows:

   ... for PCB items. Retail locations will provide drums for routine operations to other departments as mutually agreed between local personnel. Extraordinary needs of other departments may be either handled directly with General Stores, or through the Retail location.

NJM/cgf

August 6, 1981



DUKE POWER COMPANY
Operating Department

DATE: August 3, 1981

TO: PCB Committee

FROM: N. J. Melton

There will be a meeting of the PCB Committee in room 1701G of the Wachovia Center at 8:30, Thursday, August 6 for a review of activity on the Interim Measures Program including the EEI study.

NJM/cgf

RECEIVED
AUG 03 1981
DUKE POWER COMPANY
Operating Department

DATE: July 9, 1981

TO: PCB Committee

FROM: N. J. Melton

There will be a meeting Monday, July 13 at 10:00 a.m. in Room 1701G, Wachovia Center to discuss item by item the EEI survey of PCB usage. Responsibility for our preparing our response to each question will be delegated. (Absence will be interpreted as your willingness to accept any assignment delegated by those present.)

NJM/cgf

RECEIVED
JUL 09 1981
...NY

July 7, 1981

MEMORANDUM

TO: Messrs. W. A. Haller, J. E. Harwood, R. E. Holmes, P. W. Huntley, K. A. Jones, K. R. Jordan, J. E. Lansche, N. J. Melton, J. H. Parker, W. S. Price, D. P. Roche, C. T. Spry, G. T. Swearingen

FROM: W. N. Breedlove, Jr. WNBJr

SUBJECT: PCB Committee Meeting

Nick Melton chaired a meeting of the Company PCB Committee on July 2, 1981.

Changes to the Company PCB Plan were reviewed and discussed. Nick asked that Joe Harwood and Bill Breedlove work with George Swearingen to revise and update the front and back of Form 02415 (Spill Reporting). Roy Holmes also mentioned that Form 06273 (Oil Sampling) had recently been changed and that this should be reflected in the revised Plan. Ken Jordan also suggested some changes and additions to Form 06273 which were agreed to. Section 7.2 will be revised to give guidance to the field about the amount of fluid which will flow out of a failed capacitor unit. This will help in reporting spills under Superfund.

The Committee voted (by a show of hands) unanimously to accept the changes in the Plan submitted to date.

Ken Jordan reported to the group on the USWAG meeting in Dallas on June 18. Dave Roche told the Committee of the progress on the questionnaire being sent out as part of the USWAG study.

Ken mentioned the first leak reported under the Interim Measures Program on July 1, 1981. No further action is anticipated since the leak has been repaired.

RECEIVED
JUL 08 1981
DUKE POWER COMPANY
Operating Department

Nick described his and Mr. Jenkins' trip to the Franklin Institute in Philadelphia. Philadelphia Electric has a batch process using Franklin's reagent , but we want a continuous process. Trip Doggett, who also attended the meeting, is pursuing this.

Dave Roche said that the burn of contaminated mineral oil at Riverbend is now scheduled for July 22, 1981. A news release through Corporate Communications is planned.

The meeting was adjourned with the rest of the day devoted to an internal audit of the Company's PCB Program by Joe Harwood and Dave Roche.

mms

Attachment

DATE: June 22, 1981

MEMO TO: PCB Committee

FROM: N. J. Melton

Attached is a copy of the minutes of the USWAG PCB Committee Meeting held on June 18 in Dallas.

The next meeting of the PCB Committee will be in room 1701G of the Wachovia Center at 8:30 a.m. on Thursday, July 2, 1981.

The proposed agenda:

1. Revisions of PCB Plan.

2. Report and discussion of Dallas meeting of the USWAG PCB Committee.

3. Interim Measures Program

4. Other business of PCB operations.

5. Field Audit by the Committee. (You may wish to keep most of the day open if you wish to participate in this audit and inspection.)

NJM/cgf

Attachment

June 11, 1981

MEMORANDUM

TO: Messrs. W. A. Haller
J. E. Harwood
R. E. Holmes
P. W. Huntley
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
J. H. Parker
W. S. Price
D. P. Roche
C. T. Spry
G. T. Swearingen

FROM: W. N. Breedlove, Jr. WNBJr

SUBJECT: PCB Committee Meeting

Nick Melton chaired a meeting of the Company PCB Committee on June 3, 1981.

Nick updated the committee on the status of Franklin Institute's method of neutralizing PCB's in view of the fact that a somewhat similar process developed by Sunohio was recently approved by EPA Region IV. Franklin Institute is presently working with Philadelphia Electric on the treatment process and hopes to have EPA approval in the near future. Nick indicated that Duke would like to work with Franklin on a similar project.

George Swearingen indicated that the field is reporting spill quantities more accurately as a result of some contacts he has had with them. Along these lines, Joe Harwood mentioned that a letter regarding spills under Superfund (to include PCB spills) has been sent to the Company Implementation Team.

Nick began a brief discussion of spill clean-up procedures. He also asked the Committee if they felt that current mechanisms were adequate to get word of PCB rule changes to the field quickly. The group felt the mechanisms are fine but that personal contacts and audits would communicate our intentions much better.

An internal audit of the Interim Measures Program and the entire Duke PCB program was discussed and thought to be a good idea. Joe Harwood and Dave Roche will begin to plan for this in the next two or three weeks.

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JUN 15 1981
DUKE POWER NY
Operating Department

Nick asked that the group study for the next meeting the interpretations and other information recently published by EPA regarding the Interim Measures Program. He also asked Bill Breedlove to circulate to the Committee the proposed changes in the PCB Plan.

Ken Jordan reported that another outside lab, Biomedical Reference Laboratories has been approved to do PCB sample analysis.

Dave Roche also brought the group up to date on the USWAG study and the Riverbend Steam Station mineral oil burning program.

Charlie Spry and Casey Jones gave an inventory of the PCB items on hand at Toddville for disposal and discussed their efforts to get quotations from qualified disposal companies.

Attached for the Committee's review and information are the revised (6-5-81) PCB Plan and a special report on PCB disposal compiled by the Bureau of National Affairs. Revisions to the PCB Plan are denoted by a heavy black line in the right hand margin.

mms

Up to five copies may be obtained free from GAO, Document Handling and Information Services Facility, Box 6015, Gaithersburg, Md. 20760, (202) 275-6241.

Hazardous Waste

CUSTODY RELATIONSHIP RECOMMENDED FOR HAZARDOUS MATERIALS MANAGEMENT

WARRENTON, Va. — (By a BNA Staff Correspondent) — Hazardous waste generators should treat the materials they generate within the context of a custody relationship, according to Tom Jorling, former Environmental Protection Agency assistant administrator for water and hazardous materials.

Jorling, now director of the Center for Environmental Studies at Williams College, Williamstown, Mass., told an American Bar Association standing committee on environmental law conference on toxic substances and hazardous waste that "future historians will regard this period of cheap and easily obtainable resources as ridiculously squanderous."

There is a real need within our society, he explained, for a directional change away from "linear use of resources" — the concept of "use it and throw it away."

There is "no technical reason chemicals can't be prevented from being released into the environment," Jorling continued. Limited supplies of natural resources "should improve our performance" in that regard, he said, because greater emphasis will be placed on resource recovery.

Regulatory Review

EPA regulations, such as general pretreatment standards and the Resource Conservation and Recovery Act's hazardous waste regulations, are being reviewed "with a view towards suspension," Jorling said.

The immediate effect of this "return to a cowboy mentality," he said, will be to allow industry and consumers "to externalize costs at a time when real breakthroughs are being made" in technology.

"Corporations will feel no need to invest in research for innovative technologies to control pollutants," Jorling continued, adding that, "as a society, we are not matching the degree of sophistication the people think we have."

Risk Assessment

Risk assessment "will tax our legal system," Jorling told the conference. Society imposes risks upon individuals who have no choice but to assume them, he said.

Richard Arnold, circuit judge for the U.S. Court of Appeals for the Eighth Circuit, said assessing risk is "a philosophical problem not unique to toxic substances."

"Appeals decisions are sometimes unsatisfactory in an intellectual sense," he said, because "decisions are to decide a case, not to restate an entire field of law."

Where statutory construction is ambiguous, Arnold said, doubts should be resolved in favor of public health and the general consensus within the society. "The fact that legislation exists," Jorling concurred, "says the spirit of the law is to protect public health and welfare. Where [the law is] ambiguous, that's the way it should go."

BNA

SPECIAL REPORT

COMPETITION FOR PCB DISPOSAL DOLLARS, NEW PROCESSES CREATE NEW INDUSTRIES, PROMPT A WEIGHING OF COSTS

The polychlorinated biphenyl disposal business today appears to be in a state of high flux, affected by emerging new disposal technologies, transportation costs, changing federal requirements, and the perceptions of industry waste generators, according to an informal BNA survey.

BNA surveyed companies in the landfill, incineration, and PCB decontamination businesses for their prices and for information on the kinds of contaminants they are handling.

The survey indicated that recent approvals of the first commercial incinerators and a chemical destruction process, as well as the recent ban on landfilling capacitors, have shifted some of the attention in the disposal industry toward more competitiveness — taking "total title" to PCB wastes, providing a range of disposal services, and cutting transportation costs by consolidating shipments of PCB materials.

At the same time, the new developments have raised questions about cost-effectiveness and hopes for even newer and cheaper disposal techniques.

As an example of the concern over cost, a spokesperson for Wes-Con Inc., Twin Falls, Idaho, one of four U.S. landfills approved by the Environmental Protection Agency to accept PCB-contaminated liquids (50-500 parts million), said PCB landfilling was not a large part of his firm's business. He attributed the lack of business to the real costs of packing and stabilizing contaminated liquids in approved drums, and reported that some of the electrical utility companies he had spoken to were "sitting on" their stored PCBs in the hopes of cheaper disposal methods in the future.

Wes-Con charges between $200 and $240 per ton at present for landfilling PCB-contaminated materials, including liquids and transformer carcasses. The cost does not include stabilizing the liquids, which the shipper is required to do.

Varying Landfill Prices

Rates vary among landfills. Casmalia Disposal, Santa Barbara, Calif., charges a flat rate of $300 per ton, with a one-ton minimum, for landfilling PCB-contaminated materials, but does not handle liquids.

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Waste Management of Alabama, also permitted to bury contaminated liquids, charges $90.00 per 55-gallon drum, which a company spokesperson termed "a very expensive process" because of the labor involved in laying out the drums. The firm "discourages" such shipments, he said, and offers substantially lower prices for liquids shipped in tanks holding 5,000 to 10,000 gallons. Prices for bulk shipments are approximately $1.36 per gallon up to 10,000 gallons, $1.18 per gallon from there to 30,000 gallons, and "usually" are negotiable above that amount, according to the spokesman.

Waste Management does not require stabilizing of contaminated liquids in either drums or in bulk form, because of the impermeability of the clay at the site of the landfill.

Cecos CER, Williamsburg, Ohio, affiliated with Cecos International of Niagara Falls, N.Y., charges $185 per drum for non-solidified liquids and $60 per drum for liquids already solidified.

Incineration

Incineration prices, by contrast, are much higher than landfilling, although the two commercially-approved incinerators, operated by Rollins Environmental Services in Deer Park, Texas, and Engineering Systems Co. (ENSCO), El Dorado, Ark., can destroy any concentration of PCB in liquid form (Current Report, Jan. 30, p. 1386).

Rollins charges different rates for bulk-shipped and drum-packed PCB liquids. The price for incinerating liquids in drums is $650 per drum for the first five, $600 per drum for the fifth through the ninth drum, $550 for the 10th through the 24th drum, and $500 for the 25th drum and beyond.

For bulk liquids, Rollins charges $0.50 per pound for a volume of 20,000 pounds or more, and $0.55 per pound for any amount below 20,000 pounds.

ENSCO's prices vary between $200 and $700 per drum, depending on the number of drums, PCB concentration, and other factors.

One problem with the two incinerators, according to a representative of the Electrical Power Research Institute, is that they are "rather slow — you can only take a limited amount every day." He, like Wes-Con, reported that utility companies seemed to be "mainly storing" their PCB materials.

New Process

EPA also recognized the need for more PCB destruction facilities when it held a press conference May 26 to announce two regional office interim approvals for the new Sunohio PCBX chemical destruction process (May 29, p. 190).

Edwin H. Clark II, EPA acting assistant administrator for pesticides and toxic substances, said during the announcements that there was an "absolute necessity" that "new technology be developed by the private sector that will give us the tools we need to deal with the increasingly complex environmental problems we confront."

The Sunohio process was estimated by its top management to cost about $3.00 per gallon on average, but could go much higher if used on "dirty" oil, according to a Sunohio scientist.

An advantage to PCBX touted by Sunohio officials is the ability of the process to leave contaminated oil PCB-free and reusable. The officials said, however, that the process appeared to be most effective on liquids with low concentrations of PCB.

Decontamination Studies

The Electrical Power Research Institute also is interested in the possibility of reusing decontaminated liquids. One of the institute's concerns is that burning all current supplies of contaminated oil would leave an insufficient amount to replace it. The spokesperson said if every firm incinerated its transformer oil, "We'd be in big trouble. There just isn't enough replacement transformer oil."

On the other hand, he said, not enough investigation has been done into the quality of decontaminated oil. As a result, EPRI has begun funding two studies, with General Electric and the Franklin Research Center in Philadelphia, to determine how well adsorption and extraction processes work and how efficient the detoxified oil is.

The GE contract calls for a study of several processes, including one developed by GE. The Franklin Research Center, under its contract, will develop a liquid extraction process and may develop an adsorption process as well, according to the spokesman. The contracts are expected to last one year apiece.

Filtration

A final oil decontamination technique, and, according to sources, one of the most widely used, is the EPAC filter process manufactured by RTE Corp., Waukesha, Wisc.

EPAC filters, which are sized according to the amount of contaminated fluid to be treated, are attached to a PCB transformer and filter out the PCBs over time while the unit is in operation. The filtration time may range from two months to more than one year, depending on the ambient temperature, the number of filters used, and other factors. Once the filter is used, it is disposed of in a landfill.

The filter is not designed to be used on transformers containing fluids with more than about 6 percent PCBs, according to the firm. For heavily contaminated or pure fluids, the company directs users to flush and retrofill their unit before beginning filtration.

According to company estimates, the cost of the total filtration system, when used on fluid containing around 1,000 ppm PCBs, ranges from $0.23 to $1.45 per gallon. The average cost is $0.67 per gallon.

RTE does not guarantee disposal of its filters, a spokesman said. Current average rates for landfill, however, were estimated by the firm to be $15.00 for the smallest filter and $80.00 for the largest. Unlike capacitors, PCB filters are not required by EPA ultimately to be sent for physical destruction to ENSCO, the only approved capacitor disposal facility since March 1 (March 6, p. 1529).

Although landfilling filters is inexpensive now, an RTE representative said the disposal cost is the "real variable" in the cost of the total filtration system. Predicting that landfill regulations probably will become more stringent over time, he said "in general, people believe the true cost of operating these landfills has not yet been established."

Capacitor Disposal

The EPA decision to require capacitors to be shredded and incinerated — once the ENSCO facility was approved — has had a varying effect on landfills. The approval of Rollins and ENSCO to incinerate, however, also has had an effect on landfilling business, according to the survey.

The change in capacitor disposal requirements cut California-based Casmalia's PCB business by about 90 percent, according to that company.

U.S. Ecology, formerly Nuclear Engineering Co. Inc., Louisville, Ky., also did "a lot" of capacitor landfilling at its Beatty, Nev., facility before the regulations changed, a company representatve reported. The firm was charging $37.50 per 55-gallon drum to landfill capacitors.

Waste Management, whose PCB business prior to the rule change was about 80 percent in landfilling capacitors, con-

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taminated oil, and other materials, charged an average of $60 per drum of capacitors.

ENSCO now charges between $0.75 and $1.50 per pound to landfill capacitors, depending on the packaging and other conditions, a spokesperson said.

According to ENSCO, however, the firm has not begun receiving many capacitors so far, and has no backlog.

The Utility Solid Waste Activities Group, a consortium of electric utility companies, asked EPA before the capacitor disposal regulation went into effect to postpone its effective date. USWAG asked for more time because of fear that ENSCO could not handle the expected number of capacitors and because of concern over the firm's monopoly position (March 6, p. 1529).

The agency already had granted one extension to landfilling, and denied USWAG's request. The consortium reported, however, that it has continued to press the agency for permission to landfill capacitors.

Rollins, approved at present only to incinerate liquid PCBs, hopes by this summer to have the capability to incinerate solid PCB wastes, as ENSCO does, the company reported.

Transformer Disposal

EPRI has estimated that several years before PCBs became implicated as health hazards, about 5 percent of all new transformers were filled with askarel, a concentrated mixture of PCBs and tetrachlorobenzene or trichlorobenzene. The total number of such PCB transformers in existence was estimated at 140,000.

Before incineration, regulations prohibited the disposal of fluids with more than 500 ppm PCBs, and owners of such fluids had no choice but to store them until the first incinerators were approved.

Sources reported that many utility companies and other PCB transformer owners found it more convenient in the pre-incineration days to keep highly concentrated liquids stored in the transformers that contained them, rather than incur added costs and problems by transferring fluids to drums for storage.

Now that incineration is a reality, sources said, some companies are getting rid of their contaminated fluids at the incinerators and sending off the transformer carcasses to be landfilled.

Waste Management reported that whereas its PCB landfilling business used to be largely in capacitors, contaminatd oils, and other materials that could be packed in drums, it expects 50 to 60 percent of revenues now to come from transformer carcasses.

A Waste Management representative said orders, inquiries, and proposals for landfilling transformers had increased "tremendously" in the past two months.

The Department of Defense recently asked for bids to dispose of some 500-600 transformers, a deal worth an estimated one million dollars or so, sources said.

A spokesperson for Cecos CER said his company recently arranged a cooperative contract with ENSCO to dispose of transformers at the Cecos landfill and the transformer fluids at ENSCO's incinerator.

Expanding Services

It appears that the advent of incineration — and the likelihood that additional disposal technologies will come on-line — has encouraged individual disposal businesses to reach for a maximum range of services, either through contract arrangements with other companies or by adding their own new capabilities.

Waste Management, which considers itself the only disposal firm to take "total title" to PCB wastes, is looking forward to EPA approval of the Vulcanus, its ocean-going incinerator ship. The company has been seeking a berth for the ship where a transfer facility can be built to load contaminated liquids, and hopes for a test burn later this year.

In the meantime, Waste Management has been storing liquid PCBs for incineration once approval is given.

ENSCO, which does not have its own waste transportation service, reported that it has contracted widely in order to be able to consolidate shipments of capacitors and other wastes for lower transportation costs to El Dorado, Ark.

Transportation

Like the PCB business, hazardous waste transportation appears to be experiencing growing pains. The survey showed varying perspectives on the transportation business, but indicated a strong belief among disposal companies and other sources that small, specialty carriers were becoming more important.

"One by one," a source said, "the major carriers are refusing to haul hazardous wastes." He suggested the costs of protecting against accidents or spills en route are the reason.

A spokesperson for U.S. Ecology agreed, saying "quite a few" larger carriers had dropped out of waste hauling. She suggested regulations and increased liability insurance costs were to blame.

As an example of hauling precautions, she reported that the company most often contracted to carry wastes for her firm requires shippers to provide lining for the bottom of the trucks to protect against spills and leaks.

Cecos CER, which contracts with five small carriers in the East and Midwest, charges shippers by the mile in order to discourage the addition of non-waste material to make up for unfilled space in the trucks, according to a spokesperson. Cecos also requires its carriers not to take on cargo for return trips, thereby keeping them "strictly dedicated to waste use" while under Cecos contract.

Costs for shipping via Cecos carriers are "in the neighborhood" of $3.25 per mile, with a surcharge of 15 to 19 percent, the spokesperson said.

A spokesperson with the National Solid Wastes Management Association said small, specializing firms were favored in the transportation business because they know the analytical laboratories were waste concentrations can be calculated as well as the location of disposal facilities, and they may do their own packing and accumulating.

He said his impression was that many firms hauling wastes "don't know what the hell they're doing."

Although transportation figures varied among the survey respondents, figures in the area of $3.00 per mile were quoted.

EPA, when it was looking into the possible effects of requiring all capacitors to be sent to ENSCO for destruction, canvassed several transportation companies and waste generators for shipping and hauling figures.

According to figures in EPA's draft survey, capacitor shipments could be made from Philadelphia for as little as $1.33 per mile, with an 18 percent fuel surcharge, and $1.95 per mile from San Francisco.

With an estimate from ENSCO that 400 capacitors could be loaded on a single tractor-trailer, the agency calculated an individual capacitor could be shipped to the incinerator for an average price of $10.00.

From further calculations of 430,000 capacitors being transported annually to ENSCO from utilities, and 200 million electricity users across the U.S., EPA determined that the annual cost per utility customer for destroying capacitors would be about $0.02.

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PCB Comm. 6-3-81

NSM — FRANKLIN INSTITUTE WILL HAVE EPA TESTS WITHIN 2 WEEKS + NOW HAVE PLANT TO PRODUCE REAGENT. WILL KEEP IN TOUCH WITH IT.

— SUPERFUND 100 LBS OF CHEMICALS (10 LBS OF PCB's)

→ ARJ — RETAIL DOING AUDIT ON COMPLIANCE WITH PCB PLAN

— IMP. DIST. 3/4 TO be completed (THUS FAR 6 OUT OF 34 TESTED ABOVE 50 ppm)

— AUDIT ON IMP (NO?) + AUDIT ON PCB PLAN COMPANY WIDE?

— DAVE + JOE WILL BE MAIN CONTACT PEOPLE FOR EPA AUDIT. (NEED TO SETUP BACK-UP FOR ME ON PCB RECORDS)

— PLAN (1) YELLOW TAG, (2) CAN IN DRUM BY ITSELF (3) NOT BEING ABLE TO LANDFILL CAP. (4) PROTECTIVE CLOTHING DROP NEOPRENE. (5) LIST OF REPORTING NAMES ON FORM (6) REPORTING TO DISPATCHER?

— BILL BREEDLOVE WILL SEND OUT DRAFT REVISION TO PLAN.

DATE: May 28, 1981

TO: PCB Committee

FROM: N. J. Melton

Because of some conflicts in scheduling, the PCB subcommittee meeting is rescheduled for Wednesday, June 3 at 8:30 a.m. in the conference room on the 17th floor of the Wachovia Center.

NJM/cgf

RECEIVED
MAY 28 1981
DUKE POWER COMPANY
Operating Department

DATE: May 26, 1981

TO: PCB Subcommittee

FROM: N. J. Melton

SUBJECT: Meeting Notice

Please attend a meeting of the PCB Subcommittee on Thursday, June 4, 1981 in the conference room on the 17th floor of the Wachovia Center.

Items proposed for the agenda are:

1. Interim Measures Program

    a. progress reports
    b. EPA interpretations and enforcement

2. Changes required in the Duke Power PCB Plan

3. Spill reporting

4. Requirements for PCB spill clean-ups.

5. PCB transformers and apparatus near waterways.

NJM/cgf

Enclosed: Memo from Wald Harkrader & Ross
Portions of Federal Register of May 20, 1981
EPA Enforcement Facts and Strategy - PCBs and Interim Measures Program

RECEIVED
MAY 27 1981
COMPANY
Operating Department

May 11, 1981

MEMORANDUM

TO: Messrs. J. H. Francis
W. A. Haller
J. E. Harwood
R. E. Holmes
P. W. Huntley
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
D. P. Roche
C. T. Spry
G. T. Swearingen

FROM: W. N. Breedlove, Jr. WNBjr

SUBJECT: PCB Committee Meeting

Nick Melton chaired a meeting of the Company PCB Committee on April 30, 1981.

Redacted for Privilege

Nick asked that Dave Roche, Alan Shub, Ken Jordan, Roy Holmes (or Lee Tatum), and Pat Huntley to work on a subcommittee to begin an in-house survey of existing equipment and develop sampling methods for analyzing this equipment.

RECEIVED
MAY 13 1981
DUKE POWER COMPANY
Operating Department

Dave reported on the test burn of oil at Riverbend on Wednesday, April 22, 1981. Problems with the flow rate were discovered and are being corrected. There was brief news media coverage of the burn and also coverage of PCB's stored at Toddville for an upcoming special on hazardous wastes (Channel 9).

The Interim Measures Program was discussed by Pat Huntley and Ken Jordan. Pat indicated that 30-40 food-related facilities were inspected. None of these will have to be inspected weekly. Also, only two PCB transformers will have to be inspected quarterly. Ken stated that in distribution, the divisions are finishing their surveys and do not expect to have a great number which will have to be inspected weekly or quarterly.

Lee Tatum indicated that any samples associated with the Interim Measures Program are receiving highest priority for analysis. The second chromatograph is in but there is no automatic sampling capability yet.

Joe Harwood briefly mentioned the decision made by the Company Hazardous Waste Committee not to report any old PCB disposal sites under EPA's Superfund regulations due to a lack of disposal records.

mms

xc: Messrs. Jim Parker - Construction
Allan Shub - Steam Production
Lee Tatum - Transmission

April 1, 1981

J. H. Francis
W. A. Haller
J. E. Harwood
R. E. Holmes
P. W. Huntley
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
D. P. Roche
C. T. Spry
G. T. Swearingen

SUBJECT: Duke Power Company PCB Committee Meeting, April 1, 1981

The PCB Committee met, at the request of N. J. Melton, to discuss responsibilities for the company's participation in the Edison Electric Institute PCB study. W. N. Breedlove chaired the meeting in the absence of N. J. Melton.

D. P. Roche explained the scope and timetable of the EEI study, which officially begins April 12, 1981. Discussion by the committee followed of the potential contribution the company can make to this study. The group agreed on the following recommended assignment of responsibilities, pending management approval:

TASK	DEPARTMENT	RESPONSIBLE INDIVIDUALS OR UNIT
1. Statistically Valid Sampling Survey	Steam Production Transmission Distribution	Offline Applications-Scientific Support, R. E. Holmes, K. R. Jordan
2. Sampling of Equipment	Distribution Operating Transmission	K. R. Jordan, P. W. Huntley R. E. Holmes
3. Analysis of Samples	Transmission	R. E. Holmes
4. Summary of Spill Records and Cleanup Procedures	Operating Distribution	G. T. Swearingen K. R. Jordan
5. Cost of Inspections	Distribution	K. R. Jordan
6. Availability of Disposal	Steam Production General Services	D. P. Roche K. A. Jones
7. Testing and Reporting of Occupational Exposure	Steam Production	Industrial Hygiene

Tasks 1 through 3 would have to be completed within 3 months of the start of the study, and Task 4 would have to be completed within 6 months. The remainder of the study tasks must be completed within 9 months of the starting date.

An additional task, completed by the committee at this meeting, is to suggest a questionnaire format that can be used by EEI to obtain PCB information from utilities. The committee's suggested format (attached) will be submitted to EEI.

As soon as the extent of the necessary sampling survey is understood, the committee will provide W. A. Haller with a written plan and cost estimate for participation in the study, to be submitted to upper management for their approval.

On an unrelated matter, it was agreed that the Duke Power PCB Plan should be revised to state that capacitors should be sent to Toddville in drums separately from drums of spill cleanup debris, because the debris can still be landfilled but capacitors must be incinerated.

William N. Breedlove, Jr.

William N. Breedlove, Jr.
Technical Services - Transmission

WNB/mms

Attachment

xc: B. Caldwell
G. L. Johnston
W. A. Coley
R. C. Pacetti
A. H. Shub
R. F. Gray
D. W. Anderson

Attachment 1
PROPOSED FIRST-STAGE QUESTIONNAIRE

1. How many PCB (above 500 ppm) transformers?

<100 KVA	_____	Total _____
100 KVA - 499 KVA	_____	est. _____
500 KVA - 999 KVA	_____	vol. _____
1 MVA - 99 MVA	_____	(gal.)_____
≥100 MVA	_____	_____

2. How many PCB (above 500 ppm) capacitors?

<100 KVAR	_____	Total _____
≥100 KVAR	_____	est. _____
		vol.
		(gal.)

3. How many oil-filled transformers?

<100 KVA	_____	Total_____
100 KVA - 499 KVA	_____	est. _____
500 KVA - 999 KVA	_____	vol. _____
1 MVA - 99 MVA	_____	(gal)_____
≥100 MVA	_____	_____

4. Do you have data on PCB contamination of transformers? _____

5. What percentage of transformers have you sampled? _____

6. How many oil-filled regulators?

<500 KVA	_____	Total _____
≥500 KVA	_____	est. _____
		vol.
		(gal.)

7. Do you have data on PCB contamination of regulators? _____

8. What percentage of regulators have you sampled? _____

9. How many oil-filled switches, reclosers and circuit breakers?

Switches	_____	Total _____
Reclosers	_____	est. _____
Circuit breakers:		vol.
<24 KV	_____	(gal.)_____
24 KV - 68 KV	_____	_____
69 KV - 199 KV	_____	_____
≥200 KV	_____	_____

10. Do you have data on PCB contamination of switches?_____

11. What percentage of switches have you sampled?_____

12. Do you have data on PCB contamination of reclosers?_____

13. What percentage of reclosers have you sampled?_____

14. Do you have any data on PCB contamination of circuit breakers?_____

15. What percentage of circuit breakers have you sampled?_____

16. List any other oil-filled equipment (such as cables, etc.).

	Total
_____	est. _____
_____	vol. _____
_____	(gal)_____

17. Have you identified PCB equipment located at food and feed facilities?_____
with potential to leak to waterways?_____

18. Same as above for oil-filled equipment.

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APR 03 1981
DUKE POWER COMPANY
Operating Department

REPORT OF MEETING OF THE DUKE POWER COMPANY
PCB SUB-COMMITTEE

Present were Pat Huntley, Roy Holmes, Ted Roche, Joe Harwood, Dave Roche, Ken Jordan, W. A. Haller, K. A. Jones, N. J. Melton. The meeting was held on March 20, 1981 in the 17th floor conference room of the Wachovia Center.

Ken Jordan and Pat Huntley gave brief reports of their meetings with Distribution and Operating personnel who will be responsible for implementing the Interim Measures Program. Their reports indicated that the expected questions were raised on interpretation of Food and Feed Facilities but that the meetings appeared to be successful in informing the field people and supervisors on the need to conform to this Interim Measures Program. The sub-committee acknowledged the outstanding work that has been done by Ken and Pat in initiating this Interim Measures Program. They were voted the "Atta Boy" award.

Redacted for Privilege

Dave Roche discussed the EEI study which would be made and submitted to EPA to assist them making regulations for PCB. Dave Roche is now a member of the task force of the USWAG PCB Committee which is writing the scope of the study.

As soon as the draft of the scope is circulated to utilities, a copy will be given to each member of the Duke Power PCB Sub-committee for comment. A call meeting of the committee will be held soon after the distribution of the scope.

NJM

3/24/81

RECEIVED
MAR 26 1981
DUKE POWER COMPANY
Operating Department

March 2, 1981

MEMORANDUM

TO: Messrs. J. H. Francis, W. A. Haller, J. E. Harwood, R. E. Holmes, P. W. Huntley, K. A. Jones, K. R. Jordan, J. E. Lansche, N. J. Melton, D. P. Roche, C. T. Spry, G. T. Swearingen

FROM: W. N. Breedlove, Jr. WNBJr

SUBJECT: PCB Committee Meeting

Nick Melton chaired a meeting of the Company PCB Committee on February 27.

Nick reported that Corey Trench of EEI has advised him that EPA has flatly denied an extension of time on the landfill burial of PCB capacitors. More efforts will be made in this area to point out to EPA the quantities of capacitors to be disposed of, the capacity of storage and/or incineration facilities, the cost of disposal, etc.

A meeting was held with upper management on February 26 to explain Duke's obligations under the Interim Measures Program. Management supported and commended the Committee's work to date on this program.

Ken Jordan and Pat Huntley briefly described how field personnel will be instructed to inspect and determine risk at food and feed facilities under the IMP. Preliminary inspection forms were handed out. It was decided that Ken, Pat, and George Swearingen would develop a new leak report form to use in the General Office for reporting moderate leaks. Bill Breedlove will be responsible for having the inspection and leak forms formatted and printed (on 2-part paper) as soon as possible.

Roy Holmes reported that favorable results were obtained from the air sampling tests performed in the transformer shop at Toddville.

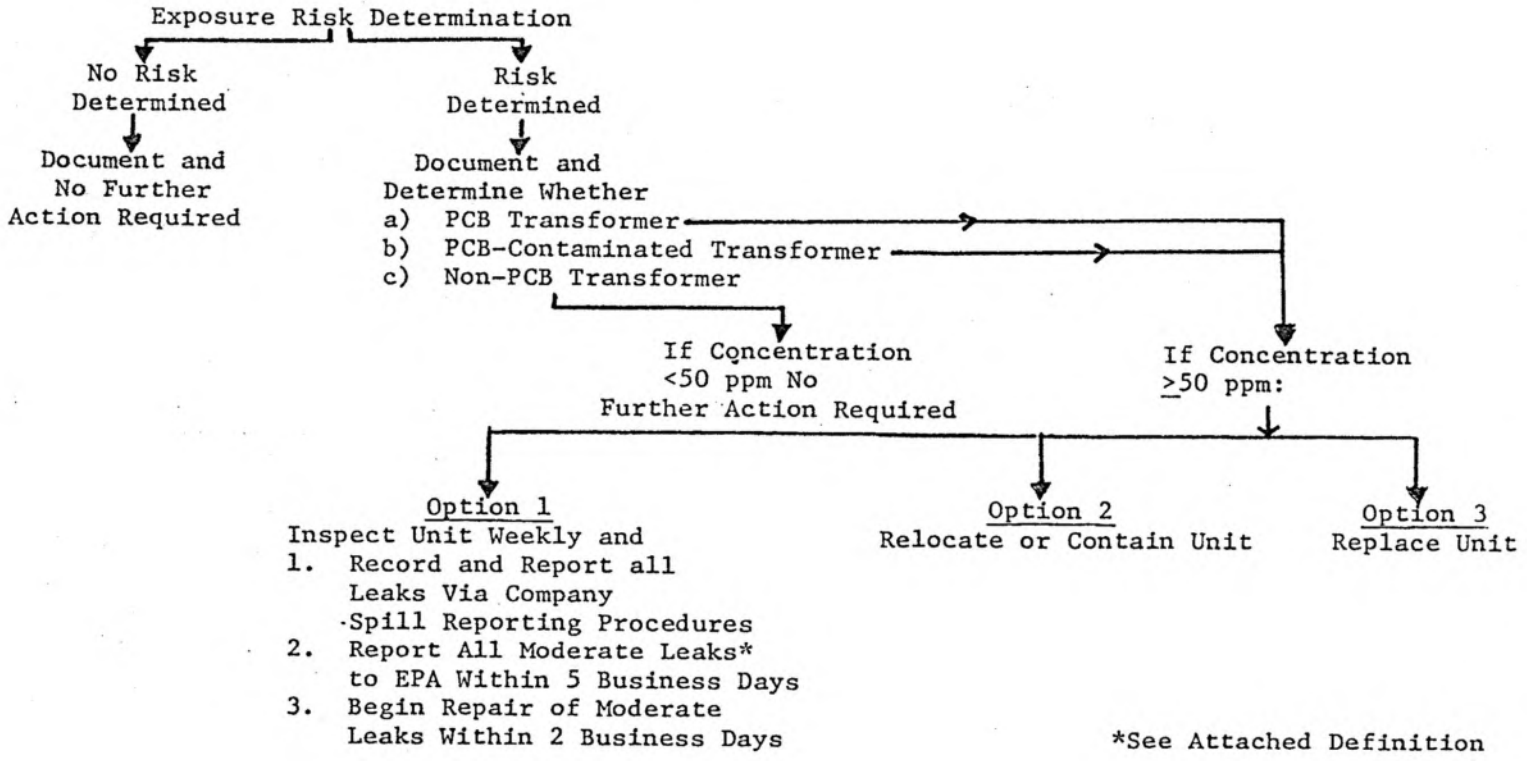
No date and time were selected for the next Committee meeting.

WNB,Jr./mms

Attachment

RECEIVED
MAR 03 1981
DUKE POWER COMPANY
Operating Department

INTERIM MEASURES PROGRAM FOR FOOD
AND FEED FACILITIES (As Defined in Attachment)



3:24-cv-01281-MGL Date Filed 06/05/26 Entry Number 121-24 Page 89 of 137

February 23, 1981

MEMORANDUM

TO: Messrs. J. H. Francis
W. A. Haller
J. E. Harwood
R. E. Holmes
P. W. Huntley
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
D. P. Roche
C. T. Spry
G. T. Swearingen

FROM: W. N. Breedlove, Jr. WNBJr

SUBJECT: PCB Committee Meeting

Nick Melton chaired a meeting of the Company PCB Committee on February 20.

The Interim Measure Program was discussed at length and the definition of covered facilities and the outline of the program were revised extensively. A flowchart was also developed to be used as an aid to the outline. It was agreed that once these documents were re-typed, Nick would transmit the "final" versions to the Committee. (these documents are attached).

In preparation for field inspections which will be a major part of the IMP, Pat Huntley and Ken Jordan will develop inspection forms. These forms will include requests for any other information which might be helpful to USWAG or its contractor in the upcoming equipment study.

The next meeting of the Committee will be at 9:00 a.m., February 27 in Conference Room WC-1701G.

mms

Attachments (USWAG and other pertinent correspondence are included in addition to documents mentioned above)

xc: F. A. Jenkins

RECEIVED
FEB 25 1981
DUKE POWER COMPANY
Operating Department

INTERIM MEASURES PROGRAM FOR TRANSFORMERS

I. Identify the applicable food and feed facilities on Duke System.

A. Inspect applicable facilities and rule on exposure risk.

1. If there is no exposure risk, document the inspection and ruling. No further action is required.

2. If there is an exposure risk, take actions described in items "B" through "D".

B. Determine whether PCB transformer, PCB-contaminated transformer, or non-PCB transformer. Definitions are given in the "PCB Plan for Duke Power Company".

C. Duke's choices unless test show non-PCB transformer (PCB concentration 50 ppm or greater).

1. Weekly inspections

a. Document by date and initials of inspector.

b. Report leaks according to "D" below.

2. Relocation of unit or construction of containment facility for discharged fluid.

3. Replace transformer with non-PCB transformer.

D. Requirements for leak reporting and repair.

1. Record and report all leaks through existing channels for PCB spill reporting.

2. Report all moderate leaks to EPA within 5 business days. Duke will report through existing channels for PCB spill reporting.

3. Begin repair of moderate leaks within 2 business days.

E. If transformers are tested and PCB concentration is below 50 ppm, Duke is not obligated to make weekly inspections.

II. PCB transformers (concentrations 500 ppm or above) on Duke System but not at food or feed facilities.

A. Quarterly inspections are required.

1. Document by date and initials of inspector.

2. Report leaks according to "B" below.

B. Requirements for leak reporting and repair.

1. Reocrd and report all leaks through existing channels for PCB spill reporting.

2. No leak reporting to EPA.

3. Begin repair of moderate leaks within 2 business days.

III. Keep records of all inspections and all leaks and repairs for 3 years.

February 20, 1981

Redacted for Privilege

John E. Lansche

JEL/fhb

cc: Mr. Steve C. Griffith, Jr.
Mr. William L. Porter
Mr. N. J. Melton
Dr. W. A. Haller
Mr. D. W. Anderson

RECEIVED
FEB 23 1981
SUBSTATION
APPARATUS ENGINEERING

Definitions

Applicable food and feed facilities

Food and feed facilities are all federally inspected meat, poultry products, and egg establishments. Duke Power has lists of these establishments. Also included in the definition of food and feed facilities are facilities manufacturing, processing, packaging, or holding human food or animal feed.

Primary concern involved in this identifying food and feed facilities is the containment of any contamination which would cause widespread distribution of contaminated products. Excluded from the definition are retail establishments such as grocery stores and restaurants, farms, grazing lands, feed-lots, orchards. Wholesale groceries and packing plants are included. Decisions will have to be made on the definition with the question "are you comfortable that food and feed cannot be contaminated."

Posing an exposure risk

Any transformer must be considered to be PCB contaminated unless the oil has been tested and shown to contain less than 50 ppm PCB. The transformer is considered a risk to food and feed products unless the PCB transformer or PCB contaminated transformer is in a location such that a discharge of the dielectric fluid cannot contaminate the food and feed products or processes.

Leaks

Means any instance in which there are PCBs on any portion of the external surface.

Moderate leak

Any leak which results in any quantity of PCBs running off or about to run off the external surface of a PCB or PCB-contaminated transformer.

LAW OFFICES
WALD HARKRADER & ROSS

1300 NINETEENTH STREET, N.W., WASHINGTON, D.C. 20036
AREA CODE 202
828-1200
CABLE ADDRESS: WALRUS
TELEX (RCA): 248591 (WHR)

MEMORANDUM

February 17, 1981

TO: USWAG Policy Committee
USWAG PCB Committee

FROM: Wald, Harkrader & Ross

RE: PCB Litigation and Other Recent Developments



Redacted for Privilege

LAW OFFICES
WALD HARKRADER & ROSS

1300 NINETEENTH STREET, N. W., WASHINGTON, D. C. 20036
AREA CODE 202
[redacted]
CABLE ADDRESS: WALRUS
TELEX (RCA): 248591 (WHR)

MEMORANDUM

February 17, 1981

TO: USWAG Policy Committee
USWAG PCB Committee

FROM: Wald, Harkrader & Ross

RE: PCB Committee Meeting, Dallas, February 9, 1981

Redacted for Privilege

WALD, HARKRADER & ROSS



February 18, 1981

MEMORANDUM

TO: J. H. Francis
W. A. Haller
J. E. Harwood
R. E. Holmes
P. W. Huntley
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
D. P. Roche
C. T. Spry
G. T. Swearingen

FROM: W. N. Breedlove, Jr. WNBJr

SUBJECT: PCB Committee Meeting

Nick Melton chaired a meeting of the Company PCB Committee on February 13.

Redacted for Privilege

Casey Jones reported to the group on the specifications for shippers of PCB waste. These quidelines had been developed in a subcommittee earlier in the week. After some discussion, Joe Harwood moved that the specifications be accepted with deletion of specific quantity references. Roy Holmes seconded the motion and it passed on voice vote. A letter will be sent to John Holland from Nick stating the specifications for obtaining qualified vendors.

Dave Roche and Charlie Spry reported on the "dry run" of oil movement from Toddville to Riverbend. There were some minor problems, but they have been worked out.

The Interim Measures Program* for PCB transformers was discussed at length. The definition of which facilities are covered (developed by Joe Harwood and Pat Huntley) was discussed and some changes were made to it. Also the outline of Duke's responsibilities under the program was examined and modified. The definition and outline will be available for presentation to upper management at a meeting that Bill Haller is arranging to begin the implementation part of the program.

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FEB 19 1981
DUKE POWER COMPANY
Operating Department

The Committee then considered the remainder of Ken Jordan's questions about PCB's held over from the February 6 meeting. As a result of one of Ken's questions, Nick asked Bill Breedlove to check on whether SPCC Plans for Company facilities which are covered under oil spill regulations must contain a specific reference to PCB spills. It was decided to discuss Ken's list of "Comments from Distribution Personnel" at the next meeting.

The next meeting of the Committee will be held Friday, February 20 at 9:00 a.m. in Conference Room WC-1701G.

mms

Attachment

Redacted for Privilege

RECEIVED
FEB 19 1981
DUKE POWER COMPANY
Operating Department

February 16, 1981

Mr. W. N. Breedlove, Jr.

[redacted]

Redacted for Privilege

John E. Lansche

JEL/fhb

RECEIVED
FEB 19 1981
DUKE POWER COMPANY
Operating Department

February 10, 1981

TO:

J. H. Francis
W. A. Haller
J. E. Harwood
R. E. Holmes
P. W. Huntley
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
D. P. Roche
C. T. Spry
G. T. Swearingen

FROM: W. N. Breedlove, Jr. WNBJr

SUBJECT: PCB Committee Meeting

Nick Melton chaired a meeting of the Company PCB Committee on February 6, 1981.

The Committee's membership was examined briefly and it was decided to drop Bill Saxon's name at Nick's request.

The need for a Company-wide PCB program was discussed. The consensus indicated that field personnel are very well informed about PCBs and that no program is necessary at this time, particularly in light of the recent court decision. Dave Roche did suggest that the results of air sampling tests performed at Toddville (in the PCB storage buildings and at the transformer shop) be made known to field locations to ease any fears about safety hazards that personnel may still have.

Ken Jordan gave a subcommittee report on investigations into the use of outside testing labs for spills. It was agreed that Ken, Joe Harwood, and Dave Roche would work toward getting 3 additional labs across the system approved for use by the end of March. Roy Holmes mentioned that Toddville was purchasing an additional chromatograph with an automatic sample injection system to improve reliability and capability.

Problems with Zeigler Liquid Waste Management were brought up and Casey Jones asked the Committee for guidance as to providing reference information to ICC at Zeigler's request, the use of other waste management firms, etc. Nick asked that Casey head a subcommittee including Joe Harwood, Dave Roche, and Bill Breedlove to look into these problems and to develop general guidelines for the employment of waste disposal companies.

Dave Roche reported that a "dry run" of the movement of oil from Toddville to Riverbend would be made on February 9. Dave also passed out copies of information that will be given to Riverbend employees regarding the safety aspects of burning mineral oil containing low levels of PCB in a fossil fuel boiler.

RECEIVED
FEB 12 1981
DUKE POWER COMPANY
Operating Department

Nick reminded the protective clothing subcommittee to finalize their decisions and report to the Committee. Bill Breedlove is responsible for this group.

The most important item discussed at the meeting was the Interim Measure Program proposed to the court by EEI. The program is voluntary; however, failure to comply will subject owners of PCB equipment to punitive action based on the court's recent decision in the EDF vs. EPA case.

An outline of the requirements of the Interim Measures Program was put on the board during the meeting and is duplicated below.

Interim Measures Program

I. Identify Food and Feed Facilities on Duke System Subject to Program

   A. Inspect Facilities and Rule on Exposure Risk (Document Findings)
   B. Determine if PCB in Transformers
   C. If Concentration of PCB $\geq$ 50 ppm, Duke Has Choice of:
      1. Weekly Inspections
      2. Relocation of Unit
      3. Unit Replacement
   D. All Moderate Leaks Must Be Reported to EPA
   E. If Concentration of PCB $<$ 50 ppm, Duke Is Not Obligated to Inspect

II. Identify PCB Transformers ($\geq$ 500 ppm) on Duke System Other Than Those At Food or Feed Facilities

   A. Quarterly Inspections
   B. No Leak Reporting to EPA

It was agreed that leak reporting would be accomplished through the existing mechanism already in place for oil, PCB, and hazardous waste spills.

In order to determine the applicability of the Interim Measures Program to Duke, two small subgroups were asked to work on 1) the definition of food/feed facilities as interpreted by Duke, and 2) the meaning of the program to Duke and its impact on operations for management's review. The first subgroup consists of Joe Harwood and Pat Huntley. The second consists of Nick Melton, Pat Huntley, Roy Holmes, and Bill Breedlove.

The last item of business was discussion of several questions posed by Ken Jordan and Distribution Department employees. The Committee fielded about half of the questions before lunch and it was agreed to consider the remainder at the next meeting.

The next meeting of theCommittee will be Friday, February 13, 1981, at 9:00 a.m. in Conference Room WC-1701G.

WNB:nlm

TO: PCB Committee

FROM: N. J. Melton

The PCB Committee will meet at 9:00 a.m, Friday, February 6 in room 1120 of the Wachovia Center.

Proposed Agenda:

1. Need for a Duke Power Company presentation on PCBs

2. Report on qualification of outside labs for PCB testing.

3. Discussion of Interim Measures Program approved by the Court.

   Please study the Interim Measures Program and be prepared to interpret how the Program affects Duke Power and how best to respond as a company.

4. Review questions submitted by Ken Jordan. See attachment 2.

NJM/cgf

RECEIVED
FEB 02 1981
DUKE POWER COMPANY
Operating Department

January 30, 1981

December 10, 1980

TO: Messrs. J. E. Francis
J. E. Harwood
R. E. Holmes
P. W. Huntley
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
D. P. Roche
W. E. Saxon
C. T. Spry
G. T. Swearingen

FROM: W. N. Breedlove, Jr. WNBJr

SUBJECT: PCB Committee Meeting

A meeting of the PCB Ad-Hoc Committee was held on December 2, 1980 to discuss several items of interest. Nick Melton chaired the meeting.

Nick brought the Committee up to date on the status of EPA's proposed ban of PCB and PCB-contaminated equipment from food/feed facilities. Harry Omishi's comments as spokesman for USWAG have been received and have since been circulated to the Committee. Joe Harwood mentioned that the official comment period has been extended until March 4, 1981 (per Corey Trench at EEI).

Nick has asked John Lansche to request a list of facilities regulated under the recent final rule for new or replacement PCB equipment in food/feed facilities from the appropriate agencies (USDA, FDA, EPA). Pat Huntley and Ken Jordan were asked to give John a detailed map of Duke's service area for this purpose.

A Baltimore Gas and Electric film showing proper PCB spill clean-up will be shipped to Nick on December 15, 1980. Duke plans to videotape the film for later use.

Ken Jordan mentioned that there is currently a great need for employee education about PCB's. Not everyone has seen the Duke Power slide program about personnel safety nor has there been any recent programs about PCB safety. It was suggested that the Duke slide program and the BG & E film be reviewed this month and some type of employee education and awareness program be developed for presentation across the system. Joe Harwood and Dave Roche agreed to work with Nick on a brief questionnaire to survey the responses and needs of the attendees at the slide/film review meeting.

RECEIVED
DEC 15 1980
DUKE POWER COMPANY
Operating Department

Lee Tatum from Substation Maintenance at Toddville reported to the group on the problems with the Tracor chromatograph that is used to test mineral oil for PCB content. It is hoped that the problems have been recognized by now and that the system will be back in use very soon.

Ken Jordan reported on the area meetings held in Distribution to discuss the revised Duke PCB Plan and other PCB-related matters. Some comments from the field:

1. The biggest problem seems to be having to treat all oil spills from transformers as PCB spills unless the oil is tested and found not to be PCB. The turn-around time for sample testing has been slowed by problems with the Duke chromatograph.
2. The field would like to keep the yellow copy of Form 02756.
3. Straw has been used more effectively than Conwed and other sorbents for oil spills on water.
4. Personnel are very concerned about PCB safety.
5. The question of using diesel fuel or varsol as a solvent instead of kerosene was raised.

The first item that Ken mentioned seems to be the most pressing problem. To remedy this, outside labs will be qualified at several locations across the system and test samples will be analyzed almost immediately for PCB content. In this way the spill can be identified as PCB or none-PCB and clean-up can take place accordingly without undue delay. Ken Jordan was asked by Nick to work with Joe Harwood and Dave Roche (and Mill Power) to qualify several labs.

Bill Breedlove reported that changes in the PCB Plan have been red-lined to indicate that the yellow copy may be kept in the field. Pat Huntley noted that Form 02756 should be revised to agree with this change. Ken Jordan also suggested that there be a place on the form where the clean-up from a PCB-contaminated transformer could be noted. This would be only for Duke's information.

Dave Roche passed out some information to those involved in the manifesting of oil under RCRA. The labels that state that the oil in a PCB container has a concentration between 50 and 500 ppm are now on order according to Casey Jones.

Also attached for the Committee's review are several items from USWAG relative to the recent EDF vs. EPA court decision.

mms
Attachments

cc: Jim Abernathy without attachments
Lee Tatum without attachments

November 25, 1980

Memo To: PCB Committee

From: Mr. N. J. Melton

Subject: PCB Committee Meeting
December 2, 1980 2:00 p.m.
Wachovia Center, Room 850

Agenda:

1. Report of PCB Task Force meetings and actions.
   a. EDF vs EPA
   b. Food/Feed Regulations
   c. Other matters
2. Baltimore Gas & Electric - Film
3. Report of meetings with Distribution
4. Laboratory facilities and requirements

NJM/vlc

RECEIVED
NOV 25 1980
DUKE POWER COMPANY
Operating Department

November 21, 1980

MEMO TO: PCB Committee

FROM: N. J. Melton

There will be a meeting of the Ad-Hoc Committee on PCBs on December 2, 8:30 a.m. in room 1120 of the Wachovia Center.

The agenda will be sent later.

NJM/vlc

RECEIVED
NOV 24 1980
DUKE POWER COMPANY
Operating Department

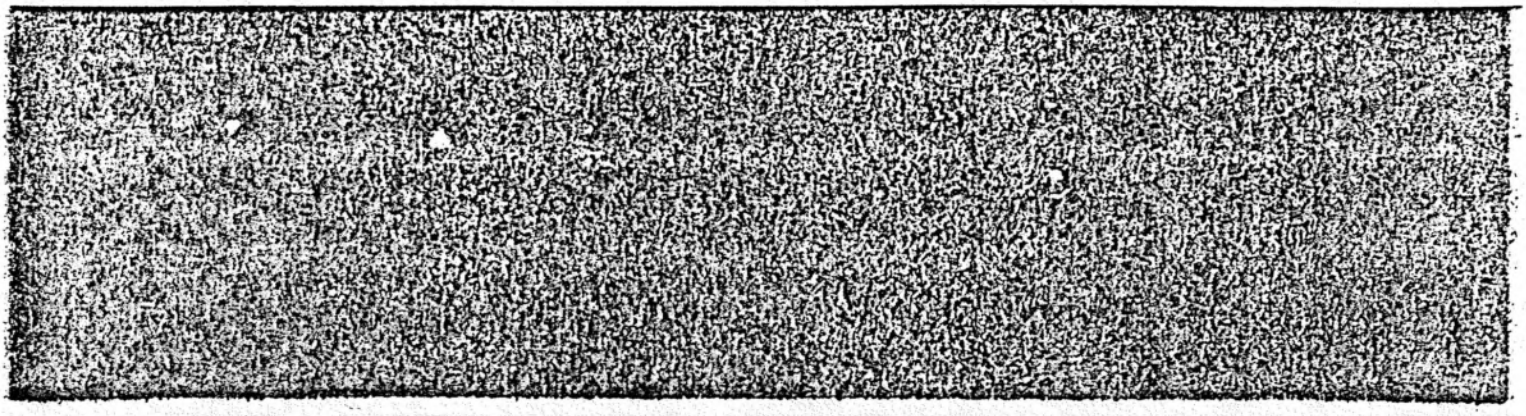
PROOF

THE FLUID IN THIS CONTAINER HAS BEEN TESTED TO DETERMINE THE CONTENT OF POLYCHLORINATED BIPHENYLS (PCB). BASED ON THE TEST RESULTS, THE FLUID CONTAINS BETWEEN 50 AND 500 PPM OF PCB.

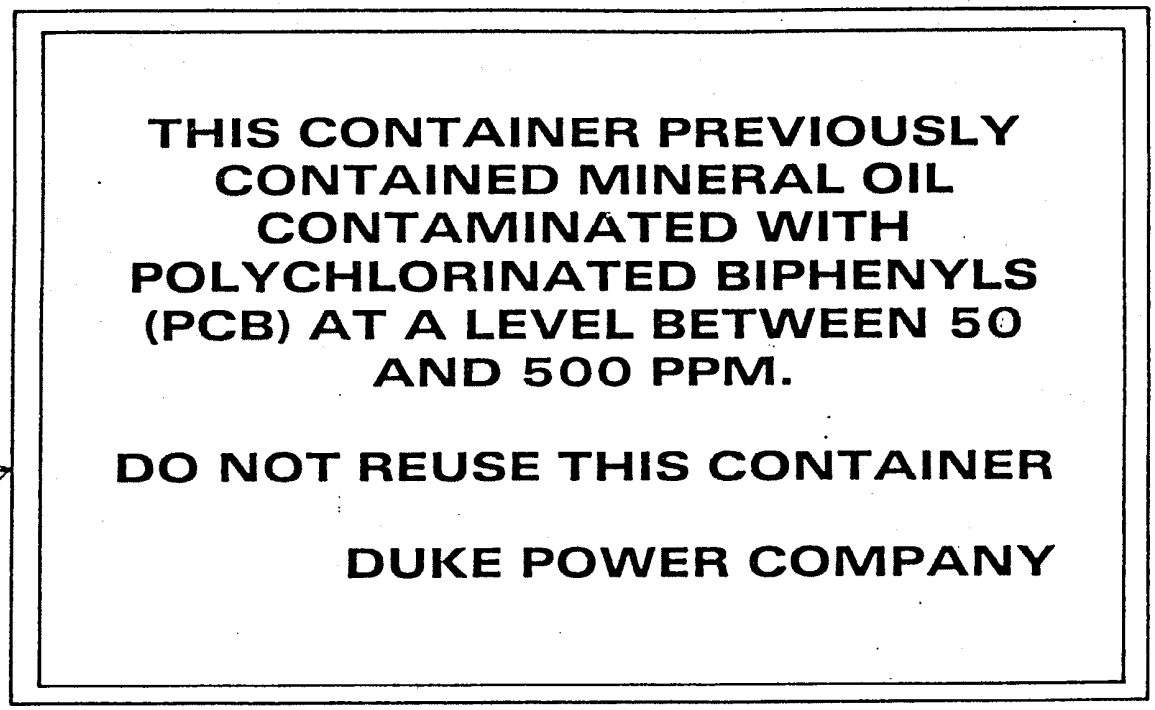
DUKE POWER COMPANY

BLACK ON WHITE

2000



PROOF



RED →

2000

BLACK & Red ON White

3:24-cv-01281-MGL Date Filed 06/05/26 Entry Number 121-24 Page 11 of 137

4-2-80 WC-8 @ 2 PM Full PCB Committee

PCB's 4-1-80

PWH, ARJ, Roy Ho, Bill Breedlove.

Cap. can ≅ $ 15-18
drum ≅ $ 85-90 (Chem $22 disposal $65)
Now require capacitor cans in drums for "final disposal" along with absorbent material.

Vance Martin Dist Trans — usually bushings + cover off top & very little oil loss.
very rare to lose large amount of oil.
≅ 2000 per year have cover blown off.

4-2-80

Operating paying for cloth contaminated with PCB? notify NJM.

Ken, Bill, & D on testing cast trans. & Food processing

January 18, 1980

TO: Messrs. P. W. Downing, Jr.
J. H. Francis
J. E. Harwood
J. L. Hodges
R. E. Holmes
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
D. P. Roche
W. E. Saxon
G. T. Swearingen

FROM: W. N. Breedlove, Jr. WNBJr

SUBJECT: PCB Committee Meeting

A meeting of the PCB Ad-Hoc Committee was held on January 4 to discuss revisions to the Duke Power PCB Plan and several other items. In the absence of Nick Melton, Bill Breedlove chaired the meeting.

The Company PCB Plan revisions were reviewed by the group. Several good suggestions were made and will be incorporated into the Plan for clarification and to hopefully improve readability and understanding by field personnel. John Lansche agreed to give the Committee an interpretation on the placement of the two additional PCB labels (PCB capacitor identification and PCB records location).

The Committee also reviewed revisions to PCB Disposal Record Form 02756 and PCB Annual Report Forms 06109-06112. Dave Roche reported

Redacted for Privilege

Redacted for Privilege Construction of a new PCB protected storage building at Toddville was also mentioned briefly.

Once the revisions are made to the PCB Plan, it will be circulated to the committee for a final review before distribution.

mms

RECEIVED
JAN 21 1979
DUKE POWER COMPANY
Operating Department

RECEIVED
JUL 30 1979

July 27, 1979

DUKE POWER COMPANY
Operating Department

TO: Messrs. R. S. Crowell
P. W. Downing, Jr.
J. H. Francis
J. L. Hodges
R. E. Holmes
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
D. P. Roche
W. E. Saxon
G. T. Swearingen

FROM: W. N. Breedlove, Jr. WNBJr

SUBJECT: PCB Ad-Hoc Committee

A meeting of the PCB Ad-Hoc Committee was held on Tuesday, July 17, at 2:00 p.m. Nick Melton chaired the meeting. The purpose of the meeting was to discuss proposed changes in Duke Power Company's PCB Plan to comply with EPA's Final PCB Ban Rule.

Dave Roche brought the committee up to date on EEI's involvement in the lawsuit between the Environmental Defense Fund and EPA. Bill Breedlove mentioned that the Electronic Industries Association and the National Electrical Manufacturers Association had filed a joint motion to intervene in support of EPA's Final PCB Ban Rule. Joy Manufacturing Company, which manufactures mining machinery, has also filed to intervene in the case on the side of EPA.

Dave Roche pointed out that USWAG through the PCB Task Force has scheduled a meeting with EPA to discuss spill clean-up procedures. EPA is presently developing guidelines for PCB spill clean-up. Nick, Ken Jordan, and John Lansche will speak for Duke.

Nick handed out copies of a letter from Harry Onishi who heads the EEI PCB Task Force. Onishi's letter was a response to Nick's letter of June 21 expressing Duke's concerns about the Final PCB Ban Rule.

Revisions to Form 02756 were discussed briefly. The revised form must be formatted to fit the card size and be printed.

Dave Roche and Parker Downing submitted a proposal for incinerating low level (50 ppm - 500 ppm) PCB contaminated mineral oil in a Duke coal-fired boiler. They recommended that the committee request an economic analysis by Steam Production to determine the desirability of such an alternative. No action was taken on this at the meeting.

The rest of the meeting was devoted to considering changes to Duke's PCB Plan. It was agreed that all changes would be consolidated by Bill Breedlove and the revised plan would be sent to the committee for comments.

mms

RECEIVED
JUN 22 1979
DUKE POWER COMPANY
Operating Department

June 20, 1979

TO: Messrs. R. S. Crowell
P. W. Downing, Jr.
J. H. Francis
J. L. Hodges
R. E. Holmes
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
D. P. Roche
W. E. Saxon
G. T. Swearingen

FROM: W. N. Breedlove, Jr.

SUBJECT: PCB Ad-Hoc Committee

A meeting of the PCB Ad-Hoc Committee was held on Tuesday, June 19, at 2:00 p.m. Nick Melton chaired the meeting. The purpose of the meeting was to examine EPA's final PCB regulations which were promulgated on May 31 and determine those changes in Duke Power Company's PCB procedure that will be necessary.

Dave Anderson from Design Engineering briefed the committee on the history and development of USWAG (Utilities Solid Waste Activity Group). Several Duke people are involved in USWAG including Dave, L. C. Dail, Charlie Dewey, George Swearingen, and Ralph Bostian to name a few. EEI's PCB Task Force is being placed under USWAG for consolidation's sake. The Environmental Defense Fund has petitioned in court for a review of EPA's final PCB regulations (see attached article). EEI feels that the PCB Task Force under USWAG should intervene in the litigation to help prevent more stringent rules and possibly to lessen those found in the May 31 document. Rose, Schmidt, Dixon, etc. law firm will handle PCB litigation even though USWAG normally retains another firm. Dave appealed to Nick on behalf of L. C. Dail and Charlie Dewey for Nick on his designee to become involved in the PCB Task Force because of these developments. Nick will talk with Frank Jenkins before making any decision.

Several items were mentioned prior to detailed discussion of the new regulations. The gas chromatograph for analyzing soil samples has been shipped to Steam Production's Environmental Lab at McGuire. They are expecting it any day. There will also be another gas chromatograph at Toddville for analyzing oil samples.

Because of an incident on a customer's property near Lexington, N.C., sampling substation soil to determine background PCB levels was discussed. There is no good way to distinguish "new" PCB's from "old" PCB's in the event of a spill.

On the subject of spills, Nick asked Bill Saxon to work with Stan Carter and Ken Jordan in developing soil sampling kits. Parker Downing has also been involved in this.

In order to prepare changes in the existing Duke PCB Procedure, Nick assigned various sections to individuals for study and recommendations:

Section I - Saxon
Breedlove

Section II - Jordan
Jones

Section III -	Storage	Disposal
	Jordan	Downing
	Jones	Roche
	Hodges	

Section IV - Breedlove
Roche
Jones
Downing

Section V - Jones
Hodges

Nick also asked that Roy Holmes and Ken Jordan look into the possibility of adding a Section VII to cover "Protection from Spills During Routine Servicing."

A subcommittee to examine changes necessary in the PCB Disposal Record, Form 02756 was formed. Bill Breedlove will chair a group including Ken Jordan, Jim Hodges, Casey Jones, and Parker Downing to work on this.

Other items mentioned and which may require further action:

1. Ken Jordan suggested that the 50ppm concentration level be challenged. Spills appear to be biggest problem because background levels in substations could be greater than 50 ppm.

2. Roy Holmes mentioned that some bucket trucks and cranes use askarel as an insulating/hydraulic fluid. This needs to be investigated.

3. SPCC Plans and containers other than approved 55-gallon drums were briefly discussed.

4. The requirement for central location of PCB records was questioned. The wording in the final rule is slightly different from what was there before. John Lansche will be contacted for an interpretation.

5. Ken Jordan asked if an exemption would be necessary for servicing appliances which contain small PCB capacitors. This is not clear.

A schedule for subsequent meetings of the Committee was tentatively set:

June 26 - Meet again primarily to discuss Duke involvement in PCB Task Force action on EDF lawsuit.

July 6 - Submit recommendations for changes in Duke PCB procedure to Nick.

July 17 - Meet again to discuss changes.

mms

Attachment

xc: Mr. Dave Anderson
Mr. C. A. Dewey, Jr.

Polychlorinated Biphenyls

EPA BAN EXEMPTS 99.3 PERCENT OF PCBs, CLAIMS EDF IN FILING SUIT AGAINST EPA

The Environmental Defense Fund filed suit June 7 against the Environmental Protection Agency claiming that EPA has ignored the intent of Congress by promulgating a polychlorinated biphenyl (PCB) ban which permits more uses than it prohibits.

Jacqueline Warren, Environmental Defense Fund staff attorney, said "EPA has effectively exempted 99.3 percent of the PCBs now in use from the ban regulations. An exception so large makes a mockery of Congress' clearly stated intent to put an expeditious end to human and environmental exposure to PCBs resulting from their manufacture, use, and uncontrolled disposal."

EDF filed a petition for review under Section 19 of the Toxic Substances Control Act with the U.S. Court of Appeals for the District of Columbia Circuit, asking the court to review the final PCB ban regulations. The petition states that Congress intended PCB manufacture and use "to be phased out expeditiously," and asks the court to remand the regulations to EPA for revisions which would be more consistent with congressional intent.

Section 19 allows anyone to petition the courts for review of a final regulation under TSCA for any reason as long as the petition is filed within 60 days after the rule is promulgated.

EPA promulgated the final PCB manufacturing, processing, distribution in commerce, and use ban May 31 (Current Report, June 1, p. 289). At the same time EPA published its proposed disposition of petitions filed for manufacturing exemptions to the final PCB rule and procedural rules for filing for exemptions to the processing, distribution in commerce, and use ban.

PCBs are believed to cause cancer and other adverse health effects in humans. PCBs are also being regulated by the Food and Drug Administration and the Occupational Safety and Health Administration.

Areas of Contention

According to Warren, EDF has three major objections to the final PCB rules — the "overwhelming concern" EPA has given to the economic impact of the regulations, the concept that anything contaminated with less than 50 parts per million PCB is not a PCB substance under the regulations (except in oil used for dust control), and EPA's extensive use authorization provisions.

Warren contends that EPA subverted congressional intentions to ban PCBs in its decision on each of these issues.

She said that Section 6(e) of TSCA, which specifically bans PCB manufacture and use, says that PCB regulations should be promulgated in accordance with an earlier subpart of Section 6, but 6(e) explicitly excludes the provision which requires EPA to factor in risks and benefits of regulations including economic consequences.

According to Warren, Congress has already weighed the consequences of regulating PCBs and determined that the costs of such regulation do not outweigh the potential hazards of PCBs.

Warren also said that Congress intended for EPA to regulate all PCB substances not just those above 50 ppm. She said that while EDF was not satisfied with the 50 ppm regulatory cutoff level, the real point of contention is that, under the final regulation, EPA considers any substance contaminated with PCBs at less than 50 ppm not to be a PCB substance.

EPA's only exception to this definition of PCBs is the ban EPA placed on using any oil contaminated with any detectable levels of PCBs for dust control on roads. According to EPA's economic impact analysis, the dust control ban is likely to have the most significant economic impact of any provision in the final rule.

The final PCB ban lists specific use authorizations for more than 10 different uses for varying lengths of time. According to Warren, EDF feels that EPA should have moved more swiftly to eliminate these uses in some cases and in others allowed a much shorter phasing-out period.

Warren said that EPA "second-guessed Congress" in establishing such extensive use authorizations based on economic considerations.

"Although the statute allows for limited exceptions to the general ban," Warren said, "EPA's regulations have created an overwhelming general exception to a very limited ban. The agency is not implementing a legislative mandate here; it has rewritten the law."

Previous Comments

In comments during the PCB rulemaking EDF criticized EPA for first setting the regulatory cutoff level at 500 ppm for the disposal and marking regulations. EDF also criticized EPA's proposed rule for failing to ban more uses of PCBs and allowing unregulated disposal of PCBs in small capacitors such as fluorescent light ballasts.

EDF claims that disposal of these capacitors will result in uncontrolled disposal of 167,000,000 pounds of PCBs.

EDF stated that it is still unsatisfied with EPA's handling of the disposal of small PCB capacitors but that the disposal issue will not be addressed in this lawsuit.

EPA now has 40 days to file an index to the PCB rulemaking record. EDF will then be required to file a brief formally stating its objections to the final PCB rule.

Additional PCB petitions

EDF may not be the only group filing a petition for review. Edison Electric Institute sent a request to EPA asking the agency to confirm the promulgation date of the final PCB ban for purposes of judicial review.

EPA replied that it considered May 31 as the promulgation date for the purposes of Section 19 petition for review.

An attorney for EEI said that EEI is seriously considering filing a petition but has not yet made a definite decision. He said that EEI is "seriously considering what role they should play in the judicial review process."

Apparently several other industrial groups are also contemplating the possibility of filing for judicial review.

A review petition action taken by industry could conceivably counterbalance the suit filed by EDF in judicial decisionmaking.

March 26, 1979

To: Messrs. R. S. Crowell
P. W. Downing, Jr.
J. H. Francis
J. L. Hodges
R. E. Holmes
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
W. E. Saxon
G. T. Searingen

RECEIVED
MAR 27 1979
DUKE POWER COMPANY
Operating Department

From: W. N. Breedlove, Jr.

Subject: PCB Ad-Hoc Committee
South Carolina Hazardous Waste Regulations

A meeting of the PCB Ad-Hoc Committee was held on Thursday, March 22 at 9:00 a.m. Bill Breedlove chaired the meeting. The purpose of this meeting was to discuss the impact of the new S.C. Hazardous Waste Regulations on Duke Power Company, particularly regarding electrical apparatus containing PCB's and other "hazardous" substances, waste oil, solvents, etc.

John Lansche gave a brief report on Duke's involvement in the acceptance of these regulations. Through written and oral statements, Duke has objected to many provisions contained in the regulations and has urged that they not be adopted. However, the regulations will become effective no later than 90 days after March 13, unless the S.C. Legislature acts to the contrary. Duke must now decide what, if any, course of action to take in this matter.

The regulations were reviewed section by section to discuss items of concern which will, or are likely to, affect Duke's operations. The group's comments are listed below:

Section R.61-79

The words "statistically equivalent" in definition 74, representative sample, were questioned as to meaning.

Definition 79, shipment, and definition 91, transport, were discussed because their meanings are not completely clear.

There is no definition for "discarded." Conceivably all PCB waste could be "discarded" at Toddville.

Section R.61-79.1

John Lansche indicated that Duke should test any substances currently used that may meet one of the hazardous waste tests given in subsection C.

The phrase "designated by the Department" in subsection C(4), line 086 causes concern as to its full implications.

Appendix IV includes paint wastes, solvents, waste oil, etc. This is burdensome because if Duke is considered as one "person" under the regulations generating more than 220 pounds of waste in South Carolina per month, all such wastes generated on the Duke system in South Carolina would be included. A more reasonable approach would be to consider each Duke facility under the 220 pounds per month requirement.

Section R.61-79.2

A possible loophole in the regulations exists in subsection A(9) if Duke can be considered a "retailer."

Subsection D refers only to treatment, storage or disposal "within the State." and is not applicable to PCB's.

Subsection E(1)(b) requires an annual analysis of each waste to determine if its chemical composition has changed. This would require gathering a great quantity of information from manufacturers and suppliers each year.

The manifest system and generator reports described in subsection F and G are probably the most onerous and burdensome requirements in this section and the following sections. Each "shipment" of PCB or other waste must have a manifest (4 copies) to describe it. Collection of waste from a central location will require an additional manifest. Copies of these manifests must be filed with the Department each month within seven days after the end of the month.

Subsection H requires marking PCB waste with a South Carolina controlled waste label in addition to the federal PCB label.

Subsection L regarding spills will require notification and a written report within fifteen days to the Department. Reporting will be more detailed under these regulations, but Duke can comply without great difficulty.

An interpretation as to whether Duke is considered a waste oil collector inasmuch as insulating oil from electrical apparatus is reprocessed at Toddville is necessary before the full impact of subsection M can be assessed. If Duke is considered a waste oil collector, the manifest system must be complied with.

Section R.61-79.3

Will written records of inspections be required under subsection E(3) or will non-recorded visual inspections suffice?

Section R.61-79.4

The fund requirements for closure and post closure in subsection G and general financial responsibility in subsection H should be addressed by Dick Ranson.

Subsection I should be clarified so as to exempt temporary (less than 90 days) storage.

The monitoring requirements of subsection L should be waived for temporary storage.

Section R.61-79.5

The latest revision of the regulations eliminated the requirements for listing of all vehicles which will be used to transport "hazardous" wastes.

Section R.61-79.6

According to A(2), temporary (less than 90 days) storage is exempted, but section R.61-79.2G must be complied with.

It was decided by the Committee that, in addition to the group's comments listed above, each member would submit his own comments on the regulations to John Lansche so as to cover all items of concern.

Recommendations

The PCB Ad-Hoc Committee recommends that Duke ask the Department that electrical equipment containing PCB's and other so called "hazardous" waste be exempted from the South Carolina regulations because:

1. PCB's are already governed by existing federal regulations.

2. It will be difficult, if not impossible, to determine which equipment contains "hazardous" substances.

As a condition for exemption, Duke might agree to treat all capacitor spills in South Carolina as PCB spills. The Committee believes that such an exemption would eliminate a great many of the Company's objections to the regulations.

The Committee also recommends that Duke request that each Company facility be treated as one person for the purposes of subsection R.61-79.2 A(10) regarding 220 pounds of waste generated per month.

mms

xc: Messrs. J. A. Cloninger
G. L. Finley

RECEIVED
DEC 13 1978
DUKE POWER COMPANY
Operating Department

December 12, 1978

MEMORANDUM

TO: Messrs. R. T. Barden
R. S. Crowell
P. W. Downing, Jr.
J. H. Francis
J. L. Hodges
R. E. Holmes
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
W. E. Saxon
G. T. Swearingen

FROM: W. N. Breedlove, Jr.

SUBJECT: PCB Ad-Hoc Committee

A meeting of the PCB Ad-Hoc Committee was held on Friday, December 8, at 9:00 a.m. Nick Melton chaired the meeting.

Ken Jordan gave an updated report on the Durham capacitor spill and the soil sample test results. According to En-Cas Analytical Laboratories of Winston-Salem, PCB content in the soil was well below 500 ppm.

Stan Carter has written a soil sampling procedure to test for PCB's. Nick asked that Parker Downing, Jim Hodges, Ken Jordan, and George Swearingen review and comment on the proposed procedure.

George Swearingen described the legal reporting requirements for PCB spills. John Lansche mentioned that there are proposals in the works to require PCB spill reporting to EPA for spills on land, but at present, there are no legal reporting requirements to EPA for spills on land nor to North and South Carolina for spills anywhere.

John Francis described the PCB safety program presentations to date and the reactions and questions that have resulted. The program has been well received so far.

Casey Jones gave a report on PCB disposal. Nine truckloads of PCB items have already been shipped. There are approximately 250 non-leaking capacitors and 200 55-gallon drums yet to be shipped. The 200 drums contain soil and debris only-all leaking capacitors in drums have been shipped. Our direct disposal costs to date are $75-80,000. This works out to $16 per capacitor and $65 per drum.

RECEIVED
DEC 13 1978
DUKE POWER COMPANY
Drilling Department

Parker Downing gave a report on the feasibility of in-house soil testing for PCB's. The McGuire Environmental Lab will probably buy a gas chromatograph for testing. It will take about ninety days from the order date to become operational.

Nick talked to Dick Thorsell of EEI regarding EPA's final rule on PCB Manufacturing, Processing, Distribution in Commerce, and Use Bans. Thorsell indicated that EPA may exclude mineral oil-filled transformers and allow burning of PCB contaminated oil in utility boilers. The final regulations should be published in early 1979.

Casey Jones gave the lot numbers, quantities of issue, and cost for protective clothing and equipment:

Lot Number	Description	Cost
543-800	Apron (100/roll)	$12/roll
543-810	Boot (50/roll)	$ 5/roll
543-840	Glove (25/roll)	$ 2.80/roll)

The remainder of the meeting was devoted to recommended changes in the existing Duke Power Company procedure for handling and disposing of PCB's. Nick is planning to revise the procedure according to the recommendations and send copies of the revised document to members of the committee for comments. In connection with this, one Form 02756 (latest revision)is attached for information.

Attachment

mms

cc: Mr. G. L. Finley

RECEIVED
NOV 14 1978
DUKE POWER CO.
Operating Department

November 13, 1978

MEMORANDUM

TO: Messrs. R. T. Barden
S. L. Carter
R. S. Crowell
P. W. Downing, Jr.
J. H. Francis
E. N. Hedgepeth, Jr.
J. L. Hodges
R. E. Holmes
F. A. Jenkins
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
G. T. Swearingen
H. L. Wilson, Jr.

FROM: W. N. Breedlove, Jr.

SUBJECT: PCB Ad-Hoc Committee

A meeting was held Friday, November 10 at 9:30 a.m. to discuss cleanup, testing, and reporting of PCB spills. Nick Melton chaired the meeting.

The Distribution Department is particularly concerned about PCB spills since cleanup usually involves contact with customers, property owners, and sometimes the news media. Ken Jordan explained a situation that currently exists in Durham, North Carolina. A PCB spill was located and immediately cleaned up; however, a test of the soil after cleanup by the N. C. Department of Natural Resources and Community Development showed that the PCB concentration was as high as 920 ppm. Present EPA regulations define concentrations above 500 ppm as PCB mixtures. Upon notification of the test results, additional soil was removed from the spill site and soil samples were again taken. The results of the second tests are not yet known. The City of Durham is planning to issue a news release following satisfactory resolution of the problem.

A discussion of testing soil samples before and after PCB spill cleanup followed. Nick stated that an EPA representative in Atlanta indicated that testing was the only sure means to document cleanup of a spill. John Lansche feels that

[redacted]

decide otherwise. Mr. Jenkins suggested that outside laboratories and possibly the Steam Production laboratory at McGuire be used for testing. Ken Jordan will coordinate this testing for Distribution.

George Swearingen brought up the subject of reporting PCB spills to the Coast Guard. At present, only George and Bob Barden are reporting spills for all of Duke Power Company. George urged that several other individuals in different departments be trained to report spills (PCB and oil). Failure to report a spill within twenty-four hours can result in a $10,000 fine. After some dis-

cussion in which everyone agreed it was a good idea, Nick asked George to write a recommendation to management for endorsement by the PCB Ad-Hoc Committee to change the designation of individuals who can report spills.

Casey Jones distributed to the committee descriptions of PCB safety equipment including lot numbers. Ken Jordan and Roy Holmes will work with Casey to finalize the protective clothing list. John Francis stressed again that a representative of management should be present to answer questions regarding the availability of protective clothing and the replacement policy for personal clothing when John's PCB Safety Program is presented beginning in December.

Nick reminded individuals on the committee who were to rewrite sections of the Duke Power PCB procedure to be working on those sections for a meeting in early December. Nick also said he would check the account number that has been set up for PCB cleanup and disposal charges to see that it is valid for use by all departments (the number set up is a transmission account number).

WNB,Jr/mmb

October 23, 1978

RECEIVED
OCT 24 1978
DUKE POWER COMPANY
Engineering Department

COPIES MAILED 10/26/78
H.K. SLEDGE III
E.T. DORTON
S.A. CUNNINGER

Memorandum

TO: Messrs. R. S. Crowell
P. W. Downing, Jr.
J. H. Francis
J. L. Hodges
R. E. Holmes
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
W. E. Saxon
G. T. Swearingen

FROM: William N. Breedlove, Jr.

SUBJECT: PCB Ad-Hoc Committee

A meeting was held Friday, October 13, at 2:00 PM to discuss several items of concern involving PCB's. Nick Melton chaired the meeting. Those present were

Bill Breedlove	Ken Jordan
Parker Downing	John Lansche
John Francis	Nick Melton
Jim Hodges	Bill Saxon
Roy Holmes	George Swearingen

Nick Melton, John Lansche and Bill Breedlove briefly discussed EPA's hearing on the latest proposed PCB regulations held August 21 in Washington, D.C. Nick testified on behalf of Duke. The Edison Electric Institute also testified at the hearing and is still submitting follow-up comments to EPA in an effort to have them lessen their restrictions on the disposal of transformer oil contaminated with low levels of PCB's. The final version of these proposed regulations is not expected until after the first of next year.

The committee next discussed PCB spills and Duke's clean-up procedure. Distribution has been collecting several 55-gallon drums of soil, grass, etc. during each clean up. Their position is that it is better to be safe than sorry. With no detailed guidelines as to how deep PCB's will leach into soil, clean-up depths have varied and may have been excessive. Parker Downing presented the committee a copy of a study that evaluated PCB leaching in various types of soil. Nick asked that Bill Breedlove write up a statement based on this study and any other information available, indicating general guidelines that could be used by the men in the field during clean up of a spill. The committee agreed that in every case, judgement should be used to avoid cleaning up more than is necessary. Nick reminded everyone that burial space alone in a chemical waste landfill is $60 for each 55-gallon drum.

In connection with spills, the committee discussed company policy on the replacement of clothing contaminated with PCB's. A motion was made by John Lansche and

seconded by Jim Hodges that the committee recommend to management that some uniform policy regarding PCB-contaminated clothing be adopted. John Lansche agreed to write up the recommendation for submittal to the Executive Committee.

John Francis of Corporate Safety indicated that he had received a great many calls and requests from field personnel regarding the effects of PCB's on them. John feels that some type program is necessary to alleviate the fears that some employees now have about handling PCB's. He presented a program that he had developed to fill this need. The reaction from the committee was good. Ken Jordan moved (seconded by Jim Hodges) that:

> "Unless negative reaction is received by the PCB Committee Chairman by October 20, the PCB Ad-Hoc Committee recommends that Corporate Safety present their program on handling PCB's systemwide. The Committee also recommends that a representative from management in the respective departments attend these meetings to provide information regarding implementation of operating policies and procedures."

It was suggested that several sections of Duke's PCB Marking, Storage, Disposal and Pollution Prevention Plan be revised as follows:

1. Ken Jordan will rewrite part of Section 4.1.
2. Lot numbers for protective clothing and equipment will be added.
3. The ratio of kilograms to gallons of PCB's will be included.
4. The account number for clean-up and disposal expenses, 566.4, will be added.
5. The requirement for marking of leaking capacitors will be clarified.
6. The third paragraph of Section 5.0 will be rephrased.
7. Any other changes deemed necessary will be made.

An "EPA Inspection Manual" has been requested from the Atlanta office of EPA for information.

At Mr. Jenkins' request, we are looking into asking EPA to allow Duke to dispose of diluted PCB liquid by incineration in our fossil fuel generating plants.

cg

HKS & JCH

RECEIVED
JUL 19 1978
DUKE POWER COMPANY
Operating Department

July 18, 1978

MEMORANDUM

TO: Messrs. R. S. Crowell
P. W. Downing, Jr.
J. L. Hodges
R. E. Holmes
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
W. E. Saxon
G. T. Swearingen

FROM: W. N. Breedlove, Jr.

SUBJECT: PCB Regulations (Part III) Proposed in Federal Register dated Wednesday, June 7, 1978

A meeting was held Wednesday, July 12, at 9:30 a.m. to exchange and discuss comments that had been prepared by several members of the PCB Ad-Hoc Committee regarding the PCB Regulations (Part III) proposed in the Federal Register dated Wednesday, June 7, 1978. Nick Melton chaired the meeting. Those present were:

Bill Breedlove	Ken Jordan
Parker Downing	Nick Melton
Jim Hodges	Bill Saxon
Roy Holmes	George Swearingen
Casey Jones	

We began by discussing Ken Jordan's comments. Ken had prepared a list of his thoughts and ideas on the concentration level that determines a "PCB mixture." We talked about the possibility of setting the PCB mixture level high enough to exclude all oil filled transformers without testing. This would be justified on the basis of the impact that low level contaminations would have on the environment.

Bill Breedlove took a look at the economic costs of applying the proposed regulations to oil filled transformers. Three alternatives were compared:

1. Test all transformers immediately
2. Assume all transformers to be PCB transformers
3. Test all power transformers immediately and assume the rest to be PCB transformers

RECEIVED
JUL 19 1978
DUKE POWER COMPANY
Operating Department

There were several comments as to costs that had not yet been determined as well as costs that should be included. Ken Jordan suggested that we prepare a bar graph showing costs on a yearly basis. This chart might include separate entries for transformers and capacitors.

Roy Holmes presented some figures he had prepared on the costs for exposure and contamination control plans. We need clarification by EPA as to which apparatus and locations will require control plans.

In the area of oil reprocessing, it was pointed out that if we cannot reprocess transformer oil, we will lose the value of the oil plus our capital investment in the reprocessing facility itself.

Parker Downing gave us his and Henry Teeter's comments on the feasibility of incinerating PCB contaminated transformer oil and solid wastes in our fossil fuel generating plants. It appears that incineration of the contaminated oil is a good possibility. Some waste oil has been incinerated at Lee and other stations in the past with little difficulty. The solid waste incineration would require modifications to the furnace. This is an area that needs further study.

It was agreed that Nick Melton and Bill Breedlove would work with John Lansche to develop a rough draft consolidating our comments. These comments would be reviewed by the PCB Ad-Hoc Committee and submitted to EPA by August 7, 1978. Rulemaking hearings begin in Washington, D.C. on August 21, 1978.

mms

xcc: Mr. G. L. Finley

RECE
JUL 2 9 1978
DUKE POWER
Operating Department

July 3, 1978

MEMORANDUM

TO: Messrs. R. S. Crowell
P. W. Downing, Jr.
J. L. Hodges
R. E. Holmes
K. A. Jones
K. R. Jordan
J. E. Lansche
N. J. Melton
W. E. Saxon
G. T. Swearingen

RECEIVED
JUL 05 1978
DUKE POWER COMPANY
Operating Department

FROM: W. N. Breedlove, Jr.

SUBJECT: PCB Regulations (Part III) Proposed in Federal Register dated Wednesday June 7, 1978

A meeting was held Wednesday, June 28 at 9:00 a.m. to discuss Duke Power Company's approach to PCB Regulations (Part III) proposed in the Federal Register dated Wednesday, June 7, 1978. Nick Melton chaired the meeting. Those present were:

Bob Barden	Ken Jordan
Bill Breedlove	John Lansche
Park Downing	Nick Melton
Jim Hodges	Bill Saxon
Roy Holmes	Henry Teeter

Nick began by asking for comments on those areas in which we have concern or forsee problems. Bill Saxon pointed out a need for clarification regarding EPA's definition of "significant exposure" and the exposure that is unavoidable during routine maintenance and/or transformer rebuilds.

Ken Jordan took issue with EPA's determination of the concentration level that constitutes a "PCB mixture." Any level chosen will be fairly arbitrary. Ken also suggested that for economics sake, the adverse effects of spills at particular locations such as steam or hydro plants which are generally located close to large bodies of water be weighted more heavily than spills at pole-top capacitor locations. This would be similar to the way dams are ranked on the basis of their potential destructive capacity.

Henry Teeter and Parker Downing discussed the possible adaptation of our fossil fuel generating plants to incinerate PCB wastes, both fluids and solids. It seems that this is a possibility, but we have not studied the problem in detail.

Nick tried to identify the costs for determining which of our transformers contain PCB mixtures. Do we test all transformers now and mark them accordingly, do we test at the time of disposal, or do we assume all transformers in service contain PCB mixtures and dispose of them as PCB wastes? Economics will dictate which route we take.

Jim Hodges talked a little bit about the PCB exposure and contamination control plan required by the proposed regulations. He asked if capacitors could be exempted from this part of the regulations.

We all agreed that we should formally submit comments to EPA regarding the proposed regulations and appear to testify at the August 21 hearing. John Lansche feels that we should represent Duke Power Company's position even though EEI is planning to appear to speak for the industry.

In order to prepare our comments from a company-wide standpoint, the following individuals agreed to prepare statements on particular areas:

Ken Jordan	- Concentration level that determines a "PCB mixture"
Henry Teeter & Parker Downing	- Feasibility of incinerating liquid and solid PCB wastes in fossil fuel generating plants
Roy Holmes	- Annual amount of oil reprocessed by Duke
Bill Breedlove	- Economic comparison of testing and marking transformers containing PCB mixtures

We will meet again on July 12, to discuss these statements and any other comments that anyone may have about the proposed regulations.

mms

xcc: G. L. Finley

DUKE POWER COMPANY
TRANSMISSION DEPARTMENT, SUBSTATION SECTION
P. O. BOX 2178 422 SOUTH CHURCH STREET
CHARLOTTE, N. C. 28242

RECEIVED
JUN 14 1978
DUKE POWER COMPANY
Operating Department

June 8, 1978

Mr. F. A. Jenkins, Vice President
Transmission Department
Building

Subject: PCB Marking, Storage, Disposal and Pollution Prevention Plan for Duke Power Company

Because of concern over potential damage caused by PCB's and because of increased regulation activity, an Ad-Hoc Committee was formed in 1976 in Duke Power Company to study the problems of PCB's. This committee is presently composed of the following:

N. J. Melton - Transmission Substation Engineering, Chairman
R. S. Crowell - Design Engineering
P. W. Downing, Jr. - Steam Production
J. L. Hodges - Operating Department
R. E. Holmes - Substation Maintenance
K. A. Jones - General Stores
K. R. Jordan - Distribution Engineering
J. E. Lansche - Legal Staff
W. E. Saxon - Transmission Substation Engineering
G. T. Swearingen - Operating Department

EPA published the final rules on the disposal and marking requirements for polychlorinated biphenyls in the Federal Register of Friday, February 17, 1978. The Ad-Hoc Committee has reviewed these published rules, has consulted with other Utilities, has consulted with the Duke Power Company Safety Group, and has secured some verbal interpretations from the Atlanta Office of EPA. From these sources the committee has prepared a document interpreting the regulations for Duke Power Company use.

The Ad-Hoc Committee on PCB's recommends:

1. That this document, after actions that you deem appropriate, be issued as the official procedures to be used by Duke Power Company.

2. That the Transmission Departments Technical Services be responsible for coordinating the accumulation of the data for the annual report to EPA.

3. That the Transmission Departments Technical Services be charged with the responsibility of keeping the plan in line with changes in rules and regulations and coordinating the needed changes with other concerned Duke Power Company Departments.

N. J. Melton

N. J. Melton, Chairman
Ad-Hoc Committee on PCB's

vlc

cc: All Committee Members

MEETING OF AD-HOC COMMITTEE ON PCB's

April 12, 1978

RECEIVED
APR 19 1978
DUKE POWER COMPANY
Operating Department

The group discussed Mr. John Lansche's interpretation of the PCB Regulations Section 761.10(b)(3) regarding the requirement to dispose of soil and debris which had become contaminated with PCB's "as a result of placement of PCB's in a disposal site prior to the publication date of these regulations...". It was agreed that the regulations would be almost impossible to carry out and would have great economic impact as well as environmental impact on landfill areas. It was also pointed out that Mr. Lansche had properly observed that the requirement was new and was not published in the Proposed Regulations Federal Register of May 24, 1977; therefore, we had no opportunity to comment on this portion of the Regulations.

It was agreed that the Ad-Hoc Committee would take the following action:

(1) Consider methods to determine if we can more accurately identify specific burial sites of PCB's.

(2) Confirm the accuracy of the present list and determine how the list was accumulated.

(3) Review some method of determining the size of landfill or areas that would have to be excavated and some estimate of cost to excavate these landfills.

A presentation was made by Mr. John Yinger of Ziegler Liquid Waste Management Inc. of their abilities and procedures in disposing of capacitors and transformers.

Further discussions were held on marking with Mr. Ven Burwell showing samples of marking materials available. Mr. Burwell was to secure more definite prices. The opinion was that it would be better to purchase aluminum 6x6 markings and some plastic adhesive backed marking. Suggestive quantities were given to Mr. Burwell.

NJM

N. J. Melton
Apparatus Engineering

bgb
4-18-78

Exhibit 25
DUK_00016374 - DUK_00016386
(Confidential)
1978 Duke PCB Disposal and Prevention Plan

DUKE POWER COMPANY
P. O. Box 2178
CHARLOTTE, N. C. 28242

FRANK A. JENKINS
VICE PRESIDENT
TRANSMISSION
(704) 373-4313

RECEIVED
JUN 27 1978
DUKE POWER COMPANY
Operating Department

June 15, 1978

TO: INTERESTED PARTIES

SUBJECT: Procedure for Marking, Storage and Disposal of PCB Materials and Pollution Prevention Plan for Duke Power Company

A Committee, under the chairmanship of N. J. Melton, with representatives from all areas of the Company has developed the attached policy for Polychlorinated Biphenyl materials in compliance with Environmental Protection Agency regulations. This procedure has been reviewed and is being distributed for use. Annual reporting, as required by EPA, will be done for the Company by Technical Services Section, Transmission Department.

Frank A. Jenkins

Attachment

cc: Committee Members

DISTRIBUTION: D,E,F,K,N
E. N. Hedgepeth (G,H,I,J)

PCB MARKING, STORAGE, DISPOSAL AND POLLUTION PREVENTION PLAN
FOR
DUKE POWER COMPANY

Purpose

These procedures are developed for the protection of the environment from Polychlorinated Biphenyl (PCB) contamination and to comply with the Environmental Protection Agency (EPA) regulations described in the Federal Register Part V dated Friday, February 17, 1978. These procedures are to be implemented on July 1, 1978, and supersede all instructions pertaining to handling, storing, and disposing of capacitors, transformers, or other items containing PCBs or contaminated with PCBs.

The electric system utilizes transformers, circuit breakers, voltage regulators, capacitors, and oil reclosers to properly serve our customers. The equipment, including capacitors and some transformers containing PCB insulating fluid, is sealed and historically has exhibited no significant threat to the environment of Duke Power Company's service area.

Scope

Polychlorinated Biphenyl (PCB) is a 40-year-old man-made chemical compound which recently has given concern, and by EPA regulations, must be handled with care because it is now considered an environmental contaminant with pervasive and persistent characteristics which cause it to accumulate in the food chain. Power capacitors used by Duke Power Company for substations, pole-top, and surge protection contain from one to four gallons of PCB liquid as an insulating fluid. These capacitors occasionally fail and could result in a rupture of the tank causing a small PCB loss. The failed unit, any spilled liquid, or any contaminated material (including soil and rags) must be disposed of in an environmentally safe manner. Duke Power Company also has some transformers at steam generating stations and in the distribution network which contain PCB insulating fluids.

These guidelines will address the following areas:

SECTION I. Identification of PCB items
SECTION II. Marking Requirements
SECTION III. Temporary storage of PCB items prior to disposal
SECTION IV. Records and reports
SECTION V. Spill reporting and clean-up
SECTION VI. Methods of Disposal by the Central Storage Facility

Section I

Identification of PCB Items

1.1 The term "PCB Items" is defined to include (PCB) chemical substances, mixtures, articles, containers, article containers, and equipment. Street and area luminaires, fluorescent light ballasts, major and small appliances and their associated capacitors are excluded from the requirements of this document.

1.2 The following are PCB trade names probably to be found on Duke Power Company System. Askarel is the generic term.

Abestol - American Corp.
Chlorextol - Allis Chalmers
Clorinol - Sprague Electric
Diaclor - Sangamo Electric
Dykanol - Cornell Dubilier
Elemex - McGraw Edison
Inerteen - Westinghouse Electric
Noflamol - Wagner Electric
Pyranol - General Electric
Saf-T-Kuhl - Kuhlman Electric

1.3 PCB items which may be found on Duke System are as follows:

Capacitors - pole-mounted, rack-mounted, housed, protective devices in generator neutrals.

Transformers - indoor, switchgear, vaults, precipitators, rectifiers, power supplies for precipitators, protective devices in generator neutrals.

Other Items - soil, ground, vegetation, fluids, fluid mixtures, rags, trash, cans, drums, bags, tanks, bushings, or any material contaminated with PCBs by spillage or leakage.

Section II

Marking Requirements

2.1 As of July 1, 1978, the following shall be marked:

a. All stock transformers containing PCBs.
b. All stock capacitors containing PCBs.
c. All PCB containers - i.e., package, bottle, bag, barrel, drum, tank, etc.
d. Any stock equipment which contains a PCB capacitor with 3 lbs. or more of PCB fluid (approximately 1 quart).
e. Storage areas, including temporary areas, used to store PCBs for disposal.
f. All PCB items when they are removed from service.

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2.2 As of October 1, 1978, the following shall be marked:

All transport vehicles carrying transformers or any containers with more than 45 kg (99.4 lbs) of PCB mixture. Note: Marking is not required when carrying capacitors.

2.3 As of January 1, 1979, the following shall be marked:

a. All in-service transformers containing PCBs.
b. All in-service capacitors containing PCBs.
c. All in-service equipment containing a large high-voltage PCB capacitor.

2.4 Marking Requirements

Marking of PCB items shall be made with the labels available from General Stores. Lot number 485-139 is a thin aluminum label. An adhesive sealant is available from Lot number 521-323 to use for attaching this label to metal. A vinyl adhesive backed label is available from Lot number 485-146.

2.4.1 In-Service Capacitors - Each housing, rack, or metal elevating structure containing one or more PCB capacitors shall be marked with the metal label (Lot number 485-139) available from General Stores. The label will be permanently secured. The metal PCB label (not the nameplate) will be removed when the rack, housing, or metal elevating structure contains no PCB capacitors.

In addition, each Non-PCB Capacitor in the house or rack must be identifiable from the ground by either the manufacturer's blue nameplate, the manufacturer's blue decal, or a green dot, at least two inches in diameter, applied to the can.

2.4.2 Spare Capacitor Cans - Each can shall be marked with the label available from General Stores.

CAUTION
CONTAINS
PCBs
(Polychlorinated Biphenyls)
A toxic environmental contaminant requiring special handling and disposal in accordance with U S Environmental Protection Agency Regulations 40 C F R 761 For Disposal Information contact the nearest U S E.P.A. Office.

In case of accident or spill, call toll free the U S Coast Guard National Response Center:
800-424-8802
Also Contact DUKE POWER COMPANY
Tel. No _____

2.4.3 Transformers - Any transformer which has insulating fluid with PCB content of 500 ppm or greater shall be labeled with the label available from General Stores.

2.4.4 Containers - Any drum, barrel, or other container used to store PCB items or materials shall be labeled with the PCB label available from General Stores.

2.4.5 Storage Areas - (including temporary storage areas) Any storage area used to store PCB items for disposal shall be suitably marked with the PCB label available from General Stores. For PCB items stored in drums or other containers, the properly marked container will satisfy this requirement.

2.5 Label Removal - When all capacitor units containing PCBs in a station rack, pole-top rack, or house are removed, the label on that rack, pole, or house shall be removed.

Section III

Temporary Storage of PCB Items For Disposal

3.0 Temporary storage of PCB items for disposal may be for thirty days. Prior to the expiration of the thirty-day period, the item must be moved to the Toddville central storage facility.

3.1 Transformers

3.1.1 Non-Leaking Transformers

Properly marked non-leaking transformers designated for disposal may be stored for up to thirty days in a convenient location. Prior to the expiration of the thirty-day temporary storage period, the transformer must be moved to the central storage facility at Toddville. Precautions shall be taken to protect the transformer during storage and during transit from tank rupture or spillage of any liquid.

3.1.2 Leaking Transformers

Take immediate action to prevent the loss of fluid and to limit the area of contamination. Qualified personnel shall be notified to properly drain the transformer and arrange clean-up as required in Section V. The drained or repaired non-leaking transformer can then be moved to the central storage facility at Toddville.

3.2 Capacitors

3.2.1 Non-Leaking Capacitors

Non-leaking capacitors designated for disposal may be stored temporarily for thirty days at a district or branch stores location. Within thirty days after removal from service, a non-leaking capacitor designated for junk shall be moved to the PCB central storage facility at Toddville. Precautions shall be taken in handling and moving non-leaking capacitors so that bushings will not be broken nor the can punctured.

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3.2.2 Leaking Capacitors

A leaking capacitor is defined as a capacitor with PCB substance on any portion of its external surface.

All leaking capacitors shall be stored in properly marked sealed drums available from General Stores. The cover of the drum must be gasketed and firmly clamped. Leaking capacitors in a properly marked sealed drum shall be stored at Toddville central storage facility within thirty days. A tag shall be attached to each drum describing the contents of each drum and the date the item was placed in the drum. Care shall be taken in loading and transporting to prevent further damage to the capacitor or damage to the drum.

3.3 Other PCB Items for Disposal

All soil, rags, paper, gravel, vegetation, fluid mixtures, cans, bags, or any other material contaminated with PCBs shall be stored in a properly marked drum which may be secured from General Stores. The cover of the drum must be gasketed and firmly clamped for storage. The drums must be stored in an area protected from the weather. Within thirty days the sealed drums shall be moved to the Toddville central PCB storage location.

3.4 Listed are the General Stores pickup points for PCB contaminated items.

NORTH CAROLINA PICKUP POINTS

Albemarle, N.C.
Brevard, N.C.
Burlington, N.C.
Chapel Hill, N.C.
Charlotte, N.C.
Dan River Station
Durham, N.C.
Elkin, N.C.
Gastonia, N.C.
Greensboro, N.C.
Hendersonville, N.C.
Hickory, N.C.
High Point, N.C.
Hillsborough, N.C.
Kannapolis, N.C.
Kernersville, N.C.
Lenoir, N.C.
Madison, N.C.
Marion, N.C.
Marshville, N.C.
Mebane, N.C.
Mooresville, N.C.
Mt. Airy, N.C.
No. Wilkesboro, N.C.
Randleman, N.C.
Reidsville, N.C.
Rutherfordton/Spindale, N.C.
Salisbury, N.C.
Shelby, N.C.
Winston-Salem, N.C.

SOUTH CAROLINA PICKUP POINTS

Anderson, S.C.
Chester, S.C.
Greenville, S.C.
Greenwood, S.C.
Greer, S.C.
Lancaster, S.C.
Piedmont, S.C.
Spartanburg, S.C.
York, S.C.

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3.5 Central storage facilities are located at 610 Toddville Road, Charlotte, North Carolina, under the responsibility of the Manager of Toddville Stores. The building has no floor drains, drain valves, expansion joints, sewer lines or other openings that would permit liquid to flow from the curbed area.

Section IV

Records and Reports

4.0 Annual Report - PCBs In Service

Beginning in 1979, a report will be submitted to the EPA by July 1 covering the previous calendar year. The Transmission Department will be responsible for the annual report to EPA.

4.1 Distribution Department

When a PCB capacitor or a PCB transformer is removed from service for disposal, all applicable information will be filled out on Form 02756. The third copy (card) of Form 02756 will be attached to the capacitor/transformer and shipped with the capacitor/transformer for disposal. The plastic transformer repair card pocket should be used with Form 02756. Other copies of the Form 02756 may be discarded.

Prior to January 31, 1979, each district and independent branch will send the following information to the Supervisor, Distribution Quality Assurance, as of December 31, 1978:

a) Total number of PCB capacitor units in service and in stock.

b) Total number of PCB transformers in service and in stock, and the total weight (kilograms) of any PCB fluid in the transformers.

c) Total weight (kilograms) of any PCBs in containers, including their identification (liquids, capacitors, etc.)

This inventory, when combined with the Form 02756 received each year will be used by Quality Assurance to determine the net amount of each category at the end of the year.

4.2 Operating/Steam Production Department/Transmission Department

Beginning July 1, 1978, when a PCB capacitor or a PCB transformer is removed from service, all applicable information will be filled out on Form 02756. The first copy of Form 02756 shall be sent to System Voltage and Load Engineer, Voltage and Load Section, Operating Department, Charlotte, North Carolina. The second copy may be discarded or kept. The third copy (card) of Form 02756 shall be attached to the capacitor/transformer and shipped with the capacitor/transformer for disposal. Plastic envelopes available from the Stationary Department as "Transformer Card Pockets" should be used to protect the card copy of Form 02756.

4.3 General Stores Records

General Stores central PCB storage facility shall maintain the following records of each item received.

(1) Origin of item (branch, substation and steam station).
(2) Date placed on transport to General Stores.
(3) Date placed in storage.
(4) Total weight in kilograms of PCB substance(s) with identification of contents such as liquid, soil, waste rags, capacitor or number (quantity) of capacitors.
(5) Date of transfer to the disposal company for burial or incineration.
(6) Name and location of the disposal company receiving PCB items for burial or incineration.

Section V

Spill Reporting and Clean-up

5.0 Introduction

"Spill" means any accidental discharge of PCBs onto or into the land or water.

Loss of dielectric fluid from capacitor units and transformers shall be assumed to be a loss of PCB material unless the fluid can positively be identified by a manufacturer's label or another label as non-PCB. The tanks of all failed capacitor units should be carefully inspected for leaks. Failed capacitors often have bulged tanks but do not always leak. Leaking units shall be immediately removed for disposal and shall be handled according to Section III. A "leak" means any instance in which a PCB item has any PCB chemical substance on any portion of its external surface.

Top priority shall be given to clean-up of any PCB spill. Clean-up action must be immediate regardless of time of day or weather conditions. Quick response and effective clean-up minimizes the impact of the spill to the environment.

Any vehicle or other equipment contaminated by PCB material shall be cleaned up and decontaminated as soon as possible. Any clean-up material, such as rags, absorbent material, or cleaning fluids shall be stored in sealed containers and disposed of according to Sections III and VI.

5.1 Administration

5.1.1 Distribution Equipment

The Superintendent/Supervisor of Operations in the district or independent location (branch) will have direct responsibility for the clean-up operations.

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5.1.2 Generating Plants

The Plant Manager/Superintendent or his designee will be in direct charge of clean-up operations.

5.1.3 Equipment Under the Operating Department

The local supervisor will be in direct charge of clean-up operations.

5.2 Reporting

Any employee discovering a spill shall report the spill to his supervisor who shall report to the General Office in Charlotte, George Swearingen, Manager Environmental Health, telephone (704) 373-4210 during office hours. At other times a report shall be made to the closest dispatching office of the Operating Department for relay to General Office Dispatcher (704) 373-4413. The Spill Report Form (attached) shall be filled out to complete reporting.

5.3 Clean-up of Metal or Pavement

Sufficient Oil Dri shall be applied as soon as possible to the area where dielectric fluid is spilled to absorb all fluid. The Oil Dri shall be removed and stored in properly marked sealed drums as it becomes saturated or after 30 minutes contact time.

Small amounts of fluid may be wiped up with paper toweling or rags and disposed of in an approved container.

After all fluid has been removed, the area should be washed with soapy water and rinsed. The wash and rinse waters should be recovered if possible and disposed of as other wastes that are contaminated.

5.4 Clean-Up of Spillage to Gravel, Soil, Etc.

As soon as possible after a spill, Oil Dri should be applied in sufficient quantity to absorb all fluid that can be leached out of the gravel or soil. The saturated Oil Dri should be placed in properly marked sealed drums for disposal. All contaminated gravel, soil, vegetation, etc. shall be removed and stored in properly marked sealed drums for disposal. Clean replacement soil and/or gravel should be returned to the area of clean-up if it is necessary to restore the area where the spill occurred.

5.5 Clean-Up of Spillage into Water

Most PCB fluids weigh approximately 1.5 times the same volume of water; therefore, PCBs will sink in water. Special actions and assistance will be needed for spills in streams or lakes.

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If the spill occurs in a lake or river, the floating dielectric fluid shall be restricted in movement by an oil boom as soon as possible. Fiber perl or conwed absorbent blanket should be applied to the sheen and when it becomes saturated placed in properly marked sealed drums for proper disposal. This shall be repeated until all visable sheen has been removed.

If PCB dielectric fluid is spilled into a small stream, the stream should be dammed up with an earthen dike downstream from any visible sheen. A submerged outlet (pipe of sufficient size with elbow to handle stream flow) should be installed in the dam if possible to make a water pool so that the PCB dielectric fluid will surface making recovery easier. Conwed blankets and/or fiber perl should be added and recovered when saturated and stored in properly marked sealed drums for disposal. This procedure should be repeated until all sheen has disappeared. The dike should be left in place for a minimum of 24 hours to help allow any suspended PCB fluid to surface for removal and proper disposal.

5.6 Safe Handling of PCB

CAUTION: Care must be exercised to avoid getting the PCB liquid on one's body. Contact with it may cause skin irritation or other problems. Prolonged over-exposure may cause skin lesions, nausea, vomiting, and abdominal pain.

Employees assigned to cleaning up a PCB spill shall take the following personal precautions if it is not possible to avoid contact with the solution or saturated objects:

a) Resistant gloves, boots, overshoes, and bib-type aprons of the neoprene, polyethylene, or florelastomer (viton) type should be used if contact is unavoidable. Porous gloves and other material which might absorb and retain PCB shall not be used. All garments must be regularly inspected for defects and maintained in a clean condition.

b) Chemical-type eye protection or a face shield (8" minimum) shall be worn while handling PCBs. If eyes come in contact with PCB, they shall be irrigated immediately with large quantities of water for 15 minutes. They shall then be examined by a physician.

c) Whenever possible, skin which has come in contact with PCBs should be first washed with waterless soap and wiped with disposable towels. Cleaning materials shall be properly disposed of with other contaminated wastes. This should be followed by washing with warm water and soap, especially before eating, drinking, smoking or using toilet facilities.

d) In case of spillage on the clothing, the clothing should be removed as soon as practical, the skin washed and the clothing properly disposed of in properly marked sealed drums. Employee should immediately wash as outlined in "c)".

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e) Forced ventilation is required for enclosed work areas where PCB's are open to the air. If sufficient forced ventilation is not available, respirators shall be used with available forced ventilation. An acceptable ratio is one part PCB to one billion parts of air.

Medicinal washes or mild detergents followed by the application of cold cream will reduce any irritation resulting from the contact of any open cut or abrasions with PCB.

Crews dispatched to clean up PCB spilled from a power capacitor(s) or a transformer failure should have the following equipment available to them:

1. Neoprene gloves or similar resistant material
2. Shovels
3. Cotton or wool rags
4. Approved cleaning solvent (Penetone, kerosene)
5. Buckets, local purchase - 2.5-5 gallons
6. Safety glasses
7. Waterless soap and disposable towels
8. 55-gallon drums with gasket and sealable top. A minimum of 10 drums will be available at each of the Regional Service Centers (Ex. Charlotte, Greensboro, Greenville) having electric equipment and one or more drums at any location deemed appropriate by local supervisory personnel. Toddville Warehouse will be the coordinating department responsible for maintaining this supply of drums. Distribution and operating zones, districts and local areas will be directly responsible for storing the empty drums. General Stores personnel will be responsible for picking up and delivering the packaged contaminants to the central storage facility at Toddville Warehouse. Under no circumstance will any drums of contaminant be stored in any remote location longer than thirty days. General Stores is responsible for pickup. See the list in Section III for pickup locations.
9. Additional absorbent material should be available in the local operations centers, hydro plants and steam stations if needed.

Section VI

Methods of Disposal by Central Storage Facility

6.0 Introduction

Disposal is defined very broadly to include any action that may be related to the ultimate disposition of a PCB substance, article, or mixture. Incinerators and chemical waste landfills must be approved by the EPA Regional Administrators. PCB mixtures, substances, or articles with contamination of 500 parts per million, (PPM), or more must be disposed of in the following way:

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6.1 Miscellaneous PCB Contaminated Materials

Soil, rags, trash or any other type debris which has become contaminated must be disposed of in an incinerator or, until January 1, 1980, in a chemical waste landfill.

6.2 Transformers

A transformer shall be drained of all free flowing liquid, then filled with a solvent (kerosene, xylene, toluene or any other solvent in which PCBs are readily soluble), allowed to stand for 18 hours and then drained thoroughly. The transformer then can be disposed of in a chemical waste landfill. The solvent mixture must be disposed of in an incinerator.

6.3 Containers Contaminated with PCB's

Containers such as packages, cans, bottles, bags, barrels, drums, tanks or any other device used to contain a PCB chemical substance, but not to include capacitor cans or transformer tanks, shall be drained of any free flowing PCB liquid prior to disposal in a chemical waste landfill. If containers are not drained of free flowing PCB fluid, they must be disposed of in an incinerator.

6.4 Small Capacitors

Small capacitors which contain less than three lbs. of dielectric fluid can be disposed of as municipal solid waste in local landfills.

6.5 Large Capacitors

Large capacitors which contain 3 lbs. or more of PCB dielectric fluid must be disposed of in an incinerator, or until January 1, 1980, in a chemical waste landfill.

Information Needed to Report Spill of Oil and Other Hazardous Material

Date of spill:_____

Time report received:_____

Name of person making report:_____

Phone number where above can be reached:_____

Name of person receiving report:_____

Time spill occurred:_____

Exact location (mailing address; county; name of nearest stream, creek, river, lake, etc.):_____

_____

_____

Estimated volume of oil:_____

Type of oil:_____

How did spill occur?_____

_____

_____

What is presently being done to contain oil:_____

_____

_____

Methods being used to clean up oil?_____

_____

_____

Weather conditions at site:_____

_____

Name of person responsible for clean-up operations?_____

_____

Phone numbers: home_____office_____

Copy of this report and chronological report of events from time of spill until complete clean-up should be sent through your supervisor to George T. Swearingen, Operating Department, General Office, with copy retained for your files.

Exhibit 26

DUK_00030133

1992 Ltr. Regarding Contaminated Waste Mineral Oil

1992 REPORT - HIGH EFFICIENCY BOILER

A total of 203,900 gallons of waste mineral oil were received from off-site at Riverbend Steam Station during 1992, of which 50,900 gallons were non-PCB (less than 50 ppm). A total of 117.62 kg. of PCB were received, and a total of 102.09 kg. of PCB were burned, at Riverbend during 1992.

Exhibit 27

DUK_00000295 - DUK_00000300

(Confidential)

George Swearingen Handwritten Notes to 1970 Presentation for the Proceedings Workshop

PRESENT APPROACHES TO MOSQUITO CONTROL ON DUKE POWER COMPANY IMPOUNDMENTS

Approximately fifty years ago Duke Power Company recognized the importance of pond sanitation and mosquito control on its impoundments and founded a Health and Sanitation Department. We have tried to stay abreast of the changing times and titles and this Department continues today as the Environmental Health Department. The ~~Environmental Health~~ Department is primarily concerned with pond sanitation and mosquito control on our impoundments along with water supplies and waste disposal systems around our construction and plant sites.

(1-) With the breeding of Anopheles quadrimaculatus on the hydroelectric impoundments during the "Malaria Years", control measures were introduced and have continued each year during the mosquito breeding season. This activity has continued to increase for the past fifty years with the development of the Catawba River Basin. The size of our program ~~is still increasing~~ continues to grow with the acquisition of Lake Greenwood in South Carolina, the development of the two reservoirs associated with the Keowee-Toxaway Project Here in Northwestern South Carolina and the rapid progress associated with the Belews Creek Project between Winston-Salem and Greensboro.

(slow slide 2—) At the present time our mosquito control operations consist of ~~we are carrying out~~ survey work and a larviciding program on approximately 2,500 miles of shoreline in North and South Carolina. (2-) ~~Practically all of our mosquito control~~ are

SLIDE 3 goes back of page here

Our survey work ~~is really should be~~ divided into two parts or phases:

1- The original basic survey — here we determine the species of mosquitoes, source location, densities and flight ranges. This is done before we make any significant changes in the terrain. We like to get at least two years background information because we just this makes our information more presentable & valid.

2 - The operational survey — this is a continuing evaluation which is extremely valuable in the day to day operations of the program. This really serves as a comparison tool — week by week & year by year. Biting collections and dipping for larvae are our principal methods employed during our operational survey work. We also use resting stations on occasion (slide 4) but they are difficult to maintain and their location must be carefully chosen. You have to "think like a mosquito" when you pick your site for locating the stations. Also, the resting stations are subject to vandalism. On occasion we also use light-traps.

After careful study of our survey information we decide what type of control effort would be best for this situation. The majority of our control effort on the lakes is accomplished by larviciding crews using boats equipped with power sprayers. We also have several mobile truck mounted units, hand sprayers and occasionally, ~~use of~~ small mist blowers that are frequently used on problem areas that are difficult to reach at regular intermittent treatments. slides 4 thru 9

PAR 1 We are following the recommendations of the two State Medical Entomologists. Our larviciding crews work the same areas if it is at all possible because they are more familiar with the potential problems. The knowledge of submerged stumps ~~slues~~, shoals, rocks, creek runs and shallow areas are very necessary for an efficient operation, in addition to protecting men and equipment. We have daily work sheets for all crews that prevent overlapping and they also furnish us an accurate ~~volume~~ record of the volume of larvicide applied, area covered, time work was done and crew involved. We try to operate on an 8 day cycle, but occasionally we will vary 1 or 2 days from our schedule due to the weather. We are using a mixture of transformer oil (really about 99% mineral oil) and number 2 diesel fuel at the present time as our larvicide. We generally start larviciding operations in early April and continue throughout the breeding season until first frost. go to back of page here for par. on minnows.

We have some 22 cities that draw their raw water supplies from our reservoirs, so we must be very careful what we use in the way of larvicides, insecticides and herbicides. slides 10 & 11 We by-pass these water intakes by approximately ¼ mile depending on wind direction at time of larvicide application. We are not using any of the chlorinated hydrocarbons or stomach poisons on our reservoirs. In fact, we do not use any insecticides on our impoundments at the present time. We do use herbicides to a limited extent following cutting operations on shoreline maintenance. slide 12 If you cut willows and do not poison the stump,

Even though Public Health will will always come first in determining the control efforts practiced by the company, we may someday change our total control program. Much research has been done to discover a biological control agent, no pe[illegible] Studies with algae, protozoa, nematodes, bacteria and rickettsia to infect mosquito larvae as methods of control have been tried. Some species of larvae are predaceous and devour larvae of other species. Attempts at all of these have found that they were not successful on any large scale effort. Many other efforts with plants and various species of birds have not proven successful. In actual practice, mosquito eating fish offer the greatest opportunities in biological control for a non-research program such as ours.

We are in the early stages of raising Gambusia affinis for restocking the shallow protected areas of the lakes as an added measure to insure more complete control in potential mosquito breeding areas. At the present time we have one pond in which we are raising Gambusia and two additional ponds that will be stocked tomorrow. These fish reproduce very rapidly and next spring we believe we will have sufficient quantities to begin our restocking program in the lakes.

you may expect the density of the sprouts to be 10 fold your original problem.

We do a little experimenting in our control efforts with most anything we think will work.

We have a ~~very~~ flat bottom that has silted in for many years in the headwaters of ~~one of our lakes~~ about 30 acres in size. This bottom is only flooded ~~during periods of high water~~ when the lake is at full pond elevations or during periods of high waters from heavy rain. Since most of the deposited soil is topsoil from the surrounding mountains, this bottom supports a very dense growth of weeds, vines and other undesirable plants during the growing season. ~~Last winter~~ TWO YEARS AGO we decided to plant this bottom in bald cypress seedlings at the rate of approximately 600 per acre WITH HOPES THAT THE CYPRESS TREES WILL ~~We hope the trees will lower the water table a few inches and~~ help smother out the underbrush that plagues us today. ALSO, THE TREES SHOULD LOWER THE WATER LEVEL IN THE NATURAL DEPRESSIONS THAT HAVE RESULTED FROM THIS SILTING.

I sincerely believe that the solid waste problem on our properties and properties of others surrounding and in close proximity to our lakes creates a greater mosquito nuisance situation than our lakes have created for many years. ~~I would certainly listen to any suggestions that any of you may have regarding this problem.~~ THE MAGNITUDE OF THIS PROBLEM CONTINUES TO INCREASE BUT WE HOPE TO SEE THIS TREND REVERSED IN THE NEAR FUTURE. FACILITIES MUST BE AVAILABLE AND CONVENIENT TO ALL RESIDENTS IF WE HOPE TO SEE ANY PERMANENT IMPROVEMENT.

Duke Power Company owns some 300,000 acres of land in the watershed areas surrounding its reservoirs. The majority of this land is in improved forests that are managed and controlled by Graduate Foresters. This forest management program not only makes money on the timber operations, but the quality of the water in our reservoirs is greatly improved. The lakes were red a few years ago but today they have a nice blue color.

~~Duke Power Company also has an Environmental Test Section which~~ This watershed program helps our mosquito program because it tends to reduce the quantity of floatage on the lakes following heavy rainfall.

add It will be a few years ETC, ETC.

PAR about SOURCE Reduction on Next page should go here.

PAR

His

Duke Power has a lot of land - a few meets to be improved

monitors our reservoirs on an established frequency for such things as temperature, dissolved oxygen, pH, total Fe, total Mn, turbidity and BOD. I do not want to steal any of Mr. Cornell's thunder, but Duke Power Company is one of the participants in a joint study on thermal effects which the Division of Inland Fisheries of the North Carolina Wildlife Resources Commission are also participating.

Much of our effort on mosquito control at Duke Power Company is put into source reduction if it is at all feasible. If there is a good permanent solution, we prefer this method over continuous temporary operations. We are also aided in our mosquito control efforts by the drawdown on our impoundments, and the heavy boat traffic created by fishermen, and other pleasure seekers. The shoreline development of cottage sites is one of the most permanent and economical means available to inhibit mosquito breeding. In closing I would like to say that world travel being what it is today, we are only a few hours by air from many malarial areas of the world. Returning servicemen from Vietnam and Peace Corps Volunteers may also harbor the malaria parasite. With these potential threats and the ever-present potential threat of the arbor-virus diseases, we see the need for a continuation of an active and intensive mosquito control program by Duke Power Company. Thank you.

Note:

This paper will be presented by George T. Swearingen to a group of State and Federal Officials attending a "Workshop on Mosquito Control in North Carolina" sponsored by N. C. State University, N. C. State Board of Health and The Water Resources Research Institute of the University of North Carolina.

Exhibit 28

DUK_00000289 - DUK_00000294

(Confidential)

Swearingen Draft of Presentation before the 1977 Meeting of the Mid Atlantic Mosquito Control Association

BASIC MOSQUITO CONTROL ON LAKES

I feel that the number one priority of any mosquito control program today and in the future may be compatibility with the environment. We have been challenged and accused many times the last several years of using the wrong insecticides, applying them poorly, and upsetting the ecosystem. Some changes were warranted and I hope the decisions we have made in recent years will prove to have been the correct ones in the years to come. However, my firm belief is the public health and comfort of our citizens should never take a back seat when considering program alternatives.

Public sentiment today is a great challenge to many of our programs, often times disregarding the merit of the challenge. We must strive to stay ahead of our challengers by using the best available technology, carefully applied, with complete follow-up.

These feelings I have shared with you apply to any program, but now I would like to elaborate a little more fully about our program on lakes or impounded waters used for hydro-electric generation and cooling water for steam and nuclear stations.

and if anyone knows of intervenors and instant ecologists the utility industry does.

The newer lake basins on the Duke Power Company system (the ones constructed in the last twenty years) have been completely cleared of all trees and other growth, with one exception and this was a pumped storage facility that was cleared 110 feet below full pond elevation. ← this lake 380' deep However, by the time the water floods the basin we have had considerable weed and scrub brush growth reappear. This may cause some problems around the edges especially if there is floatage of any significance. This floatage should be removed as it collects in piles large enough to warrant the time and labor costs involved. In fact, the largest brood of "Quads" that I have seen in over 10 years of mosquito work on impoundments was in floatage on a new impoundment that was about half filled in the middle of October.

Where we build small impoundments today for emergency cooling water and chemical wastes at our nuclear stations we take a dozer and cut a berm around the edge to create a water depth of at least two feet at the shoreline. The cost of doing this on large impoundments along with the recreational and other uses would not make it feasible. I have seen lakes where little or no clearing was done and they have had problems upon problems since the area was flooded. Our company management ~~feels~~ Feels that complete clearing of basins is money well spent and a real maintenance saving in the long run.

Howie said it "sure as hell" ruins the fishing.

I can not over emphasize the importance of survey work.

After impounding the water you must decide on the type larviciding program you will carry on and this should be based on good survey work. Since the thirties we have used several insecticides including Paris Green, DDT and others. Today we use #2 fuel oil with a spreader. TRITON B-1956 I am not here to suggest or tell you what to use in the way of a larvicide, I am merely saying this is what we have done for many years and it has proven to be successful. and it is approved by the States and EPA. We use boats rigged with power sprayers to apply the larvicide. Our boats are aluminum with semi-V hulls. We use gear pumps with by-pass valves driven by six HP air cooled engines. For years we used pressure nozzles but we had trouble with them stopping up occasionally and have since changed to a plain nozzle which restricts the discharge opening to approximately 3/16 inch. We get adequate pressure with this simple nozzle and good spray distance and considerably less down time. We have several small back-pack mist blowers, various sprayers (hand and power) and some large mist blowers used in our forestry program that are available if we need them. We have done very little adulticiding over the years and I much prefer to get them before they fly.

For several years we have used Gambusia affinis to supplement our larviciding program on several of our lakes.

On one 4,000 acre impoundment we have used Gambusia exclusively for 4 years ~~without a~~ ONLY A COUPLE OF COMPLAINTS However, this impoundment has more boating traffic per surface acre in the spring, summer and fall months than any impoundment on our system. The wave action from this traffic can only be an asset to the control effort.

We also get a great boost from Mother Nature with the waves created from wind action. This greatly restricts the areas that are conducive to mosquito breeding and practically eliminates all large open areas. We are now concerned with the protected coves, small pockets cut off by low water, areas protected by tree growth and pot holes in some of the tributary streams. If low water levels and cold temperatures really play significant parts in mosquito existence and propagation we should see the results this spring, because we have had frost since early October and the lowest overall temp. on record.

Recreational uses on and around impoundments may play a very significant role in the success of a control program. Where the shoreline lots are leased or sold the large majority of the inhabitants, whether they are summer residents or permanent, tend to clean the shoreline and maintain it in an excellent manner.

We continue to have the unconscious and unconcerned people who dispose of their garbage, trash and rubbish

in a manner that does create mosquito breeding sites and destroys the beauty of the countryside. We have a great deal of trouble dealing with these indiscriminate dumpers. Generally, we find more mosquito breeding coming from dumps and other artificial breeding sites around the lakes than we do from the impoundments themselves. We follow up on mosquito complaints as soon as possible after we know of the problem. For more than 10 years I could count the times on my fingers when I investigated a complaint that I did not find mosquitoes breeding on the premises. Some of our most vicious and persistent biters are the flood water species. When you speak of floodwater you definitely can't forget the pot hole breeders.

Every winter we draw our lakes down several feet to help control the spring rains and consequent flooding. This helps our program because it allows us to do some coppice clearing and shoreline maintenance. We do not practice water fluctuation specifically for mosquito control. However, we do have considerable fluctuation on our impoundments because we have 13 hydro stations and 11 dams on the Catawba River alone. At our Keowee-Toxaway Project in the northwestern corner of South Carolina we have our second largest hydro station on the lower lake and a pumped storage generating facility on the upper lake which creates considerable fluctuation on the impoundments daily.

In conclusion, I feel that the ones of us working on impounded waters should start with as clean basins as possible, use proven and safe larvicides, proper surveillance techniques, and have a thorough knowledge of the bodies of water and the land area surrounding them. Very probably, some of my most profitable and trouble preventing allies are ~~my~~ OUR many friends and contacts around our lakes, especially the operators of the old country stores. When they hear of a complaint or problems around the lakes most of them will get word back to us. All of you know that if any action is going on in a community the quickest way to hear it is around the stools and checkerboard.

-00-

THIS PAPER IS TO BE PRESENTED TO THE MIDDLE ATLANTIC MOSQUITO CONTROL ASSOCIATION MEETING AT WILLIAMSBURG, VA. MARCH 2, 1977.

Exhibit 29

DUK_00012433 - DUK_00012436

Sammy Fretwell, "State will test for PCBs in Lake Wateree Fish," The State, Dec. 13, 2009



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ADS BY LOCKED ON

State will test for PCBs in Lake Wateree fish

Federal data show elevated toxin levels

By SAMMY FRETWELL - sfretwell@thestate.com

State biologists will begin testing fish at Lake Wateree next year for PCBs, a suspected cancer-causing pollutant that federal data show has tainted predator species in the popular reservoir.

Wateree was one of the 17 percent of lakes tested nationally in which fish registered PCB levels above a federal health safety standard this decade, according to data released last month by the U.S. Environmental Protection Agency.

The S.C. Department of Health and Environmental Control - charged with warning the public if fish are unsafe to eat - says it wants to know more about PCBs in the lake 30 miles northeast of Columbia.

"Testing will give us better information," DHEC spokesman Thom Berry said. "Once we do that, it will give us more data in which to make some conclusions."

The federal data were collected eight years ago for a baseline report assessing chemicals in fish at 500 lakes across the nation. DHEC apparently has not checked Lake Wateree's fish for PCBs routinely since the 2001 federal tests.

Officials with the state agency said in a Dec. 4 e-mail to The State that they had gathered some data in the 1990s on PCBs. But the e-mail said they did not think the levels were enough to warn the public about eating Lake Wateree's fish. The agency had no "available" data since 2001, the e-mail said.

Berry could not say last week if the agency would issue advisories against eating some types of fish at Lake Wateree. The lake now has no advisories telling people to limit fish consumption. He said DHEC had not tested in some cases because of "a resource issue," but the department has recently hired a laboratory worker to do that.

THE DANGER

PCBs, short for polychlorinated biphenyls, are manufactured chemicals once used extensively by industry as coolants and lubricants.

They can settle into waterways through air or water pollution and, over time, build up in fish. Production of PCBs was banned in the United States during the late 1970s as evidence mounted that they were dangerous to people's health. Scientists have found PCBs to cause liver cancer in laboratory animals, and the EPA has classified PCBs as a probable human carcinogen. The chemicals also can cause developmental problems in children, including a decrease in short-term memory, and impair children's immune systems.

Lake Wateree is the second major reservoir in the Midlands found by the EPA to have elevated levels of a contaminant in fish tested, according data used to compile the Nov. 10 baseline study.

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At Lake Murray, largemouth bass showed elevated amounts of the toxic metal mercury, according to the data. DHEC testing since 2000 verified elevated mercury contamination in 40 percent of the bass tested at Lake Murray, although the agency said the pollution levels weren't consistent enough to warrant health warnings.

The EPA's national study found some level of mercury or PCBs in fish from every body of water tested across the country. In addition to Lake Wateree, Lake Hartwell in Anderson County also fell within the 17 percent of lakes with PCB levels in game fish above the health standard of 12 parts per billion. Another 49 percent of the lakes contained mercury levels in game fish that were above a federal health standard, including Lake Murray.

State officials for years have warned of high PCB levels in Lake Hartwell. But people familiar with Lakes Murray and Wateree were surprised that fish there also showed elevated contaminant levels.

"I don't think PCBs were on anyone's radar," Catawba Riverkeeper David Merryman said.

PCB levels in largemouth bass at Lake Wateree registered 80.223 parts per billion, more than six times the health safety standard used by the EPA in its November report.

The testing was done on largemouth bass and carp; EPA officials caution that the sampling was limited.

Still, the findings could spur action at the state level, according to the EPA.

"The results can only indicate where a state may consider doing additional monitoring to determine whether or not issuing a fish advisory is appropriate," EPA spokeswoman Enesta Jones said in a Dec. 3 e-mail to The State newspaper.

A POTENTIAL BLOW

The findings at lakes Wateree and Murray are a potential blow to recreation and tourism at both of the popular waterways.

Like Lake Murray northwest of Columbia, Wateree is filled with weekend boaters, anglers and swimmers during the summer. Thousands of people also live or own weekend homes along its 242-mile shoreline, which touches Kershaw, Fairfield and Lancaster counties.

The 13,000-acre lake is one in a string of man-made reservoirs along the Catawba River from north of Charlotte to near Camden. It was built in 1920, initially to provide hydro-electric power for Duke Energy customers. Lake Wateree drains into the Wateree River, which flows past the newest, easternmost section of Congaree National Park. The Wateree then joins the Congaree River to form the Santee River above lakes Marion and Moultrie.

Merryman, the riverkeeper for the Catawba River watershed, said the EPA's recent report shocked him.

"In this report, Wateree has some really high readings; they are quite drastic," Merryman said. "DHEC needs to get in there and find out what these concentrations are. If those levels the EPA found are true, we need fish advisories."

Merryman said DHEC should have been checking fish before now to ensure public safety.

"This is DHEC being non-aggressive and kind of overlooking an issue they really should be tackling," Merryman said.

Dick Foote, chairman of a Lake Wateree citizens committee that monitors water quality, would also like to know more.

"What does it mean overall? And what does it mean in the long term?" he asked. "I'm a little concerned when we jump to conclusions."

Merryman noted that Wateree was one of three lakes on the Catawba River chain with high PCB levels in fish tested for the 2009 EPA report. Lakes Norman and Mountain Island in North Carolina were the others, he said.

North Carolina hopes to test those lakes for PCBs, said Douglas Campbell, branch chief of the Tarheel State's occupational and environmental epidemiology division.

Merryman suggested that Lake Wateree may be suffering PCB contamination in fish because it sits at the bottom of the Catawba River chain. Charlotte is the largest city in the region, and the surrounding metropolitan area continues to develop, even in tough economic times.

Berry said he didn't know why PCBs would have shown up in Lake Wateree's fish. But some reports have indicated the toxic chemical was dumped into the lake during the 1940s as part

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of an effort to kill mosquitoes, The State reported in 1997.

In 1997, DHEC investigated reports of PCB-laden transformer oil being put into the lake, but Berry could not say whether the agency concluded the dumping had occurred.

Officials with the N.C. Division of Water Quality suggested the EPA report contained errors on the levels of PCBs found in lake fish there. Some of the laboratory samples may have been contaminated, the agency's Susan Massengale said in an e-mail Friday to The State.

Denise Keehner, an EPA official familiar with the study, said federal scientists verified the data before publishing the report.

"We had extensive quality assurance and quality control," she said.

Reach Fretwell at (803) 771-8537.

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Comments: 8 Showing: Newest first

Beset wrote on 12/13/2009 11:46:55 AM: +

And to spread the criticism around a bit, when will South Carolina's environmental and conservation groups drag some of their attention from Greenland's ice cap and the SC Statehouse's activities and start to pay at least some attention to the fights over environment "in the trenches," in permitting and monitoring and enforcement decisions or indecisions, in the agency actions and inactions. It is there that so much is lost. There it is typically DHEC and money/influence in the balance of the decision equation, with no counterbalance.

DHEC would do better if it had some active oversight to keep it on its toes and on the right path and some active support in hard decisions where that is deserved.

Recommend (1) Report abuse

Beset wrote on 12/13/2009 11:33:46 AM: +

"I will rely on EPA and DHEC to find out what it is." I will rely on EPA.

"a poorly managed organization" You might also look a little closer at DHEC.

South Carolina needs a better run environmental agency. Why is seemingly no one interested in fixing that agency, or to make my comment more charitable, improving that agency? People want to move it, others want to deify it as is, and no one talks about improving it internally.

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bertha wrote on 12/13/2009 10:49:08 AM: My, what a lovely NEW set of clothes the state "newspaper" has made for the emperor today. And all his faithfull servants tagging right along..Tsk, Tsk. PCB's were banned by Congress in 1976. So, where is this coming from? Mosquito control in the 1940's? Really? If they haven't been elevated in past tissue samples - why there? why now? I'm sure there is some logical explanation and I will rely on EPA and DHEC to find out what it is. Not on this rag, nor a bunch of social miscreants willing to be scared by a poorly managed organization with a political agenda like the state. Shame on you Sammie, for scaring people like this.

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JohnHartz wrote on 12/13/2009 10:32:28 AM: "Treat the earth well: it was not given to you by your parents, it was loaned to you by your children. We do not inherit the Earth from our Ancestors, we borrow it from our Children."

Ancient Native American Proverb

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Beset wrote on 12/13/2009 09:12:18 AM: =

Yeah, what Runargorum says!

I have been moderate and I hope constructive in my various past criticisms of DHEC and

yet even so the DHEC shill and apologist JustTheFacts has lambasted me for daring to pose that a single thing can be amiss in that heavenly court of an agency, in his view. Runargorum seems instead to suggest that the devil's own handiwork can be seen at DHEC and perhaps I should defer to his experience-based judgment here. Poor JustTheFacts may just have apoplexy.

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Runargorun wrote on 12/13/2009 08:33:06 AM: Hey Sage, how can you be surprised at anything DHEC does NOT do? I've tussled with them for over 20 years and a lousier group of liars and crooks will be hard to find. DHEC is not a regulatory agency, it's a publicly funded service to help environmental criminals cover their tracks and to rubberstamp the efforts of developers, manufacturers and the politically connected to skirt the intent of laws so they can do what they want. With what little energy DHEC has left over they try to cover their own tracks, explain away their negligence, justify their environmentally abusive decisions and stonewall the people trying to fight for environmental justice. Some state agency. Paid for my many, catering to a few, frerquently on the wrong side of the law but in the pockets of the powerful.

Recommend (5) Report abuse



sage_of_the_lakelands wrote on 12/13/2009 08:09:38 AM: As huge as DHEC's budget is, and they haven't even tested before now??? I just assumed that the monitoring is an ongoing effort! Nevermind. I'm not surprised. I know too much about the state of this state.

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Exhibit 30

James Glover Deposition Excerpts

Q. And the reason you did that is because you -- was that because you didn't have fish data?

A. There were no data outside of Coughlan. And because of high detection limits, it wouldn't be expected to find what we're finding in all the other reservoirs.

Q. Okay. Now, are you aware -- let me ask. You know, looking at this map, do you know -- well, let me rephrase. Is it your understanding that Duke Power carried out mosquito control activities at all of these reservoirs?

A. It's what's reported in the literature.

Q. Which literature is that?

A. If you look at our manuscript, it's Gage 1925. It's in our literature cited. And Clark 1931, not cited in there, although I may have put it in my disclosure, is a news article from 1937. Gage 1925 was -- Gage worked for the U.S. Public Health Service and in the bulletin of U.S. Public Health Service he wrote he did a study of reservoirs that were being treated for mosquito control and Mountain Island reservoir was highlighted. He wrote -- he had a whole section about just Mountain Island reservoir. He did an Anopheles mosquito survey. They looked at -- they talked of the Gambusia fish that were

going to be released into the reservoir. He said that the operation, which I assume was Duke Power, hired a medical staff that its sole purpose was to control Anopheles mosquitoes.

In Clark '31, that was published in the Southern Medical Journal. Again, it's cited in our paper. There Clark did an overview of mosquito control on High Rock reservoir. But at the back, there was three medical -- at least three medical doctors. One from Chicago, one from Alabama, and Dr. Boldridge, which you had listed here in one of your -- in one of the documents, who worked for Duke Power, and he wrote quite a bit about doing mosquito control programs on the reservoirs. In it he said that they were conducting mosquito control on 30 of their -- of their reservoirs, including eight major reservoirs. I'm not sure what the 30 entailed. It might have been small ponds that were located on their property. The eight reservoirs, this is before Lake Norman was constructed, undoubtedly was their major reservoir, including Mountain Island Reservoir and Lake -- Fishing Creek Reservoir. And so at least in 1931, they were treating -- in fact, Dr. Boldridge wrote in that Clark 1931 that it would be criminal for a power plant not to be conducting mosquito

control. This is in the days of malaria. So -- and then in the '37 news article, they were highlighting mosquito control in Lake Wateree where they were spraying oils. And in that same vein, they mentioned that Duke Power was spraying all the reservoirs. All 30. They mentioned 30, again, reservoirs. They were conducting this oiling of all 30 reservoirs. This was '37. Dr. Swearingen said that they were doing -- conducting mosquito control on all the reservoirs in the Howells '71. I don't know -- I guess this is internal documents that Butler had that I didn't where they were occurring and where they weren't. Maybe it was public and I missed it. But clearly there was mosquito control going on on all these reservoirs. As Dr. Boldridge, it would be criminal not to. There was lawsuits. He mentions lawsuits. Hundreds of thousands of dollars -- millions of dollars of lawsuits because people think they have malaria.

At some point, perhaps these dropped out of the rotation. I don't know if it was in the '70s, the '80s, the '90s. I have no idea. But they were going on in the '30s and malaria was still a thing in the '40s. I think they probably were still treating them in the '40 and probably '50s and '60s because we

finished?

A. Yes, I'm done.

Q. Now, with regard to the 2021 article you published with Dr. Gundersen, you considered other sources of PCBs?

A. We did.

Q. And you considered urban runoff from the City of Charlotte as a potential source of PCBs to downstream reservoirs?

A. That was our conclusions.

Q. Can you say that again? I'm sorry.

A. That was our findings. That's based on our spatial analysis and the patterns of PCBs. We considered that there was other sources particularly in the Catawba River, the Fishing Creek Reservoir, and Sugar Creek. Especially Catawba River where mosquito control was not likely to have ever occurred.

Q. Okay. All right. Let's look at page -- the next page with the map in your report. So page 5 of your report.

A. This?

Q. Yes, sir. So the first sentence on this page says, "Speculation on a potential source of contamination of the reservoirs in the Catawba chain

include recent reports of an illicit discharge into the Mecklenburg Wastewater Treatment Plant and the discovery of PCBs in sewage sludge used in land application within the watershed."

A. Yes.

Q. What do you mean by -- I guess I'm trying to understand the word "speculation" there. What do you mean by that?

A. That's what scientists do. We speculate on potential other sources. A hypothesis. You could use whatever word you want. I think it's pretty self-explanatory.

Q. Okay. So I guess what I'm -- what you're saying, then, is that it is possible that the illicit discharge from the Mecklenburg Wastewater Treatment Plant or PCBs in sewage sludge may have contributed PCBs to the reservoirs in the Catawba chain? Is that what you're saying?

MS. FICKLING: Objection to form.

THE WITNESS: No, no. In fact, we summarized -- first of all, in our manuscript itself, it would have been inappropriate to list all these speculations and more that Dr. Butler didn't even include, including illicit waste discharge that happened in one county in North Carolina outside

these basins where lots of PCBs were legally disposed of in the middle of the night by a trucking company. That would be speculation. There's no evidence of that or any of these other things that could contribute.

So we -- we had a subheading under other potential sources of past industrial pollution and we felt like we captured all these things in that. Why I don't think that it was the sewer sludge is because the land application, which was not -- was -- didn't become part of a waste disposal process until the '80s and '90s and we're seeing the same patterns in the 1970s that we're seeing today in Catawba River reservoirs.

So it would be impossible for the sludge to have contaminated these waterways in the 1970s because it didn't exist. As far as the illicit discharge into the Mallard Creek Wastewater Plant, the assumption would have to be that this had been an ongoing thing since the '70s because of the patterns within it and that it could have -- theoretically, it could have contributed to it, but also it would be impossible for either of those things to contaminate Lake Wylie and Mountain Island reservoir and Lake Norman because they're upriver from those. So I

think those sources are unlikely for those reasons.

The reason these things were caught, the sludge, was because we have environmental regulations. We have -- we had monitoring reports. They have to monitor for the sludge and it comes through our compliance and enforcement section at DHEC, and that is what -- that was the discovery was. And so you would also have to assume that the sludge was undetected up until that point. Not in the -- well, it didn't exist in the '70s, but even when it was applied.

The other reason I don't think it was the sewage sludge, despite, is there's regulations on these land applications. There's repairing buffers that prevent them from getting -- they're high in the watershed. The assumption that they would come all the way down these tributaries and produce this widespread contamination of all these reservoirs is very unlikely. Where I've seen large amounts of PCBs, it's a direct input like Lake Hartwell and Langley and Burlington. And it makes more sense to us -- our evidence suggests that the widespread contamination is a direct application of transformer oils on the surface of the waters and not some runoff from some contaminated soil that exist high in the

watershed.

But it was worth mentioning and it's not inappropriate to -- to think of all these sources and more, but you need evidence of it.

BY MR. NYFFELER:

Q. Sure. Let's look at your article, GL-2. I'm on page 87. Okay. Under the heading for "Spatial Analysis" in the right column, you see that?

A. Uh-huh.

Q. The first sentence says, "Testing for differences of PCBs for point data was not possible due to small sample sizes at many locations." You see that?

A. Yes.

Q. What do you mean by "point data"?

A. If you look at -- in our manuscript at Figure 2, these are specific locations where fish were collected within these -- so they're points. They're -- they're -- so there's, I think, four sampling locations in Lake Wateree. I apologize for the small print, but you can see the levels of PCBs if you go about halfway down. Lake Wateree -- I see DHEC data, Lake Wateree. I see EPA data, Lake Wateree. I see DHEC data, Lake Wateree.

So there's four different points. Each

Exhibit 31
DUK_00012445 - DUK_00012446
(Confidential)
2009.12.15 – Email - PCBs in Lake Wateree Fish

From: Thompson, Andy <Andy.Thompson@duke-energy.com>
Sent: Tuesday, December 15, 2009 11:01 PM
To: Jester, Steve; Walls, Jason A
Subject: RE: PCBs in Lake Wateree Fish - FW: See highlighted Section

Thanks, Steve. This EPA survey has been floating around for about two months. The first issue was mercury. We have good data on Mt. Island and Norman on mercury because we sample fish and look for the heavy metals we release into the lakes under our NPDES permits (mercury is very low). However, we do not test for PCBs since our operations do not release this chemical into the environment.

This is the first that I have heard about DHEC looking into a complaint that DE had dumped chemicals. Interesting.

From: Jester, Steve
Sent: Tuesday, December 15, 2009 4:50 PM
To: Thompson, Andy; Walls, Jason A
Subject: FW: PCBs in Lake Wateree Fish - FW: See highlighted Section

I am sharing the notes below just FYI

From: Manuel, Ken
Sent: Tuesday, December 15, 2009 3:26 PM
To: Galleher, George A; Johnson, Steven R; Barwick, Hugh
Cc: Bowen, Tommy W; Carriker, Joseph W; Hall, Joe S; Jester, Steve; Jolley, Scott; Lineberger, Jeff; Sinclair, Travis L; Sugg, Steadman
Subject: PCBs in Lake Wateree Fish - FW: See highlighted Section

Thanks George for the heads-up. This question also arose in the late 1990s because of a citizen report to DHEC that in the 1940s (probably war years) the Duke mosquito control program disposed of drums of "chemicals" in Lake Wateree. I believe DHEC may have conducted some type of sonar search of the Beaver Creek arm of Wateree but their investigation found no evidence to support the allegation. Beaver Creek on Wateree has been the location of the mosquito control program since it began in 1923.

From discussions with former mosquito control management only No. 2 diesel fuel, paris green (an arsenic based pesticide power used in malaria control in the 40s) and some used motor oil (during the war years) had been used for mosquito larval control up to the time the program began using modern mosquito control larvicides in the 1980s, such as Bti. To my knowledge PCB transformer oil was never used probably because it has never been considered a standard mosquito control method, and that it cost more than low cost ubiquitously available diesel fuel.

From: Galleher, George A
Sent: Monday, December 14, 2009 10:08 AM
To: Johnson, Steven R; Barwick, Hugh; Manuel, Ken
Subject: FW: See highlighted Section

Anyone seen or have the report. Ken, note reference to PCB's in oil used for mosquito control in the 40's.

George A. Galleher, PE
Duke Energy

Hydro Fleet Operations and Compliance
Office Phone 704-382-5236
email address: george.galleher@duke-energy.com

From: Johnson, Steven R
Sent: Monday, December 14, 2009 9:53 AM
To: Barwick, Hugh; Galleher, George A; Oakley, Mark
Subject: See highlighted Section

Lake Norman and Mt. Island will soon receive scrutiny. They implicate transformer oil from old Mosquito days. Apparently all concerns from an EPA study published this year.

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Exhibit 32

DUK_00012099 - DUK_00012102

(Confidential)

2010.08.25 – Email – Toxic Chemicals in Popular S.C. Lake

From: Barwick, Hugh <Hugh.Barwick@duke-energy.com>
Sent: Wednesday, August 25, 2010 3:39 PM
To: Bruce, Ed; Fragapane, Phil; Huff, Jennifer R; Johnson, Steven R; Lineberger, Jeff; Oakley, Mark; Styer, Tami C
Subject: FW: Toxic chemicals in popular S.C. lake
Attachments: ATT00001..c

FYI.

From: Manuel, Ken
Sent: Wednesday, August 25, 2010 10:37 AM
To: Jester, Steve
Cc: Coughlan, David J; Harrell, Duane; Barwick, Hugh; Vaughan, Gene E; Bowen, Tommy W
Subject: Fw: Toxic chemicals in popular S.C. lake

Steve at the bottom of the news article is mention of PCBs used in mosquito control. Over the years I've reviewed old company mosquito control documents and there is nothing to indicate PCBs were ever used nor has DDT, which had been suggested by some. Boldridge did however collect and apply used motor oil during WWII to continue mosquito control operations. Logic would indicate PCBs as a strategic war material would never have been available in large enough quanities to say nothing about the cost.

Ken

From: Coughlan, David J
To: Manuel, Ken; Bowen, Tommy W; Harrell, Duane; Vaughan, Gene E; Barwick, Hugh
Sent: Wed Aug 25 10:10:05 2010
Subject: FW: Toxic chemicals in popular S.C. lake

Please forward as you feel appropriate. Fifth paragraph from the bottom is noteworthy.

Dave

From: Tracy, Bryn [mailto:bryn.tracy@ncdenr.gov]
Sent: Wednesday, August 25, 2010 9:53 AM
To: Coughlan, David J
Subject: FW: Toxic chemicals in popular S.C. lake

You probably read this --

Bryn H. Tracy
Sr. Environmental Specialist
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From: Massengale, Susan [mailto:susan.massengale@ncdenr.gov]
Sent: Wednesday, August 25, 2010 9:14 AM
To: denr.dwq.clips@lists.ncmail.net
Subject: Toxic chemicals in popular S.C. lake

From The State (South Carolina)

Toxic chemicals in popular S.C. lake

By Sammy Fretwell
sfretwell@thestate.com
Posted: Wednesday, Aug. 25, 2010

Some of Lake Wateree's most popular game fish are polluted with a cancer-causing material that has made them unsafe to eat in more than moderate amounts.

The state Department of Health and Environmental Control has issued a health advisory for striped bass, blue catfish and largemouth bass after finding PCBs in those species at Lake Wateree. The advisory tells people to limit consumption of those fish.

DHEC's warning makes Lake Wateree only the second lake in South Carolina — and the first in the Midlands — to carry a fish consumption advisory for PCBs, which have persisted in the environment decades after production of the toxic industrial material stopped.

PCBs, or polychlorinated biphenyls, are considered probable human carcinogens and have been linked to liver cancer in rats. People can be exposed by consuming food and water containing PCBs, as well as breathing airborne particles of the toxic material. Industrial spills into water and air can send the material into rivers and lakes.

DHEC issued the fish advisory for PCBs this past spring on its website but has not yet posted warning signs at boat landings and other areas along the lake where people fish.

Agency spokesman Adam Myrick said DHEC is working with the Department of Corrections to produce the signs. He could not predict when they would be posted, but he said there should be about eight signs.

"We have identified the boat landings where they will go up,'' he said.

State data showing the level of PCBs in each fish species were not available Tuesday.

Lake Wateree, about 30 minutes north of Columbia, is one of the most popular recreational lakes in the state, attracting anglers and boaters alike.

But the lake is among 17 percent of the country's reservoirs with elevated PCB levels in fish, a 2009 federal study said.

Last fall, a U.S. Environmental Protection Agency report found PCBs in Lake Wateree's largemouth bass at nearly six times a public health safety standard. The report also noted elevated mercury levels in some Lake Murray fish.

After the EPA report came out last fall, DHEC tested Lake Wateree's fish for PCBs for the first time in years. Results of the testing prompted DHEC to issue the advisories, which have not been reported widely in the media. Myrick said his agency continues to investigate the PCB problem at Lake Wateree.

David Merryman, the riverkeeper for the Catawba River basin, said he's glad DHEC tested Lake Wateree's fish. The lake is the southernmost in the Catawba River basin and just above the Wateree River.

"People are eating and consuming these fish, and they need to know what's in them,'' Merryman said. "We need to know there is a problem and move forward. We have to recognize that this is a chronic pollutant.''

According to DHEC, people should not eat more than one meal per month of blue catfish or striped bass. People also should not eat more than one meal per week of largemouth bass, the agency says. Each advisory is based on a meal of about eight ounces of fish.

There are no restrictions on black crappie, another popular fish, according to the health and environmental agency.

PCBs that wash into rivers and lakes build up in the fat or tissue of some longer-lived fish species. While the water itself remains relatively free of the pollutants, the contamination settles to the bottom of lakes and binds to soils. It can slowly accumulate in fish that suck in microscopic amounts of the pollutant over time. Unlike with mercury in fish, DHEC says, some threats from PCBs can be reduced if people carefully cut the fatty tissue away from fish they catch.

Manufactured decades ago as coolants, lubricants and fire retardants, PCBs are made up of some 209 compounds and were once relied upon extensively by industry.

Among other things, they were used as insulating fluids in electrical transformers and as fluids in vacuum pumps and compressors, according to the EPA. PCBs haven't been produced since the late 1970s because of evidence that they build up in the environment and pose health risks. They get into lakes and rivers through both air and water pollution.

DHEC's finding of PCB contamination in fish at Lake Wateree reflects a broader concern in the Catawba River basin, which extends from north of Charlotte to near Congaree National Park southeast of Columbia. Sprawling Charlotte often is cited as a reason for contamination in the river system south of there.

Earlier this year, Merryman's Catawba Riverkeeper organization found PCBs at Mountain Island Lake, a North Carolina reservoir also on the Catawba River chain.

Dan Tufford, a USC water quality researcher familiar with Lake Wateree, said he suspects industrial pollution has contributed to the PCB findings in fish.

"There is a lot of industry upriver from Lake Wateree,'' said Tufford, who tracks water quality issues at the lake. "The potential for this kind of contamination has always been there.''

Lake Wateree also has had questions about PCBs before. Sometime in the 1940s, workers for a power company used PCBs in an attempt to kill mosquitoes on the lake, former employees have said.

Dick Foote, who heads a citizens' committee studying water quality at Lake Wateree, said it could be difficult to rid the popular reservoir of PCBs in fish.

"I don't know that there's anything you can do about it,'' he said. "You could dredge the entire lake, which you might as well say is impossible, or you could cover it all with something. That also is practically impossible. I think it's just a fact of life.''

Foote said the key is for people to know about the fish consumption advisories at Lake Wateree. He noted that the advisories do not prohibit eating certain fish, only to be careful about the amount eaten.

"It's like lots of things — lots of things you do in moderation,'' he said. "Just be aware of what you can do and what you can't do.''

Read more: http://www.thestate.com/2010/08/25/1432008/toxic-chemical-prompts-warnings.html#ixzz0xcMCCBO9

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DENR- Division of Water Quality
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Exhibit 33
DUK_00023136 - DUK_00023137
(Confidential)
2011 Duke Energy PCB Talking Points

PCBs and Mercury in the Carolinas
Talking Points
July 20, 2011
For Internal Use Only

PCBs

PCBs are synthetic chemicals (polychlorinated biphenyls) that were manufactured from 1929 to 1977 and found in electrical equipment, such as voltage regulators and switches and used to cool electrical capacitors and transformers. The manufacture of PCBs was banned in 1979.

- PCBs have entered the environment through both wide past industrial use and disposal. The environmental transport of PCBs is complex and nearly global in scale. Despite active research spanning five decades, extensive regulatory actions, and an effective ban on their production since the 1970s, PCBs still persist in the environment.
- PCBs commonly were used as a flame retardant in electrical equipment, such as transformers, before their manufacture was banned in 1979.
- Duke Energy systematically phased out large-volume transformers containing PCBs. We have a comprehensive program that continues today to eliminate smaller transformers containing PCBs when we encounter them in the field.
- We have an aggressive process for responding to oil spills to ensure any oil containing old PCBs is remediated quickly and disposed of properly. This protects surface and ground waters from contact with PCBs.
- PCBs are not found in coal or coal combustion byproducts and therefore would not be a concern in water leaving ash basins. Duke Energy does not monitor for PCBs since it has never generated or manufactured PCBs, as they are not associated with power plant operations.

Mercury

Mercury is a naturally occurring element found in the soil and water. Mercury also is found in coal and is released from the combustion process. In terms of quantity, mercury is among the smallest of the Hazardous Air Pollutants (HAPS) that come from coal combustion.

Mercury is a global issue. About one-third of the mercury emitted into the air from industrial sources in the U.S. comes from power plants. Globally, U.S. power plants are responsible for about 2 percent of the total industrial mercury, or less than 1 percent of the mercury emitted from all sources (including natural emissions). For most of the U.S., more than 60 percent of the mercury measured at monitoring stations, and thus deposited on land or water, originates outside the country (EPRI.)

- Duke Energy's large base-load coal stations utilize emission controls that remove 70 to 90 percent of the mercury before it can leave the stack.
- Our smaller fossil-fired units do not have emission controls that capture mercury, primarily because we operate them only during peak periods and will be retiring these units in the near future. Because of their size and limited operation, those units account for very few mercury emissions.
- In 2009, Duke Energy Carolinas coal-fired generation emitted less than 1 ton of mercury to air and water.
- In 2010, Duke Energy Carolinas coal-fired generation emitted just over one ton of mercury to air, water and land:
    - Air: 454 lbs (785 in 2009)
    - Water: 0 lbs (110 in 2009)
    - Land: 2193 lbs (785 in 2009)
    - Generation was up in 2010; however Allen's new FGD reduced air emissions. The beneficial reuse demand was reduced, so land storage on-site in ash basins and dry landfills increased.

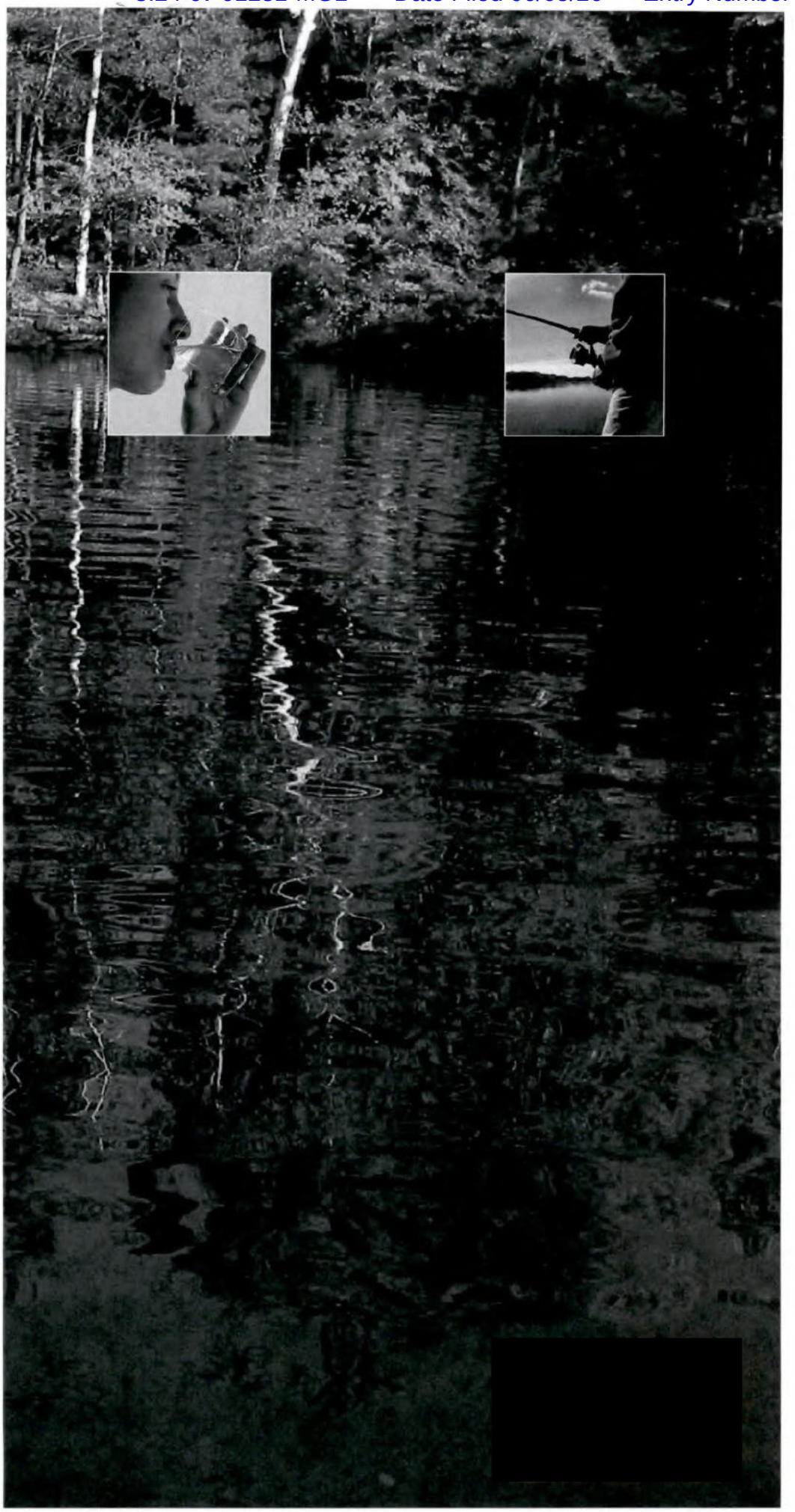
- Duke Energy monitors mercury levels coming from ash basins.
    - At scrubbed plants, we monitor at least quarterly and typically see extremely low mercury levels of less than 10 parts per trillion leaving ash basins since scrubber wastewater is highly treated first. This is below the state water quality standards of 12 parts per trillion, even before attenuation (mixing).
    - At unscrubbed plants, we see mercury at undetectable levels and therefore do not have limits for it in our wastewater permits because the levels are so low. (Background: The detection limit required for the unscrubbed plants is higher, meaning the instrument we use for analysis is not required to be as precise. Mercury is monitored every five years in conjunction with the renewal of our wastewater permits.)

Fish Studies

- Our fish studies for trace metals on Lake Norman, Mountain Island Lake and other lakes in our system demonstrate that mercury levels in fish are well below state levels of concern.
- Duke Energy has tested for mercury in Mountain Island Lake fish since 1991. Sunfish, largemouth bass and common carp are sampled annually, and we continue to find mercury in very low concentrations, well below state standards for any type of advisory.

Exhibit 34

2006 Relicensure Pamphlet



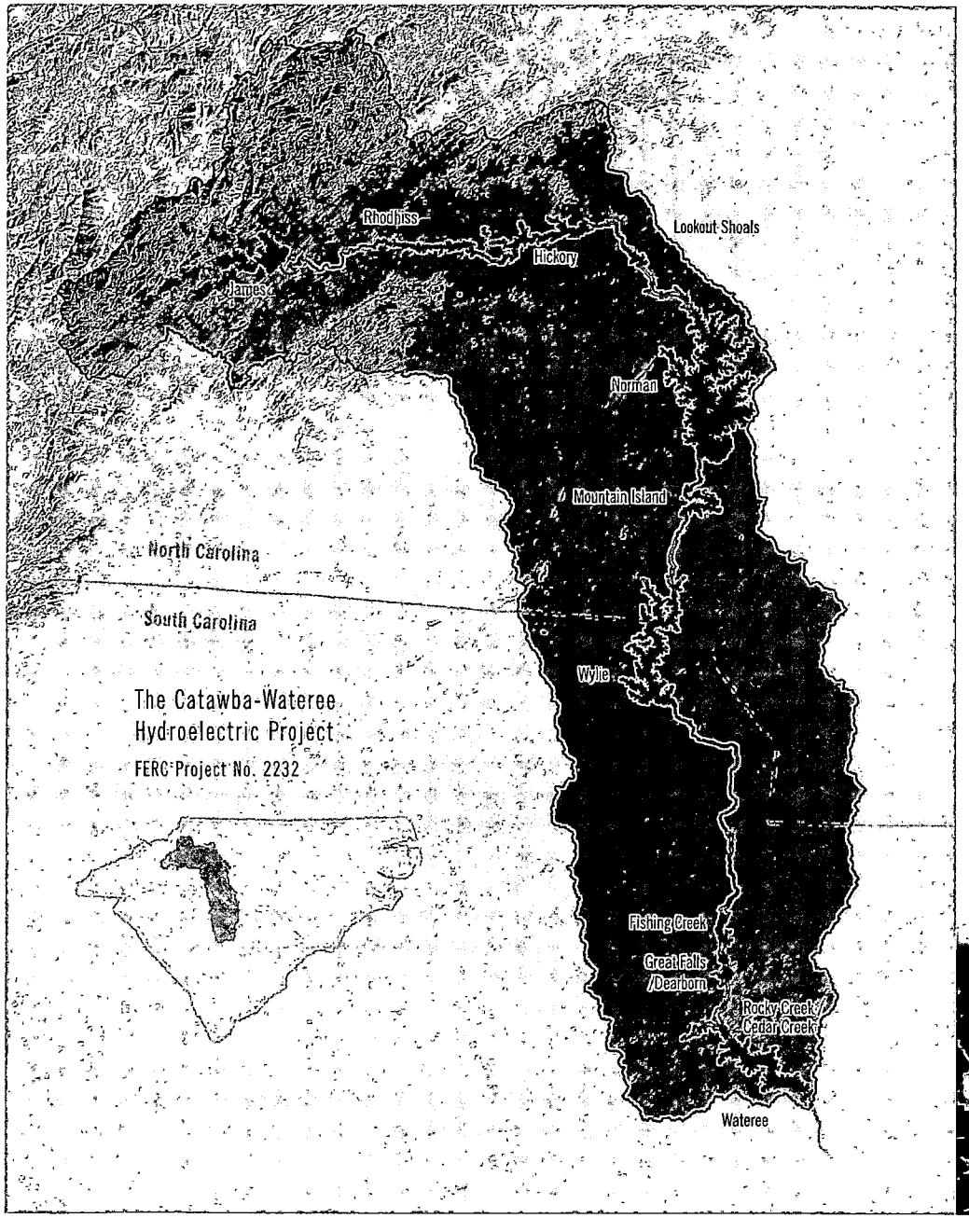


A Partnership with the
Catawba-Wateree River

Highlights of the Comprehensive Relicensing Agreement for the Catawba-Wateree Hydroelectric Project

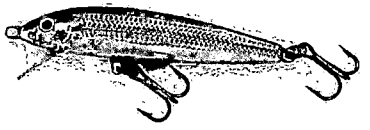
December 2006

DUKE ENERGY®



A Partnership with the Catawba-Wateree River

We depend on the River; it depends on us.



The Catawba-Wateree River community depends on the river, as it has for millennia since Paleoindian bands traveled its banks. Historically, through significant evolutions in how we use the river, our reliance on it continued. Today, as increased needs threaten to strain its capabilities, it is time to renew our partnership with the Catawba-Wateree River so now it can depend on us. Through an unprecedented three-year relicensing process convened by Duke Energy, the community worked to identify the needs for the river today and 50 years into the future and completed a Comprehensive Relicensing Agreement that establishes that new partnership.



River use in the 1700s and 1800s evolved from fishing and transportation to harnessing the river's power with water wheels that operated grist mills and saw mills. The first cotton mill south of the Potomac River was powered by the Catawba in Lincoln County. Water-powered cotton mills burgeoned in the late 1800s creating mill towns and a booming textile economy. 1904 heralded another evolutionary development in the use of the river when the old Catawba Hydro Station (now Wylie Hydro) electrified the Victoria Cotton Mill near Fort Mill, SC. After 1904, Duke built 10 more dams on the river, which collectively became the Catawba-Wateree Hydro Project (Project). The last dam formed Lake Norman in 1963.

The latest evolutionary step took shape in the second half of the 1900s when the region's surging population placed greater demands on the lakes and river for water and electricity, which is now supplied mostly by coal-fired and nuclear power plants on the lakes. Moreover, while livelihoods from the river were diminished, the region came to value the lakes for recreation and aesthetics; which drove shoreline development.



Duke Energy elected to involve stakeholders in developing proposed terms of its new license for the Project. What emerged was a new invigorated partnership going beyond relicensing – a partnership that will serve both the region and the river for generations.

"Anglers and paddlers, biologists and business people; homeowners and industry participants, environmental agencies and developers; city and civic professionals, citizens and others have sacrificed their time and shared their expertise to develop sustainable plans for the river for the next generation. We are extremely grateful to these dedicated individuals for their contributions that will allow our children and grandchildren to benefit from this wonderful natural resource."

Ellen Ruff, *president of Duke Energy Carolinas*



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Building the Partnership

"Alone we can do so little; together we can do so much." - Helen Keller

Stakeholder Teams included federal, state and local governments, tribes, resource agencies, special interest groups, homeowner groups, recreationists, industry, Duke Energy and individuals representing interests in the environment, economic development, fish and wildlife, water quality, cultural resources, land conservation, regional planning, lake level and shoreline management, public water supply, electricity supply and recreation.

More than 30 studies addressed fish and other aquatic species, hydro plant operations, water supply demands for the next 50 years; cultural resources and how to better protect them; water-related recreation needs; improvements in managing lake shorelines; terrestrial wildlife and wetlands, water quality improvements, and land conservation.

To strengthen and continue its partnership with the community, Duke Energy committed to work with stakeholders in a basin-wide collaborative process to obtain its new operating license for the Project from the Federal Energy Regulatory Commission (FERC). The goal was to strike a balance among the Project's power generation uses while benefitting fish and wildlife and providing other beneficial public uses such as water supply and recreation.

The overarching purpose of the stakeholder process was to develop the best-adapted balance of uses and recommend it to the FERC. It was an intensive and rewarding process that spanned three years. It began in 2003 when Duke Energy convened six stakeholder teams with 160 representatives from more than 80 organizations. Working first to evaluate both the needs of the river and the community, the teams identified nearly 2,100 interests in the Project.



Between 2003 and 2006, stakeholders reviewed more than 30 studies to better understand how the Project affects these interests and then participated in hundreds of collaborative meetings to consider alternatives and, in the end, found a balance that best satisfies the needs.

The result: on August 12, 2006, the partnership was established when 70 parties signed the Comprehensive Relicensing Agreement.

"This may be the single most significant community planning event that has occurred in this river basin, and the results are going to have a very positive impact on the river and communities along the river for decades to come."

Jeff Lineberger, Duke Energy's Hydro Licensing Manager

History of the Catawba-Wateree River

Paleo Indian Period 12,000 - 10,000 B.P.	Archaic Period 10,000 - 2,000 B.P.	Woodland Period 5,000 - 500 B.P.	Mississippian Period 950 - 500 B.P.
Small bands of Paleon-Indians occupied transient camps along smaller, upland streams.	Residential camps are made in the bottomland along the tributary streams of rivers; a preference for living along the major waterways develops; groups moved to access food resources.	Residential camps were located in the navigable areas of the river.	Large village sites were located on floodplains; the villages were also located on terraces and levees of major drainages.
River primarily used for food	River primarily used for food	River primarily used for food	Developed agriculture and farmsteads

Use of River's Resources

Relicensing Timeline

2002 and before

- Conducted public outreach for stakeholder process input

2003

- Filed First Stage Consultation Document (February)
- Hosted eight public consultation meetings (March)
- Received scoping comments and 568 study requests
- Convened NC and SC Relicensing Teams (June)
- Filed Notice of Intent to Relicense with the FERC (July)
- Convened four Regional Advisory Groups (August)
- Developed study plans

2004

- Completed first-year field studies
- Signed joint teams' charter (February)
- Compiled and discussed 225 composite stakeholder interests in the river
- Established Resource Committees addressing Water Quality, Hydro Operations, Terrestrial Resources, Cultural Resources, Aquatic Resources, and Recreation and Shoreline Management.
- Issued the first Draft Agreement-in-Principle (October)
- Convened Land Ad Hoc Committee



2005

- Completed second-year field studies
- Discussed 12 successive drafts of the Agreement-in-Principle
- Completed and reviewed results from more than 30 studies
- Convened the Recreation, and Operations Ad Hoc Committees

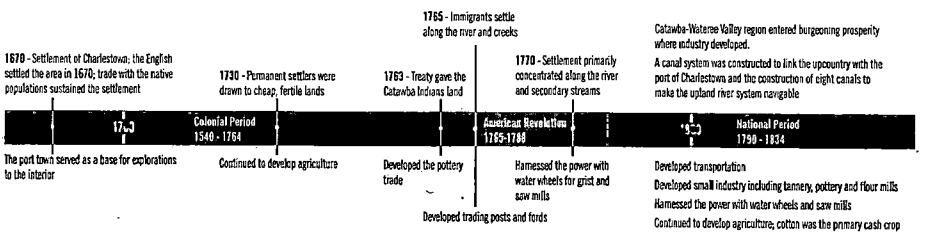


2006

- Completed Draft License Application for public review (January)
- Secured 97 stakeholder signatures agreeing in consensus with the Agreement-in-Principle (April)
- Held Joint Agency Meeting (May)
- Developed first draft of the Comprehensive Relicensing Agreement (CRA)
- Discussed four successive drafts of the CRA
- 70 Parties signed Comprehensive Relicensing Agreement (August 12)
- Duke filed License Application with the FERC including signed CRA and Explanatory Statement (August 29)
- Implemented the updated Shoreline Management Plan (September)
- Convened the Final Agreement Committee (September)
- Organized the Water Management Group Convening Committee

2007 and beyond

- Implementation of CRA
- Issuance of New License by FERC



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Ongoing Partnership Management

Like the resource it seeks to protect, wildlife conservation must be dynamic changing as conditions change, seeking always to become more effective.

Author, Rachel Carson

While the FERC will ensure compliance with its license, there are a number of provisions to manage the CRA. Some are described below.

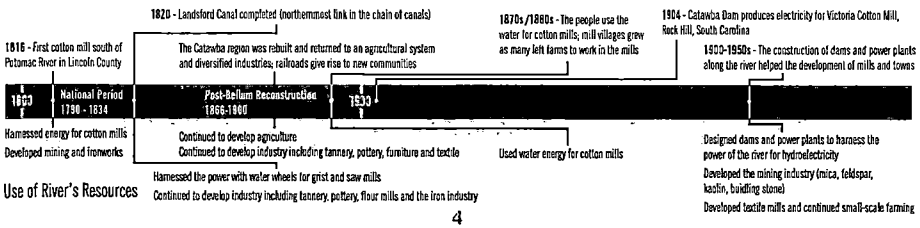
- The **Final Agreement Committee** will meet at least annually to ensure clear communication among the parties, assist in the effective implementation of the CRA, and make recommendations for any needed modifications.



- The **Water Management Group** will identify, fund and manage projects to help preserve, extend and enhance the basin's capabilities to provide water for public water supply, power production, industry and agriculture in concert with maintaining the ecological integrity of the waterway.
- The **Drought Management Advisory Group** will work with Duke to monitor and manage a coordinated basin-wide response to droughts and low-inflow conditions.
- **State and federal agencies and tribes** will be consulted for any needed revisions to the procedures established in the Maintenance and Emergency Protocol or in the Species Protection Plans.
- A **Recreation Flow Schedule Planning Group** will meet each year to schedule discretionary recreation flows and recommend any improvements to the recreational flow release schedules.
- **Stakeholder recreation workgroups** will convene at seven and 14 years into the new license to recommend adjustments to the Recreation Management Plan. A recreation workgroup will be convened at 20 years to help coordinate the complete reassessment of future recreation uses and needs of the Project.
- **Shoreline Management Plan (SMP)** workgroups will convene in the first year of the new license to discuss implementation of the SMP classification mapping and the Shoreline Management Guidelines (SMG) permitting criteria. Duke will consult with this workgroup to establish an SMG effectiveness baseline, which will then be tested every 10 years.

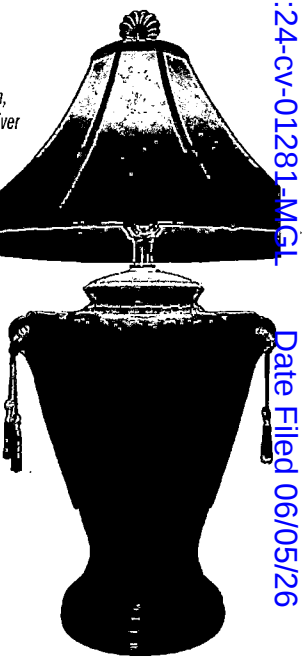


History of the Catawba-Wateree River



Widespread Benefits for the Region and the River

The Partnership will benefit more than 1.3 million people who depend on the river for energy production, drinking water, industrial uses, cultural resources and recreational amenities. The Catawba-Wateree River will sustain a healthy ecosystem of natural resources to attract people and businesses to the region.



New and Improved Recreation Facilities.
New and enhanced public access areas will create more opportunities for canoeing, kayaking, fishing, swimming, camping and picnicking. Approximately 45 new access areas will be added and approximately 28 will be expanded. Fishing piers will be added at 14 sites, swimming areas at 14 sites and restrooms at 29 sites. Nine courtesy docks will be constructed and portage trails will be added or improved at eight sites. Canoe/Kayak launches will be added at 19 sites. Picnicking will be added or improved at 27 sites and parking areas will be added, expanded or improved at 56 sites.



New Opportunities for River-Based Recreation.
Pre-scheduled water releases for recreation will create additional canoeing and kayaking opportunities in the river sections of the Project below Lakes James, Hickory, Wylie and Wateree. Pre-scheduled white water recreation will be available in both the Great Falls bypassed reaches.

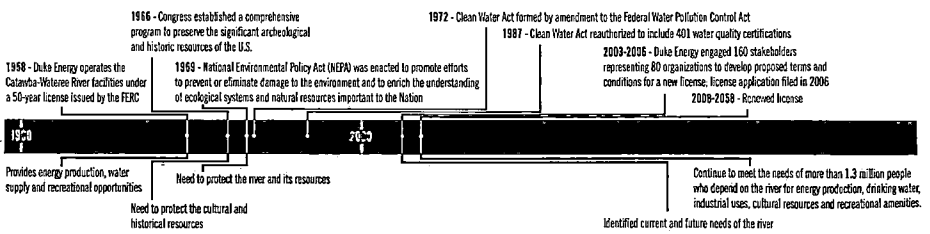
More Land Available for Recreation and Conservation.
More than 2,500 acres owned by Crescent Resources (a division of Duke Energy) will be dedicated for public recreation and conservation. State and local governments will be offered more than 3,400 acres of additional recreational land at discounted prices. Depending on the license term, Duke Energy will also make $9.3 million to $12.3 million available to state agencies to purchase additional land for recreation and conservation within the river basin.

New Lake Level Ranges.
Lake level ranges (minimum, target and maximum) have been established to protect drinking water, industrial and power generation water intakes, fisheries and recreation and property owner interests.

More Information Available on the Lakes and River.
Reservoir levels (historical and near term), water release times, generation schedules and maps to public access areas will be made available.



Improved Safety Awareness.
Signs in English, Spanish and international symbols will provide additional safety information.



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The Numbers.

- 80 organizations represented
- 160 Stakeholder Team Members
- 2,100 interests identified
- 225 composite interests addressed
- 2 State Relicensing Teams
- 4 Regional Advisory Groups
- 7 Resource Committees
- 30+ studies conducted
- 184,000 hours in the field on studies
- 315 stakeholder team meetings
- 58,000 hours in meetings
- 1.3 million people to benefit
- One river to benefit

Improved Coordination with Local and State Governments.
A Memorandum of Understanding (MOU) template has been developed for Duke Energy and governmental entities that oversee lands abutting the Project Boundaries to better coordinate (a) data sharing; (b) enforcement of buffer regulations; (c) permitting reviews; and (d) local government plans or authority related to those abutting lands. The MOU discussions began in September 2006.

Increased Aquatic Species Habitat.
Higher flow releases will substantially increase aquatic habitat above exisitng conditions and will return consistent water flows to some parts of the river for the first time in more than 80 years. Increased minimum continuous flows will be released 24 hours a day into the riverine reaches below Lakes James, Hickory, Lookout Shoals, Wylie and Wateree. Minimum continuous flows will be re-instituted into the bypassed reaches below the Catawba Dam at Lake James, and into the Great Falls Short and Long Bypassed Reaches.



Enhanced Habitat and Species Protection.
Species protection plans for monitoring, management and protection of federal and state listed species including Rocky Shoals spiderlily, Schweinitz's sunflower, dwarf-flowered heartleaf, bald eagle, shortnose sturgeon and mussels will be developed. Duke Energy will contribute $1 million to each of the two state habitat enhancement funds established during relicensing to support, protect and enhance fish and wildlife habitat.



Enhanced Water Quality.
New equipment will be installed to enhance the quality of water released from hydroelectric plants. In these flow releases, improvements in dissolved oxygen will meet state water quality requirements and enhance fish habitat. At Lake James, a new aerating flow valve will be installed at Catawba Dam and aerating capabilities will be added to Linville Dam. New aerating hydro units will be installed at Rhodhiss, Oxford, Wylie, Fishing Creek and Wateree. Aerating flow valves will be installed at Oxford. Equipment will be modified to improve dissolved oxygen at Lookout Shoals and the Great Falls Diversion Dam and Headworks.

Coordinated Basin-wide Water Management.
A new protocol has been developed to establish a basin-wide approach to reduce water use during droughts. These reductions apply to hydroelectric generation, water flows for recreation and public water system withdrawals. The goal is to stretch the available water supply during drought conditions until rain restores reservoir water storage, stream flow and groundwater to normal levels. Duke Energy and the public water system owners are also establishing a Water Management Group to jointly fund long-term initiatives that will improve water quantity and quality management across the Catawba-Wateree River Basin.

Improved Shoreline Management and Protection.
The Shoreline Management Plan has been updated to allow private and public access with protecting the environmental, public recreational, cultural and scenic values. Use of the updates began in September 2006. Overall, the updates have resulted in more refined shoreline mapping and additional restrictions on construction activity within the Project boundaries of the reservoirs.

Widespread Benefits (continued)

Enhanced Cultural Resources Management.
A New Historic Properties Management Plan establishes a comprehensive program to preserve the significant archaeological and historic resources potentially affected by the Project. The Plan includes retaining the outward historic features of the Project hydroelectric structures and managing historic properties. Other cultural resource enhancements include creating a new public interpretive site at the historic Dearborn Armory at Great Falls, SC and contributions and signage for improvements to significant segments of the Overmountain Victory National Historic Trail.



Flood Management Improvement at Lake Wateree.
If the New License is issued for a term of 50 years, Duke Energy has agreed to assist with flood management at Lake Wateree by installing a bladder dam to increase the regulated flow capacity by approximately 50 percent.

Conservation Easements.
One-hundred-foot wide conservation easements will be established on approximately 29 miles of land adjoining the Johns River, Catawba River and Linville River in North Carolina and 5.5 miles on the Catawba River in South Carolina.

Major Renewable Energy Source.
The Catawba-Wateree Hydroelectric Project will continue to provide a clean, renewable and efficient energy source to the Carolinas producing enough electricity each year to supply approximately 108,000 average-sized homes.



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Partners with the River

The Comprehensive Relicensing Agreement



Alexander County, NC

American Whitewater

Area II Soil & Water Conservation Districts (NC)

Bowater Incorporated

Burke County, NC

Caldwell County, NC

Carolina Canoe Club

Catawba County, NC

Catawba Indian Nation

Catawba Indian Nation Tribal Historic Preservation Office

Catawba Lands Conservancy

Catawba Regional Council of Governments

Catawba Valley Heritage Alliance

Catawba-Wateree Relicensing Coalition

Centralina Council of Governments

Chester Metropolitan District (SC)

City of Belmont, NC

City of Camden, SC

City of Charlotte, NC

City of Gastonia, NC

City of Hickory, NC

City of Morganton, NC

City of Mount Holly, NC

City of Rock Hill, SC

Crescent Resources, LLC

Duke Energy Corporation

Duke Power Company LLC

Foothills Conservancy

Gaston County, NC

Great Falls Hometown Association

Harbortowne Marina

International Paper

Iredell County, NC

Kershaw County, SC

Kershaw County Conservation District (SC)

Lake James Homeowners

Lake Wateree Association

Lake Wylie Marine Commission

Lancaster County Water & Sewer District (SC)

Lincoln County, NC

Lugoff-Elgin Water Authority (SC)

McDowell County, NC

Mecklenburg County, NC

Mountain Island Lake Association

Mountain Island Lake Marine Commission

North Carolina Department of Environment and Natural Resources with its Divisions of Forest Resources, Parks and Recreation, Water Quality, and Water Resources

North Carolina Wildlife Federation

North Carolina Wildlife Resources Commission

R & N Marina

South Carolina Department of Archives and History

South Carolina Department of Natural Resources

South Carolina Department of Parks, Recreation and Tourism

South Carolina Electric & Gas

South Carolina Wildlife Federation

Springs Global US, Inc.

Town of Davidson, NC

Town of Great Falls, SC

Town of Valdese, NC

Trout Unlimited, Inc.

Union County, NC

Wateree Homeowners Association (Fairfield County)

Western Piedmont Council of Governments

York County, SC

York County Culture & Heritage Commission

William B. Cash

Shirley M. Greene

Frank J. Hawkins

Timothy D. Mead

Merlin F. Perry

Joseph W. Zdenek

Stakeholder process was facilitated by Kearns & West, Inc.

Environmental and engineering studies were conducted by Devine Tarbell and Associates.







CONTACT

For more information and updates and other relicensing news, contact Duke Energy at **www.duke-energy.com**.

DUKE ENERGY®

Exhibit 35

DUK_00004371

(Confidential)

2015.05.04 - Duke Energy Statement to Homeowners – Safe and Government Approved Larvicide

May 04, 2015

CONTACT:

Office: 704/382-8350
24 Hour: 704/382-8333

DUKE ENERGY OPENS IT'S NINETY THIRD MOSQUITO SEASON

CHARLOTTE – This week, Duke Energy is celebrating the 93th anniversary of its mosquito control program, the oldest continuous environmental program of any utility in the U. S and one of the first in North America.

"Duke Energy's mosquito control program started in 1923, shortly after the company impounded the first three of 11 reservoirs on the Catawba River," said Steve Jester, VP of Water Strategy, Hydro Licensing and Lake Services. "This important program actually began the foundation for the strong philosophy of environmental stewardship that sustains Duke Energy's multifaceted environmental programs today."

When malaria was a prevalent health risk in the Southeast, Duke Energy's founder, James Buchanan Duke, commissioned Frank Moon Boldridge, a former World War I army doctor and malaria expert, to create and oversee the program. Dr. Boldridge continued his post with Duke Power for 43 years. More than two dozen diseases are now known to be transmitted by mosquitoes to humans and domestic animals.

Today, the program continues at five-of Duke Energy's largest impoundments. These lakes include lakes James, Norman, Wylie and Wateree on the Catawba River and Lake Keowee on the upper Savanna River.

Duke Energy crews travel along 1,700 miles of reservoir shoreline, a distance that would stretch from Maine to Key West, Florida, every 10 days, looking for and spraying mosquito breeding habitats. Duke Energy's treatment season is from May through October each year.

Program employees also report floating hazards to navigation, invasive weed species, and keep the lakes clean of debris that could form potential mosquito breeding habitats. In 2014, the mosquito control crews removed more than 50,000 pounds of mosquito breeding debris from the lakes.

Duke Energy's program uses a safe and government approved larvicide that attacks only mosquito larvae. For helpful homeowner mosquito control information contact your county environmental health specialists located at your county health department and or visit the following internet websites:

Exhibit 36

JONES_001167 - JONES_001169

Public Statement about Safe and Government Approved Larvicide

Duke Energy mosquito control program in its 90th year

May 22, 2013

Share This Story

CHARLOTTE, N.C. - Duke Energy has begun the 90th year of its reservoir mosquito control program.

Conducted annually since 1923, this public health program was started by company founder James B. Duke. It provides mosquito control along the shoreline of five of the company's largest urbanized reservoirs, including lakes James, Norman, Wylie, Wateree and Keowee.

The program, which operates from May through the end of October, is the oldest continuous environmental program of any utility in the U. S and one of the first in North America.

Two-person boat crews seek out specific mosquito breeding habitats along the 1,700 miles of Duke Energy's reservoir shoreline and apply a safe and government-approved larvicide that attacks only mosquito larvae.

Mosquitoes are not just annoying. They can spread disease, including West Nile Virus.

North Carolina and South Carolina have more than 60 mosquito species, many of which have adapted to live near homes. Removing or managing the water in which they breed is an effective way to reduce the mosquito population.

Shoreline homeowners are encouraged to inspect their property and empty or discard unwanted containers that may hold water for long periods. Standing water can produce a brood of hungry mosquitoes within six to eight days during the summer.

Use these tips to reduce mosquito habitat at your home:

- Empty any clogged rain gutters, flower pot saucers, yard/deck furniture, toys or other items holding water.
- Fill tree holes with builders' sand.
- Clean bird baths regularly.
- Empty beached boats with clogged drains or sagging boat covers.
- Encourage neighbors to inspect and drain standing water on their property.

- When working or playing outdoors, use mosquito repellent containing no more than 20 percent DEET.

Homeowners living away from Duke Energy reservoirs should contact their local county health department for assistance with mosquito concerns, such as blocked and flooded roadside ditches, abandoned swimming pools, debris piles and low-lying areas that may collect and allow water to stand.

For helpful homeowner mosquito control information contact your county environmental health specialists located at your county health department and or visit the following websites:

In North Carolina:www.ces.ncsu.edu/depts/ent/notes/Urban/mosquito.htm

In South Carolina:www.scdhec.gov/environment/envhealth/pests/mosquitoes.htm

About Duke Energy Carolinas

Duke Energy is the largest electric power holding company in the United States with more than $110 billion in total assets. Its regulated utility operations serve approximately 7.2 million electric customers located in six states in the Southeast and Midwest. Its commercial power and international business segments own and operate diverse power generation assets in North America and Latin America, including a growing portfolio of renewable energy assets in the United States.

Headquartered in Charlotte, N.C., Duke Energy is a Fortune 250 company traded on the New York Stock Exchange under the symbol DUK. More information about the company is available at: www.duke-energy.com.

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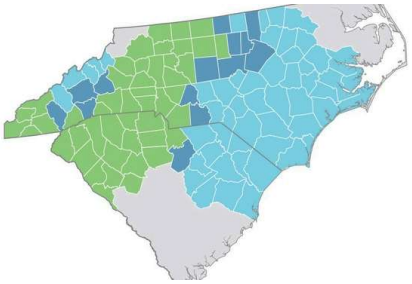


Duke Energy supports local conservation efforts with $550,000 in funding for North Carolina environmental impact programs



Duke Energy seeks to extend operations for another 50 years at Bad Creek, supporting unprecedented growth in the Carolinas

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North Carolina

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Exhibit 37

DUK_0002434

Duke Talking Points – Safe and Government Approved Larvicide

It's mosquito-breeding time. Are you doing all you can to prevent the pests?

It's almost mosquito time, and although malaria is no longer the threat it was 85 years ago, today many mosquito-transmitted diseases such as West Nile Virus continue to be a concern for lake shoreline residents and visitors alike.

Duke Energy's two-man boat crews travel along 1,500 miles of reservoir shoreline, a distance that would stretch from Maine to Key West, Florida, every 10 days, looking for and spraying mosquito breeding habitats during the mosquito treatment season from May 1 through Oct. 31 each year.

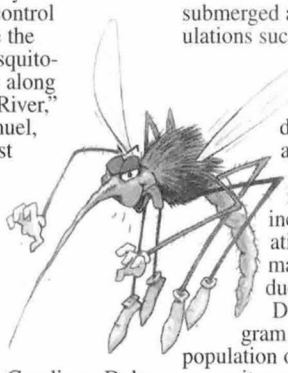
"The company's commitment to mosquito control helps manage the spread of mosquito-borne disease along the Catawba River," said Ken Manuel, senior scientist with Duke.

Working in close coordination with public health and natural resource agencies in both Carolinas, Duke Energy's mosquito control program uses a safe and government - approved larvicide that attacks and kills only mosquito larvae. In addition, the teams also identify, tie up and expedite removal of floating hazards to navigation such as logs and old discarded piers and help keep the lakes clean of debris that could form mosquito breeding habitats. In 2007, the mosquito control crews removed more than 58,000 pounds of mosquito breeding debris containers from the lakes.

Crews also look for exotic invasive aquatic plants on their routes. Their early detection of submerged aquatic weed populations such as hydrilla has helped to protect reservoir drinking water availability, reduce mosquito breeding habitat, increase lake recreation potential and maintain power production operations.

Duke Energy's program helps reduce the population of lake-breeding mosquitoes but residents must also take a part to have an impact on container-breeding mosquitoes living in residential backyards. Mosquitoes can breed in discarded tires, buckets, tin cans, yard toys, clogged gutters, flower pots, stumps and tree holes, according to the information from Duke Energy.

"A simple mud puddle caused by a leaking faucet can provide a breeding area for hundreds of mosquitoes. This program has proven very effective at controlling species of lake-breeding mosquitoes" but Duke reminds us all not to be backyard breeders.



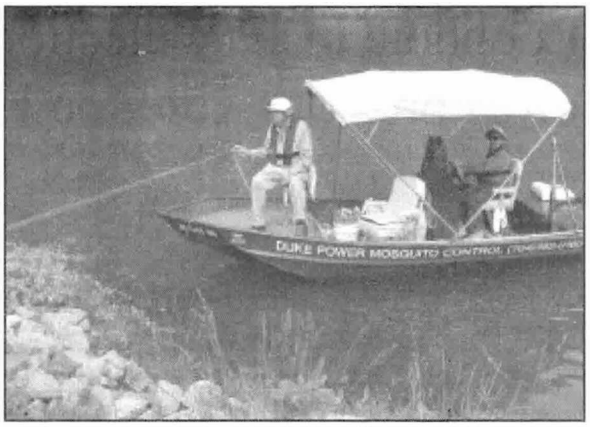


Photo courtesy of Duke Energy

Duke's mosquito control team at work

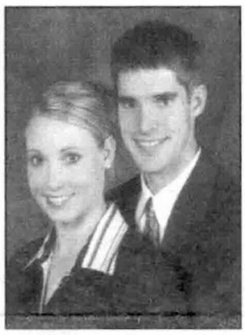
Eliminate or routinely empty:

- ❒ Areas that retain pools of water
- ❒ Scrap tires
- ❒ Uncovered boats
- ❒ Rain gutters
- ❒ Flower pot saucers or planters that hold water
- ❒ Discarded jugs or other open containers
- ❒ Tree holes (fill with builder's sand)

Around Your Home

- ❒ Empty and change the water in birdbaths, pet watering dishes and fountains at least once a week.
- ❒ Cover rain barrels with tight fitting lids or mosquito screening
- ❒ Stock landscape catchment basins, ornamental ponds or water gardens with fish
- ❒ Keep grass around ponds and stream banks trimmed to eliminate adult mosquito resting places
- ❒ Make sure swimming pools remain treated.

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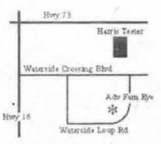
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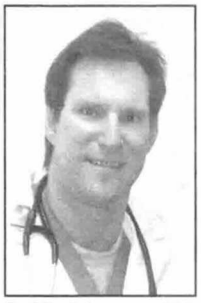
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Exhibit 38
DUK_0004409
(Confidential)
85th Anniversary Talking Points

EXECUTIVE BRIEFING
FOR ELLEN RUFF

DATE: Monday, April 28, 2008

ACTIVITY: 85th Anniversary Celebration – Reservoir Mosquito Control Program

WHERE: The Charles Mack Citizens Center
215 North Main Street, Mooresville, NC 28115
Mosquito boat on display.

WHEN: 10 a.m. – 2 p.m. (includes travel time)
Celebration Luncheon -- 11 a.m. – 1 p.m. (Informal luncheon with brief remarks)

WHO: Hydro Licensing and Lake Services
Mosquito Control Team
External guests:
Nolan Newton, Chief, NC DENR-Public Health Pest Management;
L.A. Williams, Director of DHEC's Division of General Sanitation;
Robert Collins, Vice Pres. NC Mosquito and Vector Control Association;
Nathan Helzer, Pres. SC Mosquito Control Association;
Tammy Brewer, Past President Mid-Atlantic Mosquito Control Assoc;
Dennis Salmen, Manager, Mecklenburg Co. Mosquito Control Assoc;
Carlton Layne, Vice Pres. Aquatic Plant Management Society

Select media including *Charlotte Observer* (Lake Norman bureau), *Lake Wylie Pilot, Lake Norman Times, Morganton News Herald invited*

TRANSPORTATION
Steve Jester, Ellen Ruff and Marilyn Lineberger will ride together.

10 a.m. – 11 a.m.	Travel to The Charles Mack Citizens Center in Mooresville	Pick up at back entrance to Energy Center (Mint Street)
11 a.m. – 12 p.m.	- Welcome and Introduction – Steve Jester - Invocation – Mike Bailey, Pastor Mt. Zion UMC-Cornelius, NC - Lunch	The Charles Mack Citizens Center
12 p.m. – 12:30 p.m.	- Remarks - Ellen Ruff – Duke Energy - Ken Manuel – brief slide show with history of program - (Nolan Newton – NC, L. A. Williams – SC) - Close – Steve Jester	The Charles Mack Citizens Center
12:30 p.m. – 1 p.m.	Photos and interviews with any media present.	Ellen, Steve, Ken (I'm checking to see if the company

Exhibit 39
DUK_00014122 - DUK_00014123
(Confidential)
Duke Response to PCB Consumption Advisories

Talking Point Regarding EPA

- The EPA survey of chemical residues in lake fish tissue was released in November, 2009. The study is a statistically-based fish tissue survey during the period of 2000-2003 and included 500 lakes in the lower 48 states. This type of study does not show long-term trends that are needed to determine what issues may be occurring in a lake or their possible causes. Its purpose was to screen many lakes and identify those in need of further study.

- The survey looked at a wide range of trace element and organic contaminants in fish. Current emphasis is primarily on mercury and PCB contamination in fish, though declining trends in once dangerous contaminants (e.g., DDT and its breakdown products) were largely ignored. Three Duke Energy lakes were included in the study: Lake Norman, Mt. Island Lake and Lake Wateree.

- Duke Energy conducts annual surveys of trace metals in Mt. Island fish as a requirement of the Riverbend National Pollution Discharge Elimination System (NPDES) permit. Our studies monitoring mercury since 1991 show that mercury occurs in very low concentrations in Mt. Island fish, well below state standards for any type of advisory.

- Regular monitoring of fish populations occurs near the Marshall Steam Station and McGuire Nuclear Station on Lake Norman. Fish populations near each station are typical for a Piedmont North Carolina reservoir and indicate no long-term adverse environmental impacts. A recent Duke Energy study of mercury in largemouth bass near the Marshall Steam Station also showed low levels below values of regulatory concern.

- Duke Energy does not sample for PCBs in its fish tissue monitoring studies. However, a fish health assessment of the entire Catawba River was conducted in 1993 and Duke did look at PCB's as part of a wide ranging suite of chemical contaminants. Our data found PCBs below detectable limits based on our study methodology and indicated no areas of gross PCB contamination. We also found that mercury was not an issue in Catawba River largemouth bass populations.

- In our fish tissue analysis program, we look for waste stream trace metals permitted for release by our NPDES permit. PCBs are not released into the environment through our normal plant operations and are not part of our NPDES permit. We do not perform fish tissue analysis on Lake Wateree since we do not have a fossil or nuclear station located on that lake.

- PCBs were banned in the late 1970s. However, PCBs are very widespread and have been in the environment for many years. We would expect to see some small level of PCB contamination due to this fact. In fact, the EPA study indicated that PCB's were found in all fish samples from across the United States. PCBs are long-lived in the environment and degrade slowly..

Exhibit 40

DUK_00014157

(Confidential)

2009.12.17 Email Re: EPA Fish Contamination Report

From: Franklin, Penny C <Penny.Franklin@duke-energy.com>
Sent: Thursday, December 17, 2009 1:56 PM
To: Thompson, Andy A; Oakley, Mark; Walls, Jason A
Cc: Lineberger, Jeff; Coughlan, David J
Subject: RE: New Clips on BurrellesLuce 2.0 Portal

I just spoke with Dave Mitchell and we'll have input before COB today.

From: Thompson, Andy
Sent: Thursday, December 17, 2009 8:53 AM
To: Oakley, Mark; Walls, Jason A
Cc: Lineberger, Jeff; Franklin, Penny C; Coughlan, David J
Subject: RE: New Clips on BurrellesLuce 2.0 Portal

I have talking points with Penny right now and she is running getting input from EHS. Once it is approved, I will send it to you.

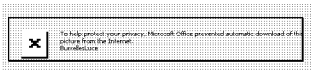
Andy

From: Oakley, Mark
Sent: Thursday, December 17, 2009 8:45 AM
To: Thompson, Andy; Walls, Jason A
Cc: Lineberger, Jeff; Franklin, Penny C; Coughlan, David J
Subject: FW: New Clips on BurrellesLuce 2.0 Portal

Andy and Jason;
Please see the two articles below related to the EPA fish contamination report. This thing is picking up steam in the media in both SC and NC and the Riverkeeper (of all people) is emerging as the expert. We need to mash the gas as much as possible to get our Q&A document out (pls refer to my HST meeting summary e-mail sent yesterday). I'd really like to use it to get a note out to C-W CRA Parties and WMG members before COB tomorrow.
Thanks.

From: Burwell, Jennifer C
Sent: Thursday, December 17, 2009 6:05 AM
To: Duke Energy Lake Services; Duke Energy Hydro Licensing
Subject: FW: New Clips on BurrellesLuce 2.0 Portal

From: BurrellesLuce [MConnect-Email@burrellesluce.com]
Sent: Thursday, December 17, 2009 3:39 AM
To: Burwell, Jennifer C
Subject: New Clips on BurrellesLuce 2.0 Portal



3 New Articles
3 Print

Wednesday
December 16, 2009

View and organize all your news, create clipbooks, and retrieve coverage reports—**log in** to the Burrelles*Luce* 2.0 Portal

Exhibit 41

DUK_00011550

(Confidential)

2013.05.22 Email Re: Press Release for 90th Mosquito Control Anniversary

From: Hoffmann, Lisa M
Sent: Wednesday, May 22, 2013 8:11 PM
To: Duke Energy Hydro Licensing; Duke Energy Lake Services
Cc: Manuel, Ken
Subject: FW: Duke Energy mosquito control program in its 90th year -- distributed in North Carolina and South Carolina at 2 p.m. ET
Attachments: 5-22-13 FE_G MosquitoAnniversary_FINAL.docx

The news release attached and below was distributed to North and South Carolina news media outlets this afternoon. I'm sure the people who live and play at these lakes are eternally grateful (and far less itchy). - Lisa

From: Shiel, Tom Jr
Sent: Wednesday, May 22, 2013 2:01 PM
To: Executive Distribution for Final New Releases
Subject: Duke Energy mosquito control program in its 90th year -- distributed in North Carolina and South Carolina at 2 p.m. ET

DUKE ENERGY

Media Contact: Lisa Hoffmann
Office: 704.382.1218 | 24-Hour: 800.559.3853

May 22, 2013

Duke Energy mosquito control program in its 90th year

CHARLOTTE, N.C. – Duke Energy has begun the 90th year of its reservoir mosquito control program.

Conducted annually since 1923, this public health program was started by company founder James B. Duke. It provides mosquito control along the shoreline of five of the company's largest urbanized reservoirs, including lakes James, Norman, Wylie, Wateree and Keowee.

The program, which operates from May through the end of October, is the oldest continuous environmental program of any utility in the U. S and one of the first in North America.

Two-person boat crews seek out specific mosquito breeding habitats along the 1,700 miles of Duke Energy's reservoir shoreline and apply a safe and government-approved larvicide that attacks only mosquito larvae.

Mosquitoes are not just annoying. They can spread disease, including West Nile Virus.

North Carolina and South Carolina have more than 60 mosquito species, many of which have adapted to live near homes. Removing or managing the water in which they breed is an effective way to reduce the mosquito population.

Exhibit 42

2026.04.06 – Email Serving Discovery Responses

From: Dunlap, Kevin A.
To: Jessica Fickling; Jim May; Lucy Dinkins; Vincent Sheheen; Austin Sheheen; gib@solomonsandlawton.com
Cc: Nash E. Long - Hunton Andrews Kurth LLP (nlong@hunton.com); Powell, Melanie
Subject: Jones v. Duke Energy
Date: Monday, April 6, 2026 8:17:17 PM
Attachments: image834600.png
Duke_Jones - Duke Energy"s Responses to Plaintiffs 2nd RFPs - 355058530-v4.pdf
Duke_Jones - Duke Energy"s Responses to Plaintiffs 3rd RFPs - 355042386-v2.pdf
Duke_Jones - Defs" 4th Supplemental Responses to Plaintiffs ROGs - 355385468-v4.pdf
Duke_Jones - Verification of Zach Hall ISO 4th Supp Resps to ROGs - 355406668-v2.pdf
Jones v. DEC_DE Corp AMENDED Privilege Log 02.xlsx

Counsel,

In response to Plaintiff's Second and Third Requests to Produce, Duke Energy conducted a reasonable search of its files for information responsive to those requests. The new document requests led Duke Energy to search for documents in new locations, where Duke Energy found some documents responsive to Plaintiff's First Set of Requests for Production and Interrogatories Nos. 5, 7, and 8. Duke Energy is producing those newly-found documents together with the documents responsive to the Second and Third Set of RFPs. Please see the link below. An updated Privilege Log 02 is attached. Duke Energy is also providing with this production supplemental interrogatory responses based on the newly-discovered documents.

Please note that although one of these documents is marked "attorney-client privileged," we have determined that this document is actually work product and not a privileged attorney-client communication. The production of that document therefore does not constitute a waiver of the attorney-client privilege.

2026-04-06 - Production Set 11
Password: wm3fBXWCP477
Link Expires 5.6.26
https://hunton.egnyte.com/fl/TTdKmgtV47k4

Kevin Dunlap
Partner



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IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF SOUTH CAROLINA
COLUMBIA DIVISION

Clyde Marcus Jones, II, on behalf of himself and all others similarly situated, Plaintiffs, v. Duke Energy Corporation and Duke Energy Carolinas, LLC, Defendants.	Civil Action No.: 3:24-cv-1281-MGL **DEFENDANT DUKE ENERGY CAROLINAS, LLC'S RESPONSES TO PLAINTIFF'S SECOND REQUESTS TO PRODUCE**

Defendant Duke Energy Carolinas, LLC ("DEC"), by counsel, hereby provides its objections and responses to Plaintiff's Second Requests to Produce.

OBJECTIONS TO PLAINTIFF'S DEFINITIONS

1. DEC objects to Plaintiff's definition of the terms "you," "your," and "Defendant" as overly broad, unduly burdensome, and not proportional to the needs of the case to the extent they are intended to include any entity other than Duke Energy Corporation and Duke Energy Carolinas, LLC. The responses contained herein are based solely on information related to and/or available to Duke Energy Corporation and Duke Energy Carolinas, LLC.

2. DEC objects to Plaintiff's definition of the term "transformer oil" as overly broad, unduly burdensome, not proportional to the needs of the case, vague, ambiguous, and amenable to multiple interpretations. Consistent with historical uses of this term, such as was used in the 1959 edition of the National Electrical Code Handbook and its regulations regarding oil-insulated transformers and Askarel-insulated transformers, for purposes of their responses to the Requests, Defendants interpret "transformer oil" to mean a flammable dielectric fluid composed of highly

refined mineral oil, petroleum distillates, or similar hydrocarbon-based fluids that does not contain PCBs and is used inside oil-insulated transformers to cool components and provide electrical insulation. Defendants further specifically object to the use of the phrase "transformer oil" to the extent the Requests conflate "transformer oil" with "Askarel." In fact, "transformer oil" is distinct from and does not refer to "Askarel," a generic name for synthetic nonflammable dielectric fluids that were typically composed of various mixtures of polychlorinated benzenes and PCBs and were used inside Askarel-insulated transformers to cool components and provide electrical insulation and, when decomposed by the electric arc, evolve only nonflammable gaseous mixtures.

OBJECTIONS AND RESPONSES TO REQUESTS TO PRODUCE

1. For the period from January 1, 1960 through December 31, 1979, produce all documents, including all policies, procedures, correspondence, and/or communications relating to the safe handling, storage and/or disposal of PCBs.

OBJECTIONS AND RESPONSE:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. DEC objects to this Request as overly broad, unduly burdensome, not proportional to the needs of the case, and to the extent it seeks documents that are not in the possession of Defendants due to the passage of time. Additionally, DEC objects to this Request to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection. DEC further objects to this Request insofar as it is duplicative of Request No. 25 in Plaintiff's First Requests to Produce.

Subject to and without waiving its objections, DEC states that it has produced all documents responsive to this Request identified after reasonable search and inquiry. By way of example, see June 15, 1978 PCB Marking, Storage, Disposal and Pollution Prevention Plan

(DUK_00016374-16386); January 2, 1979 PCB Marking, Storage, Disposal and Pollution Prevention Plan (DUK_00016360-16373); Duke Power Company PCB Record Annual Report for 1979 (DUK_00029289-29425); 1970s documents reflecting return shipment to Monsanto for disposal (DUK_00023353-23368).

2. For the period from January 1, 1960 through December 31, 1979, produce all documents, to include policies, procedures, communications, and/or correspondence relating to the safe handling of transformer oil.

OBJECTIONS AND RESPONSE:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. DEC objects to this Request as overly broad, unduly burdensome, not proportional to the needs of the case, and to the extent it seeks documents that are not in the possession of Defendants due to the passage of time. Additionally, DEC objects to this Request to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states that it has produced all documents responsive to this Request identified after reasonable search and inquiry. By way of example, see Duke Power Company PCB Record Annual Report for 1978 (DUK_ 00016390-16573) and the January 2, 1979 PCB Marking, Storage, Disposal and Pollution Prevention Plan (DUK_00016360-16373).

3. For the period from January 1, 1960 through December 31, 1979, produce all documents, correspondence, and/or communications by and between Defendant and Monsanto Industrial Chemicals, Co. relating to the storage, handling, and/or disposal of PCBs, to include safe handling practices.

OBJECTIONS AND RESPONSE:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. DEC objects to this Request as overly broad, unduly burdensome, not proportional to the needs of the case, and to the extent it seeks documents that are not in the possession of Defendants due to the passage of time. Additionally, DEC objects to this Request to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states that it has produced all documents responsive to this Request identified after reasonable search and inquiry. See DUK_00023362-23363; DUK_00023393-23394; DUK_00023376-23377.

4. Produce any document, including correspondence and/or communications, in-house studies, and/or memoranda, relating to the cross-contamination of mineral oil with PCBs.

OBJECTIONS AND RESPONSE:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. DEC objects to this Request as vague on the grounds that the term "cross-contamination" is vague and not defined. DEC also objects to this Request as overly broad, unduly burdensome, not proportional to the needs of the case, and to the extent it seeks documents that are not in the possession of Defendants due to the passage of time. Additionally, DEC objects to this Request to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states that it has produced documents responsive to this Request identified after reasonable search and inquiry. See, e.g., oil sample

data forms (DUK_00043581-00086111) and PCB Plan for Duke Power Company, including revisions. DEC further refers to documents demonstrating that as of the mid-1970s, the trend in the industry was to rely on outside repair shops to handle askarel transformers. See 1976 Versar Report at DUK_00101047-59, and the 1973 Weinstein Waste Oil Recycling Report, at PDF pages 267-268, which will be produced with Defendants' Production 11.

5. Produce any document, including correspondence and/or communications, in-house studies, or segregation plan, relating to the prevention of transformer oil cross-contamination.

OBJECTIONS AND RESPONSE:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. DEC objects to this Request as vague on the grounds that the term "cross-contamination" is vague and not defined. DEC also objects to this Request as overly broad, unduly burdensome, not proportional to the needs of the case, not limited to any timeframe, and to the extent it seeks documents that are not in the possession of Defendants due to the passage of time. Additionally, DEC objects to this Request to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection. DEC further objects to this Request to the extent it is duplicative of Request No. 4 above.

Subject to and without waiving its objections, DEC states that it has produced documents responsive to this Request identified after reasonable search and inquiry. See, e.g., oil sample data forms (DUK_00043581-00086111) and PCB Plan for Duke Power Company, including revisions. DEC further refers to documents demonstrating that as of the mid-1970s, the trend in the industry was to rely on outside repair shops to handle askarel transformers. See 1976

Versar Report at DUK_00101047-59 and the 1973 Weinstein Waste Oil Recycling Report, at PDF pages 267-268, which will be produced with Defendants' Production 11.

6. Produce any testing of transformer oil used in Defendant's mosquito control program.

OBJECTIONS AND RESPONSE:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. DEC also objects to this Request as overly broad, unduly burdensome, not proportional to the needs of the case, and to the extent it seeks documents that are not in the possession of Defendants due to the passage of time. DEC further objects to this Request to the extent it is not limited to activities of the Mosquito Control Program on Lake Wateree, which is the only Duke Energy reservoir at issue in this action. Additionally, DEC objects to this Request to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states that, after reasonable search and inquiry, it has not identified any documents indicating that transformer oil was used in the Mosquito Control Program on Lake Wateree.

7. For the period from January 1, 2021 through the present, produce any documents exchanged with credit ratings agencies.

OBJECTIONS AND RESPONSE:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. DEC further objects to this Request as overly broad, unduly burdensome, and not proportional to the needs of the case. DEC additionally objects to this Request to the extent it seeks documents that contain sensitive trade secrets, proprietary data, or other confidential business information.

Subject to and without waiving its objections, DEC states that documents responsive to this Request—specifically, documents sufficient to show the credit ratings of both Defendants, as well as presentations made to credit ratings agencies—are being produced in Defendants' Production No. 11. Responding further, DEC states that, after reasonable search and inquiry, it did not identify any documents exchanged with credit ratings agencies that pertain to this matter or Plaintiff's allegations.

8. For the period from January 1, 2021 through the present, produce any documents relating to Defendant's use of reserves for environmental remediation.

OBJECTIONS AND RESPONSE:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. DEC also objects to this Request as overly broad, unduly burdensome, and not proportional to the needs of the case. DEC specifically objects to this Request to the extent it is not limited to environmental remediation of PCBs on Lake Wateree, which is the limited focus of Plaintiff's claims. Additionally, DEC objects to this Request to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states that it conducted a reasonable search and inquiry for any documents relating to Defendants' use of reserves for environmental remediation of PCBs on Lake Wateree. No responsive documents were identified.

Respectfully submitted,

Dated: April 6, 2026

/s/ Kevin A. Dunlap
Kevin A. Dunlap (Fed. ID No. 5564)
Steven D. Weber (Fed. ID No. 8042)
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IN THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF SOUTH CAROLINA COLUMBIA DIVISION

Clyde Marcus Jones, II, on behalf of himself and all others similarly situated, Plaintiffs, v. Duke Energy Corporation and Duke Energy Carolinas, LLC, Defendants.	Civil Action No.: 3:24-cv-1281-MGL **CERTIFICATE OF SERVICE**

I hereby certify that on April 6, 2026, I served Defendant Duke Energy Carolinas, LLC's Responses to Plaintiff's Second Requests to Produce on Plaintiff via email, addressed as follows:

Jessica L. Fickling
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/s/ Kevin A. Dunlap

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF SOUTH CAROLINA
COLUMBIA DIVISION

Clyde Marcus Jones, II, on behalf of himself and all others similarly situated, Plaintiffs, v. Duke Energy Corporation and Duke Energy Carolinas, LLC, Defendants.	Civil Action No.: 3:24-cv-1281-MGL **DEFENDANTS DUKE ENERGY CORPORATION AND DUKE ENERGY CAROLINAS, LLC'S RESPONSES TO PLAINTIFF'S THIRD REQUESTS TO PRODUCE**

Defendants Duke Energy Corporation and Duke Energy Carolinas, LLC (collectively, "Duke Energy"), by counsel, hereby provide their objections and responses to Plaintiff's Third Requests to Produce.

OBJECTIONS TO PLAINTIFF'S DEFINITIONS

1. Duke Energy objects to Plaintiff's definition of the terms "you," "your," and "Defendant" as overly broad, unduly burdensome, and not proportional to the needs of the case to the extent they are intended to include any entity other than Duke Energy Corporation and Duke Energy Carolinas, LLC. The responses contained herein are based solely on information related to and/or available to Duke Energy Corporation and Duke Energy Carolinas, LLC.

2. Duke Energy objects to Plaintiff's definition of the term "transformer oil" as overly broad, unduly burdensome, not proportional to the needs of the case, vague, ambiguous, and amenable to multiple interpretations. Consistent with historical uses of this term, such as was used in the 1959 edition of the National Electrical Code Handbook and its regulations regarding oil-insulated transformers and Askarel-insulated transformers, for purposes of their responses to the Requests,

Defendants interpret "transformer oil" to mean a flammable dielectric fluid composed of highly refined mineral oil, petroleum distillates, or similar hydrocarbon-based fluids that does not contain PCBs and is used inside oil-insulated transformers to cool components and provide electrical insulation. Defendants further specifically object to the use of the phrase "transformer oil" to the extent the Requests conflate "transformer oil" with "Askarel." In fact, "transformer oil" is distinct from and does not refer to "Askarel," a generic name for synthetic nonflammable dielectric fluids that were typically composed of various mixtures of polychlorinated benzenes and PCBs and were used inside Askarel-insulated transformers to cool components and provide electrical insulation and, when decomposed by the electric arc, evolve only nonflammable gaseous mixtures.

OBJECTIONS AND RESPONSES TO REQUESTS TO PRODUCE

1. Produce a copy of any exhibits You may use at trial, including any illustrative or demonstrative exhibit.

OBJECTIONS AND RESPONSE:

Duke Energy incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. Duke Energy objects to this Request as overly broad, unduly burdensome, and not proportional to the needs of the case. Additionally, Duke Energy objects to this Request to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection. Duke Energy further objects to this Request as premature, including insofar as it purports to require the creation of documents that do not presently exist.

Subject to and without waiving its objections, Duke Energy states that it will disclose those exhibits it may use at trial in accordance with the scheduling order entered by the Court.

2. Produce all documents provided to any expert witness You intend to call at trial.

OBJECTIONS AND RESPONSE:

Duke Energy incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. Duke Energy objects to this Request as overly broad, unduly burdensome, and not proportional to the needs of the case. Additionally, Duke Energy objects to this Request to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection. Duke Energy further objects to this Request to the extent it exceeds the requirements of Fed. R. Civ. P. 26(b)(4)(C)(ii)-(iii) which protect communications between a party's attorney and any testifying expert witness except to the extent the communications identify facts or data upon which the expert relied in forming their opinions.

Subject to and without waiving its objections, Duke Energy states that documents responsive to this Request will be produced with Production 11. Other responsive documents were included in prior productions.

3. Produce all non-privileged written or recorded statements or affidavits, including notes or drafts, from persons who are witnesses to facts relating to this action, including but not limited to, any taped conversations or communications of any witness.

OBJECTIONS AND RESPONSE:

Duke Energy incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. Duke Energy objects to this Request as overly broad, unduly burdensome, and not proportional to the needs of the case. Additionally, Duke Energy objects to this Request to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts,

and/or any other applicable privilege or protection.

Subject to and without waiving its objections, Duke Energy states that it does not possess any written or recorded statements or affidavits, including notes or drafts take from any person who is a witness to facts relating to this action.

4. Produce a copy of all agreements (and modifications to such agreements) with each expert You intend to call at trial.

OBJECTIONS AND RESPONSE:

Duke Energy incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. Duke Energy objects to this Request as overly broad, unduly burdensome, and not proportional to the needs of the case. Additionally, Duke Energy objects to this Request to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection. Duke Energy further objects to this Request to the extent it exceeds the requirements of Fed. R. Civ. P. 26(b)(4)(C) which protects communications between a party's attorney and any testifying expert witness except as addressed in subsections (i) through (iii) of the Rule.

Subject to and without waiving its objections, DEC states that documents responsive to this Request will be produced with Production 11.

5. Produce all invoices submitted for this matter by any expert You intend to call at trial and documents sufficient to show all payments made to such experts.

OBJECTIONS AND RESPONSE:

Duke Energy incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. Duke Energy objects to this Request as overly broad, unduly burdensome, and not proportional to the needs of the case. Additionally, Duke Energy objects to this Request to

the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection. Duke Energy further objects to this Request to the extent it exceeds the requirements of Fed. R. Civ. P. 26(b)(4)(C) which protects communications between a party's attorney and any testifying expert witness except as addressed in subsections (i) through (iii) of the Rule.

Subject to and without waiving its objections, DEC states that documents responsive to this Request will be produced with Production 11.

6. Produce all documents received in response to subpoenas or Freedom of Information Act requests issued in this case.

OBJECTIONS AND RESPONSE:

Duke Energy incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. Duke Energy objects to this Request as overly broad, unduly burdensome, and not proportional to the needs of the case. Additionally, Duke Energy objects to this Request to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection. Duke Energy further objects to this Request on the grounds that it seeks documents and information equally accessible to the Plaintiff.

Subject to and without waiving its objections, DEC states that documents responsive to this Request will be produced with Production 11.

Respectfully submitted,

Dated: April 6, 2026

/s/ Kevin A. Dunlap

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IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF SOUTH CAROLINA
COLUMBIA DIVISION

Clyde Marcus Jones, II, on behalf of himself and all others similarly situated, Plaintiffs, v. Duke Energy Corporation and Duke Energy Carolinas, LLC, Defendants.	Civil Action No.: 3:24-cv-1281-MGL **CERTIFICATE OF SERVICE**

I hereby certify that on April 6, 2026, I served Defendants Duke Energy Corporation and Duke Energy Carolinas, LLC's Responses to Plaintiff's Third Requests to Produce, on Plaintiff via email, addressed as follows:

Jessica L. Fickling
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/s/ Kevin A. Dunlap

Case No. 3:24-cv-01281-MGL
Jones v. Duke Energy Carolinas, LLC and Duke Energy Corporation
Privilege Log 02

Family Date	Author / From	To	CC	BCC	File Name / Subject	Description of Redacted Portion	Privilege Basis	File Extension	Privilege Action
9/15/1996	Duke Energy				06000044	Legal advice regarding letter to EPA	Attorney Client Privilege	.pdf	Redact for Privilege
9/19/1984	Duke Energy				10001402	Legal advice provided to Duke Energy PCB Committee; summaries of discussions with USWAG containing legal advice and litigation strategy; memoranda from USWAG outside counsel containing legal opinions	Attorney Client Privilege	.pdf	Redact for Privilege
01/06/2006	Duke Energy				DUKE POWER 1996 .doc	Analysis of legal requirements in North Carolina and South Carolina for the control of mosquito populations on hydrolectric impoundments	Attorney Client Privilege	.doc	Redact for Privilege
10/29/2015	Duke Energy				Mosquito Control Enabling Legislation -DUKE POWER MOSQUITO CONTROL PROGRAM 1996 .doc	Analysis of legal requirements in North Carolina and South Carolina for the control of mosquito populations on hydrolectric impoundments	Attorney Client Privilege	.doc	Redact for Privilege
09/26/2003	Kenneth L Manuel				Mosquito Control Program Summary 2003.doc	Analysis of legal requirements in North Carolina and South Carolina for the control of mosquito populations on hydrolectric impoundments	Attorney Client Privilege	.doc	Redact for Privilege
04/11/2024	Duke Energy				01001808.pdf	Analysis of legal requirements in North Carolina and South Carolina for the control of mosquito populations on hydrolectric impoundments	Attorney Client Privilege	.pdf	Redact for Privilege
04/16/2024	Duke Energy				03000448.pdf	Analysis of legal requirements in North Carolina and South Carolina for the control of mosquito populations on hydrolectric impoundments	Attorney Client Privilege	.pdf	Redact for Privilege
04/16/2024	Duke Energy				03000541.pdf	Legal analysis of state mosquito abatement regulations	Attorney Client Privilege	.pdf	Redact for Privilege
12/18/2015	Duke Energy				Duke Power Company Reservoir Mosquito Control Program Draft.pdf	Analysis of legal requirements in North Carolina and South Carolina for the control of mosquito populations on hydrolectric impoundments	Attorney Client Privilege	.pdf	Redact for Privilege
11/20/2015	Duke Energy				GarryRicePROFSnote.pdf	Legal analysis of regulatory authorities governing mosquito control	Attorney Client Privilege	.pdf	Redact for Privilege
10/26/2015	Duke Energy				Mosquito Control Enabling Legislation -DUKE POWER MOSQUITO CONTROL PROGRAM 1996 .doc	Legal analysis of state mosquito abatement regulations	Attorney Client Privilege	.doc	Redact for Privilege
03/10/2009	Kenneth L Manuel				Mosquito Control Program Summary 2003.doc	Analysis of legal requirements in North Carolina and South Carolina for the control of mosquito populations on hydrolectric impoundments	Attorney Client Privilege	.doc	Redact for Privilege
10/26/2015	Duke Energy				Mosquito Control Enabling Legislation -DUKE POWER MOSQUITO CONTROL PROGRAM 1996 .doc	Legal analysis of state mosquito abatement regulations	Attorney Client Privilege	.doc	Redact for Privilege
02/06/2009	Jester, Steve [Steve.Jester@duke-energy.com]	Bodenheimer, Steve [Steve.Bodenheimer@duke-energy.com]			FW Lease Question - FW Mosquito Control Facility Leases (Lake Wylie and Lake Wateree).msg	Request for legal advice regarding enforceability of Lake Wylie lease	Attorney Client Privilege	.msg	Redact for Privilege
02/06/2009	Manuel, Kenneth L [klmanuel@dukeenergy.com]	Mack, Karol P [Karol.Mack@duke-energy.com]*; Blum, Heather P [Heather.Blum@duke-energy.com]	Bowen, Tommy W [Tommy.Bowen@duke-energy.com]; Jester, Steve [Steve.Jester@duke-energy.com]		Lease Question - FW Mosquito Control Facility Leases (Lake Wylie and Lake Wateree).msg	Request for legal advice regarding enforceability of Lake Wylie lease	Attorney Client Privilege	.msg	Redact for Privilege
02/06/2009	Jester, Steve [SDJester@dukeenergy.com]	Bodenheimer, Steve [Steve.Bodenheimer@duke-energy.com]			FW Lease Question - FW Mosquito Control Facility Leases (Lake Wylie and Lake Wateree).msg	Request for legal advice regarding enforceability of Lake Wylie lease	Attorney Client Privilege	.msg	Redact for Privilege
02/13/2009	Manuel, Kenneth L [klmanuel@dukeenergy.com]	Rice, Garry S [Garry.Rice@duke-energy.com]*	Jester, Steve [Steve.Jester@duke-energy.com]; Bowen, Tommy W [Tommy.Bowen@duke-energy.com]		Re AMCA Legislative Update - Latest on 6th Circuit Decision on CWA & Aquatic Pesticide.msg	Legal advice regarding NPDES permits	Attorney Client Privilege	.msg	Redact for Privilege
09/27/2011	Bowman, Lauren [Lauren.Bowman@duke-energy.com]*	Jester, Steve [Steve.Jester@duke-energy.com]	Spak, Michelle S. [Michelle.Spak@duke-energy.com]*		FW Duke Energy leases with Crescent Resources (Lake Wylie and Lake Wateree mosquito control facilities).msg	Request for information to support legal opinion on mosquito facility least dispute	Attorney Client Privilege	.msg	Redact for Privilege

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IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF SOUTH CAROLINA
COLUMBIA DIVISION

Clyde Marcus Jones, II, on behalf of himself and all others similarly situated, Plaintiffs, v. Duke Energy Corporation and Duke Energy Carolinas, LLC, Defendants.	Civil Action No.: 3:24-cv-1281-MGL **DEFENDANTS' FOURTH SUPPLEMENTAL RESPONSES TO PLAINTIFF'S INTERROGATORIES**

Defendants Duke Energy Corporation and Duke Energy Carolinas, LLC ("DEC") (hereafter collectively, "Defendants"), by counsel, hereby provide these supplemental responses to Plaintiff's Interrogatories.

OBJECTIONS TO PLAINTIFFS' DEFINITIONS

1. Defendants reincorporate by reference all objections to Plaintiff's definitions asserted in their prior responses and supplemental responses to any of Plaintiff's Interrogatories.

RESPONSES TO INTERROGATORIES

1. Identify, by full names, addresses and telephone numbers, all persons and/or witnesses known to the party or counsel to have knowledge of facts concerning this case, including but not limited to consultants or other experts who are not expected to testify at trial but who have relevant knowledge including of the mosquito control program, and indicate whether written or recorded statements have been taken from such persons, indicate who has possession of such statements, and for each such person, set forth either a summary sufficient to inform the other party of the important facts known to or observed by such person and provide a copy of any written or recorded statements taken from such person.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. DEC objects to this Interrogatory as overly broad, unduly burdensome, and not proportional to the needs of the case to the extent it requires DEC to identify "all persons" with knowledge or information on the extremely broad topics at issue in this Interrogatory. Additionally, DEC objects to this Interrogatory to the extent it seeks information equally available to Plaintiff, information in the public domain, or information that is not within DEC's possession, custody, or control. DEC further objects to this Interrogatory to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states that it identified individuals with potential knowledge relevant to this case in its previously served Rule 26(a)(1) Initial Disclosures. Discovery is ongoing and investigation continues. To the extent additional information responsive to this Interrogatory is located, DEC will supplement as appropriate.

SUPPLEMENTAL RESPONSE:

Based on information currently available to DEC, in addition to the persons previously identified in its Rule 26(a)(1) Initial Disclosures, the following persons known to DEC are also likely to have knowledge of facts concerning this case. None of these individuals has provided any written or recorded statement to DEC.

- **David Roche – Mr. Roche was formerly a scientist in Duke Energy's Environmental Health & Safety division and was a member of the Company's PCB Committee.**
- **William Breedlove – Mr. Breedlove is an engineer who was employed by Duke Energy prior to his retirement and served as a member of the Company's PCB Committee.**

- **David Coughlan – Mr. Coughlan is a former Duke Energy fisheries scientist and author of the 1995 report "Contaminants in Largemouth Bass Collected from the Catawba River (NC/SC)."**

Discovery is ongoing and investigation continues. To the extent additional information responsive to this Interrogatory is located, DEC will supplement as appropriate.

SECOND SUPPLEMENTAL RESPONSE:

In response to Interrogatory No. 1, DEC further identifies the following individuals:

- **Robert Barden – Mr. Barden has personal knowledge of the Duke Energy Mosquito Control Program from 1973 through the end of 1995.**
- **Debra Cheney – Ms. Cheney is a real estate title searcher and has personal knowledge of the process used to conduct a title search on the Kershaw County properties surrounding Lake Wateree.**
- **Kenneth Sanders – Mr. Sanders is a real estate title searcher and has personal knowledge of the process used to conduct a title search on the Fairfield County properties surrounding Lake Wateree.**

2. Identify whether any Defendant has sold or otherwise transferred any ownership interest in or operating responsibility in the Site and describe any such transaction. That description should include, among other information, the date of the transaction, the identity of the buyer, the purchase price, and any other material information related to the transaction. To the extent this information is contained in any documents produced by Defendant, identify those documents by Bates number.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein, including specifically the definition of the "Site." DEC objects to this

Interrogatory as overly broad, unduly burdensome, vague, ambiguous, not limited to any specific time period, and not proportional to the needs of the case. Additionally, DEC objects to this Interrogatory to the extent it seeks information equally available to Plaintiff, information in the public domain, or information that is not within Defendant's possession, custody, or control. DEC further objects to this Interrogatory to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states that, at this time, its Real Estate department has not located any records of transactions related to Parcel No. 111-04-40-051 in Kershaw County, which is the parcel identified by Plaintiff as the "Site." Upon information and belief, Parcel No. 111-04-40-051 is owned by a private party. DEC states that it is the title owner of Parcel No. 111-04-40-051A, which is the location of the former Lake Wateree Mosquito Control Facility. DEC became the title owner of Parcel No. 111-04-40-051A in December 2011 when it purchased that property from Crescent Resources. DEC is continuing to investigate and will supplement as appropriate.

<u>SUPPLEMENTAL RESPONSE</u>:

Adopting its proposed definition of the "Site" as the site of the former Lake Wateree Mosquito Control Facility, DEC states that it has produced the following documents related to its purchase of the Site: DUK_00013262-13264; DUK_00013301-13310; DUK_00013320-13329. As reflected in those documents, prior to the purchase, Duke Energy Corporation leased the Site from Crescent Resources, LLC. After the lease was rejected pursuant to Crescent Resources' Chapter 11 Plan in June 2010, DEC purchased the Site from Crescent Resources for $90,000.00 in December 2011. Funds for the purchase were made available from the Hydro Strategy, Licensing and Lake Services 2011 budget.

3. Identify all substances, supplies, materials, and/or equipment stored at the Site including the duration of any such storage, and the method of any disposal.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein, including specifically the definition of the "Site." Additionally, DEC objects to this Interrogatory on the grounds that the term "substances" is vague and not defined. DEC also objects to this Interrogatory as overly broad, unduly burdensome, vague, ambiguous, not limited to any specific time period, and not proportional to the needs of the case to the extent it seeks a comprehensive listing of anything stored at the "Site" and is not limited to substances, supplies, materials, and/or equipment used in the Mosquito Control Program, which is the subject of this case. DEC further states that, due to the passage of time, some of the information requested may be impossible to recreate. Given that the Mosquito Control Program ran for 93 years and was discontinued over nine years ago, it is difficult to determine what materials were actually stored at the former Lake Wateree Mosquito Control Facility, much less in what quantities and for how long they were stored. DEC therefore objects to this Interrogatory to the extent that it is required to provide information no longer within its possession, custody, or control, or within the memory of its employees.

Subject to and without waiving its objections, DEC states that, after reasonable search and inquiry, it has identified and is producing the following categories of documents which may provide information responsive to this Interrogatory:

- **Certain EPCRA Chemical Inventory Tier II Reports for the Lake Wateree Mosquito Control Facility. See DUK_00002520-2523; DUK_00002524-2530; DUK_00002535; DUK_00002565-2571.**
- **Records relating to larvicides that were used in the Mosquito Control Program. See,**

e.g., DUK_00004426-4444; DUK_00004461-4506; DUK_00004535-4544; DUK_00005203-5214; DUK_00000145-158; DUK_00000161-169; DUK_00000621-622; DUK_00000625-626; DUK_00001727-1728; DUK_00001735-1736; DUK_00001814-1816.

The foregoing are merely examples of documents produced by DEC which may be responsive to this Interrogatory. Discovery is ongoing and investigation continues. To the extent additional information responsive to this Interrogatory is located, DEC will supplement as appropriate.

SUPPLEMENTAL RESPONSE:

DEC withdraws its objection to this Interrogatory on the basis that the term "substances" is vague and undefined. Adopting its proposed definition of the "Site" as the site of the former Lake Wateree Mosquito Control Facility, DEC states that it has produced all available chemical inventories for the Site. See DUK_00002768-2856. These inventories cover various years from 1992 through 2016. DEC has not located any such inventories for earlier time periods. After reasonable investigation, DEC has determined that, due to the passage of time, it does not possess information or knowledge sufficient to identify all substances, supplies, materials, and/or equipment stored at the Lake Wateree Mosquito Control Facility prior to the 1990s.

4. Identify all materials, substances, supplies, and/or equipment used to implement the Defendant's Mosquito Control Program and in what quantity. For each item identified please identify the manufacturer and brand or industry name and provide any product specifications to include ingredients.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its Objections and Answer to Interrogatory No. 3 as

if fully set forth herein.

Subject to and without waiving its objections, DEC further responds that the manner in which the Mosquito Control Program was implemented evolved over the course of its 93-year operation. From 1923 until the late 1980s, the major larviciding material was fuel oil. DEC has produced documents reflecting the administration and composition of these historic larvicides. By way of example and not limitation, see DUK_00000145-158; 00000161-169; 00000621-622; 00000625-626; 00001727-1728; 00001735-1736; 00001814-1816.

In the late 1980s liquid Bacillus thuringeinesis israelensis ("Bti") replaced the use of fuel oil. From that time until the Program's discontinuation in 2016, the predominate larvicide used was Vectobac 12AS (Bti). In areas intermittently not connected to the lake due to fluctuating water levels, immature mosquito growth regulator Altocid and the mono-molecular oil film product Arosurf were sometimes used.

A data summary produced at DUK_00004461-4506 indicates that, from 1998 through 2016, the following total quantities of materials were used during mosquito control operation activities throughout the entire Mosquito Control Program: 271.36 gallons of Bti liquid; 49,973 Altosid briquets; 34.95 gallons of Altosid liquid; and 290.86 gallons of Monomolecular Surface.

DEC has produced various labels and information sheets for these products which it has identified after reasonable search and diligent inquiry. By way of example and not limitation, see DUK_00002107-2108; DUK_00002109-2112; DUK_00002132-2142; DUK_00002151-2162. Additional information pertaining to the materials used in the Mosquito Control Program can be found elsewhere in DEC's production, including at DUK_00004426-4444; DUK_00004461-4506; DUK_00004535-4544; DUK_00005203-5214.

Discovery is ongoing and investigation continues. To the extent additional

information responsive to this Interrogatory is located, DEC will supplement as appropriate.

SUPPLEMENTAL RESPONSE:

After reasonable investigation, DEC has determined that, due to the passage of time, it does not possess information or knowledge sufficient to identify all materials, substances, supplies, and/or equipment used to implement the Defendant's Mosquito Control Program over the Program's 93-year duration. As noted in its Supplemental Response to Interrogatory No. 3, DEC has located and produced all available chemical inventories for the Lake Wateree Mosquito Control Facility, which cover various years from 1992 through 2016.

Due to the passage of time, information related to materials used in the earlier years of the Mosquito Control Program is limited. DEC has located and produced all available spray logs for Lake Wateree. See DUK_00001526-1904. These spray logs, which cover various years from 1941 through 1987 , indicate the quantities of oil applied to Lake Wateree. Beginning in the 1950s, the logs also indicate the type(s) of oil. For example, logs from the 1950s and early 1960s reflect the use of crankcase oil and in some instances drip oil. Logs from 1968-1970 reflect the use of outboard oil, motor oil, and #2 fuel oil. DEC has also produced historic documents that reflect the contents of oil mixtures used to implement the Mosquito Control Program during the early 1940s. See, e.g., DUK_00000157 (May 1943: "10% gas house oil, 50% waste, strained crankcase oil and 40% of light fuel oil); DUK_00000164 (March 1943: 25% #2 fuel oil, 20% gas oil, 55% used auto oil); DUK_00000161 (Sept. 1942: "This oil consists of 25% gas house oil, 25% fuel oil No. 2 and 50% strained used auto waste oil);

5. Identify all environmental testing, monitoring, sampling, or analyses Defendant (either directly or through third parties) conducted at the Site, including the dates, results, and

entities who performed such work, as well as any remediation, clean-up, corrective and/or abatement action of the Site, and the dates, nature and outcome of same.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein, including specifically the definition of the "Site," and further objects to the Interrogatory on the grounds that the terms "remediation" and "clean-up" are vague and undefined. DEC objects to this Interrogatory as overly broad, unduly burdensome, and not proportional to the needs of the case to the extent it seeks information related to anything other than the Mosquito Control Program and PCBs which are the subjects of this case. DEC further objects to this Interrogatory on the grounds that it is not limited to any specific time period. DEC states that, due to the passage of time, some of the information requested may be impossible to recreate. DEC therefore objects to this Interrogatory to the extent that it is required to provide information no longer within its possession, custody, or control, or within the memory of its employees. DEC further objects to this Interrogatory to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states that it recalls an investigation led by South Carolina's State Law Enforcement Division (SLED) in the 1990s into the presence of PCBs at or near the Lake Wateree Mosquito Control Facility. In connection with the SLED investigation, the South Carolina Department of Health and Environmental Control (DHEC) performed sampling. Upon information and belief, this sampling included auguring of soil in the vicinity of where oil tanks had previously been stored at the property, as well as sediment samples taken from Lake Wateree. It is DEC's

understanding that the investigation ceased following the sampling event as DEC was not further contacted by SLED. DEC was never made aware of the facts that had triggered the investigation.

After reasonable and diligent inquiry, DEC has not identified any further information responsive to this Interrogatory, nor has it been able to locate documents pertaining to the SLED investigation or any DHEC sampling. Discovery is ongoing and investigation continues. To the extent additional information responsive to this Interrogatory is located, DEC will supplement as appropriate.

SUPPLEMENTAL RESPONSE:

In 1997, Duke Energy and SCDHEC undertook an environmental site investigation at the Lake Wateree Mosquito Control Facility to determine if the site had been impacted by Duke Energy activities.

An initial soil sampling event was conducted on August 13, 1997 utilizing direct push / Geoprobe sampling techniques to collect soil samples from four sampling locations at the site. Samples were collected and submitted to Pace Analytical for both PCBs and petroleum hydrocarbon (diesel fuel) analysis on August 14, 1997. High concentrations of Total Petroleum Hydrocarbons (TPH) were detected. Initial results for PCBs were inconclusive, with some samples showing "non-detect" for PCBs and one sample indicating the possible presence of PCBs and the confounding presence of TPH. Subsequent testing confirmed that the initial PCB results were a false positive likely caused by one or more technical issues related to interference from significant levels of TPH contamination in the sample.

Subsequent sampling events at the site in September 1997, June 1998, and August 1998 continued to detect high levels of petroleum constituents, but PCBs were not detected. A "dig and haul" remediation work plan to address the petroleum contamination was approved by

SCDHEC in September 1998. Duke Energy thereafter undertook remediation activities which involved excavation, treatment, and appropriate disposal of the impacted soil by a SCDHEC permitted contractor. On October 20, 1998, Duke Energy received a Soil Recycling Certificate confirming that the petroleum-contaminated soil had been properly treated.

6. Identify, by full names, addresses, and telephone numbers, each person whom you expect or propose to call as an expert witness at the trial of the case, and, as to each expert so identified, state the subject matter on which he is expected to testify, the substance of the facts and opinions to which he is expected to testify, and a summary of the grounds for each opinion.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. DEC objects to this Interrogatory as premature. DEC's expert disclosures are not yet due under the Court's Scheduling Order. DEC further objects to this Interrogatory to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection, including the protections contemplated by Rule 26(b)(4)(C).

Subject to and without waiving its objections, DEC states that it identified persons whom it expects to call as expert witnesses in the parties' Rule 26(f) report. DEC will supplement this information as required by the Scheduling Order and Rule 26.

SUPPLEMENTAL RESPONSE:

In accordance with the Court' Scheduling Order and Rule 26, Defendants disclosed their experts on March 13, 2026. See ECF No. 106.

7. Identify any document advising Defendant of possible contamination caused by

or relating to the Mosquito Control Program and describe how Defendant was made aware.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein, including specifically the definition of "contamination." DEC objects to this Interrogatory as overly broad, unduly burdensome, vague, ambiguous, and not proportional to the needs of the case to the extent it seeks information relating contamination by any substance other than PCBs, which are the subject of this case. Additionally, DEC objects to this Interrogatory on the grounds that it is not limited to any specific time period. DEC states that, due to the passage of time, some of the information requested may be impossible to recreate. DEC therefore objects to this Interrogatory to the extent that it is required to provide information no longer within its possession, custody, or control, or within the memory of its employees. DEC further objects to this Interrogatory to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states that, other than the SLED investigation which is discussed in DEC's Answer to Interrogatory No. 5, it does not recall any instance prior to the filing of this lawsuit in which it was advised of possible contamination caused by or relating to the Mosquito Control Program. Consistent with that recollection, after reasonable search and inquiry, DEC has not identified any document responsive to this Interrogatory. Discovery is ongoing and investigation continues. To the extent additional information responsive to this Interrogatory is located, DEC will supplement as appropriate.

SUPPLEMENTAL RESPONSE:

Defendants incorporate by reference their supplemental response to Interrogatory

No. 5. Documents pertaining to the 1997 environmental site investigation and subsequent remediation at the Lake Wateree Mosquito Control Facility were identified by Duke Energy in the process of its efforts to locate documents responsive to Request No. 8 in Plaintiff's Second Requests to Produce. These documents will be produced with Defendants' Production 11.

8. Identify all environmental studies and assessments conducted by Defendant of Lake Wateree since 1969. To the extent this information is contained in any documents produced by Defendant, identify those documents by Bates number.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein and further objects to this Interrogatory on the grounds that the term "assessments" is vague and not defined. Additionally, DEC objects to this Interrogatory as overly broad, unduly burdensome, vague, and ambiguous. DEC states that, due to the passage of time, some of the information requested may be impossible to recreate. DEC therefore objects to this Interrogatory to the extent that it is required to provide information no longer within its possession, custody, or control, or within the memory of its employees. DEC further objects to this Interrogatory to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states that it will produce documents pertaining to the 1995 report by David J. Coughlan entitled "Contaminants in Largemouth Bass Collected from the Catawba River (NC/SC)," which includes some data collected in Lake Wateree.

Responding further, DEC states that various studies involving Lake Wateree were

conducted in connection with the relicensing of the Catawba-Wateree Hydroelectric Project by the Federal Energy Regulatory Commission (FERC). To the extent documents reflecting these studies are still in DEC's possession, they will be produced. Relevant documents may also be publicly available through the FERC eLibrary.

Discovery is ongoing and investigation continues. To the extent additional information responsive to this Interrogatory is located, DEC will supplement as appropriate.

Supplemental Response:

DEC withdraws its objection to this Interrogatory on the grounds that the term "assessment" is vague and undefined. As previewed in its earlier answer to this Interrogatory, DEC has produced all documents in its possession pertaining to the 1995 report by David J. Coughlan entitled "Contaminants in Largemouth Bass Collected from the Catawba River (NC/SC)." See DUK_00024295-24780. In addition to searching its own records, DEC has conducted a reasonable search of the FERC e-Library for information responsive to this Request using keywords including but not limited to "Wateree" and "environmental." DEC has located the following environmental studies and reports that were conducted and prepared in connection with the relicensing:

- **Fish Community Assessment**
- **Reservoir Fish Habitat Assessment**
- **Diadromout Fish Studies**
- **Instream Flow Assessment**
- **Fish Entrainment Evaluation**
- **Mussel Survey**
- **Macrobenthic Survey**
- **Water Quantity, Quality & Aquatic Resources Consultation**

- **FERC Final Environmental Impact Statement**

These additional studies and reports will be produced as part of DEC's Production 08.

SECOND SUPPLEMENTAL RESPONSE:

Defendants incorporate by reference their supplemental response to Interrogatory No. 5. Documents pertaining to the 1997 environmental site investigation and subsequent remediation at the Lake Wateree Mosquito Control Facility were identified by Duke Energy in the process of its efforts to locate documents responsive to Request No. 8 in Plaintiff's Second Requests to Produce. These documents will be produced with Defendants' Production 11.

9. Describe in detail all claims and lawsuits in which Defendant has been involved concerning contamination at or near the Site or Lake Wateree. In describing such claims or lawsuits, provide the date of the claim or lawsuit, the person(s), by name, address, and telephone number, bringing the claim or lawsuit, the subject matter of the claim or lawsuit, and the state, county and court in which the lawsuit was filed, as well as the caption of the lawsuit.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein, including specifically those for the "Site" and further objects to this Interrogatory on the grounds that the term "claims" is vague and not defined. DEC also objects to this Interrogatory as overly broad, unduly burdensome, vague, and ambiguous and to the extent it seeks information equally available to Plaintiff, information in the public domain, or information that is not within DEC's possession, custody, or control. DEC states that, due to the passage of time, some of the information requested may be impossible to recreate. DEC further objects to this Interrogatory to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable

privilege or protection.

Subject to and without waiving its objections, DEC states that, after reasonable search and inquiry, it has not identified any information responsive to this Interrogatory.

10. Identify all efforts that were made to notify or warn the owners of property adjoining the Site of Contamination at the Site, including specifically:

. the identity of each person making such efforts;

. the identity of each person notified or warned;

. the date(s) such persons were notified or warned;

. any written documents or agreements obtained from each person notified or warned.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein, including specifically those for the "Site" and "contamination." DEC objects to this Interrogatory as overly broad, unduly burdensome, vague, ambiguous, and not proportional to the needs of the case to the extent it seeks information relating to contamination by any substance other than PCBs, which are the subject matter of this case. DEC also objects to this Interrogatory to the extent it seeks information pertaining to notifications or warnings provided by any individual or entity other than DEC. DEC further objects to this Interrogatory to the extent it seeks information equally available to Plaintiff, information in the public domain, or information that is not within DEC's possession, custody, or control. DEC states that, due to the passage of time, some of the information requested may be impossible to recreate. Additionally, DEC objects to this Interrogatory to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting

experts, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states, after reasonable search and inquiry, it has not identified any information responsive to this Interrogatory. Responding further, DEC states that it is not aware of any instance of contamination at or near the Lake Wateree Mosquito Control Facility caused by DEC and thus there would not have been any reason for DEC to notify neighboring property owners.

11. Identify all efforts that were made to notify or warn any owners of property adjoining Lake Wateree of the Contamination of Lake Wateree, including specifically:

. the identify of each person making such efforts;

. the identify of each person notified or warned;

. the date(s) such persons were notified or warned;

. any written documents or agreements obtained from each person notified or warned.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein, including specifically for "contamination." DEC objects to this Interrogatory as overly broad, unduly burdensome, vague, ambiguous, and not proportional to the needs of the case to the extent it seeks information relating to contamination by any substance other than PCBs, which are the subject matter of this case. DEC also objects to this Interrogatory to the extent it seeks information pertaining to notifications or warnings provided by any individual or entity other than DEC. DEC further objects to this Interrogatory to the extent it seeks information equally available to Plaintiff, information in the public domain, or information that is not within DEC's possession, custody, or control. DEC states that, due to the passage of time, some of the information requested may be impossible to recreate. DEC further objects to this Interrogatory to the extent it seeks disclosure of information that

is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states that the South Carolina Department of Health and Environmental Control (now the South Carolina Department of Environmental Services) has issued a fish consumption advisory for Lake Wateree due to the presence of PCBs. After reasonable search and diligent inquiry, DEC has not identified any other information responsive to this Interrogatory. Responding further, DEC states that it is not aware of any instance of contamination to Lake Wateree caused by DEC and thus there would not have been any reason for DEC to notify neighboring property owners.

SUPPLEMENTAL RESPONSE:

As previously stated, fish consumption warnings were and are issued by a South Carolina state agency to all citizens of the state and visitors to affected water bodies. The state agency (DHEC, then DES) contacts Duke Energy to request permission to place warning signs on any lake access points owned by Duke Energy. Duke Energy has always cooperated with the state by agreeing to the placement and location of any such sign.

The fish advisories are, and always have been, public knowledge. *See e.g.*, DUK_00014149-14151; DUK_00012100- 12102. Further, as Plaintiff acknowledged in his sworn deposition testimony, people can read the fish advisories and make their own decisions. *See* Clyde Marcus Jones Dep. Tr. 192:2-4.

12. Identify by date and content all communications between Defendant any Plaintiff Defendant [*sic*]. To the extent this information is contained in any document(s) produced by Defendant, identify the document(s) by Bates number.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. DEC objects to this Interrogatory as overly broad, unduly burdensome, vague, ambiguous, and not limited to any specific time period. DEC also objects to this Interrogatory to the extent it seeks information equally available to Plaintiff, information in the public domain, or information that is not within DEC's possession, custody, or control. DEC states that, due to the passage of time, some of the information requested may be impossible to recreate. DEC therefore objects to this Interrogatory to the extent that it is required to provide information no longer within its possession, custody, or control, or within the memory of its employees. Additionally, DEC objects to this Interrogatory on the grounds that it is confusing as written.

Subject to and without waiving its objections, DEC states that Plaintiff Clyde Marcus Jones, II received customer correspondence from DEC regarding his monthly power bill. DEC has not identified any other communications between DEC and Plaintiff Clyde Marcus Jones, II. To the extent this Interrogatory is intended to seek communications between DEC and other Lake Wateree property owners, DEC has produced responsive documents identified after a reasonable search and inquiry. By way of example and not limitation, see DUK_00004572-4575; DUK_00006982-6983; DUK_00006990.

Discovery is ongoing and investigation continues. To the extent additional information responsive to this Interrogatory is located, DEC will supplement as appropriate.

13. Identify all documents in Defendants' possession, custody, or control relating to Fish Consumption Advisories issued for Lake Wateree, including but not limited to correspondence, reports, environmental studies, appraisals, and any other documents.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. DEC objects to this Interrogatory as overly broad, unduly burdensome, vague,

ambiguous, not limited to a specific time period, and not proportional to the needs of the case to the extent it requires DEC to identify "all documents" relating to the broad topic identified in this Interrogatory. DEC also objects to this Interrogatory to the extent it seeks information equally available to Plaintiff, information in the public domain, or information that is not within DEC's possession, custody, or control. DEC further objects to this Interrogatory to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states that it has produced responsive documents identified after reasonable search and inquiry. By way of example and not limitation, see DUK_00012099-12102; DUK_00012110-12111; DUK_00008241-8246; DUK_00008398-8405.

Discovery is ongoing and investigation continues. To the extent additional information responsive to this Interrogatory is located, DEC will supplement as appropriate.

SUPPLEMENTAL RESPONSE:

DEC withdraws its previously-stated objection to Plaintiff's definition of the term "Fish Consumption Advisories." DEC supplements its response to this Interrogatory to identify the following additional documents: DUK_00009575-9576; DUK_00014118-14123.

14. Set forth a list of photographs, videotapes, plats, sketches or other prepared documents in possession of Defendants that relate to the claim(s) or defense(s) in the case. To the extent this information is contained in any documents produced by Defendant, identify those documents by Bates number.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set

forth herein. DEC objects to this Interrogatory on the grounds that the term "prepared documents" is vague and not defined. Additionally, DEC objects to this Interrogatory as overly broad, unduly burdensome, vague, ambiguous, and not limited to any specific time period. DEC also objects to this Interrogatory to the extent it seeks information equally available to Plaintiff, information in the public domain, or information that is not within DEC's possession, custody, or control. DEC further objects to this Interrogatory to the extent it seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states that it has produced documents responsive to this Interrogatory that have been identified after reasonable search and inquiry. By way of example and not limitation, see DUK_00006988; DUK_00002939; DUK_00002940-2941; DUK_00002944; DUK_00002947-2949. DEC is continuing to investigate what materials in its possession may be responsive to this Interrogatory and will supplement as appropriate.

SUPPLEMENTAL RESPONSE:

DEC withdraws its previous objection to this Interrogatory on the grounds that the term "prepared documents" is vague and not defined. DEC supplements its response to this Interrogatory to state that, since initially responding, it has collected over 300 documents containing Lake Wateree property records and maps. These documents will be produced as part of DEC's Production 08.

15. Set forth the names and addresses of all insurance companies that have liability insurance coverage or any other coverage relating to the claims and set forth the number or numbers of the policies involved and the amount or amounts of liability or other coverage provided

in each policy.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. DEC objects to this Interrogatory as overly broad, unduly burdensome, vague, ambiguous, and not limited to any specific time period. DEC further objects to this Interrogatory to the extent it calls for a legal conclusion or otherwise seeks disclosure of information that is protected from disclosure by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC states that it has not identified any insurance policies responsive to this Interrogatory.

16. Identify all documents consulted, referred to, or relied upon in answering, and/or that contain information responsive to, any of the foregoing interrogatories. To the extent this information is contained in any documents produced by Defendant, identify those documents by Bates number.

OBJECTIONS AND ANSWER:

DEC incorporates by reference its objections to Plaintiff's definitions as if fully set forth herein. DEC objects to this Interrogatory as overly broad, unduly burdensome, and not proportional to the needs of the case to the extent it requires DEC to identify "all documents" relevant to the sweeping categories of information sought in these Interrogatories. DEC further objects to this Interrogatory to the extent it seeks information equally available to Plaintiff, information in the public domain, or information that is not within DEC's possession, custody, or control. Additionally, DEC objects to this Interrogatory to the extent it seeks disclosure of information that is protected from disclosure

by the attorney-client privilege, attorney work product protection, the privilege accorded to consulting experts, and/or any other applicable privilege or protection.

Subject to and without waiving its objections, DEC refers to its Productions 01, 02, 03, and 04 (DUK_00000001-00015089). Discovery is ongoing and investigation continues. To the extent additional information responsive to this Interrogatory is located, DEC will supplement as appropriate.

FIRST SUPPLEMENTAL RESPONSE:

DEC supplements its response to this Interrogatory to additionally refer to its Productions 05, 06, and 07 (DUK_00015090-00034123), as well as its forthcoming Production 08.

SECOND SUPPLEMENTAL RESPONSE:

DEC further supplements its response to this Interrogatory to additionally refer to its Productions 08, 09, and 10, and forthcoming Production 11.

INTERROGATORY NO. 17:

List each year that transformer oil was used as part of the Mosquito Control Program that is the subject of this case.

OBJECTIONS AND ANSWER:

Defendants incorporate by reference their objections to Plaintiff's definitions as if fully set forth herein, including specifically the definition of "transformer oil." Defendants object to this Interrogatory as overly broad, unduly burdensome, vague, ambiguous, not limited to any specific time period, and not proportional to the needs of the case, including specifically insofar as the Interrogatory seeks information pertaining to Mosquito Control Program activities that were carried out anywhere other than on Lake Wateree, which is the subject of this action. Defendants further object to this Interrogatory to the extent that it calls for expert testimony,

analysis, and opinions that are beyond the scope of permissible fact discovery.

Subject to and without waiving their objections, Defendants state that, after reasonable search and inquiry, they have not identified any evidence that transformer oil was used as part of the Mosquito Control Program at Lake Wateree.

SUPPLEMENTAL RESPONSE:

There is no evidence that transformer oil was ever used as part of the Mosquito Control Program at Lake Wateree.

Prior to 1968, the evidence indicates that Duke Power's primary larvicide was No. 2 fuel oil. Because this larvicide was largely invisible when sprayed on a lake surface, a small quantity of used motor oil (aka crankcase oil) was mixed in with the No. 2 fuel oil to create a visible sheen on the water to allow spraying crews to visually see where they had sprayed for mosquitoes. This practice was well established and acknowledged by the Centers for Disease Control (CDC).

In 1968, state health officials for North Carolina and South Carolina were invited to Duke Power to observe its mosquito control practices, which at the time were being audited by Dr. Brown of Columbia Medical School. One of the attendees at this meeting in 1968 was Don Ashton, a longtime mosquito entomologist for North Carolina, and it was Mr. Ashton's suggestion that used transformer oil be mixed with No. 2 fuel oil to provide the same visible sheen on the water as was obtained with motor oil. By 1968, Duke Power's MCP was using paper logs to track components sprayed on reservoirs that included a column for "transformer oil." Not one of these logs indicates that transformer oil was ever applied to Lake Wateree.

In 1970, at North Carolina Mosquito Control workshop, Mr. Ashton acknowledged that at least two electric utilities were using transformer oil mixed with No. 2 fuel oil as a larvicide. At that same workshop, Mr. A.C. Harris of Carolina Power & Light stated that it was following the larvicide program developed by Don Ashton and that it would use transformer oil instead of

motor oil whenever it had some to use. George Swearingen also stated that Duke Power was using No. 2 fuel oil and transformer oil and that they were following the recommendation of health officials for North Carolina and South Carolina.

There is no evidence that Duke Power may have used any transformer oil in its MCP at any reservoir after 1970. On April 3, 1970, Congress passed the Water Quality Improvement Act, which amended the Federal Water Pollution Control Act (commonly known as the Clean Water Act) to prohibit the discharge of oil into or onto waters of the United States. When the newly-created U.S. Environmental Protection Agency (EPA) adopted the regulations mandated by the Act on November 21, 1971, those regulations expressly specified that it was unlawful to discharge a sufficient quantity of oil to cause a film or sheen upon or discoloration of the surface of the water to appear. The regulations also required notifying the U.S. Coast Guard of any release of oil.

Use of transformer oil at Lake Wateree also would not have made logistical sense. Wateree is located at the edge of what was then Duke Power's service area, a long way from most of the Company's transformers. In the 1960s and 70s, prior to construction of the interstate, it would have taken several hours to drive from the Toddville facility in Charlotte, NC to the Lake Wateree Mosquito Control Facility to transport transformer oil, making its use at Wateree impractical.

Evidence discovered during this litigation corroborates Duke's understanding. Bob Barden was first employed at Duke starting in 1973, and he testified that nothing was used in the MCP except No. 2 fuel oil while he worked there. He also testified that George Swearingen possessed a letter from the U.S. Coast Guard that authorized Duke Power to spray No. 2 fuel oil onto reservoirs, despite the fact that it created a visible sheen. Spraying of No. 2 fuel oil did not violate the CWA, even though the statutory definition of "oil" included "fuel oil," because it was

not understood to be a waste oil for which a permit was required. *See Nat'l Cotton Council of Am. v. EPA*, 553 F.3d 927, 936 (6th Cir. 2009) ("[A]s long as the chemical pesticide 'is intentionally applied to the water [to perform a particular useful purpose] and leaves no excess portions after performing its intended purpose[], it is not a "chemical waste,"' … and does not require an NPDES permit.").

INTERROGATORY NO. 18:

Identify the total approximate volume of transformer oil used as part of the Mosquito Control Program.

OBJECTIONS AND ANSWER:

Defendants incorporate by reference their objections to Plaintiff's definitions as if fully set forth herein, including specifically the definition of "transformer oil." Defendants object to this Interrogatory as overly broad, unduly burdensome, vague, ambiguous, not limited to any specific time period, and not proportional to the needs of the case, including specifically insofar as the Interrogatory seeks information pertaining to Mosquito Control Program activities that were carried out anywhere other than on Lake Wateree, which is the subject of this action. Defendants further object to this Interrogatory to the extent that it calls for expert testimony, analysis, and opinions that are beyond the scope of permissible fact discovery.

Subject to and without waiving their objections, Defendants incorporate by reference their response to Interrogatory No. 17 as if fully set forth herein. Responding further, Defendants stated that, based on information and belief after reasonable search and inquiry, the approximate volume of transformer oil used at Lake Wateree is zero.

SUPPLEMENTAL RESPONSE:

Defendants have no record of applying any quantity of transformer oil to Lake Wateree. Notably, not one of the spray logs for the Lake Wateree Mosquito Control Program reflects the

use of transformer oil.

INTERROGATORY NO. 19:

State what year Defendants last used transformer oil as part of the Mosquito Control Program and why Defendants stopped using it.

OBJECTIONS AND ANSWER:

Defendants incorporate by reference their objections to Plaintiff's definitions as if fully set forth herein, including specifically the definition of "transformer oil." Defendants object to this Interrogatory as overly broad, unduly burdensome, vague, ambiguous, not limited to any specific time period, and not proportional to the needs of the case, including specifically insofar as the Interrogatory seeks information pertaining to Mosquito Control Program activities that were carried out anywhere other than on Lake Wateree, which is the subject of this action. Defendants further object to this Interrogatory to the extent that it calls for expert testimony, analysis, and opinions that are beyond the scope of permissible fact discovery.

Subject to and without waiving their objections, Defendants incorporate by reference their responses to Interrogatory Nos. 17 and 18 as if fully set forth herein. Responding further, Defendants stated that, based on information and belief after reasonable search and inquiry, transformer oil was never used in the Mosquito Program at Lake Wateree.

SUPPLEMENTAL RESPONSE:

Defendants incorporate by reference their supplemental response to Interrogatory No. 17.

Respectfully submitted,

Dated: April 6, 2026

/s/ Kevin A. Dunlap
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Attorneys for Defendants

IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF SOUTH CAROLINA
COLUMBIA DIVISION

Clyde Marcus Jones, II, on behalf of himself and all others similarly situated, Plaintiffs, v. Duke Energy Corporation and Duke Energy Carolinas, LLC, Defendants.	Civil Action No.: 3:24-cv-1281-MGL **CERTIFICATE OF SERVICE**

I hereby certify that on April 6, 2026, I served Defendants' Fourth Supplemental Responses to Plaintiff's Interrogatories on Plaintiff via email, addressed as follows:

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IN THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF SOUTH CAROLINA
COLUMBIA DIVISION

Clyde Marcus Jones, II, on behalf of himself and all others similarly situated, Plaintiffs, v. Duke Energy Corporation and Duke Energy Carolinas, LLC, Defendants.	Civil Action No.: 3:24-cv-1281-MGL **VERIFICATION**

COMES NOW Zachary S. Hall who deposes and states that he is Duke Energy Corporation's Vice President of Environmental, Health & Safety and he is authorized to make this verification on behalf of Defendants.

The undersigned has reviewed Defendants' Fourth Supplemental Responses to Plaintiff's Interrogatories (the "Supplemental Responses") and states that the Supplemental Responses were prepared with the assistance of counsel and with the assistance of, and in reliance upon, other employees of Defendants. The Supplemental Responses are based upon and necessarily limited by information currently recollected and documents currently collected.

Subject to the foregoing limitations, the undersigned states that the Supplemental Responses are true and correct where derived from his own knowledge and, where derived from the knowledge of others, are true and correct to the best of his knowledge, information, and belief.

April 6, 2026

Zachary S. Hall

Exhibit 43

Christina Brunk Deposition Excerpts

A. I don't think so.

Q. Will you look at paragraph 30 of your report, please.

A. Sure. Yes.

Q. Would you agree that Lake Wateree is known for fishing and recreation?

A. I'm sorry, is that in here?

Q. It says "Today Lake Wateree is a destination for campers, fishermen, bird-watchers, and recreational boaters."

A. Yes.

Q. Okay.

A. I agree with that.

Q. Okay. And did you know that Lake Wateree is under a fish consumption advisory due to the presence of PCBs before you became involved in this case?

A. No.

Q. And sitting here today, are you aware that Lake Wateree is under a fish consumption advisory due to PCBs?

A. Yes.

Q. And how did you first learn about the fish consumption advisories for Lake Wateree?

A. Probably reading the complaint. It may be

A. Because of all of the things we document in the first opinion as to how this is a public -- a piece of public information. Public knowledge.

Q. Do you know how many of the sellers in the approximately thousand transactions you reviewed were actually aware of the fish consumption advisory?

A. We document several of those in the report. Folks that we know had explicit knowledge and sold. But I don't know the total number.

Q. Do you agree that the primary attraction of the properties on Lake Wateree is the lake?

MR. LONG: Object to the form.

You can answer.

THE WITNESS: I mean, I certainly think if you are buying a property on Lake Wateree, the lake is a huge draw.

BY MS. DINKINS:

Q. At least the vast majority of houses that were built on Lake Wateree were built there because of the lake, right?

A. I would think so.

Q. Okay. If you'll look at page 31 of your report.

A. Okay.

Q. And page 31 begins the discussion of your

Exhibit 44

Dr. Gretchen Greene Expert Report

Damage Estimate in the Matter of Jones v. Duke



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Damage Estimate in the Matter of Jones v. Duke

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2/10/26

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1. Opinions

Lake Wateree is a central South Carolina lake that supports both residential living and local recreation. Since 2010, the lake has been subject to a state-issued Fish Consumption Advisory due to PCB contamination.[1] Although the lake remains biologically productive, the advisory limits safe use and has changed how residents perceive water quality. Those constraints translate into real economic damages for people who live and rely on the lake. This report will quantify economic losses to shoreline property owners as a result of poor water quality caused by the PCB contamination. The quantification of these losses is separated into three categories of detrimental economic effects to such property interests that are most often studied. These are diminution in property value, homeowner loss of use and enjoyment of the property, and natural resource damages. Using a variety of data sources including parcel-level property data, recreational fishing data, and standard tools from environmental and real estate economics, each of these damages is estimated for the class of homeowners.

Damages to Property Values

Comparative studies of shoreline property values and water contamination have been ongoing in this country since the 1960s.[2] A review of this economic evidence from comparable inland lake markets shows that clean, fully usable lakes typically support lake-related property premiums of 5 percent to 61 percent. Using a conservative estimate of 12 percent of total property value loss deriving from the contamination at Lake Wateree, damages are estimated to be at least **$144,906,649** out of the over $1.2 billion value of waterfront property.

The estimate of lost value was corroborated through a model developed to see if property values on Lake Wateree indeed demonstrate conventional waterfront values as seen elsewhere. A hedonic property value model was created that shows property values in Kershaw County behave as expected. Once the influence of square footage, and lot size for parcels is included, the model shows that waterfront properties indeed showed a premium for different levels of water amenity. The estimates of water-derived value compare to similar literature on this topic and support the analysis that the water amenity value in this market is diminished.

Loss of Use and Enjoyment

Homeowners on Lake Wateree purchased their homes in part to have access to recreational fishing on the lake. A robust body of economic research has been developed to quantify the value of recreational fishing that is lost to anglers due to the presence of fish consumption advisories. An estimate of the number of trips taken per year is estimated, and the foregone value of each trip due to the advisories is developed. The losses are evaluated for past losses and future losses to estimate the complete damages.

[1] *South Carolina Department of Health and Environmental Control (SCDHEC). Fish Consumption Advisories. Accessed October 2025.* *https://des.sc.gov/data-tools/fish-consumption-advisories/lake-wateree-fish-consumption-advisory*

[2] Nicholls, Sara, and John L. Crompton. 2018. "A Comprehensive Review of the Evidence of the Impact of Surface Water Quality on Property Values." *Sustainability* 10, no. 2: 500. https://doi.org/10.3390/su10020500

Across roughly 2,045 waterfront homes, an estimated 5,174 residents live adjacent to the lake. Using participation and trip frequency data from the U.S. Fish and Wildlife Service, an estimated 11,680 fishing trips are taken per year by lakefront homeowners. The per-trip loss of value for the presence of fish consumption advisories is estimated to be about 14 percent of the value of a trip; or $9.31[3] per trip. Annual recreational losses to lakefront residents are estimated at approximately $84,777. Summing those losses over the roughly 15-year duration of the advisory, and the anticipated future presence of the advisory to the year 2040, the total damages are estimated to be **$2.7 million**.

Natural Resource Damage Assessment

Natural resource damages are typically derived from injuries to public natural lands. Damages are calculated for ecological harm, as well as human use loss The human use damage would, in this case, likely center around the lost value to recreational anglers, but would apply to all of the anglers who are not also homeowners. Applying the same participation and valuation framework to the full populations of Kershaw, Lancaster, and Fairfield Counties that live around Lake Wateree yields cumulative recreational fishing losses estimated at approximately $67 million for past damages between 2010 and 2025, and $39.7 million for future damages to 2040. This totals **$106.8 millio**n over the duration of the advisory. These figures are presented for context only and are not included in plaintiff-specific damages.

Summary

Taken together, the results show that Lake Wateree's economic value is closely linked to water quality and safe use, and that continued contamination and advisory conditions leave both recreational value and property value diminished absent remediation. The estimated total damages are $144.9 million for property values, and $2.7 million for lost use and enjoyment for a grand total of **$147.6 million.**

[3] Jakus et al. 1998; Morey and Breffle 2006 (updated to 2020 dollars)

2. Facts and Data Considered in the Case

In the early part of the 20th century, growing demand for electricity led to installations of sundry hydro-electric generating dams throughout the U.S. These installations created new lakes of various sizes. About eight miles north of Camden, in Kershaw County, South Carolina, the Duke power defendants' predecessors (altogether, "Duke") built the hydroelectric station that created Lake Wateree.

The newly created Lake Wateree shoreline came to be vested in the plaintiffs herein, who allege suffering damage as a result of Duke's misconduct. In order of appearance in their amended complaint, Plaintiffs recite suffering damage by diminution of property values, degradation of natural resources, financial loss, loss of use and enjoyment of property, natural resource damages, infringement upon inalienable property rights, increased risk of exposure to PCBs, and physical or emotional injuries.

The first formal PCB fish consumption advisory for Lake Wateree was issued in May 2010 and remains in effect today.[4] The current advisory recommends one meal per week for black crappie and one meal per month for blue catfish, channel catfish, largemouth bass, striped bass, and white bass. This followed EPA testing in 2009 that showed PCB levels in fish above federal safety standards. Advisory signage was posted at lake access points in August 2010, more than a year after the contamination results were first reported. Over time, the advisory has expanded to cover multiple species and remains active in 2026.

This report quantifies the damages plaintiffs suffered across three categories: Diminution in Property Values/Financial Loss, Loss of Property Use and Enjoyment, and Natural Resource Damages. For each category of complaint, damages will be quantified using the most common economic methods, the best available data to achieve a reasonable degree of certainty.

Damages to Property

The combined assessed value of the 2,045 lakefront properties in our study is $1,207,555,412 based on county assessor parcel data, particularly the official market valuations used for taxation and appraisal. Assessed values provide a consistent and comprehensive measure of relative property value across the lake.

We used two strategies to estimate the magnitude of property damages in Lake Wateree. The first is based on economics research of differing water quality factors and contaminants on waterfront properties. Using a percent of loss overall value, this loss estimate is multiplied by the total value of the properties to estimate damages.

Next, to support estimates of comparable damages from economic research, properties on Lake Wateree are analyzed to determine how the assessed property values conform with other analyses of waterfront properties. This was done using data from Kershaw County.

[4] South Carolina Department of Health and Environmental Control (SCDHEC). Fish Consumption Advisories. Accessed October 2025. *https://des.sc.gov/data-tools/fish-consumption-advisories/lake-wateree-fish-consumption-advisory*

Research Review

Researchers have studied how pollution affects home values for decades. These studies show that when lakes are polluted or unsafe to use, nearby homes lose value. The size of the loss is not random. It falls within a fairly consistent range across different places and different types of contamination.

In a published 1992 study, Mendelsohn and his coauthors examined home sales near PCB-contaminated waters in New Bedford Harbor, Massachusetts.[5] The authors analyzed repeat sales of the same homes over time, allowing them to compare prices before and after the PCB contamination became widely known. This approach controlled for housing characteristics and broader market trends and isolated the effect of contamination awareness. The study reports a mean home value of $71,630 in the sample. After PCB contamination became public, homes closest to the contaminated harbor sold for $7,000 to $10,000 less than comparable homes farther away. Relative to the mean home price, this corresponds to a price reduction of approximately 9 to 14 percent ($7,000 ÷ $71,630 ≈ 9.8%; $10,000 ÷ $71,630 ≈ 14.0%).

In a published 2023 study, Cassidy, Meeks, and Moore reviewed housing markets near polluted waters in the Great Lakes region. They compared home prices near contaminated areas to similar homes farther away and tracked prices over time, including before and after cleanup. When an area was officially designated as contaminated, the study found nearby home values dropped by 15.8 percent. When cleanup finally occurred, much of that lost value returned. This study shows that contamination alone, even without visible damage to homes, can reduce property values by around 16 percent.[6]

In 2022, Gardner looked at homes near two lakes in Michigan with long histories of industrial pollution, including oil spills and chemical waste. He compared home prices near the polluted lakes to similar homes farther away and looked at how prices changed after cleanup. The study found that homes near contaminated lakes lost 10.3 to 12.4 percent of their value. After cleanup, losses were reduced to 3.3 to 4.5 percent, meaning most of the lost value was recovered. This study shows that contamination typically reduces home values by about 10 to 12 percent, and that cleanup restores much of that value.[7]

In 2015, Tuttle and Heintzelman studied mercury contamination and property values, looking at more than 12,000 home sales near lakes in the Adirondacks. Mercury made fish unsafe to eat, even though the lakes still looked clean. They found that lakes with mercury contamination experienced statistically significant declines in nearby home values, showing a 23 to 29 percent decline in waterfront property values for lakes that had low pH levels (associated with mercury contamination).

More broadly, Nicholls and Crompton reviewed more than 40 different studies that examined water quality and home values across the United States. Rather than studying one lake, they summarized results from many places. They found that most studies showed property value losses from poor water quality in the range of 5 to 15 percent, with larger losses when pollution affected recreation or safety.

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[5] Mendelsohn, R., Hellerstein, D., Huguenin, M., Unsworth, R., & Brazee, R. (1992). Measuring hazardous waste damages with panel models. Journal of Environmental Economics and Management, 22(3), 259–271. https://doi.org/10.1016/0095-0696(92)90032-R.

[6] Cassidy, Alecia, Robyn Meeks, and Michael R. Moore. 2023. "Cleaning up the Great Lakes: Housing Market Impacts of Removing Legacy Pollutants." *Journal of Public Economics* 225: 105012. https://doi.org/10.1016/j.jpubeco.2023.105012

[7] Gardner, Gregory. 2022. "Economic Benefits of Remediating the White Lake and Muskegon Lake Areas of Concern." *Journal of Great Lakes Research* 48, no. 4: 1070–1081. Economic benefits of remediating the White Lake and Muskegon Lake Areas of Concern | Request PDF

This review confirms that losses in the single-digit to low-teen percentage range are common and widely accepted in the economics literature.[8]

In another survey of geographies, Michael Moore and his coauthors studied how lake water clarity affects nearby home prices across 113 lakes in the United States. They found that for every 0.1 meter improvement in water clarity, nearby homes were worth about one percent more on average. That means clearer water is something people value and are willing to pay for in the housing market. Their work shows that water quality is an important part of what makes lake homes more valuable, even if the homes themselves haven't changed.[9]

Collectively these studies confirm the impact of water quality on home values. Because the estimates of percent of home value lost ranges from 5 to 29 percent, a central and conservative value of 12 percent loss for Lake Wateree is selected. This value is also the center value from the Mendelsohn study, which was focused on PCB contamination.

Kershaw County Benchmark

The research reviewed above provides clear evidence of the effect of poor water quality on property values. The following analysis was developed to see if the Lake Wateree home values are expected to behave in a similar way. Kershaw County data for the Lake Wateree waterfront homes provide a clear and practical benchmark for interpreting whether Lake Wateree may be expected to follow patterns similar to other areas where water quality is linked to home values.

For example, a hedonic property value study by Espey et al.,[10] analyzed residential property values across three counties in upstate South Carolina. That study separated the effects of urban versus rural location from the effects of lake proximity, allowing the value of water access itself to be isolated. Using observed property transaction data, Espey found that parcels with direct lakefront locations command premiums of approximately 52 to 61 percent, properties with direct lake access saw premiums of 34 to 39 percent, and properties with lake views alone command premiums of 26 to 36 percent, relative to otherwise comparable non-lake properties. These represent large portions of total property value attributable specifically to proximity to water. Importantly, the study shows that water proximity mattered far more than whether a property was urban, suburban, or rural, underscoring the central role of lake access in residential pricing.

As the Espey study examines inland lakes within the same regional housing market context as Lake Wateree and employs a standard hedonic property value framework, it provides a particularly relevant benchmark for expected lake-related premiums under clean and fully usable conditions. To evaluate lake-related value premiums at Lake Wateree, a simple hedonic regression model was estimated, using

[8] Nicholls, Sara, and John L. Crompton. 2018. "A Comprehensive Review of the Evidence of the Impact of Surface Water Quality on Property Values." *Sustainability* 10, no. 2: 500. https://doi.org/10.3390/su10020500

[9] Moore, Michael R., Jonathan P. Doubek, Hui Xu, and Bradley J. Cardinale. 2020. "Hedonic Price Estimates of Lake Water Quality: Valued Attribute, Instrumental Variables, and Ecological-Economic Benefits." *Ecological Economics* 176: 106692. https://doi.org/10.1016/j.ecolecon.2020.106692

[10] Espey, M., Espey, J., & Shaw, W. D. (2007). Price determinants of residential properties: Evidence from three counties in upstate South Carolina. *Journal of Real Estate Research, 29*(4), 447–460.
https://ageconsearch.umn.edu/record/37055/files/Espey%20JAAE%20December%202007.pdf

parcel-level data for approximately 1,300 waterfront properties in Kershaw County, representing a substantial sample of the Lake Wateree housing market. Details of this model are provided as Exhibit A.

Our results indicate that open-water (Big Water) properties command an average premium of approximately $93,454, while Mid-Cove properties command an average premium of approximately $43,744, relative to baseline shoreline parcels. These estimates represent some of the lake value inherent to the at-risk properties surrounding Lake Wateree. It reflects that there is a portion of market value clearly most sensitive to water quality, fish safety, and lake reputation. These asset value increments, however, fall short of what Espey found to be the water-related housing value premium of 34 to 61 percent. This is likely because the data used included only lakefront properties, and so the basic value difference between simple waterfront and non-waterfront is not known at this time. Still, the Big Water and the Mid-Cove premiums, over and above the unknown simple waterfront premium, align with other research on waterfront property value behavior. Using the minimal lake premium found by Espey—at 34 percent—we might estimate that the Mid-Cove and Big Water premiums (representing 13 percent and 23 percent of the mean value for each category respectively) would add to this for a total of 47 and 57 percent of the total value dependent on the lake itself. Assuming the share of properties that are simple waterfront, Mid Cove, and Big Water are the same as seen in Kershaw County, (7.7, 32.1, and 60.2 percent respectively) this suggests a combined value of at least $626.9 million that would be dependent upon the lake itself – or about 52 percent.

Given the long-standing contamination and the presence of fish consumption advisories which constrain recreational use and influence buyer perceptions, such lake-derived value (from a clean and remediated lake) is likely not being realized at Lake Wateree This benchmarking and deeper analysis supports the idea that – instead of 34 percent of value from water as is found in Espey – approximately 22 percent might represent the simple waterfront value at Lake Wateree (12 percent less following the review of research). If this were the case, the results would support the initial $144.9 million damage estimate.

Total Damages

Taken together, the body of evidence from the research review, and the analysis of property values in Kershaw County supports a conservative estimate of approximately 12 percent to represent the contamination-related suppression of lake amenity value. Importantly, this estimate does not assume either a collapse in property markets nor the full capitalization of contamination effects in the real estate market. Rather, it reflects a partial erosion of the lake-related premium consistent with documented impacts of contamination and long-standing advisories in comparable systems.

Applying this conservative 12 percent amenity suppression scenario to the estimated **$1.2 billion** in lake-dependent property value yields **$144,906,649** in estimated lake wide property value exposure attributable to contamination-related stigma and restricted use. This figure represents total damage to property value until remediation and advisory removal could restore full market confidence. The estimate is developed using standard economic methods for assessing loss and are determined with a reasonable amount of certainty.

Loss of Personal Use and Enjoyment

The use and personal enjoyment of lakefront property typically involves being able to recreate in and on water with relative ease. This includes boating, fishing, swimming, and other water-based recreational

activities. When fish consumption advisories are in place, a reduced level of enjoyment is expected from a fishing trip, and also homeowners might take fewer trips, and/or more trips to other locations. Empirical studies of recreation demand find anglers are less likely to select waters with consumption advisories relative to otherwise comparable waters. Advisories create a "quality penalty" even when fishing is still allowed. Because advisories restrict safe consumption, they reduce the utility of fishing for the anglers who value harvest and perhaps feed the fish to children or would like to frequently consume them. For the plaintiffs, the lake is the proximate, default site. A moderate suppression rate captures reduced casual trips, reduced harvest-oriented trips, and reduced household participation without assuming total elimination.[11]

The total number of fishing trips taken by lakefront property owners in one year can be estimated using a series of calculations involving different known values. It is known, for example, that there are 2,045 homes within the study area; an average household size of 2.53,[12] therefore, puts the total population at approximately 5,174.

The United States Fish and Wildlife Service claims that the 2022 freshwater fishing participation rate in South Carolina was 11 percent.[13] Accordingly, we can estimate 569 lakefront anglers enjoy an average fishing frequency of 16 trips, per angler, per year. This brings the reasonably estimated total number of annual lakefront fishing trips to 9,106.

Losses are modeled conservatively, as a partial suppression of fishing activity (reduced trips and/or reduced willingness to harvest/consume), rather than a complete loss of fishing. The total annual value of lakefront fishing trips for this population can be found by multiplying the number of annual trips (9,106) by the value of each trip (a figure which is estimated at $66.22) to generate a total annual value to affected property owners, of approximately $602,998.

The literature in other areas of the country, where fish consumption advisories for PCBs were either removed (an increase in value) or installed (a decrease) suggest $9.31 as the increment, per trip, for enjoying or losing the prerogative to consume the fish that are caught. [14] Multiplied by the reasonably approximated 9,106 number of trips in our test generates $84,777 in annual estimated loss from fish consumption advisories.

In calculating damages which occur over time, annual damages need to be totaled for past losses, and for future losses. A rate of three percent is customary for discounted future losses and compounded past losses. An equation for each summation is provided below to clarify the calculations.

[11] Jakus, P. M., Downing, M., Bevelhimer, M. S., & Fly, J. M. (1997). Do sportfish consumption advisories affect reservoir anglers' site choice? *Agricultural and Resource Economics Review, 26*(2), 198–204. https://doi.org/10.1017/S1068280500002665.

[12] US Census Bureau. Quick Facts: Kershaw County, South Carolina. Available here.

[13] US Fish & Wildlife Service. 2023. 2022 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Available here.

[14] Jakus et al. 1998; Morey and Breffle, 2006 (updated to 2025 dollars).

The equation for past losses back to 2010 when fish consumption advisories were first introduced:

$$\sum_{t=2010}^{2025} L_t * (1+r)^{(2025-t)}$$

Where,

- L is the annual value of losses ($84,777)
- r is the discount rate
- t is the year, or time

And the equation for future losses to 2040 is:

$$\sum_{t=2026}^{2040} L_t * (1+r)^{(2025-t)}$$

This results in a total of approximately $1.71 million in past losses since 2010, and an estimated $1.01 million in future losses from present day to 2040, for a **total damage of $2.72 million.**

Countywide Recreational Losses (NRDA)

Natural resource damages are typically owed to the public for harming natural lands. Damages are calculated for ecological harm, as well as loss of human use. The human use damage would, in this case, likely center around the lost value to recreational anglers, but would apply to all of the anglers who are not also homeowners. Applying the same participation and valuation framework to the broader population living around Lake Wateree yields substantially larger aggregate losses for the counties. There were approximately 204,000 people in the three-county area of Kershaw, Lancaster, and Fairfield County, South Carolina in 2024.[15] When generalized to these counties, cumulative recreational fishing losses are estimated at approximately $67 million for past damages between 2010 and 2025, and $39.7 million for future damages to 2040. This totals **$106.8 millio**n over the duration of the advisory. These figures are presented for context only and are not included in plaintiff-specific damages.

Summary

Damages to plaintiffs were evaluated across two distinct and non-overlapping channels: lost recreational use and enjoyment, and diminished property values due to contamination. The methods applied reflect standard practice in environmental economics, natural resource damage assessment, and hedonic property valuation.

Recreational losses were estimated using a participation-based valuation framework that multiplies the affected population by fishing participation rates, average trip frequency, and per-trip recreational value. This approach captures reductions in use and enjoyment attributable to contamination-related

[15] U.S. Census Bureau website, data for 2024, available here.

advisories. The estimated damages for foregone use and enjoyment totals **$2.72** million for the period between 2010 and 2040. Should conditions persist beyond that, the damages would be larger.

Property value impacts were evaluated using a review of similar literature demonstrating how property values are harmed by contaminated waters. A 12 percent loss is estimated for Lake Wateree, producing an estimated loss of **$144.9** million for the class. In an effort to benchmark the results to Lake Wateree, a regression model was developed for the study area, and results support the conclusion that the waterfront property values at Lake Wateree are vulnerable to the same losses as waterfront properties on other geographies experiencing similar water quality contamination. Total damages are therefore estimated to be **$147.6 million.**

3. Exhibits

Two exhibits are provided to support this expert report. Exhibit A covers details surrounding the hedonic property value model used to support the diminished property value estimation. Exhibit B is a copy of Dr. Greene's Curriculum Vitae.

Exhibit A – Hedonic Property Value Model

Objective

The goal of this analysis is to understand how property values around Lake Wateree are structured, and how much of the market depends on lake-related location premiums rather than just house characteristics. This matters because contamination risk affects value through the lake itself. If the lake becomes less usable or carries stigma, the highest exposure properties are the ones whose value is most tied to water access and shoreline position. This analysis is designed to quantify that dependence in a defensible way.

Data Preparation

The dataset comes from Kershaw County parcel-level assessor records and includes roughly 1,366 parcels around Lake Wateree. Key fields include:

- total appraised value
- square footage
- acreage
- primary neighborhood (lake segment)
- land-use codes
- dock indicators

Appraised value is used as the dependent measure because it provides a consistent valuation benchmark across the entire lake market even without sale-by-sale transaction data.

Kershaw Data Summary

Neigh_Group	Count	Value Median	Value Mean	Sqft Median	Acre Median
Other	105	167,400	224,596	1,529	0.96
MidCove	439	282,000	327,877	1,599	0.79
BigWater	822	359,650	412,664	1,747	0.78

Several steps were taken to modify the data so that it would be appropriate for use in the regression model. This was necessary because assessor data contains zeros, missing entries, and mixed land classifications.

Square footage values of zero or negative were treated as missing, not real home sizes. These parcels were not removed from the dataset overall, but they were excluded from any calculations requiring valid structure size (such as value per square foot). A zero square footage entry usually reflects an undeveloped lot or missing assessor detail, not an actual zero-sized structure.

Acreage values were retained whenever positive. Parcels with very large acreage were kept in the dataset because they represent real legacy tracts on the lake, even if they behave differently from typical residential parcels. Invalid acreage values were treated as missing only where acreage-based calculations were needed.

Several variables were evaluated but ultimately excluded from the final specification:

- Year built was too incomplete and inconsistent to rely on.
- Dock presence was tested but did not add independent explanatory power once lake geography was controlled for.
- Land use categories were simplified, but detailed land-use controls were not emphasized because they overlap strongly with acreage effects.

The goal was to keep the model interpretable and focused on lake exposure.

The primary neighborhood codes were grouped into three meaningful lake segments:

- Big Water (LWBW): open-water access and highest premium shoreline
- Mid-Cove (LWMC): transitional areas with partial exposure
- Other / Cove baseline: sheltered segments with lower premiums

This segmentation captures the basic geographic structure of the lake market. Open-water usability and perceived water quality differ across these zones, and values reflect that.

To improve interpretability, the two continuous structural variables in the dataset, square footage and acreage, were transformed into mean-centered measures:

- sqft_centered = sqft_clean – mean(sqft_clean)
- acre_centered = acreage_clean – mean(acreage_clean)

Centering ensures that the regression intercept corresponds to a realistic baseline parcel with average characteristics. In this specification, the structural coefficients are interpreted as the marginal value associated with being above or below the lakewide average home size or lot size.

Because Lake Wateree includes a small number of unusually large parcels and structures, medians were also computed to describe a typical shoreline property:

- Median square footage ≈ 1,674 sq ft
- Median acreage ≈ 0.79 acres

Regression Model

The final hedonic pricing model was estimated using Ordinary Least Squares (OLS) to quantify how property values vary across Lake Wateree shoreline segments after controlling for basic structural characteristics.

The final descriptive specification is:

$$value = neigh_{group} + sqft_{centered} + acre_{centered} + \varepsilon$$

where,

- **value** is the total appraised value of the parcel
- **neigh_group** is a categorical shoreline exposure indicator with three levels:
  - Other/Cove baseline (reference group)
  - Mid-Cove
  - Big Water
- **sqft_centered** measures home size relative to the lakewide mean
- **acre_centered** measures lot acreage relative to the lakewide mean, and
- ε is a term that covers the remaining factors affecting value

This model results are shown below and is designed as a descriptive decomposition of value rather than a predictive pricing tool. The coefficients quantify systematic lake-location premiums while holding constant typical differences in house size and land area.

Hedonic Regression Results

```
> summary(model_clean)

Call:
lm(formula = value ~ neigh_group + sqft_centered + acre_centered,
    data = wat)

Residuals:
    Min      1Q  Median      3Q     Max
-305679  -62098  -20453   26850 1237012

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)       337615.31   16527.14  20.428  < 2e-16 ***
neigh_groupMidCove  42744.01   17882.89   2.390    0.017 *
neigh_groupBigWater 93454.88   17263.28   5.414 7.56e-08 ***
sqft_centered         131.97       3.66  36.062  < 2e-16 ***
acre_centered        2244.76     540.68   4.152 3.55e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 128700 on 1120 degrees of freedom
  (241 observations deleted due to missingness)
Multiple R-squared:  0.5688,    Adjusted R-squared:  0.5673
F-statistic: 369.4 on 4 and 1120 DF,  p-value: < 2.2e-16
```

The final model explains roughly 57 percent of the variation in appraised values, which is strong for heterogeneous lakefront real estate data.

The regression results identify large and statistically significant location premiums. Holding home size and acreage constant Mid-Cove parcels carry an estimated premium of approximately $42,744 and Big Water parcels carry an estimated premium of approximately $93,455 relative to the baseline segment.

These effects confirm that shoreline geography is a dominant driver of value around Lake Wateree, independent of structural housing characteristics.

The intercept of the centered model represents the expected value of a baseline parcel with average acreage and square footage in the Cove/Other reference segment. This baseline value is approximately $338,000, providing the anchor point from which the Mid-Cove and Big Water premiums are interpreted. The model also confirms expected structural relationships. Each additional square foot above the lakewide average is associated with roughly $132 in appraised value, while each additional acre above the lakewide average contributes approximately $2,245. Structure size remains important, but the shoreline exposure premiums are substantial even after controlling for these factors.

Defining a Typical Home

To make the regression results easier to interpret, the analysis defines a "typical" Lake Wateree parcel using the median physical characteristics of the shoreline housing stock and the baseline neighborhood category. This reference parcel is intended to represent a standard home in the Cove/Other segment, rather than an unusually large tract or high-end outlier.

In practical terms, the typical parcel is characterized by approximately 1,674 square feet of living area and about 0.79 acres of land, which correspond to the median values in the dataset. Because the regression is estimated using mean-centered predictors, these characteristics are expressed as deviations from the lakewide averages. Specifically, square footage is centered as 1,674 minus the mean square footage, and acreage is centered as 0.79 minus the mean acreage.

Under this centered specification, the regression intercept represents the expected value of a baseline Cove/Other parcel with average acreage and square footage. This intercept serves as the anchor point from which the Mid-Cove and Big Water location premiums are interpreted.

Interpretation Framework

All regression coefficients are interpreted as adjustments relative to this baseline parcel. The Mid-Cove coefficient captures the value difference associated with Mid-Cove location compared to an otherwise similar parcel in the Cove/Other segment. The Big Water coefficient measures the additional premium associated with open-water exposure. The centered square footage and acreage terms reflect the marginal contribution of being above or below the lakewide average in home size or lot size.

Together, this framework provides a clear way to separate structural value from lake-dependent location value. It supports the broader conclusion that property values around Lake Wateree are systematically shaped by location relative to the lake.

Exhibit B – Dr. Greene Curriculum Vitae

GREENE ECONOMICS



Gretchen Greene, PhD

PRINCIPAL ECONOMIST/MANAGING PARTNER

Dr. Gretchen Greene has over 30 years of diverse economics experience in water management, energy, and community economics. Dr. Greene has expertise in ecosystem service valuation, natural resource damage assessment (NRDA), recreation, and public infrastructure investment. She also brings expertise in endangered species economics; land conservation and sustainable economic development; benefit cost analysis; demographics, socioeconomics, and environmental justice; decision analysis with uncertainty; and survey design and data analysis. She has worked as an independent external reviewer for the US Army Corps of Engineers with expertise in benefit cost analysis, flood damages, transportation costs, and plan formulation. An experienced facilitator, Dr. Greene has developed focus groups and surveys covering a variety of environmental topics. She has worked in dozens of different cultural environments, from southern Africa to Mongolia to Native American communities. She has worked with numerous federal, state, tribal, and municipal agencies as well as private industrial clients and law firms.

Qualifications

- PhD, Food and Resource Economics: University of Florida, Gainesville, FL
- MS, Food and Resource Economics: University of Florida, Gainesville, FL
- BA, Religion Studies: Wellesley College, MA

Professional Associations

- American Water Research Association (AWRA)
- Population Association of America (PAA)
- American Agricultural Economic Association (AAEA)

Key Skills

- Benefit Cost Analysis
- Ecosystem Service Valuation
- Natural Resource Damage Assessment
- Water Resource Management
- Economics of Recreation
- Public Infrastructure Investment
- Economic Decision Making Under Climate Uncertainty

Selected Project Experience

Water Management and Natural Resource Damages

Little Colorado Basin Adjudication, Department of Justice - Arizona

Dr. Greene testified in court and by deposition regarding the future domestic, commercial, municipal, and industrial water needs of Hopi Indian Reservation and the Navajo Indian Reservation within the Little Colorado River Basin, Arizona and New Mexico. *In re Little Colorado River System and Source*, No. 6417-203 (Ariz. Super. Ct. (Apache Cty.)

Settlement Support, Natural Resource Damage Case, Briggs and Morgan – Albemarle Sound, North Carolina

Dr. Greene reviewed the analysis of recreational fishing values in the Roanoke River and Albemarle Sound in support of a confidential client of Briggs and Morgan. In response to the review, Dr. Greene led a team that conducted an alternative valuation of the economic damages resulting from historic releases to the sound and a series of fish consumption advisories. Dr. Greene worked with the client to develop strategies and presentation materials for the on-going settlement negotiations.

Development of Baseline Information System Related to Gulf Oil Spill, Arnold and Porter – Washington DC

Dr. Greene led the human-use side of developing a Web-based information management system that compiles, evaluates, and facilitates access to publicly available data, reports, articles, and geospatial information related to baseline ecological and human-use services provided within the Gulf of Mexico. The system was used to aid in determining the public loss related to the spill.

Phase 2 of an analysis of the Hudson River Polychlorinated Biphenyl (PCB) Natural Resource Damage Assessment (NRDA), Scenic Hudson, Inc- NY

Dr. Greene was part of a team for Phase 2 of an analysis of the Hudson River Polychlorinated Biphenyl (PCB) Natural Resource Damage Assessment. Dr. Greene developed preliminary estimates of damages associated with injury to the natural environment including historic and future value for foregone and diminished recreational fishing and a preliminary estimate of water quality. The analysis of recreational fishing uses a functional benefit transfer approach based on a meta-analysis of economic literature associated with fishery consumption advisories. The water quality estimate used a unit benefit transfer approach.

Fish-Consumption and Recreation Survey, Upper Columbia River Remedial Investigation/Feasibility Study and Human Health Risk Assessment, Teck Cominco – Spokane, Washington

Dr. Greene worked with the U.S. Environmental Protection Agency and the National Park Service in the RI/FS process of assessing risk to human health. She oversaw and reviewed the Upper Columbia River recreation and fish-consumption surveys. She reviewed and developed the data quality objectives, survey sample design, survey instrument, enumeration, and data analysis steps of the process.

Human Use Impacts Resulting from Petroleum Corporation Oil Spill, CITGO – Louisiana

Dr. Greene assessed the human use impacts resulting from a CITGO oil spill in the Calcasieu River Estuary in Louisiana. A series of site visits and helicopter overflights was conducted to investigate the recreational sites and types of activities potentially affected by the spill and the level of recreational activity in the spill impact zone. Dr. Greene designed and implemented a recreational use survey and analyzed survey data and other information to estimate the economic value of lost and diminished recreational use.

Expert Witness on Present Water Use and Future Water Needs for Domestic, Commercial, and Municipal Purposes and Present and Future Comprehensive Groundwater Need, Lummi Indian Nation – Washington

Dr. Greene served as expert witness on the domestic, commercial, and municipal water needs of the Lummi Nation. The work included conducting a population projection and estimating the future water requirements of the Tribe on a per capita basis. Water demand forecasts were used in this study covering the comprehensive groundwater needs of the Lummi Nation. Dr. Greene contributed a socioeconomic analysis of the reservation. *U.S. v. State,* No. 01-0047 (W.D. Wash. *allowing testimony over objection* Feb. 22, 2005).

Traditional Ecological Knowledge Study, First Nation and Ministry of Transportation, Ontario, Canada

Dr. Greene worked with a First Nation and the Ministry of Transportation of Ontario to provide estimates of damages to lands occupied by the highway traversing reserve lands. Estimates for foregone market losses such as timber stumpage fees, as well as non-market value estimates for subsistence and traditional and community values, are being developed.

Lead in Water Cost Study, Office of Superintendent of Public Instruction (OSPI) - Washington State

Dr. Greene reviewed Department of Health (DOH) data regarding lead in the water of public schools. The team reviewed data, sampling approaches, and gathered additional information about other relevant areas such as building construction dates, plumbing, and water fixtures used. Working closely with a water engineering team, Dr. Greene estimated the costs of remediating all of the lead in water in schools for Washington State.

Economic Value of Tropical Rainforest Land in Latin America, Confidential Oil and Gas Client – Ecuador

Dr. Greene led a team providing litigation support to a confidential client on potential damage to tropical rainforest land in Latin America as a result of oil and gas exploration and extraction. The project involved literature reviews on the total economic value of the land, including direct use values, indirect or ecological use values, and passive or nonuse values.

Tool for Selection of Sustainable Remediation Strategies for the Great Lakes Region, Confidential Client – Northeast United States

Dr. Greene developed a decision-making tool for selection of alternative remediation strategies based on principles of green remediation consistent with U.S. Environmental Protection Agency and U.S. Navy guidance documents. Metrics

used in the decision framework include water quality, water quantity, sediment quality and quantity, air quality, recreation and other human uses, and ecological or habitat services.

Settlement Support for Soboba Tunnel Damages Natural Resource Damages Case, Soboba Band of Luiseno Indians – Hemet, California

Dr. Greene supported Luebben, Johnson, and Barnhouse in estimating the value of foregone water to the Soboba Tribe over a period of 70 years. The foregone water resulted from damages related to the leakage into a tunnel built by the federal government. Damages were estimated for a variety of different legal strategies. The settlement involved three water districts and federal, local, and state entities.

Damages Related to Mining Lease Dispute, Wilson Elser Moskowitz Edelman & Dicker – Dallas, Texas

Dr. Greene provided expert testimony in deposition regarding alleged damages related to a mineral lease and water permitting procedures. The case was heard in the District Court of Tulsa County, State of Oklahoma. *Hanson Aggregates, LLC v. Ashby Inv., LLC*, No. 2011-380 (Tulsa Cty. Dist. Ct.)

Recreation Economics and Ecosystem Services

Expert Testimony on Economic Value of Hunting and Fishing in Missouri

Dr. Greene provided expert testimony in court and in deposition for a case involving a ban on imports and exports of deer in the state of Missouri. Testimony covered the economic stimulus provided by, and the economic value of, deer hunting, and was based on a study completed for the Missouri Department of Conservation by Ramboll Environ on the economic value of hunting and fishing in Missouri. *Hill v. Commission*, No. 15-CC-5-01 (Mo. 20th Cir. Ct. 2015).

Recreational Benefits of Proposed Water-Storage Facility, Fort Apache Indian Reservation - Arizona

Dr. Greene estimated the economic benefits of a proposed water-storage facility on future tourism visitation and related tourist expenditures to the Fort Apache Indian Reservation. Benefits were measured in terms of increased value of improved fish habitat, increased value of recreation for Tribal members and tourists, benefits to the Tribal fish hatchery program. The study also included a discussion of cultural values. A regional economic impact analysis was also completed, quantifying profits to local and Tribal businesses and income and employment increases. Visitors from within Arizona and from other states were estimated separately. The results of this analysis were used in negotiations related to Salt River Project basin-wide water rights adjudications and Gila River basin adjudications.

Economic Benefits of Improved Instream Flow in the Upper Yakima Basin, Bureau of Reclamation - Yakima, Washington

Dr. Greene conducted an evaluation of the recreational benefits associated with the acquisition of water rights to enhance stream flows in the Taneum Creek basin. The study included a direct survey of recreational anglers to determine their willingness to pay for increased stream flows to benefit fish. Recreation participation rates and demand, as well as the benefits of various levels of improved fishing quality, were estimated using a random utility model. Regional economic impacts were also developed to describe the impact from recreational anglers' expenditures on the economies of the Yakima Basin.

Economic Considerations for Land Preservation as a Strategy for Watershed Protection in the Cahaba River Basin, EDAW – Atlanta, Georgia

Dr. Greene prepared a report which provided an overview of the economic benefits and costs of preserving and conserving land in the rapidly developing Cahaba Watershed and included an evaluation of different preservation mechanisms. A summary of the strengths and weaknesses of preservation mechanisms included a review of land leases, donations, transferable development rights, product contracts, conservation easements, and fee purchases. Benefits of watershed protection that were evaluated included values for protecting water quality and water supply; enhancing recreation; preserving habitat; reducing erosion; and enhancing property values and tax revenues. Costs included payments for land purchase, management, and enforcement; foregone tax revenues; and the opportunity cost of development.

4. Qualifications

Dr. Gretchen Greene has over 30 years of diverse economics experience in natural resource, energy, and community economics. Dr. Greene focuses on quantifying the value of environmental quality changes and bringing that into economic decision making. She has expertise in water demand and management, ecosystem service valuation, natural resource damage assessment, and public infrastructure investment. She brings expertise in endangered species economics; land conservation and sustainable economic development; cost-benefit analysis; demographics, socioeconomics, and environmental justice; decision analysis with uncertainty; and survey design and data analysis. Recent interests have focused on water infrastructure investment in the face of increasing concern about emerging contaminants and a changing climate. Dr. Greene has significant experience with flood damage assessments and often works as a reviewer for the U.S. Army Corps of Engineers for their water infrastructure investment projects. An experienced facilitator, Dr. Greene has developed focus groups and surveys covering a number of environmental topics. She has worked in dozens of different cultural environments, from southern Africa to Mongolia to Native American communities. She has worked with numerous federal, state, tribal, and municipal agencies as well as private industrial clients and law firms.

Dr. Greene has a PhD and master's degree in Food and Resource Economics from the University of Florida and a bachelor's degree from Wellesley College in Massachusetts. In her spare time, she teaches economics at Clark College in Vancouver Washington.

5. Other Cases (Previous 4 Years)

In re Little Colorado River System and Source, No. 6417-203 (Ariz. Super. Ct. (Apache Cty.)

6. Compensation

My hourly rate for work on this project is $275/hour.

7. References

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Exhibit 45

Dr. Michael Tachovsky Deposition Excerpt

BY MR. LONG:

Q Are you aware of any evidence at all that any of the properties you analyzed had PCBs on them?

A Not as I sit here right now. It's a question for other experts.

Q Are you telling this court that those properties that are not contaminated by PCBs are similarly situated to the properties in your case studies that were contaminated by PCB?

A Yeah, so also can be adjacent or proximate, which means you don't necessarily have PCBs on you but you are next to a property that does or next to a source of PCBs or dioxins.

Q Just so I am specific, you are telling the court that a property that is not contaminated by PCBs is similarly situated to those that are?

A What I am saying is -- actually, I'm saying it a little bit different -- is you don't have to have contaminants on you for your market value to be impacted.

Q Let me ask you to answer this question.

Do you in your expert opinion believe that properties that are contaminated by PCBs are similarly situated to those that are not?

A They can be. There can be similarities.

Exhibit 46

Marc Jones Deposition Excerpts

Go ahead.

THE WITNESS: I would have to ask my attorneys about that, but I am the primary owner of 75 percent of the property, so...

BY MR. LONG:

Q. Did you speak to your daughter Kathryn Jones Demetri about becoming a plaintiff in this lawsuit?

A. I did not.

Q. So between the time frame of 2024 and present, was there anyone else living at the property other than your daughter Kathryn Jones Demetri and her husband, Nathan?

A. What were your dates again?

Q. 2024 and present date.

A. Not to include rental?

Q. Yeah, we'll talk about rentals in a second, but is there anyone else that has lived there in that time frame?

A. Forgive me, what's your definition of lived?

Q. Spent any time there.

A. Yes, my family.

Q. And when you say your family, who are you referring to?

A. That would be, again, my sisters, their children, spouses, and my mother.

Q. And what about yourself, have you stayed at the property in this time frame from 2024 to date?

A. I have.

Q. And for what purpose?

A. For the purpose that the house was purchased, the intent.

Q. For family gatherings?

MS. FICKLING: Objection to form.

Go ahead.

THE WITNESS: That would be one of them.

BY MR. LONG:

Q. Any other purpose that you visited since your daughter started living there in 2024 and became the primary resident?

MS. FICKLING: Objection to form.

THE WITNESS: I'm sorry, ask that question again.

BY MR. LONG:

Q. Yeah, you told me that your daughter was a primary resident of the property for a period of time; is that fair?

A. Oh, I don't personally remember filing a challenge.

Q. Do you know -- do you recall any such challenge having been filed?

A. Um...

I don't -- I don't recall.

Q. Do you believe value the of your property has decreased since the purchase by your family in 2001?

MS. FICKLING: Objection to form.

Go ahead.

THE WITNESS: Ask that question again.

BY MR. LONG:

Q. Do you believe the value of your property has decreased since its purchase by your family in 2001?

MS. FICKLING: Same objection.

THE WITNESS: What is your definition of value?

BY MR. LONG:

Q. You can apply whatever definition that common word means to you.

MS. FICKLING: Objection to form.

THE WITNESS: Well, in the spirit that the house was purchased, yes.

Q. Are you able to say to what degree, amount, or percentage anybody's property value around the lake has been impacted by PCBs?

MS. FICKLING: Objection to form.

THE WITNESS: That would be for the experts to determine.

BY MR. LONG:

Q. And do you have any opinion you're prepared to offer me at this point?

MS. FICKLING: Objection to form.

Go ahead.

THE WITNESS: Opinion of what?

BY MR. LONG:

Q. To what degree, amount, or percentage anybody's property value has been impacted as a result of PCBs in the lake?

MS. FICKLING: Same objection.

THE WITNESS: I would say that all property values have been affected by PCBs in the lake.

BY MR. LONG:

Q. Yeah, I heard your testimony on that, but my question is different. My question is to what degree, whether it's percentage or amount, has any impact of any individual property occurred?

property has he or did he -- does he or did he own?
MS. FICKLING: Same objection.
THE WITNESS: Well, can I take that statement back?
BY MR. LONG:
Q. Sure. Do you need to correct it?
A. Correct it, yes.
Q. Yeah.
A. To my knowledge, he did not own, his parents owned.
Q. Okay. Fair enough. Do you know where that was located?
A. Yes.
Q. What's the address?
A. I don't know specifically the address.
Q. Do you know the area?
A. I do.
Q. What area?
A. There would be two, to my knowledge. Number one, the first, would be Deals Marina where his home was growing up. And then second would be -- again, he did not own -- but his parents, after selling the marina, built a house on Lake Wateree, so technically he did not own that property, to my knowledge.

Exhibit 47

Jeff Lineberger Deposition Excerpt

BY MR. SHEHEEN:

Q. I just need a yes-or-no answer to this one. But if they were responsible for the PCB contamination, would they be responsible for mitigating associated harm?

MS. DURANTE: Object to form.

THE DEPONENT: If harm could be absolutely proved that it came from Duke Energy, then we would be accountable for our -- for our part.

BY MR. SHEHEEN:

Q. I understand.

MR. SHEHEEN: Thank you very much. That's it for me.

MS. DURANTE: One more redirect.

EXAMINATION

BY MS. DURANTE:

Q. Mr. Lineberger, does Duke Energy discharge into Lake Wateree?

A. Duke Energy does not discharge into Lake Wateree, except for the flow of the river at the upstream Cedar Creek reservoir.

So the water that's flowing down the river into Cedar Creek reservoir eventually goes either through the dam or passes over the dam in a

Exhibit 48

Dr. James Glover Expert Report

James B Glover, Ph.D.
8421 E Brookwood Drive Tucson, AZ 85750
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1. Academic and Professional Background

My degrees are in Biology with an emphasis on aquatic ecology, environmental health, and public health. During graduate school (M.S. Marshall University, Huntington WV; Ph.D. University of Louisville, KY) my research focused on freshwater aquatic insects. While completing my education I was an instructor as a Graduate Teaching Assistant for a variety of collegiate courses ranging from Limnology, Ecology, and Cellular and Molecular Biology. I also taught at a local community college and after receiving my degree became an Assistant Professor in the Department of Biology at the University of Louisville, and taught courses such as General Biology, Ecology, and Human Anatomy and Physiology. I became an environmental manager at the South Carolina Department of Health and Environmental Control (SCDHEC) in the early 1990s where I worked and later managed the Water Monitoring and Aquatic Biology Sections for my entire career. The primary duties of this group were to monitor and assess the conditions of the waters of the State of South Carolina. This included assessments of conditions related to toxic algal blooms, conduct aquatic bioassessments, monitoring and assessment of pathogen indicators such as fecal coliform or Escherichia coli, physical and chemical assessments of waters of the state, and the assessment of tissue for harmful chemicals in a variety of biota such as fish, shellfish, blue crabs, and American alligators.

Over my career I participated in numerous conferences on a variety of topics related to water quality monitoring and assessment throughout North America. In 2007 I organized and hosted the Society of Freshwater Science Annual Meeting in Columbia, SC. Nearly 1000 participants came to this international conference with 21 Nations represented. I have also served on numerous expert committees for the USEPA and a variety of professional organizations as well as an officer for EPA Region IV Water Pollution Biologists Association.

While at SCDHEC I served on several graduate student committees and was an adjunct professor in The Department of Toxicology, Clemson University, The Department of Entomology, Clemson University, and The Arnold School of Public Health, University of South Carolina. The thesis project most closely related to PCBs was: LaPlaca, Stephanie, M.S. Endocrine disruption in largemouth bass (Micropterus salmoides) from a PCB contaminated reservoir. 2017. University of South Carolina. The Norman J. Arnold School of Public Health. In addition to the well-known effects of PCBs on human health these chemicals have also been shown to be endocrine disruptors in fish, resulting in an intersex condition. Ms. LaPlaca's, who was one of my employees, thesis was related to this phenomenon, and I helped conceive and direct the study.

I was highly involved in many special investigations related to environmental contamination. This included the Reedy River Oil Spill by Colonial Pipeline in 1996, the Sangamo Weston Lake Hartwell PCB contaminated site, Langley Pond state-lead cleanup site involving a variety of contaminants including PCBs, Burlington Industries Cheraw NPL involving PCBs, the former Hoechst-AG Pacolet Contaminated site that included PCBs, Tin Products/Cardinal Chemical Company organotin illicit discharge, and Coal Tar contamination on the Congaree River in SC.

I retired from SCDHEC in 2017. My Curriculum Vitae is attached at the end of this document. I am being compensated at a rate of $300/hour for the preparation of this report.

2. **Work in the field in environmental science including bodies of water in South Carolina, which required warnings based on levels of PCBs in fish tissue.**

As noted above, staff with the Aquatic Biology Section were responsible for a variety of environmental monitoring and assessment activities. The primary focus was on aquatic systems such as wetlands, freshwater streams and rivers, reservoirs, estuaries, and other marine ecosystems. The authority and the mandate to conduct these monitoring and assessment activities came from the 1972 Federal Water Pollution Control Act (The Clean Water Act) and the South Carolina Pollution Control Act, formally the SC Water Pollution Control Act of 1950. Part of the duties of this section, which I managed, was to conduct fish tissue monitoring and analysis for various contaminants, and produce consumption advisories for citizens, providing guidance on the kinds and quantities of fish that can be safely consumed from waters of the state. In South Carolina there were two primary contaminants of concern. They were mercury (Hg) that was found in many fish species throughout the state and Polychlorinated Biphenols (PCBs), that were more spatially confined in scope of contamination. Besides consumption advisories my staff and I were frequently called on as experts to investigate sources, be involved with permitting decisions, and provide guidance to other SCDHEC staff involved in the many aspects of environmental contamination.

3. The basis of consumption advisories.

Fish consumption advisories became widespread in the United States in the 1970s, shortly after the formation of the United States Environmental Protection Agency in 1970. Knowledge that fish could bioaccumulate and biomagnify various contaminants in their flesh and that consumption of fish could pose a risk to human health grew in the decades that followed. To my knowledge all states have some form of fish consumption advisory program either managed at the state, regional, or national level. Some tribes in the US also have consumption advisory programs.

4. Research with Dr. Gundersen

A. Methodology

The technical details of methodology can be found in the Materials and Methods section of Glover J. and Gundersen D. 2021. Widespread contamination of polychlorinated biphenyls in South Carolina and North Carolina (USA): A legacy of malarial eradication and mosquito control. *Journal of the South Carolina Water Resources* 8(1): 83-97.

After the discovery of PCBs in the tissue of fish in the Catawba River Basin in 2009 an investigation was initiated to attempt to determine the source. The first step was to conduct a spatial analysis of PCBs in fish tissue from all waters of the state of SC, including from watersheds that may occupy parts of other states. This involved the delineation of shared watersheds outside of SC to include those in Georgia, North Carolina, and a small part of Virginia. Using GIS technology, a shape file was created to include all waters that were in SC or flowed into waters of the state. The second step was to accumulate all available fish tissue PCB data from locations within these watersheds into a single database. SCDHEC had contemporary data (from about 1993) in various excel spreadsheets while historic data dating back to the 1970s were obtained from the USEPAs STORET database. Data from recent studies were obtained from USEPA and for Georgia and North Carolina from their respective state agencies. A technical report was also discovered that was conducted by Duke Power that contained fish tissue data from the Catawba River Watershed. Additional fish species were also collected and analyzed for PCBs from reservoirs located in the Catawba River Chain of South Carolina by SCDHEC staff. A shape file was created containing all sampling points using latitudes and longitudes of the sampling sites. The large database of PCB fish tissue data

could then be linked to the GIS shape file to produce maps showing spatial patterns for various species of fish. Patterns could answer important questions such as whether PCB contamination in fish was widespread and randomly distributed or was the contamination confined to the Catawba River Watershed?

A thorough literature search was also conducted. It was during this literature search that the publication of The Proceedings Workshop on Mosquito Control in North Carolina, Mosquito Control Association from 1970 was discovered. In these published proceedings several authors indicated that used transformer oil was being used as a larvicide on reservoirs in the Catawba and Yadkin/Pee Dee watersheds. After this discovery, additional literature reviews related to mosquito control in the southeastern US were also conducted.

B. Outcome/ Conclusion

The technical details of outcomes and conclusions can be found in the Discussion and Conclusion sections of Glover and Gundersen (2021).

The spatial and statistical analysis, along with the acknowledged use of transformer oils as a larvicide in the Carolinas, provided evidence that the widespread contamination found in Lake Wateree was the result of past mosquito control activities which were carried out by Duke Energy.

In May 1970 a Workshop on Mosquito Control was held in Rougemont North Carolina. Participants included public health officials but utilities, the Tennessee Valley Authority (TVA), the US Army Corps of Engineers, and the U.S. Military were also well represented. The proceedings were published August 1970, which included the questions and answers for the speakers (Howells 1970). To the question of what chemicals hydroelectric plants use for mosquito control D.F. Ashton with the NC State Board of Health replied that "A mixture of No. 2 fuel oil and used transformer oil is used by two electric companies. The oil is applied at the rate of ten to fifteen gallons per acre." George Swearingen of Duke Power reported that "We are using transformer oil and No. 2 diesel fuel at the present." It was estimated that 2500 miles of shoreline were being treated in North Carolina and South Carolina beginning in April and ending in October, with treatments occurring every 8 days. L.C. Harris with Carolina Power and Light (now Duke Energy) and superintendent of the Blewett Tillery Hydroelectric Project (Figure 2) on the Great Pee Dee/Yadkin River stated "When we have transformer oil, we use it because it doesn't cost us anything. The reason that burned cylinder oil and transformer oil were used in the beginning was that it leaves a beautiful film on the water, and the men could see where they had gone. If you use nothing but No. 2 fuel oil, you can hardly see it." Motor oil was reported at 20% by volume with the application rate of 150 gallons per day.

It is unclear whether other utility operators around the world may have used transformer oil on their reservoirs for mosquito control. While the TVA used oiling and pesticides on their many reservoirs water elevation management became a progressively more important part of its mosquito control program than oiling (Breeland 1961). In response to a question about water level management Duke Power's Sweringen in 1970 responded "They figure its cheaper to maintain a control program over all the lakes like we'er doing than to try to do it with water management. The flow of power is small, and we don't have the water they have in TVA." (Howells 1970). Much earlier in 1931 this same sentiment was shared by Clark regarding mosquito control on High Rock Reservoir in NC (Figure 2) who wrote "..water is our stock and trade, and it would be out of the question for our company deliberately to waste one, two or three feet of water during the

summer months when ordinarily we are making every effort to conserve it" (Clark 1931). The only other instance that we found where PCB oil was used in a mosquito control program was in the Yukon Territories of Canada, where widespread PCB contamination was attributed to mosquito oiling (Nordin et al 1993).

Other sources of PCB contamination were considered and discussed in Glover and Gundersen (2021). Many of the reservoirs in the Catawba River chain are located downriver of the City of Charolette and the highest tissue levels are found near the confluence of the Catawba River and Sugar Creek. Past industrial activities along with contemporary illicit discharges into the Mecklenburg Wastewater Treatment Plant could contribute to the elevated levels found in these reservoirs. Land application of sewage sludge in the basins could also be a contributing factor. While this speculation is not without merit, we concluded that the weight of evidence points to the direct application of transformer oil on the waters surface as a larvicide for mosquito control and contributed in part to the PCBs found in fish tissue in the Catawba and Yadkin reservoirs of the Carolinas.

PCBs were once widely used in a variety of industrial applications, are persistent in the environment, and have been discovered in soils throughout the US including many locations in South Carolina. This includes the Catawba Basin but also sites outside this watershed. Figure 1 is taken from Glover and Gundersen (2021). One of the important features of this map is not only where PBCs were found but also where they were not found in largemouth bass. Of the 145 points (sampling sites) in Figure 1 shown in green (mean total PCBs <0.05 ppm), 94% had no detectable PCBs found in any of the fish samples analyzed for Aroclors. The spatial coverage of this dataset is extremely comprehensive. The combined datasets represent 2,075 individual or composite samples analyzed for PCBS and 4,232 fish specimens, making this possibly one of the most comprehensive PCB fish tissue state datasets in the US. While PCB contaminated soils have been found throughout South Carolina, it is within the reservoirs of Catawba and Yadkin watersheds where widespread contamination in fish tissue have been found. But outside of the three identified areas where a source is known, (Lake Hartwell, Langley Pond, The Great Pee Dee River), PCB contamination in fish at levels that would trigger a consumption advisory are rare, despite the widespread use of PCBs throughout the state.

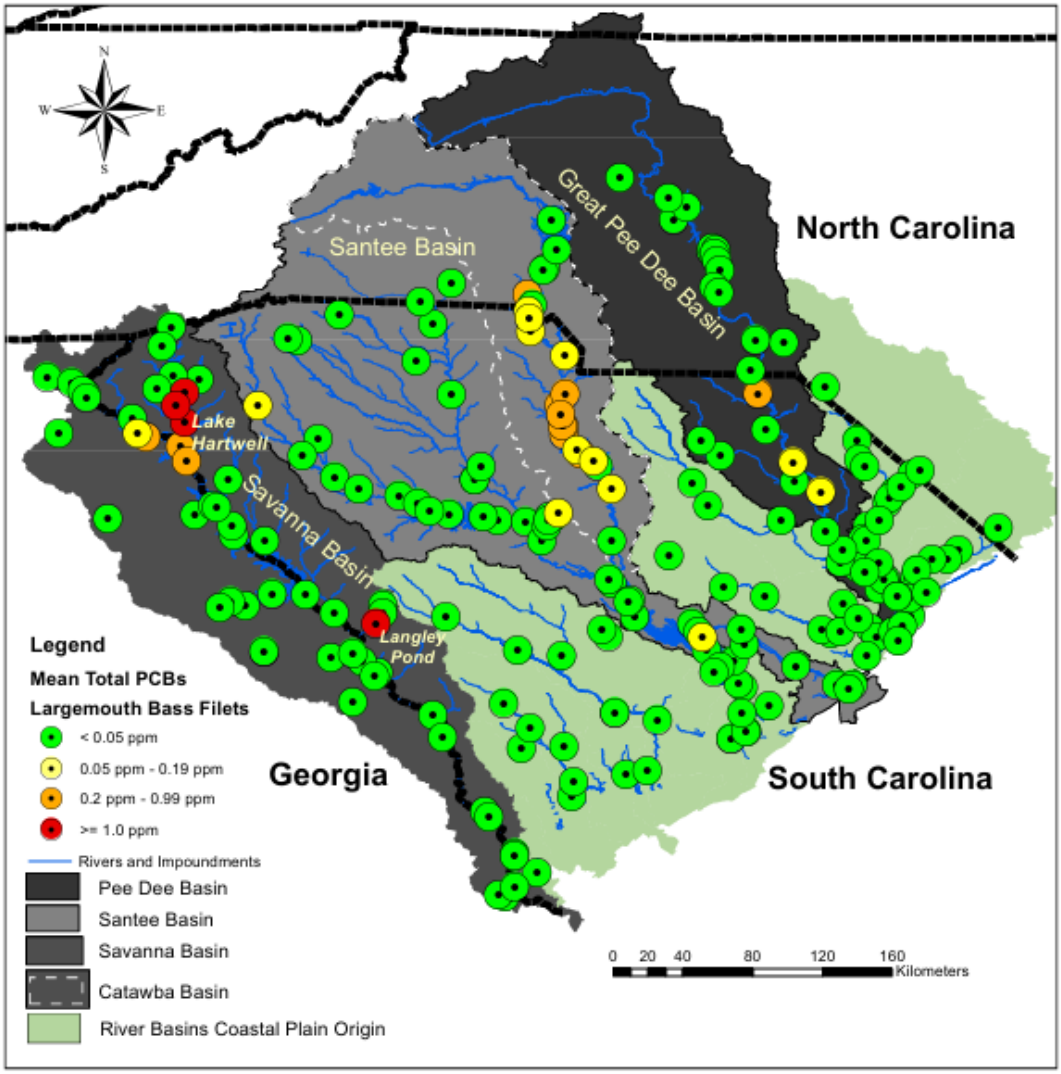


Figure 1. Mean total PCBs (ppm wet weight) in largemouth bass fillets from waters of South Carolina, showing major drainage basins of the state.

Speculation on a potential source of contamination of the reservoirs in the Catawba Chain include recent reports of an illicit discharge into the Mecklenburg Wastewater Treatment plant and the discovery of PCBs in sewage sludge used in land application within the watershed. While these are potential sources, we believe these are not the primary sources of PCBs, if they have contributed at all. Reports from the 1970s indicated the same pattern of contamination within the Catawba River reservoirs in SC as is seen today. Aldridge (1978) wrote "Reservoirs and the number of stations on the Catawba-Wateree River that have fish containing low levels of PCB's seem to indicate areas that should be of immediate concern." These were data collected between 1974-1976 suggesting long term contamination that predates the use of land application practices of today or the recent illicit discharge discovered in the Mecklenburg Wastewater Treatment Plant. Further, while levels of PCBs are much lower in largemouth bass from reservoirs upriver of the Charlotte drainage, the PCB levels in other species of fish are sufficiently elevated to trigger a consumption advisory (Table 1, Figure 2). For reservoirs in the Catawba and Yadkin watershed, where there was an acknowledged use of transformer oil

as a larvicide for mosquito control, restrictive consumption advisories are in place for most. For those reservoirs where an advisory is not in place it is generally because fish tissue data were unavailable (Table 1- Taken from Glover and Gundersen 2021).

Table 1. Fish Consumption Advisories for PCBs in Select Basins in South Carolina

Basin	State	Reservoir	Year Built	Fish Consumption Advisory—PCBs*
Catawba	NC	Lake James	1923	No
Catawba	NC	Rhodhiss Res.	1925	No
Catawba	NC	Hickory Res.	1927	No
Catawba	NC	Lookout Shoals Res.	1915	No
Catawba	NC	Lake Norman	1963	STP, HYS (NCDHHS)
Catawba	NC	Mountain Island Res.	1924	BLC, CHC (NCDHHS)
Catawba	NC/SC	Lake Wylie	1904	LMB (NCDHHS); LMB, CHC, BKS (SCDHEC)
Catawba	SC	Fishing Creek Res.	1916	LMB, BLC, CHC, WHB, BKS (SCDHEC)
Catawba	SC	Great Falls Res.	1907	No
Catawba	SC	Cedar Creek Res.	1909	LMB, BLC, CHC, WHB, BKS (SCDHEC)
Catawba	SC	Lake Wateree	1920	LMB, BLC, CHC, WHB, STB, BKS (SCDHEC)
Pee Dee	NC	High Rock Res.	1927	Catfish all species (NCDHHS)
Pee Dee	NC	Tuckertown Res.	1962	No
Pee Dee	NC	Badin Lake	1917	LMB, Catfish all species (NCDHHS)
Pee Dee	NC	Falls Res.	1919	Catfish all species (NCDHHS)
Pee Dee	NC	Lake Tillery	1928	Catfish all species (NCDHHS)
Pee Dee	NC	Blewett Falls Res.	1912	No
Savannah	SC/GA	Lake Hartwell	1959	All Species (SCDHEC); LMB, CHC, STP, HYS (GADNR)
Savannah	SC	Langley Pond	1870	All Species (SCDHEC)

Note. LMB = largemouth bass, HYS = hybrid striped bass, BLC = blue catfish, CHC = channel catfish, BKS = black crappie, WHB = white catfish, STP = striped bass. *No Advisory generally because of lack of data rather than absence of tissue PCBs.

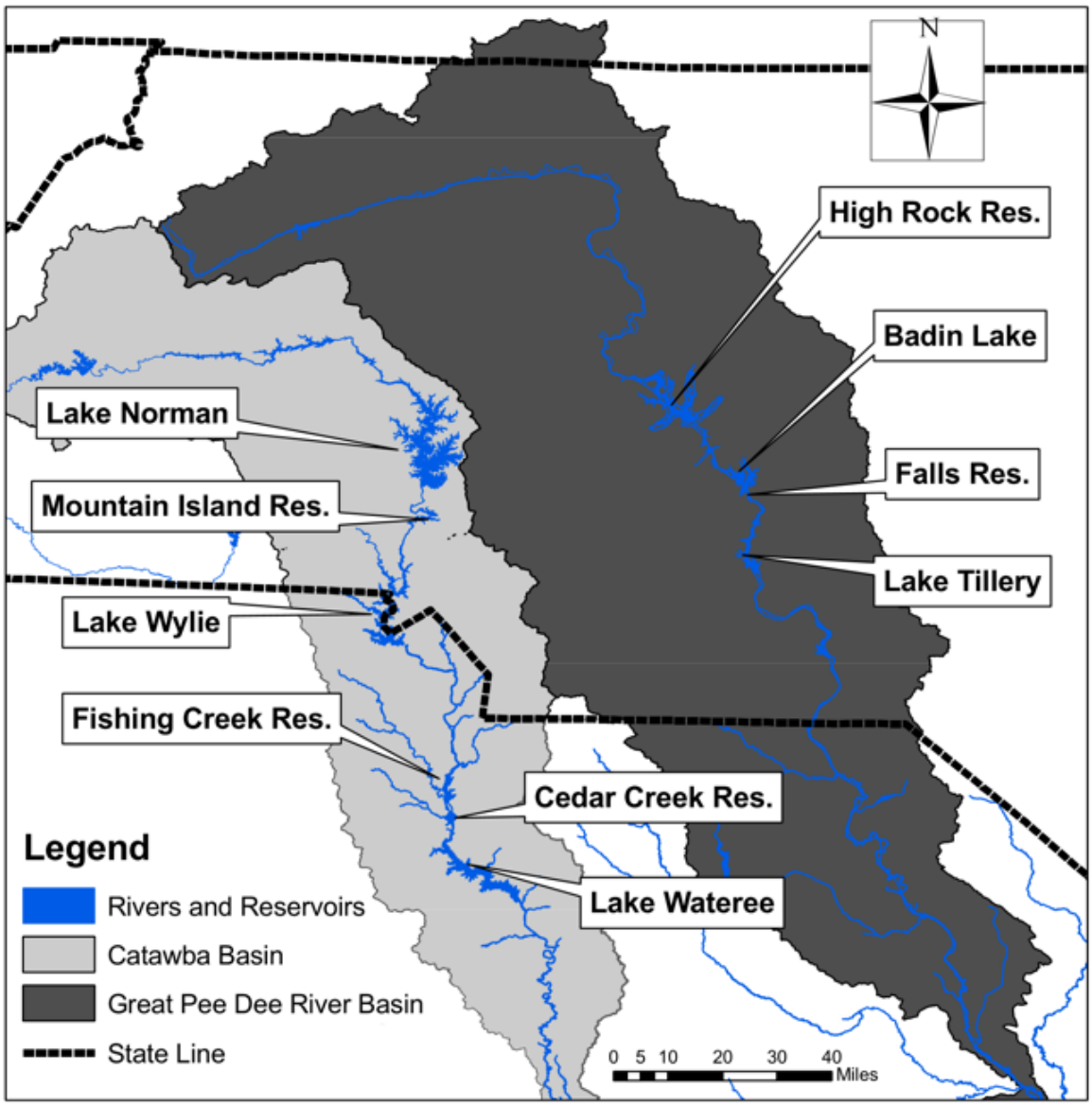


Figure 2. Reservoirs in the Catawba and Great Pee Dee/Yadkin Watersheds with fish consumption advisories because of PCB contamination.

From the NC Mosquito Control conference in 1970 there is evidence that the use of transformer oil for mosquito control had been occurring for many years, and long before the creation of the USEPA in 1970 or the passage of the Clean Water Act in 1972. Both these events ushered in widespread construction and upgrades to wastewater treatment plants and later the use of land application practices for the disposal of sewage sludge. The phrase "..the reason transformer oil.." was used "..in the beginning.." suggests that this was not a rare or recent practice in 1970. This supports an allegation by Mr Bruce McIsaac who in a 1997 State Newspaper article (Fretwell 1997) suggested that when he work for the Duke Power Mosquito Control Program in 1947 and 1948 transformer oils were frequently used as a larvicide. Mr McIsaac was quoted that "We put out 50 55-gallon drums of transformer oil a day." and "he knows Duke's mosquito-control program used transformer oil because a company supervisor told him what the material was." However, in the same article a former coworker refuted Mr McIsaac and claimed only

motor oil was being used. In the 1970 NC Mosquito Control Conference publication Harris, Blewett Tillery Hydroelectric Project, was quoted "When we have transformer oil, we use it because it doesn't cost us anything." Howells (1970). This suggests that the use of transformer oil was on an ad hoc basis and depended on availability. This could account, in part, for the relative differences in concentrations of PCBs in different reservoirs of the Catawba and the Yadkin/Pee Dee impoundments.

It is unclear to what extent the reservoirs within the Catawba and the Yadkin basin were treated with transformer oil. It was assumed that all reservoirs within the Catawba Chain were treated for mosquitoes at some point in the past. Duke Power's Sweringen in 1970 was quoted "They figure its cheaper to maintain a control program over all the lakes like we'er doing…", suggesting all lakes were being treated. In a 1937 Charlotte News article (Bingham 1937) it was reported that "motorboats cruise over 30 lakes, spraying oil which means death to the mosquitos.", although it is unknown which 30 waterbodies this article is referencing.

We concluded that the widespread contamination of fish with PCBs within reservoirs of the Catawba and Yadkin watersheds was due, in part, by direct application of transformer oil as a larvicide for mosquitos. We base this on the spatial patterns of PCBs in fish tissue within the region. Where there is no known source PCBs are rare in fish in the study area, despite large urban areas and past industrial sites that occur throughout South Carolina. However, PCBs are common and widespread in fish tissue within the Catawba and Yadkin Basins. We suggest that these activities had occurred in the past, as evidenced by the patterns of PCBs in fish tissue within South Carolina, which were similar in the 1970s as they are today. The acknowledged use of transformer oil for mosquito control in 1970 by staff with Duke Power, The North Carolina State Board of Health, and Blewett Tillery Hydroelectric Project suggests that these activities were common knowledge amongst staff within multiple organizations in the state of NC who dealt with mosquito control. This is supported by an allegation from a former Duke Power employee who claimed to have used transformer oil in mosquito control in the late 1940s as reported in The State Newspaper in the 1990s. There are other potential sources of contamination, including past industrial activities, particularly in the Sugar Creek Watershed near Charlotte NC or an Alcoa Plant in the Yadkin Basin. However, reservoirs upriver of both Sugar Creek, that drains into the Catawba River, and the Alcoa Plant in the Yadkin Basin also have fish contaminated with PCBs sufficiently elevated to trigger consumption advisories, ruling out these as potential sources for contamination in those impoundments (Figure 2). While there may be other sources for the PCB contamination, we believe it would be difficult to quantify the relative contributions of each. Taken together, and in the absence of other data, we believe the weight of evidence strongly points to the direct application of transformer oil on the reservoirs within the Catawba and Yadkin Watersheds as the cause of the elevated PCB levels in fish tissue.

5. Peer Reviewed Process

The peer reviewed process is a system of evaluating scholarly work, typically an article, book, or manuscript, by experts in the same field to ensure its quality before publication. Before the PCB manuscript was published the first author had already published an overview of mercury in fish tissue in SC (Glover, J.B., M.E. Domino, K.C. Altman, J.W. Dillman, W.S. Castleberry, J.P. Eidson, and Mattocks. 2010. Mercury in South Carolina Fishes, SC. *Ecotoxicology* 19:781-785.) which not only provided the spatial extent of mercury in fishes of SC but also developed a conceptual model as to why levels were high in some ecoregions or waterbody types but lower in others. In addition to the investigation as the source of PCBs into the Catawba and Yadkin/Pee

Dee Basins, Glover and Gunderson 2021 also provided a comprehensive assessment of PCBs in fish tissue throughout SC, which was one of the objectives.

For the mercury study I selected the international journal *Ecotoxicology*, as our results had global ramifications. I chose Clemson Universities' *Journal of the South Carolina Water Resources* as our results were more targeted to those in the Carolinas. As is typical of scientific journals an editor conducts an initial assessment and if acceptable assigns two or sometimes three reviewers for submitted articles. The authors often do not know the identities of the reviewers, which makes the process anonymous or "blind". The reviewers can suggest to the editor rejection of the article, accept with suggested revisions, or accept as submitted. At least some revisions are generally suggested, and the authors can make revisions and resubmit. After all revisions are satisfied, additional editorial suggestions are often made to improve grammar and the flow of the manuscript. The entire process generally improves the final product before publication. The peer review process is considered the gold standard for insuring the credibility of scholarly work in the scientific arena.

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Bingham, F. 1937. Duke ponds free from pesky, biting mosquitos. *The Charlotte News,* August 24, 1937.

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Howells, D. 1970. *Proceedings workshop on mosquito control in North Carolina*. Quails Roost Conference Center, Rougemont, North Carolina. Pp. 1-144.

Nordin K, Burns B, Lendrum B. 1993. Use, disposal, and transportation of selected contaminants in Yukon: Arctic Environmental Strategy—Canada's Green Plan. Canada: Indian and Northern Affairs.

James B. Glover, Ph.D.
Curriculum Vitae

Education

The University of Louisville Louisville KY, 1988-1993
Ph.D. Biology
Dissertation Project: The taxonomy and life histories of the larvae of the North American caddisflies in the genera *Triaenodes* and *Ylodes* (Trichoptera: Leptoceridae).
Advisor: Charles V. Covell Jr., Ph.D.

Marshall University Huntington WV, 1986-1988
M.S. Biology
Masters Thesis: A taxonomic and distributional study of the adult caddisflies of the family Leptoceridae (Insecta: Trichoptera).
Advisor: Donald Tarter, Ph.D.

The University of Charleston Charleston WV, 1982-1986
B.S. Biology

Professional Experience

- **Manager- Aquatic Biology Section.** 2007-2017. The South Carolina Department of Health and Environmental Control. Columbia SC
- **Senior Scientist**. 2005-2007. The South Carolina Department of Health and Environmental Control. Columbia SC
- **Environmental Health Manager.** 1994-2005. The South Carolina Department of Health and Environmental Control. Columbia SC
- **Adjunct Professor**. 2000-2012. Clemson University, Department of Entomology, Soils, and Plant Sciences. Clemson SC
- **Adjunct Professor**. 2000-2003. Clemson University, Department of Environmental Toxicology. Clemson SC
- **Assistant Professor**. 1993-1994. The University of Louisville, Department of Biology. Louisville KY
- **Adjunct Professor**. 1990-1993. Jefferson Community College, Department of Biology. Louisville KY
- **Graduate Teaching Assistant**. 1988-1993. The University of Louisville, Department of Biology. Louisville KY
- **Graduate Teaching Assistant**. 1986-1988. Marshall University, Department of Biology. Huntington WV

Awards

- 2004 EQC Technical Employee of the Year, SCDHEC
- 2000, 2010 EQC Team of the Year Member, SCDHEC
- 1993 The Beechmont Award for Outstanding Thesis or Dissertation in Science, The University of Louisville

Select Committees

- 2013-2017. Santee Experimental Forest Biological Response to Nutrients Workgroup.
- 2013-2015 (Chair 2015). Society for Freshwater Science Award of Excellence and Distinguished Service.
- 2013-2020. The Society of Freshwater Science Taxonomic Certification Committee
- 2011. DHEC representative at Nutrient Independent Applicability Meeting in Washington D.C.
- 2010-2015. Insect Committee (Chair). South Carolina State Wildlife Action Plan. 2015.
- 2008-2010. SCDHEC Environmental Quality Control Mercury Reduction Work Group.
- 2009-2011. SC Public Health Consortium.
- 2007-2014. CDC South Carolina Harmful Algal Bloom Workgroup.
- 2006-2007. Chair of the Local Arrangements Committee of the Society for Freshwater Science Hosted international conference in Columbia SC.
- 2004-2005. Representative for the States to the USEPA National Wadable Stream Survey. Corvallis, OR, Washington DC, Albuquerque NM.
- 2000. Advisory Committee for The Nature Conservancy.
- 1996-2000. Advisory Committee for the Reedy River Task Force.
- 1997-1998. The USEPA BioStoret Workgroup. Presented at 1997 Washington DC Meeting.
- 1994-2017. Numerous ad hoc committees during tenure at the SCDHEC

Presentations at Select Conferences

- Fifth Interagency Conference of Research in the Watersheds, 2015
- North Carolina Lakes Management Conference 2012
- South Carolina Water Resources Conference: 2008, 2010
- Carolinas Air Pollution Control Association: Fall 2008.
- The Society for Freshwater Science: 1996, 1999, 2000(2), 2001, 2004, 2006, 2007, 2009 (2), 2013
- The 8th National Monitoring Conference 2012
- The Southeastern Water Pollution Biologists Association: 1994, 1995, 1996, 1997, 1998, 2000, 2002
- Congaree National Park Annual Meeting: 2008
- Water Environment Association of South Carolina Laboratory Committee Workshop: 2005
- South Carolina Environmental Conference: 2004
- The Carolina Area Benthological Workshop: 1997, 2001, 2006(2) ,2010, 2103
- The South Carolina Fisheries Society: 2005
- The North American Lakes Management Society: 2004
- Society of Environmental Toxicology and Chemistry: 2002
- The Entomological Society of America: 1992, 2002
- The South Carolina Entomological Society: 2002
- The Southern Division of the American Fisheries Society Mid-Year Meeting: 2000
- The 8th International Symposium on Trichoptera: 1995

Select Presentations

Glover J., Omernik, J, Hughes R., Griffith G., and Weber M. 2015. Watersheds, ecoregions, and hydrologic units; the appropriate use of each for research and environmental management decisions. Fifth Interagency Conference on Research in the Watershed. Charleston SC. (oral submitted)

Glover J. 2012. Insights into Biotic, Spatial, and Temporal Trends in Fish tissue Contamination from 37 years of Monitoring by the South Carolina Department of Health and Environmental Control. 8th National Monitoring Conference. Portland OR. (oral, submitted)

Glover, J.B. et. al. 2008. The influence of landuse on aquatic macroinvertebrates in streams and rivers of South Carolina. South Carolina Water Resources Conference. Charleston, SC (oral, submitted).

Select Presentations *(continued)*

Glover, J.B. 2006. The 55th Annual Meeting of the North American Benthological Society, Columbia South Carolina. The North American Benthological Society. Anchorage, AK (oral opening session, invited).

Glover, J.B. 2006. The Colonial Pipeline oil spill of 1996 and a decade of monitoring of the Reedy River near Greenville, South Carolina. The Carolina Area Benthological Association. Raleigh, NC (oral, invited).

Glover, J.B., C.R. Parker, and J.C. Morse. 2002. Status of our knowledge of North American caddisflies (Trichoptera). The Entomological Society of America. Fort Lauderdale, FL (oral, invited).

VanGenderen, E.J., S.L. Knuteson, A.R. Johnson, M.A. Schlautman, **J.B. Glover**, J.R. Tomasso and S.J. Klaine. 2002. Integrating spatial aquatic toxicity data with Geographic Information Systems (GIS). Society of Environmental Toxicology and Chemistry, Salt Lake City, UT (oral, invited).

Glover, J.B. 2001. An assessment of the SC Timed Qualitative, Multi-habitat, Macroinvertebrate Collecting Technique. Southeastern Water Pollution Biologist Association. Bowling Green, KY (oral, submitted).

Canada, D.K., R.D. Maree, S.E. Ayers, S.A. Blake, M.R. Borders, W.R. Borders, D.M. Daniels-Hester, C.L. Glover, D.R. House, D.B. Mackey, K.M. Scott, A.N. Ulmer, L.B. Glover, **J.B. Glover**. 2001. Macroinvertebrate biological assessments of streams in South Carolina by high school minority students. North American Benthological Society. Keystone, CO (poster, submitted). The students and teacher of this project were awarded the 2001 Champions of the Environment Award presented by Governor Jim Hodges of South Carolina.

Glover, J.B. and J.C. Morse. 2001. New species of Trichoptera from the Southeast. North American Benthological Society. Keystone, CO (poster, submitted).

Peer Reviewed Publications

Glover J. and Gundersen D. 2021. Widespread contamination of polychlorinated biphenyls in South Carolina and North Carolina (USA): A legacy of malarial eradication and mosquito control. *Journal of the South Carolina Water Resources* 8(1): 83-97.

Trettin C., Amatya M., Muwamba A., **Glover J**., Wenerick, R. 2021. Chapter 15: Ecoregion 8.5.3 Southern Coastal Plain: Santee Experimental Forest, South Carolina. Biological responses to stream nutrients: a synthesis of science from experimental forests and ranges. Gen. Tech. Rep. PNW-GTR-981. Portland OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station: 389-414.

Omernik J., Griffith G., Hughes R., **Glover J.,** and Weber, M. 2016. How misapplication of the hydrologic unit framework diminishes the meaning of watersheds. *Enivonmental Management* 4:60(1): 1-11.

Glover, J.B., M.E. Domino, K.C. Altman, J.W. Dillman, W.S. Castleberry, J.P. Eidson, and Mattocks. 2010. Mercury in South Carolina Fishes, SC. *Ecotoxicology* 19:781-785.

Peer Reviewed Publications *(continued)*

Glover J. and Altman K. 2010. Factors contributing to the temporal trends in tissue mercury levels in largemouth bass from Lake Murray (South Carolina, USA) *Proceedings of the 2010 South Carolina Water Resources Conference*, held October 13-14, 2010, at the Columbia Metropolitan Convention Center.

Glover, J.B. and M.A. Floyd. 2004. Larvae of the genus *Nectopsyche* (Trichoptera: Leptoceridae) in eastern North America, including a new species from North Carolina. Journal of the North American Benthological Society. 23(3): 526-541.

Griffith, G.E., Omernick, J.M., Comstock, J.A., Schafale, M.P., McNab, W.H., Lenat, D.R., MacPherson, T.F., **Glover, J.B**., and Shelburne, V.B. 2002. Ecoregions of North Carolina and South Carolina (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,500,000).

Glover, J.B. 1996. Larvae of the caddisfly genera *Triaenodes* and *Ylodes* (Trichoptera: Leptoceridae) in North America. Ohio Biological Survey Bulletin. New Series Vol. 11 No. 2. Vii+ 89p.

Glover, J.B., and D.C. Tarter. 1989. The leptoceridae (Trichoptera) of West Virginia. Entomological News. 101:35-38.

Select Technical Reports

Glover, J.B. 2017. An investigation into the potential impacts of coal tar contamination on the invertebrate community of the Congaree River near the city of Columbia, Richland County, SC. The South Carolina Department of Health and Environmental Control Technical Report No. 0804-17. Bureau of Water, SC.

Glover, J.B. 2011. An aquatic macroinvertebrate bioassessment of the Pacolet River between Lake Blalock and Interstate I-85 (Spartanburg County, SC). The South Carolina Department of Health and Environmental Control. Bureau of Water. Columbia, South Carolina. S.C. DHEC Technical Report Number- 8A19-11.

South Carolina Wildlife Action Plan. 2015. Chapter 3. Insects. Pp 3-51 to 3-54.

Grants and Project Development

- 2009. **James Glover**. Mercury in fish and small pond health; a statistical model that provides fish tissue Hg estimates from small freshwater ponds in South Caroliana, USA. Part of the CDC EPHT program.
- 2009. **James Glover**. Ambient monitoring for metals in surface water and sediment using clean collection techniques with an emphasis on mercury. USEPA section 106 monitoring initiative grant. $200,000 awarded to Dr. Jane Guentzel, Coastal Carolina University.
- 2003. James Bulak, Edward Younginer, and **James Glover**. Comprehensive monitoring of the aquatic community of the Reedy River watershed. South Carolina Reedy River Mitigation Trust Fund. $313,000
- 2003. **James Glover**. The use of a randomized-design for assessment of wadeable streams in South Carolina, USA. USEPA
- 1998. **James Glover**. Ecoregion delineation and reference site project. USEPA
- 1988. **James Glover**. Grant for Academic Excellence. University of Louisville.

Journal Reviewer

International Journal of Environmental Research and Public Health
Environmental Monitoring and Assessment
Society for Freshwater Science
Journal of Afrotropical Zoology
Zootaxa
Contributions of the American Entomological Institute
Memoirs of the American Entomological Institute

Served as Committee Member for Graduate Students

LaPlaca, Stephanie, M.S. Endocrine disruption in largemouth bass (Micropterus salmoides) from a PCB contaminated reservoir. 2017. University of South Carolina. The Norman J. Arnold School of Public Health.

Tatyana S. VSHIVKOVA, Ph.D. Phylogeny of Family Limnephilidae (Insecta: Trichoptera) with emphasis on Tribe Limnephilini (Subfamily Limnephilinae). December 2006. Clemson University, Department of Entomology, Soils, and Plant Sciences, Clemson, SC.

Eric Van Genderen, Ph.D. Spatial and Temporal Variation in the influence of Natural Organic Matter to ameliorate copper toxicity. December 2003. Clemson University, Department of Environmental Toxicology, Clemson SC.

Outreach

- 1997-Date. Guest Lecturer at Wofford University Stream Biology Class. Spartanburg, SC.
- 2006-2007. Participant at The South Carolina Junior Academy of Science Workshop. Columbia, SC.
- 2004-2009. Speaker at the SCDHEC EQC School (2-3 sessions per year).
- 1998-2006. Workshop leader for Lynches Woods Environmental Day. Newberry, SC (featured on WACH FOX News at 10).
- 2006. Guest participant at Gilbert Middle School Environmental Workshop. Gilbert, SC.
- 2006. Guest speaker for Monique Armstrong, Student Teacher, University of South Carolina
- Master's Program in Secondary Science. Blythewood High School, Columbia, SC.
- 1995, 1999, 2005, 2013. Guest Speaker at SCDHEC Bureau of Water, Monthly Mix Meeting.
- 2004. Guest Speaker at SCDHEC Bureau of Air, Monthly Air it Out Meeting.
- 2000, 2004. Guest Speaker at Clemson University Graduate Student Monthly Seminar Series.
- 2004. Guest Speaker at Timmerman School. Columbia, SC.
- 1999, 2003. Participant in the North American Benthological Societies Taxonomy Fair.
- 2003. Guest Speaker at The Harmony School. Columbia, SC.
- 2002. Guest Lecturer at the Governors School for Science and Mathematics, Hartsville, SC.
- 1999-2002. Advisor for Heathwood Hall Episcopal School Minority Student Stream Monitoring Program. Columbia, SC.
- 1999-2002. Mentor for Kayleen Scott (Heathwood Hall Episcopal School). Senior Exhibition. Effects of Land Use On Aquatic Macroinvertebrate Communities within A Watershed.
- 1995-2001. Macroinvertebrate Training Sessions for Teaching KATE 4 H Leaders. Aiken, SC.
- 1996-2001. Participant at the Governors School for Science and Mathematics Interim Workshop, Columbia, SC.
- 1997-2001. Workshop leader for Lee State Park Environmental Day. Lee County, SC.
- 1997-2001.Guest Speaker: Meadowfield Elementary School Environmental Day. Columbia, SC
- 1999-2000. Mentor for Treye Byars (Midlands Technical College, Columbia, SC). Comparison of the EPA Rapid Bioassessment Protocols III and the South Carolina DHEC Protocols for analyzing the water quality of streams and rivers.
- 1999. Guest Lecturer at University of Southern Indiana Stream Biology Class. Evansville, IN.
- 1998. Guest Speaker at the Madison WV Garden Club Annual Meeting. Madison, WV.

Teaching Experience

Assistant Professor 1993-1994
The University of Louisville 1993-1994
Human Anatomy and Physiology; Organismic Biology; Introduction to Biology; Environmental Science; Biology of Populations

Adjunct Professor
Jefferson Community College 1990-1993
Introduction to Ecology; Introduction to Biology; Human Biology

Graduate Teaching Assistant
The University of Louisville 1988-1993
Organismic Biology; Cellular and Molecular Biology

Marshall University 1986-1988
Biology for Non-majors; Biology for Majors; Limnology

James B Glover

James B. Glover

02/09/2026

Date

Exhibit 49

Dr. Eric Butler Deposition Excerpts

THE WITNESS: I count seven.

BY MR. STONE:

Q. Thank you for that. Seven.

So seven different sites, correct?

A. Yes.

Q. And you list Catawba Paper Mill, but you don't have any reason to believe that -- or you've not seen any studies that show that the Catawba Paper Mill caused PCB contamination of the Catawba-Wateree Basin.

MR. NYFFELER: Objection to form.

THE WITNESS: Well, I don't have any data specific to Catawba Paper Mill to inform that decision. But there have been numerous paper mills in the United States that have been studied, and most of them, or many of them, have been associated with PCB contamination.

BY MR. STONE:

Q. So you are sort of guessing that there may be some PCB contamination on that site.

MR. NYFFELER: Objection to form.

THE WITNESS: I'm not guessing. For over ten years, carbonless copy paper was in commerce. Well, for more than ten years, but it started in the late '50s and went through the

migrated into Lake Wateree. And I guess there's a potential that non-Askarel transformer fluid, if it was used in that spray on Lake Wateree, that -- and if that was -- and then if that oil contained PCBs, then that could be a potential source.

BY MR. STONE:

Q. So you said a lot there, sir. So -- but you did say that Duke Power could have been a potential source of PCB contamination on Lake Wateree, correct?

MR. NYFFELER: Objection to form.

THE WITNESS: I couldn't hear you.

BY MR. STONE:

Q. You said a lot there, so I just want to unpack it. You did say that Duke Energy could have been a potential source of PCB contamination on Lake Wateree, correct?

A. I did.

Q. Sir, why -- you -- you listed these known and potential sources of PCBs in the Catawba-Wateree Basin. Why did you not list the Superfund site in the Willamette River?

MR. NYFFELER: Objection to form.

THE WITNESS: The Willamette River is not connected to Lake Wateree, so there's no

A. Some of them are Superfund sites.
Q. And the two Superfund sites you have listed, the Rock Hill Chemical Company site and the Carolawn, Incorporated Superfund site, they both have records of decisions from the EPA, correct?
MR. NYFFELER: Objection to form.
THE WITNESS: I'd have to look into that.
BY MR. STONE:
Q. Well, in order for them to be designated as a Superfund site, the EPA had to come -- they had to produce a record of decision, correct?
MR. NYFFELER: Objection to form.
THE WITNESS: That's kind of the -- eventually and ultimately they would need to have a record of decision.
BY MR. STONE:
Q. Have you reviewed the records of decision for the Rock Hill Chemical site and the Carolawn site?
MR. NYFFELER: Objection to form.
THE WITNESS: I have not.
- - -
(ROD Rutledge Property Superfund marked Plaintiff's Exhibit Number 6 for identification.)

Sir, the following paragraphs after what I just read describe the contaminants of concern found on the property, correct?

MR. NYFFELER: Objection to form.

THE WITNESS: Describes four of them.

BY MR. STONE:

Q. It says, "Four contaminants of concern (COCs), trichloroethene (TCE) 1, 2-dichloroethene, vinyl chloride, and manganese, were detected in the groundwater," correct?

A. Yes.

Q. It does not say that PCBs were detected, correct?

A. Correct.

MR. NYFFELER: Objection to form.

BY MR. STONE:

Q. Further down on page 14, sir, do you see where it says "Surface and Subsurface Soil Contamination"?

A. Yes.

Q. It says, "A total of 65 soil samples were collected and analyzed for all TCL/TAL parameters," correct?

A. Yes.

Q. I should ask you: Based on your training and

cities are well known to be sources of PCBs to the environment.

BY MR. STONE:

Q. Sir, you keep saying "POTW." Can you define that for me?

A. Yes. A POTW is a Publicly Operated Water Treatment Works.

Q. Okay. Thank you.

A. Publicly Operated Treatment Works.

Q. Yeah. You mentioned Charlotte being upstream from Lake Wateree, correct?

A. Yes.

Q. And it's your position that just being upstream from a major metropolitan area like Charlotte could be a source of PCBs; is that correct?

A. That being downstream from a major metropolitan area like Charlotte is likely to receive inputs of PCBs from that region, from that urban area.

Q. I appreciate the correction. I meant downstream.

A. Yes.

Q. But you don't have any examples of large PCB spills coming from the city of Charlotte.

A. I don't.

I --

A. Yes.

Q. -- handed it to you earlier. Okay. Now we're on the right one.

A. Yes.

Q. Apologize.

So Exhibit 9 is titled "Sixth Five-Year Review Report for Carolawn, Inc. Superfund Site, Chester County, South Carolina;" is that correct?

A. Yes.

Q. It is dated September 2023.

A. Yes.

Q. And it was prepared by the U.S. Environmental Protection Agency, Region IV, Atlanta, Georgia, correct?

A. Yes.

Q. Can you please turn to page 1 of the document after the table of contents?

A. Yes.

Q. Do you see the second paragraph where it says "Site Background"?

A. Yes.

Q. It describes it as a 60-acre site located at 5093 Morrison Road in Fort Lawn, Chester County, South Carolina, correct?

contaminants of concern on that site, according to the EPA, correct?

A. Well, there was removal in 1981 and another removal in 1986, an additional 17 storage tanks. And I believe this document, which is the RI -- this is the sixth -- fifth year -- does have a finding of PCBs in the soil, even after the removal, which exceeded the non-carcinogenic hazard quotient for Aroclor 1254. So it's not like -- wasn't PCB-free apparently.

Q. No. But the EPA considered the Carolawn Superfund site to not have PCBs as a contaminant of concern, correct?

A. That's true.

Q. So you have these listed, this 4.5-acre site and the 60-acre site located upstream of Lake Wateree, as, in your own words, known and potential sources of PCBs in the Wateree-Catawba Basin; is that correct?

A. Yes.

Q. Sir, I want to go back to -- I want to go to Exhibit 2, which is your second report.

Well, before I do, sir: Your first report, Exhibit 1, you offered it in support of Duke's opposition to plaintiff's motion for class

certification, correct?

A. Yes.

Q. And you were not making any legal opinions -- you were not offering any legal opinions in that report; were you?

A. Correct.

Q. You were not offering opinions on the number of potential class members, correct?

A. Not directly.

Q. You were not offering any opinions on the amount of damages that those class members might be entitled to.

A. Correct, I was not.

Q. You were not offering any legal opinion on the commonality of those damages.

MR. NYFFELER: Objection to form.

THE WITNESS: I did not.

BY MR. STONE:

Q. All right, sir. Going on to Exhibit 2, I want to start with your opinions that you provide. You provide a list -- list of opinions. This is on page 7 of Exhibit 2. You see that, sir?

A. Yes.

Q. And you list these by bullet points. Would you -- would you agree that these are your opinions

in this report?

MR. NYFFELER: Object to the form.

THE WITNESS: This would be a very -- a summary of them, yes.

BY MR. STONE:

Q. Okay. I want to start with the first -- first -- first bullet. Do you see that, where it says, "I have seen no evidence of the presence of PCBs on plaintiff properties."

A. I see that.

Q. Did I read that correctly?

A. Yes.

Q. When you say you have seen no evidence of the presence of PCBs on plaintiff properties, are you saying you haven't seen any soil or sediment studies that show PCBs on the properties?

MR. NYFFELER: Object to the form.

THE WITNESS: It's -- this reflects the fact that I haven't seen any analytical chemistry data, any chemistry data, depicting PCB concentrations for any soils surrounding -- you know, surrounding the lake, including, I believe, the plaintiff's properties.

BY MR. STONE:

Q. So when you say "no evidence" -- so you're

aware that the plaintiff properties are lakefront properties on Lake Wateree, correct?

MR. NYFFELER: Object to the form.

THE WITNESS: I -- I'm aware that they surround or border Lake Wateree.

BY MR. STONE:

Q. And when you say "no evidence," sir, you're aware that there's both circumstantial evidence and direct evidence, right?

MR. NYFFELER: Object to the form of the question.

THE WITNESS: I've heard of those terms, yes.

BY MR. STONE:

Q. And so direct evidence would be something like: We tested some sediments, and we determined that there were PCBs present in the sediments on the plaintiff properties. That would be direct evidence --

MR. NYFFELER: Object to the form --

BY MR. STONE:

Q. -- correct?

MR. NYFFELER: -- of the question.

THE WITNESS: I'm not comfortable with the use of the word "sediment on plaintiff

properties." I don't -- I'm unaware that the plaintiffs have -- unless they have a pond or something on their property, I don't see how they would have sediments on their property.

BY MR. STONE:

Q. Okay. Let's say --

A. They would have soil on their property.

Q. Let's say "soil." Is that better?

A. Yes. Now, what's the question again?

Q. That would be direct evidence of PCBs on their property, correct?

MR. NYFFELER: Object to the form.

THE WITNESS: Yes. If they -- if -- and usually in sites that I work on, they are -- there's data, soil data, for the properties that are at issue or in question or in dispute, and -- and I haven't seen any soil data for PCBs or soil data of any sort associated with the plaintiff properties.

BY MR. STONE:

Q. So, sir, you discussed in your first report fate and transport of PCBs, correct?

A. Somewhat, yes.

Q. And PCBs can travel through groundwater, correct?

MR. NYFFELER: Object to the form.

THE WITNESS: PCBs are not really thought of as significantly traveling through groundwater unless there's some very extreme circumstances at play.

BY MR. STONE:

Q. Okay. Can they travel through surface water?

A. They can travel through surface water.

Q. Can they travel through the air?

A. They can travel through the air.

Q. And can they travel through the intestines of an animal that moves from one area to another?

MR. NYFFELER: Object to the form.

THE WITNESS: PCBs, I presume, could be -- I mean, animals, mobile animals, can be vectors of PCBs.

BY MR. STONE:

Q. And so if the plaintiffs' properties are waterfront properties and the fish in Lake Wateree that those properties abut have -- are contaminated with PCBs, would that be evidence that there is PCBs on their property?

MR. NYFFELER: Object to the form of the question.

THE WITNESS: It would -- let's say if somebody buried a fish that was -- had PCBs in it from Lake Wateree on their property, that that would be an example of evidence that there's PCBs on their property.

The -- the -- the connection between a fish and an upland neighboring section of soil is I don't think significant enough to be considered as a route or a mechanism for PCBs to make it onto that property. And if you did some work, collected fish, put them on the property, perhaps, in that one location, that would be a vector or an example. But as a general -- as a general notion, I'm unfamiliar with that as a -- as a mechanism.

BY MR. STONE:

Q. If, say, a company sprayed PCB-containing substances on the water abutting those properties, would that be evidence that there is PCBs on the property?

MR. NYFFELER: Object to the form of the question.

BY MR. STONE:

Q. Even if just circumstantial evidence?

A. Depending on the nature of the spraying, if

it was -- if it was distributed by mist and if the -- and, like you say, you're stipulating the liquid that they're spraying has PCBs, then it's possible.

Q. Going on to your second bullet, sir, "Glover and Gundersen" -- I'm reading from your second bullet on page 7 of Exhibit 2. You write, "Glover and Gundersen (2021), Dr. Glover (2026), and Mr. Workman (2026a), all seem to make the incorrect assumption that 'transformer oil,'" in parentheses -- or, sorry, in quotation marks -- "refers to Askarel transformer fluid."

Did read that correctly?

A. Yes.

Q. So, sir, you're saying that they're making an incorrect assumption here, correct?

A. I'm saying that my reading of those documents reveals to me that they think that either all transformer oil -- all fluids from transformers have PCBs in them and that -- that people over time have casually used "transformer oil" to mean Askarel PCB-containing dielectric fluids.

Q. So it's your position that Dr. Glover and Dr. Gundersen and Mr. Workman have assumed that -- they've incorrectly assumed that the transformer oil that Duke sprayed on Lake Wateree all contained

BY MR. STONE:

Q. From what period of time, sir?

A. Well, in the late '60s to mid-'70s, that's when I'd say. That 5 percent is derived from literature in that time frame.

Q. So, sir, we've established a couple things, though, right? So Duke Power had a mosquito control program on Lake Wateree, correct?

A. Yes.

Q. And they sprayed oil as part of that mosquito control program. They sprayed tens of thousands of gallons of oil every year on Lake Wateree, correct?

THE WITNESS: Object to the form of the question.

THE WITNESS: Well, I can't confirm the volume, but they did spray substantial amounts of oil on Lake Wateree every summer of the program, every year of the program, throughout the breeding season for the mosquitos.

BY MR. STONE:

Q. And they did so for public health purposes, right, to keep the mosquitos down?

MR. NYFFELER: Object to the form.

THE WITNESS: Correct.

was willing to use waste lubricating oil in its mosquito control program. And, I believe, like it had in previous years.

BY MR. STONE:

Q. And the transformer oil that was applied in the mosquito control program, your position is it did not contain Askarel.

MR. NYFFELER: Object to the form.

THE WITNESS: My position is that it was -- that they didn't spray an Askarel-based dielectric fluid. But I did say that the mineral oil that they potentially -- that they maybe used, or potentially used, in their mosquito control program throughout the basin in '68 and '69 may have contained PCBs.

BY MR. STONE:

Q. And so the point is: You don't know, correct, sir? Like, you don't know if Duke Power sprayed PCB-containing oil on Lake Wateree.

MR. NYFFELER: Object to the form.

THE WITNESS: Well, I can say, again: I have an opinion that they never sprayed Askarel-based dielectric fluids on Lake Wateree or any of their lakes because -- for a number of reasons, but that when they sprayed, and if they

references to the mineral oil transformer in those documents.

MR. NYFFELER: Thank you, Dr. Butler. I have no further questions. Counsel may have some follow-up.

- - -

REEXAMINATION

- - -

BY MR. STONE:

Q. Dr. Butler, referring back to the CDM report that was handed to you by Duke's counsel just a few minutes ago --

A. Yes.

Q. -- is that chart that was pointed out by counsel with -- it was -- sorry. This is page number 46 again.

A. I see it.

Q. The chart that says "Sampling Investigation by EPA NJ 8/26/85." Do you see "PCBs"? It says 33?

A. Yes.

Q. Is that the source? Did you -- did you find that source yourself and put that in your report?

A. I had staff do research on these potential industrial sources, and they found this document and reviewed it to find this number.

Exhibit 49-1

EPA Report for Rock Hill Chemical Co Superfund Site

FIFTH FIVE-YEAR REVIEW REPORT FOR ROCK HILL CHEMICAL CO. SUPERFUND SITE YORK COUNTY, SOUTH CAROLINA



September 2021

Prepared for

U.S. Environmental Protection Agency
Region 4
Atlanta, Georgia

Randall Chaffins

Randall Chaffins, Acting Director
Superfund & Emergency Management Division

9/14/21

Date

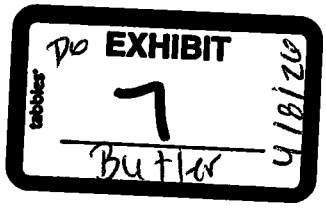


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LIST OF ABBREVIATIONS & ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
BRA	Baseline Risk Assessment
bgs	Below Grade Surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminants of Concern
DCE	Dichloroethene
EPA	United States Environmental Protection Agency
FS	Feasibility Study
FYR	Five-Year Review
ICs	Institutional Controls
MTBE	Methyl-tertiary-butyl Ether
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
POTW	Publicly Owned Treatment Works
PRP	Potentially Responsible Party
RAO	Remedial Action Objectives
RD	Remedial Design
RG	Remedial Goals
RHCC	Rock Hill Chemical Co.
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
SCDHEC	South Carolina Department of Health and Environmental Control
SVE	Soil Vapor Extraction
TCE	Trichloroethene
UAO	Unilateral Administrative Order
OU	Operable Unit
µg/L	Microgram per Liter
UU	Unlimited Use
UE	Unrestricted Exposure
VC	Vinyl Chloride

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and documents recommendations to address them.

The U.S. Environmental Protection Agency is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP)(40) Code of Federal Regulations (CFR) Section 300.430(f)(4)(ii)) and considering EPA policy.

This is the Fifth FYR for the Rock Hill Chemical Co. Superfund Site (the Site). The triggering action for this policy review is the signature date of the previous FYR. The FYR has been prepared because hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of one operable unit (OU): OU-1 addresses the soil remedial action (RA) and the groundwater RA. This FYR Report addresses the entire Site.

The South Carolina Department of Health and Environmental Control (SCDHEC) conducted the FYR and prepared this report regarding the remedy implemented at the Rock Hill Chemical Co. Superfund Site in Rock Hill, York County, South Carolina. The SCDHEC personnel conducted this review from October 2020 to March 2021. The EPA is the lead agency for developing and implementing the remedy for the cleanup at the Site. The relevant entities were notified of the initiation of the FYR. The review began on October 12, 2020.

Site Background

The Rock Hill Chemical Co. (also known as the Rutledge Property) Superfund Site is located next to U.S. Highway 21 (Cherry Road) and Farlow Street in Rock Hill, York County, South Carolina 29730. The Site covers approximately 4.5 acres of land in a light commercial and residential area, across from the Rock Hill Mall. All residents and businesses in the area of the Site are connected to the municipal water supply. From 1960 through 1964, the Site was the location of the Rock Hill Chemical Co. (RHCC), a facility where paint solvents were distilled and reportedly, textile dye products were recovered. While RHCC was operating, residue from RHCC's distillation still bottoms, drum bottoms, and storage tank bottoms, were placed in piles on the surface of the facility property and later covered with fill dirt and construction debris. During its operation, RHCC accepted waste oils and solvents from generators, separated them, and sold the extracted solvents and oils back to the generators.

The reclamation process used a single pot still, a filter press and a small steam generator. In this operation, waste fluids were reprocessed by separating solvents from the oil phase, filtering the oil through a charcoal filter press and repackaging the reclaimed oil for distribution to clients. The waste fluids initially were contained in drums, but as the process expanded, above ground storage tanks were added as needed. Paint sludges, textile dye products, still bottoms, and other wastes generated during the reclamation process, were stored in piles placed directly onto the ground. In some cases, waste products were buried at the Site. Still bottoms generated from the reclamation process, were incorporated into various layers of fill dirt and construction debris used to fill low areas of the property to help support heavy machinery. Tanks used to hold liquid wastes before reclamation had, on occasion, leaked onto the

ground, creating a potential source of contamination. One such leak was caused by a faulty tank valve. Another release occurred when a valve on one of the tanks was deliberately opened by a trespasser, which caused chemicals to spill onto the ground. In October 1964, a fire at the facility caused drums of oil and chemicals to explode, releasing their contents into the environment. After the fire, the RHCC partnership was dissolved. Since that time, no other industrial activity has taken place at the Site. No projected land use changes were identified during this FYR.

In 1986 the responsible party conducted a soil removal action under the supervision of SCDHEC. In 1987, EPA conducted a time-critical removal action to remove and dispose approximately 46,000 gallons of waste from above ground tanks, along with additional contaminated soil. These soil removal actions were completed prior to the 1993 Remedial Investigation/Feasibility Study; post-excavation soil conditions were evaluated in the Baseline Risk Assessment.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Rock Hill Chemical Co.		
EPA ID: SCD980844005		
Region: 4	**State:** SC	**City/County:** Rock Hill/York
SITE STATUS		
NPL Status:		
Multiple OUs? No	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency:		
Author name: Craig VanTrees with support from SCDHEC		
Author affiliation: EPA		
Review period: 10/12/2019 – 03/15/2021		
Date of site inspection: March 12, 2020		
Type of review:		
Review number: 5		
Triggering action date: 09/29/2016		
Due date *(five years after triggering action date)*: 9/29/2021		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

As part of the Site's 1993 Remedial Investigation/Feasibility Study (RI/FS) completed by the EPA, a Baseline Risk Assessment (BRA) was conducted to determine the current and future effects of site contaminants on human health. The BRA concluded that the soil removal actions were effective in both eliminating the risk to human health due to exposure from contaminated soils and eliminating contaminated soils as a source of continued groundwater contamination. Trichloroethene (TCE), 1,2-dichloroethene (DCE), vinyl chloride, and manganese were identified as the contaminants of concern (COCs) in groundwater at the Site. Methyl tert-butyl ether (MTBE) was not identified as a COC at the Site, but it is being monitored due to the proximity of an upgradient groundwater plume containing MTBE. Future ingestion of groundwater under a residential land use scenario was the only medium posing a potential unacceptable level of risk to human health or the environment.

The BRA calculated carcinogenic risk and non-carcinogenic Hazard Index ratios for both a current land use scenario, with residents near the Site (site visitor), as well as on-site workers, and a potential future land use scenario (residential). The BRA determined that the total cancer risk for the future site residential scenario was 2.63×10^{-2}, which exceeds EPA's acceptable risk range of 1×10^{-4} to 1×10^{-6}. The non-carcinogenic Hazard Index for the future site residential scenario was 400 for an adult and 950 for a child, both of which exceed the acceptable Hazard Index of 1.0. These carcinogenic and non-carcinogenic risks are attributable to the ingestion of groundwater. The BRA concluded that surface soils, surface water, and sediments at the Site are not media of concern.

Table 1 - COCs by Media

COCs	Media
Organic Compounds 1,2-Dichloroethene, Trichloroethene, Vinyl Chloride **Inorganic Compounds** Manganese	Groundwater

Response Actions

Based on the Feasibility Study, BRA, and Applicable or Relevant and Appropriate Requirement (ARARs), the Remedial Action Objectives (RAOs) listed below were established for the Rock Hill Chemical Co. Site in the 1994 Record of Decision (ROD).

- Reduce to acceptable levels the excess risk to humans and environmental receptors associated with the medium and contaminants of concern at the Site. This will be accomplished by reducing the concentrations of contaminants that result in excess risk to human health and the environment.

- Reduce the potential for ingesting contaminants in the groundwater or inhaling volatilized contaminants from the groundwater where:
  - Carcinogen concentrations are above federal or state standards, or in the absence of standards, are above levels that would exceed an acceptable cancer risk range of 1×10^{-4} to 1×10^{-6}; and

- Non-carcinogen concentrations are above federal or state standards, or in the absence of standards, are above levels that would exceed an acceptable Hazard Index of 1.0.

The major components of the remedy selected in the 1994 ROD include:

- Extraction of contaminated groundwater;
- Direct discharge to the Publicly Owned Treatment Works (POTW) of extracted groundwater;
- Deed restrictions;
- Long term groundwater monitoring; and
- Additional work during the remedial design phase including: determining the relationship of the contamination detected in private wells to the contamination detected in on-site wells, collecting additional background surface soil samples to confirm the variance in manganese levels is consistent with the environmental settings, and collecting additional surface water and sediment samples to determine if the selected background sample is representative of true background decisions.

The Site's ROD selected a remedy that included extraction of contaminated groundwater with direct discharge to the POTW and long-term groundwater monitoring. No pretreatment is required prior to discharge to the sewer line. The ROD also required implementation of institutional controls to prevent the future use of contaminated groundwater for purposes such as a potable water supply or irrigation of garden vegetables. Permit restrictions issued by the State of South Carolina would restrict all well drilling permits for new wells on the Site property that could draw contaminated groundwater for potable water use or irrigation of garden vegetables.

The ROD required that the following, additional fieldwork be conducted during the remedial design: (1) sampling and analysis of additional background soil samples to confirm that the variance in the previous background manganese concentrations are representative of actual Site conditions; (2) sampling and analysis of additional background sediment and surface water samples to confirm that the previous background tetrachloroethene concentrations are representative of actual site conditions; and (3) evaluation of several private wells near the Site. Evaluation of the private wells included additional well sampling and analysis and investigation of the wells' construction characteristics. This evaluation was required to determine if low levels of contamination previously detected in the wells was Site related.

Table 2 - ROD Established Remediation Goals

ROD Established Remediation Goals (micrograms per liter [µg/L])		
Contaminant of Concern	**1994 ROD Cleanup Levels**	**Source**
1,2-Dichloroethene	70	MCL[1]
Trichloroethylene (TCE)	5	MCL
Vinyl Chloride	2	MCL
Manganese	200	Background Levels [2]

[1] State and Federal Maximum Contaminant Level (MCL) under the Safe Drinking Water Act (1974)
[2] EPA set a rounded-up cleanup goal based on an average background concentration of 185 µg/L

Status of Implementation

In 1995, the EPA issued a Unilateral Administrative Order (UAO) requiring the PRPs to develop and implement the remedial design for the cleanup approach specified in the ROD. Remedial design began in March 1995 and was completed in September 1996. The Site's groundwater remedial system began operation in December 1996. Contaminant levels in groundwater have been monitored annually since 1995. The Institutional Controls (ICs) restricting use of groundwater required by the ROD have been implemented with the exception of three parcels currently owned by Rutledge Realty Company. The EPA and PRPs continue to work towards implementing ICs on those parcels.

Other construction activities related to the Site's remedial system included: (1) installation of a new manhole to allow discharge of recovered groundwater into the City of Rock Hill's sanitary sewer system, through which it would travel to the POTW; (2) installation of a submersible pump into the recovery well; (3) installation of piping, fittings, meters and valves between the recovery well and the new manhole; and (4) installation of instrumentation to allow continuous operation of the system.

The ROD required supplemental groundwater sampling and analyses during the Remedial Design (RD) assessment to update the data on the contaminant concentrations and the extent of migration. The results of the additional fieldwork conducted during the RD assessment activities required by the ROD were as follows:

- The analysis of the additional background soil samples confirmed that the manganese concentrations detected in previous background soil samples are representative of site conditions (The Fletcher Group, Inc. (1995)).
- The analysis of the additional background sediment and surface water samples confirmed that the tetrachloroethene concentrations detected in previous background sediment and surface water samples are not site-related (The Fletcher Group, Inc. (1995)).
- The evaluation of the private wells revealed that there were no site-related contaminants in the private wells (The Fletcher Group, Inc. (1995)).

Two remedial technologies were pilot tested during 2011 and 2012. The pilot tests consisted of *in-situ* anaerobic bioremediation in the vicinity of MW-02SH and a soil vapor extraction system (SVE) in the vicinity of MW-03SH/MW-03RK/RW-01. The results of the two pilot tests are as follows:

In August 2011, the *in-situ* anaerobic bioremediation pilot test was conducted immediately upgradient of saprolite monitoring well MW-02SH using biological enhancement via injections. As a result of the injections, the VOC concentrations in MW-2SH decreased to less than the performance standard by June 2013. While TCE and 1,2-DCE concentrations in MW-2SH remain below their respective performance standards, VC concentrations have remained above the performance standard of 2 ug/L, since June 2014. The June 2020 data shows that TCE concentrations remain at <1.0 ug/L, below the performance standard of 5.0 ug/L; *cis*-1,2 DCE was detected at 7.3 ug/L, below the performance standard of 70 ug/L; and vinyl chloride was detected at 2.3 ug/L, slightly above the performance standard of 2.0 ug/L. Also note the manganese concentration has decreased from 3350 ug/L in June 2012 to 1130 ug/L in June 2020. This could indicate that the aquifer in the area is returning to pre-pilot test, less anaerobic conditions

Between July and August of 2016, the bentonite plug at the bottom of recovery well RW-01 failed. The effluent flow rate increased from approximately 4,000 gallons a day to 12,000 gallons a day. An effluent sample from RW-01 did not detect any concentrations of the organic COCs above remedial goals. In October 2016 the USEPA and SCDHEC approved abandoning the well.

When the RW-01 was abandoned, MW-03RK operations increased from 12 to 24 hours a day. The pump is designed to operate for five (5) minutes each hour to dewater the well. From the start of groundwater recovery in late December of 1995, the total volume of groundwater recovered was approximately 29,380,171 gallons (1995 to 2020).

Prior to well abandonment, mass removal from RW-01 had reached asymptotic conditions. Based on the TCE concentration detected at MW-03RK, a recorded estimate of 0.003 pounds of TCE was removed from MW-03RK from July 1, 2019 through June 30, 2020. The calculated mass of TCE removed from the Site since RW- 01 began operating is an estimated 56.14 pounds. More than 95 percent of that mass was removed before 2008.

Compared to recovery well RW-01, monitoring well MW-03RK has a greatly reduced flow and does not provide the same level of hydraulic containment as RW-01. While the use of MW-03RK does not maintain the same large area of hydraulic containment as RW-01, its use does provide hydraulic control in the area of highest groundwater contamination.

The use of MW-03RK as a permanent replacement for recovery well RW-01 should be evaluated in terms of well construction versus well usage. The remedy could be further optimized using High-Resolution Site Characterization (HRSC) strategies in the area of remaining groundwater contamination.

Groundwater at the Site has also been impacted by a former off-site gasoline service station covered under the state's underground storage tank trust fund program. In 1996, methyl-tertiary-butyl ether (MTBE), a gasoline constituent, was detected in the sewer discharge analyses. It was concluded that the source of MTBE in the monitoring wells and the recovery well is contaminant migration from the gas station and is not connected with the operations from the Rock Hill Chemical Co. operations. The annual groundwater samples from the Site monitoring wells are analyzed for MTBE in addition to the Site COCs.

Table 3 - History and Performance of Groundwater Extraction System

Timeframe	Action	Outcome
1995	Recovery well (RW-01) became operational.	Significant reductions in concentrations observed. Concentrations stabilized at greater than performance standards
2004	Began pulse pumping of RW-01 with the pump on sensor in saprolite well MW-03SH (15' below grade surface (bgs)) and the pump off sensor in RW-01 (70' bgs).	Improved mass removal. Concentration stabilized near performance standards.
2011	Initiated two pilot tests: 1) Dual phase recovery system – vacuum extraction in conjunction with groundwater extraction around RW-01. Vacuum extraction from MW-03SH, MW-03RK and RW-01. Resumed continuous operation at RW-01. Pump On at 50' bgs and Pump Off at 115' bgs.	Concentration reduction in MW-03SH.
	2) In-situ bioremediation pilot test around MW-02SH. Amendment injection grid covered area where COC's were present.	Reduction of COC concentrations to below performance standards in MW-02SH.
2012	RW-01 did not sufficiently dewater MW-03RK for the SVE system to have influence. Installed submersible pump in MW-03RK to supplement RW-01. Vacuum extraction operated for 12 hours during the day.	Concentrations continued to decrease in area of MW-03SH and MW-03RK.
2016 to Present	Abandon RW-01 due to bentonite plug failure. Blower on SVE system malfunctioned and has remained offline since. Operation of MW-03RK began on a continuous basis.	Continue to monitor COC response to decreased hydraulic stress.

Institutional Controls (ICs)

The 1994 ROD required institutional controls in the form of deed restrictions and well permit restrictions for groundwater. Deed restrictions would prevent the future use of the contaminated groundwater for purposes such as potable water supply or irrigation of edible garden vegetables. Permit restrictions, issued by the State of South Carolina, would restrict all well drilling permits that were issued for new wells on the Site property, that may access contaminated groundwater for potable water use or irrigation of edible vegetables.

Table 4 and Figure 1 include the institutional controls associated with areas of interest at the Site. Three recorded instruments have been filed in York County, South Carolina that stipulate groundwater restriction requirements for parcels 6340000108, 6340701047 and 6340701058.

Appendix F provides a copy of the deed notices for the following parcels: 6340000108, 6340701047, and 6340701058.

The property owner has been working with the EPA and SCDHEC on preparation of a restrictive covenant for the part of the Site located on their property (Parcels 6340000003, 6340000108 and 6340000109). The EPA anticipates the restrictive covenant will be recorded by 11/29/2024.

IC Summary Table

Table 4 - Summary of Planned and/or Implemented Institutional Controls (ICs)

Media, Engineered Controls and Areas that Do not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)[2]	IC Objective	Title of IC Instrument Implemented and Date (or Planned)
Groundwater	No Longer Needed	Yes	6340701044	Restrict use of groundwater as a drinking water source or irrigation source for edible vegetables until the MCLs are met.	Declaration of Covenants and Restrictions (DCR) Instrument #201400275671
Groundwater	No Longer Needed	Yes	6340701047	Restrict use of groundwater as a drinking water source or irrigation source for edible	2014 DCR Instrument #201400278921

				vegetables until the MCLs are met.	
Groundwater	No Longer Needed	Yes	6340701058	Restrict use of groundwater as a drinking water source or irrigation source for edible vegetables until the MCLs are met.	2015 DCR Instrument #201500310017
Groundwater	Yes	Yes	6340000003, 6340000108, and 6340000109	Restrict use of groundwater as a drinking water source or irrigation source for edible vegetables until the MCLs are met.	None

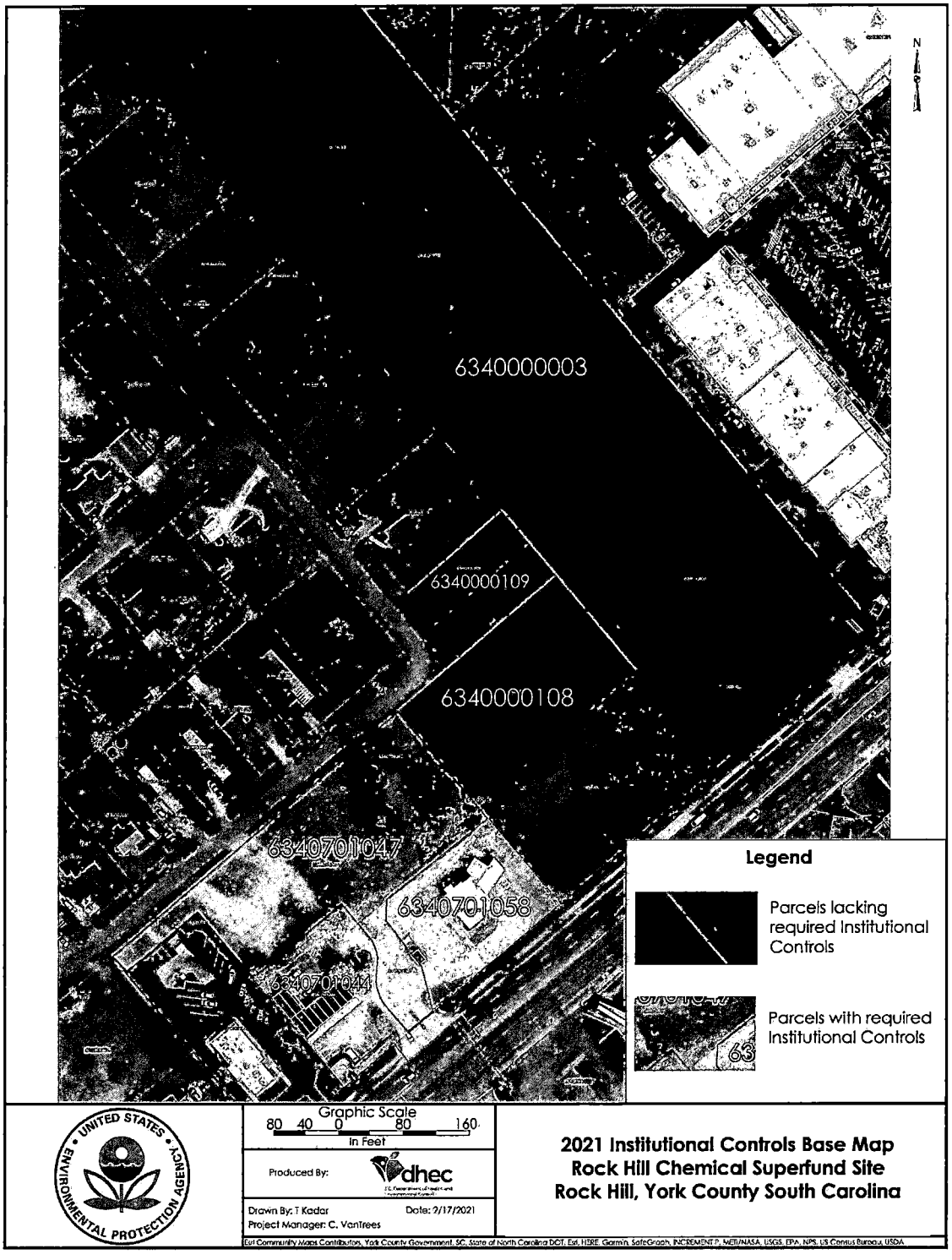


Figure 1 - Institutional Controls Base Map

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the last five-year review as well as the recommendations from the last five-year review and the current status of those recommendations.

Table 5 - Protectiveness Determinations/Statements from 2016 FYR

OU #	Protectiveness Determination	Protectiveness Statement
OU-1	Protective	The remedy at OU-1 currently protects human health and the environment because highly contaminated soils above the cleanup level have been excavated and removed, groundwater extraction and discharge treatments continue to effectively reduce contaminant concentrations in groundwater and institutional controls have been implemented to restrict groundwater exposure pathways.[1]

Table 6 - Status of Recommendations from 2016 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
OU-1	Changes have occurred to the applicable risk criteria for manganese, making the RSL less stringent than the remediation goal. The groundwater remedial goal may no longer valid.	Re-evaluate the groundwater remedial goal for manganese and derive new site-specific risk-based remedial goal. Modify Site remedy decision document to include the revised remedial goal.	Ongoing	The EPA is evaluating the groundwater remedial goal for manganese.	NA

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

A public notice was made available by a newspaper posting in *The Herald,* on October 28, 2020, stating that there was a five-year review and inviting the public to submit any comments to the EPA. The results of the review and the report will be made available at the Site information repository located both at York County Library located at 138 E Black St, Rock Hill, South Carolina 29730 and the EPA's online repository https://www.epa.gov/superfund/rock-hill-chemical-rutledge-property.

[1] The 2016 FYR protectiveness statement did not distinguish between short-term and long-term protectiveness. In 2016 the remedy was protective in the short-term because soil above cleanup levels had been excavated and removed, groundwater extraction and discharge treatments continued to reduce contaminant concentrations in groundwater, and no exposures were occurring. In 2016, institutional controls were needed to ensure long-term protectiveness.

The FYR process included interviews regulatory agencies involved in Site activities or aware of the Site. The purpose is to document the perceived status of the Site and any perceived problems or successes with the phases of the remedy implemented to date. All the interviews were conducted in person, via telephone, or completed by email after the Site inspection. The interviews are summarized below. Appendix C provides the complete interviews.

Sara MacDonald is the SCDHEC Project Manager (PM) for the Site. The Responsible Party (RP) maintains the Site and the remedy components in good working order. Overall, Ms. MacDonald's impression of the Site is positive.

Richard Jacobs works for the SynTerra Corporation and has managed remedial activities at the Site for years. Mr. Jacobs states the project has proceeded with the normal annual sampling and maintenance of the site. The cleanup has prevented site contaminates from affecting potential receptors. The current remedy is maintaining the overall objective of protecting human health and the environment.

Data Review

The ROD, Unilateral Administrative Order, and the Statement of Work require annual sampling of the monitoring wells in June of each year. This annual monitoring well sampling over this FYR period includes MW-01SH, MW-01RK, MW-02SH, MW-02RK, MW-03SH, MW-03RK, MW-04SH, MW-04RK, MW-06SH, MW-06RK, MW-08SH, MW-08RK and MW-009SH.

The historical COC groundwater data are summarized in Appendix H, Table 10. Maps showing the concentrations of TCE, total manganese, cis-1,2-dichloroethene, and vinyl chloride in the saprolite and bedrock aquifers in 2020 are included in Appendix I, Figures 13 through 20. Figure 22 in Appendix I is a hydrogeologic cross-section that provides the vertical perspective of 2020 TCE data.

Manganese

Manganese is the only inorganic groundwater COC. Data for this FYR review period indicate total manganese concentrations were greater than the ROD established remediation goal (RGs) of 200 µg/L for the following wells: MW-02SH, MW-03SH, MW-04SH, MW-06SH, and MW-09SH.
The manganese concentrations in June 2019 were also greater than the USEPA tap water screening criteria (430 µg/L) at wells MW-04SH, MW-06SH and MW-09SH. The total manganese concentration in MW-02SH increased in 2012 as indicated by the results of the in-situ anaerobic bioremediation pilot test.

In October 2011, samples from MW-02SH, MW-04SH, MW-06SH, and MW- 09SH were analyzed for total and dissolved manganese concentrations. The data confirmed that the total manganese concentrations comprise soluble manganese. This can be the result of the natural anaerobic aquifer conditions often found in low-lying areas.

The total manganese concentrations are less than the RG in the upgradient saprolite wells, MW-01SH and MW-08SH1, and in all the bedrock monitoring wells.

Prior to operation of the recovery well, the total concentration of manganese found at the saprolite monitoring well MW-03SH was greater than the groundwater performance standard. During operation of the recovery well, the total manganese concentration was less than the performance standard. After abandonment of the recovery well in November 2016, the total manganese concentration increased. During the time the recovery well (RW-01) was in operation, the decrease in manganese

concentrations that was observed was attributed to dewatering the area, which created aerobic aquifer conditions and a higher oxidation-reduction potential that favors precipitation of soluble manganese.

Maps showing the total manganese concentrations in the saprolite and bedrock aquifers for June 2020 are included in Appendix I (Figures 15 and 16 respectively). A summary of the manganese data is included in Appendix H, Table 11.

Wells MW-02SH, MW-03SH, MW-03RK, and RW-01 have demonstrated detectable organic COC concentrations in the past and are the focus for this data review.

MW-02SH/MW-02RK

As a result of the in-situ bioremediation pilot test from 2012, the MW-02SH TCE and cis-1,2-DCE concentrations remained at less than their RGs (5 µg/L and 70 µg/L respectively) for this FYR review period. The VC concentration has remained slightly greater than the RG of 2 µg/L. In addition, the following was determined:

- The TCE concentration has remained less than the detection limit since February 2012.
- The cis-1,2-DCE concentration has remained at less than the performance standard since February 2012 (7.3 µg/L in June 2020).
- The VC concentration has been decreasing from a high of 14.4 µg/L to 2.3 µg/L in June 2020.

No organic COCs were detected in MW-02RK during this FYR review period, which is consistent with historical data.

The historical COC concentration trends for MW-02SH are shown in Appendix G, Figure 2. The most recent 10 years of TCE data are shown in Appendix G, Figure 6.

MW-03SH/MW-03RK

Wells MW-03SH and MW-03RK have historically had the highest organic COC concentrations at the Rutledge site. Since initiating RW-01 (recovery well) operations in December 1995, concentrations have significantly decreased.

Significant data points for MW-03SH include:

- In June 2011, before the vacuum extraction began in August 2011, TCE concentration was 3.5 µg/L, and the cis-1,2-DCE concentration was 2.3 µg/L.
- From June 2012 to June 2015, the TCE and cis-1,2-DCE concentrations were less than the detection limit of 1.0 µg/L.
- The June 2016 TCE concentration was 2.3 µg/L, and cis-1,2-DCE was 1.7 µg/L.
- The recovery well RW-01 was abandoned in November 2016. The following sampling event, in June 2017, showed an increase in TCE and cis-1,2-DCE concentrations above their respective RGs of 5 µg/L and 70 µg/L. TCE was detected at 8.6 µg/L and cis-1,2- DCE was 3.7 µg/L.

- The TCE concentrations increased in June 2020 and cis-1,2-DCE concentrations decreased. TCE was measured at 173 µg/L, and cis-1,2- DCE was measured at 52 µg/L (below the RG of 70 µg/L).

Significant data points for MW-03RK include:

- Since June 2004, the TCE concentrations have fluctuated between 38 µg/L (October 2012) to 579 µg/L (July 2017).
- The TCE concentration in June 2020 was 316 µg/L which is above the TCE RG of 5 µg/L.
- The concentrations of *cis*-1,2 DCE has consistently remained within the historic range of 270 µg/L to 100 µg/L since June 2011. Concentrations were 258 µg/L in June 2020 (above the RG of 70 µg/L).
- The VC concentrations have remained at less than the method detection limit of 1.0 µg/L since April 2012.

Trichloroethene, cis-1,2-dichlorothene, vinyl chloride, and total manganese concentrations versus time are shown in Appendix G, Figure 3 and 4.

RW-01

The organic COC concentrations in RW-01 decreased significantly after groundwater recovery began in 1995. However, in August 2016, after the bentonite plug failed, an effluent sample was taken from RW-01 demonstrating that all organic COCs were at less than RGs. RW-01 was abandoned in November 2016 with USEPA and SCDHEC approval.

Trichloroethene, cis-1,2-dichlorothene, vinyl chloride, and total manganese concentrations versus time are shown in Appendix G, Figure 5.

Summary

Overall, the TCE concentrations have decreased significantly at wells MW-02SH, MW-03SH, MW-03RK, and RW-01 since 1995. Concentrations are currently less than RGs at all wells except MW-02SH, MW-03SH and MW-03RK.

After implementation of the in-situ anaerobic bioremediation pilot test, the TCE and cis-1,2-DCE concentrations for MW-02SH have decreased to less than the RGs. The concentration of VC in June 2020 was 2.3 µg/L, which is slightly greater than the RG of 2.0 µg/L.

An increase in TCE and cis-1,2-DCE concentrations has been observed in MW-03SH following the shutdown of RW-01 in 2016. TCE concentrations appear to have stabilized at a level exceeding the RG of 5 µg/L; however, cis-1,2-DCE concentrations decreased in 2020 to less than the RG of 70 µg/L.

TCE and 1,2-DCE concentrations in MW-03RK continue to exceed RGs and appear to have been unaffected by the shutdown of RW-01.

Site Inspection

The site inspection was conducted on December 2, 2020. The inspection team consisted of the following personnel: Craig VanTrees (US EPA RPM), Michael Simpson (PRP Representative), Sara MacDonald

(SCDHEC PM), Evan Etheridge (SCDHEC), and Timothy Kadar (SCDHEC). The purpose of the inspection was to assess the protectiveness of the remedy.

A visual inspection of the recovery well, monitoring wells, SVE equipment, unnamed tributary to the Catawba River, and Site property was conducted. The recovery well and treatment system was in good condition and secured by a chain-link fence with locked gate. Wells were in good condition and secured with padlocks. Recovery well monitoring, control, and data acquisition can be accessed remotely or from on-site.

The Site is mostly wooded with the remnants of a building foundation in the lower southwest corner. Trails are cut through the woods to access groundwater wells and other points of interest on-site. There is some evidence of trespassing and the illegal disposal of household waste on-site.

Craig VanTrees, the EPA RPM, visited the York County Library Site information repository located at 311 North Main Street in Fountain Inn, South Carolina on December 2, 2020. The Site information repository consisted of:

- Administrative Record through 1994 on CDROM
- Documents and Data through April 2003 on USB Stick
- The Second FYR as a printed document

At the request of the Library and in response to the coronavirus pandemic, the Administrative Record was made available in a secure electronic format at the EPA's Superfund Site's Home Page. The link is as follows:

https://www.epa.gov/superfund/rock-hill-chemical-rutledge-property..

The Library will provide patrons with the appropriate website link, internet access and onsite publicly available computers.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary:
The review of documents, ARARs, risk assumptions and the site inspection indicate that the remedy is functioning in accordance with decision documents. The decision documents included contaminated groundwater extraction and discharge to the POTW until cleanup goals are achieved. The groundwater extraction system has significantly reduced the concentration of volatile organic compounds around the recovery well and has contained the COCs on site.

The ROD required implementation of institutional controls as part of the selected remedy. These institutional controls included deed restrictions to prevent future use of contaminated groundwater and the prevention of new wells from being drilled on properties that might draw water from the contaminated groundwater. These institutional controls have implemented on three parcels and the EPA is working to file and record ICs on the remaining parcels.

As the concentration of contaminants in groundwater decreased, the mass removal rate for the recovery well also decreased. In 2011, two pilot tests were initiated to evaluate enhanced removal of residual

COCs at the Site. The pilot tests consisted of in-situ anaerobic bioremediation in the vicinity of MW-02SH and soil vapor extraction system in the vicinity of MW-03SH/MW-03RK/RW-01.

The results from the pilot tests showed that the in-situ anaerobic bioremediation in the vicinity of MW-02SH and the dual phase (vapor and water) extraction system on MW-03RK and RW-01 are suitable additions to the remedy in the removal of residual COCs at the Site.

RW-01 failed and was abandoned in October 2016. With the abandonment of RW-01, MW-03RK operations increased from 12 to 24 hours a day. Compared to recovery well RW-01, monitoring well MW-03RK has a greatly reduced flow and does not provide the same level of hydraulic containment as RW-01. MW-03RK does provide hydraulic control in the area of highest groundwater contamination.

The use of MW-03RK as a permanent replacement for recovery well RW-01 should be evaluated in terms of well construction versus well usage. Recovery well RW-01's boring log and construction schematic is included in Appendix I, Figure 21. A hydrogeologic cross-section of the Site is included in Appendix I, Figure 22.

Asymptotic conditions have been reached at the Site. The total calculated mass of TCE removed from the Site since the beginning of remedial operations is 56.14 pounds. Ninety-five percent of that mass was removed by 2008. Based on the TCE concentration detected at MW-03RK, a recorded estimate of 0.003 pounds of TCE was removed from MW-03RK from July 1, 2019 through June 30, 2020.

The remedy could be further optimized using High-Resolution Site Characterization (HRSC) strategies in the area of remaining groundwater contamination.

ICs were a part of the remedy included in the 1994 ROD. The purpose was to restrict groundwater usage at the Site. ICs are in place for some parcels at the Site and the EPA is working to file and record ICs on the remaining parcels.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of the remedy selection still valid?

Question B Summary:
The RAOs used at the time of the remedy selection are still valid. While some of the exposure assumptions, toxicity data, and cleanup levels were based on information that has changed over time, these changes do not affect the short- or long-term protectiveness of the remedy as discussed in the following paragraphs.

RGs adopted for the Site are summarized in Appendix E, along with their basis. Appendix E shows the current EPA Maximum Contaminant Levels and identifies if there was a change from those adopted in the Site ROD.

No changes have occurred in the MCLs since the 1994 ROD and the 2016 Fourth Five-Year Review. The cleanup goals based on the current MCLs are still valid for the Site COCs. The cleanup goal of 200 µg/L for manganese was site-specific based on the average background concentration. Toxicity data for manganese was updated in 1995 and the current regional screening level for manganese in tap water is 430 µg/L. The RG for manganese is less than the current regional screening level for tap water and remains protective. The RAOs (see Appendix E) used at the time of the ROD are still valid.

This FYR did not identify any changes to the assumptions applied to the site-specific, risk-based remedial goal calculations at the time of the 1994 ROD that affects current or future protectiveness of the site.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

Question C Summary:
No other information has come to light that could call into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the FYR:
None

Issues and Recommendations Identified in the Five-Year Review:

OU(s): Sitewide	**Issue Category: Institutional Controls**			
	Issue: Institutional Controls have not been implemented as required by the ROD.			
	Recommendation: Implement Institutional Controls as required by the ROD.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	11/29/2024

OTHER FINDINGS

In addition, the following are recommendations that were identified during the FYR and may improve performance of the remedy, accelerate site close out, but do not affect current and/or future protectiveness:

- *Toxicity data for manganese was updated in 1995 and the current regional screening level for manganese in tap water is 430 µg/L. Review the manganese cleanup goal to determine if the cleanup goal remains valid.*
- *Evaluate the effectiveness of MW-03RK as a permanent replacement for recovery well RW-01.*
- *Evaluate the use of High-Resolution Site Characterization (HRSC) strategies to optimize remediation of the remaining groundwater plume.*

VII. PROTECTIVENESS STATEMENT

Sitewide Protectiveness Statement
Protectiveness Determination: Short-term Protective
Protectiveness Statement: The Site's remedy currently protects human health and the environment in the short term because soil above cleanup levels has been excavated and removed, groundwater extraction and discharge treatments continue to reduce contaminant concentrations in groundwater and no exposures are occurring. However, for the remedy to be protective in the long-term, institutional controls, as required by the Record of Decision, need to be implemented to ensure long-term protectiveness.

III. NEXT REVIEW

The next five-year review report for the Rock Hill Chemical Co. Superfund Site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

U.S. Environmental Protection Agency, Region IV TES VIII. (1993). *Final Baseline Risk Assessment, Rutledge Property Superfund Site, Rock Hill, York County, South Carolina.* Atlanta, Georgia.

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SynTerra. (2018). 2018 Annual Corrective Action Report for the Rutledge Property Superfund Site, Prepared For: CNA Holdings LLC, Successor to Hoechst Celanese Corporation. Greenville, South Carolina
SynTerra. (2019). 2019 Annual Corrective Action Report for the Rutledge Property Superfund Site, Prepared For: CNA Holdings LLC, Successor to Hoechst Celanese Corporation. Greenville, South Carolina.

SynTerra. (2020). 2020 Annual Corrective Action Report for the Rutledge Property Superfund Site, Prepared For: CNA Holdings LLC, Successor to Hoechst Celanese Corporation. Greenville, South Carolina

APPENDIX B – CURRENT SITE STATUS

Environmental Indicators
- Current human and environmental exposures at the Site are under control.

Are Necessary Institutional Controls in Place?
☐ All ☒ Some ☐ None *Yes*

Has EPA Designated the Site as Sitewide Ready for Anticipated Use?
☐ Yes ☒ No

Has the Site Been Put into Reuse?
☐ Yes ☒ No

APPENDIX C – PRESS NOTICE

The Herald

Order Confirmation

Customer SC DHEC	**Payor Customer** SC DHEC
Customer Account 511171	**Payor Account** 511171
Customer Address 2600 BULL STREET COLUMBIA SC 29201 USA	**Payor Address** 2600 BULL STREET COLUMBIA SC 29201 USA
Customer Phone 803-898-0640	**Payor Phone** 803-898-0640
Customer Fax	**Customer EMail** jacksolb@dhec.sc.gov
Sales Rep tpennington@charlotteobserver	**Order Taker** tpennington@charlotteobserver

PO Number	Payment Method	Blind Box	Tear Sheets	Proofs	Affidavits
Rock Hill Chemical a/k/a Rutledge	Invoice		0	0	1

Net Amount	Tax Amount	Total Amount	Payment Amount	Amount Due
$153.81	$0.00	$153.81	$0.00	$153.81

Ad Order Number	Order Source	Ordered By	Special Pricing
0004793049		Timothy Kadar	

Invoice Text
Public Notice- Chemical a/k/a Rutledge Property

Promo Type

Package Buy

Materials

Ad Order Information

Ad Number	Ad Type	Production Method	Production Notes
0004793049-01	RHL-Legal Liner	AdBooker	

External Ad Number	Ad Attributes	Ad Released	Pick Up
		No	

Ad Size	Color
2 X 35 li	

Product	Placement	Times Run	Schedule Cost
RHL- The Herald	0300 - Legals Classified	1	$153.81

Run Schedule Invoice Text	Position
Public Notice Rock Hill Chemical a/k/a R	0301 - Legals & Public Notices

Run Dates
10/28/2020

PUBLIC NOTICE

Rock Hill Chemical a/k/a Rutledge Property

York County, South Carolina

The U.S. Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (DHEC) are conducting a Five-Year Review of the former Rock Hill Chemical (Rutledge Property) site located in Rock Hill, South Carolina. This is a federal Superfund site with ongoing cleanup activities. The purpose of the review is to evaluate remedial activities of the past five years and make sure that the cleanup continues to protect human health and the environment. During the review, DHEC staff will conduct interviews with local residents, officials, and others who are familiar with the site. We value input about site conditions and want to hear any concerns of the local community. **You are encouraged to participate in the review by contacting us with your comments or questions through December 7, 2020.**

The Five-Year Review process is expected to be complete in summer 2021, at which time a report will be written on our findings. Any comments received about the site will be summarized in the report. The report will be available on EPA's website and at the York County Library located at 138 East Black Street, Rock Hill, South Carolina 29730. For more information about the Rock Hill Chemical site, please visit:

http://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0403425

For comments, questions, or to participate in an interview, please contact:

Technical Comments: Craig VanTrees, EPA Remedial Project Manager, at (404) 562-8447, or by e-mail at vantrees.craig@epa.gov.

EPA Community Involvement: Zariah Lewis, EPA Community Involvement Coordinator, at (404) 562-8342, or by e-mail at lewis.zariah@epa.gov.

Community Involvement : Donna Moye, DHEC Community Liaison, at (803) 898-1382, or by e-mail at moyedd@dhec.sc.gov.

Please share this with others you know who might be interested.

4793049

APPENDIX D – SITE INSPECTION CHECKLIST

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site name: Rock Hill Chemical Co.	**Date of inspection: December 2, 2020**
Location and Region: Rock Hill, York County, SC; Region 4	**EPA ID: SCD980844005**
Agency, office, or company leading the five-year review: SCDHEC	**Weather/temperature: Overcast 55F**

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☐ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other *In-situ* Bioremediaiton
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** _____ (Name) _____ (Title) mm/dd/yyyy (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached _____

2. **O&M staff** _____ (Name) _____ (Title) mm/dd/yyyy (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached _____

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.). Fill in all that apply.

   Agency South Carolina Department of Health and Environmental Control

Contact	Name		Date	Phone No.
	Sara MacDonald	DHEC	10/10/2020	803-898-0876

   Problems; suggestions; ☐ Report attached see Appendix C

   Agency South Carolina Department of Health and Environmental Control

Contact	Name		Date	Phone No.

   Problems; suggestions; ☐ Report attached see Appendix C

4. **Other interviews** (optional) ☒ Report attached see Appendix D

EPA Region 4: Craig VanTrees, Remedial Project Manager

(PRP Contractor): Michael Simpson, PRP's Representative

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	**O&M Documents**			
	☒ O&M manual	☒ Readily available	☒ Up to date	☐ N/A
	☒ As-built drawings	☒ Readily available	☒ Up to date	☐ N/A
	☒ Maintenance logs	☒ Readily available	☒ Up to date	☐ N/A
	Remarks: _____			
2.	**Site-Specific Health and Safety Plan**	☒ Readily available	☒ Up to date	☐ N/A
	☒ Contingency plan/emergency response plan	☒ Readily available	☒ Up to date	☐ N/A
	Remarks: _____			
3.	**O&M and OSHA Training Records**	☒ Readily available	☒ Up to date	☐ N/A
	Remarks: _____			
4.	**Permits and Service Agreements**			
	☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
	☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
	☒ Waste disposal, POTW	☒ Readily available	☐ Up to date	☐ N/A
	☐ Other permits _____	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
6.	**Settlement Monument Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
7.	**Groundwater Monitoring Records**	☒ Readily available	☒ Up to date	☐ N/A
	Remarks: _____			
8.	**Leachate Extraction Records**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
9.	**Discharge Compliance Records**			
	☐ Air	☐ Readily available	☐ Up to date	☒ N/A
	☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			
10.	**Daily Access/Security Logs**	☐ Readily available	☐ Up to date	☒ N/A
	Remarks: _____			

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State

☐ PRP in-house ☒ Contractor for PRP

☐ Federal Facility in-house ☐ Contractor for Federal Facility

☐ _____

2. **O&M Cost Records**

☐ Readily available ☒ Up to date

☐ Funding mechanism/agreement in place ☐ Unavailable

Original O&M cost estimate _____ ☐ Breakdown attached

Total annual cost by year for review period if available

From mm/dd/yyyy To mm/dd/yyyy _____ ☐ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: _____

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☒ N/A

Remarks: The main components of the remedial system - above ground piping, power, shed, etc., is enclosed within an area surrounded by chain link fence with locked gates. It appeared to be in good condition.

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☒ N/A

Remarks:

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive by) self-reporting

Frequency _____

Responsible party/agency:

Contact _____ _____ mm/dd/yyyy _____

Name Title Date Phone no.

Reporting is up-to-date ☐ Yes ☐ No ☒ N/A

Reports are verified by the lead agency ☐ Yes ☐ No ☒ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☒ N/A

Violations have been reported ☐ Yes ☐ No ☒ N/A

Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

Remarks: ICs are not fully implemented on the impacted parcels.

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☐ No vandalism evident

Remarks: Household waste and garbage are being illegal disposed on on-site. Evidence of homeless people camping onsite.

2. **Land use changes on site** ☐ N/A

Remarks: None

3. **Land use changes off site** ☐ N/A

Remarks: None

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☒ N/A

1. Roads damaged ☐ Location shown on site map ☐ Roads adequate ☒ N/A

Remarks:

B. Other Site Conditions

Remarks:

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☐ Settlement not evident
   Arial extent _____ Depth _____
   Remarks: _____

2. **Cracks** ☐ Location shown on site map ☐ Cracking not evident
   Lengths _____ Widths _____ Depths _____
   Remarks: _____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Arial extent _____ Depth _____
   Remarks:

4. **Holes** ☐ Location shown on site map ☐ Holes not evident
   Arial extent _____ Depth _____
   Remarks: _____

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established
   ☐ No signs of stress ☐ Trees/Shrubs (indicate size and locations on a diagram)
   Remarks:

6. **Alternative Cover** (armored rock, concrete, etc.) ☐ N/A
   Remarks:

7. **Bulges** ☐ Location shown on site map ☐ Bulges not evident
   Arial extent _____ Height _____
   Remarks: _____

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
   ☐ Wet areas ☐ Location shown on site map Arial extent _____
   ☐ Ponding ☐ Location shown on site map Arial extent _____
   ☐ Seeps ☐ Location shown on site map Arial extent _____
   ☐ Soft subgrade ☐ Location shown on site map Arial extent _____
   Remarks: _____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map
   ☐ No evidence of slope instability
   Arial extent _____
   Remarks: _____

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1.	**Flows Bypass Bench**	☐ Location shown on site map	☐ N/A or okay
	Remarks: _____		
2.	**Bench Breached**	☐ Location shown on site map	☐ N/A or okay
	Remarks: _____		
3.	**Bench Overtopped**	☐ Location shown on site map	☐ N/A or okay
	Remarks: _____		
C. Letdown Channels		☐ Applicable ☒ N/A	
1.	**Settlement** (Low spots)	☐ Location shown on site map	☐ No evidence of settlement
	Arial extent _____		Depth _____
	Remarks: _____		
2.	**Material Degradation**	☐ Location shown on site map	☐ No evidence of degradation
	Material type_____		Arial extent _____
	Remarks: _____		
3.	**Erosion**	☐ Location shown on site map	☐ No evidence of erosion
	Arial extent _____		Depth _____
	Remarks: _____		
4.	**Undercutting**	☐ Location shown on site map	☐ No evidence of undercutting
	Arial extent _____		Depth _____
	Remarks: _____		
5.	**Obstructions**	Type _____	☐ No obstructions
	☐ Location shown on site map	Arial extent _____	
	Size _____		
	Remarks: _____		
6.	**Excessive Vegetative Growth**	Type _____	
	☐ No evidence of excessive growth		
	☐ Vegetation in channels does not obstruct flow		
	☐ Location shown on site map	Arial extent _____	
	Remarks: _____		
D. Cover Penetrations		☐ Applicable ☒ N/A	
1.	**Gas Vents**	☐ Active	☐ Passive
	☐ Properly secured/locked	☐ Functioning	☐ Routinely sampled ☐ Good condition
	☐ Evidence of leakage at penetration		☐ Needs Maintenance ☐ N/A
	Remarks: _____		

2. **Gas Monitoring Probes**

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A

Remarks: _____

3. **Monitoring Wells** (within surface area of landfill)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A

Remarks: _____

4. **Extraction Wells Leachate**

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A

Remarks: _____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☐ N/A

Remarks: _____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. **Gas Treatment Facilities**

☐ Flaring ☐ Thermal destruction ☐ Collection for reuse

☐ Good condition ☐ Needs Maintenance

Remarks: _____

2. **Gas Collection Wells, Manifolds and Piping**

☐ Good condition ☐ Needs Maintenance

Remarks: _____

3. **Gas Monitoring Facilities** (e.g., gas monitoring of adjacent homes or buildings)

☐ Good condition ☐ Needs Maintenance ☐ N/A

Remarks: _____

F. Cover Drainage Layer ☐ Applicable ☒ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A

Remarks: _____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A

Remarks: _____

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

1. **Siltation** Area extent _____ Depth _____ ☐ N/A

☐ Siltation not evident

Remarks: _____

2.	**Erosion**	Area extent _____	Depth _____
	☐ Erosion not evident		
	Remarks: _____		
3.	**Outlet Works**	☐ Functioning	☐ N/A
	Remarks: _____		
4.	**Dam**	☐ Functioning	☐ N/A
	Remarks: _____		
H. Retaining Walls		☐ Applicable	☒ N/A
1.	**Deformations**	☐ Location shown on site map	☐ Deformation not evident
	Horizontal displacement _____		Vertical displacement _____
	Rotational displacement _____		
	Remarks: _____		
2.	**Degradation**	☐ Location shown on site map	☐ Degradation not evident
	Remarks: _____		
I. Perimeter Ditches/Off-Site Discharge		☐ Applicable	☒ N/A
1.	**Siltation**	☐ Location shown on site map	☐ Siltation not evident
	Area extent _____		Depth _____
	Remarks: _____		
2.	**Vegetative Growth**	☐ Location shown on site map	☐ N/A
	☐ Vegetation does not impede flow		
	Area extent _____		Type _____
	Remarks:		
3.	**Erosion**	☐ Location shown on site map	☐ Erosion not evident
	Area extent _____		Depth _____
	Remarks: _____		
4.	**Discharge Structure**	☐ Functioning	☐ N/A
	Remarks: _____		
VIII. VERTICAL BARRIER WALLS		☐ Applicable	☒ N/A
1.	**Settlement**	☐ Location shown on site map	☐ Settlement not evident
	Area extent _____		Depth _____
	Remarks: _____		

2. **Performance Monitoring** Type of monitoring _____

☐ Performance not monitored

Frequency _____ ☐ Evidence of breaching

Head differential _____

Remarks: _____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**

☐ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☒ N/A

Remarks:

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**

☒ Good condition ☐ Needs Maintenance

Remarks:

3. **Spare Parts and Equipment**

☒ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks:

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps, and Electrical**

☐ Good condition ☐ Needs Maintenance

Remarks: _____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**

☐ Good condition ☐ Needs Maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: _____

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)

☐ Metals removal ☐ Oil/water separation ☒ Bioremediation

☐ Air stripping ☐ Carbon adsorbers

☐ Filters _____

☐ Additive (e.g., chelation agent, flocculent)

☐ Others

☒ Good condition ☐ Needs Maintenance

☒ Sampling ports properly marked and functional

☒ Sampling/maintenance log displayed and up to date

☒ Equipment properly identified

☐ Quantity of groundwater treated annually _____

☐ Quantity of surface water treated annually _____

Remarks:

2. **Electrical Enclosures and Panels** (properly rated and functional)

☐ N/A ☒ Good condition ☐ Needs Maintenance

Remarks: _____

3. **Tanks, Vaults, Storage Vessels**

☒ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs Maintenance

Remarks: _____

4. **Discharge Structure and Appurtenances**

☒ N/A ☐ Good condition ☐ Needs Maintenance

Remarks: _____

5. **Treatment Building(s)**

☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair

☒ Chemicals and equipment properly stored

Remarks: _____

6. **Monitoring Wells** (pump and treatment remedy)

☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition

☒ All required wells located ☐ Needs Maintenance ☐ N/A

Remarks:

D. Monitoring Data

1. **Monitoring Data**	
☒ Is routinely submitted on time	☐ Is of acceptable quality
2. **Monitoring data suggests:**	
☒ Groundwater plume is effectively contained	☒ Contaminant concentrations are declining
E. Monitored Natural Attenuation	
1. **Monitoring Wells** (natural attenuation remedy)	
☐ Properly secured/locked	☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located	☐ Needs Maintenance ☒ N/A
Remarks:	

X. OTHER REMEDIES	
If there are remedies applied at the Site and not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.	
XI. OVERALL OBSERVATIONS	
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). The remedy is to reduce to acceptable levels the excess risk to humans and environmental receptors associated with the medium (groundwater) and contaminants of concern at the Site. The recovery well, RW-01, failed and was abandoned in October 2016. The operations of monitoring well MW-03RK was increased from 12 to 24 hours a day to help rectify the loss of RW-01. Compared to recovery well RW-01, monitoring well MW-03RK has a reduced flow and does not provide the same level of hydraulic containment as RW-01. Still, MW-03RK does provide hydraulic control in the area of highest groundwater contamination. The use of MW-03RK as a permanent replacement for RW-01 should be evaluated.
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. The O&M plan for the Site calls for annual groundwater monitoring and the extraction and discharge of contaminated groundwater to the POTW. O&M is adequate at the Site.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. The remedy could be further optimized using High-Resolution Site Characterization (HRSC) strategies in the area of remaining groundwater contamination.

Site Inspection Team:
Craig VanTrees, RPM, EPA Region 4
Michael Simpson, PRP Representative
Sara MacDonald, SCDHEC
Evan Etheridge, SCDHEC
Timothy Kadar, SCDHEC
Richard Jacobs, SynTerra Corporation

Interview Form for Five-Year Review

Site Name: Rock Hill Chemical
Interviewer's Name: Timothy Kadar **Affiliation:** SCDHEC
Interviewee's Name: Sara MacDonald, Project Manager **Affiliation:** SCDHEC
Contact Information: 2600 Bull Street
Columbia, SC 29201
macdonsn@dhec.sc.gov

Type of Interview: Email
Date: 1/11/2021

What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

Overall, the project is going alright. The shallow plume is mostly cleaned up from an enhanced bio pilot study. A small bedrock plume remains that is treated with an extraction well that discharges to the POTW.

2. What is your assessment of the current performance of the remedy in place at the Site?

The recovery well failed and the current well used for extraction was not designed for this purpose. The plumes are small, and the recovery seems to be asymptotic. The extraction well does not have much influence on the shallow plume.

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities from residents in the past five years?

I am not aware of any complaints or inquiries regarding site-related environmental issues or remedial activities from residents.

4. Has your office conducted any site-related activities or communications in the past five years? If so, please describe the purpose and results of these activities.

The DHEC office has conducted site visits, hurricane inspection visits, conference calls and report reviews to further understand the project and move towards closure.

5. Are you aware of any changes to state laws that might affect the protectiveness of the Site's remedy?

I am not aware of any changes to state laws that that might affect the protectiveness of the Site's remedy.

6. Are you comfortable with the status of the institutional controls at the Site? If not, what are the associated outstanding issues?

There is still an outstanding IC that EPA and the PRP are working to get in place.

7. Are you aware of any changes in projected land use(s) at the Site?

I am not aware of any changes in projected land use at the Site.

8. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy?

EPA needs to do a risk assessment for manganese. From the available history for this site, manganese is naturally occurring and should never have been listed as a Site COC. Since the enhanced biological injections, manganese has increased, but the other site COCs have decreased. EPA needs to determine a more appropriate value based on background and/or risk for the site to reach completion. It does not seem possible to clean up the site to the manganese ROD goal as it is below natural background levels.

Interview Form for Five-Year Review

Site Name: Rock Hill Chemical Co. Superfund Site
Interviewer's Name: Timothy Kadar **Affiliation:** SCDHEC
Interviewee's Name: Richard H. Jacobs, SynTerra
Contact Information: 148 River Street, Suite 220
Greenville, South Carolina 29601
rjacobs@synterracorp.com
(864) 527-4678 (direct)
(864) 430-1455 (mobile)

Type of Interview: Email
Date: January 14, 2021

1. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

The project has proceeded with the normal annual sampling and maintenance of the site. The cleanup has prevented site contaminates from affecting potential receptors.

2. What is your assessment of the current performance of the remedy in place at the Site?

The current remedy is maintaining the overall objective of protecting human health and the environment.

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities from residents in the past five years?

None to my knowledge.

4. What is the frequency of Operation and Maintenance activities and site inspections? To your knowledge, has the maintenance been implemented at the site?

We provide monthly inspections and maintenance as needed for the system.

5. Are you aware of any changes in projected land use(s) at the Site?

None to my knowledge.

6. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy?

Not at this time.

APPENDIX E – DETAILED ARARs REVIEW

Appendix E includes a review of relevant, site-related documents including the RODs, AROD, remedial action reports and recent monitoring data.

CERCLA Section 121(d)(1) requires that Superfund remedial actions attain "a degree of cleanup of hazardous substance, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment." The remedial action must achieve a level of cleanup that at least attains those requirements that are legally applicable or relevant and appropriate. In performing the FYR for compliance with ARARs, only those ARARs that address the protectiveness of the remedy are reviewed.

- Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, remedial action, location or other circumstance found at a CERCLA site.
- Relevant and appropriate requirements are those standards that, while not "applicable," address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are more stringent than federal requirements may be applicable or relevant and appropriate.
- To-Be-Considered (TBC) criteria are non-promulgated advisories and guidance that are not legally binding but should be considered in determining the necessary remedial action. For example, TBCs may be particularly useful in determining health-based levels where no ARARs exist or in developing the appropriate method for conducting a remedial action.

Chemical-specific ARARs are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish an acceptable amount or concentration of a chemical that may remain in, or be discharged to, the ambient environment. Examples of chemical specific ARARs include (MCLs) under the federal Safe Drinking Water Act and ambient water quality criteria enumerated under the federal Clean Water Act (CWA).

Action-specific ARARs are technology- or activity-based requirements or limits on actions taken with respect to a particular hazardous substance. These requirements are triggered by a remedial activity, such as discharge of contaminated groundwater or in-situ remediation.

Location-specific ARARs are restrictions on hazardous substances or the conduct of the response activities solely based on their location in a special geographic area. Examples include restrictions on activities in wetlands, sensitive habitats and historic places.

Remedial actions are required to comply with the chemical specific ARARs identified in the ROD. In performing the five-year review for compliance with ARARs, only those ARARs that address the protectiveness of the remedy are reviewed.

Table 7 - Action Specific ARARs

Table 7 Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation**
Underground Injection Control Requirements (e.g., injection of reagents or surfactants during ISCO)			
Injection of fluids, solids, or mixtures into subsurface	No owner or operator shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR Part 142 or may otherwise adversely affect the health of persons.	Class V wells [as defined in 40 CFR 144.6(e)] used in experimental technologies to inject reagents into underground source of drinking water – **applicable**.	40 CFR 144.82(a)(1) 40 CFR 144.12(a)
	The movement of fluids containing wastes or contaminants into underground sources of drinking water as a result of injection is prohibited if the presence of the waste or contaminant: • May cause a violation of any drinking water standard under R61-58.5; or, • May otherwise adversely affect the health of persons. As defined in R.61-87.2: "Fluid" means material or substance which flows or moves whether in a semisolid, liquid, sludge, gas, or any other form or state.	Underground injection of any fluids into the subsurface or ground waters of the State of South Carolina – **applicable**.	SCDHEC R.61-87.5
	No person shall construct, use or operate a Class V.A. well for injection in violation of R61-87.5.	Class V.A injection wells used in experimental technologies [as classified in R.61-87.11(E)(1)(g)]– **applicable**	SCDHEC R.61-87.11(E)(2)(b)
Operation of underground injection wells	At a minimum, the following information concerning the injection formation shall be determined or calculated: (1) Fluid pressure; (2) Estimated fracture pressure; (3) Physical and chemical characteristics of the injection zone.	Operation of Class V.A. wells used in experimental technologies [as classified in R.61-87.11(E)(1)(g)] for underground injection into the subsurface or ground waters of the State of South Carolina – **applicable**	SCDHEC R.61-87.14(D)

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Table 7 Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation**
	Shall at all times properly operate and maintain all facilities and systems of treatment and controls which are installed or used.		SCDHEC R.61-87.13(X)
	Shall report malfunction of injection system which may cause fluid migration into or between underground sources of drinking water; shall immediately stop injection upon determination that the injection system has malfunctioned and could cause fluid migration into or between underground sources of drinking water; shall not restart the injection system until the malfunction has been corrected.		SCDHEC R.61-87.13(EE)
Monitoring of underground injection wells	An appropriate number of monitoring wells shall be completed into the injection zone and into any underground sources of drinking water which could be affected by the injection operation. These wells shall be located in such a fashion as to detect any excursion of injection fluids, process by-products, or formation fluids outside the injection area or zone. If the operation may be affected by subsidence or catastrophic collapse the monitoring wells shall be located so that they will not be physically affected.	Monitoring of Class V.A. wells, [as classified in R.61-87.11(E)(1)(g)], used for underground injections into the subsurface or ground waters of the State of South Carolina – **applicable**	SCDHEC R.61-87.14(G)(1)
	In determining the number, location, construction and frequency of monitoring of the monitoring wells the following criteria shall be considered: (a) The population relying on the USDW affected or potentially affected by the injection operation; (b) The proximity of the injection operation to points of withdrawal of drinking water; (c) The local geology and hydrogeology; (d) The operating pressures and whether a negative pressure gradient is being maintained;		SCDHEC R.61-87.14(G)(2)

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Table 7 Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation**
	(e) The nature and volume of the injected fluid, the formation water, and the process by-products; and (f) The injection well density.		
	Monitoring requirements shall, at a minimum, specify: • Monitoring of the nature of injected fluids with sufficient frequency to yield representative data on its characteristics; • Monitoring of injection pressure and either flow rate or volume semi-monthly, or metering and daily recording of injected and produced fluid volumes as appropriate; • Demonstration of mechanical integrity at least once every five years during the life of the well; • Monitoring of the fluid level in the injection zone semi- monthly, where appropriate and monitoring of the parameters chosen to measure water quality in the monitoring wells semi-monthly. *Note: Monitoring of injections and monitoring wells will be conducted pursuant to an EPA-approved monitoring plan documented in appropriate CERCLA Remedial Design (RD)/RA document.*		SCDHEC R.61-87.14(G)(3)(a)-(d)
Plugging and abandonment of underground injection wells	The well to be abandoned shall be in a state of static equilibrium with the mud weight equalized top to bottom, by a method prescribed by DHEC prior to the placement of the cement plug(s).	Abandonment of Class V.A wells for underground injection of any fluids into the subsurface or ground waters of the State of South Carolina – **applicable**	SCDHEC R.87.15(B)
	The well must be plugged in such a manner which will not allow the movement of fluids either into or between underground sources of drinking water.		SCDHEC R.87.15(C)
	Wells must be closed in a manner that complies with prohibition of fluid movement in 40 CFR 144.82(a). Also, any soil, gravel, sludge, liquids, or other materials	Class V wells [as defined in 40 CFR 144.6(e)] used to inject any fluids into the subsurface or	40 CFR 144.82(b)

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Table 7 Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation**
	removed from or adjacent to the well must be disposed or otherwise managed in accordance with substantive applicable Federal, State, and local regulations and requirements.	groundwater –**applicable**	
Discharge of Wastewater from Treatment Unit			
Disposal of RCRA characteristic wastewaters	Are not prohibited, if the wastes are managed in a treatment system which subsequently discharges to waters of the U.S. pursuant to a permit issued under 402 of the CWA (i.e., NPDES permitted) unless the wastes are subject to a specified method of treatment other than DEACT in 40 CFR 268.40, or are D003 reactive cyanide.	Land disposal of hazardous wastewaters that are hazardous only because they exhibit a hazardous characteristic and are not otherwise prohibited under 40 CFR Part 268 – **applicable**.	40 CFR 268.1(c)(4)(i)
	Are not prohibited, if the wastes are treated for purposes of the pre-treatment requirements of section 307 of the CWA unless the wastes are subject to a specified method of treatment other than DEACT in 40 CFR 268.40, or are D003 reactive cyanide.		40 CFR 268.1(c)(4)(ii)
General duty to mitigate for discharge of WWTU	Take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of effluent standards which has a reasonable likelihood of adversely affecting human health or the environment.	Discharge of pollutants to surface waters – **applicable**	40 CFR § 122.41(d) SCDHEC R.61-9 §122.41(d)
	Properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used to achieve compliance with the effluent standards. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures.		SCDHEC R.61-9 §122.41(e)(1)

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Table 7 Action-Specific ARARs			
Action	**Requirements**	**Prerequisite**	**Citation**
Technology-based treatment requirements for wastewater discharge	To the extent that EPA promulgated effluent limitations are inapplicable, State shall develop on a case-by-case basis under § 402(a)(1)(B) of the CWA, technology based effluent limitations by applying the factors listed in 40 CFR § 125.3(d) and shall consider: the appropriate technology for this category or class of point sources; and any unique factors relating to the discharger.	Discharge of pollutants to surface waters from other than a POTW – **applicable**	40 CFR § 125.3(c)(2) SCDHEC R.61-9 §125.3(c)(2)
Water quality based-effluent limits for wastewater discharge	Must develop water quality-based effluent limits that ensure that: • The level of water quality to be achieved by limits on point sources(s) established under this paragraph is derived from, and complies with all applicable water quality standards; and Effluent limits developed to protect narrative or numeric water quality criteria are consistent with the assumptions and any available waste load allocation for the discharge prepared by the State and approved by EPA pursuant to 40 CFR § 130.7.	Discharge of pollutants to surface waters that causes, or has reasonable potential to cause, or contributes to an instream excursion above a narrative or numeric criterion within a State water quality standard established under §303 of the CWA – **applicable**	40 CFR § 122.44(d)(1)(vii) SCDHEC R.61-9 § 122.44(d)(1)(vii)
Monitoring requirements for discharges from WWTU	In addition to §122.48 and to assure compliance with effluent limitations, one must monitor, as provided in subsections (i) thru (iv) of §122.44(i)(1). *Note: Monitoring parameters, including frequency of sampling, will be developed as part of the CERCLA process and included in a Remedial Design, Remedial Action Work Plan, or other appropriate CERCLA document.*	Discharge of pollutants to surface waters – **applicable**	40 CFR §122.44(i)(1) SCDHEC R.61-9 §122.44(i)(1)
	All effluent limitations, standards and prohibitions shall be established for each outfall or discharge point, except as provided under §122.44(k)		40 CFR §122.45(a) SCDHEC R.61-9 §122.45(a)

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Table 8 - Chemical Specific ARARs

Table 8 Chemical-Specific ARARs			
Action/Media	**Requirements**	**Prerequisite**	**Citation**
Classification of groundwater	All South Carolina groundwater that is a potential underground sources of drinking water is classified Class GB under SCDHEC R. 61-68H.9.	Groundwater, except within mixing zones, within the state of South Carolina – **applicable**	SCDHEC R. 61-68H.2
Restoration of ground water as a potential drinking water source	All inorganic and organic contaminants in underground sources of drinking water may not exceed Maximum Contaminant levels (MCLs) as set forth in SCDHEC R.61- 58, State Primary Drinking Water Regulations.	Groundwater classified as underground source of drinking water (USDW) as (defined in SCDHEC Reg. 61-68B.62) – **relevant and appropriate**	SCDHEC R. 61-68H.9.b *(Groundwater Quality Standards for Class GB Ground Waters)* 40 CFR Part 141 Subpart G (*National Primary Drinking Water Regulations)*
	Shall not exceed concentrations or amounts such as to interfere with use, actual or intended, as determined by SCDHEC.	Presence of waste, pesticides, other synthetic organic compounds, deleterious substances, or constituents thereof not specified in SCDHEC R. 61- 68H.9a or b. in Class GB groundwater – **relevant and appropriate**	SCDHEC R. 61-68H.9.c
Discharge to surface water	Any discharge into waters of the State must receive a degree of treatment and/or control which shall produce an effluent which is consistent with the Act, the Clean Water Act (P.L. 92-500, 95-217, 97-117, 100-4), this regulation, and related regulations.	Discharge of pollutants (including toxic substances) into waters of the State of South Carolina – **applicable**	SCDHEC R. 61-68E.4.a
All ground and surface waters	All ground waters and surface waters of the State shall at all times, regardless of flow, be free from: a. Sewage, industrial waste, or other waste that will settle to form sludge deposits that are unsightly,	Standards applicable to all waters of the State - ***applicable***	SCDHEC R. 61-68E.5

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Table 8 Chemical-Specific ARARs			
	putrescent, or odorous to such degree as to create a nuisance, or interfere with classified water uses or existing water uses; b. Floating debris, oil, grease, scum, and other floating material attributable to sewage, industrial waste, or other waste in amounts sufficient to be unsightly to such a degree as to create a nuisance or interfere with classified water uses or existing water uses; c. Sewage, industrial, or other waste which produce taste or odor or change the existing color or physical, chemical, or biological conditions in the receiving waters or aquifers to such a degree as to create a nuisance, or interfere with classified water uses (except classified uses within mixing zones as described in this regulation) or existing water uses; and, d. High temperature, toxic, corrosive, or deleterious substances attributable to sewage, industrial waste, or other waste in concentrations or combinations which interfere with classified water uses (except classified uses within mixing zones as described in this regulation), existing water uses, or which are harmful to human, animal, plant or aquatic life.		

ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulations*
CWA = Clean Water Act of 1972
DEACT = deactivation
EPA = U.S. Environmental Protection Agency
NPDES = National Pollutant Discharge Elimination System
RCRA = Resource Conservation and Recovery Act of 1976
SCDHEC = South Carolina Department of Health and Environmental Control
WWTU = Wastewater Treatment Unit

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Groundwater ARARs

According to the Site's 1994 ROD, the groundwater ARARs for 3 of the 4 groundwater COCs are the MCLs (40 CFR Part 141-143). No MCL existed for manganese when the Site's ROD was signed. The EPA established remedial goals in the Baseline Risk Assessment using appropriate ARARs. These calculations were based on a future child resident ingestion of groundwater scenario with a total cancer risk range of 1×10^{-4} to 1×10^{-6} or a non-carcinogenic Hazard Index of 1.0.

Table E-3 presents the 1994 list of COCs and compares them to the current applicable ARARs. This FYR did identify a change to an assumption applied to the site-specific, risk-based remedial goal calculation at the time of the 1994 ROD. The oral reference dose for manganese used in the 1994 ROD was 5.00×10^{-3} (IRIS 1993). The current oral reference dose for manganese at the time of this FYR is 1.40×10^{-1} (IRIS 1995).

The change does not affect current or future protectiveness of the site.

Table 9 - Summary of ARAR Changes

Contaminant of Concern	1994 ROD ARARs (µg/L)	Basis	Current[a] MCL (EPA, 2021) (µg/L)	ARAR Change
Volatile Organic Compound				
1,2-Dichloroethene	70	MCL	70	No
Trichloroethylene (TCE)	5	MCL	5	No
Vinyl Chloride	2	MCL	2	No
Inorganics				
Manganese	200[b]	Background	None 434[c]	Yes

[a] Current ARARs are based on Federal (40 CFR 141 -143) and South Carolina Department of Health and Environmental Control State Primary Drinking Water Regulations (South Carolina Code of Regulations Chapter 61-58) and are the same. Federal standards are based on National Primary Drinking Water Maximum Contamination Levels and state standards are based on South Carolina R.61-58.5 Maximum Contaminant Levels in Drinking Water.

[b] EPA set a cleanup goal of 200 ug/l based on an average background concentration of 185 ug/l in the 1993 Feasibility Study.

[c] EPA Resident Risk-Based Regional Screening Levels (RSL) for Tap Water (Hazard Index = 1)

Table 10 - Screening-Level Risk Review of Groundwater Remediation Goals

Contaminant of Concern	Groundwater Remedial Goal (µg/L)	Tapwater RSL 10^{-6} (µg/L)	Tapwater RSL HQ=1 (µg/L)	Risk[c]	HQ[c]
Volatile Organic Compound					
1,2-Dichloroethene[a]	7.00E+01	NA	3.61E+01	NA	1.94E+00
Trichloroethylene[a] (TCE)	5.00E+00	4.94E-01	2.83E+00	1.01E-05	1.77E+00
Vinyl Chloride[a]	2.00E+00	1.88E-02	4.44E+01	1.07E-04	4.51E-02
Inorganics					
Manganese[b]	2.00E+02[b]	NA	4.3E+2	NA	4.61E-01

a - Based on National Primary Drinking Water Regulations Maximum Contaminant Level
b - EPA set a cleanup goal of 200 ug/l based on an average background concentration of 185 ug/l in the 1993 Feasibility Study
c – carcinogenic risk
d – noncarcinogenic child health index

APPENDIX F – INSTITUTIONAL CONTROLS

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201400275671
Electronic Filing
From: Hutchens Law Firm
Thru: SIMPLIFILE

201400275671
Filed for Record in
YORK COUNTY, SC
DAVID HAMILTON
10-29-2014 At 11:35 am.
RESTR COVEN 17.00
State Tax .00
County Tax .00

STATE OF SOUTH CAROLINA)
) **DECLARATION OF COVENANTS**
COUNTY OF YORK) **AND RESTRICTIONS**

DEED BOOK 14270 PAGE 72

THIS DECLARATION OF COVENANTS AND RESTRICTIONS ("Declaration") is made and entered into this 25 day of July, 2014, by **Dail Group, LLC** (the "Declarant") and the **South Carolina Department of Health and Environmental Control** ("Department").

RECITALS

WHEREAS, this Declaration is entered into pursuant to S.C. Code §44-56-200 et seq.; and

WHEREAS, Declarant is the owner of a certain portion of real property known as the Rock Hill Chemical Company Superfund Site in Rock Hill, York County, South Carolina, that was conveyed to Declarant by deed dated July 24, 2014 and recorded in Deed Book 14270, Page 72 of the Office of Register of Deeds of York County, and more particularly described in Exhibit A attached hereto and incorporated herein by reference ("Property"); and

WHEREAS, the Property subject to this Declaration is a portion of the property known as the Rock Hill Chemical Company Superfund Site ("Site"), as depicted in Exhibit B, attached hereto and incorporated by reference; and

WHEREAS, the Property has been the subject of a remedial action pursuant to a Record of Decision ("ROD") issued on June 27, 1994, a Unilateral Administrative Order for Remedial Design/Remedial Action ("UAO") dated February 6, 1995, and an Administrative Order on Consent [CER-04-2000-0200] ("AOC") dated March 8, 2000, entered into by the United States Environmental Protection Agency ("EPA") and the following Potentially Responsible Parties ("PRPs"): (1) BASF Corporation; (2) Burlington Industries, Inc.; (3) Chase Packaging, Inc.; (4) CTS Corporation; (5) Engraph, Inc.; (6) FMC Corporation, (7) Lithium Division; (8) CNA Holdings, Inc.; (9) Homelite Division of Textron; (10) Rexam Inc.; (11) Rutledge Realty Company, Inc.; and (12) W.R. Grace and Company under the Comprehensive Environmental Response Compensation and Liability Act ("CERCLA"), 42 U.S.C. §§ 9601, et seq.; and

WHEREAS, the PRPs are responsible for conducting response actions at the Site with EPA oversight pursuant to the AOC and UAO; and

WHEREAS, Declarant has cooperated with ongoing remediation to the Property to commercial-use standards as required by the AOC; and

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WHEREAS, the Property may be used for certain purposes without further remediation in accordance with the provisions of the AOC; and

WHEREAS, Declarant has agreed to impose certain restrictions on the manner in which the Property may be developed and used in the future; and

WHEREAS, the PRPs have agreed to perform or fund response work specified in the UAO which includes the implementation of these institutional controls; and

WHEREAS, it is the intention of all parties that the EPA is a third party beneficiary of said restrictions and said restrictions shall be enforceable by the EPA, Department, and their successor agencies; and

WHEREAS, EPA has worked closely with the Department in developing the AOC, EPA will assist the Department in monitoring and enforcing this Declaration.

NOW, THEREFORE, KNOW ALL MEN BY THESE PRESENTS that Declarant hereby declares and covenants on behalf of itself, its heirs, successors, and assigns that the Property described in Exhibit A shall be held, mortgaged, transferred, sold, conveyed, leased, occupied, and used subject to the covenants herein, to include the following restrictions, which shall touch and concern and run with the title to the Property.

1. Declarant covenants for itself, its heirs, successors and assigns that groundwater beneath the Property shall not be used for potable use, irrigation of edible garden vegetables, or other such uses without prior approval from EPA and the Department or their successor agencies.

2. Declarant covenants for itself, its heirs, successors and assigns that the Property shall not be used in a manner that would interfere with the groundwater extraction and treatment system on the Property without prior approval from EPA and the Department or their successor agencies.

3. Declarant covenants for itself, its heirs, successors and assigns that there shall be no drilling of groundwater wells on the Property without prior approval from EPA and the Department or their successor agencies.

4. Declarant covenants for itself, its heirs, successors and assigns that the EPA, the Department, their successor agencies, and all other parties performing response actions under EPA's or the Department's oversight shall be provided reasonable access for (i) inspecting the Property, (ii) monitoring, (iii) verifying information, (iv) sampling the Property, (v) assessing the need for additional response or quality control practices, (vi) implementing the work required under the AOC, (vii) inspecting and copying records, (viii) assessing the responsible party's

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compliance, (ix) assessing compliance with existing land use restrictions under the AOC and this Declaration, or (x) to take samples as may be necessary to enforce this Declaration.

5. The covenants and restrictions set forth herein shall run with the title to the Property and shall be binding upon Declarant, its heirs, successors and assigns and any subsequent purchaser of the Property. It is expressly agreed that the Department and EPA shall have the right to enforce these covenants and restrictions upon Declarant, its heirs, successors and assigns and any subsequent purchaser of the Property. Declarant and its heirs, successors, and assigns and any subsequent purchaser of the Property shall include the following notice on all deeds, mortgages, plats, or any legal instruments used to convey any interest in the Property (failure to comply with this paragraph does not impair the validity or enforceability of these covenants):

NOTICE: This Property Subject to Declaration of Covenants and Restrictions and any subsequent Amendments Recorded at _____

6. Declarant shall record this Declaration of Covenants and Restrictions in a timely fashion in the Office of Register of Deeds of York County, South Carolina, and shall re-record it at any time the Department may require to preserve its rights. Declarant shall pay all recording costs and taxes necessary to record this document in the public records. Declarant shall provide a copy of the recorded Declaration to the Department within sixty (60) days of the recorded date. The copy shall show the date and Book and Page number where the Declaration has been recorded.

7. This Declaration shall remain in place until such time as the Department has made a written determination that the covenants and restrictions set forth herein are no longer necessary. The Department shall not consent to any such termination unless the requirements of the AOC have been met. This Declaration shall not be amended without the written consent of the Department or its successor agency. The Department shall not consent to any such amendment or termination without the written consent of EPA.

8. It is expressly agreed that EPA is not the recipient of a real property interest but is a third party beneficiary of the Declaration of Covenants and Restrictions and, as such, has the rights of enforcement.

9. This Declaration only applies to the Property expressly identified in Exhibit A and does not impair the Department's and EPA's authority with respect to the Property or other real property under the control of Declarant.

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IN WITNESS WHEREOF, Declarant has caused this instrument to be executed as of the date first above written.

WITNESSES:

DAIL GROUP, LLC
a North Carolina limited liability company
By: William L. Dail

William L. Dail, Manager
(Name and Title)

STATE OF ~~SOUTH~~ North CAROLINA)
)
COUNTY OF ~~YORK~~ Cumberland) ACKNOWLEDGEMENT

I hereby certify that before me personally appeared William L. Dail of Dail Group, LLC, a North Carolina limited liability company, to me known to be the person described in and who executed the foregoing instrument on behalf of said company, and said party acknowledged the execution thereof to be his/her free act and deed for the uses and purposes therein mentioned.

Witness my hand and official seal this 25 day of July, 2014

Notary Public for NC
My Commission Expires: 6-2-2018

SUSAN R. BENOIT Cumberland County NOTARY PUBLIC NORTH CAROLINA

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IN WITNESS WHEREOF, the Department has caused this instrument to be executed as of the date first above written.

WITNESSES:

South Carolina Department of Health and Environmental Control

By: Daphne G. Neel

Daphne G. Neel, Chief
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control

STATE OF SOUTH CAROLINA)
) ACKNOWLEDGEMENT
COUNTY OF YORK)

I, Veronica F Kennedy (Notary Public), do hereby certify that, Daphne G. Neel, Chief, Bureau of Land and Waste Management of the South Carolina Department of Health and Environmental Control, personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official seal this 11th day of September, 2014.

Veronica F Kennedy
Notary Public for Richland Cty, South Carolina
My Commission Expires: My Commission Expires April 9, 2017

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This Declaration of Covenants and Restrictions is hereby approved by the United States Environmental Protection Agency as a third party beneficiary this 12 day of September 2014

United States Environmental Protection Agency

Randall Chaffins
Acting Director
Superfund Division
U.S. Environmental Protection Agency, Region 4

Exhibit "A"

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1541.80
652.30

RECORDED
YORK COUNTY
TAX ASSESSOR'S OFFICE
DATE 7-29-14
TAX MAP NO. 634-07-01-044
INITIALS

201400264928
Filed for Record in
YORK COUNTY, SC
DAVID HAMILTON, CLERK OF COURT
07-28-2014 At 03:45 pm.
DEED 10.00
State Tax 1541.80
County Tax 652.30
OR Vol 14270 Page 72 - 75

STATE OF SOUTH CAROLINA

COUNTY OF YORK

DEED TO REAL ESTATE

THIS DEED is made the day herein below stated, by and between **Jacqueline N. Dail, individually, and Jacqueline Newton Dail, successor Trustee of the Curtis M. Dail Amended and Restated Revocable Trust under Agreement of August 31, 2007, as Amended**, hereinafter called **GRANTOR**, which expression shall include his, her or their heirs and assigns, and/or its successors and assigns, wherever the context so requires, or admits, of the one part, and **Dail Group, LLC**, whose address is 4525 Goldsboro Road, Wade, North Carolina 28395, hereinafter called **GRANTEE**, which expression shall include his, her or their heirs and assigns, and/or its successors and assigns, forever, wherever the context so requires or admits, of the other part; and in this agreement, the singular shall include the plural, and the plural shall include the singular, and one gender shall include all genders.

KNOW ALL MEN BY THESE PRESENTS, that **GRANTOR**, for and in consideration of the sum of **FIVE HUNDRED NINETY-THREE THOUSAND DOLLARS ($593,000.00)**, paid to **GRANTOR**, by **GRANTEE**, in the State aforesaid, the receipt whereof is hereby acknowledged, has bargained, sold and released, and by these presents does grant, bargain, sell and release unto the said **GRANTEE**, the following described property, located in York County, South Carolina, to-wit:

SEE EXHIBIT "A" ATTACHED HERETO

TMS #: 634-07-01-44

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TAX NOTICE ADDRESS: DAIL GROUP, LLC
4525 GOLDSBORO ROAD
WADE, NORTH CAROLINA 28395

The within conveyance is also subject to all restrictions and easements of record and/or easements upon the ground.

TOGETHER with all and singular the rights, members, hereditaments and appurtenances to said premises belonging, or in anywise incident or appertaining.

TO HAVE AND TO HOLD all and singular the said premises before mentioned unto said GRANTEE.

AND the said GRANTOR does hereby bind itself, its heirs, successors and assigns, to warrant and forever defend all and singular the said premises unto the said GRANTEE, as hereinabove provided, against itself and its heirs, successors and all other persons whomsoever lawfully claiming, or to claim the same or any part thereof.

IN WITNESS WHEREOF, the GRANTOR has caused these presents to be signed and sealed this 24th day of July, 2014.

SIGNED, SEALED AND DELIVERED IN THE PRESENCE OF:

(#1 witness sign here)

(Notary sign as #2 witness)

GRANTOR

Jacqueline N. Dail

Jacqueline N. Dail, Individually

The Curtis M. Dail Amended and Restated Revocable Trust under Agreement of August 31, 2007 as Amended

Jacqueline Newton Dail

Jacqueline Newton Dail, Successor Trustee

(#1 witness sign here)

(Notary sign as #2 witness)

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STATE OF NORTH CAROLINA)
) ACKNOWLEDGMENT
COUNTY OF Johnston)

I, the undersigned notary, do hereby certify that the above-subscribed Grantor(s), Jacqueline N. Dall, Individually, and Jacqueline Newton Dall as Successor Trustee of the Curtis M. Dall Amended and Restated Revocable Trust under Agreement of August 31, 2007, as Amended, personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and seal this 24 day of July, 2014.

JOHNSTON COUNTY, NC NOTARY PUBLIC MARION A. YOUNG

Notary Public for NORTH CAROLINA
My Commission Expires: 4-6-14

(Seal)

Instrument VOL PAGE
201400275671 OR 14465 257

EXHIBIT "A"

All that certain piece, parcel or lot of land lying, being and situate on the northwestern side of Cherry Road (U.S. Highway 21 Business) in the City of Rock Hill, York County, South Carolina, and being more particularly described as follows: BEGINNING at a 5/8" rebar on the northwestern edge of the right of way of Cherry Road, corner of the within property and Tax Parcel Number 634-00-00-011 and running thence with the line of said property N. 38° 22' 13" W. 170.00 feet to an 5/8" pin; thence turning and running with the line of Lot 3 as shown on the Plat, N. 51° 34' 37" E. 138.80 feet to a 5/8" pin; thence turning and running with the line of Lot 3, the following four (4) courses and distances: (1) S. 38° 30' 56" E. 48.27 feet to an "X" mark in concrete; (2) in a circular curve to the right having a radius of 52.39 feet for an arc distance of 46.82 feet to a concrete nail; (3) in a circular curve to the left having a radius of 52.35 feet for an arc distance of 46.82 feet to a 5/8" pin; and (4) S. 38° 22' 12" E. 40.00 feet to a concrete monument on the northwestern edge of the right of way of Cherry Road; thence turning and running with said edge of said right of way S. 51° 34' 37" W. 100.00 feet to the point of beginning; containing 0.469 acres, according to said plat. Known as "Property Surveyed for Cherry Street Associates, LLC" drawn by J. B. Fisher, SCRLS#4179-B, dated May 30, 1997, last revised November 3,1997, and recorded in Plat Book D-207, Page 3, Office of the Clerk of Court for York County, South Carolina.

TOGETHER WITH an interest in the Joint Driveway lying between Lot 1 and this Lot 2, as set forth in that certain Joint Driveway Agreement entered into between Cherry Street Associates, LLC, and David N. Ring dated September 1, 2004, and recorded September 13, 2004, in Record Book 6545 at Page 44 and subject to the provisions of said Agreement.

This being a portion of the identical property conveyed to Curtis M. Dall and Jacqueline N. Dall by Tuck McGregor Properties, LLC, a South Carolina Limited Liability Company, by Deed dated June 8, 2009, and recorded in the Office of the Clerk of Court for York County on June 19, 2009, in Deed Book Volume 10852 at Page 211. Further, the one-half interest owned by Curtis M. Dall was conveyed by Deed of Distribution to Jacqueline Newton Dall, Successor Trustee of the Curtis M. Dall Amended and Restated Revocable Trust under Agreement of August 31, 2007, as Amended; the Deed of Distribution was dated July 16, 2014, and recorded in the Office of the Register of Deeds for York County, South Carolina, on July 28, 2014, in Deed Book 14270 at Page 169

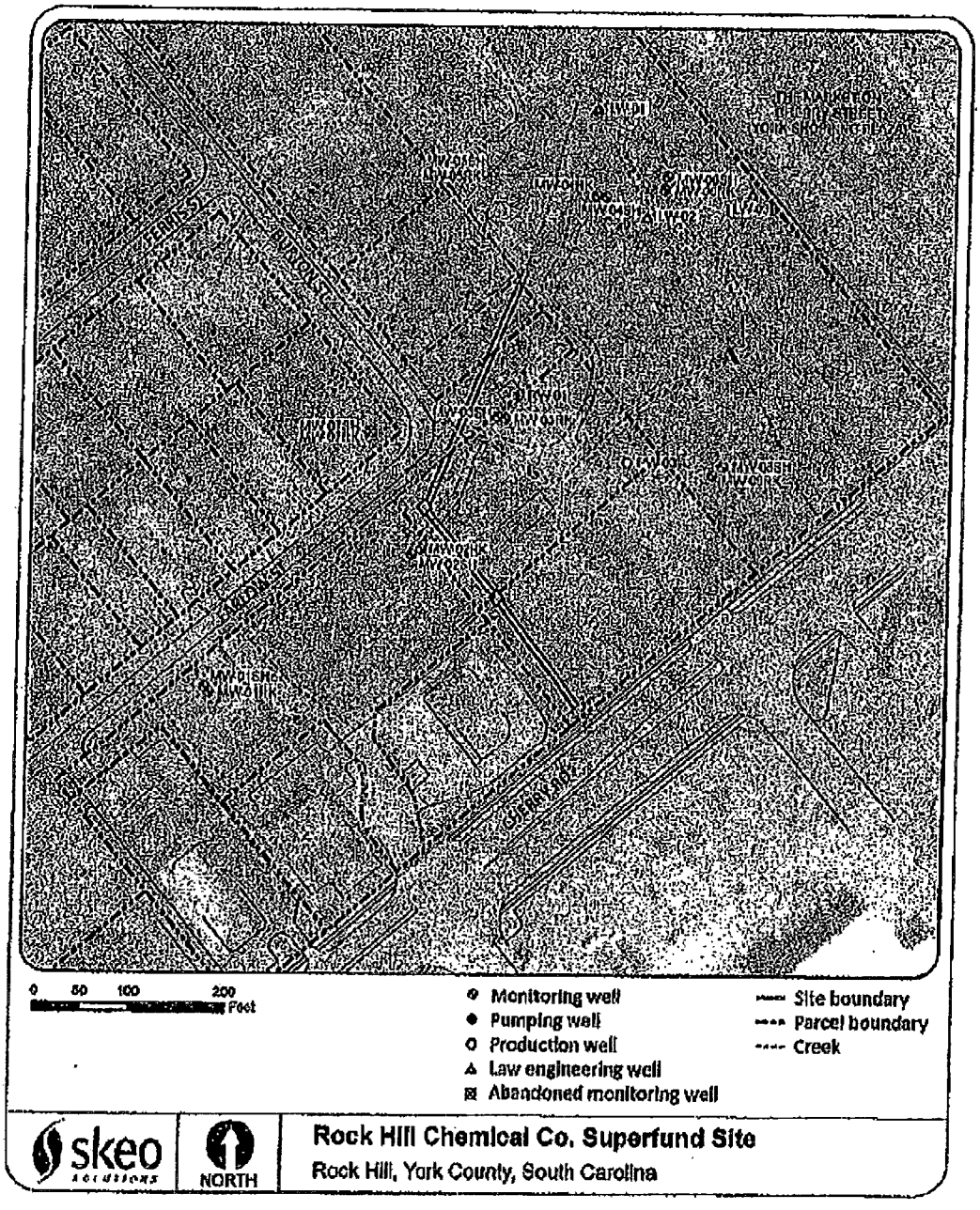
TMS# 634-07-01-44

Instrument 201400275671 OR Vol 14270 Page 75

Instrument VOL PAGE
201400275671 OR 14465 258

Exhibit B

Figure 2: Detailed Site Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site, and is not intended for any other purpose.

20140027892l
Filed for Record in
YORK COUNTY, SC
DAVID HAMILTON, CLERK OF COURTS
11-26-2014 At 10:16 am.
RESTR COVEN 22.00
OR Vol 14524 Page 295 - 310

STATE OF SOUTH CAROLINA)
)
COUNTY OF YORK)

DECLARATION OF COVENANTS AND RESTRICTIONS

DEED BOOK____, PAGE____

THIS DECLARATION OF COVENANTS AND RESTRICTIONS ("Declaration") is made and entered into this 12th day of June, 2014, by **Cherry Street Associates, LLC,** a South Carolina limited liability company ("Declarant") and the **South Carolina Department of Health and Environmental Control** ("Department").

RECITALS

WHEREAS, this Declaration is entered into pursuant to S.C. Code §44-56-200 et seq.; and

WHEREAS, Declarant is the owner of a certain portion of real property known as the Rock Hill Chemical Company Superfund Site in Rock Hill, York County, South Carolina, that was conveyed to Declarant by deed dated August 20, 1997, and recorded in Deed Book 1949, Page 45 of the Office of Register of Deeds of York County, and more particularly described in Exhibit A attached hereto and incorporated herein by reference ("Property"); and

WHEREAS, the Property subject to this Declaration is a portion of the property known as the Rock Hill Chemical Company Superfund Site ("Site"), as depicted in Exhibit B, attached hereto and incorporated by reference; and

WHEREAS, the Property has been the subject of a remedial action pursuant to a Record of Decision ("ROD") issued on June 27, 1994, a Unilateral Administrative Order for Remedial Design/Remedial Action ("UAO") dated February 6, 1995, and an Administrative Order on Consent [CER-04-2000-0200] ("AOC") dated March 8, 2000, entered into by the United States Environmental Protection Agency ("EPA") and the following Potentially Responsible Parties ("PRPs"): (1) BASF Corporation; (2) Burlington Industries, Inc.; (3) Chase Packaging, Inc.; (4) CTS Corporation; (5) Engraph, Inc.; (6) FMC Corporation, (7) Lithium Division; (8) CNA Holdings, Inc.; (9) Homelite Division of Textron; (10) Rexam Inc.; (11) Rutledge Realty Company, Inc.; and (12) W.R. Grace and Company under the Comprehensive Environmental Response Compensation and Liability Act ("CERCLA"), 42 U.S.C. §§ 9601, et seq.; and

WHEREAS, the PRPs are responsible for conducting response actions at the Site with EPA oversight pursuant to the AOC and UAO; and

WHEREAS, Declarant has cooperated with ongoing remediation to the Property to commercial-use standards as required by the AOC; and

Instrument 20140027892l OR Vol 14524 Page 295

WHEREAS, the Property may be used for certain purposes without further remediation in accordance with the provisions of the AOC; and

WHEREAS, Declarant has agreed to impose certain restrictions on the manner in which the Property may be developed and used in the future; and

WHEREAS, the PRPs have agreed to perform or fund response work specified in the UAO which includes the implementation of these institutional controls; and

WHEREAS, it is the intention of all parties that the EPA is a third party beneficiary of said restrictions and said restrictions shall be enforceable by the EPA, Department, and their successor agencies; and

WHEREAS, EPA has worked closely with the Department in developing the AOC, EPA will assist the Department in monitoring and enforcing this Declaration.

NOW, THEREFORE, KNOW ALL MEN BY THESE PRESENTS that Declarant hereby declares and covenants on behalf of itself, its heirs, successors, and assigns that the Property described in Exhibit A shall be held, mortgaged, transferred, sold, conveyed, leased, occupied, and used subject to the covenants herein, to include the following restrictions, which shall touch and concern and run with the title to the Property.

1. Declarant covenants for itself, its heirs, successors and assigns that groundwater beneath the Property shall not be used for potable use, irrigation of edible garden vegetables, or other such uses without prior approval from EPA and the Department or their successor agencies.

2. Declarant covenants for itself, its heirs, successors and assigns that the Property shall not be used in a manner that would interfere with the groundwater extraction and treatment system on the Property without prior approval from EPA and the Department or their successor agencies.

3. Declarant covenants for itself, its heirs, successors and assigns that there shall be no drilling of groundwater wells on the Property without prior approval from EPA and the Department or their successor agencies.

4. Declarant covenants for itself, its heirs, successors and assigns that the EPA, the Department, their successor agencies, and all other parties performing response actions under EPA's or the Department's oversight shall be provided reasonable access for (i) inspecting the Property, (ii) monitoring, (iii) verifying information, (iv) sampling the Property, (v) assessing the need for additional response or quality control practices, (vi) implementing the work required under the AOC,

Instrument 2014002821 OR Vol 14524 Page 296

(vii) inspecting and copying records, (viii) assessing the responsible party's compliance, (ix) assessing compliance with existing land use restrictions under the AOC and this Declaration, or (x) to take samples as may be necessary to enforce this Declaration.

5. The covenants and restrictions set forth herein shall run with the title to the Property and shall be binding upon Declarant, its heirs, successors and assigns and any subsequent purchaser of the Property. It is expressly agreed that the Department and EPA shall have the right to enforce these covenants and restrictions upon Declarant, its heirs, successors and assigns and any subsequent purchaser of the Property. Declarant and its heirs, successors, and assigns and any subsequent purchaser of the Property shall include the following notice on all deeds, mortgages, plats, or any legal instruments used to convey any interest in the Property (failure to comply with this paragraph does not impair the validity or enforceability of these covenants):

NOTICE: This Property Subject to Declaration of Covenants and Restrictions and any subsequent Amendments Recorded at _____

6. Declarant shall record this Declaration of Covenants and Restrictions in a timely fashion in the Office of Register of Deeds of York County, South Carolina, and shall re-record it at any time the Department may require to preserve its rights. Declarant shall pay all recording costs and taxes necessary to record this document in the public records. Declarant shall provide a copy of the recorded Declaration to the Department within sixty (60) days of the recorded date. The copy shall show the date and Book and Page number where the Declaration has been recorded.

7. This Declaration shall remain in place until such time as the Department has made a written determination that the covenants and restrictions set forth herein are no longer necessary. The Department shall not consent to any such termination unless the requirements of the AOC have been met. This Declaration shall not be amended without the written consent of the Department or its successor agency. The Department shall not consent to any such amendment or termination without the written consent of EPA.

8. It is expressly agreed that EPA is not the recipient of a real property interest but is a third party beneficiary of the Declaration of Covenants and Restrictions and, as such, has the rights of enforcement.

Instrument 2014002789221 OR Vol 14524 Page 297

9. This Declaration only applies to the Property expressly identified in Exhibit A and does not impair the Department's and EPA's authority with respect to the Property or other real property under the control of Declarant.

Instrument 2014002789221 OR Vol 14524 Page 2928

IN WITNESS WHEREOF, the Department has caused this instrument to be executed as of the date first above written.

WITNESSES:

South Carolina Department of Health and Environmental Control

By: Daphne G. Neel

Daphne G. Neel, Chief
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control

STATE OF SOUTH CAROLINA)
) ACKNOWLEDGEMENT
COUNTY OF YORK)

I, Veronica E Kennedy (Notary Public), do hereby certify that, Daphne G. Neel, Chief, Bureau of Land and Waste Management of the South Carolina Department of Health and Environmental Control, personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official seal this 15th day of May, 2014

Veronica E Kennedy
Notary Public for South Carolina
My Commission Expires: My Commission Expires April 2, 201[illegible]

Instrument 20140027721 OR Vol 14524 Page 299

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IN WTINESS WHEREOF, Declarant has caused this instrument to be executed as of the date first above written.

WITNESSES:

CHERRY STREET ASSOCIATES, LLC,
a South Carolina limited liability company

By: _____

Gregory S. Parsons

(Name and Title) manager

STATE OF SOUTH CAROLINA)
) ACKNOWLEDGEMENT
COUNTY OF YORK)

I hereby certify that before me personally appeared Gregory S. Parsons of Cherry Street Associates, LLC, a South Carolina limited liability company, to me known to be the person described in and who executed the foregoing instrument on behalf of said Company, and said party acknowledged the execution thereof to be his/her free act and deed for the uses and purposes therein mentioned.

Witness my hand and official seal this 10th day of April, 2014.

Sandra M Crane

Notary Public for SC

My Commission Expires: 9/7/2022

Instrument 2014002795921 GR Vol 14524 Page 300

5

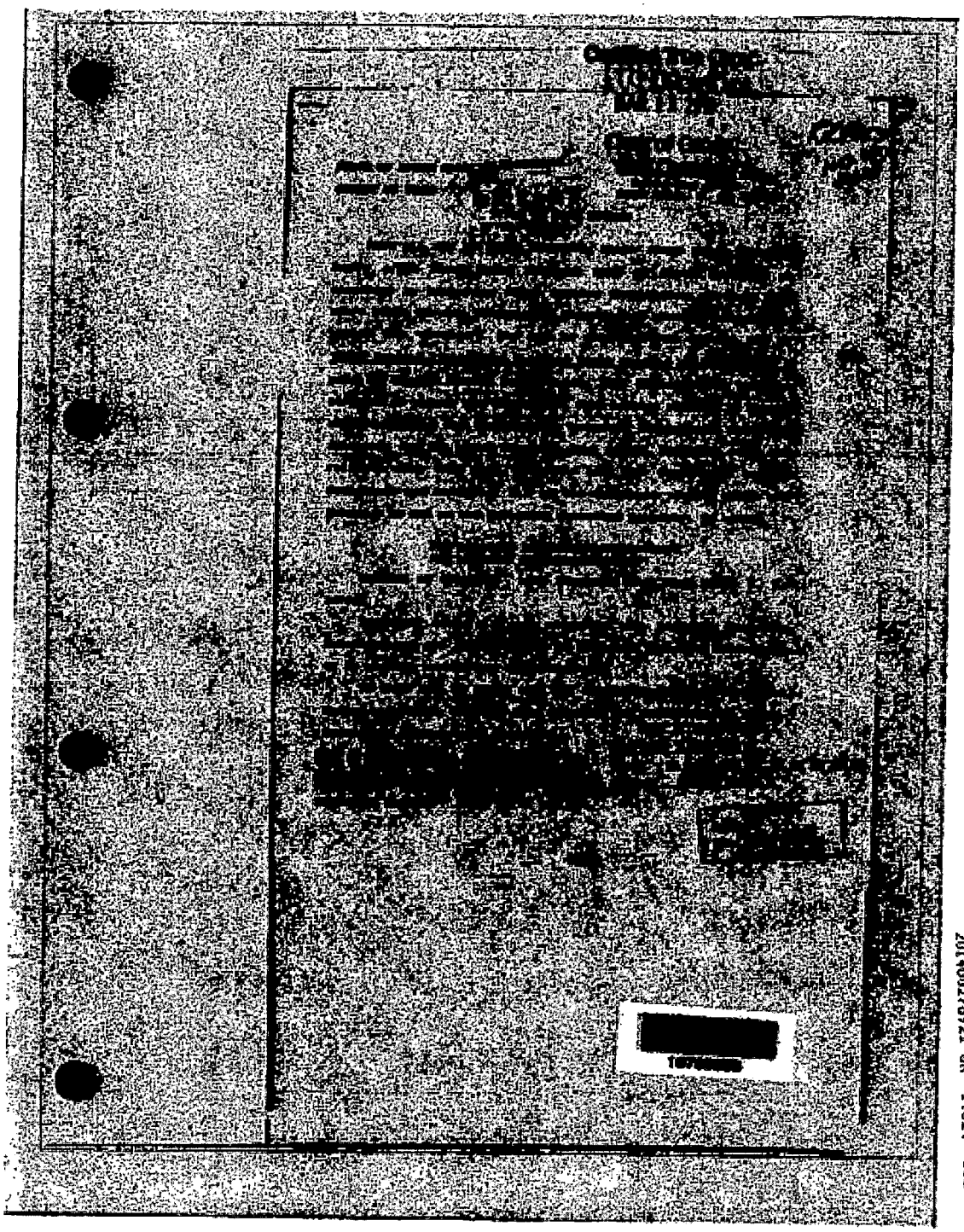
This Declaration of Covenants and Restrictions is hereby approved by the United States Environmental Protection Agency as a third party beneficiary this 25 day of June 2014

United States Environmental Protection Agency

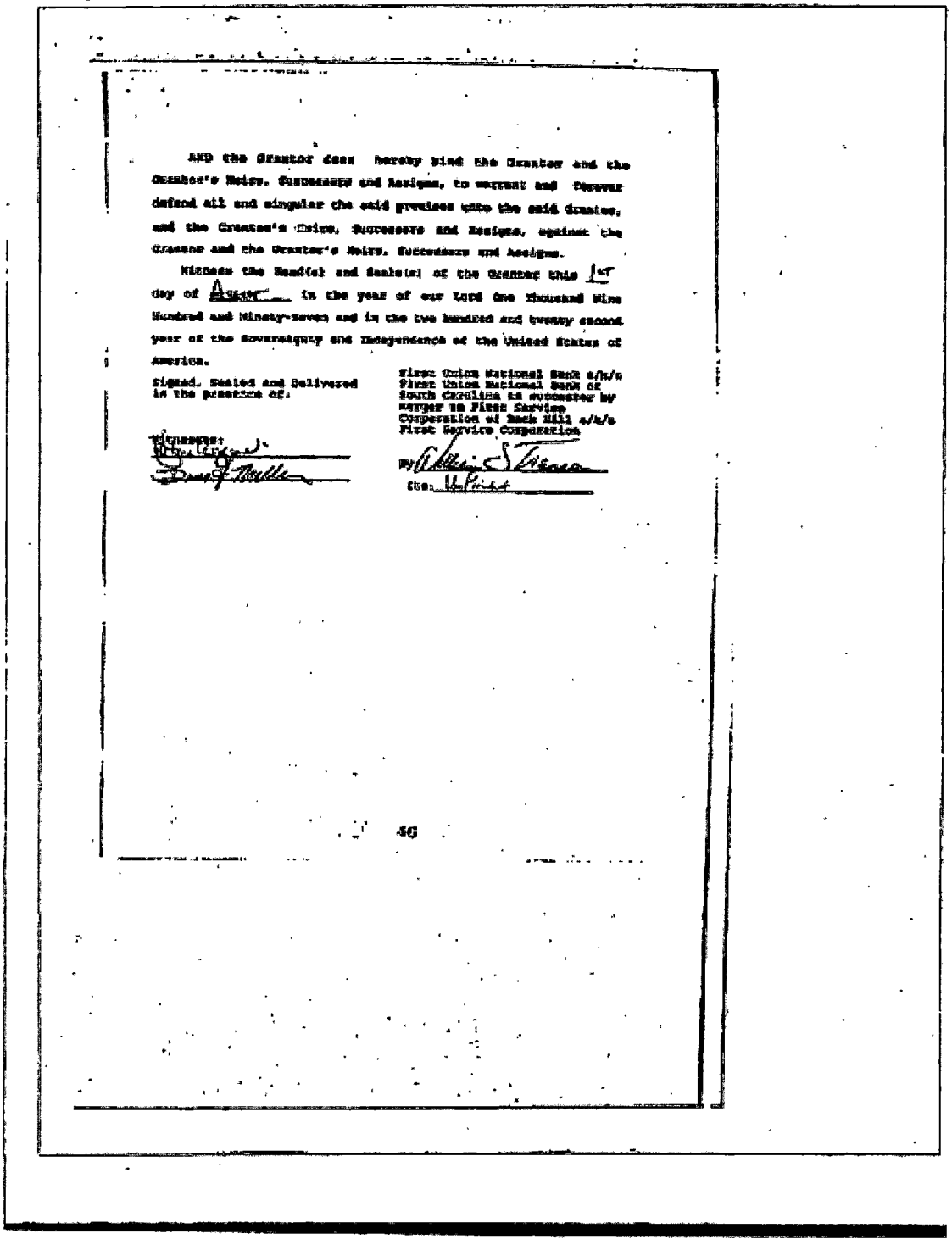
Franklin E. Hill
Director
Superfund Division
U.S. Environmental Protection Agency, Region 4

Instrument 201400278921 OR Vol 14524 Page 301

BAD ORIGINAL



3:24-cv-01281-MGL Date Filed 06/05/26 Entry Number 121-50 Page 73 of 137



AND the Grantor does hereby bind the Grantor and the Grantor's Heirs, Successors and Assigns, to warrant and forever defend all and singular the said premises unto the said Grantee, and the Grantee's Heirs, Successors and Assigns, against the Grantor and the Grantor's Heirs, Successors and Assigns.

Witness the Hand(s) and Seal(s) of the Grantor this 1st day of August in the year of our Lord One thousand Nine Hundred and Ninety-Seven and in the two hundred and twenty second year of the Sovereignty and Independence of the United States of America.

Signed, Sealed and Delivered in the presence of:

Witnesses:

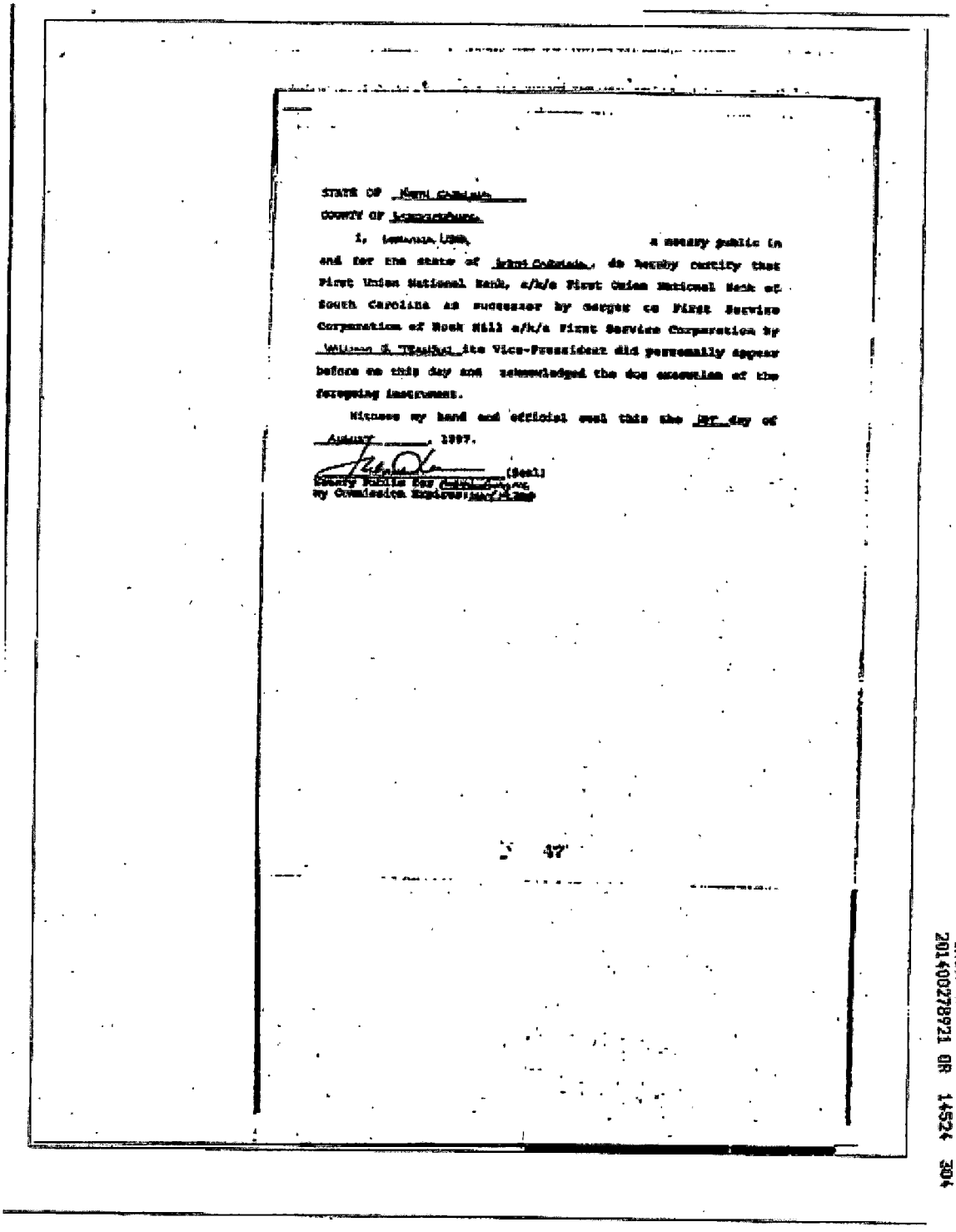
First Union National Bank a/k/a First Union National Bank of South Carolina as successor by merger to First Service Corporation of Rock Hill a/k/a First Service Corporation

By: [signature]

Its: V.P.

SC

Instrument 20140032892I DR Vol 14524 Page 303



STATE OF [illegible]

COUNTY OF [illegible]

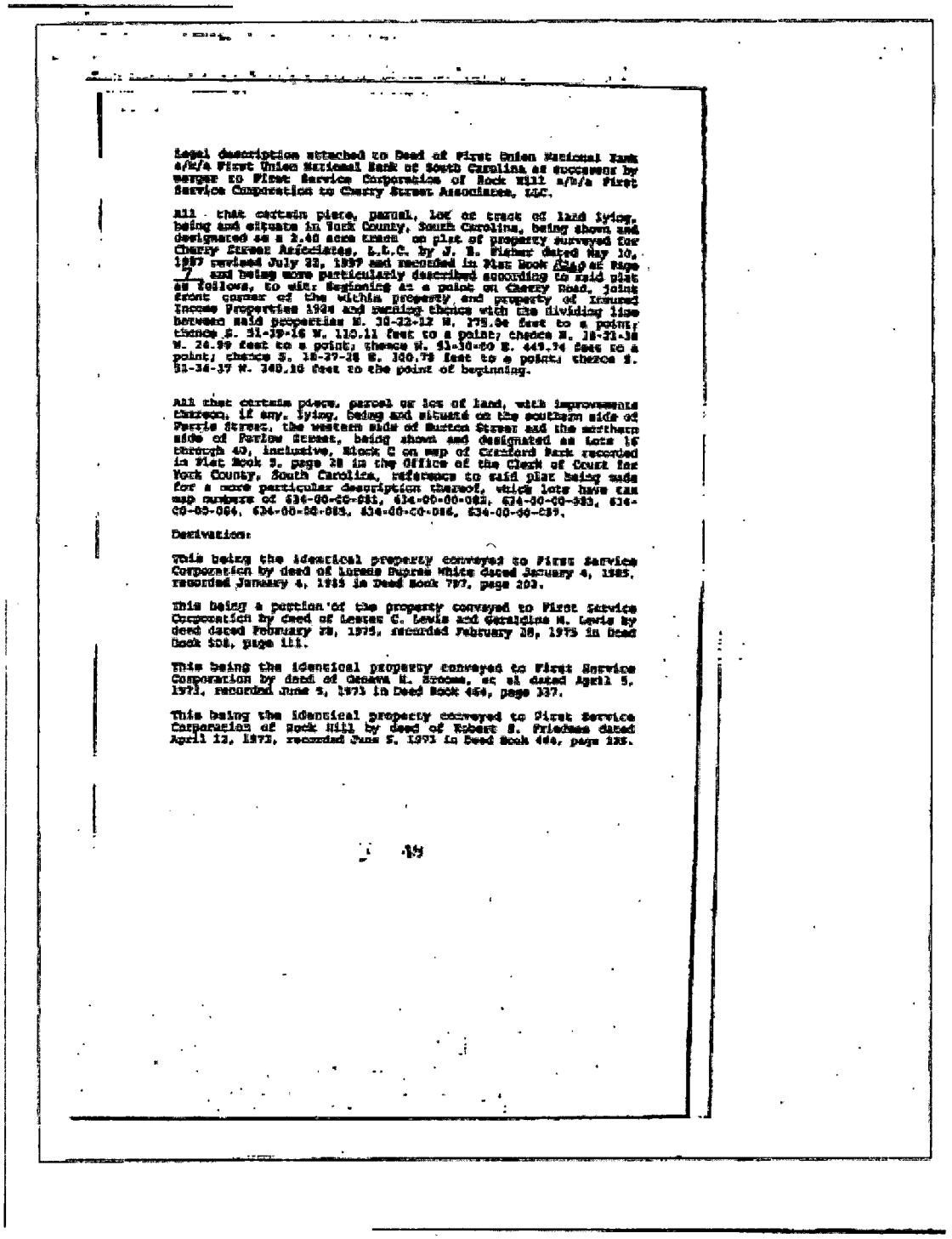
I, [illegible], a notary public in and for the state of [illegible], do hereby certify that First Union National Bank, a/k/a First Union National Bank of South Carolina as successor by merger to First Service Corporation of Rock Hill a/k/a First Service Corporation by [illegible] its Vice-President did personally appear before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official seal this the 1st day of August, 1997.

[illegible] (Seal)
Notary Public for [illegible]
My Commission Expires: [illegible]

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Instrument 20140027892I OR Vol 14524 Page 304



Legal description attached to Deed of First Union National Bank a/k/a First Union National Bank of South Carolina as successors by merger to First Service Corporation of Rock Hill a/k/a First Service Corporation to Cherry Street Associates, LLC.

All that certain piece, parcel, lot or tract of land lying, being and situate in York County, South Carolina, being shown and designated as a 2.48 acre tract on plat of property surveyed for Cherry Street Associates, L.L.C. by J. B. Fisher dated May 10, 1997 revised July 22, 1997 and recorded in Plat Book A447 at Page 7, and being more particularly described according to said plat as follows, to wit: Beginning at a point on Cherry Road, joint front corner of the within property and property of Insured Income Properties 1984 and running thence with the dividing line between said properties N. 38-22-12 W. 175.04 feet to a point; thence S. 51-39-16 W. 110.11 feet to a point; thence N. 38-21-38 W. 24.99 feet to a point; thence W. 51-38-50 E. 449.74 feet to a point; thence S. 38-37-28 E. 180.73 feet to a point; thence E. 51-34-37 W. 340.16 feet to the point of beginning.

All that certain piece, parcel or lot of land, with improvements thereon, if any, lying, being and situate on the southern side of Perrin Street, the western side of Burton Street and the northern side of Parlow Street, being shown and designated as Lots 16 through 40, inclusive, Block C on map of Cranford Park recorded in Plat Book 3, page 28 in the Office of the Clerk of Court for York County, South Carolina, reference to said plat being made for a more particular description thereof, which lots have tax map numbers of 634-00-00-081, 634-00-00-082, 634-00-00-083, 634-00-00-084, 634-00-00-085, 634-00-00-086, 634-00-00-087.

Derivation:

This being the identical property conveyed to First Service Corporation by deed of Loreda Dupree White dated January 4, 1985, recorded January 4, 1985 in Deed Book 797, page 203.

This being a portion of the property conveyed to First Service Corporation by deed of Lester C. Lewis and Geraldine M. Lewis by deed dated February 28, 1975, recorded February 28, 1975 in Deed Book 508, page 111.

This being the identical property conveyed to First Service Corporation by deed of Geneva M. Broome, et al dated April 5, 1973, recorded June 5, 1973 in Deed Book 464, page 337.

This being the identical property conveyed to First Service Corporation of Rock Hill by deed of Robert S. Friedman dated April 12, 1972, recorded June 5, 1973 in Deed Book 446, page 135.

-19-

Instrument 20140027892I OR Vol 14524 Page 305

RESTRICTION IN DEED FROM FIRST UNION NATIONAL BANK TO CHERRY STREET ASSOCIATES, LLC

A portion of the property described herein is part of the Rock Hill Chemical Company Site ("Site"). The "Site" is located on the NORTH side of North Cherry Road in Rock Hill, South Carolina, which encompasses a 4.5 acre area. The portion of the property that is part of the Site (the "Property") is described herein as:

All those certain pieces, parcels or lots of land lying, being, and situated in Ebenezer Township Number 3, near Rock Hill, in the County of York, and State of South Carolina, and being shown and designated as (parcels) 46, 47, 48, 49, 50, 51, 52, and 53 in Block B on Map of Cranford Park, prepared by White and Norett, Reg. Surv., November 16, 1948, recorded in the Office of the Clerk of Court for York County in Plat Book 5, at page 28, and also shown as Lot C on Map of Property to be acquired by Brenda Thompson, trustee, prepared by W. C. White, R.L.S., September 27, 1972.

The "Property" is hereby made subject to the following restrictive covenants:

a. The United States Environmental Protection Agency ("EPA"), its agents and delegates and their respective authorized representatives shall be permitted to enter upon the Property for purposes of implementing the remedial actions required under the Record of Decision ("ROD") for the Site prepared by Region IV of EPA on or about June 27, 1994, including operation and maintenance, or for performing any response actions deemed necessary by EPA;

b. All purchaser(s), transferee(s) or tenant(s) agree not to interfere with or disturb EPA's or the potentially responsible parties' (or their successors) performance of any remedial action required under the ROD, including operation and maintenance, or any response actions deemed necessary by EPA;

c. All purchaser(s), transferee(s) or tenant(s) of the Site shall inform any person or entity that acquires any title, ownership, leasehold, easement or other interest in the Property, or any portion thereof, or appurtenances thereto, of the requirements, conditions, and operative effect of Section VI,T. of the Administrative Order on Consent between First Union Bank of South Carolina and the United States Environmental Protection Agency, bearing EPA Docket No.: I-93-C (the "Consent Order"); and

d. The obligations set forth herein shall run with the land and shall bind (and be deemed to be record notice to) any and all persons, companies, or entities and their successors and assigns who now or may hereafter acquire any title, ownership, leasehold, easement, or interest in the Property or any portion thereof, or any appurtenance(s) thereto, in accordance with applicable state law.

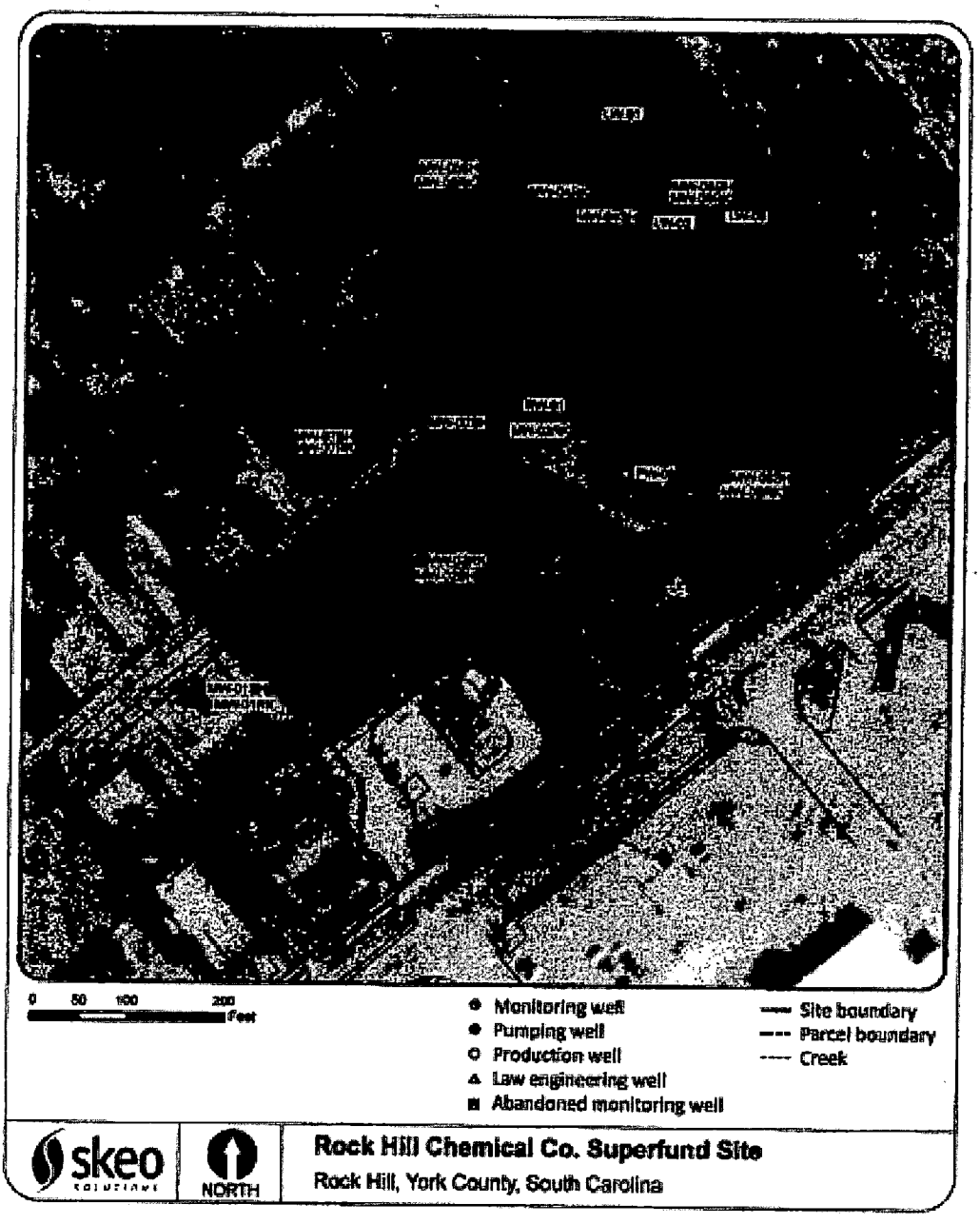
49

Instrument 20140027B721 OR Vol 14524 Page 306

3:24-cv-01281-MGL Date Filed 06/05/26 Entry Number 121-50 Page 77 of 137

BAD ORIGINAL

Figure 2: Detailed Site Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site, and is not intended for any other purpose.

Instrument 2014002789921 OR Vol 14524 Page 307

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

RECEIVED
APR 2 1 2014
SITE ASSESSMENT, REMEDIATION & REVITALIZATION

MAR 2 1 2014

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Gregory Parsons
Cherry Street Associates, LLC
1565 Ebenezer Road
Rock Hill, South Carolina 29732

Re: Rock Hill Chemical Company Superfund Site

Dear Mr. Parsons:

I am contacting you regarding the Rock Hill Chemical Company Superfund Site (Rock Hill Site) located in Rock Hill, York County, South Carolina. According to relevant deed records, Cherry Street Associates, LLC owns a portion of the Rock Hill Site (Parcel #6340701047) that is located in the southwestern corner of the Rock Hill Site. The Rock Hill Site has been the subject of a remedial action pursuant to a Record of Decision (ROD) issued on June 27, 1994. The ROD selected a remedy that included extraction of contaminated groundwater with direct discharge to a wastewater treatment plant and long-term ground water monitoring. Also, the ROD required implementation of institutional controls to prevent the future use of contaminated groundwater for purposes such as a potable water supply or irrigation of garden vegetables.

The Rock Hill Chemical Company PRP Group (PRP Group) has implemented certain groundwater cleanup activities to address ground water conditions across the Rock Hill Site, including your property. The U.S. Environmental Protection Agency requires that you execute a Declaration of Covenants and Restrictions (Declaration) to ensure that current and future use of your property is consistent with the cleanup activities for the Rock Hill Site, and to provide access to your property to conduct operation and maintenance (O&M) activities at the Rock Hill Site. O&M activities conducted at the Rock Hill Site consist primarily of annual groundwater sampling. Other O&M activities include periodic mowing and routine equipment maintenance and repair.

The EPA, South Carolina Department of Health and Environmental Control (SCDHEC) and the PRP Group prepared the attached Declaration based on environmental data collected from the Rock Hill Site during earlier investigations. This data is available in the EPA's record depository for the Rock Hill Site, which the EPA has maintained at the York County Library, 138 East Black Street, Rock Hill, South Carolina 29730.

The Declaration will restrict the following: ground water to non-potable (i.e., non-drinking water) uses; use of the land that would interfere with the groundwater extraction and treatment system on the property; and any drilling of ground water wells on the property. Also, the Declaration would allow for reasonable access to the property to conduct O&M activities.

Instrument 2014002789721 OR Vol 14524 Page 308

Please execute the enclosed Declaration and have your signature witnessed and notarized, and then return the original to me. Upon receipt, I will obtain signatures from SCDHEC and the EPA, and forward the Declaration to the PRP Group to file the fully executed Declaration with the York County Office of Register of Deeds and return a date-stamped copy to the EPA, SCDHEC and you.

We appreciate your cooperation with the cleanup of the Site. If you have any questions regarding this information, you can contact me at (404) 562-8493 or Kim Jones at (404) 562-9553.

Sincerely,

Bilal Harris

Bilal Harris
Assistant Regional Counsel
Office of Environmental Accountability

Enclosures (3)

cc: Phillip L. Conner, Nexsen Pruet, LLC

Instrument 2014002789?1 OR Vol 14524 Page 309

52254

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

APR 17 2014

RECEIVED
APR 21 2014
SITE ASSESSMENT, REMEDIATION & REVITALIZATION

SCANNED 4-21-14

Greg Cassidy
SCDHEC
2600 Bull Street
Columbia, South Carolina 29201

Re: Rock Hill Chemical Company Superfund Site

Dear Mr. Cassidy:

Enclosed please find the signed Declaration of Covenants and Restrictions signed by Cherry Street Associates, LLC concerning the Rock Hill Chemical Company Superfund Site, located in Rock Hill, York County, South Carolina. Please review, sign and return for EPA's signature the enclosed Declaration of Covenants and Restrictions to the following:

Bilal Harris
Assistant Regional Counsel
U.S. Environmental Protection Agency
Atlanta Federal Center, 13th Floor
61 Forsyth St., S.W.
Atlanta, GA 30303

If you have any questions, please contact me at (404) 562-8493.

Sincerely,

Bilal Harris

Bilal Harris
Assistant Regional Counsel
Office of Environmental Accountability

Enclosure

Instrument 2014002789221 GR Vol 14524 Page 310

201500310017
Filed for Record in
YORK COUNTY, SC
DAVID HAMILTON, CLERK OF COURTS
08-17-2015 At 01:39 pm.
RESTR COVEN 22.00
OR Vol 15082 Page 64 - 79

Recording Requested By and
When Recorded Mail to:

Turner, Padget, Graham & Laney, P.A.
P.O. Box 1473
Columbia, SC 29202
Attention: Lanneau Wm. Lambert, Jr.

(Space above this line for Recorder's Use)

STATE OF SOUTH CAROLINA)
)
COUNTY OF YORK)

DECLARATION OF COVENANTS AND RESTRICTIONS

THIS DECLARATION OF COVENANTS AND RESTRICTIONS ("Declaration") is made and entered into as of the 9th day of March, 2015, by **Five Talents Properties of SC, LLC**, a Nevada limited liability company ("Declarant") and the **South Carolina Department of Health and Environmental Control** ("Department").

RECITALS

WHEREAS, this Declaration is entered into pursuant to S.C. Code §44-56-200 et seq.; and

WHEREAS, Declarant is the owner of a certain portion of real property known as the Rock Hill Chemical Company Superfund Site in Rock Hill, York County, South Carolina, that was conveyed to Declarant by deed dated December 30, 2010, and recorded in Deed Book 11767, Page 164 of the Office of Register of Deeds of York County, and more particularly described in Exhibit A attached hereto and incorporated herein by reference ("Property"); and

WHEREAS, the Property subject to this Declaration is a portion of the property known as the Rock Hill Chemical Company Superfund Site ("Site"), located as depicted in Exhibit B, attached hereto and incorporated by reference; and

WHEREAS, the Property has been the subject of a remedial action pursuant to a Record of Decision ("ROD") issued on June 27, 1994, a Unilateral Administrative Order for Remedial Design/Remedial Action ("UAO") dated February 6, 1995, and an Administrative Order on Consent [CER-04-2000-0200] ("AOC") dated March 8, 2000, entered into by the United States Environmental Protection Agency ("EPA") and the following Potentially Responsible Parties ("PRPs"): (1) BASF Corporation; (2) Burlington Industries, Inc.; (3) Chase Packaging, Inc.; (4) CTS Corporation; (5) Engraph, Inc.; (6) FMC Corporation, (7) Lithium Division; (8) CNA Holdings, Inc.; (9) Homelite Division of Textron; (10) Rexam Inc.; (11) Rutledge Realty Company, Inc.; and (12) W.R. Grace and Company under the Comprehensive Environmental Response Compensation and Liability Act ("CERCLA"), 42 U.S.C. §§ 9601, et seq.; and

WHEREAS, the PRPs are responsible for conducting response actions at the Site with EPA oversight pursuant to the AOC and UAO; and

WHEREAS, Declarant has cooperated with ongoing remediation to the Property to commercial-use standards as required by the AOC; and

WHEREAS, the Property may be used for certain purposes without further remediation in accordance with the provisions of the AOC; and

Instrument 201500310017 OR Vol 15082 Page 64

WHEREAS, Declarant has agreed to impose certain restrictions on the manner in which the Property may be developed and used in the future subject to the limitations and qualifications herein; and

WHEREAS, the PRPs have agreed to perform or fund response work specified in the UAO which includes the implementation of these institutional controls; and

WHEREAS, it is the intention of all parties that EPA is a third party beneficiary of said restrictions and said restrictions shall be enforceable by EPA and the Department or their successor agencies; and

WHEREAS, EPA has worked closely with the Department in developing the AOC, EPA will assist the Department in monitoring and enforcing this Declaration.

NOW, THEREFORE, KNOW ALL MEN BY THESE PRESENTS that Declarant hereby declares and covenants on behalf of itself, its successors, and assigns that the Property described in Exhibit A shall be held, mortgaged, transferred, sold, conveyed, leased, occupied, and used subject to the covenants herein, to include the following restrictions, which shall touch and concern and run with the title to the Property:

1. Declarant covenants for itself and its successors and assigns that groundwater beneath the Property shall not be used for potable use, irrigation of edible garden vegetables, or such other similar uses without prior approval from EPA and the Department or their successor agencies.

2. Declarant covenants for itself and its successors and assigns that the Property shall not be used in a manner that would interfere with the groundwater extraction and treatment system on the Property without prior approval from EPA and the Department or their successor agencies.

3. Declarant covenants for itself and its successors and assigns that there shall be no drilling of groundwater wells on the Property without prior approval from EPA and the Department or their successor agencies.

4. Declarant covenants for itself and its successors and assigns that EPA, the Department, their successor agencies, and all other parties performing response actions under EPA's or the Department's oversight shall be provided reasonable access for (i) inspecting the Property, (ii) monitoring, (iii) verifying information, (iv) sampling the Property, (v) assessing the need for additional response or quality control practices, (vi) implementing the work required under the AOC, (vii) inspecting and copying records, (viii) assessing the responsible party's compliance, (ix) assessing compliance with existing land use restrictions under the AOC and this Declaration, or (x) to take samples as may be necessary to enforce this Declaration; provided; however, Declarant will receive advance notice before EPA, the Department, their successor agencies, and all other parties access the Property.

5. The covenants and restrictions set forth herein shall run with the title to the Property and shall be binding upon Declarant and its successors and assigns and any subsequent purchaser of the Property. It is expressly agreed that the Department and EPA shall have the right to enforce these covenants and restrictions upon Declarant and its successors and assigns and any subsequent purchaser of the Property. Declarant and its successors, and assigns and any subsequent purchaser of the Property shall include the following

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notice on all deeds, mortgages, plats, or any legal instruments used to convey any interest in the Property (failure to comply with this paragraph does not impair the validity or enforceability of these covenants):

NOTICE: This Property Subject to Declaration of Covenants and Restrictions and any subsequent Amendments Recorded at Book _____, page _____, York County lands records.

6. Declarant shall record this Declaration of Covenants and Restrictions in a timely fashion in the Office of Register of Deeds of York County, South Carolina, and shall re-record it at any time the Department may require to preserve its rights. The PRPs shall pay all recording costs and taxes necessary to record this document in the public records. Declarant shall provide a copy of the recorded Declaration to the Department within sixty (60) days of the recorded date. The copy shall show the date and Book and Page number where the Declaration has been recorded.

7. This Declaration shall remain in place until such time as the Department has made a written determination that the covenants and restrictions set forth herein are no longer necessary. Once that written determination has been made, the covenants and restrictions set forth herein shall be terminated and the Department shall timely record evidence of such termination in the land records of York County. The Department shall not consent to any such termination unless the requirements of the AOC have been met. This Declaration shall not be amended without the written consent of the Department or its successor agency. The Department shall not consent to any such amendment or termination without the written consent of EPA.

8. It is expressly agreed that EPA is not the recipient of a real property interest but is a third party beneficiary of the Declaration of Covenants and Restrictions and, as such, has the rights of enforcement.

9. This Declaration only applies to the Property expressly identified in Exhibit A and does not impair the Department's and EPA's authority with respect to the Property or other real property under the control of Declarant.

[Remainder of Page Intentionally Left Blank]
[Signature Pages Follow]

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SIGNATURE PAGE FOR
DECLARATION OF COVENANTS AND RESTRICTIONS

IN WITNESS WHEREOF, Declarant has caused this instrument to be executed as of the date first above written.

WITNESSES:

Callie Mayfield

Deana Adams

FIVE TALENTS PROPERTIES OF SC, LLC
a Nevada limited liability company

By: Judith Webb Ring
Judith Webb Ring, Managing Member

STATE OF FLORIDA)
) ACKNOWLEDGEMENT
COUNTY OF OKALOOSA)

I, Rose Goodwin (Notary Public), hereby certify that before me personally appeared **Judith Webb Ring, Managing Member of Five Talents Properties of SC, LLC,** a Nevada limited liability company, to me known to be the person described in and who executed the foregoing instrument on behalf of said Company, and said party acknowledged the execution thereof to be his/her free act and deed for the uses and purposes therein mentioned.

Witness my hand and official seal this 9 day of March, 2015.

Rose Goodwin
Notary Public for the State of Florida

My Commission Expires: 3/10/15 [SEAL]

ROSE GOODWIN
MY COMMISSION # EE067767
EXPIRES: March 10, 2015
Bonded thru Atlantic Bonding Co., Inc.

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TPGL 6261230v1

SIGNATURE PAGE FOR
DECLARATION OF COVENANTS AND RESTRICTIONS

IN WITNESS WHEREOF, the Department has caused this instrument to be executed as of the date first above written.

WITNESSES:

SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

By: Daphne D. Neel

Daphne G. Neel, Chief
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control

STATE OF SOUTH CAROLINA)
) ACKNOWLEDGEMENT
COUNTY OF RICHLAND)

I, Veronica F Kennedy (Notary Public), do hereby certify that **Daphne G. Neel, Chief, Bureau of Land and Waste Management of the South Carolina Department of Health and Environmental Control,** personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official seal this 27th day of March, 2015.

Veronica F Kennedy

Notary Public for South Carolina
My Commission Expires: My Commission Expires April 9, 2017

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SIGNATURE PAGE FOR
DECLARATION OF COVENANTS AND RESTRICTIONS

This Declaration of Covenants and Restrictions is hereby approved by the United States Environmental Protection Agency as a third party beneficiary this 3rd day of August, 2015.

WITNESSES:

Mary D. Lowers

Jon Rucker

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

By: Franklin E. Hill

Franklin E. Hill
Director
Superfund Division
United States Environmental Protection Agency, Region 4

STATE OF GEORGIA)
)
COUNTY OF CLAYTON)

ACKNOWLEDGEMENT

I, Pareasa Stevens, (Notary Public), hereby certify that before me personally appeared **Franklin E. Hill, Director, Superfund Division, United States Environmental Protection Agency, Region 4**, to me known to be the person described in and who executed the foregoing instrument on behalf of said Company, and said party acknowledged the execution thereof to be his free act and deed for the uses and purposes therein mentioned.

Witness my hand and official seal this 3rd day of August, 2015.

PAREASA STEVENS NOTARY PUBLIC CLAYTON COUNTY, GEORGIA MY COMMISSION EXPIRES SEPTEMBER 8, 2015

Pareasa Stevens
Notary Public for State of Georgia

My Commission Expires: September 8, 2015 [SEAL]

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EXHIBIT A

Declarant Property Deed

[See attached]

Instrument 20150031001 7 OR Vol 15082 Page 70

Recording Requested By and
When Recorded Mail to:

Turner, Padget, Graham & Laney, P.A.
P.O. Box 1473
Columbia, SC 29202
Attention: Catherine H. Kennedy

NO TITLE SEARCH PERFORMED IN THE PREPARATION OF THIS DEED

Certified True Copy
MAR 11 2011
Clerk of Court
York County

(Space Above This Line For Recorder's Use)

STATE OF SOUTH CAROLINA)
) **LIMITED WARRANTY DEED**
COUNTY OF YORK)

WHEREAS, David N. Ring a/k/a David Norman Ring died a domiciliary of Florida, owning real estate in South Carolina; and

WHEREAS, exemplified copies of the administration of the Estate of David N. Ring a/k/a David Norman Ring have been filed in the Probate Court for York County, South Carolina, in Case No. 2010ES46-328; and

WHEREAS, the Personal Representatives, pursuant to their authority granted in Item XVI of the Will of David N. Ring, a/k/a David Norman Ring, do hereby transfer the decedent's interest in the real property in exchange for a membership interest in a limited liability company;

NOW THEREFORE, KNOW ALL MEN BY THESE PRESENTS, That ***Judith Webb Ring, Michael David Ring, Adam Clinton Ring and Susan Ring Stinkard,*** as Personal Representatives of the Estate of David N. Ring a/k/a/ David Norman Ring ("GRANTOR"), for and as a contribution to and in exchange for a membership interest in ***Five Talents Properties of SC, LLC,*** a Nevada limited liability company, ("GRANTEE") and for no other consideration, subject to the reservations hereinafter stated, have granted, bargained, sold and released, and by these Presents do grant, bargain, sell and release unto the said GRANTEE the following described property (the "Property"):

All that certain piece, parcel or lot of land lying and being situate in the State of South Carolina, County of York, City of Rock Hill, on Cherry Road, containing 0.577 acres, more or less, as is shown on a plat thereof prepared by Fisher-Sherer, Inc. dated August 26, 2004, revised August 30, 2004, recorded in Plat Book C-316, page 1, which plat is incorporated herein by this reference and having such metes, bounds, courses and distances as by this reference to said plat will more fully appear.

This being the same property conveyed to David N. Ring (a/k/a David Norman Ring) by deed of Cherry Street Associates, LLC dated August 26, 2004 and recorded September 13, 2004 in Book 6546, page 42, York County Clerk of Court's office.

TMS#: 634-07-01-058

GRANTEE'S ADDRESS: Post Office Box 535
Crestview, Florida 32536

This conveyance is made subject to all restrictions and easements of record and governmental ordinances and regulations affecting the Property.

TOGETHER with all and singular, the rights, members, hereditaments and appurtenances to the said premises belonging or in anywise incident or appertaining.

RECORDED
YORK COUNTY
TAX ASSESSOR'S OFFICE
DATE 12-20-10
TAX MAP NO. 634-7-1-58
INITIALS CWH-R

20100031839
Filed For Record In
YORK COUNTY, SC
DAVID HAMILTON CLERK OF COURTS
12-20-2010 At 08:15:54 am.
DEED 13.00
State Tax .00
County Tax .00
RB Bk: 11767 Pgs: 154 - 157

10799679

BK11767 PG0154

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TO HAVE AND TO HOLD, all and singular the premises before mentioned, unto the said GRANTEE, GRANTEE'S successors and assigns, forever, subject to the reservations set forth above.

And the GRANTOR hereby binds GRANTOR and GRANTOR'S successors and assigns to warrant and forever defend all and singular the said premises unto the said GRANTEE and GRANTEE'S successors and assigns against GRANTOR and GRANTOR'S successors and assigns lawfully claiming, or to claim the same or any part thereof.

WITNESS the Grantor's Hand and Seal this 21 day of September, 2010.

SIGNED, SEALED AND DELIVERED
IN THE PRESENCE OF:

ESTATE OF DAVID N. RING
A/K/A DAVID NORMAN RING

WITNESS NO. 1

Judith Webb Ring [SEAL]
Judith Webb Ring, Co-Personal Representative

WITNESS NO. 2 ~~Deanna S. King~~

STATE OF FLORIDA)
)
COUNTY OF Okaloosa)

ACKNOWLEDGMENT

I, the undersigned Notary Public of the County and State aforesaid, do hereby certify that Grantor personally came before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official stamp or seal this 21 day of September, 2010.

Rose Goodwin (L.S.)
Notary Public for Florida
My Commission Expires: 3/10/11

STATE OF FLORIDA
Rose Marie Goodwin
Commission #DD632874
Expires: MAR. 10, 2011

BK 1767 PG 165

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[Signature page as to Michael David Ring]

WITNESS the Grantor's Hand and Seal this 21st day of October, 2010.

SIGNED, SEALED AND DELIVERED
IN THE PRESENCE OF:

WITNESS NO. 1

K. D. Parker
WITNESS NO. 2

ESTATE OF DAVID N. RING
A/K/A DAVID NORMAN RING

Michael David Ring [SEAL]
Michael David Ring, Co-Personal Representative

STATE OF ~~FLORIDA~~ Virginia)
)
COUNTY OF Loudoun)

ACKNOWLEDGMENT

I, the undersigned Notary Public of the County and State aforesaid, do hereby certify that Grantor personally came before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official stamp or seal this 21st day of October, 2010.

(L.S.)
Notary Public for ~~Florida~~ Virginia
My Commission Expires: 3-31-2012

IRA MARTIN POLIKOFF
COMMONWEALTH OF VIRGINIA
NOTARY PUBLIC

BK11767 PG0166

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[Signature page as to Adam Clinton Ring]

WITNESS the Grantor's Hand and Seal this 22nd day of October, 2010.

SIGNED, SEALED AND DELIVERED
IN THE PRESENCE OF:

WITNESS NO. 1

WITNESS NO. 2

ESTATE OF DAVID N. RING
A/K/A ~~DAVID NORMAN~~ RING

[SEAL]
Adam Clinton Ring, Co-Personal Representative

STATE OF ~~FLORIDA~~ Texas)
)
COUNTY OF Collin)

ACKNOWLEDGMENT

I, the undersigned Notary Public of the County and State aforesaid, do hereby certify that Grantor personally came before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official stamp or seal this 22nd day of October, 2010.

(L.S.)
Notary Public for Florida
My Commission Expires: 3/13/11

JEANNE J. SMITH
Notary Public,
State of Texas
Comm. Exp. 03-13-11

BK1767 PG167

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[Signature page as to Susan Ring Slinkard]

WITNESS the Grantor's Hand and Seal this 21 day of October, 2010.

SIGNED, SEALED AND DELIVERED
IN THE PRESENCE OF:

ESTATE OF DAVID N. RING
A/K/A DAVID NORMAN RING

WITNESS NO. 1

Susan Ring Slinkard [SEAL]
Susan Ring Slinkard, Co-Personal Representative

WITNESS NO. 2

South Dakota
STATE OF ~~FLORIDA~~)
)
COUNTY OF Pennington)

ACKNOWLEDGMENT

I, the undersigned Notary Public of the County and State aforesaid, do hereby certify that Grantor personally came before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official stamp or seal this 21 day of October, 2010.

(L.S.)
Notary Public for ~~Florida~~ South Dakota
My Commission Expires: June 26, 2015

VICKI SMIZER
NOTARY PUBLIC
SOUTH DAKOTA

BK1767 PG168

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STATE OF SOUTH CAROLINA)
COUNTY OF YORK)

AFFIDAVIT

Personally appeared before me the undersigned, who being duly sworn, deposes and says:

1. I have read the information on this affidavit and I understand such information.

2. Property located on Cherry Road, containing .577 Acres bearing York County Tax Map Number(s) 634-07-01-058 was transferred by Judith Webb Ring, Michael David Ring, Adam Clinton Ring and Susan Slinkard Ring, as Personal Representatives of the Estate of David N. Ring a/k/a David Norman Ring to Five Talents Properties of SC, LLC on _____, 2010.

3. Check one of the following: The Deed is:

(a) _____ Subject to the deed recording fee as a transfer for consideration paid or to be paid in money or money's worth.
(b) _____ Subject to the deed recording fee as a transfer between a corporation, a partnership, or other entity and a stockholder, partner, or owner of the entity or is a transfer to a trust or as a distribution to a trust beneficiary.
(c) X Exempt from the deed recording fee because no consideration is paid or will be paid for the transfer pursuant to No. 8. (see information section of affidavit)

4. Check one of the following if either item 3(a) or item 3(b) above has been checked (see information section of this affidavit):

(a) _____ The fee is computed on the consideration paid or to be paid in money or moneys worth in the amount of $_____
(b) _____ The fee is computed on the fair market value of the realty, which is _____
(c) _____ The fee is computed on the fair market value of the realty as established for property purposes which is _____

5. Check Yes _____ No _____ to the following: A lien or encumbrance existed on the land, tenement, or realty before the transfer and remained on the land, tenement, or realty after the transfer. If Yes, the amount of the outstanding balance of this lien or encumbrance is _____

6. The deed recording fee is computed as follows:
(a) Place the amount listed in item 4 above here: _____
(b) Place the amount listed in item 5 above here: _____ (if no amount is listed, place zero here)
(c) Subtract Line 6(b) from Line 6(a) and place result here: _____

7. The deed recording fee due is based upon the amount listed on Line 6(c) above and the deed recording fee due is: $0.00.

8. As required by Code §12-24-70, I state that I am a responsible person who was connected with the transaction as: Grantor.

9. I understand that a person required to furnish this affidavit who will willfully furnishes a false or fraudulent affidavit is guilty of a misdemeanor and, upon conviction, must be fined not more than One Thousand Dollars or imprisoned not more than one year, or both.

Judith St. Ring
_____, Personal Representative

Sworn to before me this
21 day of September, 2010
Rose Goodwin
Notary Public for Florida
My Commission Expires: 3/10/11

NOTARIAL SEAL - STATE OF FLORIDA
Rose Marie Goodwin
Commission # DD532874
Expires: MAR. 10, 2011
BONDED THRU ATLANTIC BONDING CO., INC.

BK 11767 PG 169

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INFORMATION

Except as provided in this paragraph, the term "value" means "the consideration paid or to be paid in money or money's worth for the realty." Consideration paid or to be paid in money's worth includes, but is not limited to, other realty, personal property, stocks, bonds, partnership interest and other intangible property, the forgiveness or cancellation of a debt, the assumption of a debt, and the surrendering of any right. The fair market value of the consideration must be used in calculating the consideration paid in money's worth. Taxpayers may elect to use the fair market value of the realty being transferred in determining fair market value of the consideration. In the case of realty transferred between a corporation, a partnership, or other entity and a stockholder, partner, or owner of the entity, and in the case of realty transferred to a trust or as a corporation, a partnership, or other entity and a stockholder, partner, or owner of the entity, and in the case of realty transferred to a trust or as a distribution to a trust beneficiary, "value" means the realty's fair market value. A deduction from value is allowed for the amount of any lien or encumbrance existing on the land, tenement, or realty before the transfer and remaining on the land, tenement, or realty after the transfer. Taxpayers may elect to use the fair market value for property tax purposes in determining fair market value under the provisions of the law.

Exempted from the fee are deeds:

1. transferring realty in which the value of the realty, as defined in Code Section 12-24-30, is equal to or less than one hundred dollars;

2. transferring realty to the federal government or to a state, its agencies and departments, and its political subdivision, including school districts;

3. that are otherwise exempted under the laws and Constitution of this State or of the United States;

4. transferring realty in which no gain or loss is recognized by reason of Section 1041 of the Internal Revenue Code as defined in section 12-6-40(A);

5. transferring realty in order to partition realty as long as no consideration is paid for the transfer other than the interest in the realty that are being exchanged in order to partition the realty;

6. transferring an individual grave space at a cemetery owned by a cemetery company licensed under Chapter 55 of title 39

7. that constitute a contract for the sale of timber to be cut;

8. transferring realty to a corporation, a partnership, or a trust in order to become, or as, a stockholder, partner, or trust beneficiary of the entity provided no consideration is paid for the transfer other than stock in the corporation, interest in the partnership, beneficiary interest in the trust, or the increase in value in such stock or interest held by the grantor. However, the transfer of realty from a corporation, a partnership, or a trust to a stockholder, partner, or trust beneficiary of the entity is subject to the fee even if the realty is transferred to another corporation, a partnership, or trust;

9. transferring realty from a family partnership to a partner or from a family trust to a beneficiary, provided no consideration is paid for the transfer other than a reduction in the grantee's interest in the partnership or trust. A "family partnership" is a partnership whose partners are all members of the same family. A "family trust" is a trust, in which the beneficiaries are all members of the same family. The beneficiaries of a family trust may also include charitable entities. "Family" means the grantor and the grantor's spouse, parents, grandparents, sisters, brothers, children, stepchildren, grandchildren, and the spouses and lineal descendants of any of the above. A "charitable entity" means an entity which may receive deductible contributions under Section 170 of the Internal Revenue Code as defined in Section 12-6-40(A);

10. transferring realty in a statutory merger or consolidation from a constituent corporation to the continuing or new corporation;

11. transferring realty in a merger or consolidation from a constituent partnership to the continuing or new partnership; and,

12. that constitute a corrective deed or a quitclaim deed used to confirm title already vested in the grantor, provided that no consideration of any kind is paid or is to be paid under the corrective or quitclaim deed.

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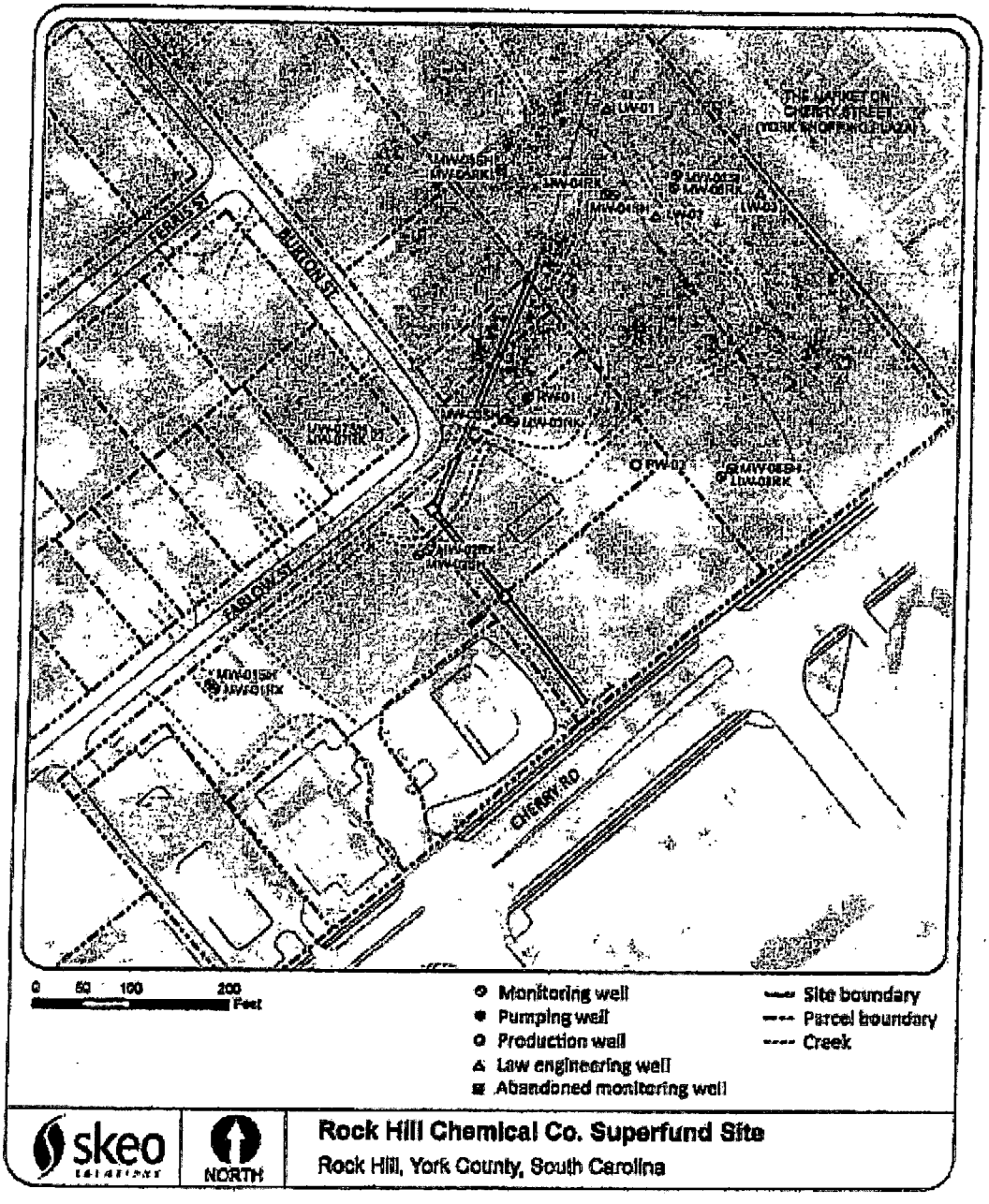
EXHIBIT B

Site Location

[See attached]

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Figure 2: Detailed Site Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site, and is not intended for any other purpose.

BAD ORIGINAL

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APPENDIX G – CONTAMINANTS OF CONCERN CONCENTRATION TRENDS

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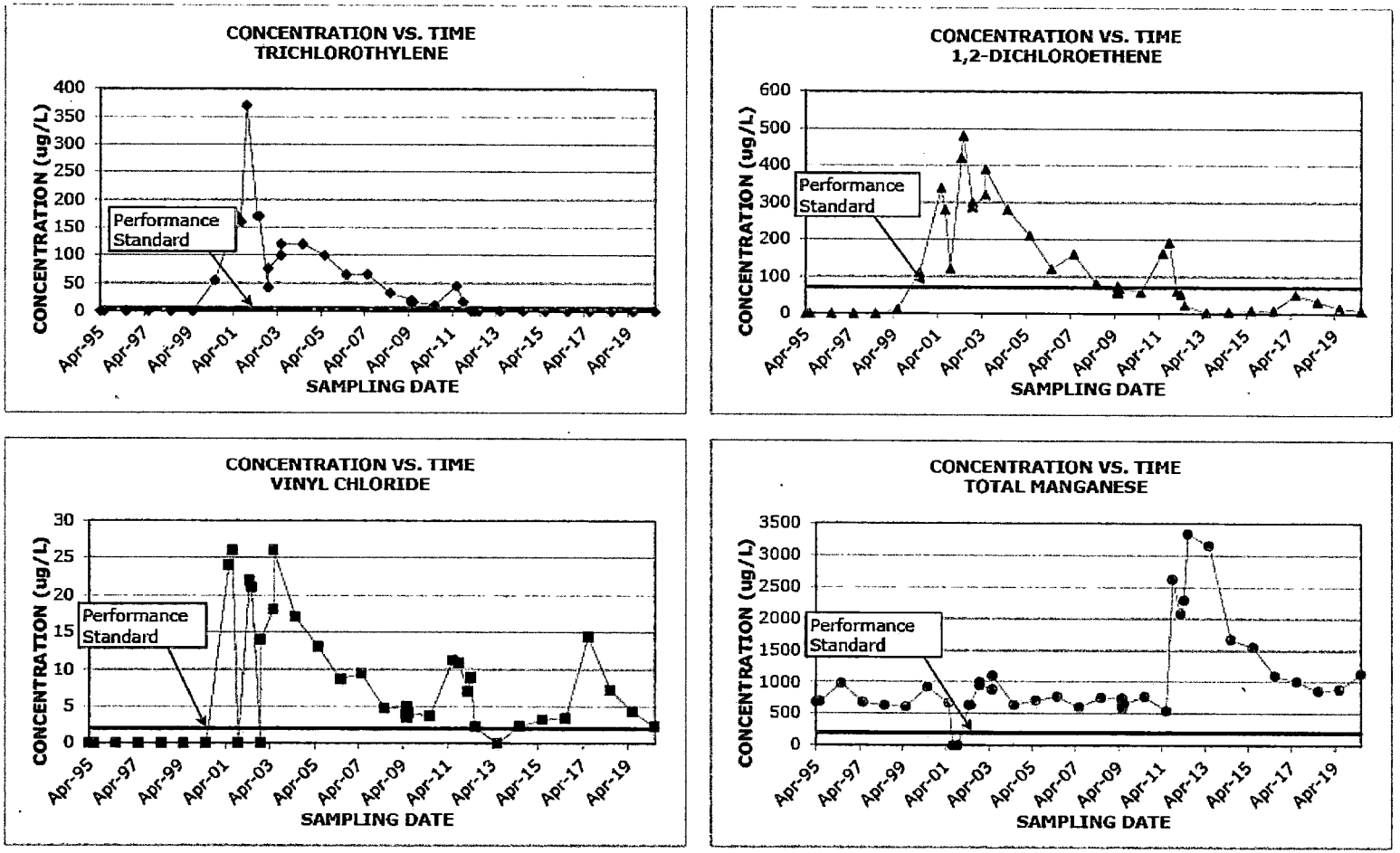


Figure 2 - COC Concentration Trends for MW-02SH

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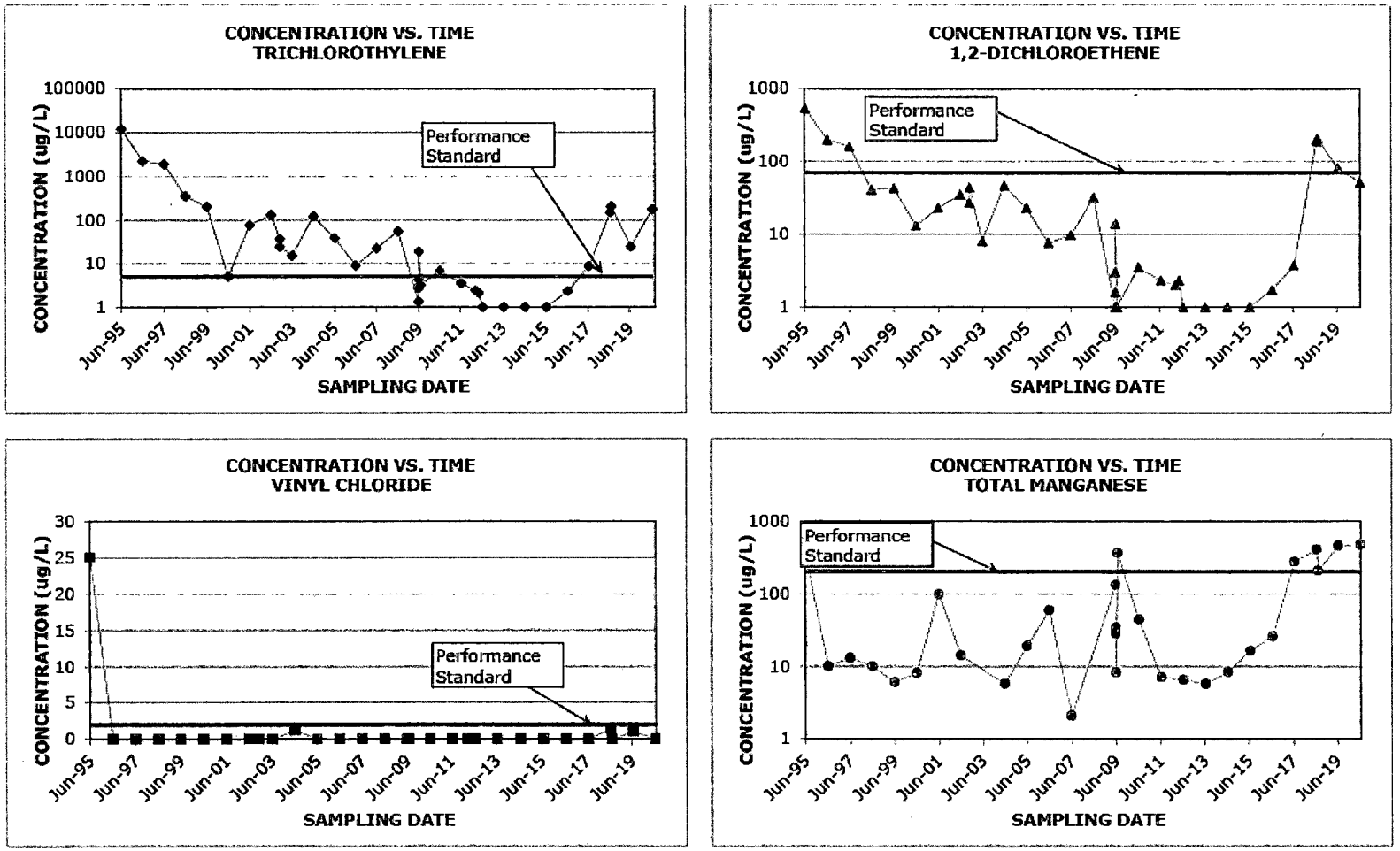


Figure 3 - COC Concentration Trends for MW-03SH

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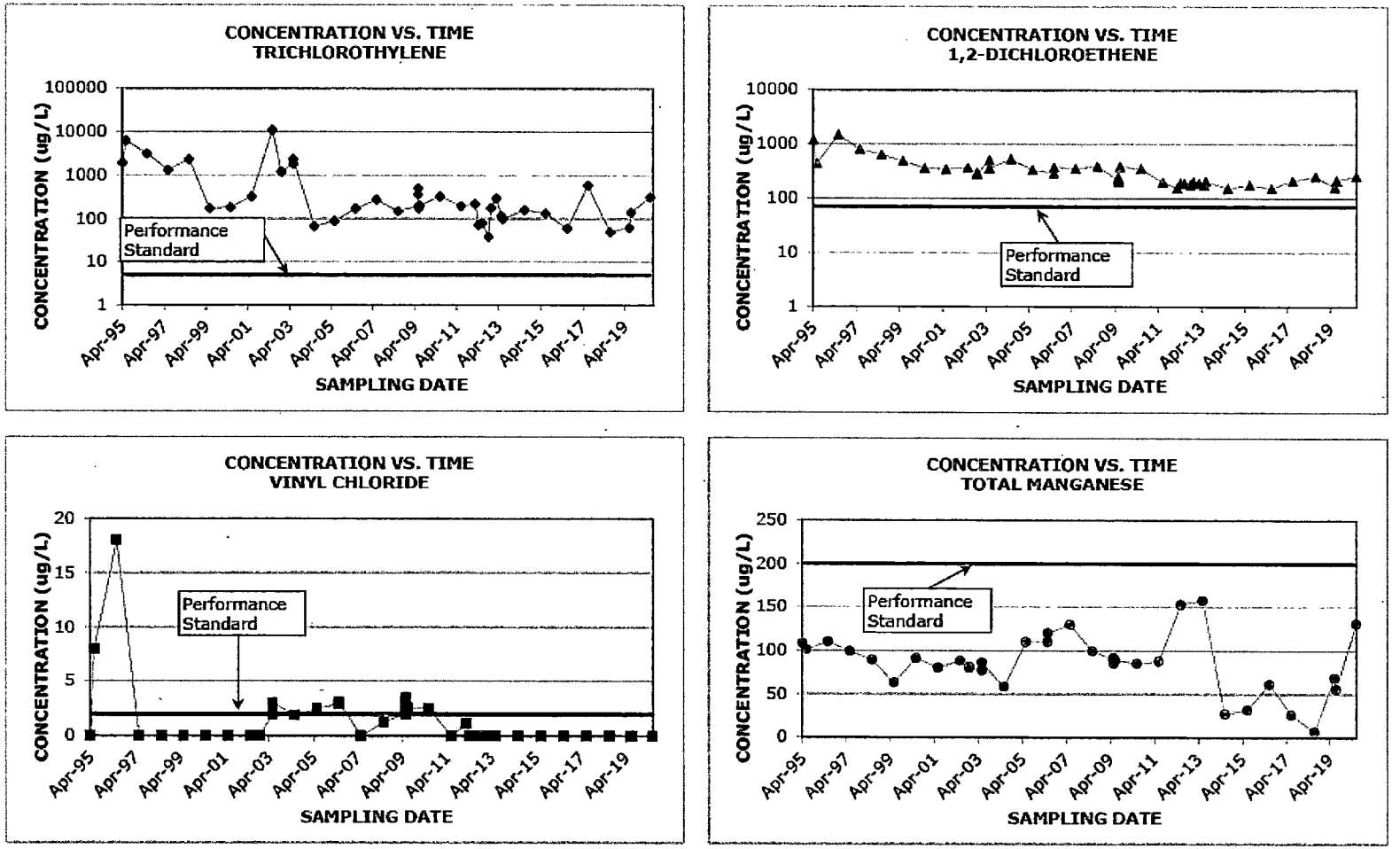


Figure 4 - COC Concentrations Trends for MW-03RK

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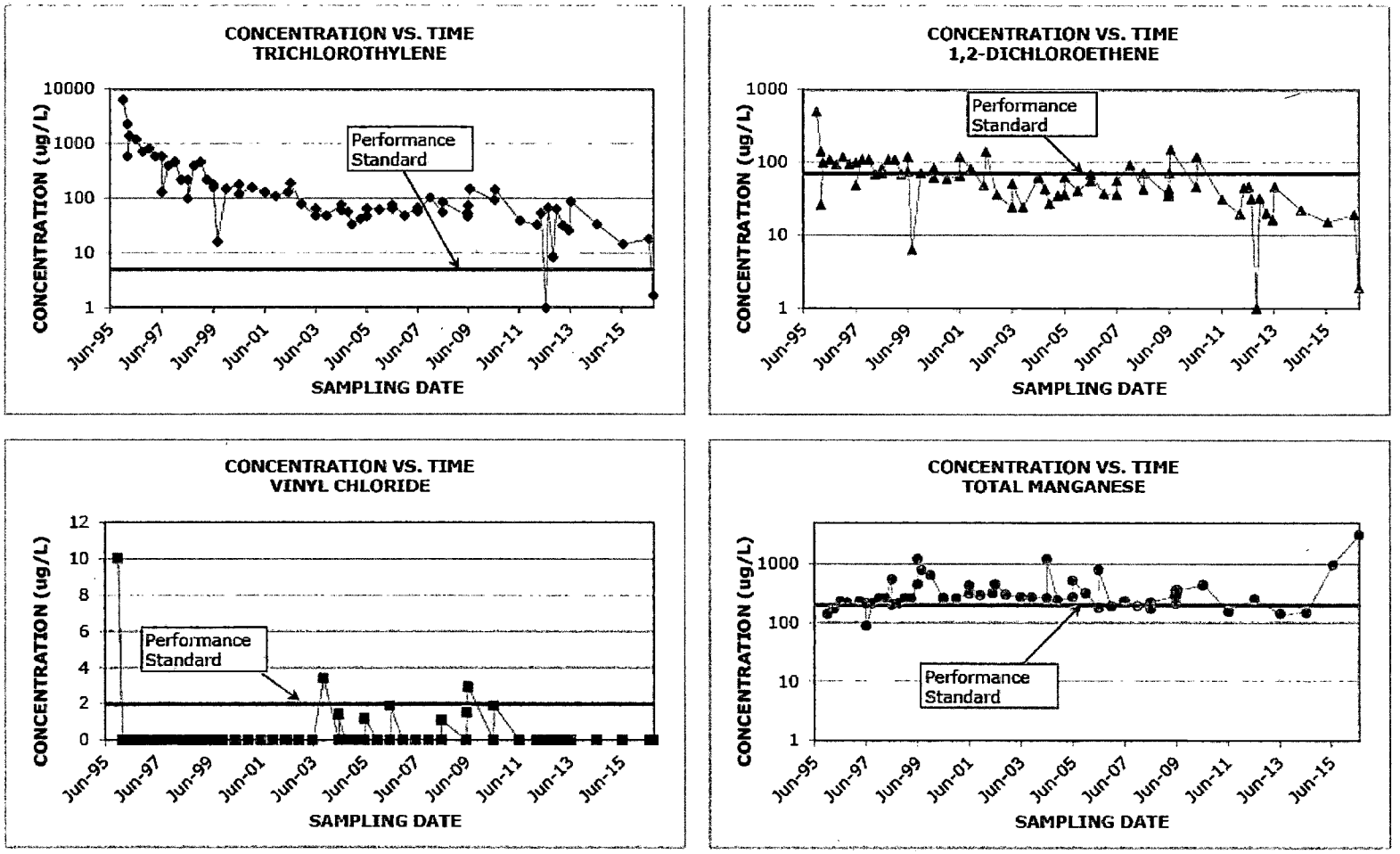
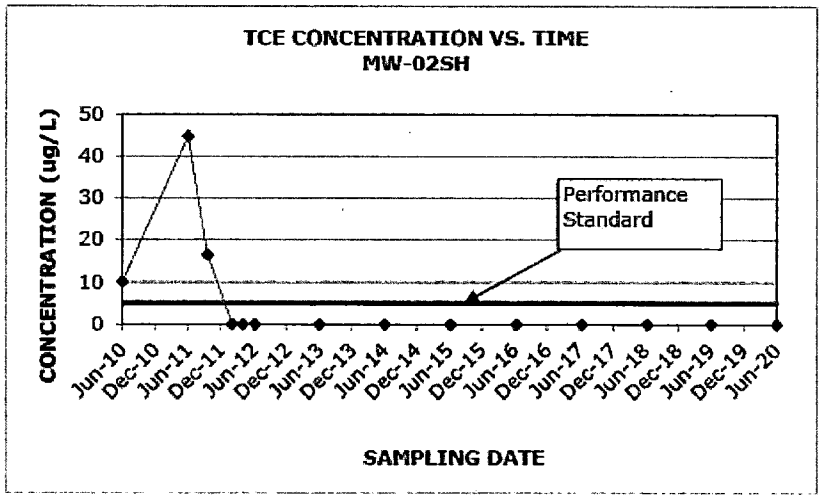
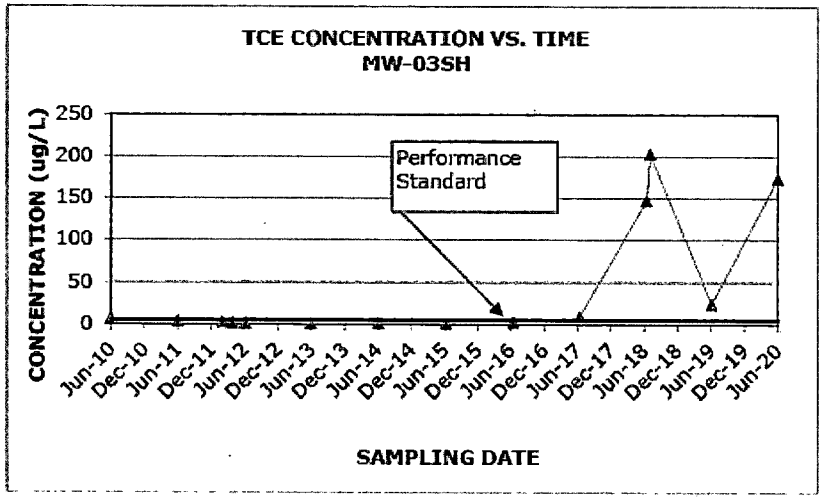
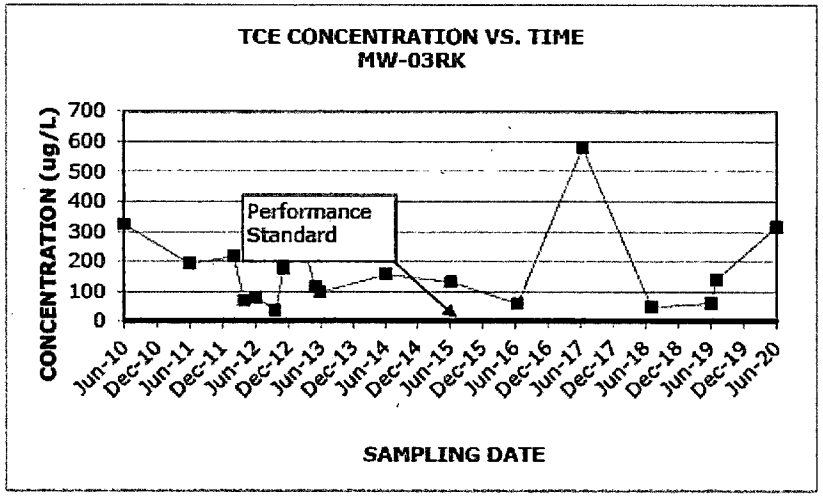


Figure 5 - COC Concentration Trends for RW-01







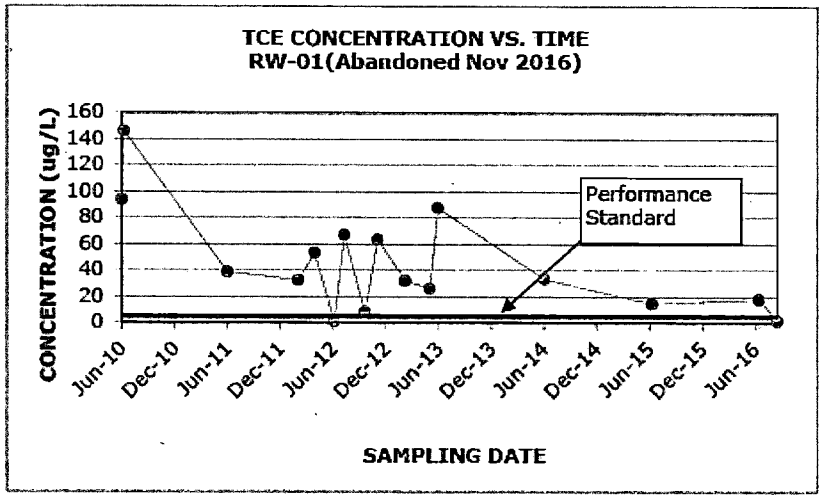


Figure 6 - TCE Concentrations from 2010 to 2020

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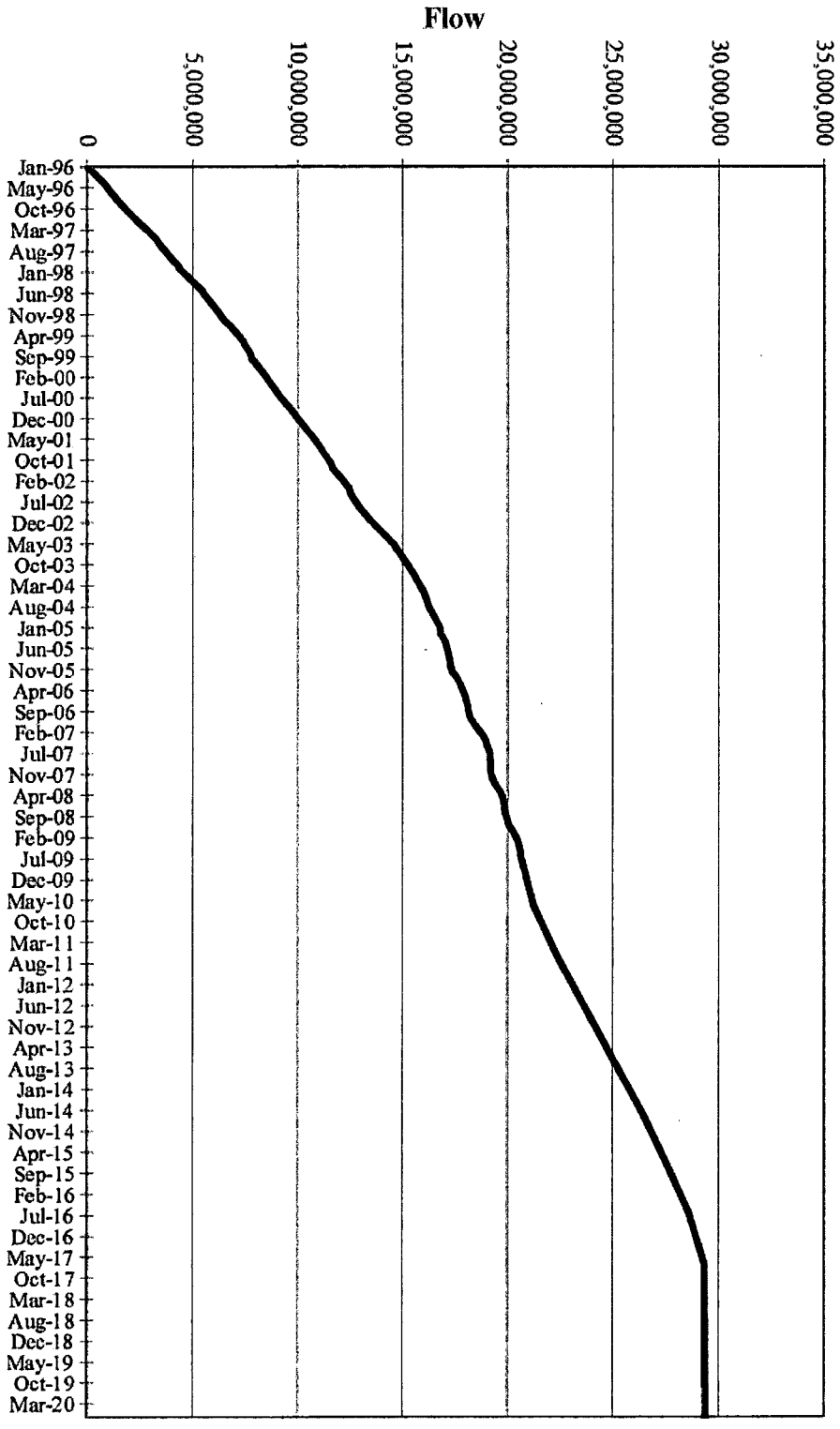


Figure 7 - Volume Recovered Since Start Up (Cumulative Flow in Gallons)

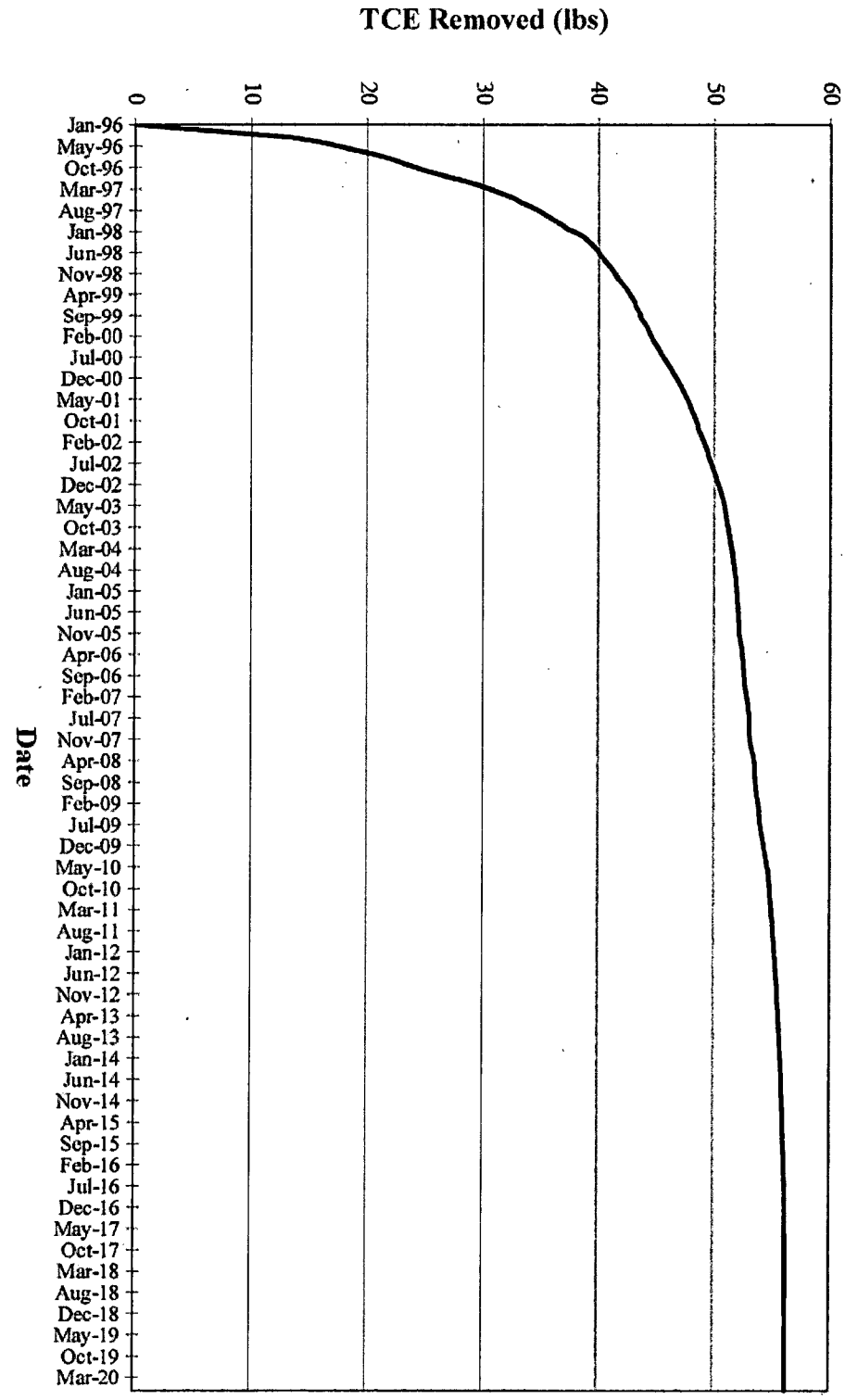


Figure 8 - Cumulative TCE Removal (Pounds Recovered Since Start Up)

APPENDIX H – CONTAMINANTS OF CONCERN IN GROUNDWATER SUMMARY

Table 11 - COCs in Groundwater Summary Table

		TCE (ug/L)	cis-1,2-DCE (ug/L)	Vinyl Chloride (ug/L)	Total Manganese (ug/L)	MTBE (ug/L)
Performance Standards		5.0 [a]	70 [a]	2.0 [a]	200 [b] / 880 [c]	Not a COC
Well	Month-Year of Sample Event					
MW-01SH	Jun-95	<1.0	<1.0	<1.0	614	ND
MW-01SH	Jun-96	<5.0	<5.0	<10.0	500	ND
MW-01SH	Jun-97	<5.0	<5.0	<10.0	1300	<5.0
MW-01SH	Jun-98 [f]	<5.0	<5.0	<10.0	483	<5.0
MW-01SH	Jun-99	<5.0	<5.0	<10.0	850	<5.0
MW-01SH	Jun-00	<5.0	<5.0	<10.0	57	<5.0
MW-01SH	Jun-01	<5.0	<5.0	<10.0	150	<5.0
MW-01SH	Jun-02	<5.0	<5.0	<10.0	120	<5.0
MW-01SH	Jun-03	<1.0	<1.0	<1.0	70	<1.0
MW-01SH	Jun-04	<1.0	<1.0	<1.0	41	<1.0
MW-01SH	Jun-05	<1.0	<1.0	<1.0	440	<1.0
MW-01SH	Jun-06	<1.0	<1.0	<1.0	260	<1.0
MW-01SH	Jun-07 [g]	<26.0	<17.0	<12.0	110	<23.0
MW-01SH	Jun-08	<1.0	<1.0	<1.0	46	<1.0
MW-01SH	Jun-09	<1.0	<1.0	<1.0	89	<1.0
MW-01SH	Jun-10	<1.0	<1.0	<1.0	100	<1.0
MW-01SH	Jun-11	<1.0	<1.0	<1.0	95	<1.0
MW-01SH	Jun-12	<1.0	<1.0	<1.0	138	<1.0
MW-01SH	Jun-13	<1.0	<1.0	<1.0	117	<1.0
MW-01SH	Jun-14	<1.0	<1.0	<1.0	110	<1.0
MW-01SH	Jun-15	<1.0	<1.0	<1.0	86	<1.0
MW-01SH	Jun-16	<1.0	<1.0	<1.0	119	<1.0
MW-01SH	Jun-17	<1.0	<1.0	<1.0	53.8	<1.0
MW-01SH	Jun-18	<1.0	<1.0	<1.0	91.9	<1.0
MW-01SH	Jun-19	<1.0	<1.0	<1.0	22.9	<1.0
MW-01SH	Jun-20	<1.0	<1.0	<1.0	41.2	<1.0
MW-01RK	Jun-95	<1.0	<1.0	<1.0	41	ND
MW-01RK	Jun-96	<5.0	<5.0	<10.0	18	ND
MW-01RK	Jun-97	<5.0	<5.0	<10.0	21	<5.0
MW-01RK	Jun-98 [f]	<5.0	<5.0	<10.0	17	<5.0
MW-01RK	Jun-99	<5.0	<5.0	<10.0	16	<5.0
MW-01RK	Jun-00	<5.0	<5.0	<10.0	17	<5.0
MW-01RK	Jun-01	<5.0	<5.0	<10.0	17	<5.0
MW-01RK	Jun-02	<5.0	<5.0	<10.0	18	<5.0
MW-01RK	Jun-03	<1.0	<1.0	<1.0	18	3.5
MW-01RK	Jun-04	<1.0	<1.0	<1.0	17	3.6
MW-01RK	Jun-05	<1.0	<1.0	<1.0	17	3.1
MW-01RK	Jun-06	<1.0	<1.0	<1.0	19	4.5
MW-01RK	Jun-07 [g]	<26.0	<17.0	<12.0	16	37J
MW-01RK	Jun-08	<1.0	<1.0	<1.0	19	4.9
MW-01RK	Jun-09	<1.0	<1.0	<1.0	17	5.4
MW-01RK	Jun-10	<1.0	<1.0	<1.0	18.6	4.1
MW-01RK	Jun-11	<1.0	<1.0	<1.0	19.2	4.6
MW-01RK	Jun-12	<1.0	<1.0	<1.0	21.7	3.1
MW-01RK	Jun-13	<1.0	<1.0	<1.0	19.1	2.8
MW-01RK	Jun-14	<1.0	<1.0	<1.0	19.4	1.7
MW-01RK	Jun-15	<1.0	<1.0	<1.0	22.6	1.2
MW-01RK	Jun-16	<1.0	<1.0	<1.0	<5.0	<1.0
MW-01RK	Jun-17	<1.0	<1.0	<1.0	9.7	<1.0
MW-01RK	Jun-18	<1.0	<1.0	<1.0	3.0J	<1.0
MW-01RK	Jun-19	<1.0	<1.0	<1.0	2.8 J	<1.0
MW-01RK	Jun-20	<1.0	<1.0	<1.0	<5.0	<1.0
MW-02SH	Apr-95	<5.0	<5.0	<10.0	684	NA
MW-02SH	Jun-95	<1.0	<1.0	<1.0	694	ND
MW-02SH	Jun-96	<5.0	<5.0	<10.0	980	ND
MW-02SH	Jun-97	<5.0	<5.0	<10.0	660	<5.0
MW-02SH	Jun-98 [f]	<5.0	<5.0	<10.0	630	<5.0
MW-02SH	Jun-99	<5.0	11	<10.0	610	<5.0
MW-02SH	Jun-00	55	110	<10.0	920	<5.0
MW-02SH	Jun-01	170	340	24	670	<5.0

Table 11 - Continued

		TCE (ug/L)	cis-1,2-DCE (ug/L)	Vinyl Chloride (ug/L)	Total Manganese (ug/L)	MTBE (ug/L)
Performance Standards		5.0 [a]	70 [a]	2.0 [a]	200 [b] / 880 [c]	Not a COC
Well	Month-Year of Sample Event					
MW-02SH	Aug-01 [s]	160	280	26	<5.0	NA
MW-02SH	Nov-01 [t]	370	120	<10	<5.0	<50
MW-02SH	May-02 [u]	170	420	22	640	<5.0
MW-02SH	Jun-02	170	460	21	640	<5.0
MW-02SH	Nov-02 [v]	42	300	<50	1000	<25
MW-02SH	Nov-02 [w]	76	287	14	950	<25
MW-02SH	Jun-03 [y,z]	100	320	16	860	<1.0
MW-02SH	Jun-03 [z]	120	390	26	1100	<1.0
MW-02SH	Jun-04 [aa]	120	260	17	640	<1.0
MW-02SH	Jun-05 [ee]	100	210	13	710	<1.0
MW-02SH	Jun-06	65	120	8.7	770	<1.0
MW-02SH	Jun-07 [ff]	66	160	9.4	600	<23
MW-02SH	Jun-08 [gg]	32	81	4.7	752	<23
MW-02SH	May-09 [hh]	20	73	5.0	740	<1.0
MW-02SH	May-09 [hh]	17	59	4.0	736	<1.0
MW-02SH	May-09 [hh]	17	60	3.9	726	<1.0
MW-02SH	Jun-09 [hh]	14	56	3.5	581	<1.0
MW-02SH	Jun-09 [hh] (D)	15	57	3.8	630	<1.0
MW-02SH	Jun-09 [hh]	17	67	4.1	657	<1.0
MW-02SH	Jun-10	10	58	3.7	767	<1.0
MW-02SH	Jun-11	44.8	163	11.2	545	<1.0
In-situ Bioremediation Pilot Test Injections August-2011						
MW-02SH	Oct-11	16.5	192	10.9	2620 (2420 dissolved)	<1.0
MW-02SH	Feb-12	<1.0	61	7	2080	<1.0
MW-02SH	Apr-12	<1.0	51	8.9	2250	<1.0
MW-02SH	Jun-12	<1.0	22	2.2	3330	<1.0
MW-02SH	Jun-13	<1.0	2.1	<1.0	3150	<1.0
MW-02SH	Jun-14	<1.0	4.4	2.3	1670	<1.0
MW-02SH	Jun-15	<1.0	8.9	3.2	1550	<1.0
MW-02SH	Jun-16	<1.0	8.6	3.4	1100	<1.0
MW-02SH	Jun-17	<1.0	50.7	14.4	1010	<1.0
MW-02SH	Jun-18	<1.0	32	7.2	960	<1.0
MW-02SH	Jun-19	<1.0	14.6	4.3	965	<1.0
MW-02SH	Jun-20	<1.0	7.3	2.3	1130	<1.0
MW-02RK	Jun-95	<1.0	<1.0	<1.0	138	ND
MW-02RK	Jun-96	<5.0	<5.0	<10.0	160	ND
MW-02RK	Jun-97	<5.0	<5.0	<10.0	140	<5.0
MW-02RK	Jun-98 [i]	<5.0	<5.0	<10.0	140	<5.0
MW-02RK	Jun-99	<5.0	<5.0	<10.0	5	<5.0
MW-02RK	Jun-00	<5.0	<5.0	<10.0	150	<5.0
MW-02RK	Jun-01	<5.0	<5.0	<10.0	140	<5.0
MW-02RK	Jun-02	<5.0	<5.0	<10.0	140	<5.0
MW-02RK	Jun-03	<1.0	<1.0	<1.0	150	<1.0
MW-02RK	Jun-04	<1.0	<1.0	<1.0	130	<1.0
MW-02RK	Jun-05	<1.0	<1.0	<1.0	140	1.4
MW-02RK	Jun-06	<1.0	<1.0	<1.0	150	2.1
MW-02RK	Jun-07 [ff]	<26.0	<17.0	<12.0	120	2.6J
MW-02RK	Jun-08	<1.0	<1.0	<1.0	132	4.3
MW-02RK	Jun-09	<1.0	<1.0	<1.0	117	4.1
MW-02RK	Jun-10	<1.0	<1.0	<1.0	126	4.1
MW-02RK	Jun-11	<1.0	<1.0	<1.0	137	5.3
MW-02RK	Jun-12	<1.0	<1.0	<1.0	130	5.2
MW-02RK	Jun-13	<1.0	<1.0	<1.0	136	5.2
MW-02RK	Jun-14	<1.0	<1.0	<1.0	153	3.8
MW-02RK	Jun-15	<1.0	<1.0	<1.0	142	2.9
MW-02RK	Jun-16	<1.0	<1.0	<1.0	11.5	1.6
MW-02RK	Jun-17	<1.0	<1.0	<1.0	50.0	<1.0
MW-02RK	Jun-18	<1.0	<1.0	<1.0	18.4	<1.0
MW-02RK	Jun-19	<1.0	<1.0	<1.0	8.1	<1.0
MW-02RK	Jun-20	<1.0	<1.0	<1.0	21.3	<1.0

Table 11 - Continued

		TCE (ug/L)	*cis*-1,2-DCE (ug/L)	Vinyl Chloride (ug/L)	Total Manganese (ug/L)	MTBE (ug/L)
Performance Standards		5.0 [a]	70 [a]	2.0 [a]	200 [b] / 880 [c]	Not a COC
Well	Month-Year of Sample Event					
MW-03SH	Jun-95	12000	540	25	340	327
Operation of RW-01 Began December 1995						
MW-03SH	Jun-96	2200	200	<10.0	10	100
MW-03SH	Jun-97	1900	160	<10.0	13	8
MW-03SH	Jun-98	350	41	<10.0	<10.0	9
MW-03SH	Jun-99	200	43	<10.0	6	16
MW-03SH	Jun-00	<5.0	13	<10.0	8	<5.0
MW-03SH	Jun-01	75	23	<10.0	98	<5.0
MW-03SH	Jun-02	130	35	<10.0	14	<5.0
MW-03SH	Nov-02 [v]	36	27	<10.0	<5.0	<5.0
MW-03SH	Nov-02 [w]	24	44	<10.0	<5.0	<5.0
MW-03SH	Jun-03	15	8	<1.0	<5.0	<1.0
MW-03SH	Jun-04	120	47	1.2	5.7	2.0
MW-03SH	Jun-05	38	23	<1.0	19	2.2
MW-03SH	Jun-06	8.9	7.6	<1.0	59	1.0
MW-03SH	Jun-07 [ff]	22	9.7	<12.0	2.1J	<2.3
MW-03SH	Jun-08	59.4	35.5	<12.0	9.4	1.5
MW-03SH	Jun-08 (D)	54.3	32.1	<12.0	<5.0	1.4
MW-03SH	May-09 [hh]	1.3	<1.0	<1.0	131	<1.0
MW-03SH	May-09 [hh]	2.7	1.6	<1.0	34	<1.0
MW-03SH	0.97J	4.2	3.0	<1.0	28.2	<1.0
MW-03SH	Jun-09 [hh]	18.4	13.9	<1.0	8.1	<1.0
MW-03SH	Jun-09 [hh]	3.2	<1.0	<1.0	365	<1.0
MW-03SH	Jun-10	6.7	3.5	<1.0	43.6	<1.0
MW-03SH	Jun-11	3.5	2.3	<1.0	7	<1.0
SVE Pilot Test Start-up August 23, 2011						
MW-03SH	Feb-12	2.4	2.0	<1.0	NA	<1.0
MW-03SH	Apr-12	2.1	2.3	<1.0	NA	<1.0
MW-03SH	Jun-12	<1.0	<1.0	<1.0	6.5	<1.0
MW-03RK Dewatering 12 Hr Cycle						
MW-03SH	Jun-13	<1.0	<1.0	<1.0	5.7	<1.0
MW-03SH	Jun-14	<1.0	<1.0	<1.0	8.3	<1.0
MW-03SH	Jun-15	<1.0	<1.0	<1.0	16.3	<1.0
MW-03SH	Jun-16	2.3	1.7	<1.0	25.6	<1.0
SVE Pilot Test Terminated / MW-03RK 24 Hr Operation Begin						
MW-03SH	Jun-17	8.6	3.7	<1.0	274	<1.0
MW-03SH	Jun-18	147	192	1.4	406	<1.0
MW-03SH	Jul-18	203	207	1.8J	207	<1.0
MW-03SH	Jun-19	24	81.1	<1.0	457	<1.0
MW-03SH	Jun-20	173	52	<1.0	475	<1.0
MW-03RK	Apr-95	1900	1200	<110	106	NA
MW-03RK	Jun-95	6200	440	8	101	95
Operation of RW-01 Began December 1995						
MW-03RK	Jun-96	3100	1500	16	110	280
MW-03RK	Jun-97	1300	800	<10.0	99	160
MW-03RK	Jun-98	2300	640	<10.0	89	62
MW-03RK	Jun-99	170	490	<10.0	63	<5.0
MW-03RK	Jun-00	160	360	<10.0	91	18
MW-03RK	Jun-01	320	345	<10.0	80	31
MW-03RK	Jun-02	11000	370	<10.0	88	41
MW-03RK	Nov-02 [v]	1200	300	<50	81	30
MW-03RK	Nov-02 [w]	1180	278	<10.0	80	38
MW-03RK	Jun-03 [gg]	1800	510	2	77	26
MW-03RK	Jun-03 [gg]	2330	360	3	86	27
MW-03RK	Jun-04	66	530	1.9	58	19
MW-03RK	Jun-05 [ee]	87	340	2.5	110	16

Table 11 - Continued

		TCE (ug/L)	cis-1,2-DCE (ug/L)	Vinyl Chloride (ug/L)	Total Manganese (ug/L)	MTBE (ug/L)
Performance Standards		5.0 [a]	70 [a]	2.0 [a]	200 [b] / 880 [c]	Not a COC
Well	Month-Year of Sample Event					
MW-03RK	Jun-06	170	290	2.9	110	16
MW-03RK	Jun-06 (D)	170	300	3.1	120	16
MW-03RK	Jun-07 [ff]	270	360	2.0J	130	16
MW-03RK	Jun-08 [gg]	147	390	1.3	99.5	13.2
MW-03RK	May-09 [hh]	191	219	2	89.8	8.9
MW-03RK	May-09 [ii]	355	226	2.8	88.6	9.2
MW-03RK	May-09 [jj]	492	246	3.5	91.1	10.3
MW-03RK	Jun-09 [kk]	173	204	2.1	85.4	12.7
MW-03RK	Jun-09 [ll]	199	306	2.6	88.8	12.8
MW-03RK	Jun-10	324	358	2.5	85.3	9.4
MW-03RK	Jun-11	192	199	<2.0	87.5	10.9
SVE Pilot Test Start-up August 23, 2011						
MW-03RK	Feb-12	217	156	1.1	NA	10.1
MW-03RK	Apr-12	70	193	<1.0	NA	9.9
MW-03RK	Jun-12	79	169	<1.0	153.0	8.7
MW-03RK Dewatering 12 Hr Cycle						
MW-03RK	Oct-12	38	161	<1.0	NA	4.2
MW-03RK	Nov-12	174	203	<1.0	NA	6.1
MW-03RK	Feb-13	295	193	<1.0	NA	9
MW-03RK	May-13	115	177	<2.0	NA	8.4
MW-03RK	Jun-13	96.9	209	<1.0	158	8.4
MW-03RK	Sep-13	76.8	184	<1.0	NA	6.4
MW-03RK	Dec-14	68.1	99	<1.0	NA	2.4
MW-03RK	Mar-14	468	270	<1.0	NA	6.3
MW-03RK	Jun-14	157	153	<1.0	27.1	1.8
MW-03RK	Jun-15	132	177	<1.0	31.8	2.3
MW-03RK	Jun-16	59	154	<1.0	61.4	2.7
SVE Pilot Test Terminated / MW-03RK 24 Hr Operation Begin						
MW-03RK	Jun-17	579	211	<1.0	26.1	3.3J
MW-03RK	Jun-18	0.97J	<1.0	<1.0	26.2	<1.0
MW-03RK	Jul-18	49.4	256	<1.0	6.8	3.0
MW-03RK	Jun-19	62	161	<1.0	68.3	3.5
MW-03RK	Jul-19	140	216	<1.0	55.8	2.0
MW-03RK	Jun-20	316	258	<1.0	131.0	2.7
MW-04SH	Apr-95	24	<5.0	<10.0	3650	NA
MW-04SH	Jun-95	26	1	<1.0	4200	15
MW-04SH	Jun-96 [e]	68	6	<10.0	NA	27
MW-04SH	Jun-96 (D)	51	<5.0	<10.0	3500	21
MW-04SH	Jun-96 (D)	50	<5.0	<10.0	3500	22
MW-04SH	Jun-97 [bl]	68	6	<10.0	NA	34
MW-04SH	Jun-97 (D)	51	<5.0	<10.0	2900	27
MW-04SH	Jun-97 (D)	48	<5.0	<10.0	3000	24
MW-04SH	Jun-98 [m,n]	32	<5.0	<10.0	2500	26
MW-04SH	Jun-98 (D) [n]	30	<5.0	<10.0	2400	22
MW-04SH	Jun-98 (D) [n]	31	<5.0	<10.0	2400	20
MW-04SH	Jun-99 [o]	14	<5.0	<10.0	2500	NA
MW-04SH	Jun-99 [p]	15	<5.0	<10.0	2500	21
MW-04SH	Jun-99 (D) [p]	15	<5.0	<10.0	NA	20
MW-04SH	Jun-00 [q]	<5.0	<5.0	<10.0	2100	16
MW-04SH	Jun-00	<5.0	<5.0	<10.0	2607	13
MW-04SH	Jun-00 (D)	<5.0	<5.0	<10.0	NA	NA
MW-04SH	Jun-01 [r]	<5.0	<5.0	<10.0	4700	<5.0
MW-04SH	Jun-01	<5.0	<5.0	<10.0	4300	5.4
MW-04SH	Jun-01 (D)	<5.0	<5.0	<10.0	4200	5.7
MW-04SH	Ma-02 [u]	<5.0	<5.0	<10.0	2400	<5.0
MW-04SH	Jun-02	<5.0	<5.0	<10.0	2600	9.3
MW-04SH	Jun-02 (D)	<5.0	<5.0	<10.0	2500	12
MW-04SH	Jun-03 [v]	<1.0	<1.0	<1.0	3200	2.6
MW-04SH	Jun-03	<1.0	<1.0	<1.0	3200	3.1
MW-04SH	Jun-03 (D)	<1.0	<1.0	<1.0	3100	3

Table 11 - Continued

		TCE (ug/L)	cis-1,2-DCE (ug/L)	Vinyl Chloride (ug/L)	Total Manganese (ug/L)	MTBE (ug/L)
Performance Standards		5.0 [a]	70 [a]	2.0 [a]	200 [b] / 880 [c]	Not a COC
Well	Month-Year of Sample Event					
MW-04SH	Jun-04 [bb]	<5.0	<5.0	<5.0	2200	5.1
MW-04SH	Jun-04	0.61 J	<1.0	<1.0	2300	4
MW-04SH	Jun-04 (D)	<1.0	<1.0	<1.0	2200	4
MW-04SH	Jun-05 [cc]	<1.0	<1.0	<1.0	660	1.8
MW-04SH	Jun-05	<1.0	<1.0	<1.0	2000	2.5
MW-04SH	Jun-05 (D)	<1.0	<1.0	<1.0	2000	2.5
MW-04SH	Jun-06	<1.0	<1.0	<1.0	1800	5.6
MW-04SH	Jun-06	<1.0	<1.0	<1.0	1900	5.8
MW-04SH	Jun-07 [ff]	<26.0	<17.0	<12.0	1500	7.3
MW-04SH	Jun-08	1.4	<1.0	<1.0	1530	12.3
MW-04SH	Jun-08 (D)	<1.0	<1.0	<1.0	NA	NA
MW-04SH	Jun-09	<1.0	<1.0	<1.0	1320	12.7
MW-04SH	Jun-10	<1.0	<1.0	<1.0	1340	12.6
MW-04SH	Jun-11	<1.0	<1.0	<1.0	1880	9.8
MW-04SH	Oct-11	NA	NA	NA	2270 (2120 Dissolved)	NA
MW-04SH	Jun-12	<1.0	<1.0	<1.0	1860	7.6
MW-04SH	Jun-13	<1.0	<1.0	<1.0	1980	2.8
MW-04SH	Jun-14	<1.0	<1.0	<1.0	1400	1.7
MW-04SH	Jun-15	<1.0	<1.0	<1.0	1340	<1.0
MW-04SH	Jun-16	<1.0	<1.0	<1.0	6950	2.0
MW-04SH	Jun-17	<1.0	<1.0	<1.0	3260	0.51J
MW-04SH	Jun-18	<1.0	<1.0	<1.0	6690	4.5
MW-04SH	Jun-19	<1.0	<1.0	<1.0	2620	3.7
MW-04SH	Jun-20	<1.0	<1.0	<1.0	4550	3.8
MW-04RK	Jun-96 [s]	<5.0	<5.0	<10.0	NA	ND
MW-04RK	Jun-96	<5.0	<5.0	<10.0	37	ND
MW-04RK	Jun-97	<5.0	<5.0	<10.0	28	<5.0
MW-04RK	Jun-98	<5.0	<5.0	<10.0	35	<5.0
MW-04RK	Jun-99	<5.0	<5.0	<10.0	39	<5.0
MW-04RK	Jun-00	<5.0	<5.0	<10.0	43	<5.0
MW-04RK	Jun-01	<5.0	<5.0	<10.0	36	5.5
MW-04RK	Jun-02	<5.0	<5.0	<10.0	34	<5.0
MW-04RK	Jun-03	<1.0	<1.0	<1.0	37	9.6
MW-04RK	Jun-04	<1.0	<1.0	<1.0	29	2.0
MW-04RK	Jun-05	<1.0	<1.0	<1.0	26	<1.0
MW-04RK	Jun-06	<1.0	<1.0	<1.0	24	<1.0
MW-04RK	Jun-07 [ff]	<26.0	<17.0	<12.0	22	<12.0
MW-04RK	Jun-08	1.3	<1.0	<1.0	20.8	<1.0
MW-04RK	Jun-08 (D)	<1.0	<1.0	<1.0	NA	NA
MW-04RK	Jun-09	<1.0	<1.0	<1.0	17.8	<1.0
MW-04RK	Jun-10	<1.0	<1.0	<1.0	17.8	<1.0
MW-04RK	Jun-11	<1.0	<1.0	<1.0	22.6	<1.0
MW-04RK	Jun-12	<1.0	<1.0	<1.0	19.9	<1.0
MW-04RK	Jun-13	<1.0	<1.0	<1.0	23.3	<1.0
MW-04RK	Jun-14	<1.0	<1.0	<1.0	20.7	<1.0
MW-04RK	Jun-15	<1.0	<1.0	<1.0	18.4	1.8
MW-04RK	Jun-16	<1.0	<1.0	<1.0	7.3	<1.0
MW-04RK	Jun-17	<1.0	<1.0	<1.0	4.2J	<1.0
MW-04RK	Jun-18	<1.0	<1.0	<1.0	<5.0	<1.0
MW-04RK	Jun-19	<1.0	<1.0	<1.0	<5.0	<1.0
MW-04RK	Jun-20	<1.0	<1.0	<1.0	4.6J	<1.0
MW-05SH	Jun-96	<5.0	<5.0	<10.0	39	ND
MW-05SH	Jun-97	<5.0	<5.0	<10.0	53	<5.0
MW-05SH	Jun-98	<5.0	<5.0	<10.0	49	<5.0
MW-05SH	Jun-99	<5.0	<5.0	<10.0	55	<5.0
(Abandoned 08/26/99)						
MW-05RK	Jun-96	<1.0	<1.0	<1.0	38	ND
MW-05RK	Jun-96	<5.0	<5.0	<10.0	41	ND

Table 11 - Continued

		TCE (ug/L)	cis-1,2-DCE (ug/L)	Vinyl Chloride (ug/L)	Total Manganese (ug/L)	MTBE (ug/L)
Performance Standards		5.0 [a]	70 [a]	2.0 [a]	200 [b] / 880 [c]	Not a COC
Well	Month-Year of Sample Event					
MW-05RK	Jun-97	<5.0	<5.0	<10.0	27	<5.0
MW-05RK	Jun-98	<5.0	<5.0	<10.0	22	<5.0
MW-05RK	Jun-99	<5.0	<5.0	<10.0	20	<5.0
MW-06SH	May-95	<5.0	<5.0	<10.0	1220	NA
MW-06SH	Jun-95	<1.0	<1.0	<1.0	1540	ND
MW-06SH	Jun-96	<5.0	<5.0	<10.0	1500	ND
MW-06SH	Jun-97	<5.0	<5.0	<10.0	1100	<5.0
MW-06SH	Jun-98	<5.0	<5.0	<10.0	910	<5.0
MW-06SH	Jun-99	<5.0	<5.0	<10.0	560	<5.0
MW-06SH	Jun-00	<5.0	<5.0	<10.0	890	<5.0
MW-06SH	Jun-01	<5.0	<5.0	<10.0	770	<5.0
MW-06SH	Jun-02	<5.0	<5.0	<10.0	690	<5.0
MW-06SH	Jun-03	<1.0	<1.0	<1.0	1600	2
MW-06SH	Jun-04	<1.0	<1.0	<1.0	800	3.2
MW-06SH	Jun-05	<1.0	<1.0	<1.0	2800	4.3
MW-06SH	Jun-06	<1.0	<1.0	<1.0	400	3.9
MW-06SH	Jun-07 #	<26.0	<17.0	<12.0	460	4.1J
MW-06SH	Jun-08	<1.0	<1.0	<1.0	426	5.9
MW-06SH	Jun-09	<1.0	<1.0	<1.0	551	7.8
MW-06SH	Jun-10	<1.0	<1.0	<1.0	379	8.4
MW-06SH	Jun-11	<1.0	<1.0	<1.0	463	8
MW-06SH	Oct-11	NA	NA	NA	938 (660 dissolved)	NA
MW-06SH	Jun-12	<1.0	<1.0	<1.0	451	9.4
MW-06SH	Jun-13	<1.0	<1.0	<1.0	540	9.7
MW-06SH	Jun-14	<1.0	<1.0	<1.0	413	9.2
MW-06SH	Jun-15	<1.0	<1.0	<1.0	459	9.4
MW-06SH	Jun-16	<1.0	<1.0	<1.0	734	6.2
MW-06SH	Jun-17	<1.0	<1.0	<1.0	1170	3.2
MW-06SH	Jun-18	<1.0	<1.0	<1.0	1360	4.8
MW-06SH	Jun-19	<1.0	<1.0	<1.0	995	3.1
MW-06SH	Jun-20	<1.0	<1.0	<1.0	1700	2.9
MW-06RK	Jun-95	2	<1.0	<1.0	216	445
MW-06RK	Jun-96	<5.0	<5.0	<10.0	150	10
MW-06RK	Jun-97	<5.0	<5.0	<10.0	<10.0	290
MW-06RK	Jun-98	<5.0	<5.0	<10.0	140	290
MW-06RK	Jun-99	<5.0	<5.0	<10.0	6	150
MW-06RK	Jun-00	<5.0	<5.0	<10.0	170	110
MW-06RK	Jun-01	<5.0	<5.0	<10.0	160	97
MW-06RK	Jun-02	<5.0	<5.0	<10.0	150	41
MW-06RK	Jun-03	<1.0	<1.0	<1.0	150	38
MW-06RK	Jun-04	<1.0	<1.0	<1.0	140	21
MW-06RK	Jun-05	<1.0	<1.0	<1.0	150	26
MW-06RK	Jun-06	<1.0	<1.0	<1.0	160	24
MW-06RK	Jun-07 #	<26.0	<17.0	<12.0	94	21
MW-06RK	Jun-08	<1.0	<1.0	<1.0	97.6	23.7
MW-06RK	Jun-09	<1.0	<1.0	<1.0	102	21.8
MW-06RK	Jun-10	<1.0	<1.0	<1.0	126	21.4
MW-06RK	Jun-11	<1.0	<1.0	<1.0	134	18.8
MW-06RK	Jun-12	<1.0	<1.0	<1.0	122	16.4
MW-06RK	Jun-13	<1.0	<1.0	<1.0	80.5	11.6
MW-06RK	Jun-14	<1.0	<1.0	<1.0	117	7.6
MW-06RK	Jun-15	<1.0	<1.0	<1.0	103	4.0
MW-06RK	Jun-16	<1.0	<1.0	<1.0	8.7	<1.0
MW-06RK	Jun-17	<1.0	<1.0	<1.0	60.1	<1.0
MW-06RK	Jun-18	<1.0	<1.0	<1.0	20.1	<1.0

Table 11 - Continued

		TCE (ug/L)	cis-1,2-DCE (ug/L)	Vinyl Chloride (ug/L)	Total Manganese (ug/L)	MTBE (ug/L)
Performance Standards		5.0 [a]	70 [a]	2.0 [a]	200 [b] / 880[c]	Not a COC
Well	Month-Year of Sample Event					
MW-06RK	Jun-19	<1.0	<1.0	<1.0	9.7	<1.0
MW-06RK	Jun-20	<1.0	<1.0	<1.0	25.6	<1.0
MW-07SH	Jun-96	<5.0	<5.0	<10.0	120	ND
MW-07SH	Jun-97	<5.0	<5.0	<10.0	25	<5.0
MW-07SH	Jun-98	<5.0	<5.0	<10.0	37	<5.0
MW-07SH	Jun-99	<5.0	<5.0	<10.0	14	<5.0
(Abandoned 08/26/99)						
MW-07RK	Jan-93	<10.0	<10.0	<10.0	NA	NA
MW-07RK	Jun-95	<1.0	<1.0	<1.0	14	ND
MW-07RK	Jun-96	<5.0	<5.0	<10.0	<10.0	ND
MW-07RK	Jun-97	<5.0	<5.0	<10.0	<10.0	<5.0
MW-07RK	Jun-98	<5.0	<5.0	<10.0	17	<5.0
MW-07RK	Jun-99	<5.0	<5.0	<10.0	19	<5.0
(Abandoned 08/26/99)						
MW-08SH	May-95	<5.0	<5.0	<10.0	160	NA
MW-08SH	Jun-96	<5.0	<5.0	<10.0	89	>260
MW-08SH	Jun-97	<5.0	<5.0	<10.0	60	240
MW-08SH	Jun-98	<5.0	<5.0	<10.0	57	210
MW-08SH	Jun-99	<5.0	<5.0	<10.0	44	150
MW-08SH	Jun-00	<5.0	<5.0	<10.0	77	130
MW-08SH	Jun-01	<5.0	<5.0	<10.0	62	97
MW-08SH	Jun-02	<5.0	<5.0	<10.0	51	57
MW-08SH	Jun-03	<1.0	<1.0	<1.0	120	61
MW-08SH	Jun-04	<1.0	<1.0	<1.0	52	32
MW-08SH	Jun-05	<1.0	<1.0	<1.0	120	<1.0
MW-08SH	Jun-06	<1.0	<1.0	<1.0	240	17
MW-08SH	Jun-07 [#]	<26.0	<17.0	<12.0	84	24
MW-08SH	Jun-08	<1.0	<1.0	<1.0	173	28.9
MW-08SH	Jun-09	<1.0	<1.0	<1.0	98.1	32.0
MW-08SH	Jun-10	<1.0	<1.0	<1.0	81.8	32.7
MW-08SH	Jun-11	<1.0	<1.0	<1.0	78.9	30.0
MW-08SH	Jun-12	<1.0	<1.0	<1.0	109.0	29.0
MW-08SH	Jun-13	<1.0	<1.0	<1.0	147	26.3
MW-08SH	Jun-14	<1.0	<1.0	<1.0	113	15.0
MW-08SH	Jun-15	<1.0	<1.0	<1.0	91	7.0
MW-08SH	Jun-16	<1.0	<1.0	<1.0	102	5.2
MW-08SH	Jun-17	<1.0	<1.0	<1.0	115.0	2.6
MW-08SH	Jun-18	<1.0	<1.0	<1.0	119.0	4.8
MW-08SH	Jun-19	<1.0	<1.0	<1.0	93.8	3.1
MW-08SH	Jun-20	<1.0	<1.0	<1.0	130.0	3.2
MW-08RK	Jun-96	<5.0	<5.0	<10.0	47	610
MW-08RK	Jun-97	<5.0	<5.0	<10.0	62	640
MW-08RK	Jun-98	<5.0	<5.0	<10.0	32	340
MW-08RK	Jun-99	<5.0	<5.0	<10.0	38	260
MW-08RK	Jun-00	<5.0	<5.0	<10.0	38	160
MW-08RK	Jun-01	<5.0	<5.0	<10.0	55	120
MW-08RK	Jun-02	<5.0	<5.0	<10.0	50	61
MW-08RK	Jun-03	<1.0	<1.0	<1.0	74	73
MW-08RK	Jun-04	<1.0	<1.0	<1.0	30	42
MW-08RK	Jun-05	<1.0	<1.0	<1.0	48	40
MW-08RK	Jun-06	<1.0	<1.0	<1.0	58	33
MW-08RK	Jun-07 [#]	<26.0	<17.0	<12.0	20	41
MW-08RK	Jun-08 [##]	<1.0	<1.0	<1.0	23	39
MW-08RK	Jun-09	<1.0	<1.0	<1.0	28.9	46

Table 11 - Continued

		TCE (ug/L)	*cis*-1,2-DCE (ug/L)	Vinyl Chloride (ug/L)	Total Manganese (ug/L)	MTBE (ug/L)
Performance Standards		5.0 [a]	70 [a]	2.0 [a]	200 [b] / 880 [c]	Not a COC
Well	Month-Year of Sample Event					
MW-08RK	Jun-10	<1.0	<1.0	<1.0	25.3	40
MW-08RK	Jun-11	<1.0	<1.0	<1.0	23.0	33.4
MW-08RK	Jun-12	<1.0	<1.0	<1.0	28.3	29.1
MW-08RK	Jun-13	<1.0	<1.0	<1.0	60.5	35.4
MW-08RK	Jun-14	<1.0	<1.0	<1.0	28.1	13.3
MW-08RK	Jun-15	<1.0	<1.0	<1.0	20.1	9.7
MW-08RK	Jun-16	<1.0	<1.0	<1.0	26.1	6.7
MW-08RK	Jun-17	<1.0	<1.0	<1.0	61.6	3.2
MW-08RK	Jun-18	<1.0	0.19J	<1.0	49.1	5.2
MW-08RK	Jun-19	<1.0	<1.0	<1.0	22.1	3.8
MW-08RK	Jun-20	<1.0	<1.0	<1.0	55.4	3.0
MW-09SH	Oct-11	NA	NA	NA	951 (952 dissolved)	NA
MW-09SH	Feb-12	<1.0	<1.0	<1.0	1600	<1.0
MW-09SH	Apr-12	<1.0	<1.0	<1.0	1510	<1.0
MW-09SH	Jun-12	<1.0	<1.0	<1.0	937	<1.0
MW-09SH	Jun-13	<1.0	<1.0	<1.0	348	<1.0
MW-09SH	Jun-14	<1.0	<1.0	<1.0	2040	<1.0
MW-09SH	Jun-15	<1.0	<1.0	<1.0	747	<1.0
MW-09SH	Jun-16	<1.0	<1.0	<1.0	3560	<1.0
MW-09SH	Jun-17	<1.0	<1.0	<1.0	3240	<1.0
MW-09SH	Jun-18	<1.0	0.3J	<1.0	4130	<1.0
MW-09SH	Jun-19	<1.0	<1.0	<1.0	1570	<1.0
MW-09SH	Jun-20	<1.0	0.45J	<1.0	4790	0.68J
PZ-1	Apr-12	<1.0	<1.0	<1.0	NA	2.7
PZ-2	Apr-12	<1.0	<1.0	<1.0	NA	<1.0
PZ-3	Apr-12	<1.0	<1.0	<1.0	NA	1.6
RW-01	Dec-95 [d,e]	6400	500	10.0	140	NA
RW-01	Feb-96 [e]	2300	142	<10.0	NA	NA
RW-01	Feb-96 [a]	590	26	<10.0	NA	NA
RW-01	Mar-96 [a]	1400	99	<10.0	170	NA
RW-01	Jun-96 [a]	1200	110	<10.0	230	360
RW-01	Sep-96 [a]	720	93	<10.0	220	290
RW-01	Dec-96 [a]	820	120	<10.0	NA	310
RW-01	Mar-97 [a]	590	95	<10.0	230	250
RW-01	Jun-97 [a]	590	100	<10.0	210	280
RW-01	Jun-97 [c]	130	48	<10.0	88	47
RW-01	Sep-97 [a]	400	110	<10.0	210	170
RW-01	Dec-97 [a]	470	110	<10.0	260	130
RW-01	Mar-98 [a]	220	69	<10.0	260	160
RW-01	Jun-98 [a]	220	82	<5.0	550	120
RW-01	Jun-98 [c]	100	71	<10.0	200	150
RW-01	Sep-98 [a]	400	110	<10.0	210	170
RW-01	Dec-98 [a]	470	110	<10.0	260	130
RW-01	Mar-99 [a]	220	69	<10.0	260	160
RW-01	Jun-99 [a]	160	75	<5.0	450	NA
RW-01	Jun-99 [c]	160	120	<10.0	1200	72
RW-01	Aug-99 [a]	16	6	<10.0	760	<5.0
RW-01	Dec-99 [a]	150	71	<10.0	640	74
RW-01	Jun-00 [a]	160	62	<10.0	260	61
RW-01	Jun-00 [c]	120	83	<10.0	260	39
RW-01	Dec-00 [a]	159	59	<10.0	260	44
RW-01	Jun-01 [a]	130	65	<10.0	310	52
RW-01	Jun-01 [c]	130	120	<10.0	430	36
RW-01	Nov-01 [a]	110	82	<10.0	290	<50
RW-01	May-02 [a]	130	48	<10.0	320	19
RW-01	Jun-02 [c]	190	140	<10.0	450	<5.0
RW-01	Nov-02 [a,x]	79	36	<10.0	300	17
RW-01	Jun-03 [a]	48	24	<1.0	270	10.0
RW-01	Jun-03 [c]	64	51	<1.0	270	9.6

Table 11 - Continued

		TCE (ug/L)	cis-1,2-DCE (ug/L)	Vinyl Chloride (ug/L)	Total Manganese (ug/L)	MTBE (ug/L)
Performance Standards		**5.0 [a]**	**70 [a]**	**2.0 [a]**	**200 [b] / 880[c]**	**Not a COC**
Well	**Month-Year of Sample Event**					
RW-01	Nov-03 [a]	48	24	3.4	270	10.0
RW-01	Jun-04 [a]	76	62	<5.0	260	15
RW-01	Jun-04 [k]	61	63	1.4	1200	10.0
RW-01	Sep-04 [a]	57	43	<5.0	NA	11
RW-01	Nov-04 [a]	33	27	<1.0	240	6.9
RW-01	Mar-05 [a]	42	35	<1.0	NA	14
RW-01	Jun-05 [a]	47	36	<1.0	270	14
RW-01	Jun-05 [k]	64	63	1.2	520	16
RW-01	Dec-05 [a]	62	41	<5.0	320	16
RW-01	Jun-06	65	55	<1.0	180	15
RW-01	Jun-06 [k]	77	69	1.9	790	15
RW-01	Dec-06 [a]	48	37	<5.0	190	14
RW-01	Jun-07 [a]	67	36	<1.0	230	15
RW-01	Jun-07 [k,#]	58	56	1.30	230	13
RW-01	Dec-07 [a]	104	92	<1.0	192	14.9
RW-01	Jun-08 [a]	56.1	42.7	<1.0	173	6.2
RW-01	Jun-08 [k]	85.2	72.7	1.1	222	9.9
RW-01	May-09 [hh]	47	34.7	<1.0	286	8.8
RW-01	May-09 [hh]	52.4	37.6	<1.0	352	8.7
RW-01	May-09 [hh]	54.7	42.7	<1.0	209	6.4
RW-01	Jun-09 [hh]	73.3	71.9	1.5	294	8.6
RW-01	Jun-09 [hh]	151	151	2.9	360	7.0
RW-01	Jun-10 [a]	93.7	46.3	<1.0	430	9.3
RW-01	Jun-10 [k]	146	120	1.9	445	6.1
RW-01	Jun-11 [k]	38.8	31	<1.0	155	4.9
SVE Pilot Test Start-up August 23, 2011						
RW-01	Feb-12	32.7	20	<1.0	NA	4.3
RW-01	Apr-12	53.4	45.2	<1.0	NA	5.0
SVE Blower Turned Off One Week Before June Sampling and Remained Off Until August 2012						
RW-01	Jun-12	<1.0	47	<1.0	253	4.1
RW-01	Jul-12	67.2	31	<1.0	NA	5.8
RW-01	Oct-12	8.4	<1.0	<1.0	NA	<1.0
RW-01	Nov-12	63.5	32	<1.0	NA	4.9
RW-01	Feb-13	32.2	20	<1.0	NA	4.5
RW-01	May-13	26.1	16.3	<1.0	NA	4.1
RW-01	Jun-13	87.7	46.5	<1.0	142	3.9
RW-01	Sep-13	9.6	8.0	<1.0	NA	2.9
RW-01	Dec-14	1.8	1.4	<1.0	NA	<1.0
RW-01	Mar-14	20.4	13.7	<1.0	NA	2.6
RW-01	Jun-14	33.5	22.2	<1.0	146	2.9
RW-01	Jun-15	14.6	15.1	<1.0	968	2.1
RW-01	Jun-16	18.2	19.2	<1.0	3110	1.4
RW-01	Aug-16	1.7	1.9	<1.0	NA	<1.0
Abandoned (Nov -16)						

Notes on Analytical Data

[a] Performance standard based on Maximum Contaminant Level (MCL).
[b] The average background concentration of MW-01SH and MW-01RK from both Phase II and Phase III investigations was 185.5 µg/L. This value was rounded to 200 µg/L for the remediation level.
[c] Current, May 2010, EPA screening level for tap water.
[d] As stated in the Performance Standards Verification Plan, RW-01 was sampled after about 21½ hours of operation.
[e] Results of analyses for the Rock Hill Sewer Authority. Samples were collected on discharge of pump at sample port inside the well housing. Samples were collected during operation of the recovery system. The system was not shut off to stabilize before sampling.
[f] Not a site COC. Source determined to be gasoline station across Cherry Road. There is no action level associated with the Superfund site.
[g] Sample collected on June 10, 1996 with pump operating. Other June 1996 samples collected June 19 and June 20, 1996 after pump was off for 4 or 5 days.
[h] Sample collected on June 9, 1997 with pump operating. Other June 1997 samples collected June 17 and June 18, 1997 after pump was off for 8 or 9 days.
[i] Sample reported with 0.011 mg/L 1,2-dichloroethane.
[j] Estimated value.
[k] Recovery well sample collected at the time of the annual sample. Pump had been off for a period before sample collection.
[l] Methylene chloride at 0.0077 mg/L in MW-1SH, 0.0089 mg/L in MW-1RK, 0.0094 mg/L in MW-2SH, 0.0090 mg/L in MW-2RK is probable laboratory contaminant.
[m] Sample collected on June 8, 1998 with pump operating. Other June 1998 samples collected June 15 and June 16, 1998 after pump was off for 7 or 8 days.
[n] Samples reported with 0.006, 0.007, and 0.008 mg/L of 1,2-dichloroethane.
[o] Sample collected on June 1, 1999 with pump operating. Other June 1999 samples collected June 16 and June 17, 1999 after pump was off for 15 or 16 days.
[p] Samples reported with 0.005 mg/L of 1,2-dichloroethane. Sample prior to turning off pump was non-detect for 1,2-dichloroethane.
[r] Sample collected on June 14, 2001 with pump operating. Other June 2001 samples collected June 26, 2001 after pump was off for 12 days.
[s] MW-02SH resampled for confirmation on August 13, 2001.
[t] MW-02SH resampled for confirmation on November 27, 2001.
[u] Sample collected on May 9, 2002 with pump operating. Other annual samples collected June 5, 2002 after pump was off for 27 days.
[v] Collected November 14, 2002 after pump had been off for 7 days. Analysis by Pace Labs
[w] Collected November 14, 2002, after pump had been off for 7 days. Analysis by Davis & Floyd.
[x] Sample collected November 7, 1992. Analysis reported with 0.0051 mg/L benzene, which is believed to be a laboratory contaminant.
[y] Sample collected on June 10, 2003, with pump operating. Other June samples collected June 19, 2003 after pump was off for 9 days.
[z] Also detected in June 10, 2003, sample: trans -1,2-DCE at 1.7 µg/L; 1,1-DCE at 3.0 µg/L; methylene chloride 7.3µg/L. On June 19, 2003, sample: trans -1,2-DCE at 3.2 µg/L; 1,1-DCE at 4.7 µg/L; methylene chloride 13µg/L.
[aa] Duplicate of Pace Sample of June 10 from MW-03RK analyzed by Test America. Also detected in Test America sample: trans -1,2-DCE at 2.8 µg/L; 1,1-DCE at 1.7 µg/L; tetrachloroethene 2.10 µg/L; toluene at 3.4 µg/L. In Pace Labs sample: trans -1,2-DCE at 3.8 µg/L; 1,1- DCE at <0.001 µg/L; tetrachloroethene 1.8 µg/L; toluene at 4.2 µg/L; 1,2,4-trimethylbenzene 1.2 µg/L.
[bb] Sample collected on June 8, 2004, with pump operating. Other June samples collected June 15 and 15, 2004 after pump was off for 7 days.
[cc] Also detected in the June 15, 2004, samples: MW-02SH - trans -1,2-DCE at 1.3 µg/L and 1,1-DCE; MW-04SH - 1,4-DCB at 0.47 (J) µg/L; MW-8SH - 1,2-DCA at 0.4 (J) µg/L diisopropyl ether at 0.45 (J) µg/L, and 1,4-DCB at 0.37 (J) µg/L; MW-8SH - diisopropyl ether at 0.82 (J) µg/L.
[dd] Sample collected on June 6, 2005, with pump operating. Other June samples collected June 13 and 14, 2005 after pump was off for 8 days.
[ee] Also detected in the June 13 and 14, 2005, samples: MW-02SH - trans -1,2-DCE at 1.1 µg/L and 1,1-DCE at 3.3 µg/L; MW-03RK - trans - 1,2-DCE at 1.9 µg/L.
[ff] Minimum detection limits reported. Also detected in the June 12 and 14, 2007, samples: MW-06SH - toluene at 2.0 (J) µg/L; MW-08RK - o-xylene at 1.4 (J) µg/L; RW-01 - toluene at 8.2 µg/L.
[gg] MW-02SH - 1.4µg/L 1,1-dichloroethene; MW-03RK - 2.1 µg/L trans -1,2-dichloroethene
[hh] Samples collected with pump on, a few hours after pumping stopped, one day after pumping stopped, one week after pumping stopped and one month after pumping stopped.

Notes on Analytical Data – Continued

D - Duplicate
NA - Not Analyzed
ND - Not Detected
J - Estimated value. Result is below the laboratory reporting limit, but above the method detection limit.
Highlighted cells indicate concentrations exceeds performance standard.

APPENDIX I – FIGURES

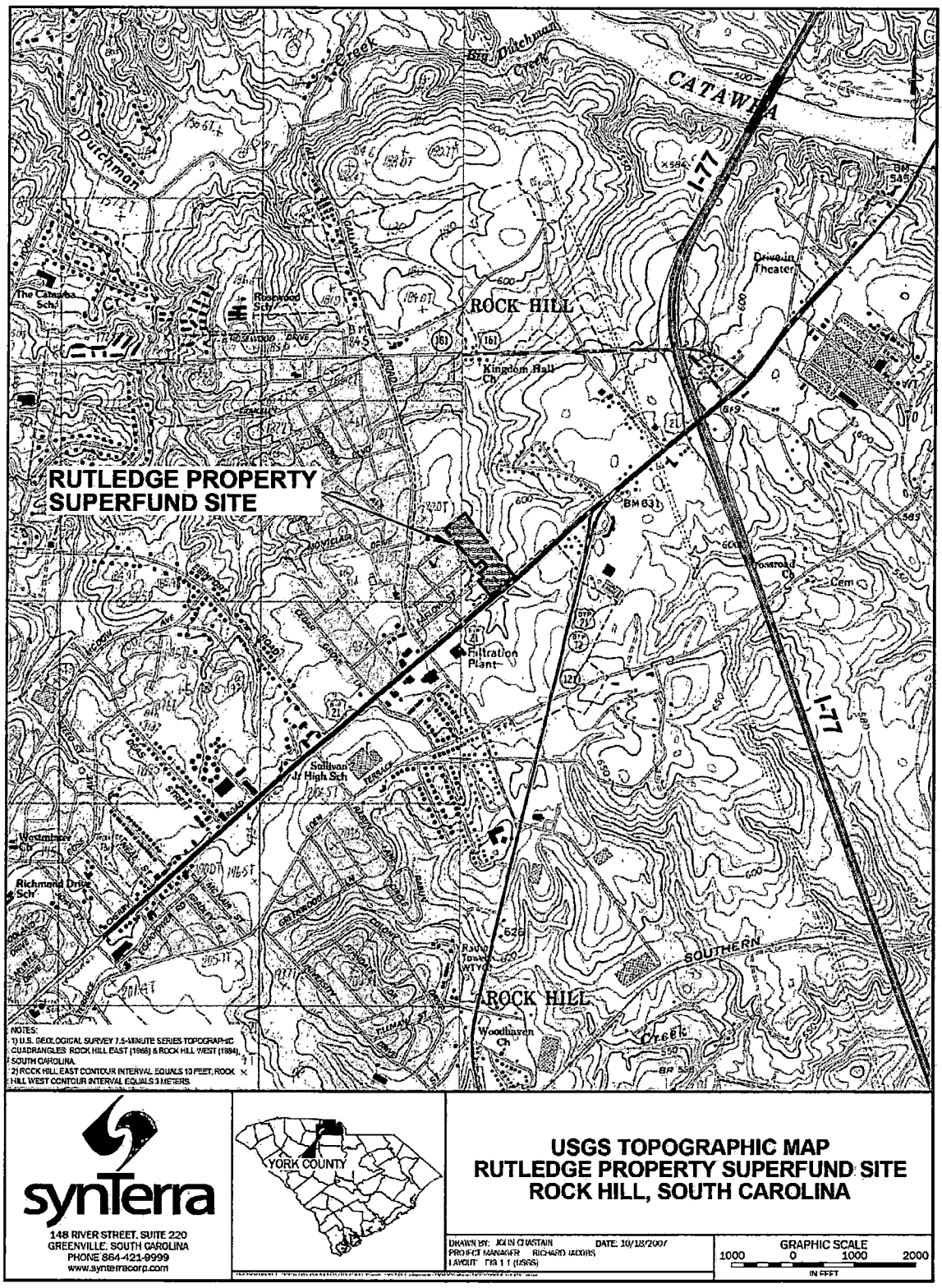


Figure 9 – USGS Topographic Map

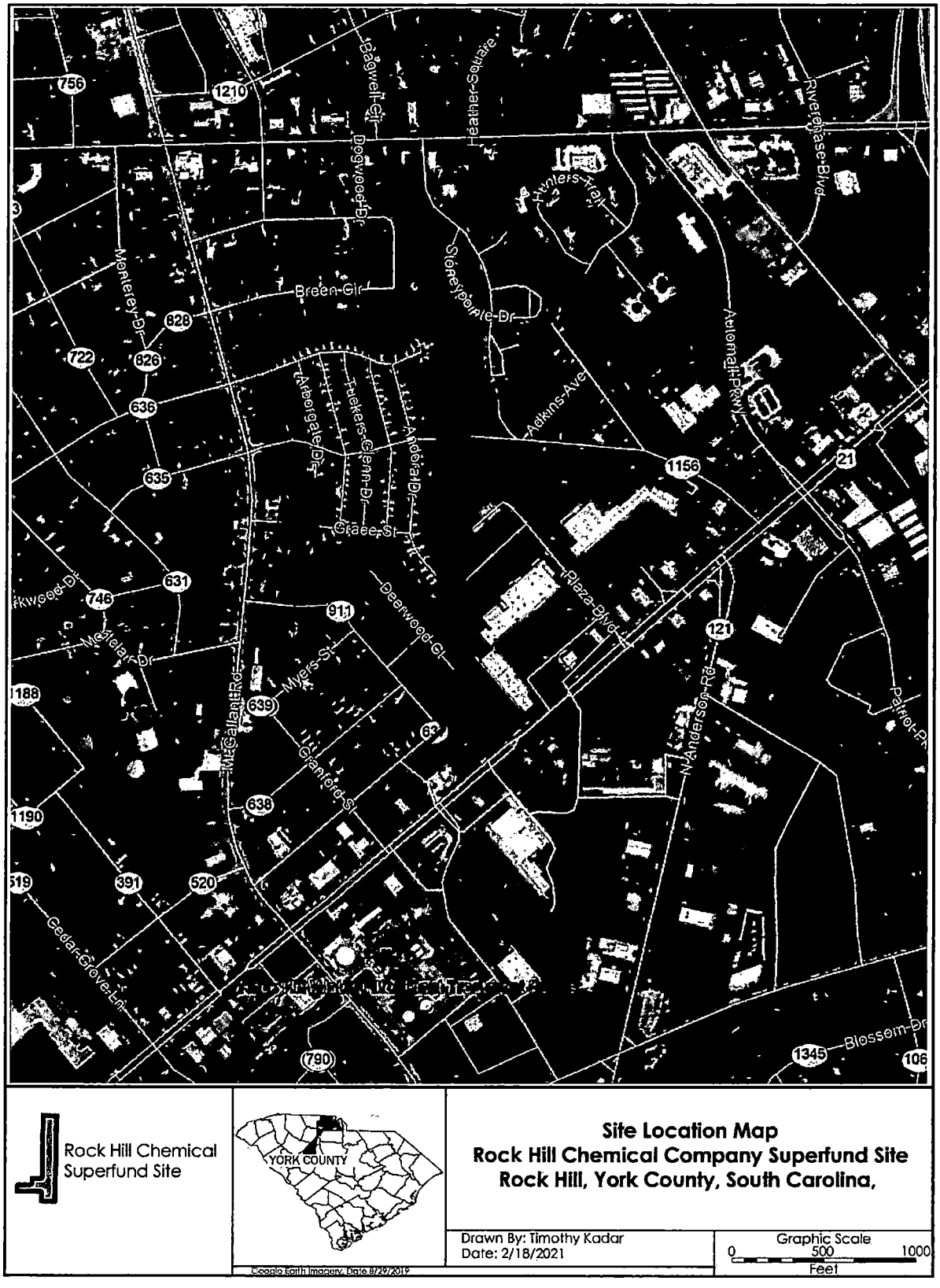


Figure 10 - Site Location Map

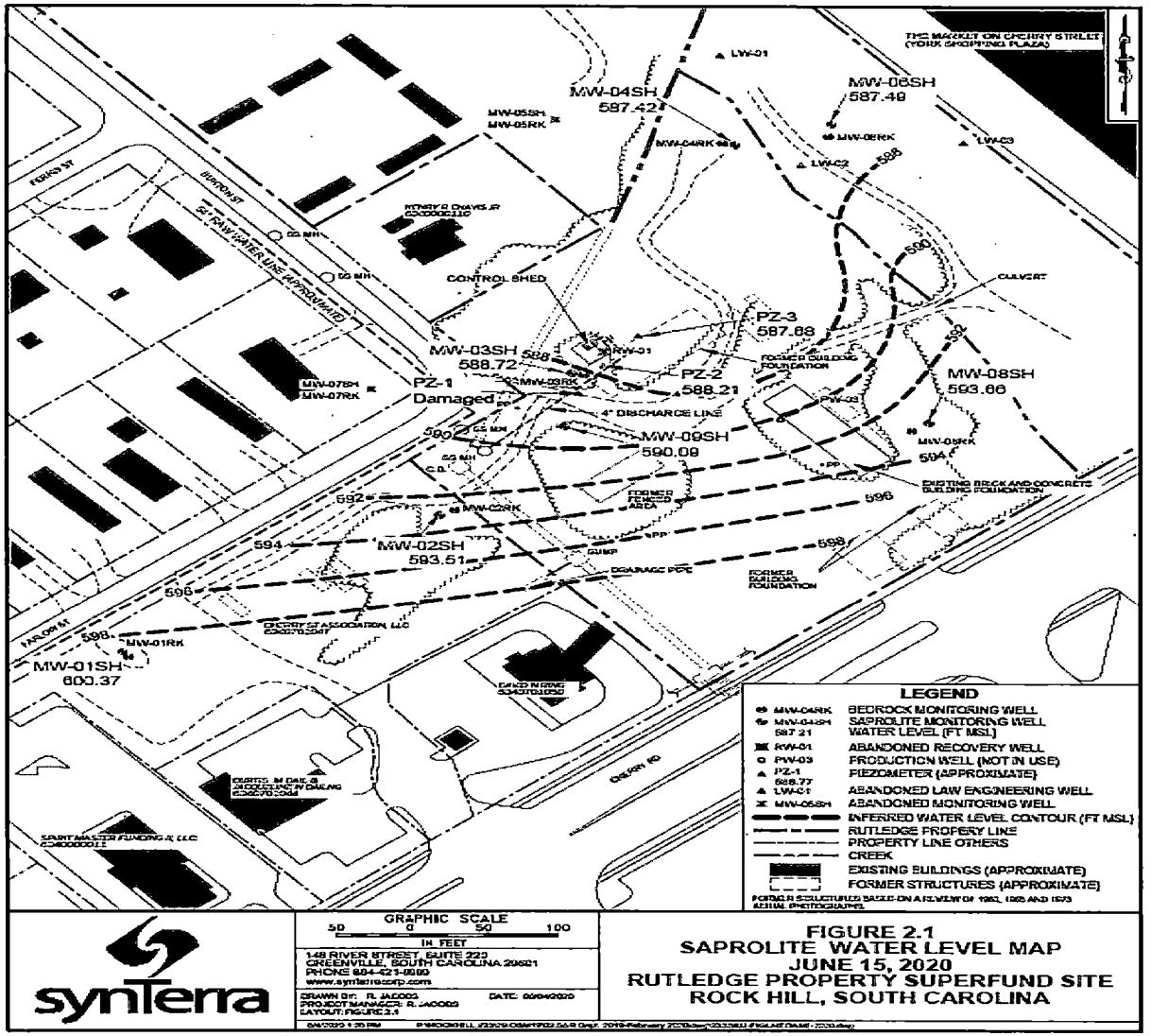


Figure 11 - Saprolite Water Level Map

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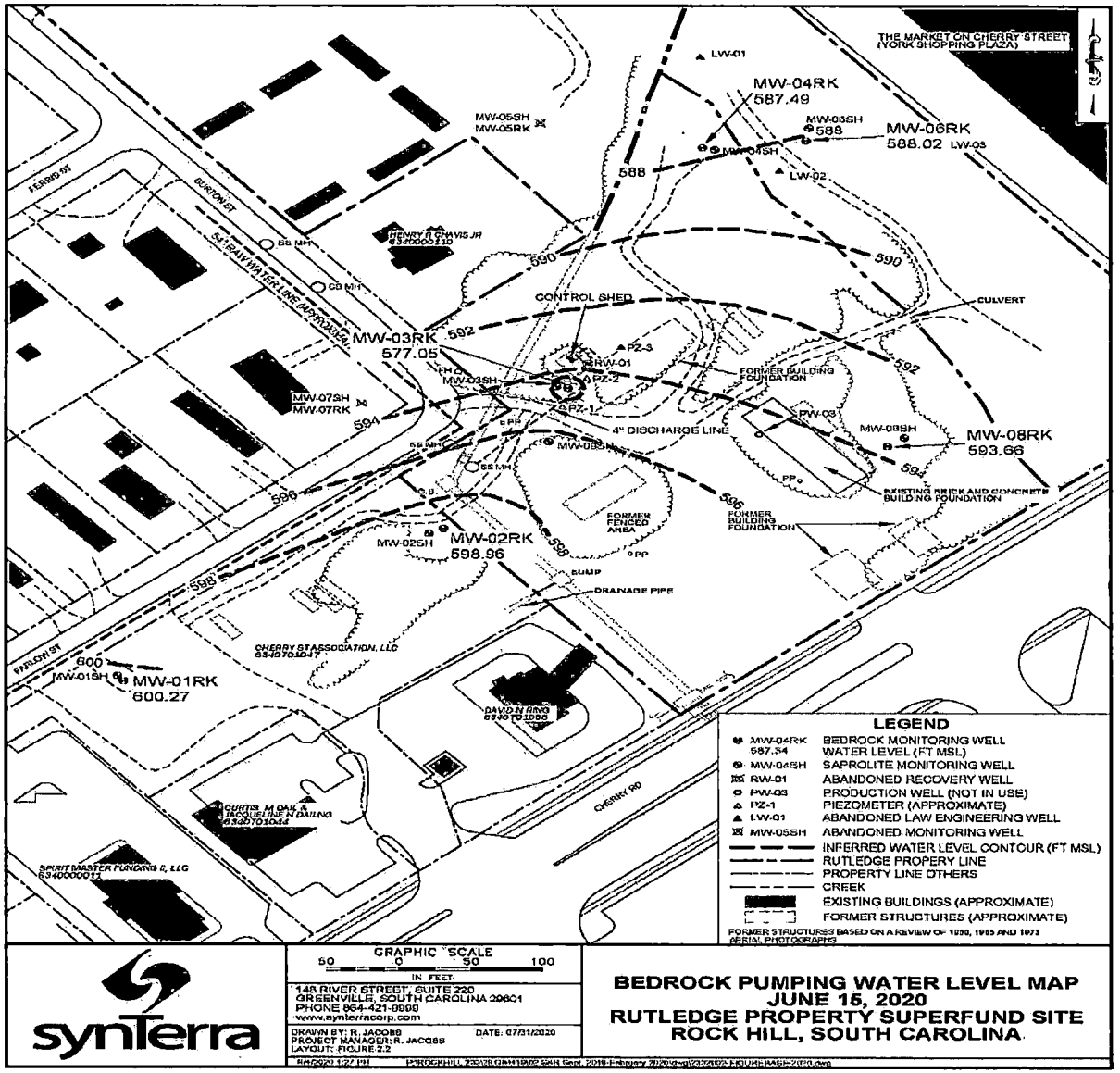


Figure 12 - Bedrock Pumping Water Level Map

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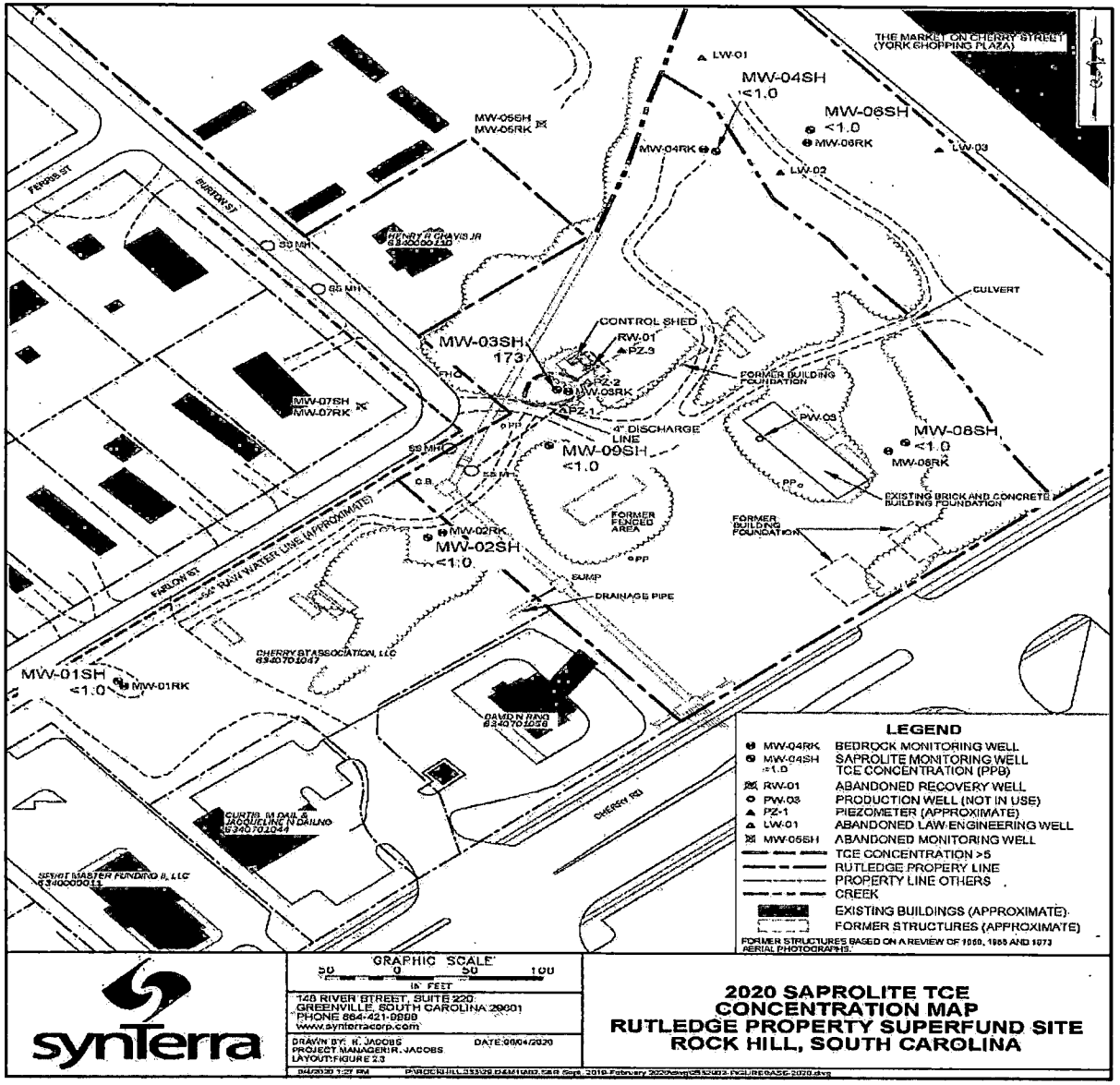


Figure 13 - 2020 Saprolite TCE Concentration Map

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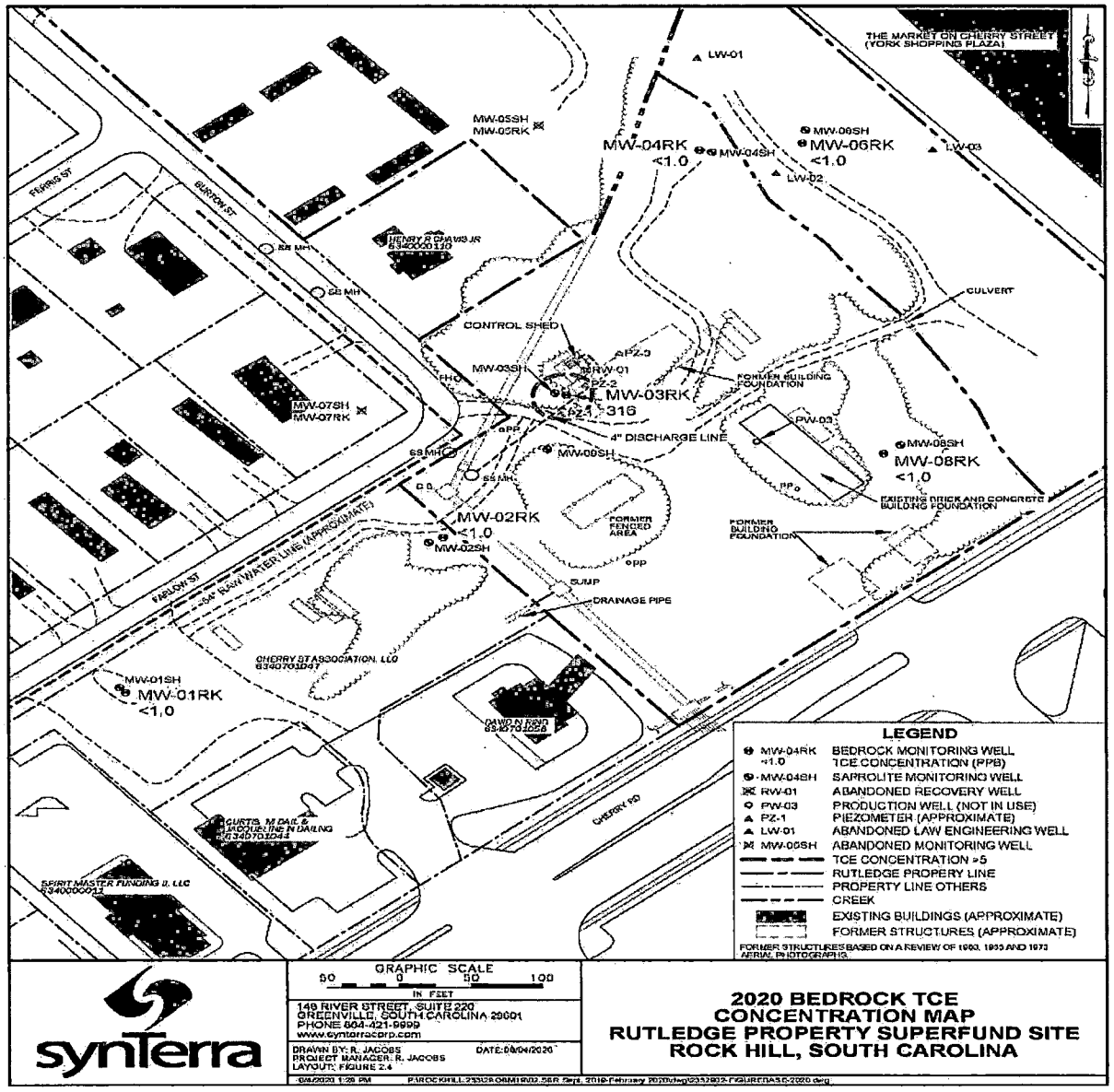


Figure 14 - 2020 Bedrock TCE Concentration Map

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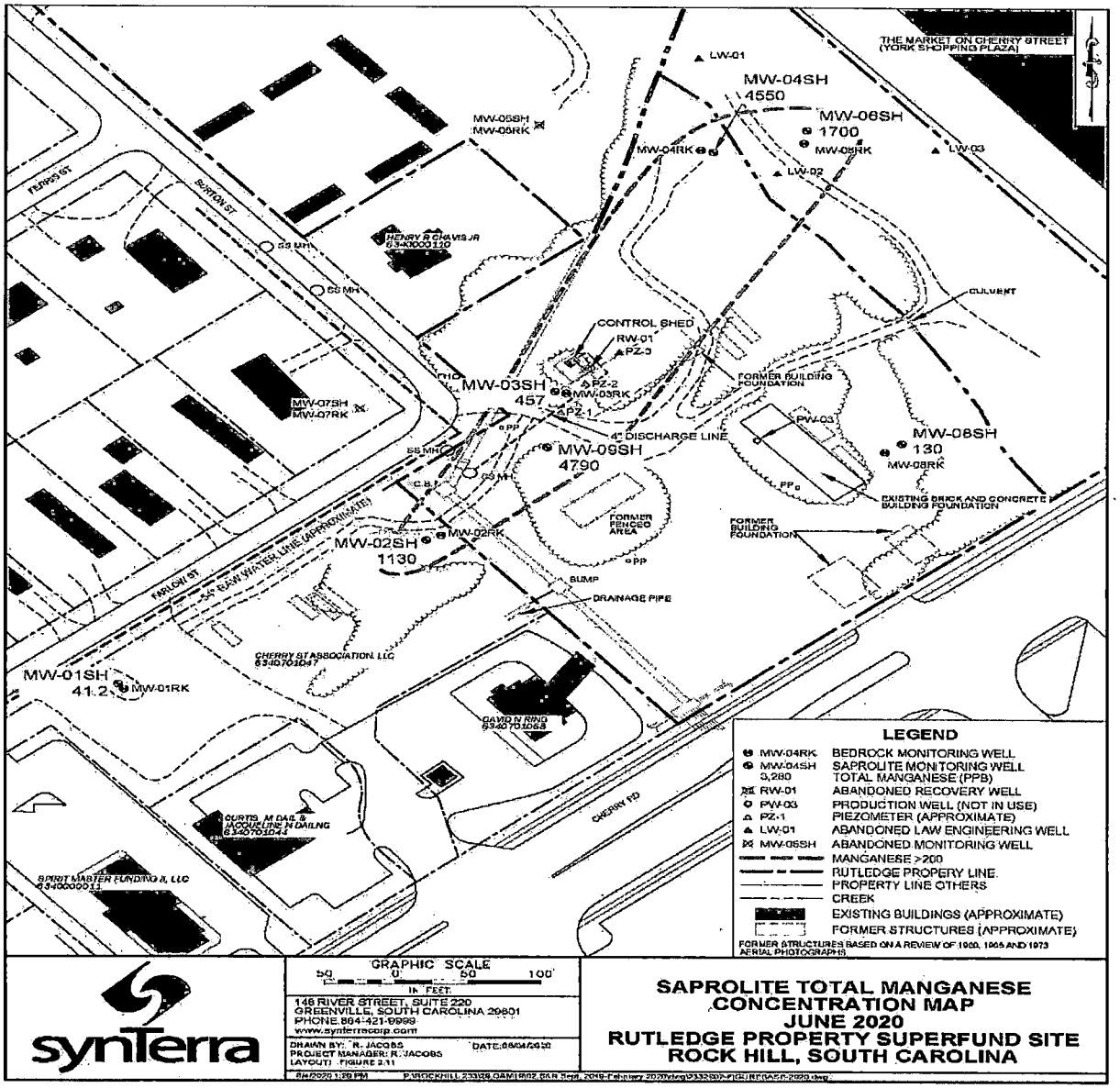


Figure 15 - 2020 Saprolite Total Manganese Concentration Map

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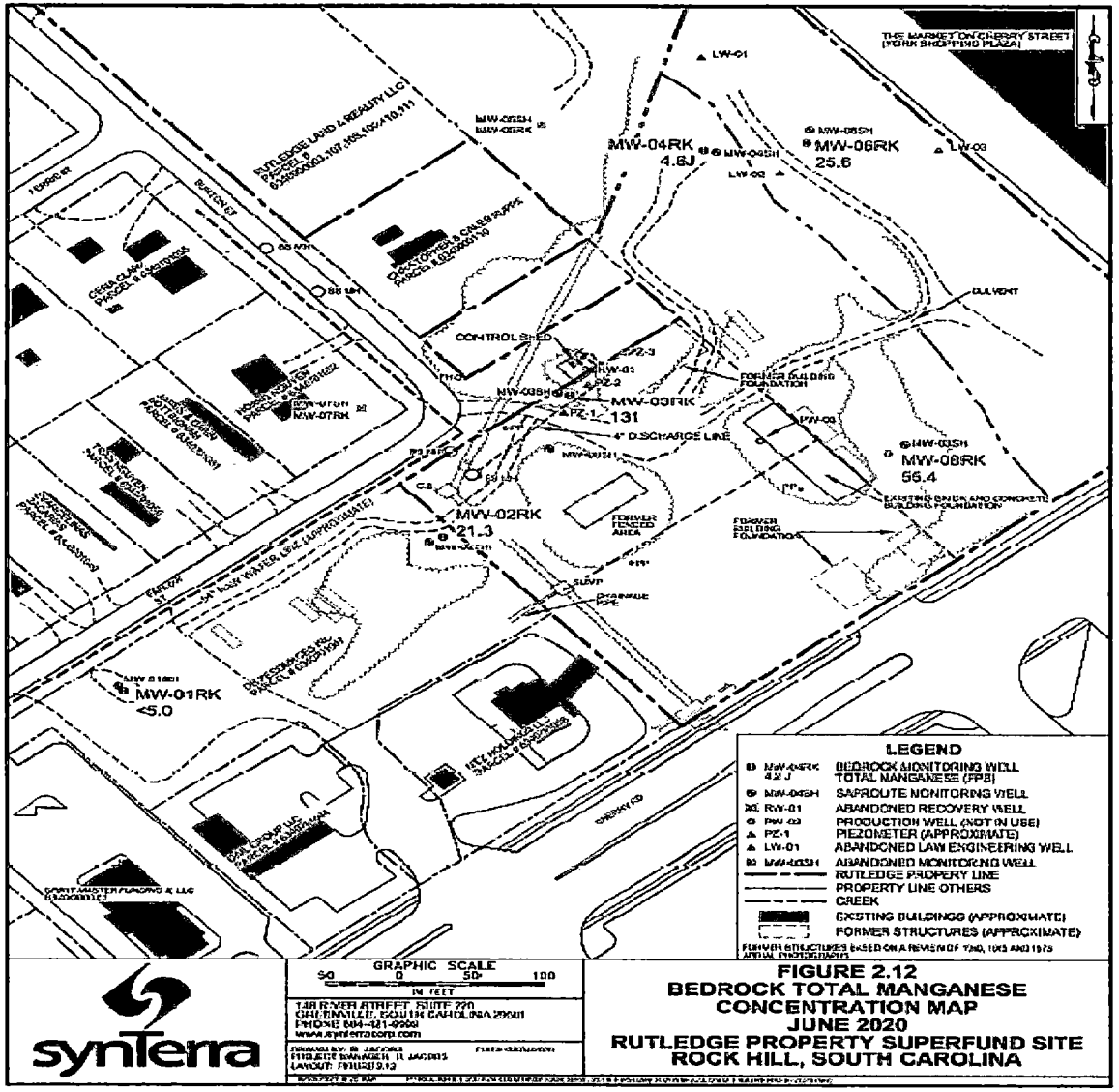


Figure 16 - 2020 Bedrock Total Manganese Concentration Map

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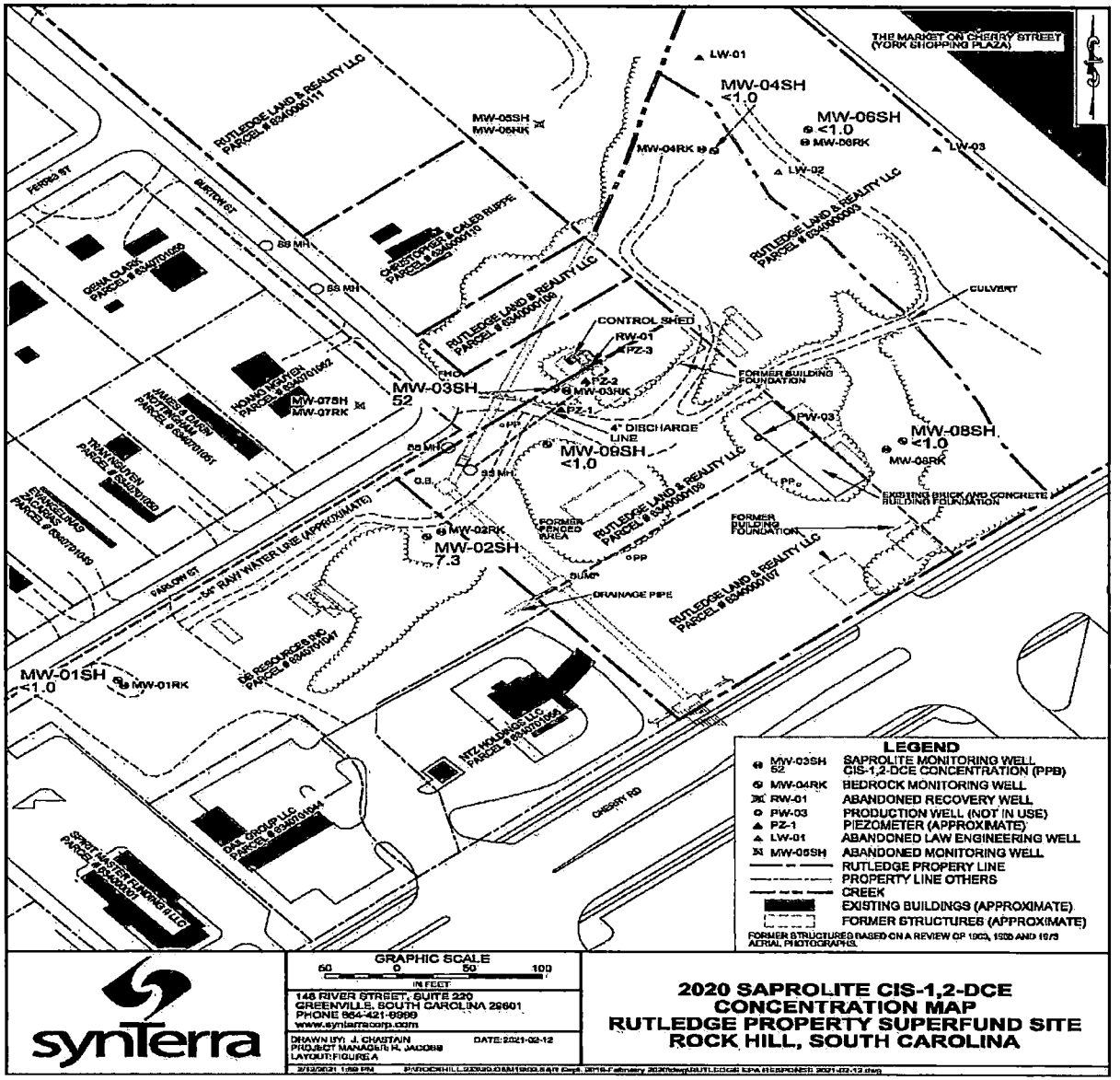


Figure 17 - 2020 Saprolite CIS-1,2-DCE Concentration Map

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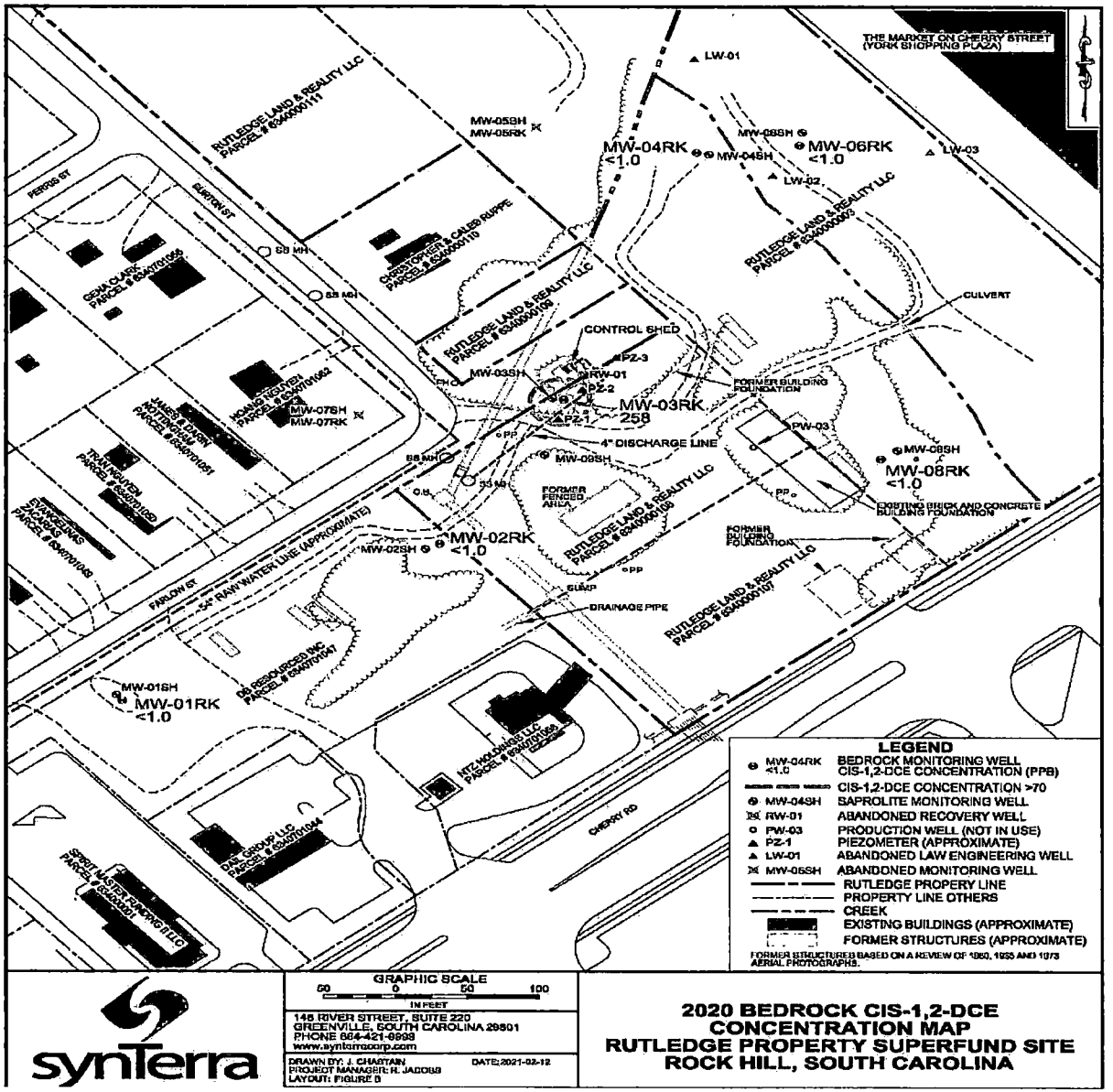


Figure 18 - 2020 Bedrock CIS-1,2-DCE Concentration Map

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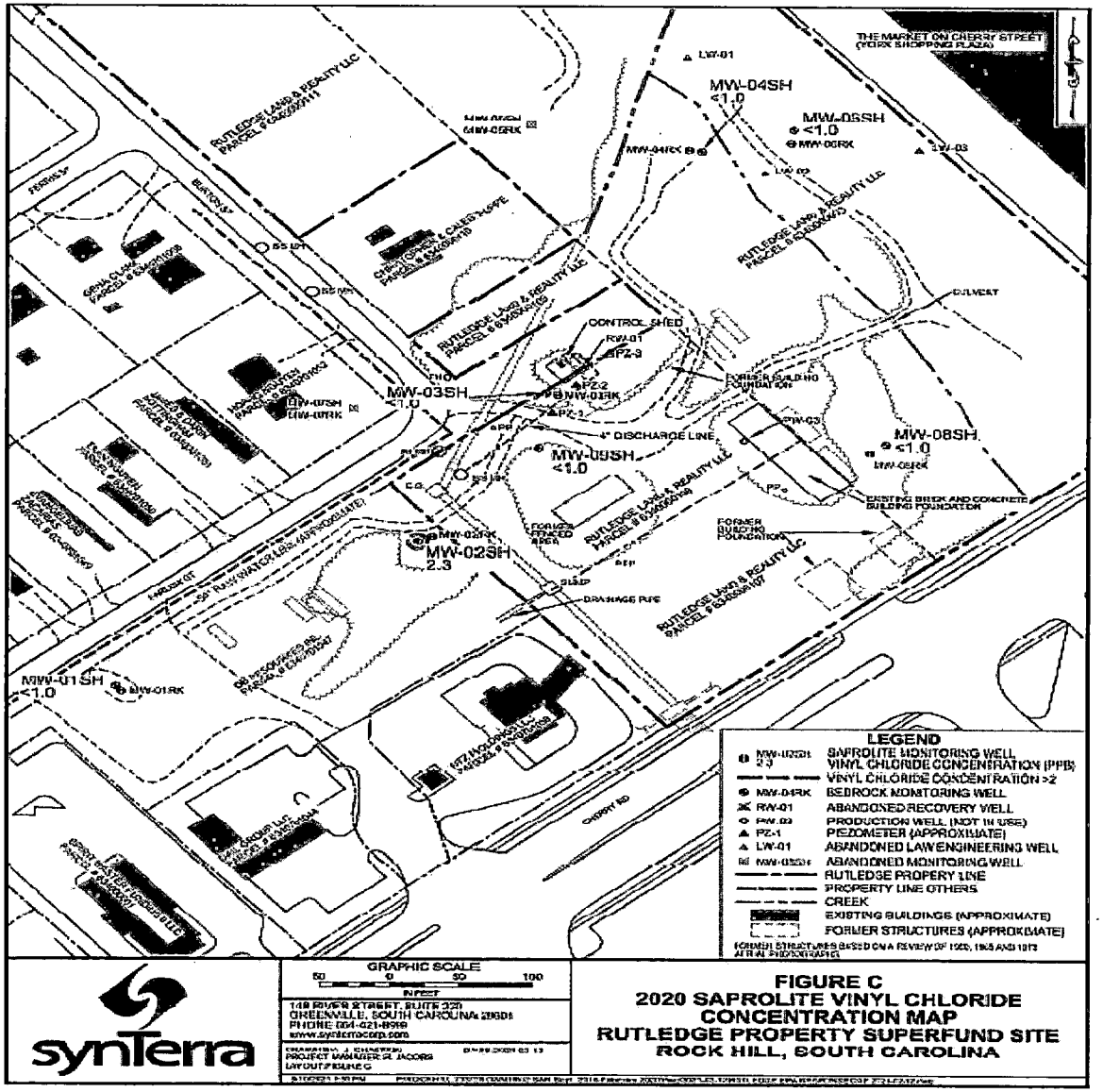


Figure 19 - 2020 Saprolite Vinyl Chloride Concentration Map

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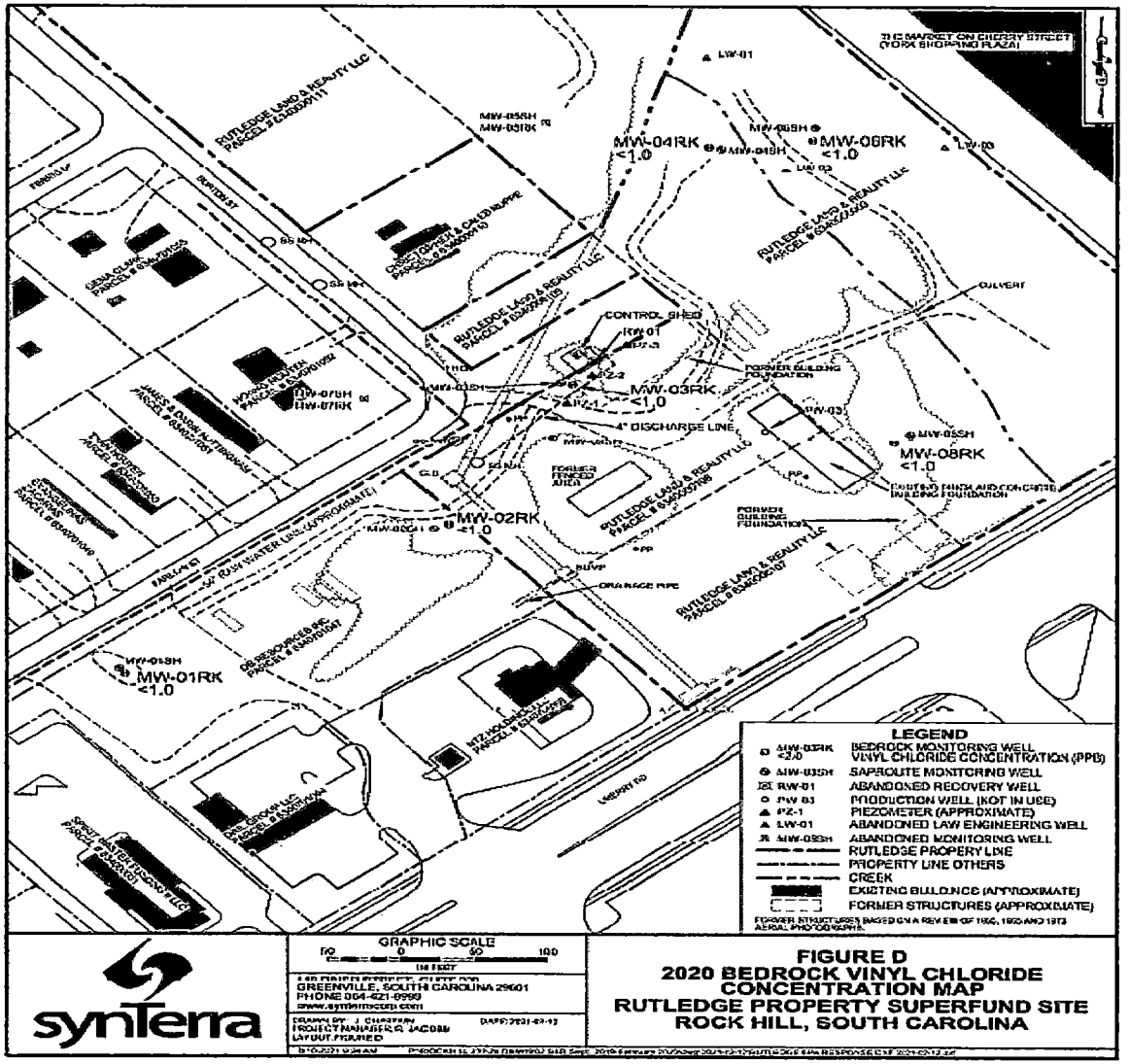


Figure 20 - 2020 Bedrock Vinyl Chloride Concentration Map

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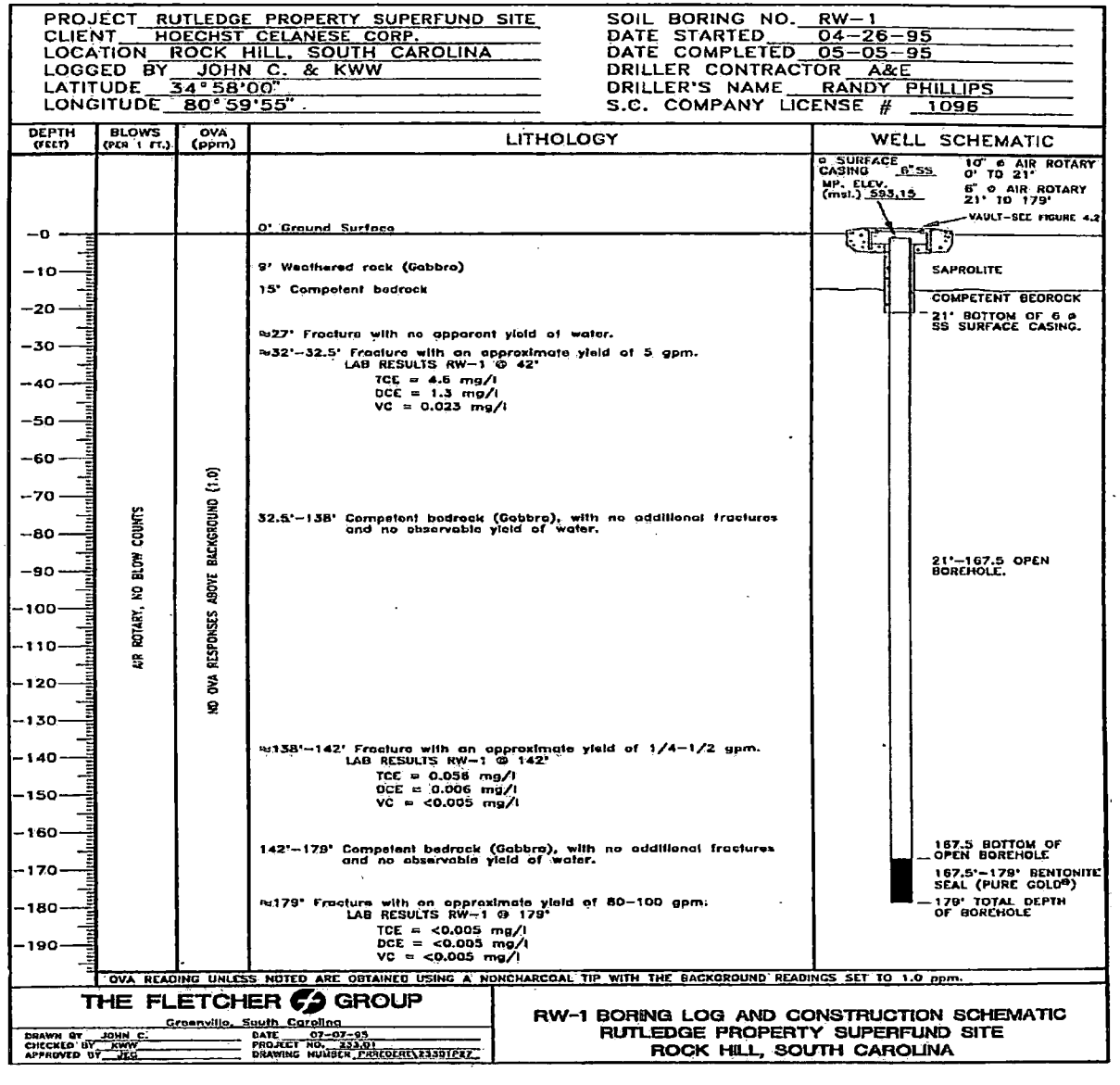


Figure 21 - RW-1 Boring Log and Construction Schematic

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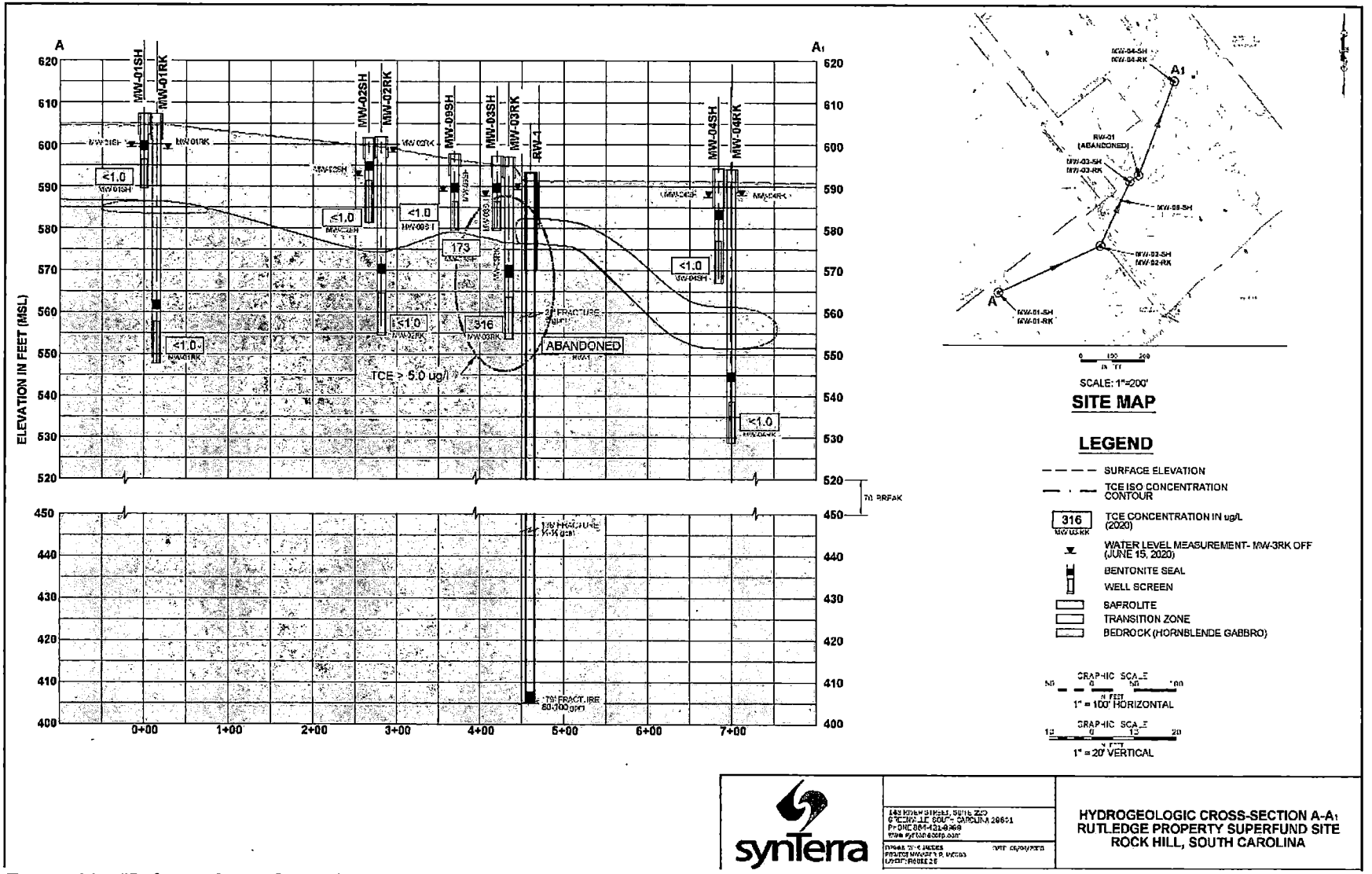
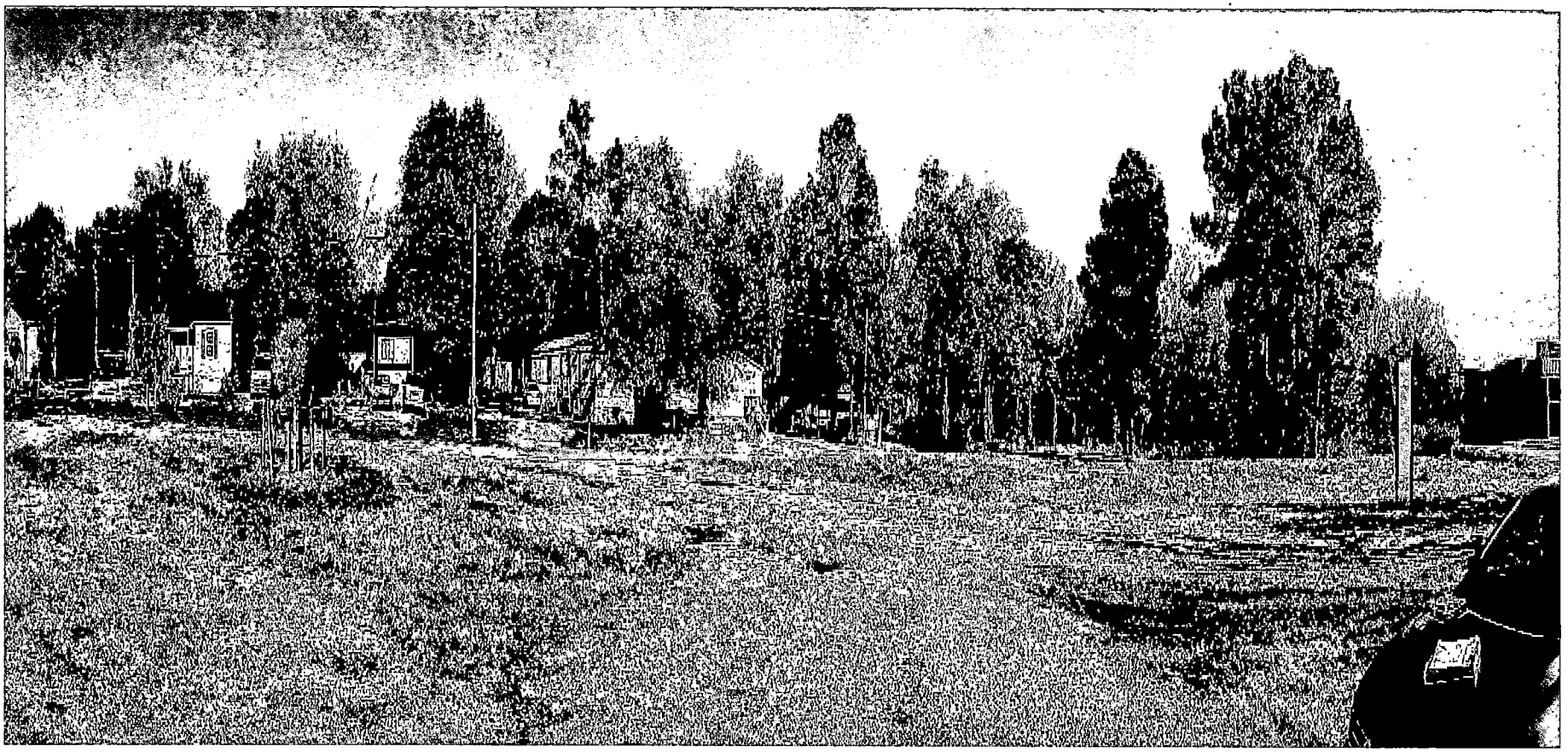


Figure 22 - Hydrogeologic Cross-Section

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APPENDIX J – SITE PHOTOGRAPHS

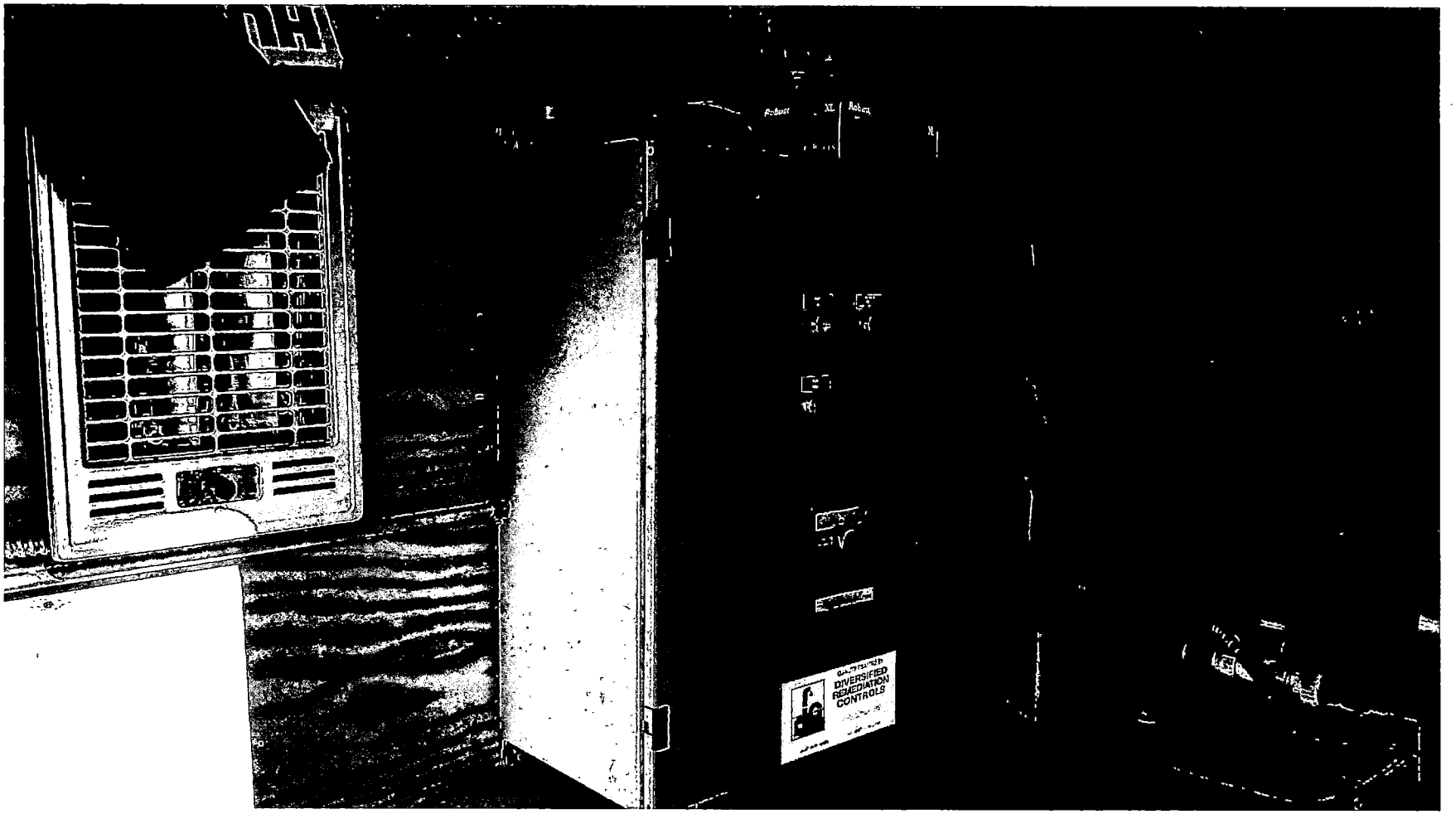


Picture 1 - Rock Hill Chemical Superfund Site (from west looking north and east)

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Picture 2 - Control Shed



Picture 3 - Control Panel in Control Shed

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Picture 5 - POTW Discharge Point

Exhibit 49-2

EPA Report for Carolawn Superfund Site

SIXTH FIVE-YEAR REVIEW REPORT FOR CAROLAWN, INC. SUPERFUND SITE CHESTER COUNTY, SOUTH CAROLINA



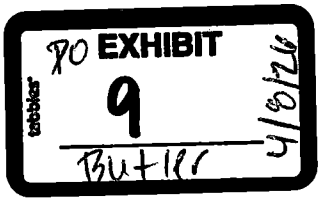
SEPTEMBER 2023

Prepared for

U.S. Environmental Protection Agency
Region 4
Atlanta, Georgia

RANDALL CHAFFINS Digitally signed by RANDALL CHAFFINS Date: 2023.09.27 16:08:52 -04'00'

Caroline Y. Freeman, Director
Superfund & Emergency Management Division



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LIST OF ABBREVIATIONS & ACRONYMS

AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIC	Community Involvement Coordinator
COC	Contaminant of Concern
COPC	Chemical of Potential Concern
CSC	Carolawn Steering Committee
DCA	Dichloroethane
DCE	Dichloroethylene
EISB	Enhanced In-Situ Biodegradation
EPA	United States Environmental Protection Agency
FFS	Focused Feasibility Study
FFS-R2	Focused Feasibility Study – Revision 2
FS	Feasibility Study
FYR	Five-Year Review
GWETS	Groundwater Extraction and Treatment System
HQ	Hazard Quotient
IC	Institutional Control
µg/L	Micrograms Per Liter
µg/m3	Microgram Per Cubic Meter
MatPb	Maternal Blood Lead Concentration at Childbirth
mg/kg	Milligram per Kilogram
MCL	Maximum Contaminant Level
MNA	Monitored Natural Attenuation
MW	Monitoring Well
NCP	National Contingency Plan
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethylene
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
RSL	Regional Screening Level
RV	Recreational Vehicle
SCDHEC	South Carolina Department of Health and Environmental Control
SVE	Soil Vapor Extraction
TCA	Trichloroethane
TCE	Trichloroethylene
UAO	Unilateral Administrative Order
UU/UE	Unlimited Use and Unrestricted Exposure
VOC	Volatile Organic Compound
WQC	Water Quality Criteria

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP)(40 Code of Federal Regulations (CFR) Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the sixth FYR for the Carolawn, Inc. Superfund site (the Site). The triggering action for this statutory review is the signature date of the previous FYR. The FYR has been prepared because hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of two operable units (OUs). OU-1 is a 3-acres area completely enclosed by a chain-link fence and the areal extent of all groundwater contamination beneath the Site. OU-2 is an undeveloped wooded area to the north and west of the fenced area of OU-1. OU-2 includes the soils, surface water and sediment in Fishing Creek. This FYR addresses both OUs.

The South Carolina Department of Health and Environmental Control (SCDHEC) conducted the FYR and prepared this report regarding the remedy implemented at the Site. The EPA is the lead agency for developing and implementing the remedy for the cleanup at the Site. The relevant entities such as the potentially responsible parties (PRPs) were notified of the initiation of the FYR. The review began on September 8, 2022.

Site Background

The 60-acre site is located at 5093 Morrison Road in Fort Lawn, Chester County, South Carolina (Figure 1). From 1970 to 1979, a waste storage and disposal facility operated at the Site. Operations disposed of about 4,500 drums of waste, several bulk storage tanks and sludge in the Site's 3-acre fenced area. Additionally, operations disposed of 660 drums and 11 storage tanks outside the fenced area in the northern portion of the Site.

Current site features include a former groundwater treatment building, monitoring wells, a fence and signage. Rural and agricultural areas surround much of the Site. The Lancaster & Chester Railroad and County Road 841 border the Site to the south. Providence Fish & Game (a hunting club) and Fishing Creek border the Site to the east. The Circle S Ranch borders the Site to the west. There are several residences southwest of the Site. The fenced OU-1 area is not currently in use; the hunting club hunts on some areas of OU-2. The club also maintains several structures near the Site for storage and hunting-related purposes and club members temporarily park recreational vehicles (RVs) in this area; they do not have any drinking water wells on site.

Groundwater beneath the Site occurs along joint/fracture planes in the bedrock, forming a bedrock aquifer. Groundwater flow is generally northeast and southeast toward Fishing Creek. Fishing Creek

Disclaimer: This map and any boundary lines within the map are approximate and subject to change.
The map is not a survey. The map is for informational purposes only regarding the EPA's response actions at the Site.

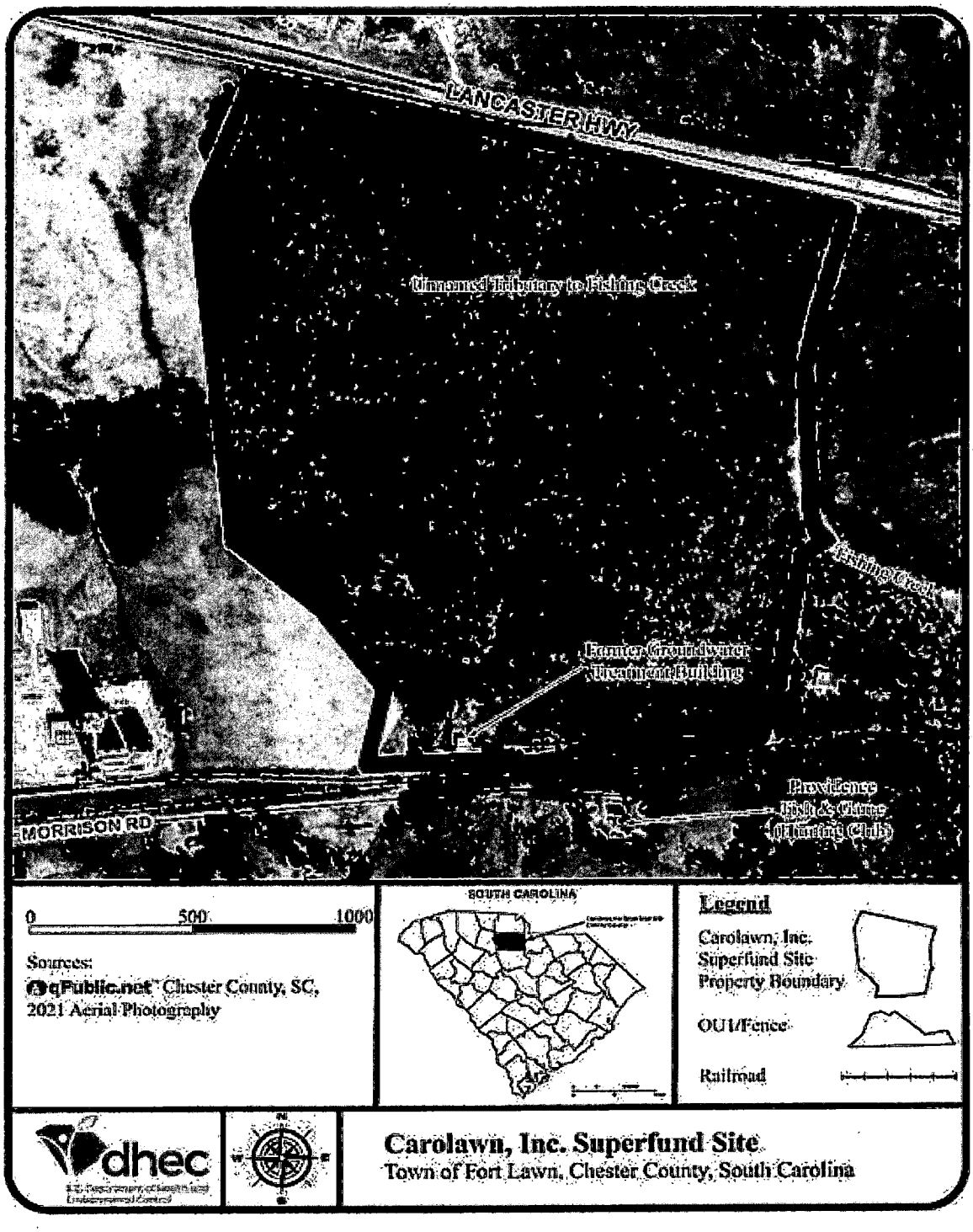


Figure 1: Site Vicinity Map

forms a hydraulic boundary to the northeast, east and southeast of the Site and is the discharge location for site groundwater. The four residences that previously used private wells in the area about 1,000 yards southwest of the Site were provided an alternative water source in 1985. They were connected to the Chester Metropolitan Sanitary District.

Appendix A provides a list of references used during this FYR. Appendix B provides detailed site status information. Appendix C provides a chronology of site events.

There are no immediate plans for the redevelopment of the vacant areas of the Site.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Carolawn, Inc.		
EPA ID: SCD980558316		
Region: 4	**State:** SC	**City/County:** Fort Lawn, Chester County
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: EPA		
Author name: Yvonne Jones (EPA) and Timothy Kadar (SCDHEC)		
Author affiliation: EPA and SCDHEC		
Review period: 9/8/2022 – 8/30/2023		
Date of site inspection: 11/17/2022		
Type of review: Statutory		
Review number: 6		
Triggering action date: 9/18/2018		
Due date *(five years after triggering action date)*: 9/18/2023		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

The PRP, the Carolawn Steering Committee (CSC), performed a remedial investigation and feasibility study (RI/FS) for OU-1 in 1989. It identified volatile organic compounds (VOCs) and lead in groundwater as the only contaminants of concern (COCs) with the potential to pose unacceptable risk

for human consumption (Table 1). Former waste storage drums and tanks were identified as the source of these COCs.

Based on the results of the 1994 RI and baseline risk assessment for OU-2, the EPA determined that surface and subsurface soils, surface water, and sediment in Fishing Creek did not pose unacceptable risks to the public or the environment. Therefore, a FS and a remedial action for OU-2 were not warranted.

Table 1: COCs by Media

COC	Media
1,1-Dichloroethane, 1,2-Dichloroethene (cis & trans), 1,1-Dichloroethene, 1,1,1-Trichloroethane, Trichloroethene, Lead	groundwater

Response Actions

The Carolawn Company abandoned the site property in 1980. SCDHEC and the EPA conducted site investigations during the early 1980s. Due to the elevated levels of site contamination, the EPA removed contaminated soils, drums, and liquid waste at the Site from December 1981 to February 1982. The EPA proposed the Site for listing on the Superfund program's National Priorities List (NPL) in December 1982. The EPA finalized the Site's listing on the NPL in September 1983. At least one local residential well showed persistently high levels of VOCs, so the EPA extended the Chester Metropolitan Sanitary District's water main to four residences near the Site in 1985. In May 1985, the CSC entered an Administrative Order on Consent (AOC) to conduct a removal action that included removing storage tanks, disposing of tank contents, and excavating and disposing of contaminated soils. The CSC conducted the removal action in 1986.

In September 1989, the EPA issued an OU-1 Record of Decision (ROD), which included the following remedial action objectives (RAOs):

- Prevent the near-term and future exposure of human receptors to contaminated groundwater both on and off site.
- Restore the contaminated aquifer for future use by reducing contaminant levels to those which will adequately protect human health and the environment.
- Control contaminant migration so contaminant releases from groundwater to Fishing Creek do not exceed cleanup criteria for human health and the environment.
- Monitor groundwater in a manner to verify effectiveness of remedial measures.
- Confirm the absence or presence of soil contamination in the storage area north of the fenced area (OU-2).

The OU-1 remedy included the following components:

- Migration Control – Remediation of Contaminated Groundwater
    - Installation of a groundwater interception and extraction system at the Site.
        - The remedy provided three water discharge alternatives for the treated groundwater: 1) the local sewer system; 2) Fishing Creek via a National Pollutant Discharge Elimination System permit or 3) on-site irrigation.
    - Implementation of appropriate institutional controls.
    - Plugging and abandonment of the adjacent contaminated private potable wells by Chester County.

- Source Control – Remediation of Contaminated Soils
  - Installation of confirmatory soil borings in the disposal area north of the fenced area to verify the presence or absence of contamination and, if present, address cleanup of this contamination in another ROD.[1]
- General Site Cleanup Activities
  - Inspection, sampling, and disposal of two inactive incinerators and two remaining drums.

ROD Established Remediation Goals for OU-1 (groundwater) are included below in Table 2.

Table 2: ROD Established Remediation Goals for OU-1

Groundwater		
COC	**Remedial Goal (mg/kg)**	**Basis**
Acetone	700	Lifetime Health Advisory
1,1-Dichloroethane (DCA)	*	*
1,1-Dichloroethene (DCE)	7	MCL
1,2- Dichloroethene (1,2-DCE)	70-cis 100 – trans	Proposed MCL Proposed MCL
1,1,1-Trichloroethane (TCA)	200	MCL
Trichloroethene (TCE)	5	MCL
Lead	5	Proposed MCL

Notes:
Source: 1989 ROD, Table 23
µg/L = micrograms per liter
MCL = maximum contaminant level
* = It is assumed that due to 1,1-DCA's similar chemical/physical characteristics with other contaminants present, the levels will decrease proportionally along with the other contaminants.

To address the soils located beyond OU-1, the EPA conducted RI activities for OU-2 and issued a ROD for OU-2 in 1995. The 1995 OU-2 ROD selected a "no action" remedy due to the absence of any significant source of contamination in soil, surface water and sediment at the Site. The ROD stated that should future monitoring of the Site indicate the presence of unacceptable risk to the environment, then the EPA may initiate cleanup actions.

[1] No source of contamination remained within the fenced area of the Site due to earlier removal actions.

Status of Implementation

From December 1991 to May 1992, CSC contractors closed at least three residential wells (which were no longer in use). The groundwater extraction and treatment system (GWETS) was installed from December 1995 to June 1996. GWETS operation began in October 1996 and ended in July 2004 when CSC shut down the GWETS, removed pumps and decommissioned the system. During operation, the system extracted about 19.2 million gallons of groundwater and 16 kilograms of VOCs from the bedrock VOC plume. It was estimated that the GWETS would have had to operate for at least another 62 years to achieve MCLs, due to the low yield of the bedrock formation. Therefore, the EPA and SCDHEC recommended a system optimization study to consider other remedial technologies to address groundwater contamination.

In 2005, the CSC conducted a pilot study to evaluate enhanced in-situ biodegradation (EISB) as a remedial option, which involved the injection of a soy-oil based product known as Newman Zone to promote accelerated biodegradation of VOCs. Post-injection monitoring data indicated biodegradation occurred. However, these conditions were not widespread, and biodegradation slowed at individual locations due to insufficient transport away from the injection boreholes. In addition, the plume extent and VOC concentrations did not change significantly in response to the EISB in the bedrock aquifer. The 2008 FYR Report recommended further evaluation of remedial technologies.

In March 2009, the EPA issued a modified Unilateral Administrative Order (UAO) to the CSC that required a focused feasibility study (FFS) to identify a groundwater remedy besides the GWETS. In August 2010, the CSC conducted a soil vapor extraction (SVE) pilot study to evaluate it as a potential interim remedial measure. The study indicated SVE was a feasible approach to reduce VOC mass in the subsurface (vadose zone), which could result in reduced VOC concentrations in groundwater. Following discussions with SCDHEC, the CSC and the Community Advisory Group, the EPA approved construction of the SVE system, which finished in January 2012. The SVE system was intended to operate until VOC recovery reached a point of diminishing returns and sufficient data were collected to complete the FFS. The SVE system operated until June 2014, when it was shut down due to a continued decrease in VOC mass removal and asymptotic VOC mass removal rates. About 160 pounds of VOC mass were removed during SVE system operation. SVE system well and piping abandonment activities took place in July 2016.

The CSC submitted a revised FFS in 2016 and the FFS – Revision 2 (FFS-R2) in 2019, which provided an update of site conditions based on remedial actions conducted to date and evaluated potential OU-1 remedial technologies. Several technologies were evaluated, including monitored natural attenuation (MNA) and enhanced permeability with groundwater extraction/treatment or with in-situ biological treatment, among others.

The EPA, SCDHEC and CSC are currently discussing the remedial options with plans to discuss the remedial options with members of the community in the coming months. The EPA will consider input from all parties prior to selecting a new remedy for the Site and amending the 1989 ROD.

Institutional Control (IC) Review

The 1989 OU-1 ROD required institutional controls at the Site, but ICs have not yet been implemented due to the lack of a viable property owner willing to execute and record institutional controls. The defunct Carolawn Company is still listed as the property owner. The CSC, SCDHEC and the EPA have agreed on draft restrictive covenants; they allow no use of OU-1, permit only commercial or industrial

land use in areas outside of OU-1 on the site parcel, require maintenance of site remedial features, preclude disturbance of soil below the top 12 inches without regulatory approval, and restrict groundwater use. Figure 2 includes site and nearby parcels that may require institutional controls, particularly due to contaminated groundwater.

Table 3: Summary of Planned and/or Implemented Institutional Controls

Media, Engineered Controls and Areas that Do not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)[a]	IC Objective	Instrument in Place
Groundwater and Soil	Yes	Yes	146-00-00-005-000	The 1989 ROD required appropriate institutional controls to be implemented. Draft institutional controls include the following restrictions: • Prevent use of OU-1. • Permit only commercial or industrial land use in areas outside of OU-1. • Require maintenance of site remedial features. • Preclude disturbance of soil below the top 12 inches without regulatory approval.	None Drafted but not yet implemented due to lack of viable property owner
Groundwater	Yes	No	146-00-00-005-000 146-00-00-018-000 146-00-00-019-000 146-00-00-037-000	Restrict groundwater use.	None

SYSTEMS OPERATIONS/OPERATION AND MAINTENANCE (O&M)

The PRPs' contractor, Geosyntec inspects the Site monthly. Inspection activities include observation of the general condition of the facility and security of the building and equipment. Additionally, biweekly lawn maintenance is conducted during the growing season. Groundwater sampling activities occur on a semi-annual basis, typically in March and September of each year, with reporting on a biennial basis. The next Biennial Groundwater Monitoring Report is due in early 2024.

Disclaimer: This map and any boundary lines within the map are approximate and subject to change.
The map is not a survey. The map is for informational purposes only regarding the EPA's response actions at the Site.

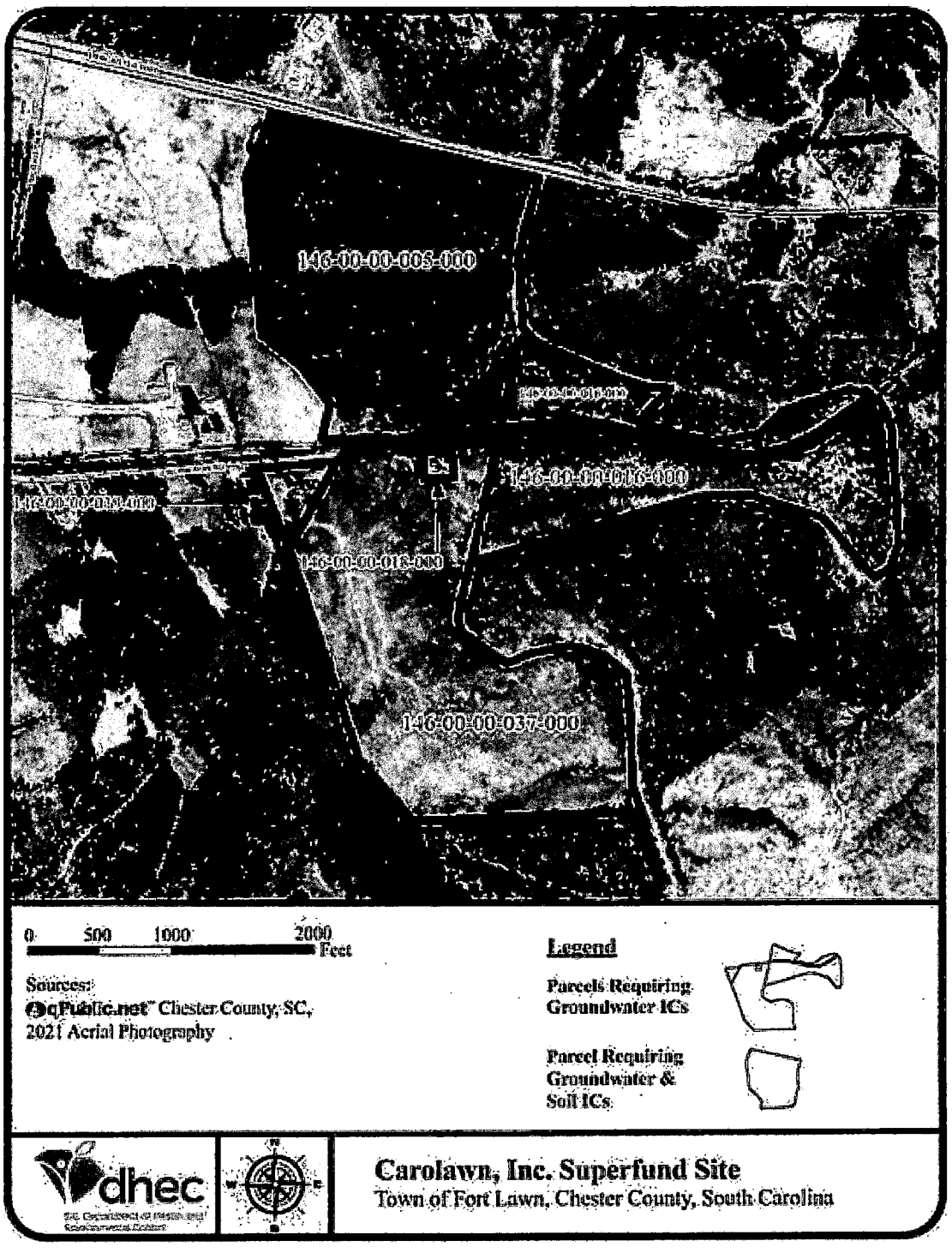


Figure 2: Institutional Controls Map

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determination and statement from the previous FYR Report (Table 4) as well as the recommendations from the previous FYR Report and the status of those recommendations (Table 5).

Table 4: Protectiveness Determination/Statements from 2018 FYR

OU #	Protectiveness Determination	Protectiveness Statement
OU-1	Short-term Protective	The remedy at OU-1 is protective in the short term because there is no complete exposure pathway to contaminated groundwater, and the GWETS and other pilot studies have reduced the amount and extent of groundwater contamination. For the remedy to be protective over the long term, the following actions should occur: • Select and implement a new groundwater remedy. Record the selected remedy in a decision document. Include all appropriate COCs and cleanup goals in the decision document. • Sample for 1,4-dioxane in groundwater and take additional action if necessary. • Implement institutional controls for OU-1. • Evaluate the need for institutional controls restricting groundwater use on properties where groundwater contamination is present. Record any needed restriction requirements in a decision document.
OU-2	Short-term Protective	The remedy at OU-2 is protective in the short term because historical removal actions, including removal of contaminated soil and drums, addressed contamination in this area. For the remedy to be protective over the long term, the following action should occur: • Evaluate the need for institutional controls for OU-2, as necessary.
Sitewide	Short-term Protective	The remedy at OU 1 is protective in the short term because there is no complete exposure pathway to contaminated groundwater, and the GWETS and other pilot studies have reduced the amount and extent of groundwater contamination. The remedy at OU-2 is protective in the short term because historical removal actions, including removal of contaminated soil and drums, addressed contamination in this area. For the remedy to be protective over the long term, the following actions should occur: • Select and implement a new groundwater remedy. Record the selected remedy in a decision document. Include all appropriate COCs and cleanup goals in the decision document. • Sample for 1,4-dioxane in groundwater and take additional action if necessary. • Implement institutional controls for OU 1. • Evaluate the need for institutional controls restricting groundwater use on properties where groundwater contamination is present. Record any needed restriction requirements in a decision document. • Evaluate the need for institutional controls for OU-2, as necessary.

Table 5: Status of Recommendations from 2018 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
OU-1	The GWETS is no longer operating due to its estimated timeframe required to meet MCLs, but a new groundwater remedy is not yet in place. Not all currently sampled VOCs that exceed MCLs were selected as COCs in the original remedy.	Select and implement a new groundwater remedy. Record the selected remedy in a decision document. Include all appropriate COCs and cleanup goals in the decision document	Ongoing	Data collection is ongoing to support the FFS and modifications to the decision document	N/A
OU-1	The 1989 ROD identified 1,1,1-TCA as a COC, and 1,4-dioxane was historically used as a stabilizer for 1,1,1-TCA. It is unknown if 1,4-dioxane is present in site media.	Sample for 1,4-dioxane in groundwater and take additional action if necessary.	Ongoing	1,4-dioxane will be included in the Spring 2024 monitoring event.	N/A
OU-1	The 1989 ROD required institutional controls, which have not been implemented due to the lack of a viable property owner.	Implement institutional controls for OU-1.	Ongoing	The PRP, the EPA, and SCDHEC have agreed on a restrictive covenant but there is no viable property owner to complete implementation	N/A
OU-1	Groundwater contamination extends beyond the site boundary; no institutional controls to limit groundwater use are in place on neighboring properties where groundwater contamination is present.	Evaluate the need for institutional controls restricting groundwater use on properties where groundwater contamination is present. Record any needed restriction requirements in a decision document.	Ongoing	Data collection is ongoing to support the FFS and modifications to the decision document	N/A
OU-2	Soil contamination (specifically chromium and PCB-1254) concentrations exceeded residential RSLs and may not allow for residential use.	Evaluate the need for institutional controls for OU-2. If required, modify the decision document as appropriate.	Ongoing	2019 FFS –R2 (Human Health Risk Assessment Update) determined there are potential risks to human health if unrestricted land use is permitted at OU-2(soils). Institutional Controls are needed to restrict residential land use.	N/A

OTHER FINDINGS

Two additional recommendations were identified during the 2018 FYR. These recommendations did not affect current and/or future protectiveness.

- If additional buildings are built over volatile groundwater contamination, this exposure pathway should be further evaluated with multiple lines of evidence to determine if mitigation is needed.
- Continue to monitor downgradient monitoring well locations to ensure the current remedy and the future selected remedy remains protective of Fishing Creek.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

On October 19, 2022, the EPA issued a press release, which announced that comprehensive reviews will be conducted of completed cleanup work at NPL Superfund sites in the Southeast, including the Carolawn Site. Appendix D contains a copy of the EPA News Release. A copy of the FYR report will be made available on the EPA website: https://www.epa.gov/superfund/carolawn.

The FYR process included interviews with regulatory agencies involved in Site activities or aware of the Site. The purpose was to document the perceived status of the Site and any perceived problems or successes with the phases of the remedy implemented to date. All the interviews were conducted in person, via telephone, or completed by email after the Site inspection. The interviews are summarized below. Completed interview forms are included in Appendix D.

Jeff Ahrens from PRP contractor Geosyntec stated that the SVE system has been an effective interim remedial measure. Overall, groundwater monitoring data suggest that concentrations of Site-specific COCs in groundwater are generally stable or decreasing, and this data supports that MNA following prior SVE activities, is effectively addressing COCs in groundwater at the Site. Former source area monitoring wells which historically had the highest concentrations of TCE at the Site (MW-05, MW-06 and MW-12) have shown greater than an order of magnitude reduction in VOC concentrations since the startup of the SVE system in 2011. Cis-1,2-DCE concentrations have reduced to concentrations below the MCL (70 µg/L) in each Site monitoring well, except for MW-16. In monitoring wells located near Fishing Creek, both TCE and cis-1,2-DCE are reported below the MCL at MW-10A, MW-11A and MW-11B in September 2022, with TCE present at a concentration of 39.5 µg/L in MW-10B, which represents an approximate 3-fold decrease since 2011.

The SVE system (conducted as an Interim Remedial Measure) proved to be an effective means of VOC source mass removal at the Site and proved to be a more effective remedial measure than the previously operated groundwater pump and treat system which was shut down with regulatory approval in 2004. Approximately 160 pounds (lbs) of VOCs were removed during the period of SVE system operation (January 2012 through June 2014); for comparison, the groundwater extraction and treatment system (GWETS) removed approximately 35 lbs of VOCs during its 7.5 years of operation. As is typical, the mass removal rate of the SVE system decreased with time due to the ongoing reduction of VOC mass in the vadose zone, and for that reason, SVE system operations were ceased, and the system was subsequently abandoned in 2016 with concurrence from EPA. The removal of VOCs from the vadose zone in the former source area by the SVE system has and will continue to result in improvements to groundwater quality over time as source depletion reduced VOC mass flux into the groundwater. Following source mass removal, the observed trends over the last five years of groundwater monitoring indicate that natural attenuation processes also serve an important function in meeting Applicable or

Relevant and Appropriate Requirements (ARARs) at the Site. Based on the removal of COC source mass and current groundwater trends observed at the Site, Geosyntec, on behalf of the performing PRPs, urges EPA to modify the 1989 ROD, and formally select MNA as the remedy for the Site. Geosyntec stand ready to assist USEPA in preparing the necessary documentation.

Christopher Slocum, the project manager with SCDHEC stated multiple groundwater remedies have been implemented and attempted throughout the Site's history, including groundwater extraction and treatment, in-situ bioremediation, and soil vapor extraction. The Site's hydrogeologic setting and the presence of contaminants in the fractured bedrock have limited the long-term effectiveness of the groundwater remedies implemented to date. The PRP contractor previously prepared a FFS to MNA as a potential groundwater remedy at the Site. While MNA may be a viable remedy due to the overall decreasing VOC concentration trends, SCDHEC has previously expressed concerns about the plume not being adequately defined to ensure that an MNA remedy will be protective. Based the 2021 groundwater data, the highest TCE concentrations at the Site were detected in monitoring well MW-10B, adjacent to Fishing Creek, at a concentration of 49.6 µg/L (*decreasing to 40.8 µg/L in 2023*). Additional characterization of groundwater discharge to the creek may be necessary to ensure that TCE is not discharging to the creek. Additionally, the northwestern and southern portions of the plume appear to be undefined, and additional monitoring wells may be needed to fully delineate the plume and support a potential MNA remedy. SCDHEC plans to continue discussions with the EPA, the PRP group, and the PRP contractor to select a groundwater remedy. Concurrently, groundwater VOC concentrations across most of the site demonstrate apparent decreasing trends. Deed restrictions to prohibit groundwater use were drafted in 2015 but have not been finalized due to the lack of a viable property owner. The restrictions are necessary to prevent any future human health risk due to exposure to contaminated groundwater. The Site is currently undeveloped and groundwater at the Site is not being used for residential purposes, and there is currently minimal risk of human exposure to contaminated groundwater at the Site. However, institutional controls restricting groundwater use are necessary to ensure long-term protectiveness of the remedy.

In May 2022, legislation (SC H.4999) was passed regarding the implementation of site-specific cleanup goals. The SCDHEC is currently working towards determining how best to implement this SC H.4999 on affected sites.

Data Review

Groundwater monitoring conducted during this FYR was intended to verify the effectiveness of remedial measures. Surface water was not sampled, but estimated surface water concentrations were calculated based on groundwater concentrations.

Groundwater

As described in multiple groundwater monitoring reports prepared by Geosyntec Consultants (Geosyntec), groundwater is currently monitored semiannually for VOCs. The well locations are shown in Appendix E, Figure E-1. Several wells are paired, with B wells having shallower well screens. The VOCs sampled that have exceeded MCLs from September 2018 to March 2023 include 1,1-DCE, cis-1,2-DCE, tetrachloroethylene (PCE), TCE and vinyl chloride; several of these VOCs are not official COCs. Several groundwater COCs are no longer sampled for as they were detected below the MCLs, including acetone, 1,1-DCA, trans-1,2-DCE, 1,1,1-TCA and lead. Appendix F, Table F-1, presents a summary of COCs detected in the groundwater at the site from October 2004 through September 2023.

The two most prevalent contaminants in groundwater at the Site are cis-1,2--DCE and TCE. Concentrations of these contaminants by well from 2011 to 2023 are shown in Appendix E, Figure E-2. Current plumes are shown in Appendix E, Figures E-3 through E-5. Groundwater flow is generally to the east in the western portion of the Site, and to the northeast and southeast toward Fishing Creek in the eastern portion of the Site. Therefore, plumes generally extend from the Site east toward the creek. See Figure E-6 in Appendix E for a potentiometric surface and flow map. The plumes in areas between the creek and Site are inferred due to a lack of wells. The MCL for TCE is 5 micrograms per liter (µg/L). The extent of the 5 µg/L TCE plume has decreased. All of the wells with TCE concentrations over 100 µg/L at the time of the 2018 FYR, have decreased in the last five years, including MW-13 (from 107 µg/L in 2018 to 44.5 µg/L in 2023) and MW-16 (from 115 µg/L in 2018 to 44.6 µg/L in 2023) as well as MW-12 which has decreased from 108 µg/L in 2018 to 5.7 µg/L in 2023. Concentrations in downgradient wells near the creek have decreased. Concentrations in monitoring well MW-11B decreased from 64.6 µg/L (in 2018) to 5.7 µg/L (in 2023). The concentrations in MW-10A/10B and MW-11A have decreased since 2018 but continue to exceed the MCL. During 2023, the concentrations in MW-10A/10B and MW-11A ranged from <5.7 µg/L to 40.8 µg/L. The TCE plume is available in Appendix E, Figure E-3.

The MCL for cis-1,2-DCE is 70 µg/L. The extent of the 70 µg/L cis-1,2-DCE plume changed slightly as the concentrations in MW-6 decreased from 142 µg/L in 2018 to 23.6 µg/L in 2023. The concentrations in MW-4 decreased from 44.3 µg/L in 2018 to 5.0 µg/L in 2023.The extent of the plume is now centered around MW-4 and MW-16. However, there was a significant decrease in the concentration at MW-16 which saw a decrease from 212 µg/L in 2018 to 70 µg/L in 2023. Concentrations also generally decreased in MW-5, MW-11A, and MW-11B. cis-1,2-DCE is still present along the northeastern edge of the creek at MW-10A/10B, but both wells showed slight decreases in their concentrations and are below the MCL. The 2023 cis-1,2- DCE plume is available in Appendix E, Figure E-4.

The MCL for 1,1-DCE is 7 µg/L. 1,1-DCE concentrations at MW-13 have decreased (from 85 µg/L in 2018 to 2.4 µg/L in 2023) and at MW-16 (from 9.1 µg/L in 2018 to 4.4 µg/L in 2023). Appendix E, Figure E-5 depicts the 2023 1,1- DCE plume.

Vinyl chloride was not detected above the MCL of 2 µg/L at the time of this FYR.

Figures depicting the concentration trends of TCE, cis-1,2-DCE and 1,1-DCE in the source area (MW-5 and MW-6) are available in Appendix E, Figures E-7and E-8. As seen in these graphs, concentrations of these contaminants have decreased overall in the last five years. Generally, groundwater contamination at the Site has decreased since the GWETS and particularly since the operation of the SVE system from 2012 to 2014. However, contamination remains above MCLs for several VOCs, which is why the EPA, the PRP and SCDHEC are continuing to discuss additional remedial options.

Surface Water

Groundwater concentrations were above MCLs for several contaminants during the most recent sampling event in wells next to the creek (MW-10A, MW-10B and MW-11A). Groundwater concentrations are below levels that would impact surface water in the creek above EPA Water Quality Criteria (WQC) for human health. To verify this conclusion with current data, the surface water concentration was predicted by applying a dilution factor (from the 2004 Remedial System Evaluation and Final Action Plan) to the maximum detected concentrations from wells MW- 10A, MW-10B and MW-11A from September 2018 to March 2023. The dilution factor represents the VOC groundwater

discharge attenuation in the creek. These estimated surface water concentrations were compared to their WQC (or the MCL if no WQC exists). All estimated surface water concentrations were less than their regulatory standards. Concentrations for cis-1,2-DCE, TCE and Vinyl Chloride have shown a slightly decreasing trend over the past five years. The highest concentration of TCE in a well near the creek was observed in 2019 at 75.8 µg/L in MW-10B; concentrations have declined in that well since then but have fluctuated and remained between 16.5 µg/L and 75.8 µg/L since 2018. Monitoring should continue to evaluate if increasing groundwater contaminant trends could impact the creek in the future.

Table 6: Estimated Surface Water Concentration Evaluation

COC	Maximum Detections from 2018 thru 2023 Sampling Events (from MW- 10A, MW-10B or MW-11B) (µg/L)	Dilution Factor[a]	Estimated Surface Water Concentration (µg/L)[b]	Current WQC[c] (µg/L)
Cis-1,2-DCE	76.1 (MW-11A) – 9/20/2018	0.001	0.0761	70[e]
TCE	75.8 (MW-10B) – 9-19-2019	0.001	0.0758	0.6
Vinyl chloride	2.2 (MW-10A) – 9/19/2019	0.001	0.0022	0.022

Notes:

a. Dilution factor from Section 2.3 of the 2004 Remedial System Evaluation and Final Action Plan.
b. Estimated surface water concentration = maximum detection x dilution factor.
c. WQC (human health for the consumption of water + organism) accessed at https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table. Last accessed October 27, 2022.
d. MCL used instead of the WQC because the WQC not available for the contaminant.

µg/L = micrograms per liter

Site Inspection

The site inspection took place on November 17, 2022. In attendance were Jeff Ahrens (Geosyntec), and Chris Slocum, Sara MacDonald, Benjamin Bair, Timothy Kadar (SCDHEC). The purpose was to assess the protectiveness of the remedy. For a full list of site inspection activities, see the Site Inspection Checklist in Appendix G.

The site inspection began with a tour of OU-1 - the former groundwater treatment building; this system is no longer used. Access to the area is controlled with a perimeter chain-link fence, locked gate and the building's doors are also locked. The fence has a "no trespassing" sign and a sign identifying the Site as a Superfund site. There was no evidence of trespassing in this area. The group also visited Fishing Creek at the northeastern part of the Site (near MW-10A and MW-10B). The monitoring wells in this area are in good condition.

The adjacent Savannah Springs Farm Hunt Club property is located south of treatment building. The hunting club cabin burned down approximately 8 to 10 years ago; the club has since rebuilt and currently has at least three structures on their property with a fourth one under construction. The RVs of several hunting club members were parked adjacent to the Site, and two of their buildings are in this area. One is raised about 15 feet off the ground, and one is on the ground behind the raised building. The third building is northeast of this area and is used for storage and hunting-related purposes. The hunting club has a no trespassing sign and a gate at Morrison Road that limits access.

SCDHEC visited the Site's information repository at the Lancaster County libraries. The Lancaster County Library (Library) has changed location within the past 5 years. The Site's Administrative Record (AR) was lost during the move. The Library requested that the AR be kept online at an EPA website. The Library can then provide access via the publicly available computers onsite and the website link.

SCDHEC visited the Fort Lawn Community Center, and they were receptive to holding the Site's AR at the Community Center. The closest library to the Site is the Great Falls Library located at 39 Calhoun Street, Great Falls, Chester County, SC 29055.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary:
A review of documents, ARARs, risk assumptions and the site inspection indicate that the Site's remedy is functioning as intended.

OU-1
The OU-1 remedy is partially functioning as intended. Removal actions addressed contaminated soil for OU-1. The GWETS operated from 1996 to 2004 and treated millions of gallons of groundwater. However, the system as operated was predicted to be unable to reach MCLs in a timely manner. The EISB and SVE pilot studies both reduced contaminant mass, but VOC contamination in groundwater persists. The CSC completed the revised FFS in 2016 and an FFS-R2 in 2019. The EPA, SCDHEC and CSC are currently working together to evaluate a final remedy to address residual groundwater contamination. After the EPA has an opportunity to solicit input from the community, the EPA will modify the decision document and formally require the new remedy.

Groundwater data currently indicate that there are no impacts to surface water in Fishing Creek above WQC. However, monitoring should continue to evaluate if increasing groundwater contaminant trends could impact the creek in the future. The 1989 ROD required institutional controls, which have not been implemented due to the lack of a viable property owner. The institutional controls are in draft form and will be recorded once there is a viable owner. Groundwater contamination also extends beyond the site boundary, but there are no known uses of this groundwater. The EPA is working with SCDHEC and CSC to implement institutional controls restricting groundwater use on properties where groundwater contamination is present.

OU-2
The OU-2 no action remedy is functioning as intended. A supplemental Human Health Risk Assessment (HHRA) conducted as part of the 2019 FFS-R2 indicates there are potential risks to human health if unrestricted land use is permitted (based on soil exposure). The HHRA supports the use of ICs to restrict land use to protect human health. See Question B for more detail.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of the remedy selection still valid?

Question B Summary:
The RAOs of preventing human exposure to contaminated groundwater, restoring the contaminated aquifer, preventing migration of contaminated groundwater to Fishing Creek remain valid. The COCs used to monitor groundwater to evaluate remedial effectiveness and the absence of soil contamination posing a risk to human health in OU-2 have changed.

The 2018 FYR Report stated that 1,4-dioxane was historically used as a stabilizer for 1,1,1-TCA and recommended including 1,4-dioxane in a future monitoring event. The 2019 supplemental HHRA found potential human health risks if the potable use of OU-1 (Sitewide) groundwater is permitted and if unrestricted land use is permitted at OU-2. The HHRA conclusions recommended revising the COC list to include vinyl chloride, 1,2-DCA, and PCE. The results support the use of ICs at the Site to restrict groundwater and land uses to protect human health.

OU-1
This FYR evaluated the validity of the Site's groundwater cleanup goals; the goals were based on proposed or established MCLs, except for acetone. MCLs used for groundwater cleanup goals all remain the same or less stringent than those selected in the 1989 ROD. See Appendix H for the full ARAR evaluation. The protectiveness of the acetone groundwater cleanup goal was evaluated using a screening-level risk evaluation conducted by comparing the cleanup goal to the EPA's residential tapwater regional screening level (RSL). See the full screening-level risk evaluation in Appendix I. Based on these evaluations, the groundwater cleanup goals set in the 1989 ROD remain valid.

Groundwater contaminants at the Site are considered volatile. A 2018 Vapor Intrusion Risk Evaluation was conducted as part of the Fifth FYR. The onsite GWETS building is inactive. The adjacent Savannah Springs Farm hunting club has several buildings near the Site for storage and deer hunting related purposes. Deer hunting season for Chester County (Game Zone 2) runs 108 days with archery only from September 15-30, primitive weapons from October 1-10, and gun hunts from October 11 to January 1. The 2018 Vapor Intrusion Risk Evaluation calculated the potential vapor intrusion risks based on conservative estimates using the EPA's Vapor Intrusion Screening Level Calculator. Commercial land use (i.e., 250 days of exposure per year with eight hours of exposure per day) was assumed for a hunter's exposure for structures near MW-13. The exact use of the storage building near MW-8 was uncertain at the time of the vapor intrusion evaluation. To be conservative, residential land use (i.e., 350 days per year and 24 hours of exposure per day) was assumed for the storage building. No unacceptable risk was determined for any structure in the 2018 Vapor Intrusion Risk Evaluation. The COCs concentrations have continued to decrease in MW-8 and MW-13. Site conditions are unchanged at the Savannah Springs Farm hunting club. If additional buildings are built over volatile groundwater contamination, the vapor intrusion exposure pathway should be further evaluated, and risk should be mitigated as needed.

The 1989 ROD stated that the rate and level of discharge of contaminants with the groundwater into Fishing Creek would not surpass the AWQC for the COCs. Several AWQC have become more or less stringent since the 1989 ROD (Appendix I). As part of the original RI/FS, an endangerment assessment was conducted to quantify the threat posed to Fishing Creek by Site groundwater. Based on the dilution factor for groundwater discharging to Fishing Creek, the low groundwater flow velocity and the level of contaminants detected at the Site, the endangerment assessment conducted during the RI/FS indicated that Site groundwater has no adverse effects on Fishing Creek under pre-remedial conditions. Maximum groundwater VOC concentrations at the Site have decreased substantially since issuance of the ROD.

While reductive dechlorination of chlorinated compounds is occurring, concentrations of daughter products such as VC have occasionally been detected in wells near Fishing Creek. In October 2014, VC was detected in MW-11A (a downgradient well adjacent to Fishing Creek) at a concentration of 9 µg/L, which represents the highest detection of VC in a well located adjacent to Fishing Creek. Applying the dilution factor for estimation of the VOC groundwater discharge attenuation in Fishing Creek as described in Section 2.3 of the *Remedial System Evaluation and Final Action Plan* (9.0 µg/L x (0.001) = 0.009 µg/L) then this calculated theoretical concentration would not exceed the current EPA water quality criterion for VC (human health-water and organism) of 0.022 µg/L. VC concentrations in this well have since decreased below detection limits. Applying the established dilution factor from the Action Plan, the maximum detected concentrations of TCE, 1,2-DCE and 1,1-DCE at the Site in March 2023, are significantly below the concentrations which are estimated to result in an exceedance of AWQCs in Fishing Creek if the well was located near Fishing Creek. In many cases, the highest detections of VOCs are located in the vicinity of the former source area (ex. the highest detection of TCE in March 2023 was 44.5 µg/L in MW-13), which is located over 800 ft from Fishing Creek. Monitoring should continue to evaluate if increasing groundwater contaminant trends could impact the creek in the future. Long-term monitoring should use current AWQC when evaluating impacts to surface water.

OU-2

This FYR also evaluated the validity of the toxicity information used to select the Site's OU-2 no action remedy. The historical maximum contaminant concentrations in soil and sediment were evaluated using a screening-level risk evaluation conducted by comparing the samples' concentrations to the EPA's current residential soil RSLs. Except for lead, hexavalent chromium, and polychlorinated biphenyl (PCB)-1254, the maximum detected concentrations of contaminants in soil are within the EPA's acceptable risk range for cancer risk and below an HQ of 1 for noncancer risk. Though the maximum detection of lead at 430 mg/kg exceeds the residential RSL, the average lead surface soil concentration was well below the RSL, indicating that unacceptable exposure risk from lead is unlikely. Maximum concentrations of hexavalent chromium and PCB-1254 exceeded residential RSLs and therefore do not allow for UU/UE. However, this screening is conservative because use of maximum concentrations and residential exposure assumptions in the assessment may overestimate risk. There is minimal potential exposure, as this site area is only used by hunters, and a recreational receptor is assumed to be on site less frequently and for a shorter duration than is assumed in the residential soil RSLs. However, to ensure long-term protectiveness, institutional controls are needed for soil in OU-2. See the full screening-level risk evaluation in Appendix J.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Table 5 includes the issues and recommendations from the 2018 FYR. As the status of the recommendations are ongoing, the issues were modified and regrouped to better articulate the recommendations.

Issues/Recommendations				
OU(s) without Issues/Recommendations Identified in the FYR:				
None				
Issues and Recommendations Identified in the FYR:				
OU(s): OU-1	**Issue Category: Remedy Performance**			
	Issue: The GWETS is no longer operating due to its estimated timeframe required to meet MCLs, but a new groundwater remedy is not yet in place. Not all currently sampled VOCs that exceed MCLs were selected as COCs in the original remedy.			
	Recommendation: Select and implement a new groundwater remedy. Record the selected remedy in a decision document. Include all appropriate COCs and cleanup goals in the decision document.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	7/3/2028
OU(s): OU-1	**Issue Category: Monitoring**			
	Issue: The 1989 ROD identified 1,1,1-TCA as a COC, and 1,4-dioxane was historically used as a stabilizer for 1,1,1-TCA. It is unknown if 1,4-dioxane is present in site media.			
	Recommendation: Sample for 1,4-dioxane in groundwater and take additional action if necessary.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	9/30/2024
OU(s): OU-1	**Issue Category: Institutional Controls**			
	Issue: The 1989 ROD required institutional controls which have not been implemented.			
	Recommendation: To prevent exposure to contaminated groundwater, restrict groundwater use on properties where concentrations are above the safe drinking water levels.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State/PRP	EPA	7/3/2028

OU(s): OU-1 and OU-2	Issue Category: Institutional Controls			
	Issue: Soil contamination, specifically chromium and PCB-1254, concentrations exceeded residential RSLs and may not allow residential use.			
	Recommendation: Modify the decision document to require ICs that restrict land use at the Site and implement ICs.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA/State/PRP	EPA	7/3/2028

OTHER FINDINGS

No additional recommendation was identified during the FYR. This recommendation does not affect current or future protectiveness.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)	
Operable Unit: OU-1	*Protectiveness Determination:* Short-term Protective

Protectiveness Statement:

The remedy at OU-1 is protective in the short term because there is no complete exposure pathway to contaminated groundwater, and the GWETS and other pilot studies have reduced the amount and extent of groundwater contamination. For the remedy to be protective over the long term, the following actions should occur:

- Sample for 1,4-dioxane in groundwater and take additional action if necessary.
- Modify the decision document to include a new groundwater remedy and identify all appropriate COCs and cleanup goals.
- Restrict groundwater use on properties where concentrations are above the safe drinking water levels to prevent exposure to contaminated groundwater.
- Modify the decision document to require ICs that restrict land use at the Site and implement ICs.

Protectiveness Statement(s)	
Operable Unit: OU-2	*Protectiveness Determination:* Short-term Protective

Protectiveness Statement:
The remedy at OU-2 is protective in the short term because historical removal actions, including removal of contaminated soil and drums, addressed contamination in this area. For the remedy to be protective over the long term, the following action should occur:

- Modify the decision document to require ICs that restrict land use at the Site and implement ICs.

Sitewide Protectiveness Statement
Protectiveness Determination: Short-term Protective

Protectiveness Statement:
The remedy at OU-1 is protective in the short term because there is no complete exposure pathway to contaminated groundwater, and the GWETS and other pilot studies have reduced the amount and extent of groundwater contamination. The remedy at OU-2 is protective in the short term because historical removal actions, including removal of contaminated soil and drums, addressed contamination in this area. For the remedy to be protective over the long term, the following actions should occur:

- Sample for 1,4-dioxane in groundwater and take additional action if necessary.
- Modify the decision document to include a new groundwater remedy and identify all appropriate COCs and cleanup goals.
- Restrict groundwater use on properties where concentrations are above the safe drinking water levels to prevent exposure to contaminated groundwater.
- Modify the decision document to require ICs that restrict land use at the Site and implement ICs.

VIII. NEXT REVIEW

The next FYR for the Site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

Biennial Groundwater Monitoring Report, Carolawn Superfund Site, Fort Lawn, Chester County, South Carolina. Prepared by Geosyntec Consultants. February 2018.

Carolawn Project Status/Groundwater Model Overview Meeting, Carolawn Superfund Site. Prepared by the Carolawn Steering Committee for EPA Region 4 and the South Carolina Department of Health and Environmental Control. May 2015.

Draft Final Operations and Maintenance Manual, Groundwater Remediation System, Carolawn Site, Chester County, South Carolina. Conestoga-Rovers & Associates. February 1997.

Fourth Five-Year Review for Carolawn Superfund Site, Fort Lawn, Chester County, South Carolina. EPA Region 4 and the South Carolina Department of Health and Environmental Control. September 2013.

Fifth Five-Year Review for Carolawn Superfund Site, Fort Lawn, Chester County, South Carolina. EPA Region 4 and the South Carolina Department of Health and Environmental Control. August 2018.

Groundwater Modeling Report, Carolawn Superfund Site, Fort Lawn, Chester County, South Carolina. Prepared by Geosyntec Consultants. September 2015.

Groundwater Sampling Technique Comparison Study Report, Carolawn Superfund Site, Fort Lawn, Chester County, South Carolina. Prepared by Geosyntec Consultants. March 2014.

Groundwater Monitoring Report, First Half 2018 – First Half 2020, Carolawn Superfund Site, Fort Lawn, South Carolina. Prepared by Geosyntec Consultants. June 2020.

Groundwater Monitoring Report, Second Half 2020 – Second Half 2021, Carolawn Superfund Site, Fort Lawn, South Carolina. Prepared by Geosyntec Consultants. March 2022.

Notification of Completion of SVE System Abandonment Activities, Carolawn Superfund Site, Fort Lawn, Chester County, South Carolina. Prepared by Geosyntec Consultants. September 2016.

Record of Decision, Carolawn Superfund Site, Fort Lawn, Chester County, South Carolina. EPA Region 4. September 1989.

Record of Decision for the Carolawn (OU-2) Superfund Site, Fort Lawn, Chester County, South Carolina. EPA Region 4. September 1995.

Remediation System Evaluation and Action Plan, Carolawn Superfund Site, Fort Lawn, Chester County, South Carolina. Prepared by O'Brien & Gere Engineers, Inc. for the Carolawn Steering Committee. August 2004.

Results from Injection Well Rehabilitation Activities and Dual Phase Extraction Tests, Carolawn Superfund Site, Fort Lawn, South Carolina. Prepared by Geosyntec Consultants. May 2010.

Results of Soil Vapor Extraction Testing at the Carolawn Superfund Site, Fort Lawn, South Carolina. Prepared by Geosyntec Consultants. November 2010.

Revised Focused Feasibility Study, Carolawn Superfund Site, Fort Lawn, Chester County, South Carolina. Prepared by Geosyntec Consultants. November 2016.

Revision 2 - Focused Feasibility Study, Carolawn Superfund Site, Fort Lawn, Chester County, South Carolina. Prepared by Geosyntec Consultants. February 2019.

Soil Vapor Extraction System Construction Completion Report, Carolawn Superfund Site, Fort Lawn, South Carolina. Prepared by Geosyntec Consultants. March 2012.

SVE System Status Report – 28 March 2014 Through 26 June 2014, Carolawn Superfund Site, Fort Lawn, South Carolina. Prepared by Geosyntec Consultants. August 2014.

Vapor Intrusion Pathway Memorandum for the Carolawn Superfund Site. Prepared by O'Brien & Gere Engineers, Inc. for the Carolawn Steering Committee. April 2008.

APPENDIX B – CURRENT SITE STATUS

Environmental Indicators
- Current human exposures at the Site are under control. - Current groundwater migration is under control.

Are Necessary Institutional Controls in Place?
☐ All ☐ Some ☒ None

Has EPA Designated the Site as Sitewide Ready for Anticipated Use?
☐ Yes ☒ No

Has the Site Been Put into Reuse?
☐ Yes ☒ No

APPENDIX C – SITE CHRONOLOGY

Event	Date
Solvents/waste storage facility first operated on site	1970
Initial operations to dispose of the inert waste from about 2,000 drums	1975
Permit issued by SCDHEC for one-time disposal of 300 to 400 drums with inert waste	1978
Site abandoned by the Carolawn Company	1980
Site investigation conducted by the EPA and SCDHEC indicated contamination on the Site and in nearby residential wells	1980
The EPA initiated first removal activity at the Site	December 1981
The EPA completed first removal action at the Site	February 1982
The EPA proposed the Site for listing on the NPL	December 1982
The EPA listed the Site on the NPL and the PRPs started the OU-1 RI/FS	September 1983
Four nearby residences connected to an alternative water supply	1985
PRPs entered an AOC to remove 17 storage tanks from the Site and dispose of waste content at an incinerator	May 1985
Second and third removal actions began	September 1985
Second and third removal actions completed	February 1986
Fourth removal action began	May 1986
Fourth removal action completed	June 1986
PRPs completed the OU-1 RI/FS pursuant to a Consent Decree and the EPA signed the OU-1 ROD (groundwater remedy)	September 1989
OU-1 remedial action initiated	May 1993
EPA started the OU-2 RI/FS	April 1994
OU-2 RI/FS completed, and the EPA signed the OU-2 ROD (no further action remedy for the area outside of the fence – soils, surface water and sediment in Fishing Creek)	September 1995
GWETS installed	1995-1996
The EPA issued a UAO to PRPs for O&M and monitoring	July 1997
Construction completion	May 1998
The EPA issued the Site's first FYR Report	August 1998
OU-1 remedial action completed	May 1999
The EPA issued the Site's second FYR Report	August 2003
With the EPA and SCDHEC approval, the GWETS was shut down as part of planned EISB pilot study treatment activities	July 2004
Completion of EISB treatment, consisting of injection of soy-oil based product	May 2005
The EPA issued the Site's third FYR Report	September 2008
The EPA issued a modified UAO that specified the requirement that an FFS be completed to identify a groundwater remedial action more effective than the GWETS	March 2009
PRP completed construction of the SVE system	January 2012
The EPA issued the Site's fourth FYR Report	September 2013
SVE system shutdown	June 2014
SVE system removed	July 2016
CSC submitted revised FFS Report	November 2016
The EPA issued the Site's fifth FYR Report	August 2018
CSC submitted FFS – Revision 2 for OU-1	February 2019
Groundwater Monitoring Report First Half 2018 – First Half 2020	June 2020

APPENDIX D – PRESS NOTICE/INTERVIEW FORMS



EPA to Review Cleanups at 45 Southeast Superfund Sites

Contact Information: region4press@epa.gov, 404-562-8400

ATLANTA (Oct. 19, 2022) – Today, the U.S. Environmental Protection Agency (EPA) announced that comprehensive reviews will be conducted of completed cleanup work at 45 National Priority List (NPL) Superfund sites in the Southeast.

The sites, located in Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee, will undergo a legally required Five-Year Review to ensure that previous remediation efforts at the sites continue to protect public health and the environment.

"The Southeast Region will benefit tremendously from the full restoration of Superfund sites, which can become valuable parts of the community landscape," **said EPA Region 4 Administrator Daniel Blackmon**. "The Five-Year Review evaluations ensure that remedies put in place to protect public health remain effective over time."

The Superfund Sites where EPA will conduct Five-Year Reviews in 2022 are listed below. The web links provide detailed information on site status as well as past assessment and cleanup activity. Once the Five-Year Review is complete, its findings will be posted in a final report at https://www.epa.gov/superfund/search-superfund-five-year-reviews.

Alabama

Alabama Army Ammunition Plant https://www.epa.gov/superfund/alabama-army-ammunition-plant
Alabama Plating Company, Inc. https://www.epa.gov/superfund/alabama-plating-co
Mowbray Engineering Co. https://www.epa.gov/superfund/mowbray-engineering
US NASA Marshall Space Flight Center
US Army/NASA Redstone Arsenal https://www.epa.gov/superfund/redstone-aresenal

Florida

ALARIC Area GW Plume https://www.epa.gov/superfund/alaric-area-groundwater-plume
Beulah Landfill https://www.epa.gov/superfund/beulah-landfill
Chevron Chemical Co. (Ortho Division) https://www.epa.gov/superfund/chevron-chemical-company
Florida Petroleum Reprocessors https://www.epa.gov/superfund/florida-petroleum-reprocessors
Miami Drum Services https://www.epa.gov/superfund/miami-drum-services
Pensacola Naval Air Station https://www.epa.gov/superfund/naval-air-station-pensacola
Raleigh Street Dump https://www.epa.gov/superfund/raleigh-street-dump
Taylor Road Landfill https://www.epa.gov/superfund/taylor-road-landfill
Tower Chemical Co. https://www.epa.gov/superfund/tower-chemical-company

Georgia

Alternate Energy Resources Inc. https://www.epa.gov/superfund/alternate-energy-resources
Peach Orchard & Nutrition Co. Rd PCE Groundwater Plume Site https://www.epa.gov/superfund/peach-orchard-road-pce-plume
Powersville Site https://www.epa.gov/superfund/powersville-site
T.H. Agriculture & Nutrition Co (Albany Plant) https://www.epa.gov/superfund/t-h-agriculture

Kentucky

A.L. Taylor (Valley of the Drums) https://www.epa.gov/superfund/al-taylor-valley-of-drums
Brantley Landfill https://www.epa.gov/superfund/brantley-landfill
Distler Brickyard https://www.epa.gov/superfund/distler-brickyard
Distler Farm https://www.epa.gov/superfun https://www.epa.gov/superfund/lee-lane-landfilld/distler-farm
Lee's Lane Landfill https://www.epa.gov/superfund/lee-lane-landfill
National Electric Coil Co./Cooper Industries https://www.epa.gov/superfund/national-electric-coil-cooper-industries
Tri City Disposal Co. https://www.epa.gov/superfund/tri-city-disposal

North Carolina

ABC One Hour Cleaners https://www.epa.gov/superfund/abc-one-hour-cleaners
Aberdeen Pesticide Dumps https://www.epa.gov/superfund/aberdeen-contaminated-groundwater
Benfield Industries, Inc. https://www.epa.gov/superfund/benfield-industries
Cherry Point Marine Corps Air Station https://www.epa.gov/superfund/cherry-point-marine-corps
CTS of Ashville, Inc. https://www.epa.gov/superfund/cts-millsgap
GEIGY Chemical Corp (Aberdeen Plant) https://www.epa.gov/superfund/ciba-geigy-corporation
Gurley Pesticide Burial https://www.epa.gov/superfund/gurley-pesticide-burial
North Carolina State University (Lot 86, Farm Unit #1) https://www.epa.gov/superfund/north-carolina-state-university
Sigmon's Septic Tank Service https://www.epa.gov/superfund/sigmon-septic-tank

South Carolina

Admiral Home Appliances https://www.epa.gov/superfund/admiral-home-appliances
Beaunit Corp (Circular Knit & Dyeing Plant) https://www.epa.gov/superfund/beaunit
Carolawn Inc. https://www.epa.gov/superfund/carolawn
Elmore Waste Disposal https://www.epa.gov/superfund/elmore-waste-disposal
International Minerals and Chemicals (IMC) https://www.epa.gov/superfund/imc
Kalama Specialty Chemicals https://www.epa.gov/superfund/kalama-specialty-chemicals
Koppers Company, Inc. (Charleston Plant) https://www.epa.gov/superfund/koppers-charleston-plant
Savannah River Site (USDOE) https://www.epa.gov/superfund/savannah-river-site
SCRDI Bluff Road https://www.epa.gov/superfund/scrdi-bluff-road

Tennessee

Mallory Capacitor Co. https://www.epa.gov/superfund/mallory-capacitor
Memphis Defense Depot (DLA) https://www.epa.gov/superfund/memphis-defense-depot

Background

Throughout the process of designing and constructing a cleanup at a hazardous waste site, EPA's primary goal is to make sure the remedy will be protective of public health and the environment. At many sites, where the remedy has been constructed, EPA continues to ensure it remains protective by requiring reviews of cleanups every five years. It is important for EPA to regularly check on these sites to ensure the remedy is working properly. These

reviews identify issues (if any) that may affect the protectiveness of the completed remedy and, if necessary, recommend action(s) necessary to address them.

There are many phases of the Superfund cleanup process including considering future use and redevelopment at sites and conducting post cleanup monitoring of sites. EPA must ensure the remedy is protective of public health and the environment and any redevelopment will uphold the protectiveness of the remedy into the future.

The Superfund program, a federal program established by Congress in 1980, investigates and cleans up the most complex, uncontrolled or abandoned hazardous waste sites in the country and endeavors to facilitate activities to return them to productive use. In total, there are more than 280 Superfund sites across the Southeast.

More information:

EPA's Superfund program: https://www.epa.gov/superfund

EPA.GOV

INTERVIEW FORM FOR FIVE-YEAR REVIEW

Site Name: Carolawn, Inc. Superfund Site

Interviewer's Name: Timothy Kadar **Affiliation:** SCDHEC

Interviewee's Name: Chris Slocum **Affiliation:** SCDHEC, Federal Remediation
Project Manager

Contact Info: SCDHEC
2600 Bull Street
Columbia, SC 29201
slocumcb@dhec.sc.gov

Type of Interview: Email
Date: December 12, 2022

1. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

Multiple groundwater remedies have been implemented and attempted throughout the Site's history, including groundwater extraction and treatment, in-situ bioremediation, and soil vapor extraction. The Site's hydrogeologic setting and the presence of contaminants in the fractured bedrock have limited the long-term effectiveness of the groundwater remedies implemented to date. The PRP contractor previously prepared Focused Feasibility Studies (FFS's) to demonstrate Monitored Natural Attenuation (MNA) as a potential groundwater remedy at the Site. While MNA may be a viable remedy due to the overall decreasing VOC concentration trends, DHEC has previously expressed concerns about the plume not being adequately defined to ensure that an MNA remedy will be protective. Based on the most recent groundwater data, the highest trichloroethylene (TCE) concentrations at the Site were detected in monitoring well MW-10B, adjacent to Fishing Creek, at a concentration of 49.6 parts per billion (ppb). Additional characterization of groundwater discharge to the creek may be necessary to ensure that TCE is not discharging to the creek. Additionally, the northwestern and southern portions of the plume appear to be undefined, and additional monitoring wells may be needed to fully delineate the plume and support a potential MNA remedy. DHEC plans to continue discussions with EPA, the PRP group, and the PRP contractor to select a groundwater remedy.

2. What is your assessment of the current performance of the remedy in place at the Site?

There is currently no active groundwater remedy in place at the Site. Several previous remedial actions at the Site were implemented but were discontinued due to asymptotic performance. The PRP contractor prepared FFS's in 2016 and 2019 which proposed Monitored Natural Attenuation (MNA) as the remedy for the groundwater plume. While DHEC is still in discussions with EPA, the PRP group, and the PRP contractor to select a groundwater remedy, groundwater VOC concentrations across most of the site demonstrate apparent decreasing trends.

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities from residents in the past five years?

I am not aware of any complaints or inquiries regarding site-related environmental issues or remedial

activities from residents in the past five years.

4. Has your office conducted any site-related activities or communications in the past five years? If so, please describe the purpose and results of these activities.

DHEC has participated in multiple site visits, meetings, and conference calls with EPA, the PRP contractor, and the PRP group. DHEC regularly reviews groundwater monitoring reports and other technical documents submitted by the PRP contractor and provides written comments as appropriate. The purpose of DHEC's participation in site-related activities is to provide support to EPA.

In September 2021, DHEC received an inquiry from Lancaster and Chester Railroad Company (L&C) about a potential purchase of part of the site for use as a lay down yard. DHEC participated in calls with L&C in September 2021 and October 2021, but no additional discussions between DHEC and L&C have been had to date.

In November 2021, DHEC received a request from Toeroek Associates, Inc. to complete an interview form regarding the Site. Toeroek was working with EPA Region 4 to perform interviews with officials and community members with knowledge of the Site. The interviews were intended to evaluate the remedy and work that was put in place and assess community reaction to the Site. The interview form was completed and returned to Toeroek on November 30, 2021.

5. Are you aware of any changes to state laws that might affect the protectiveness of the Site's remedy?

In May 2022, legislation (SC H.4999) was passed regarding the implementation of site-specific cleanup goals. The SCDHEC is currently working towards determining how best to implement that on affected sites.

6. Are you comfortable with the status of the institutional controls at the Site? If not, what are the associated outstanding issues?

Deed restrictions to prohibit groundwater use were drafted in 2015 but have not been finalized due to the lack of a viable property owner. The restrictions are necessary to prevent any future human health risk due to exposure to contaminated groundwater. The Site is currently undeveloped and groundwater at the Site is not being used for residential purposes, and there is currently minimal risk of human exposure to contaminated groundwater at the Site. However, institutional controls restricting groundwater use are necessary to ensure long-term protectiveness of the remedy.

7. Are you aware of any changes in projected land use(s) at the Site?

I am not aware of any changes in projected land use(s) at the Site.

8. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy?

As discussed in responses to previous questions, DHEC, EPA, the PRP group, and the PRP contractor should continue discussing the proposed change of the groundwater remedy. Institutional controls in the form of land use restrictions have been drafted but have not been implemented due to the lack of a viable property owner. Institutional controls restricting groundwater use are necessary to ensure long-term protectiveness of the remedy.

INTERVIEW FORM FOR FIVE-YEAR REVIEW

Site Name: Carolawn, Inc. Superfund Site

Interviewer's Name: Timothy Kadar **Affiliation:** SCDHEC

Interviewee's Name: Jeff Ahrens, P.E.(SC) **Affiliation:** Geosyntec Consultants

Contact Info: 1300 South Mint Street, Suite 300
Charlotte, NC 28203
(704) 227-0850
jahrens@geosyntec.com

Type of Interview: Email
Date: February 2, 2023

1. What is your overall impression of the project, including cleanup, maintenance, and reuse activities (as appropriate)?

Overall, groundwater monitoring data suggest that concentrations of Site-specific constituents of concern (COCs) in groundwater are generally stable or decreasing, and this data supports that monitored natural attenuation (MNA), following prior soil vapor extraction (SVE) activities, is effectively addressing COCs in groundwater at the Site. Former source area monitoring wells which historically had the highest concentrations of TCE at the Site (MW-05, MW-06 and MW-12) have shown greater than an order of magnitude reduction in VOC concentrations since the startup of the SVE system in 2011. TCE concentrations in MW-05 and MW-12 have decreased to concentrations below the MCL (5 µg/L) and at MW-06, TCE has reduced from 1,230 µg/L to 40.4 µg/L from March 2011 to September 2022. Cis-1,2-DCE concentrations have reduced to concentrations below the MCL (70 µg/L) in each Site monitoring well, except for MW-16. In monitoring wells located near Fishing Creek, both TCE and cis-1,2-DCE are reported below the MCL at MW-10A, MW-11A and MW-11B in September 2022, with TCE present at a concentration of 39.5 µg/L in MW-10B, which represents an approximate 3-fold decrease since 2011.

The SVE system (conducted as an Interim Remedial Measure) proved to be an effective means of VOC source mass removal at the Site and proved to be a more effective remedial measure than the previously operated groundwater pump and treat system which was shut down with regulatory approval in 2004. Approximately 160 pounds (lbs) of VOCs were removed during the period of SVE system operation (January 2012 through June 2014); for comparison, the groundwater extraction and treatment system (GWETS) removed approximately 35 lbs of VOCs during its 7.5 years of operation. As is typical, the mass removal rate of the SVE system decreased with time due to the ongoing reduction of VOC mass in the vadose zone, and for that reason, SVE system operations were ceased and the system was subsequently abandoned in 2016 with concurrence from EPA.

The removal of VOCs from the vadose zone in the former source area by the SVE system has and will continue to result in improvements to groundwater quality over time as source depletion reduced VOC mass flux into the groundwater. Following source mass removal, the observed trends over the last five

years of groundwater monitoring indicate that natural attenuation processes also serve an important function in meeting ARARs at the Site.

2. What is your assessment of the current performance of the remedy in place at the Site?

The current remedy for the Site, as stated in the ROD, is groundwater extraction and treatment. However, with Agency approval, the GWETS system was shut down in 2004, and after a series of interim remedial measures (IRM), the site has been in monitored natural attenuation (MNA) since mid-2014. Monitoring data collected during this five-year review period (2018 through 2022) indicate that COCs in groundwater are attenuating naturally.

The GWETS system was installed in 1996 and operated from 1996 to 2004 at a cost of $2.1 million. This system removed approximately 35 lbs of VOCs over the 7.5 years of operation. The Carolawn PRP Group, with Agency Oversight, has voluntarily conducted a series of interim remedial measures to further reduce source mass and promote natural attenuation of COCs remaining in groundwater. Enhanced in-situ biological treatment was completed in the former source area from 2004 to 2011 at a cost of $2.2 million. While successful in treating groundwater in close proximity to the injection points, the radius of influence was limited by site specific characteristics. As a final interim remedial measure, the PRP Group installed and operated an SVE system to treat impacted soils in the former source area. The system was installed in 2012 and operated for approximately 30 months at a cost of $750,000. The SVE system removed approximately 160 lbs of VOCs during the period of operation (January 2012 through June 2014). Since mid-2014, the PRP Group has spent another $850,000 to conduct groundwater monitoring and reporting, facility maintenance, conduct Agency-requested fate and transport modeling, meet with the Agencies, and prepare two revisions of the Focused Feasibility Study.

In conjunction with the observation that COC concentrations in groundwater are generally stable or decreasing, the SVE system appears to have been an effective Interim Remedial Measure (IRM). As indicated in the Focused Feasibility Study Report (FFS-R2) (completed in February 2019), on-going groundwater monitoring activities support that monitored attenuation would provide the most effective overall protection of human health and environment and provide compliance with ARARs. MNA is supported by reducing concentrations of VOCs in individual wells, an overall reduction in the plume footprint with time, and evidence of intrinsic biodegradation of VOCs (including the presence of daughter products, as well as methane and ethene production). Additionally, groundwater flow and transport modeling evaluations and first-order decay analysis presented in the March 2022 Biennial Groundwater Monitoring Report showed that TCE and DCE present in groundwater near Fishing Creek are expected to attenuate to concentrations below their respective MCL within an approximate 30-year timeframe (and it is noted that some wells have already shown reductions of VOCs to below MCLs at rates faster than the model predicted timeframes). An MNA remedy received the highest ranking amongst remedial alternatives in the RFFS (ranking highest amongst comparable alternatives in overall protectiveness of human health and the environment; compliance with regulatory requirements; long-term effectiveness and performance; reduction in toxicity, mobility and volume; short-term effectiveness; implementability; cost; and sustainability and is Geosyntec's recommended alternative to consider in modifying the 1989 ROD.

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities from residents in the past five years?

No.

4. What is the frequency of Operation and Maintenance activities and site inspections? To your knowledge, has the maintenance been implemented at the site?

The Site is inspected on a monthly basis by Geosyntec staff. Inspection activities include observation of the general condition of the facility and security of the building and equipment. Additionally, bi-weekly lawn maintenance is conducted during the growing season. Groundwater sampling activities occur on a semi-annual basis, typically in March and September of each year, with reporting on a biennial basis. The next Biennial Groundwater Monitoring Report is due in early 2024.

5. Are you aware of any changes in projected land use(s) at the Site?

No.

6. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy?

As discussed above, significant remedial progress has been achieved at the Site during the past five years, particularly with respect to the SVE system's removal of COC source mass from the vadose zone (i.e., its primary objective as a voluntary IRM). This COC removal in turn resulted in reducing the COC flux to the groundwater and has undoubtedly contributed to the observed decreasing groundwater COC concentration trends. Based on the removal of COC source mass and current groundwater trends observed at the Site, Geosyntec, on behalf of the performing PRPs, urges USEPA to modify the 1989 ROD, and formally select MNA as the remedy for the Site. Geosyntec stand ready to assist USEPA in preparing the necessary documentation.

cc: King & Spalding for the PRP Group
SCDHEC

APPENDIX E – GROUNDWATER MONITORING FIGURES

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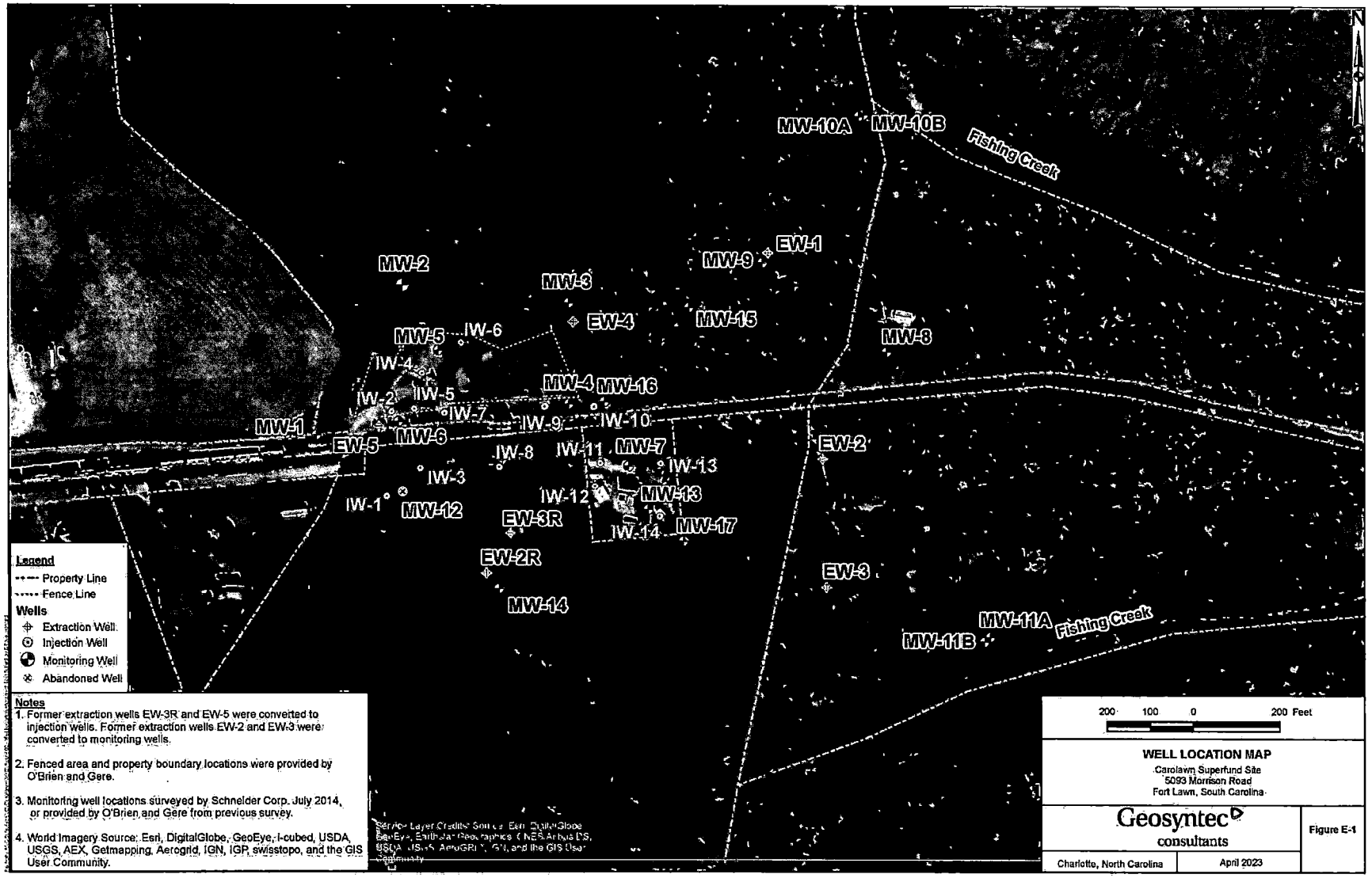


Figure E-1: Well Location Map

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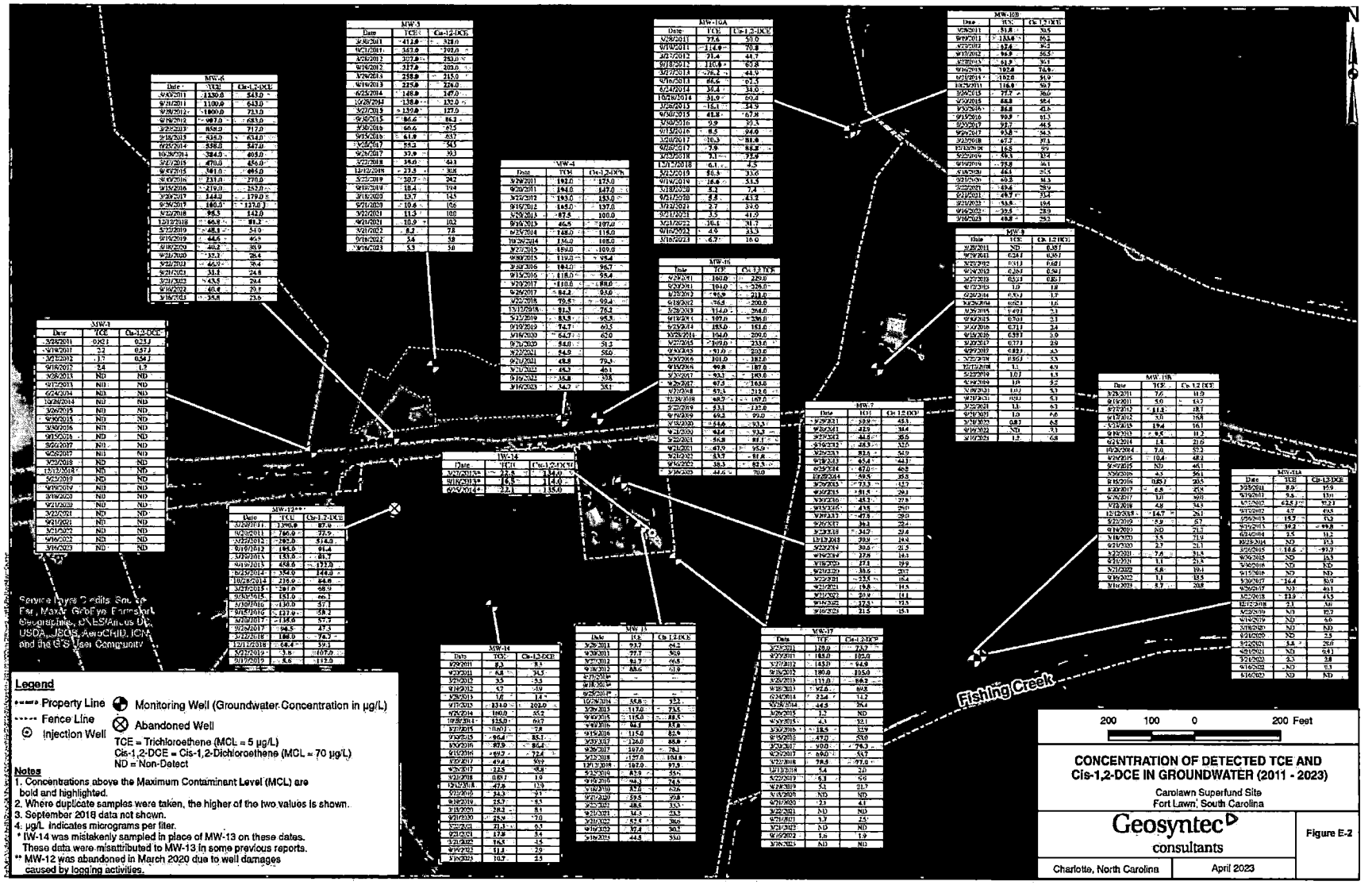


Figure E-2: Concentration of Detected TCE and Cis-1,2-DCE in Groundwater (2011-2023)

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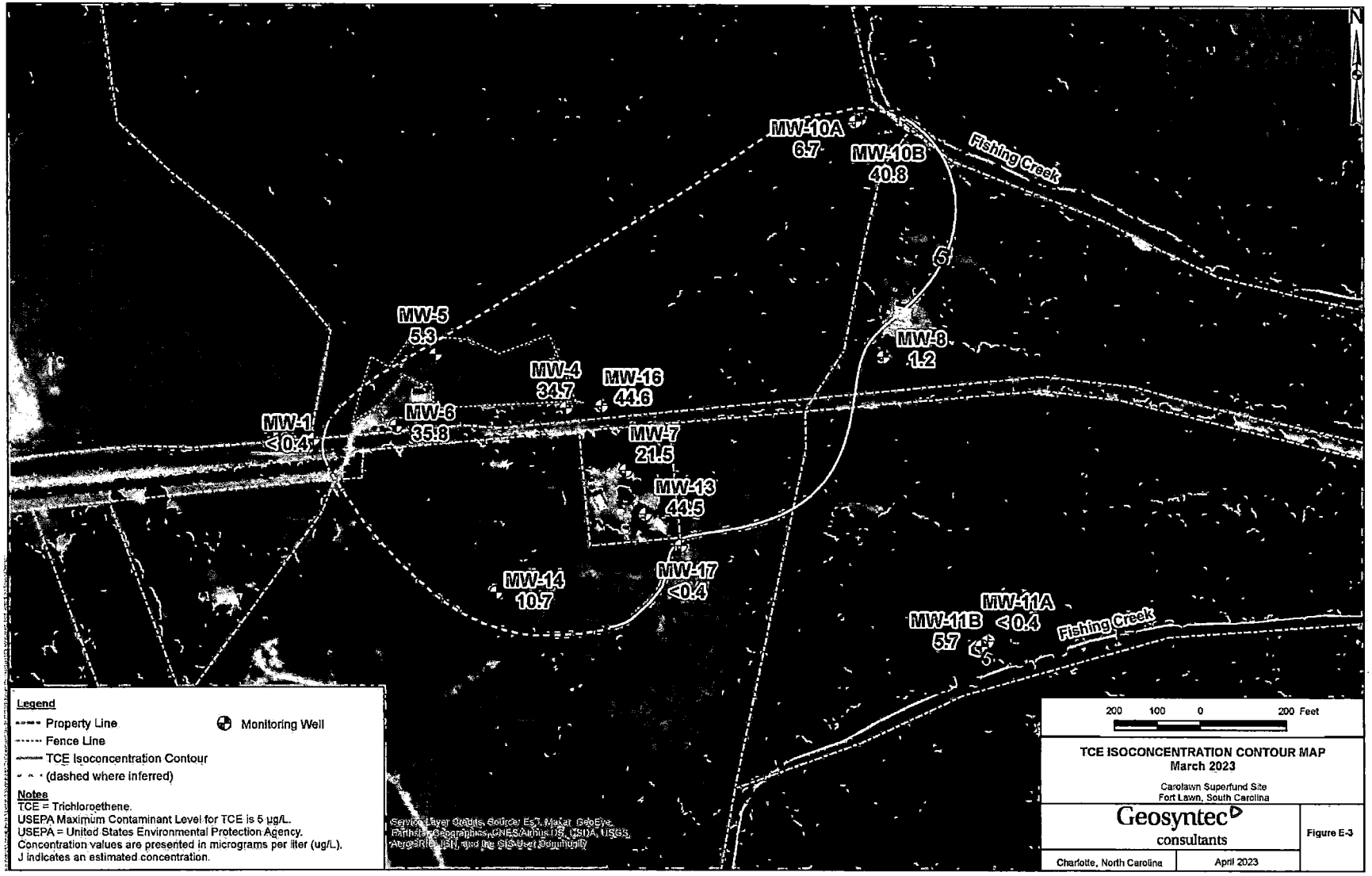


Figure E-3: TCE Isoconcentration Contour Map (March 2023)

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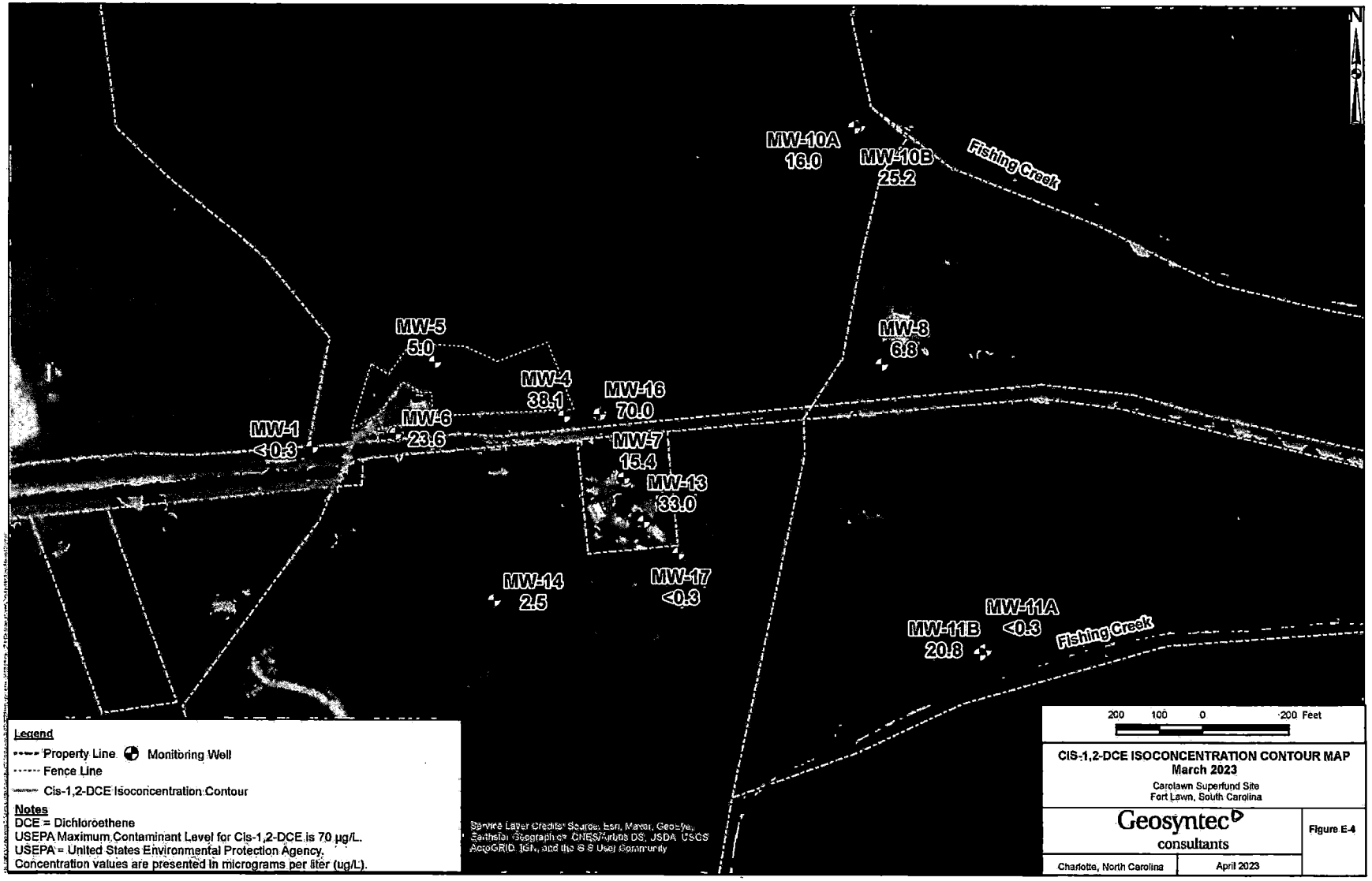


Figure E-4: Cis-1,2-DCE Isoconcentration Contour Map (March 2023)

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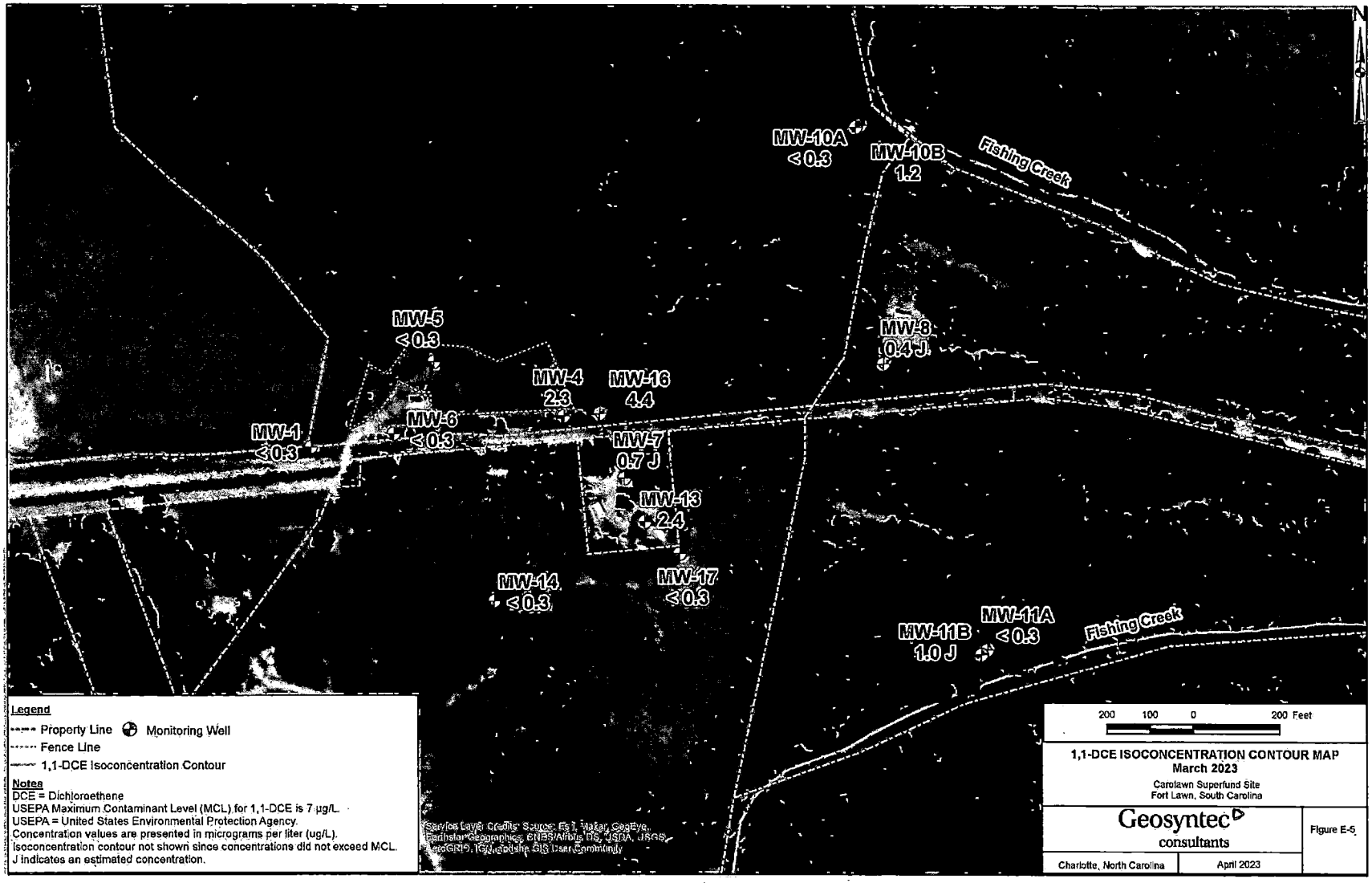


Figure E-5: 1,1-DCE Isoconcentration Contour Map (March 2023)

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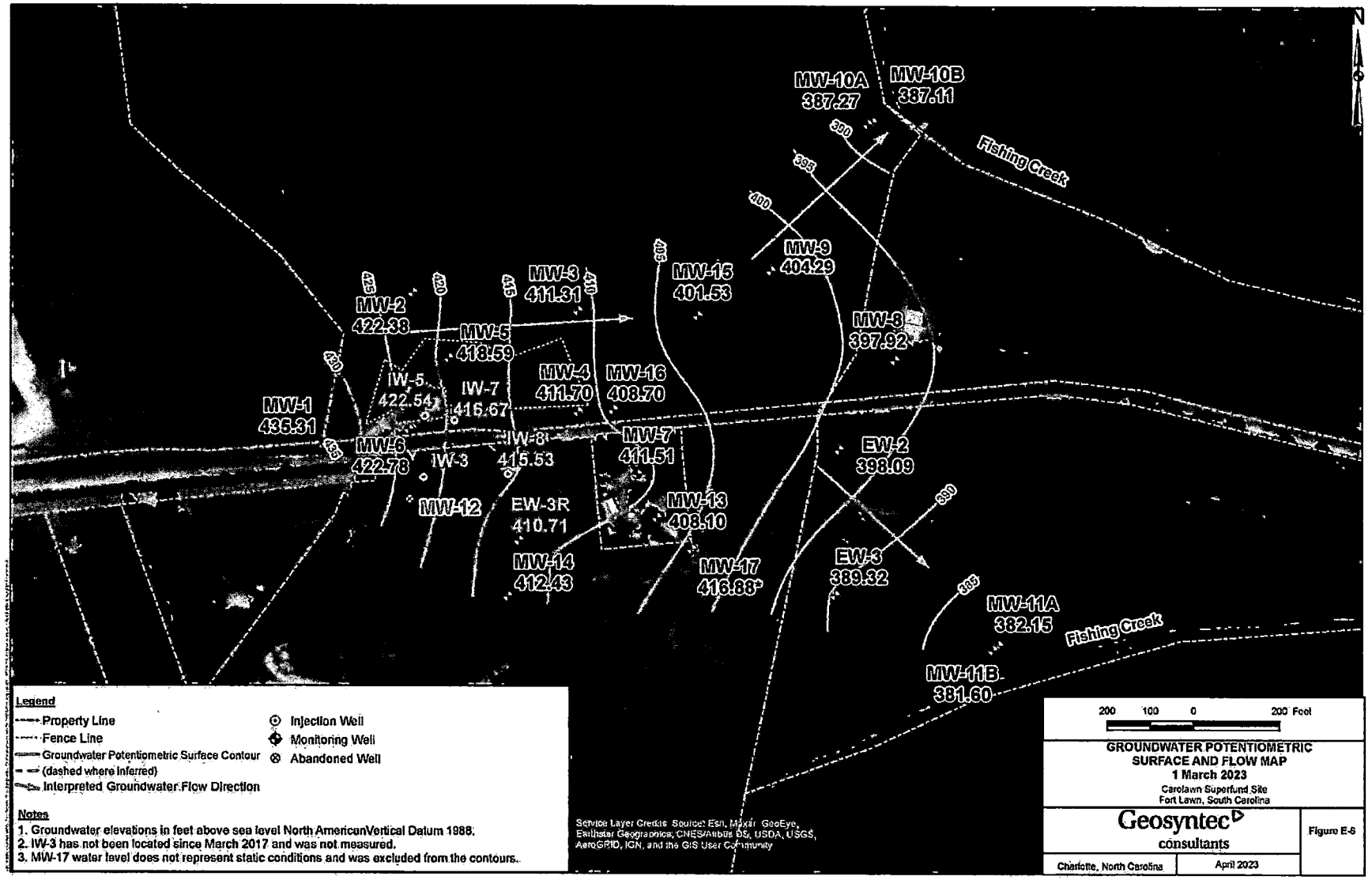
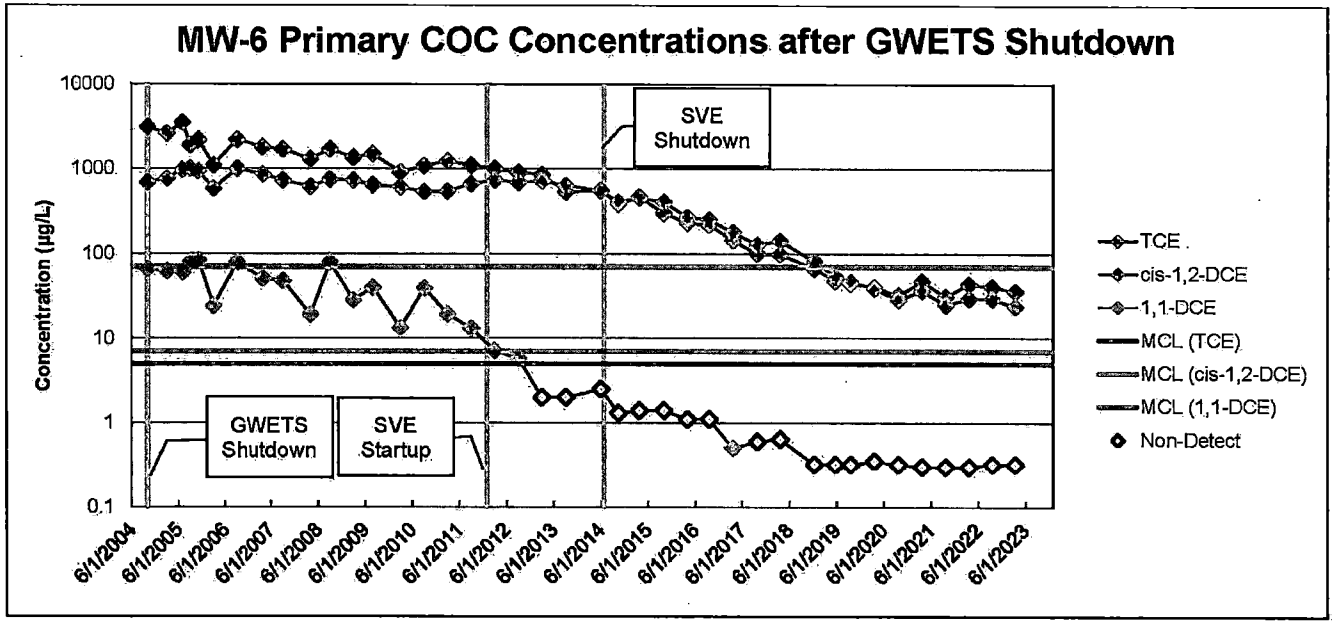


Figure E-6: Groundwater Potentiometric Surface and Flow Map (March 2023)

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Notes:
Non-detects represented at the detection limit.
GWETS – Groundwater Extraction and Treatment System
SVE – Soil Vapor Extraction
COC – Constituent of Concern
µg/L – micrograms per liter
TCE – trichloroethene
DCE – dichloroethane
MCL – maximum contaminant level

MW-6 PRIMARY COC CONCENTRATIONS AFTER GWETS SHUTDOWN
Carolawn Superfund Site
Fort Lawn, South Carolina

Geosyntec consultants

Figure E-7

Charlotte, North Carolina | April 2023

Figure E-7: MW-6 Primary COC Concentrations After GWETS Shutdown

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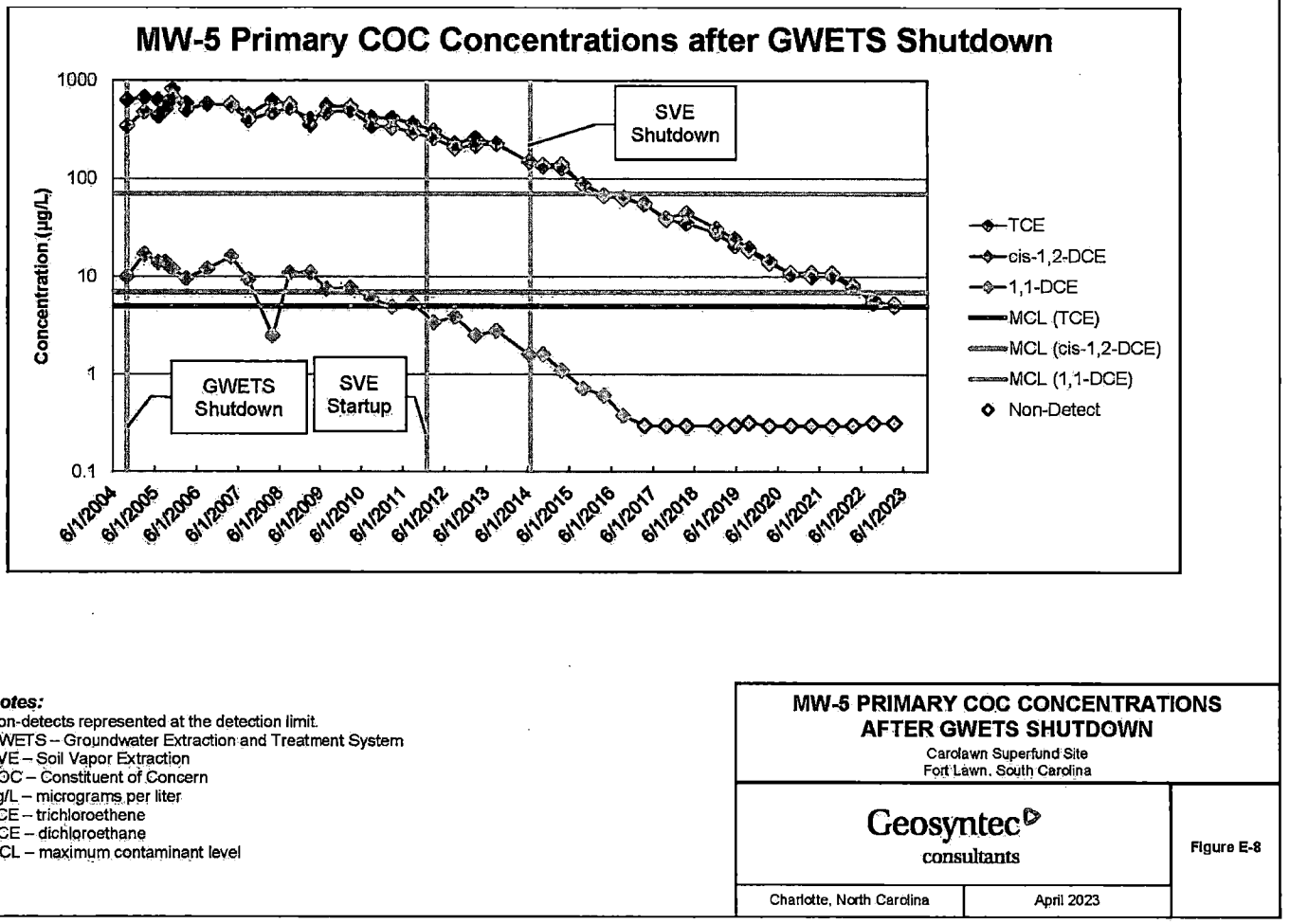


Figure E-8: MW-5 Primary COC Concentrations After GWETS Shutdown

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APPENDIX F – SUMMARY OF DETECTED COCS IN GROUNDWATER MONITORING WELLS OCTOBER 2004 THROUGH MARCH 2023

Table F- 1: Summary of Detected COCs in Groundwater Monitoring Wells October 2004 Through March 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
USEPA MCL (µg/L)		5	7	70	5	5	2
MW-1	10/26/2004	< 1.0	< 1.0	0.4 J	< 1.0	2.1	< 1.0
	3/15/2005	< 1.0	< 1.0	< 1.0	< 1.0	1.3	< 1.0
	9/30/2005	< 1.0	< 1.0	1.1	< 1.0	4.1	< 1.0
	3/20/2006	< 1.0	< 1.0	< 1.0	< 1.0	1.3	< 1.0
	9/26/2006	< 1.0	< 1.0	< 1.0	< 1.0	1.1	< 1.0
	4/23/2007	< 0.5	< 0.8	0.6 J	< 0.5	3.3	< 0.7
	9/18/2007	< 1.0	< 1.0	< 1.0	< 1.0	1.0	< 1.0
	4/14/2008	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	9/24/2008	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	3/24/2009	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0
	8/4/2009	< 0.4	< 0.4	< 0.2	< 0.2	0.2 J	< 0.2
	3/23/2010	< 0.4	< 0.4	< 0.2	< 0.2	0.5 J	< 0.2
	9/28/2010	< 0.1	< 0.1	0.4 J	< 0.2	1.3	< 0.2
	3/28/2011	< 0.1	< 0.1	0.3 J	< 0.2	0.8 J	< 0.2
	9/19/2011	< 1.0	< 1.0	0.6 J	< 1.0	2.2	< 1.0
	3/27/2012	< 1.0	< 1.0	0.5 J	< 1.0	1.7	< 1.0
	9/18/2012	< 1.0	< 1.0 UJ	1.2	< 1.0 UJ	2.4	< 1.0
	3/28/2013	< 0.2	< 0.2	< 0.2	< 0.3	< 0.3	< 0.4
	9/17/2013	< 0.2	< 0.2	< 0.2	< 0.3	< 0.3	< 0.4
	6/24/2014	< 0.2	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
	10/28/2014	< 0.2	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
	3/26/2015	< 0.2	< 0.3	< 0.2	< 0.3	< 0.2	< 0.5
	9/30/2015	< 0.2	< 0.3	< 0.2	< 0.3	< 0.2	< 0.3
	3/30/2016	< 0.3	< 0.2	< 0.3	< 0.3	< 0.3	< 0.3
	9/15/2016	< 0.3	< 0.2	< 0.3	< 0.3	< 0.3	< 0.3
	3/20/2017	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	9/26/2017	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	3/22/2018	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	9/20/2018**	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	12/12/2018	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	5/22/2019	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	9/19/2019	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	3/18/2020	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	9/21/2020	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	3/22/2021	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	9/21/2021	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	3/21/2022	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	9/16/2022	< 0.3 (< 0.3)	< 0.3 (< 0.3)	< 0.3 (< 0.3)	< 0.2 (< 0.2)	< 0.4 (< 0.4)	< 0.4 (< 0.4)
	3/16/2023	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4

Table F-1 (Continue)
SUMMARY OF DETECTED COCS
IN GROUNDWATER MONITORING WELLS
OCTOBER 2004 THROUGH MARCH 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl Chloride
USEPA MCL (µg/L)		5	7	70	5	5	2
MW-4	11/1/2004	4.3	11.0	120.0	9.2	140.0	< 4.0
	3/18/2005	5.1	15.0	150.0	12.0	160.0	< 1.0
	7/12/2005	0.7 J	6.7	51.0	3.6	50.0	< 1.0
	9/25/2005	2.7	12.0	110.0	11.0	100.0	< 1.0
	12/1/2005	5.0 (4.8)	13.0 (12.0)	140.0 (130.0)	15.0 (14.0)	150.0 (140.0)	< 1.0 (< 1.0)
	3/21/2006	6.6	18.0	170.0	32.0	160.0	< 1.0
	9/27/2006	7.6	17.0	170.0	33.0	180.0	< 1.0
	4/26/2007	8.8	14.0	170.0	34.0	170.0	< 0.7
	9/20/2007	9.5	15.0	160.0	47.0	170.0	< 1.0
	4/17/2008	9.3	10.0	110.0	43.0	190.0	< 1.0
	9/24/2008	8.5 (11.0)	18.0 (15.0)	180.0 (180.0)	53.0 (56.0)	220.0 (300.0)	< 1.0 (< 2.0)
	3/25/2009	7.5 J (4.7 J)	11.5 J (2.5 J)	167.0 J (87.1 J)	46.4 J (8.2 J)	111.0 J (62.3 J)	< 2.0 (< 2.0)
	8/5/2009	6.6	9.7	150.0	39.5	182.0	< 0.2
	3/24/2010	5.9	9.9	149.0	52.8	200.0	< 0.2
	9/29/2010	4.9 (5.0)	12.8 (12.3)	149.0 (150.0)	68.7 (69.3)	177.0 J (171.0)	< 0.2 (< 0.2)
	3/29/2011	5.4 (5.1)	10.0 (14.9)	142.0 (173.0)	55.3 (66.5)	192.0 (184.0)	< 0.2 (< 0.2)
	9/20/2011	5.4 (5.7)	9.6 (12.1)	133.0 (147.0)	68.7 (81.8)	191.0 (194.0)	< 1.0 (< 1.0)
	3/27/2012	5.1	12.3	153.0	70.1	193.0	< 1.0
	9/18/2012	5.1 (5.1)	9.2 (9.6)	137.0 (134.0)	56.1 (57.7)	165.0 (165.0)	< 1.0 (< 1.0)
	3/29/2013	3.7 (2.7)	7.0 (5.6)	100.0 (98.8)	38.9 (28.4)	86.0 (87.5)	< 0.4 (< 0.4)
	9/19/2013	2.0 (2.2)	3.6 (3.6)	104.0 (107.0)	13.2 (13.7)	46.5 (44.9)	< 0.4 (< 0.4)
	6/25/2014	5.4 (5.7)	8.5 (8.3)	113.0 (115.0)	22.3 (21.9)	145.0 (148.0)	< 0.7 (< 0.7)
	10/28/2014	5.2 (5.0)	9.5 (8.8)	102.0 (108.0)	30.3 (26.3)	129.0 (136.0)	< 0.3 (< 0.3)
	3/27/2015	5.3 (4.2)	7.6 (7.2)	109.0 (109.0)	31.1 (29.8)	159.0 (145.0)	< 0.5 (< 0.5)
	9/30/2015	4.3 (4.3)	7.1 (7.0)	95.4 (94.6)	23.5 (23.9)	119.0 (119.0)	< 0.5 (< 0.5)
	3/30/2016	4.0 (4.3)	6.7 (7.6)	96.7 (85.1)	19.7 (23.2)	96.0 (104.0)	< 0.3 (< 0.3)
	9/15/2016	3.3	5.4	95.4	21.4	118.0	< 0.6
	3/20/2017	2.9 (3.0)	4.5 (4.9)	80.9 (68.0)	15.9 (17.4)	99.0 (110.0)	< 0.3 (< 0.3)
	9/26/2017	2.6 (2.6)	5.8 (5.8)	93 (90.6)	18.9 (19.9)	84.2 (79.8)	< 0.4 (< 0.4)
	3/21/2018	2.6 (2.7)	5.3 (5.7)	99.4 (81.4)	12.3 (12.7)	75.2 (79.5)	< 0.4 (< 0.4)
	9/20/2018	2.7 (< 0.3)	4.8 (1.1)	87.9 (24.1)	13.7 (< 0.2)	87.4 (10.4)	< 0.4 (< 0.4)
	12/12/2018	2.2 (2.3)	4.2 (4.3)	76.2 (76.1)	11.6 (11.7)	80.1 (81.3)	< 0.4 (< 0.4)
	5/22/2019	2.0	4.9	95.5	10.9	83.5	< 0.4
	9/19/2019	1.9	4.3	69.5	11.0	74.7	< 0.4
	3/18/2020	1.5 (1.6)	3.3 J (3.6 J)	61.0 (62.0)	9.1 (9.5)	63.1 (64.7)	< 0.4 (< 0.4)
	9/21/2020	1.2 (1.1)	2.7 (2.7)	49.0 (51.2)	8.5 (9.1)	51.4 (54.0)	< 0.4 (< 0.4)
	3/22/2021	1.0 (1.0)	3.1 (3.1)	58.0 (57.8)	7.1 (8.2)	53.1 (54.9)	< 0.4 (< 0.4)
	9/21/2021	1.1 (1.3)	3.7 (2.5)	79.3 (48.6)	8.1 (8.4)	48.5 (48.8)	< 0.4 (< 0.4)
	3/21/2022	0.82 J (0.75 J)	2.3 (2.2)	46.1 (43.7)	6.5 (6.7)	45.2 (42.4)	< 0.4 (< 0.4)
	9/16/2022	< 0.3	1.8	39.8	6.0	35.8	< 0.4
	3/16/2023	< 0.3 (0.64 J)	2.1 (2.3)	36.9 (38.1)	3.7 (4.1)	32.2 (34.7)	< 0.4 (< 0.4)

Table F-1 (Continue)
SUMMARY OF DETECTED COCS
IN GROUNDWATER MONITORING WELLS
OCTOBER 2004 THROUGH MARCH 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethene	1,1-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
USEPA MCL (µg/L)		5	7	70	5	5	2
MW-5	10/31/2004	5.5	10.0	340.0	4.4	630.0	< 2.0
	3/18/2005	2.3 J (2.6 J)	16.0 (17.0)	480.0 (480.0)	3.4 J (3.5 J)	670.0 (700.0)	< 4.0 (< 4.0)
	7/13/2005	2.4 (2.4)	14.0 (14.0)	430.0 (470.0)	4.2 (4.0)	630.0 (570.0)	< 1.0 (< 1.0)
	9/29/2005	2.1	14.0	510.0	4.6	570.0	< 1.0
	11/30/2005	3.1	12.0	660.0	3.5	810.0	1.2
	3/22/2006	< 1.0	9.6	500.0	3.3	580.0	< 1.0
	9/28/2006	< 1.0	12.0	570.0	4.0	650.0	< 1.0
	4/26/2007	2.7 (3.0)	13.0 (16.0)	550.0 (570.0 J)	4.3 (4.9)	580.0 (600.0 J)	< 0.7 (< 0.7)
	9/20/2007	2.8	9.4	390.0	3.3	450.0	< 1.0
	4/17/2008	5.4	< 5.0	470.0	< 5.0	620.0	< 1.0
	9/25/2008	4.3	11.0	520.0	4.1	570.0	< 1.0
	3/25/2009	6.2	11.0	401.0	4.4	351.0	< 2.0
	8/5/2009	7.5	7.5	461.0	3.7	551.0	< 0.2
	3/25/2010	8.9	7.7	493.0	3.4	539.0	< 0.2
	9/30/2010	7.5	6.0	342.0	3.4	417.0	< 0.2
	3/30/2011	7.1	4.9	328.0	3.3	412.0	< 0.2
	9/21/2011	7.7	5.4	292.0	3.6	362.0	< 1.0
	3/28/2012	7.0 (6.9)	3.4 (3.1)	258.0 (252.0)	3.4 (3.2)	307.0 (290.0)	< 1.0 (< 1.0)
	9/19/2012	8.5	3.9	203.0	6.8	227.0	< 1.0
	3/29/2013	8.8	2.5 J	215.0	10.9	258.0	< 2.2
	9/19/2013	10.3	2.8	226.0	11.9	225.0	< 1.1
	6/25/2014	9.9	1.6 J	147.0	3.4	148.0	< 0.7
	10/28/2014	9.6	1.6	132.0	4.6	138.0	< 0.3
	3/27/2015	8.2	1.1 J	127.0	2.6	139.0	< 0.5
	9/30/2015	5.0	0.7 J	86.2	1.6 J	86.6	< 0.5
	3/30/2016	5.0	0.6 J	67.5	1.5	66.6	< 0.3
	9/15/2016	3.5	0.4 J	63.7	1.0 J	61.9	< 0.3
	3/20/2017	3.1	< 0.3	54.5	0.9 J	55.2	< 0.4
	9/26/2017	2.3	< 0.3	39.3	0.6 J	37.9	< 0.4
	3/22/2018	3.5	< 0.3	44.3	0.4 J	35.0	< 0.4
	9/20/2018**	3.9	< 0.3	37.0	0.3 J	31.1	< 0.4
	12/12/2018	3.3	< 0.3	30.8	0.44	27.5	< 0.4
	5/22/2019	3.0	< 0.3	24.2	0.4 J	20.7	< 0.4
	9/19/2019	2.8	< 0.3	19.4	0.3 J	18.4	< 0.4
	3/18/2020	2.5	< 0.3	14.5	0.3 J	13.7	< 0.4
	9/21/2020	1.9	< 0.3	10.6	< 0.2	10.6	< 0.4
	3/22/2021	1.3	< 0.3	10.0	< 0.2	11.3	< 0.4
	9/21/2021	1.4	< 0.3	10.2	< 0.2	10.9	< 0.4
	3/21/2022	1.0 J	< 0.3	7.8	< 0.2	8.2	< 0.4
	9/16/2022	0.6 J	< 0.3	5.8	< 0.2	5.4	< 0.4
	3/16/2023	< 0.3	< 0.3	5.0	< 0.2	5.3	< 0.4

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Table F-1 (Continue)
SUMMARY OF DETECTED COCS
IN GROUNDWATER MONITORING WELLS
OCTOBER 2004 THROUGH MARCH 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethane	1,4-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
USEPA MCL (µg/L)		5	7	70	5	5	2
MW-6	11/1/2004	< 100.0 (< 100.0)	66.0 J (77.0 J)	690.0 (790.0)	< 100.0 (81.0 J)	3,100 (3,200)	< 100.0 (< 100.0)
	3/20/2005	1.0 J	62.0	770.0	24.0	2,600	< 1.0
	7/12/2005	< 20.0	60.0	1,000	20.0	2,500	< 20.0
	9/29/2005	< 1.0 (< 1.0)	79.0 (92.0)	1,000 (930.0)	19.0 (23.0)	1,900 (1,800)	5.3 (7.0)
	12/1/2005	< 1.0	83.0	930.0	24.0	2,200	7.6
	3/22/2006	< 1.0 (< 1.0)	24.0 (38.0)	560.0 (650.0)	15.0 (17.0)	1,100 (1,400)	2.2 (2.1)
	9/28/2006	< 1.0 (< 1.0)	79.0 (75.0)	1,000 (990.0)	30.0 (29.0)	2,200 (2,300)	3.8 (3.6)
	4/27/2007	< 9.2	51.0 J	860.0	16.0 J	1,800 J	< 13.0
	9/26/2007	< 1.0 (< 1.0)	48.0 (62.0)	730.0 (680.0)	29.0 (26.0)	1,700 (1,500)	3.2 (2.8)
	4/17/2008	< 1.0 (< 1.0)	19.0 (20.0)	620.0 (730.0)	6.7 J (17.0)	1,300 (1,600)	< 10.0 (< 10.0)
	9/25/2008	0.8 J	79.0	750.0	30.0	1,700	3.1
	3/25/2009	< 5.0	28.3	729.0 J	16.1	1,350	< 10.0
	8/5/2009	< 0.4	39.9	641.0	16.7	1,500	2.1
	3/25/2010	< 0.4	13.2	598.0	5.6	916	3.4
	9/30/2010	< 0.3	39.2 J	535.0	22.6	1,050 J	< 0.5
	3/30/2011	< 0.6	19.2	543.0	10.2	1,230	1.9 J
	9/21/2011	< 2.0	13.0	643.0	8.8	1,100	< 2.0
	3/28/2012	0.9 J	7.1	723.0	4.3	1,000	2.0
	9/19/2012	0.4 J	5.7	683.0	2.4	907.0	1.9
	3/28/2013	< 2.2	< 2.0	717.0	< 3.2	858.0	< 4.4
	9/18/2013	< 2.2	< 2.0	634.0	< 3.2	535.0	11.3
	6/25/2014	< 2.4	< 2.5	547.0	< 2.6	558.0	< 3.3
	10/28/2014	< 1.2	< 1.3	405.0	< 1.3	384.0	< 1.6
	3/27/2015	< 1.0	< 1.4	456.0	< 1.6	470.0	< 1.3
	9/30/2015	< 1.0	< 1.4	405.0	< 1.6	301.0	< 1.3
	3/30/2016	< 1.4	< 1.1	270.0	< 1.5	231.0	< 1.6
	9/13/2016	< 1.4	< 1.1	252.0	< 1.5	219.0	< 1.6
	3/26/2017	< 0.3	0.5 J	179.0	< 0.2	144.0	< 0.4
	9/26/2017	< 0.6	< 0.6	127.0 J	< 0.4	100.0	< 0.8
	3/22/2018	< 0.6	< 0.6	142.0	< 0.4	93.3	< 0.8
	9/20/2018	< 0.3	< 0.3	104.0	< 0.2	78.1	< 0.4
	12/12/2018	< 0.3	< 0.3	81.2	< 0.2	66.8	< 0.4
	5/22/2019	< 0.3	< 0.3	54.0	< 0.2	48.1	< 0.4
	9/19/2019	< 0.3	< 0.3	46.3	< 0.2	44.6	< 0.4
	3/18/2020	< 0.3	< 0.3	38.9	< 0.2	40.2	< 0.4
	9/21/2020	< 0.3	< 0.3	28.4	< 0.2	32.2	< 0.4
	3/22/2021	< 0.3	< 0.3	36.4	< 0.2	46.9	< 0.4
	9/21/2021	< 0.3	< 0.3	24.8	< 0.2	31.1	< 0.4
	3/21/2022	< 0.3	< 0.3	29.4	< 0.2	43.5	< 0.4
	9/16/2022	< 0.3	< 0.3	29.3	< 0.2	40.4	< 0.4
	3/16/2023	< 0.3	< 0.3	23.6	< 0.2	35.8	< 0.4

Table F-1 (Continue)
SUMMARY OF DETECTED COCS
IN GROUNDWATER MONITORING WELLS
OCTOBER 2004 THROUGH MARCH 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
USEPA MCL (µg/L)		5	7	70	5	5	2
MW-7	10/29/2004	< 4.0	3.9 J	100.0	< 4.0	110.0	< 4.0
	3/17/2005	< 1.0	1.9	130.0	1.3	96.0	< 1.0
	7/11/2005	< 1.0	1.9	130.0	2.5	120.0	< 1.0
	9/28/2005	< 1.0	1.2	110.0	1.8	94.0	< 1.0
	12/1/2005	< 1.0	1.5	160.0	2.1	120.0	< 1.0
	3/21/2006	< 1.0	2.9	140.0	3.8	140.0	< 1.0
	9/27/2006	< 1.0	3.6	170.0	5.6	160.0	< 1.0
	4/26/2007	< 0.5	3.6	140.0	6.2	130.0	< 0.7
	9/19/2007	< 1.0	2.8	98.0	7.3	100.0	< 1.0
	4/16/2008	< 1.0	1.9	52.0	6.0	73.0	< 1.0
	9/24/2008	< 1.0	3.3	67.0	6.1	74.0	< 1.0
	3/24/2009	< 1.0	2.7	77.3	6.8	85.9	< 2.0
	8/4/2009	< 0.4	2.2	61.6	5.7	67.7	< 0.2
	3/24/2010	< 0.4	2.4	66.2	7.7	83.5	< 0.2
	9/29/2010	< 0.1	1.4	42.8	4.6	47.8	< 0.2
	3/25/2011	0.2 J	1.7	45.3	5.7	50.9	< 0.2
	9/20/2011	< 1.0	1.2	33.4	6.0	42.9	< 1.0
	3/27/2012	0.3 J	1.9	35.6	5.7	44.6	< 1.0
	9/15/2012	0.2 J	2.1	32.0	6.7	48.3	< 1.0
	3/26/2013	< 0.2	4.2	54.9	14.3	82.6	< 0.4
	9/18/2013	0.3 J	3.7	44.1	13.0	65.4	< 0.4
	6/25/2014	0.7 J	4.1	46.8	4.7	67.0	< 0.3
	10/28/2014	0.6 J	3.0	35.8	5.4	59.5	< 0.3
	3/26/2015	1.0 J	3.5	42.7	6.5	73.3	< 0.3
	9/30/2015	0.7 J	2.4	29.1	7.4	51.5	< 0.3
	3/30/2016	0.8 J	2.4	27.8	3.9	45.2	< 0.3
	9/15/2016	0.6 J	1.7	26.0	4.5	43.5	< 0.3
	3/20/2017	0.7 J	1.8	29.0	3.7	47.6	< 0.4
	9/26/2017	0.4 J	1.6	22.4	3.2	36.1	< 0.4
	3/22/2018	0.5 J	1.5	23.4	1.8	34.7	< 0.4
	9/20/2018**	< 0.3	< 0.3	86.3	< 0.2	82.7	< 0.4
	12/12/2018	0.3	1.0	19.9	2.2	30.9	< 0.4
	3/22/2019	0.4 J	1.2	21.5	2.2	30.6	< 0.4
	9/19/2019	0.4 J	1.0	19.4	1.8	27.8	< 0.4
	3/18/2020	0.4 J	0.9 J	19.9	1.8	27.1	< 0.4
	9/21/2020	< 0.3	0.8 J	20.7	2.0	30.6	< 0.4
	3/22/2021	< 0.3	0.5 J	16.4	1.5	22.5	< 0.4
	9/21/2021	< 0.3	0.9 J	14.5	1.5	19.8	< 0.4
	3/21/2022	< 0.3	< 0.3	14.1	1.4	20.9	< 0.4
	9/16/2022	< 0.3	0.5 J	12.5	1.1	17.5	< 0.4
	3/16/2023	< 0.3	0.74 J	15.4	1.2	21.5	< 0.4

Table F-1 (Continue)
SUMMARY OF DETECTED COCS
IN GROUNDWATER MONITORING WELLS
OCTOBER 2004 THROUGH MARCH 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
USEPA MCL (µg/L)		5	7	70	5	5	2
MW-8	10/27/2004	< 1.0	0.4 J	1.0	1.3	2.8	< 1.0
	3/16/2005	< 1.0	1.1	1.5	< 1.0	5.6	< 1.0
	9/27/2005	< 1.0	< 1.0	< 1.0	< 1.0	0.4 J	< 1.0
	4/23/2007	< 0.5	< 0.8	< 0.5	< 0.5	< 0.4	< 0.7
	9/17/2007	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	4/14/2008	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	9/23/2008	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
	3/23/2009	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0
	8/4/2009	< 0.4	< 0.4	< 0.2	< 0.2	< 0.1	< 0.2
	3/23/2010	< 0.4	< 0.4	< 0.2	< 0.2	< 0.1	< 0.2
	9/28/2010	< 0.1	< 0.1	0.3 J	< 0.2	< 0.2	< 0.2
	3/28/2011	< 0.1	< 0.1	0.4 J	< 0.2	< 0.2	< 0.2
	9/19/2011	< 1.0	< 1.0	0.4 J	< 1.0	0.2 J	< 1.0
	3/27/2012	< 1.0	< 1.0	0.6 J	< 1.0	0.3 J	< 1.0
	9/19/2012	< 1.0	< 1.0	0.6 J	< 1.0	0.3 J	< 1.0
	3/27/2013	< 0.2	< 0.2	0.8 J	< 0.3	0.5 J	< 0.4
	9/17/2013	< 0.2	< 0.2	1.8	< 0.3	1.0	< 0.4
	6/24/2014	< 0.2	< 0.3	1.7	< 0.3	0.5 J	< 0.3
	10/28/2014	< 0.2	< 0.3	1.6	< 0.3	0.6 J	< 0.3
	3/26/2015	< 0.2	< 0.3	2.1	< 0.3	0.5 J	< 0.3
	9/30/2015	< 0.2	< 0.3	2.1	< 0.3	0.7 J	< 0.3
	3/30/2016	< 0.3	0.3 J	2.4	< 0.3	0.7 J	< 0.3
	9/15/2016	< 0.3	< 0.2	3.0	< 0.3	0.9 J	< 0.3
	3/20/2017	< 0.3	< 0.3	2.9	< 0.2	0.8 J	< 0.4
	9/26/2017	< 0.3	< 0.3	3.3	< 0.2	0.8 J	< 0.4
	3/22/2018	< 0.3	0.3 J	3.3	< 0.2	0.9 J	< 0.4
	9/20/2018**	< 0.3	< 0.3	100.0	< 0.2	83.8	< 0.4
	12/12/2018	< 0.3	< 0.3	4.9	< 0.2	1.1	< 0.4
	3/22/2019	< 0.3	0.4 J	4.3	< 0.2	1.0 J	< 0.4
	9/19/2019	< 0.3	< 0.3	5.2	< 0.2	1.0	< 0.4
	3/18/2020	< 0.3	< 0.3	5.1	< 0.2	1.0 J	< 0.4
	9/21/2020	< 0.3	< 0.3	5.1	< 0.2	0.9 J	< 0.4
	3/22/2021	< 0.3	< 0.3	6.1	< 0.2	1.1	< 0.4
	9/21/2021	< 0.3	< 0.3	6.6	< 0.2	1.0	< 0.4
	3/21/2022	< 0.3	< 0.3	6.8	< 0.2	0.8 J	< 0.4
	9/16/2022	< 0.3	< 0.3	7.1	< 0.2	< 0.4	< 0.4
	3/16/2023	< 0.3	0.38 J	6.8	< 0.2	1.2	< 0.4

Table F-1 (Continue)
SUMMARY OF DETECTED COCS
IN GROUNDWATER MONITORING WELLS
OCTOBER 2004 THROUGH MARCH 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
USEPA MCL (µg/L)		5	7	70	5	5	2
MW-10A	10/25/2004	< 1.0	1.2	10.0	< 1.0	9.9	< 1.0
	3/14/2005	< 1.0	3.3	27.0	< 1.0	21.0	< 1.0
	9/26/2005	< 1.0	3.5	34.0	< 1.0	33.0	< 1.0
	3/20/2006	< 1.0	2.7	25.0	< 1.0	24.0	< 1.0
	9/25/2006	< 1.0	5.6	43.0	< 1.0	52.0	< 1.0
	4/23/2007	< 0.5	4.1	28.0	< 0.5	34.0	< 0.7
	9/17/2007	< 1.0	6.9	53.0	< 1.0	71.0	< 1.0
	4/14/2008	< 1.0	2.1	20.0	< 1.0	38.0	< 1.0
	9/23/2008	< 1.0	5.3	48.0	< 1.0	77.0	< 1.0
	3/23/2009	< 1.0	2.2	25.5	< 1.0	37.2	< 2.0
	8/3/2009	< 0.4	3.4	52.4	0.3 J	82.6	< 0.2
	3/23/2010	< 0.4	3.2	31.4	< 0.2	53.7	< 0.2
	9/28/2010	< 0.1	2.3	51.5	< 0.2	78.0	< 0.2
	3/28/2011	< 0.1	4.3	50.0	0.2 J	77.6	0.8 J
	9/19/2011	< 1.0	2.7	70.8	< 1.0	114.0	< 1.0
	3/27/2012	< 1.0	4.2	44.7	0.3 J	71.4	< 1.0
	9/18/2012	< 1.0	4.9	60.8	0.4 J	110.0	0.2 J
	3/27/2013	< 0.2	4.0	44.9	< 0.3	76.2	< 0.4
	9/16/2013	< 0.2	5.2	62.5	0.3 J	86.6	< 0.4
	6/24/2014	< 0.2	2.7	34.0	< 0.3	39.4	2.5
	10/28/2014	0.4 J	3.1	60.4	< 0.3	31.9	3.8
	3/26/2015	0.5 J	2.5	54.9	< 0.3	15.1	6.3
	9/30/2015	0.3 J	3.7	67.8	< 0.3	41.8	0.4 J
	3/30/2016	< 0.3	1.4	30.3	< 0.3	9.9	2.6
	9/15/2016	0.4 J	2.9	94.0	< 0.3	8.5	0.5 J
	3/20/2017	0.4 J	2.5	81.0	< 0.2	10.3	3.6
	9/26/2017	< 0.3	2.7	88.8	< 0.2	7.9	0.5 J
	3/22/2018	< 0.3	2.3	72.9	< 0.2	7.1	3.2
	9/20/2018**	0.5 J	1.4	25.1	2.0	33.8	< 0.4
	12/12/2018	< 0.3	< 0.3	4.5	< 0.2	6.1	< 0.4
	5/22/2019	< 0.3	2.1	33.6	< 0.2	50.3	0.8 J
	9/19/2019	< 0.3	2.1	53.5	< 0.2	16.6	2.2
	3/18/2020	< 0.3	< 0.3	7.4	< 0.2	5.2	< 0.4
	9/21/2020	< 0.3	1.1	43.2	< 0.2	5.5	2.0
	3/22/2021	< 0.3	0.7 J	39.0	< 0.2	2.7	1.7
	9/21/2021	< 0.3	0.9 J	41.9	< 0.2	3.5	1.0 J
	3/21/2022	< 0.3	0.7 J	31.7	< 0.2	10.1	1.0
	9/16/2022	< 0.3	0.6 J	33.3	< 0.2	4.9	< 0.4
	3/16/2023	< 0.3	< 0.3	16.0	< 0.2	6.7	0.61 J

Table F-1 (Continue)
SUMMARY OF DETECTED COCS
IN GROUNDWATER MONITORING WELLS
OCTOBER 2004 THROUGH MARCH 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
USEPA MCL (µg/L)		5	7	70	5	5	2
MW-10B	10/25/2004	< 1.0	2.1	18.0	< 1.0	18.0	< 1.0
	3/14/2005	< 1.0	2.6	19.0	< 1.0	15.0	< 1.0
	9/26/2005	< 1.0	2.4	27.0	< 1.0	24.0	< 1.0
	3/20/2006	< 1.0	1.9	21.0	< 1.0	20.0	< 1.0
	9/25/2006	< 1.0	3.0	30.0	< 1.0	34.0	< 1.0
	4/23/2007	< 0.5	3.3	24.0	< 0.5	32.0	< 0.7
	9/17/2007	< 1.0	4.4	45.0	< 1.0	54.0	< 1.0
	4/14/2008	< 1.0	1.3	13.0	< 1.0	23.0	< 1.0
	9/23/2008	< 1.0	6.1	48.0	< 1.0	77.0	< 1.0
	3/23/2009	< 1.0	1.7	17.4	< 1.0	29.1	< 2.0
	8/3/2009	< 0.4	3.4	41.2	0.2 J	67.5	< 0.2
	3/23/2010	< 0.4	2.4	24.5	< 0.2	45.4	< 0.2
	9/28/2010	< 0.1	4.7	50.8 J	0.3 J	93.2 J	< 0.2
	3/28/2011	< 0.1	2.5	30.5	< 0.2	51.8	< 0.2
	9/19/2011	< 1.0	2.4	66.2	0.4 J	133.0	< 1.0
	3/27/2012	< 1.0	3.2	36.2	0.2 J	62.6	< 1.0
	9/17/2012	< 1.0	4.3	56.5	0.3 J	96.9	0.6 J
	3/27/2013	< 0.2	3.4	36.1	< 0.3	61.9	< 0.4
	9/16/2013	< 0.2	6.5	70.9	0.4 J	102.0	< 0.4
	6/24/2014	< 0.5	4.7	54.9	< 0.5	102.0	< 0.7
	10/28/2014	< 0.5	4.8	59.7	< 0.5	116.0	< 0.7
	3/26/2015	< 0.2	3.0	36.0	< 0.3	77.7	< 0.3
	9/30/2015	< 0.2	5.2	58.4	< 0.3	88.8	< 0.3
	3/30/2016	< 0.3	3.6	42.6	< 0.3	86.8	< 0.3
	9/15/2016	< 0.3	4.1	61.3	< 0.3	90.9	< 0.3
	3/20/2017	< 0.3	3.0	44.5	0.2 J	92.7	< 0.4
	9/26/2017	< 0.3	3.7	54.3	< 0.2	93.8	< 0.4
	3/22/2018	< 0.3	2.7	37.1	< 0.2	67.7	< 0.4
	9/20/2018**	< 0.3	< 0.3	4.2	< 0.2	1.0 J	< 0.4
	12/12/2018	< 0.3	0.3	9.9	< 0.2	16.5	< 0.4
	5/22/2019	< 0.3	1.7	32.4	< 0.2	59.3	< 0.4
	9/19/2019	< 0.3	2.7	46.1	< 0.2	75.8	< 0.4
	3/18/2020	< 0.3	1.4 J	26.5	< 0.2	46.1	< 0.4
	9/21/2020	< 0.3	1.7	34.3	< 0.2	60.2	< 0.4
	3/22/2021	< 0.3	1.3	28.9	< 0.2	49.6	< 0.4
	9/21/2021	< 0.3	1.3	33.4	< 0.2	49.7	< 0.4
	3/21/2022	< 0.3	0.8 J	19.4	< 0.2	33.5	< 0.4
	9/16/2022	< 0.3	1.1	28.9	< 0.2	39.5	< 0.4
	3/16/2023	< 0.3	1.2	25.2	< 0.2	40.8	< 0.4

Table F-1 (Continue)
SUMMARY OF DETECTED COCS
IN GROUNDWATER MONITORING WELLS
OCTOBER 2004 THROUGH MARCH 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinylchloride
USEPA MCL (µg/L)		5	7	70	5	5	2
MW-11A	10/25/2004	< 1.0	< 1.0	0.3 J	< 1.0	1.5	< 1.0
	3/14/2005	< 1.0	< 1.0	2.1	< 1.0	2.7	< 1.0
	9/26/2005	< 1.0	< 1.0	5.7	< 1.0	4.7	< 1.0
	3/20/2006	< 1.0	3.4	19.0	< 1.0	21.0	< 1.0
	9/26/2006	< 1.0	1.6	30.0	< 1.0	1.6	< 1.0
	4/23/2007	< 0.5	1.7	9.2	< 0.5	9.3	< 0.7
	9/17/2007	< 1.0	< 1.0	6.3	< 1.0	1.3	< 1.0
	4/14/2008	< 1.0	< 1.0	6.6	< 1.0	6.2	< 1.0
	9/24/2008	< 1.0	< 1.0	4.2	< 1.0	9.8	< 1.0
	3/24/2009	< 1.0	< 1.0	18.6	< 1.0	20.5	< 2.0
	8/3/2009	< 0.4	0.7 J	19.8	< 0.2	19.0	< 0.2
	3/23/2010	< 0.4	0.8 J	9.7	< 0.2	13.9	< 0.2
	9/28/2010	< 0.1	< 0.1	9.3	< 0.2	7.4	< 0.2
	3/28/2011	< 0.1	0.4 J	10.9	< 0.2	8.0	< 0.2
	9/19/2011	< 1.0	< 1.0	13.0	< 1.0	9.6	< 1.0
	3/27/2012	0.8 J	4.9	57.2 J	1.6	62.5 J	< 1.0
	9/17/2012	< 1.0	1.3	49.3	< 1.0	4.7	< 1.0
	3/26/2013	0.4 J	1.7	33.2	0.6 J	15.7	0.6 J
	9/16/2013	1.4	6.3	99.8	1.8	39.2	< 0.4
	6/24/2014	< 0.2	0.3 J	11.2	< 0.3	2.5	< 0.3
	10/28/2014	< 0.2	0.7 J	14.3	< 0.3	< 0.3	9.0
	3/26/2015	1.3	4.6	97.7	4.1	10.6	3.2
	9/30/2015	< 0.2	0.8 J	16.3	< 0.3	< 0.2	2.7
	3/30/2016	< 0.3	< 0.2	< 0.3	< 0.3	< 0.3	< 0.3
	9/15/2016	< 0.3	< 0.2	< 0.3	< 0.3	< 0.3	< 0.3
	3/20/2017	0.5 J	1.9	30.9	0.3 J	16.4	0.7 J
	9/26/2017	0.7 J	1.5	40.1	< 0.2	< 0.4	8.1
	3/22/2018	0.7 J	2.6	43.5	0.7 J	22.9	< 0.4
	9/20/2018**	< 0.3	2.2	76.1	< 0.2	7.8	< 0.4
	12/12/2018	< 0.3	< 0.3	5.0	< 0.2	2.1	< 0.4
	3/22/2019	< 0.3	0.4 J	12.7	< 0.2	< 0.4	1.4
	9/19/2019	< 0.3	0.4 J	6.0	< 0.2	< 0.4	0.7 J
	3/18/2020	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	9/21/2020	< 0.3	< 0.3	2.5	< 0.2	< 0.4	< 0.4
	3/22/2021	0.5 J	1.0	28.0	< 0.2	5.8	1.4
	9/21/2021	< 0.3	< 0.3	0.4 J	< 0.2	< 0.4	< 0.4
	3/21/2022	< 0.3	< 0.3	2.8	< 0.2	2.3	< 0.4
	9/16/2022	< 0.3	< 0.3	9.3	< 0.2	< 0.4	0.9 J
	3/16/2023	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4

Table F-1 (Continue)
SUMMARY OF DETECTED COCS
IN GROUNDWATER MONITORING WELLS
OCTOBER 2004 THROUGH MARCH 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
USEPA MCL (µg/L)		5	7	70	5	5	2
MW-11B	10/25/2004	< 1.0	2.2	10.0	< 1.0	21.0	< 1.0
	3/14/2005	< 1.0	1.3	7.6	< 1.0	11.0	< 1.0
	9/26/2005	< 1.0	1.1	11.0	< 1.0	7.0	< 1.0
	3/20/2006	< 1.0	1.2	7.7	< 1.0	12.0	< 1.0
	9/26/2006	< 1.0	0.9 J	9.3	< 1.0	5.1	< 1.0
	4/23/2007	< 0.5	< 0.8	8.3	< 0.5	4.5	< 0.7
	9/17/2007	< 1.0	1.0 J	6.8	< 1.0	4.9	< 1.0
	4/14/2008	< 1.0	1.0 J	9.5	< 1.0	11.0	< 1.0
	9/24/2008	< 1.0	< 1.0	11.0	< 1.0	7.5	< 1.0
	3/24/2009	< 1.0	0.4 J	2.9	< 1.0	1.6	< 2.0
	8/3/2009	< 0.4	0.4 J	8.2	< 0.2	2.4	< 0.2
	3/23/2010	< 0.4	< 0.4	5.7	< 0.2	5.5	< 0.2
	9/28/2010	< 0.1	0.4 J	11.3	< 0.2	5.9	< 0.2
	3/28/2011	< 0.1	0.7 J	11.0	< 0.2	7.6	< 0.2
	9/19/2011	< 1.0	0.8 J	13.7	< 1.0	5.0	< 1.0
	3/27/2012	0.2 J	1.2	18.1	< 1.0	11.1	< 1.0
	9/17/2012	< 1.0	0.7 J	16.8	< 1.0	3.0	< 1.0
	3/27/2013	< 0.2	2.1	16.1	0.4 J	19.4	< 0.4
	9/19/2013	< 0.2	1.0	11.2	< 0.3	9.5	< 0.4
	6/24/2014	0.3 J	1.0 J	21.6	< 0.3	1.4	< 0.3
	10/28/2014	0.6 J	2.9	57.2	< 0.3	7.0	< 0.3
	3/26/2015	0.6 J	3.0	48.2	< 0.3	10.4	0.4 J
	9/30/2015	< 0.2	2.5	46.1	< 0.3	< 0.2	0.7 J
	3/30/2016	0.7 J	3.1	56.1	< 0.3	4.3	2.0
	9/15/2016	< 0.3	1.0 J	20.5	< 0.3	0.9 J	4.1
	3/20/2017	0.5 J	1.4	25.3	< 0.2	6.5	1.4
	9/26/2017	0.4 J	1.7	39.0	< 0.2	1.0	1.1
	3/22/2018	0.5 J	1.7	34.3	< 0.2	4.8	2.0
	9/20/2018**	< 0.3	2.3	34.1	< 0.2	64.0	< 0.4
	12/12/2018	0.5	1.4	26.1	< 0.2	14.7	< 0.4
	5/22/2019	< 0.3	0.4 J	6.7	< 0.2	5.9	< 0.4
	9/19/2019	< 0.3	0.8 J	21.7	< 0.2	< 0.4	< 0.4
	3/18/2020	0.4 J	1.0 J	21.9	< 0.2	3.5	0.5 J
	9/21/2020	< 0.3	< 0.3	21.1	< 0.2	2.7	< 0.4
	3/22/2021	0.3 J	1.3	31.3	< 0.2	7.6	< 0.4
	9/21/2021	0.5 J	1.0	21.3	< 0.2	1.1	< 0.4
	3/21/2022	< 0.3	0.8 J	19.4	< 0.2	5.8	< 0.4
	9/16/2022	< 0.3	0.4 J	13.5	< 0.2	1.1	< 0.4
	3/16/2023	< 0.3	0.95 J	20.8	< 0.2	5.7	< 0.4

Table F-1 (Continue)
SUMMARY OF DETECTED COCS
IN GROUNDWATER MONITORING WELLS
OCTOBER 2004 THROUGH MARCH 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinylchloride
USEPA MCL (µg/L)		5	7	70	5	5	2
MW-12*	11/1/2004	< 2.0	60.0	55.0	3.1	1300.0	< 2.0
	3/20/2005	< 1.0	67.0	75.0	2.2	1300.0	< 1.0
	7/11/2005	< 10.0	81.0	97.0	< 10.0	1300.0	< 10.0
	9/28/2005	< 1.0	84.0	58.0	3.7	1100.0	< 1.0
	12/1/2005	< 1.0	110.0	66.0	4.9	1600.0	< 1.0
	3/22/2006	< 1.0	79.0	53.0	5.1	1000.0	< 1.0
	9/28/2006	< 1.0	120.0	74.0	5.2	1400.0	< 1.0
	4/26/2007	< 0.5	88.0	48.0	4.7	900.0	< 0.7
	9/20/2007	< 1.0	94.0	53.0	4.5	940.0	< 1.0
	4/17/2008	< 1.0	51.0	32.0	< 10.0	1000.0	< 1.0
	9/25/2008	< 1.0	94.0	54.0	5.5	980.0	< 1.0
	3/25/2009	0.4 J	40.1	356.0	0.7 J	82.1	19.9
	8/5/2009	< 0.4	47.4	66.1	3.8	735.0	< 0.2
	3/25/2010	< 0.4	42.2	44.5	4.6	697.0	< 0.2
	9/30/2010	< 0.3	63.4	48.3	5.4	920.0	< 0.5
	3/29/2011	< 0.1	67.6	87.0	11.3	1390.0	< 0.2
	9/20/2011	< 1.0	46.7	77.9	6.7	766.0	< 1.0
	3/27/2012	0.3 J	42.2	514.0	2.6	202.0	1.6
	9/19/2012	< 1.0	4.7	91.4	1.5	195.0	< 1.0
	3/29/2013	< 0.2	2.5	81.7	1.4	153.0	< 0.4
	9/19/2013	< 1.1	1.7 J	172.0	< 1.6	458.0	< 2.2
	6/25/2014	< 1.2	2.1 J	144.0	< 1.3	354.0	< 1.6
	10/28/2014	< 0.6	0.9 J	84.8	< 0.6	216.0	< 0.8
	3/27/2015	< 0.5	0.7 J	68.9	< 0.8	201.0	< 0.6
	9/30/2015	< 0.4	< 0.5	66.1	< 0.7	151.0	< 0.5
	3/30/2016	< 0.6	< 0.4	57.1	< 0.6	130.0	< 0.6
	9/15/2016	< 0.6	< 0.4	58.2	< 0.6	127.0	< 0.6
	3/20/2017	< 0.6	< 0.6	57.7	< 0.4	135.0	< 0.8
	9/26/2017	< 0.6	< 0.6	47.3	< 0.4	96.5	< 0.8
	3/22/2018	< 0.3	0.5 J	74.7	0.3 J	108.0	< 0.4
	9/20/2018**	0.5 J	1.1	30.7	< 0.2	0.5 J	2.9
	12/12/2018	< 0.3	< 0.3	59.1	0.23	68.4	< 0.4
	5/22/2019	< 0.6	< 0.6	107.0	< 0.4	3.8	< 0.8
	9/19/2019	< 0.6	< 0.6	112.0	< 0.4	5.6	< 0.8

Table F-1 (Continue)
SUMMARY OF DETECTED COCS
IN GROUNDWATER MONITORING WELLS
OCTOBER 2004 THROUGH MARCH 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
USEPA MCL (µg/L)		5	7	70	5	5	2
MW-13	10/29/2004	< 10.0	17.0	210.0	< 10.0	330.0	< 10.0
	3/17/2005	< 1.0	9.4	140.0	1.7	150.0	< 1.0
	7/11/2005	< 2.0	15.0	230.0	3.7	290.0	< 2.0
	9/27/2005	< 1.0	15.0	220.0	3.1	260.0	0.7 J
	11/30/2005	< 1.0	14.0	240.0	2.5	280.0	< 1.0
	3/21/2006	< 1.0	11.0	140.0	2.7	160.0	< 1.0
	9/27/2006	< 1.0	13.0	150.0	2.3	170.0	< 1.0
	4/26/2007	< 0.5	12.0	92.0	1.8	120.0	< 0.7
	9/19/2007	< 1.0 (< 1.0)	6.1 (6.2)	61.0 (67.0)	1.2 (1.3)	77.0 (84.0)	< 1.0 (< 1.0)
	4/16/2008	< 1.0 (< 1.0)	7.7 (7.3)	42.0 (43.0)	1.4 (1.6)	99.0 (93.0)	< 1.0 (< 1.0)
	9/24/2008	< 1.0	14.0	71.0	2.1	120.0	< 1.0
	3/24/2009	< 1.0	10.5	72.6	1.8	106.0	< 2.0
	8/4/2009	< 0.4	7.3	55.1	1.6	83.1	< 0.2
	3/24/2010	< 0.4	6.0	45.4	1.8	73.8	< 0.2
	9/29/2010	< 0.1	7.6	65.2	1.7	67.2	< 0.2
	3/28/2011	< 0.1	8.1	64.2	2.8	93.7	< 0.2
	9/20/2011	< 1.0	5.5	50.9	2.9	77.7	< 1.0
	3/27/2012	0.2 J	7.5	66.8	3.6	94.7	< 1.0
	9/18/2012	0.3 J	6.5	61.9	4.1	88.6	< 1.0
	3/27/2013†	--	--	--	--	--	--
	9/18/2013†	--	--	--	--	--	--
	6/25/2014†	--	--	--	--	--	--
	10/28/2014	< 0.2	3.8	32.2	2.9	55.8	< 0.3
	3/26/2015	0.8 J	7.2	73.5	3.7	117.0	< 0.5
	9/30/2015	< 0.4	8.6	80.5	4.0	115.0	< 0.5
	3/30/2016	0.8 J	8.9	85.0	3.6	94.1	< 0.3
	9/15/2016	0.8 J	6.9	82.9	4.0	115.0	< 0.6
	3/20/2017	0.9 J	7.2	88.0	3.5	126.0	< 0.8
	9/26/2017	< 0.6	6.7	78.1	5.1	107.0	< 0.8
	3/22/2018	0.8 J	8.5	104.0	3.0	127.0	< 0.8
	9/20/2018**	< 0.3	1.7	37.0	< 0.2	0.8 J	1.3
	12/12/2018	1.0	8.1	97.9	6.4	107.0	< 0.4
	5/22/2019	0.7	3.8	55.6	3.9	82.9	< 0.4
	9/19/2019	1.0 J	5.9	74.5	4.2	94.3	< 0.4
	3/18/2020	0.6 J	4.5	62.6	3.5	82.0	< 0.4
	9/21/2020	< 0.3	3.0	39.8	3.2	59.5	< 0.4
	3/22/2021	< 0.3	2.3	33.3	2.9	48.5	< 0.4
	9/21/2021	0.3 J	1.7	23.2	1.9	34.3	< 0.4
	3/21/2022	< 0.3	2.5	38.6	1.8	52.5	< 0.4
	9/16/2022	< 0.3	1.8	30.2	1.8	37.4	< 0.4
	3/16/2023	< 0.3	2.4	33	2.1	44.5	< 0.4

Table F-1 (Continue)
SUMMARY OF DETECTED COCS
IN GROUNDWATER MONITORING WELLS
OCTOBER 2004 THROUGH MARCH 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
USEPA MCL (ug/L)		5	7	70	5	5	2
MW-14	10/26/2004	< 1.0	< 1.0	1.0 J	< 1.0	5.1	10.0
	3/16/2005	< 1.0	< 1.0	< 1.0	< 1.0	1.9	1.0 J
	9/28/2005	< 1.0	< 1.0	0.9 J	< 1.0	3.0	18.0
	11/30/2005	< 1.0	< 1.0	0.9	< 1.0	1.9	23.0
	3/21/2006	< 1.0	< 1.0	2.5	< 1.0	3.7	< 1.0
	9/26/2006	< 1.0	6.9	210.0	< 1.0	33.0	5.5
	4/24/2007	< 0.5 (< 0.5)	2.9 (2.8)	50.0 (48.0)	< 0.5 (< 0.5)	44.0 (41.0)	6.5 (6.0)
	9/20/2007	< 1.0	4.6	160.0	< 1.0	24.0	6.0
	4/15/2008	< 1.0	< 1.0	4.2	< 1.0	2.9	< 1.0
	9/25/2008	< 1.0	< 1.0	12.0	< 1.0	8.0	1.8
	3/25/2009	< 1.0	< 1.0	8.0	< 1.0	5.1	< 2.0
	8/4/2009	< 0.4	1.0	45.7	< 0.2	9.0	< 0.2
	3/24/2010	< 0.4	1.3	29.1	< 0.2	35.4	1.0 J
	9/29/2010	< 0.1	< 0.1	9.0	< 0.2	9.4	0.5 J
	3/29/2011	< 0.1	0.3 J	8.3	< 0.2	8.3	< 0.2
	9/20/2011	< 1.0	0.8 J	34.5	< 1.0	6.8	1.0 J
	3/27/2012	< 1.0	0.2 J	5.5	< 1.0	3.5	< 1.0
	9/19/2012	< 1.0	0.3 J	4.9	< 1.0	4.7	< 1.0
	3/28/2013	< 0.2	< 0.2	1.4	< 0.3	1.0	< 0.4
	9/17/2013	< 0.2	4.4	102.0	< 0.3	134.0	1.1
	6/25/2014	< 0.5	2.8	55.2	< 0.5	160.0	< 0.7
	10/28/2014	< 0.5	2.2	69.7	< 0.5	125.0	< 0.7
	3/27/2015	< 0.2	< 0.3	7.8	< 0.3	0.60 J	0.6 J
	9/30/2015	< 0.2	2.7	85.1	< 0.3	96.4	0.5 J
	3/30/2016	< 0.3	2.2	86.4	< 0.3	87.9	0.4 J
	9/15/2016	< 0.3	1.3	72.4	< 0.3	69.7	< 0.3
	3/20/2017	< 0.3	1.1	50.9	< 0.2	49.4	1.4
	9/26/2017	< 0.3	0.9 J	38.8	< 0.2	22.5	6.5
	3/22/2018	< 0.3	< 0.3	1.9	< 0.2	0.8 J	< 0.4
	9/20/2018**	< 0.3	< 0.3	73.1	0.5 J	77.6	< 0.4
	12/12/2018	< 0.3	0.6	12.9	< 0.2	47.8	< 0.4
	5/22/2019	< 0.3	0.5 J	9.1	< 0.2	34.3	< 0.4
	9/19/2019	< 0.3	< 0.3	8.3	< 0.2	25.7	0.9 J
	3/18/2020	< 0.3	0.4 J	8.4	< 0.2	28.2	< 0.4
	9/21/2020	< 0.3	< 0.3	7.0	< 0.2	25.9	< 0.4
	3/22/2021	< 0.3	< 0.3	6.5	< 0.2	21.3	< 0.4
	9/21/2021	< 0.3	< 0.3	5.4	< 0.2	17.8	< 0.4
	3/21/2022	< 0.3	< 0.3	4.5	< 0.2	16.5	< 0.4
	9/16/2022	< 0.3	< 0.3	2.9	< 0.2	11.1	< 0.4
	3/16/2023	< 0.3	< 0.3	2.5	< 0.2	10.7	< 0.4

Table F-1 (Continue)
SUMMARY OF DETECTED COCS
IN GROUNDWATER MONITORING WELLS
OCTOBER 2004 THROUGH MARCH 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
USEPA MCL (ug/L)		5	7	70	5	5	2
MW-16	11/1/2004	2.6	6.9	94.0	4.2	89.0	< 1.0
	3/18/2005	3.3	11.0	170.0	6.5	140.0	< 1.0
	9/29/2005	4.0	7.2	250.0	2.8	45.0	< 1.0
	12/1/2005	5.1	5.2	190.0	2.9	42.0	< 1.0
	3/21/2006	6.5	7.7	160.0	4.3	69.0	< 1.0
	9/27/2006	5.6	6.3	190.0	5.2	77.0	< 1.0
	4/25/2007	6.1	12.0	170.0	12.0	130.0	< 0.7
	9/19/2007	6.9	12.0	250.0	4.2	45.0	0.8 J
	4/16/2008	< 1.0	4.9	180.0	4.4	38.0	1.7
	9/24/2008	7.5	9.3	220.0	4.8	50.0	3.9
	3/24/2009	7.6	8.6	267.0	8.9	88.5	3.9
	8/5/2009	9.2	9.3	301.0	9.6	89.1	16.0
	3/24/2010	8.1	4.6	211.0	8.0	79.2	1.6
	9/29/2010	7.0	11.2	187.0	20.0	134.0	7.8
	3/29/2011	8.6	13.4	229.0	25.3	160.0	7.1
	9/20/2011	8.7	10.8	226.0	19.0	104.0	7.8
	3/27/2012	7.0	8.8	211.0	14.9	96.9	1.5
	9/18/2012	7.3	8.7	200.0	12.7	76.5	3.7
	3/28/2013	8.6	15.1	264.0	24.6	114.0	7.2
	9/18/2013	7.4	12.4	236.0	18.8	107.0	6.5
	6/25/2014	10.5	10.9	151.0	14.5	185.0	< 0.7
	10/28/2014	7.2	10.9	209.0	18.6	104.0	< 0.8
	3/27/2015	7.7	11.1	233.0	17.8	109.0	< 1.3
	9/30/2015	6.5	11.9	203.0	15.7	91.0	< 0.6
	3/30/2016	6.4	10.5	182.0	14.5	101.0	< 0.6
	9/15/2016	5.7	9.0	187.0	14.2	99.8	< 0.6
	3/20/2017	5.1	8.5	183.0	11.1	93.1	< 0.8
	9/26/2017	4.3	7.7	163.0	10.5	67.5	< 0.8
	3/22/2018	4.9	8.7	212.0	6.4	57.3	< 1.0
	9/20/2018**	0.9 J	9.1	86.6	5.5	115.0	< 0.4
	12/28/2018	4.5	8.2	167.0	8.9	68.7	< 1.0
	5/22/2019	3.4 (3.3)	5.5 (5.3)	132.0 (128.0)	7.6 (7.3)	53.1 (51.1)	< 0.8 (< 0.8)
	9/19/2019	3.4	7.3	99.0	8.9	69.2	< 0.4
	3/18/2020	2.4	5.5 J	93.3	7.7	54.6	0.4 J
	9/21/2020	2.5	4.9	93.3	8.6	62.4	< 0.4
	3/22/2021	2.4	4.8	81.1	8.9	56.8	< 0.4
	9/21/2021	3.2	4.6	95.9	6.6	47.9	0.7 J
	3/21/2022	1.8	4.5	81.8	6.3	53.7	< 0.4
	9/16/2022	1.6	3.7	82.3	5.0	38.3	0.6 J
	3/16/2023	1.8	4.4	70.0	6.0	44.6	0.6 J

Table F-1 (Continue)
SUMMARY OF DETECTED COCS
IN GROUNDWATER MONITORING WELLS
OCTOBER 2004 THROUGH MARCH 2023

Well ID	Date Sampled	Volatile Organic Compounds (VOCs)					
		1,2-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	Vinyl chloride
USEPA MCL (ug/L)		5	7	70	5	5	2
MW-17	10/29/2004	< 1.0	3.0	41.0	0.9 J	62.0	< 1.0
	3/17/2005	< 1.0	10.0	76.0	1.3	100.0	< 1.0
	9/28/2005	< 1.0	13.0	100.0	2.8	160.0	< 1.0
	3/21/2006	< 1.0	11.0	86.0	2.9	140.0	< 1.0
	9/26/2006	< 1.0	19.0	110.0	3.9	180.0	< 1.0
	4/25/2007	< 0.5	26.0	92.0	5.2	170.0	< 0.7
	9/19/2007	< 1.0	17.0	76.0	4.2	130.0	< 1.0
	4/16/2008	< 1.0	11.0	49.0	3.6	110.0	< 1.0
	9/24/2008	< 1.0	19.0	78.0	4.2	130.0	< 1.0
	3/24/2009	< 1.0	8.4	48.0	2.8	72.6	0.6 J
	8/4/2009	< 0.4	10.2	73.2	3.5	95.0	< 0.2
	3/24/2010	< 0.4	9.6	80.6	5.0	141.0	< 0.2
	9/29/2010	0.4 J	18.1	94.8	8.4	164.0	< 0.2
	3/29/2011	0.4 J	12.4	73.7	6.7	126.0	< 0.2
	9/20/2011	0.7 J	20.7	102.0	11.2	185.0	< 1.0
	3/27/2012	0.5 J	18.3	94.9	8.5	145.0	0.9 J
	9/18/2012	0.7 J	20.8	105.0	11.3	180.0	< 1.0
	3/28/2013	0.6 J	14.6	80.2	9.5	111.0	< 0.4
	9/18/2013	0.4 J	10.5	69.8	6.5	92.6	< 0.4
	6/24/2014	< 0.2	1.6	14.2	1.6	22.4	< 0.3
	10/28/2014	< 0.2	3.3	26.4	2.9	44.5	< 0.3
	3/26/2015	< 0.2	< 0.3	< 0.2	0.4 J	1.2	< 0.3
	9/30/2015	0.6 J	2.2	52.1	< 0.3	4.3	2.4
	3/30/2016	< 0.3	2.1	32.9	0.5 J	18.5	4.0
	9/15/2016	1.0 (1.0 J)	2.9 (3.0)	58.0 (56.3)	0.4 J (0.4 J)	47.0 (45.6)	3.8 (3.7)
	3/20/2017	1.1	4.1	76.3	2.3	90.0	< 0.4
	9/26/2017	0.8 J	3.6	53.7	3.0	69.0	< 0.4
	3/22/2018	1.0 J	4.3	77.0	1.9	78.5	0.9 J
	9/20/2018**	< 0.3	0.8 J	19.8	< 0.2	50.1	< 0.4
	12/12/2018	< 0.3	< 0.3	2.0	< 0.2	5.4	< 0.4
	5/22/2019	< 0.3	0.4	6.6	< 0.2	6.1	< 0.4
	9/19/2019	< 0.3 (< 0.3)	0.8 J (0.8 J)	21.7 (20.9)	< 0.2 (< 0.2)	5.1 (4.7)	< 0.4 (< 0.4)
	3/18/2020	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	9/21/2020	< 0.3	< 0.3	4.1	< 0.2	2.1	< 0.4
	3/22/2021	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4
	9/21/2021	< 0.3	< 0.3	2.5	< 0.2	1.7	2.7
	3/21/2022	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	2.9
	9/16/2022	< 0.3	< 0.3	1.9	< 0.2	1.6	2.6
	3/16/2023	< 0.3	< 0.3	< 0.3	< 0.2	< 0.4	< 0.4

APPENDIX G – SITE INSPECTION CHECKLIST

Site Name: Carolawn, Inc	**Date of Inspection: 11/17/2022**
Location and Region: Fort Lawn, South Carolina, Region 4	**EPA ID: SCD908558316**
Agency, Office or Company Leading the Five-Year Review: EPA Region 4	**Weather/Temperature: 50's and mostly sunny**

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☐ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other: Final remedy to address remaining groundwater contamination will be determined at a future date.
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☒ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (check all that apply)

1. **O&M Site Manager** Jeff Ahrens (Name) | Principal Engineer (Title) | 12/30/2022 (Date)
Interviewed ☐ at site ☐ at office ☐ by phone Phone: _____
Problems, suggestions ☒ Report attached: Appendix E

2. **O&M Staff** _____ (Name) | _____ (Title) | _____ (Date)
Interviewed ☐ at site ☐ at office ☐ by phone Phone: _____
Problems/suggestions ☐ Report attached: _____

3. **Local Regulatory Authorities and Response Agencies** (i.e., state and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices). Fill in all that apply.

Agency SCDHEC
Contact Chris Slocum (Name) | Project Manager (Title) | 12/30/2022 (Date) | _____ (Phone No.)
Problems/suggestions ☐ Report attached: _____

Agency _____
Contact _____ (Name) | _____ (Title) | _____ (Date) | _____ (Phone No.)
Problems/suggestions ☐ Report attached: _____

4. **Other Interviews** (optional) ☐ Report attached: _____

III. ON-SITE DOCUMENTS AND RECORDS VERIFIED (check all that apply)

1. **O&M Documents**

☐ O&M manual	☒ Readily available	☐ Up to date	☒ N/A
☐ As-built drawings	☒ Readily available	☐ Up to date	☒ N/A
☐ Maintenance logs	☐ Readily available	☐ Up to date	☒ N/A

Remarks: Treatment system is no longer operating

2. **Site-Specific Health and Safety Plan**	☒ Readily available	☐ Up to date	☐ N/A
☐ Contingency plan/emergency response plan	☐ Readily available	☐ Up to date	☒ N/A
Remarks: Treatment system is no longer operating			
3. **O&M and OSHA Training Records**	☐ Readily available	☐ Up to date	☒ N/A
Remarks: Treatment system is no longer operating			
4. **Permits and Service Agreements**			
☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
☐ Other permits: _____	☐ Readily available	☐ Up to date	☒ N/A
Remarks: Treatment system is no longer operating			
5. **Gas Generation Records**	☐ Readily available	☐ Up to date	☒ N/A
Remarks: _____			
6. **Settlement Monument Records**	☐ Readily available	☐ Up to date	☒ N/A
Remarks: _____			
7. **Groundwater Monitoring Records**	☒ Readily available	☐ Up to date	☐ N/A
Remarks: _____			
8. **Leachate Extraction Records**	☐ Readily available	☐ Up to date	☒ N/A
Remarks: _____			
9. **Discharge Compliance Records**			
☐ Air	☐ Readily available	☐ Up to date	☒ N/A
☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A
Remarks: Treatment system is no longer operating			
10. **Daily Access/Security Logs**	☐ Readily available	☐ Up to date	☒ N/A
Remarks: _____			

IV. O&M COSTS

1. **O&M Organization**	
☐ State in-house	☐ Contractor for state
☐ PRP in-house	☒ Contractor for PRP
☐ Federal facility in-house	☐ Contractor for Federal facility
☐ O&M Costs are summarized in the FYR Report	
2. **O&M Cost Records**	
☐ Readily available	☐ Up to date
☐ Funding mechanism/agreement in place	☐ Unavailable
Original O&M cost estimate: _____	☐ Breakdown attached

Total annual cost by year for review period if available

From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached
From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached
From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached
From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached
From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs during Review Period**
Describe costs and reasons: _____

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing Damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A
Remarks: _____

B. Other Access Restrictions

1. **Signs and Other Security Measures** ☐ Location shown on site map ☐ N/A
Remarks: Clear signage at locked front gate.

C. Institutional Controls (ICs)

Implementation and Enforcement

Site conditions imply ICs not properly implemented ☐ Yes ☐ No ☒ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ☒ N/A

Type of monitoring (e.g., self-reporting, drive by): _____

Frequency: _____

Responsible party/agency: _____

Contact _____ _____ _____ _____
Name Title Date Phone no.

Reporting is up to date ☐ Yes ☐ No ☒ N/A

Reports are verified by the lead agency ☐ Yes ☐ No ☒ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☒ No ☐ N/A

Violations have been reported ☐ Yes ☐ No ☒ N/A

Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☐ ICs are adequate ☒ ICs are inadequate ☐ N/A

Remarks: Institutional controls are in draft form and will be implemented when a viable owner aquires the site property. Institutional controls are needed for areas of off-site groundwater contamination and on-site soils..

D. General

1. **Vandalism/Trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks: _____

2. **Land Use Changes On Site** ☒ N/A

Remarks: _____

3. **Land Use Changes Off Site** ☒ N/A

Remarks: _____

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads Damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks: _____

B. Other Site Conditions

Remarks: _____

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing and Electrical**

☐ Good condition ☐ All required wells properly operating ☐ Needs maintenance ☐ N/A

Remarks: The groundwater extraction and treatment system is no longer in use and will be removed from the Site when a new remedy is implemented.

2. **Extraction System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☐ Good condition ☐ Needs maintenance

Remarks: Treatment system is no longer operating.

3. **Spare Parts and Equipment**

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: Treatment system is no longer operating.

B. Surface Water Collection Structures, Pumps and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps and Electrical**

☐ Good condition ☐ Needs maintenance

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: _____

C. Treatment System ☐ Applicable ☒ N/A

1. **Treatment Train** (check components that apply)

☐ Metals removal ☐ Oil/water separation ☐ Bioremediation

☐ Air stripping ☐ Carbon adsorbers

☐ Filters: _____

☐ Additive (e.g., chelation agent, flocculent): _____

☐ Others: _____

☐ Good condition ☐ Needs maintenance

☐ Sampling ports properly marked and functional

☐ Sampling/maintenance log displayed and up to date

☐ Equipment properly identified

☐ Quantity of groundwater treated annually: _____

☐ Quantity of surface water treated annually: _____

Remarks: Treatment system is no longer operating.

2. **Electrical Enclosures and Panels** (properly rated and functional)

☒ N/A ☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Tanks, Vaults, Storage Vessels**

☒ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs maintenance

Remarks: _____

4. **Discharge Structure and Appurtenances**

☒ N/A ☐ Good condition ☐ Needs maintenance

Remarks: _____

5. **Treatment Building(s)**

☒ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair

☐ Chemicals and equipment properly stored

Remarks: _____

6. **Monitoring Wells** (pump and treatment remedy)

☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition

☒ All required wells located ☐ Needs maintenance ☐ N/A

Remarks: _____

D. Monitoring Data

1. **Monitoring Data**

☒ Is routinely submitted on time ☒ Is of acceptable quality

2. **Monitoring Data Suggests:**

☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining

E. Monitored Natural Attenuation			
1. **Monitoring Wells** (natural attenuation remedy)			
☐ Properly secured/locked	☐ Functioning	☐ Routinely sampled	☐ Good condition
☐ All required wells located	☐ Needs maintenance		☒ N/A
Remarks: _____			
X. OTHER REMEDIES			
If there are remedies applied at the site and not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.			
XI. OVERALL OBSERVATIONS			
A. Implementation of the Remedy			
Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is designed to accomplish (e.g., to contain contaminant plume, minimize infiltration and gas emissions). The groundwater extraction and treatment system removed approximately 35 pounds of VOCs between 1998 and 2004. The PRP contractor performed pilot studies and drafted an FFS to adjust the remedy. EISB performed in 2005 did not affect the overall plume extent. The SVE system removed approximately 160 pounds of VOCs between 2012 and 2014. The SVE system was decommissioned in 2016. The FFS is in draft form.			
B. Adequacy of O&M			
Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. The PRP contractor maintains the Site, associated structures, grounds, fencing, and monitoring wells in good and operable condition.			
C. Early Indicators of Potential Remedy Problems			
Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. A final remedy for groundwater treatment is forthcoming in a future decision document.			
D. Opportunities for Optimization			
Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. None.			

Site Inspection Participants:

Jeff Ahrens, Geosyntec
Chris Slocum, Project Manager, SCDHEC
Sara MacDonald, SCDHEC
Evan Etheridge, SCDHEC
Benjamin Bair, SCDHEC
Timothy Kadar, SCDHEC

APPENDIX H – DETAILED ARARs REVIEW

Appendix H includes a review of relevant, site-related documents including the RODs, AROD, remedial action reports and recent monitoring data. CERCLA Section 121(d)(1) requires that Superfund remedial actions attain "a degree of cleanup of hazardous substance, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment." The remedial action must achieve a level of cleanup that at least attains those requirements that are legally applicable or relevant and appropriate. In performing the FYR for compliance with ARARs, only those ARARs that address the protectiveness of the remedy are reviewed.

- Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, remedial action, location, or other circumstance found at a CERCLA site.
- Relevant and appropriate requirements are those standards that, while not "applicable," address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are more stringent than federal requirements may be applicable or relevant and appropriate.
- To-Be-Considered (TBC) criteria are non-promulgated advisories and guidance that are not legally binding but should be considered in determining the necessary remedial action. For example, TBCs may be particularly useful in determining health-based levels where no ARARs exist or in developing the appropriate method for conducting a remedial action.

Chemical-specific ARARs are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish an acceptable amount or concentration of a chemical that may remain in, or be discharged to, the ambient environment. Examples of chemical specific ARARs include Maximum Contaminant Levels (MCLs) under the federal Safe Drinking Water Act and ambient water quality criteria enumerated under the federal Clean Water Act (CWA).

Action-specific ARARs are technology- or activity-based requirements or limits on actions taken with respect to a particular hazardous substance. These requirements are triggered by a remedial activity, such as discharge of contaminated groundwater or in-situ remediation.

Location-specific ARARs are restrictions on hazardous substances, or the conduct of the response activities solely based on their location in a special geographic area. Examples include restrictions on activities in wetlands, sensitive habitats, and historic places.

Remedial actions are required to comply with the chemical specific ARARs identified in the ROD. In performing the five-year review for compliance with ARARs, only those ARARs that address the protectiveness of the remedy are reviewed (Tables H-1 through H-5).

Table H-1: Chemical Specific ARARs

Standard, Requirement, or Criterion	Description	Citation
WATER REGULATIONS (Safe Drinking Water Act - 40 USC ' 300; Clean Water Act - 33 USC Section 1251-1376)		
Federal Groundwater Classification	Federal classification system to establish groundwater usage categories for aquifers as part of a groundwater protection strategy.	55 FR Part 8733
National Primary Drinking Water Regulations	Establishes maximum contaminant levels (MCLs) for specific chemicals to protect drinking water quality.	40 CFR 141.61
Ambient Water Quality Criteria	Establishes recommended highest concentration of specific pollutants or parameters in water to protect ambient water quality.	40 CFR 131.5
National Pollutant Discharge Elimination System	Discharges of extracted/treated Groundwater will be subject to Substantive requirements of the NPDES process if discharged to Local stream. NPDES is administrated by the State.	40 CFR 122, 125
Effluent Guidelines and Standards: Pretreatment Standards	Discharges of extracted/treated Groundwater will be subject to Pretreatment requirements if discharged to the publicly owned treatment works.	40 CFR 403
South Carolina MCLs in Drinking Water	Establishes maximum contaminant levels (MCLs) for specific chemicals to protect drinking water quality.	SCDHEC R. 61- 58.5

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Table H-2: Location Specific ARARs

Standard, Requirement, or Criterion	Description	Citation
Fish and Wildlife Coordination Act	The Act allows the Department of Agriculture and Commerce to assist Federal and State agencies to study the effects of domestic sewage, trade wastes, and other polluting substances on wildlife.	16 USC Sections 661 to 667e
Protection of Wetlands	Requires federal agencies to take action to avoid adversely affecting wetlands, to minimize wetlands destruction, and to preserve the value of wetlands.	(Executive Order 11990; 40 CFR 6.302 (a); 40 CFR Part 6, Appendix A)

Table H-3: Action Specific ARARs

Standard, Requirement, or Criterion	Description	Citation
Installation of Monitoring Wells	Requirements for installation of wells	SC Well Standards (R.61-71)

Groundwater ARARs

The 1989 ROD identified multiple potential chemical specific ARARs for groundwater. However, only the following ARAR was used as basis for selection of groundwater cleanup goals:

- National Primary Drinking Water Standards (MCLs) (40 CFR Part 141, Subpart B and G)

This FYR compared groundwater ARARs in the 1989 ROD against the current values of these ARARs (see Table I-4). None of the ARARs have changed since 1989. In addition, no new MCLs have been established for those remedial goals originally based on risk.

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Table H-4: Groundwater ARAR Review

Contaminant	1989 ROD Cleanup Levels (µg/L)[a]	Current ARAR (MCL) (µg/L)[c]	ARARs More or Less Stringent than Cleanup Levels?
1,1-Dichloroethene	7	7	None
1,2-Dichloroethene	70-cis 100-trans	70 100	None
1,1,1-Trichloroethane	200	200	None
Trichloroethene	5	5	None
Lead	5	15[c]	Less stringent

Notes:
a) Cleanup goals from 1989 ROD, Table 23.
b) Listed values are MCLs from https://www.epa.gov/ground-water-and-drinking-water/table-regulated-drinking-water-contaminants, accessed 12/02/22.
c) Lead is regulated by a treatment technique that requires systems to control the corrosiveness of their water. If more than 10 percent of tap water samples exceed the action level, water systems must take additional steps. For lead, the action level is 15 µg/L.
µg/L = micrograms per liter

Surface Water ARARs

The 1989 ROD identified the ambient water quality conditions in the Water Quality Criteria (WQC) as a chemical specific ARARs for surface water. The 1989 ROD stated that the rate and level of groundwater discharge of contaminants into Fishing Creek would not surpass the ambient WQC for the COCs. This FYR compared surface water ARARs in the 1989 ROD against the current values of these ARARs (see Table I-5). Several ambient WQC have changed becoming more or less stringent. Due to these changes, long-term monitoring should use current WQC when evaluating impacts to surface water.

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Table H-5: Surface Water ARAR Review

Contaminant	1989 ROD WQC (µg/L)[a]	Current ARAR (µg/L)[c]	ARARs More or Less Stringent than Cleanup Levels?
Acetone	-	Criteria currently not established	N/A
1,1-Dichloroethane	-	Criteria currently not established	N/A
1,1-Dichloroethene	0.033	300	Less Stringent
Trans 1,2-Dichloroethene	-	100	More Stringent
Cis 1,2-Dichloroethene	-	Criteria currently not established	N/A
1,1,1-Trichloroethane	19,000	10,000	Less Stringent
Trichloroethene	2.7	0.6	More Stringent
Lead	-	Criteria currently not established	N/A

Notes:
a) Cleanup goals from 1989 ROD, Table 23.
b) WQC for human health (human health for the consumption of water + organism) accessed at
- = WQC not available at the time of the 1989 ROD.
N/A = cleanup goal was not based on an ARAR; therefore, no ARAR change was included.
µg/L = micrograms per liter

Soil ARARs

The 1989 ROD did not identify chemical specific ARARs for soil. The multi-phase Remedial Investigation/Feasibility Study (RI/FS) between 1987 and 1989 determined the removal activities at the Site were effective in remediating/removing any chemicals of potential concerns (COPC). The remedy for OU-1 required additional investigation of the disposal area north of OU-1. This area was identified as OU-2. In 1995 the EPA issued a ROD of no further action as the final remedy for OU-2.

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APPENDIX I – TOXICITY ASSESSMENT

A baseline risk assessment (BRA) was completed for OU-1 at the Carolawn, Inc. site as part of the 1989 ROD.

OU-1
The BRA for OU-1 evaluated the risks to human health and the environment under present day and assumed future use conditions. The BRA considered the potential release mechanisms to the five primary environmental media of concern: air, soil, surface water, sediment, and groundwater.

The BRA identified the following potential human exposure pathways associated with the Site:

- inhalation, consumption, and dermal contact of contaminated groundwater;
- inhalation, consumption, and dermal contact of contaminated surface water; and
- consumption of contaminated fish from Fishing Creek.

The COCs identified for the Site are VOCs and one heavy metal. More specifically: acetone, 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), 1,2-dichloroethene (1,2-DCE), 1,1,1-trichloroethane (1,1,1-TCA), trichloroethene (TCE) and lead.

No new exposure pathways were identified. No new methodologies to determine risk more accurately were identified during this Five-Year Review. Groundwater cleanup levels, apart from acetone, are based the National Primary Drinking Water Regulations Maximum Contaminant Levels and are not addressed further. Acetone was based on a lifetime health advisory rather than an ARAR.

The RSLs for cancer are chemical-specific concentrations for individual contaminants that correspond to an excess cancer risk level of 1×10^{-6} (or a hazard quotient of 1 for non-carcinogens), and they have been developed for a variety of exposure scenarios (e.g., residential, commercial/industrial). RSLs are not de facto cleanup standards for a Superfund site, but they do provide a good indication of whether actions may be needed to address potential human health exposures. The EPA acceptable risk range is between 1×10^{-6} and 1×10^{-4}. RSL values that are within this range are determined from a risk standpoint to be acceptable.

To evaluate the protectiveness of the acetone groundwater cleanup goal, a screening-level risk evaluation was conducted by comparing the acetone groundwater cleanup goal to the EPA's residential tap water RSL and calculating a corresponding risk value (Table I-1). The cleanup goal corresponds to a noncarcinogenic HQ of 0.038 (below EPA's threshold value of 1), indicating that this cleanup goal remains valid.

Table I-1: Review of Groundwater Remedial Goals

Contaminant	Groundwater Remedial Goal (µg/L)[a]	Tapwater RSL[b]		Risk	HQ[c]
		10^{-6} Risk	HQ = 1		
Acetone	700	-	18,000	-	**0.038**

Notes:
a) Cleanup goal from 1989 ROD
b) Current EPA RSLs, dated May 2022, are available at http://www2.epa.gov/risk/risk-based-screening-table-generic-tables (accessed 12/01/22).
c) The noncancer HQ was calculated using the following equation: HQ = (cleanup goal ÷ noncancer RSL).
- = no RSL available/unable to calculate risk
µg/L = micrograms per liter

OU-2

To address an uncertainty stemming from insufficient confirmatory data of the 1982 and 1986 removal action of soil in the storage area north of OU-1, a RI and BRA were conducted on OU-2 in 1994. The BRA for OU-2 considered the potential release mechanisms of COPCs from the Site to two primary, environmental media of concern: soils, surface water and sediment. There were no COPCs identified for surface water. Therefore, exposure to surface water was not considered a potentially significant risk to human health or the environment and the surface water pathway was eliminated as an exposure pathway of concern. Furthermore, the EPA determined a remedial action was not warranted for the surface water in Fishing Creek.

Potential human exposure routes (for adults and children) evaluated in the BRA for OU-2 included the following:

- Incidental ingestion of surficial soil,
- Dermal contact with surficial soil,
- Incidental ingestion of sediment from Fishing Creek, and
- Dermal contact with sediment in Fishing Creek.

Future potential exposure routes for adults and children associated with Site development that were evaluated included the scenarios listed above in addition to the following:

- Incidental ingestion of subsurface soil, and
- Dermal contact with subsurface soil.

The BRA for OU-2 concluded the carcinogenic risk estimates for current and future conditions are either below the lower limit 1 x 10^{-6} or within the EPA's acceptable range of 1 x 10^{-4} to 1 x 10^{-6}. Furthermore, no noncarcinogenic hazard indices exceeded the EPA's acceptable level of 1.0. Therefore, the EPA determined that risks to human health from contaminants in the soil and sediment are within the EPA's acceptable risk range and that remediation of the soil and sediment would not be required for the protection of human health.

As part of the 1994 RI, forty-one surface and nine subsurface soil samples were collected from 41 grids within OU-2 (Figure I-1). Four sediment samples were collected from Fishing Creek. The OU-2 chemicals of potential concern (COPC) are shown in Table I-2.

Table I-2: OU-2 Soil and Sediment COPCs

COPC	Surface Soil	Subsurface Soil	Sediment
Aluminum		X	
Arsenic	X	X	X
Barium	X		
Beryllium	X	X	
Calcium	X	X	
Chromium	X	X	
Copper	X		
Iron		X	
Lead	X	X	
Magnesium	X	X	
Manganese	X	X	
Potassium		X	
Sodium	X		
Vanadium		X	
PCBs	X		
Notes: Source: Table 1, 1995 OU-2 ROD			

The maximum concentrations for each COPC from surface soil, subsurface soil and sediment are listed in Table I-3 and compared to the current EPA RSL for residential use to estimate corresponding carcinogenic and noncarcinogenic risk values.

Table I-3: OU-2 Soil and Sediment COPC Residential Risk Evaluation

COPC	Maximum Concentration (mg/kg)	Residential RSL[a] (mg/kg)		Residential Risk Evaluation[b]	
		1 x 10^{-6} Risk	HQ = 1.0	Carcinogenic Risk	Noncarcinogenic HQ
Aluminum	31,000	NA	77,000	NA	0.4
Arsenic	23	0.68	35	3.4 x 10^{-5}	0.7
Barium	1,200	NA	15,000	NA	0.08
Beryllium	4.1	1,600	160	2.6 x 10^{-9}	0.03
Calcium	49,000	NA	NA	NA	NA
Trivalent chromium	380	NA	120,000	NA	0.003
Hexavalent chromium	380	0.3	230	**1.27 x 10^{-3}**	**1.7**
Copper	410	NA	3,100	NA	0.1
Iron	50,000	NA	55,000	NA	0.9
Lead	430	400[c]		NA	NA
Magnesium	26,000	NA	NA	NA	NA
Manganese	1,100	NA	1,800	NA	0.6
Potassium	6,000	NA	NA	NA	NA
Sodium	160	NA	NA	NA	NA
Vanadium	140	NA	390	NA	0.4
PCBs	5.4 (PCB-1254)	0.24	1.2	2.3 x 10^{-5}	**4.5**
	0.440 (PCB-1248)	0.23	NA	2.0 x 10-6	NA
	0.700 (PCB-1260)	0.24	NA	3.0 x 10-6	NA

Notes:
Source: Appendix A of 1995 OU-2 ROD

a. The current EPA RSLs, dated May 2022, are available at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables (accessed 12/19/2022).

b. Screening level risk calculations were performed as follows: cancer risk = (maximum concentration/risk-based RSL) x 1 x 10-6
noncancer hazard index = (maximum concentration/HQ-based RSL)

c. The EPA has no consensus reference dose or cancer slope factor for inorganic lead, so it is not possible to calculate RSLs as it is for other chemicals. The EPA considers lead to be a special case because of the difficulty in identifying the classic "threshold" needed to develop a reference dose. The EPA evaluates lead exposure by using blood-lead modeling, such as the Integrated Exposure-Uptake Biokinetic Model. The EPA Office of Solid Waste has also released a detailed directive on risk assessment and cleanup of residential soil lead. The directive recommends that soil lead levels less than 400 mg/kg are generally safe for residential use. Above that level, the document suggests collecting data and modeling blood-lead levels with the Integrated Exposure-Uptake Biokinetic Model. For the purposes of screening, therefore, 400 mg/kg is recommended for residential soil.

NA = no RSL available or unable to calculate risk
Bold = exceeds EPA's acceptable risk values
mg/kg = milligrams per kilogram

Except for lead, hexavalent chromium and PCB-1254, the maximum detected concentrations of COPCs in soil and sediment are within the EPA's acceptable risk range for cancer risk and below an HQ of 1 for noncancer risk.

Lead

The 1995 OU-2 ROD selected a "no action" remedy due to the absence of any significant source of contamination in soil, surface water, and sediment at the Site. The maximum concentration of lead from the 1995 ROD was 430 mg/kg (see Table I-4) and slightly exceeds the residential RSL. Generally, the EPA recommends utilizing the average lead concentration across the Site to assess lead exposure risk. The average lead concentration was 66 mg/kg in surface soil, 55 mg/kg in surface and subsurface soil combined, and 2 mg/kg in sediment (as calculated from concentrations provided in Appendix A of the 1995 OU-2 ROD). These values are all below the RSL of 400 mg/kg.

Using the maximum lead concentration of 430 mg/kg, a site-specific risk model was developed using the IEUBK Model for Lead in Children. Until recently, children were identified as having a blood lead level of concern if the test result is 10 or more micrograms per deciliter (µg/dL) of lead in blood. The CDCs now use a new level based on the U.S. population of children ages 1-5 years who are in the top 2.5% of children when tested for lead in their blood. Currently that is 3.5 µg/dL of lead in blood. However, the EPA has not yet issued additional guidance updating the target blood lead level for use in the IEUBK Model. Therefore, this FYR evaluates the residential lead-in-soil risk using other updated guidance (such as the maternal blood lead concentration at childbirth (MatPb) in the IEUBK model). Using the 2017 updated MatPb in the IEUBK model, blood lead levels are calculated to be below 10 µg/dL using the maximum lead concentration in soil of 430 mg/kg.

If EPA lowers the acceptable target blood lead level below 10 µg/dl, the EPA will need to reassess the risk lead poses at the Site. Until such guidance is updated, the OU-2 "no action" remedy is currently protective.

Table I-4: Assumptions Used in the IEUBK Model

Description	Units	Model Input Values
Maternal blood lead concentrations	µg/dL	0.60
Contribution of soil lead to indoor dust	Percent	30
Concentration in air	micrograms per cubic meter	0.10
Dietary lead intake	µg/day	
6-12 months		2.66
12-24 months		5.03
24-36 months		5.21
36-48 months		5.38
48-60 months		5.64
60-72 months		6.04
72-84 months		5.95
Risk-based concentration	mg/kg	430[a]

Notes:
Values in table generated from IEUBK Lead Model Version 2.0 Build 1 for Windows. These IEUBK Model results are valid as they were produced with an official, unmodified version of the IEUBK Model with a software certificate.

While IEUBK Model output is generally written with three digits to the right of the decimal point, the true precision of the output is strongly influenced by least precise input values.

a) Value obtained from 1995 ROD for OU-2 (see Table J-3).

PCB-1254

The maximum concentration of PCB-1254 exceeded the non-cancer RSL of 1.2 mg/kg with a resulting HQ of 4.5. PCB-1254 was detected in nine soil samples ranging in concentration from 0.028 to 5.4 mg/kg. Two of the nine samples (1-SLA and 4-SLA) contained PCB-1254 concentrations above the non-cancer RSL. The highest concentration was detected in surface soil sample 1-SLA, which also contained PCB-1248 and PCB-1260. Soil sampling location 4-SLA (with a concentration of 2.9 mg/kg PCB-1254) was a surface soil sampling location located in the West Drum Area. See sample locations below in Figure I-1.

Chromium

It is unknown whether concentrations of chromium are in the trivalent or hexavalent form, so this screening level risk evaluation analyzed the maximum chromium concentration against both RSLs. When compared to the less toxic trivalent chromium, the concentration was below EPA's target HQ of 1. However, when compared to the hexavalent chromium RSLs, the concentration corresponded to cancer risk above EPA's acceptable risk range and noncancer risk above an HQ of 1. This sample was from a surface soil sampling location located in the West Drum Area (4-SLA).

Though maximum concentrations of hexavalent chromium and PCB-1254 exceed residential RSLs, this screening is conservative because use of maximum concentrations in the assessment may overestimate risk. In addition, residential RSLs were used, and this area is not currently used residentially. There is minimal potential exposure, as this site area is only used by hunters, and a recreational receptor is assumed to be on site less frequently and for a shorter duration than is assumed in the residential soil RSLs. However, to ensure long-term protectiveness institutional controls restricting land use need to be implemented.

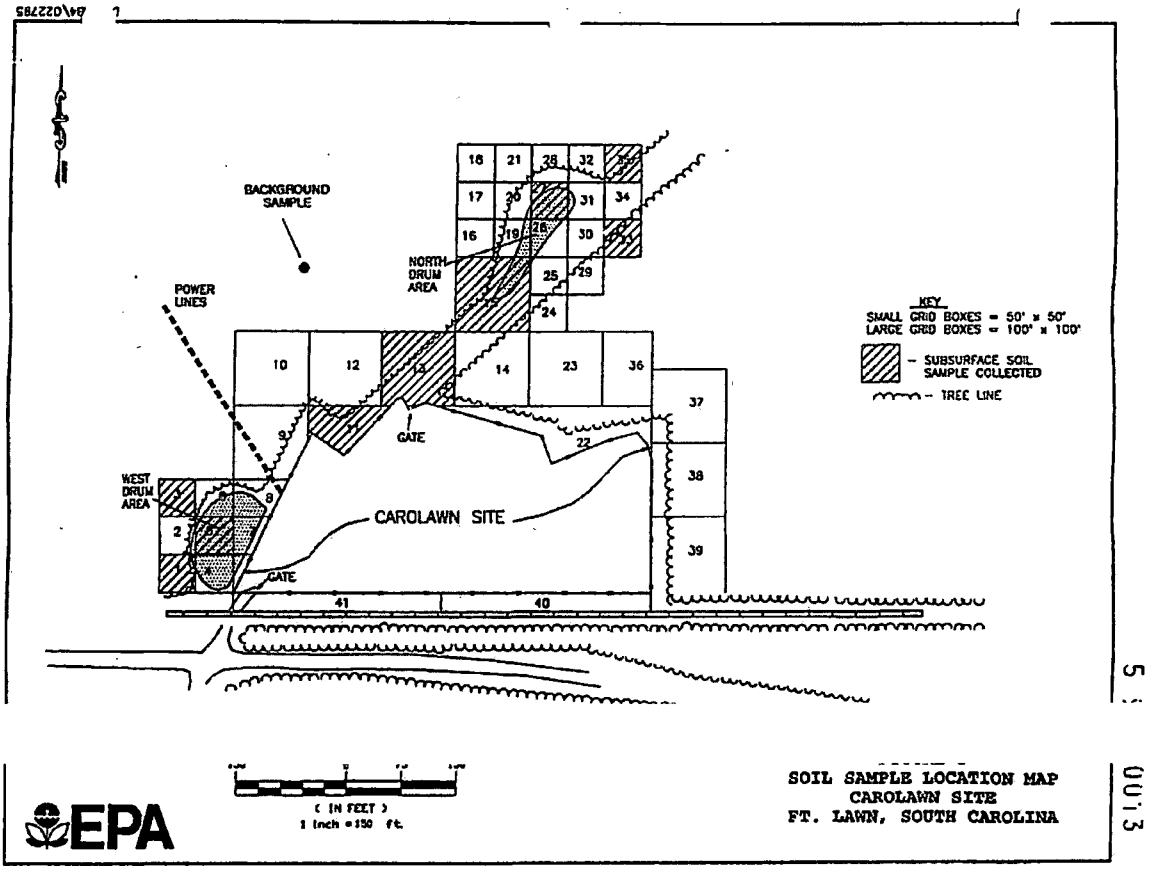
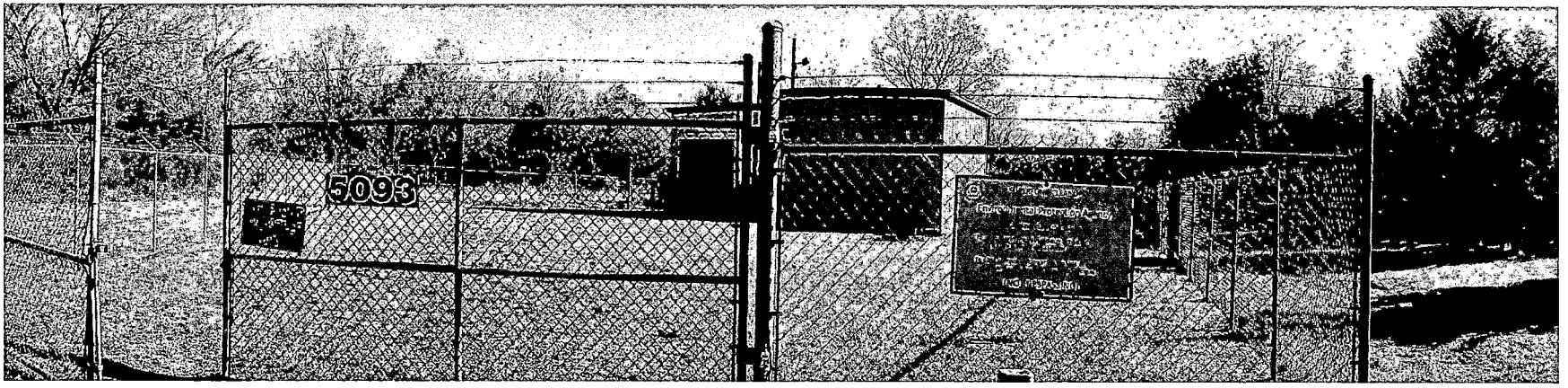


Figure I-1: OU-2 Soil Sample Location Map

APPENDIX J – SITE PHOTOGRAPHS



Site Photograph J-1: Entrance to Carolawn Inc. Treatment Building Area

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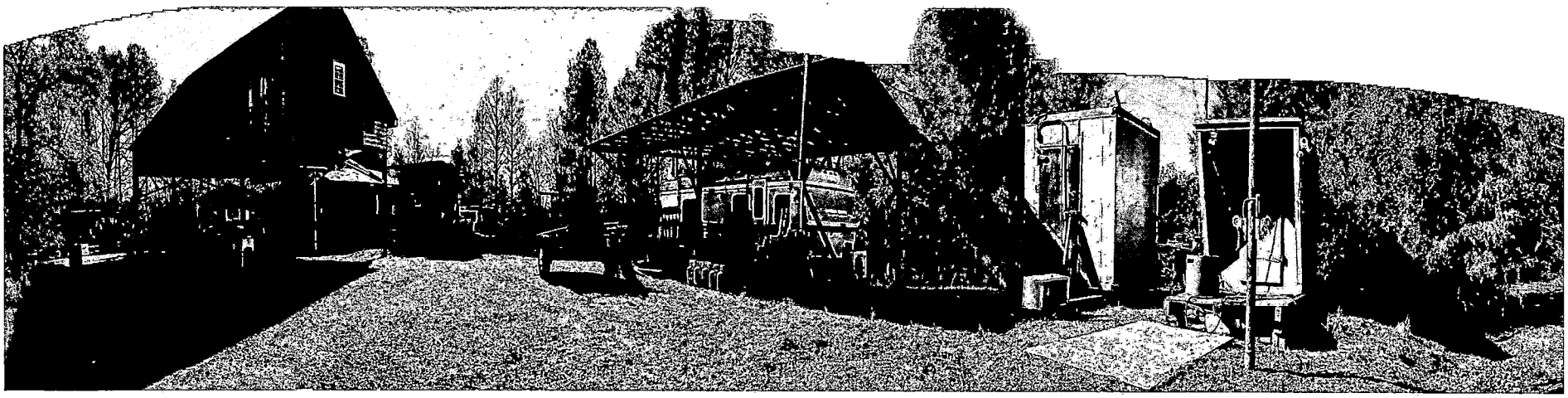
Site Photograph J-2: Morrison Road Looking West from Site Entrance

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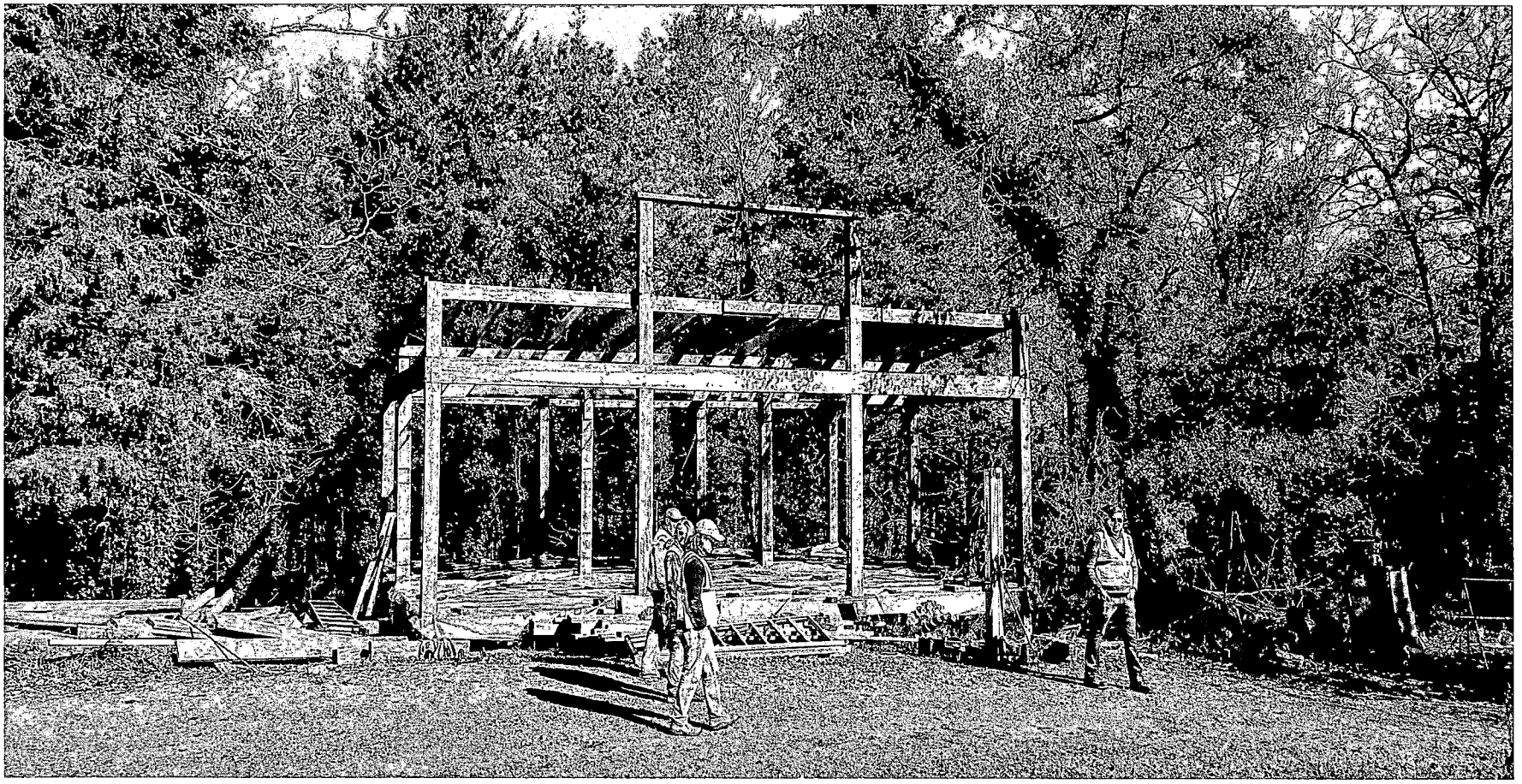
Site Photograph J-3: Entrance to Savannah Spring Farms Hunt Club (located at east end of Morrison Road)

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Site Photograph J-4: Panoramic View of the Savannah Springs Farm Hunt Club (near monitoring wells MW-7, MW-13, and MW-17)

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Site Photograph J-5: New Structure Under Construction at Savannah Springs Farms Hunt Club (near MW-7)

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Site Photograph J-6: Photo Showing New Construction is Elevated Above Ground (near MW-7)

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Site Photograph J-7: Fishing Creek Near Monitoring Wells 10A & 10B

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Site Photograph J-8: Hunting Club Building (former cabin location & near MW-8

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Exhibit 50

Dr. Michael Tachovsky Expert Report

EXPERT REPORT

In the Matter Of:

Clyde Marcus Jones, II, et al.
v.
Duke Energy Corporation and Duke Energy Carolinas, LLC

Lake Wateree PCB

Client:

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February 10, 2026

Jessica Fickling, Esq.
Wyche, P.A.
807 Gervais Street, Suite 301
Columbia, South Carolina 29201

Re: Lake Wateree PCB

Dear Ms. Fickling:

In accordance with your request, we have set forth an evaluation of the unimpaired market value of the improved residential proposed class properties ("subject properties").

The accompanying report is considered a restricted appraisal report. This report can only be understood in combination with the supporting work file documentation, deposition, and trial testimony. Accordingly, the work file is considered a part of this report. This report may be presented to the court in the legal matter Clyde Marcus Jones, II, et al. v. Duke Energy Corporation and Duke Energy Carolinas, LLC. As discovery may be ongoing, Landmark Research Group reserves the right to revise and supplement this report.

Very truly yours,



Michael Tachovsky, PhD
Certified General Real Estate Appraiser (9013)

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CASE OVERVIEW

Landmark Research Group was retained by Plaintiffs to determine the unimpaired market value of the improved residential proposed class properties ("subject properties"). This expert report, from an appraisal perspective, identifies and considers several mass appraisal methodologies and techniques for determining the unimpaired market values of residential properties, including regression analysis. The basis for our opinions includes our experience and training with standard real estate appraisal methodologies, the resources identified in this report and workfile, data collection and analysis, inspections of the proposed class area, observations of the characteristics of the proposed class properties, and past assignments involving mass appraisals.

Polychlorinated Biphenyls (PCBs)

Polychlorinated Biphenyls ("PCBs") belong to a broad family of man-made organic chemicals known as chlorinated hydrocarbons. PCBs were domestically manufactured from 1929 until manufacturing was banned in 1979. Due to their non-flammability, chemical stability, high boiling point and electrical insulating properties, PCBs were used in hundreds of industrial and commercial applications.[1]

Today, PCBs can still be released into the environment from poorly maintained hazardous waste sites that contain PCBs, illegal or improper dumping of PCB wastes, leaks or releases from electrical transformers containing PCBs, and disposal of PCB-containing consumer products into municipal or other landfills not designed to handle hazardous waste. They do not readily break down once in the environment and can remain for long periods cycling between air, water, and soil.[2]

PCBs have been demonstrated to cause a variety of adverse health effects. They have been shown to cause cancer in animals as well as a number of serious non-cancer health effects in animals, including effects on the immune system, reproductive system, nervous system, endocrine system, and other health effects. Studies in humans support evidence for potential carcinogenic and non-carcinogenic effects of PCBs. The potential health effects of PCB exposure include cancer and non-cancer effects, immune effects, reproductive effects, neurological effects, and endocrine effects.[3] The singular topic being studied at the subject properties are PCBs. PCBs are in a close family of chemicals that are related to dioxins.[4]

---

[1] "Polychlorinated Biphenyls (PCBs)," United States Environmental Protection Agency, last modified April 12, 2023, https://www.epa.gov/pcbs/learn-about-polychlorinated-biphenyls.
[2] "Polychlorinated Biphenyls (PCBs)," United States Environmental Protection Agency, last modified April 12, 2023, https://www.epa.gov/pcbs/learn-about-polychlorinated-biphenyls.
[3] "Polychlorinated Biphenyls (PCBs)," United States Environmental Protection Agency, last modified April 12, 2023, https://www.epa.gov/pcbs/learn-about-polychlorinated-biphenyls.
[4] "Learn About Dioxin," United States Environmental Protection Agency, last modified January 28, 2014, https://www.epa.gov/dioxin/learn-about-dioxin.

Lake Wateree PCB Background

Duke Energy Corporation and Duke Energy Carolinas, LLC has been in charge of managing mosquito issues on Lake Wateree. The earliest environmental program to eradicate mosquitoes on South Carolina waterways began operations in 1923. This environmental program, also known as the mosquito control program (MCP), began as a voluntary public health measure; however, it became required by state law to implement and use government-approved larvicides.[5] These operations primarily utilized kerosene, used oil, and fuel products for the first several decades. However, in the 1950s, many entities with mosquito control programs replaced these traditional products with government-approved insecticides.[6]

Transformer and fuel oils that contained PCBs were utilized to treat the miles of shoreline in South Carolina. Rather than transition to government-approved insecticides, Duke Energy continued to use the spent transformer and fuel oils to eradicate mosquitos.[7] Around 1974, the South Carolina Department of Health and Environmental Control (SCDHEC) monitored PCB levels in fish tissue and issued long-standing consumption advisories at Lake Hartwell, Langley Pond, the Catawba River Basin, and the Great Pee Dee River Basin. Five years later, in 1979, the Environmental Protection Agency banned the manufacturing, processing, distribution, disposal, and use of PCBs under the Toxic Substances Control Act.[8] In the 1990s, PCBs were identified in South Carolina waters, including Lake Wateree, prompting the SCDHEC to begin collecting fish tissue data from 44 species at 303 locations, and Duke Energy to begin its own fish contamination study.

By 2009, the EPA had concluded that potentially harmful PCB levels were in South Carolina aquatic life and that widespread PCB contamination was reported in fish from the Catawba-Wateree and Yadkin-Pee Dee River Basins.[9]

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[5] *Clyde Marcus Jones, II, et al. v. Duke Energy Corporation and Duke Energy Carolinas, LLC*, Duke Energy Defendants' Memorandum in Opposition to Plaintiff's Motion for Class Certification, Case: 3:24-cv-01281-MGL (United States District Court for the District of South Carolina Columbia Division, November 3, 2025), 2.

[6] *Clyde Marcus Jones, II, et al. v. Duke Energy Corporation and Duke Energy Carolinas, LLC*, First Amended Class Action Complaint and Demand for Jury Trial, Case: 3:24-cv-1281-MGL (United States District Court for the District of South Carolina Columbia Division, November 3, 2025), 16.

[7] *Clyde Marcus Jones, II, et al. v. Duke Energy Corporation and Duke Energy Carolinas, LLC*, First Amended Class Action Complaint and Demand for Jury Trial, Case: 3:24-cv-1281-MGL (United States District Court for the District of South Carolina Columbia Division, November 3, 2025), 16.

[8] "EPA Bans PCB Manufacture; Phases Out Uses," US Environmental Protection Agency, April 19, 1979, https://www.epa.gov/archive/epa/aboutepa/epa-bans-pcb-manufacture-phases-out-uses.html#:~:text=The%20Environmental%20Protection%20Agency%20(EPA)%20issued%20regulations,issued%20under%20the%20Toxic%20Substances%20Control%20Act.

[9] Glover and Gunderson, "Widespread Contamination of Polychlorinated Biphenyls in South Carolina and North Carolina (USA): A Legacy of Malarial Eradication and Mosquito Control," Journal of South Carolina Water Resources, 2021.

In the most recent decade, Lake Wateree was included on a list of impaired waters due to PCB levels in fish. Consequently, active fish consumption advisories posted by the South Carolina Department of Environmental Services (SCDES) limit the number of meals to be consumed for specific species found in Lake Wateree.[10] The same advisory by the SCDES notes that PCBs are found in the fatty parts of fish, so to reduce exposure, a recommended way to clean, prepare, and cook the fish is provided.

Recently, in a 2021 peer-reviewed article by James B. Glover and Deke T. Gunderson, it was set forth that Duke Energy's use of transformer and fuel oils for mosquito control was the source of basin-wide PCB contamination.

Timeline

The following is a timeline outlining Lake Wateree PCB events:

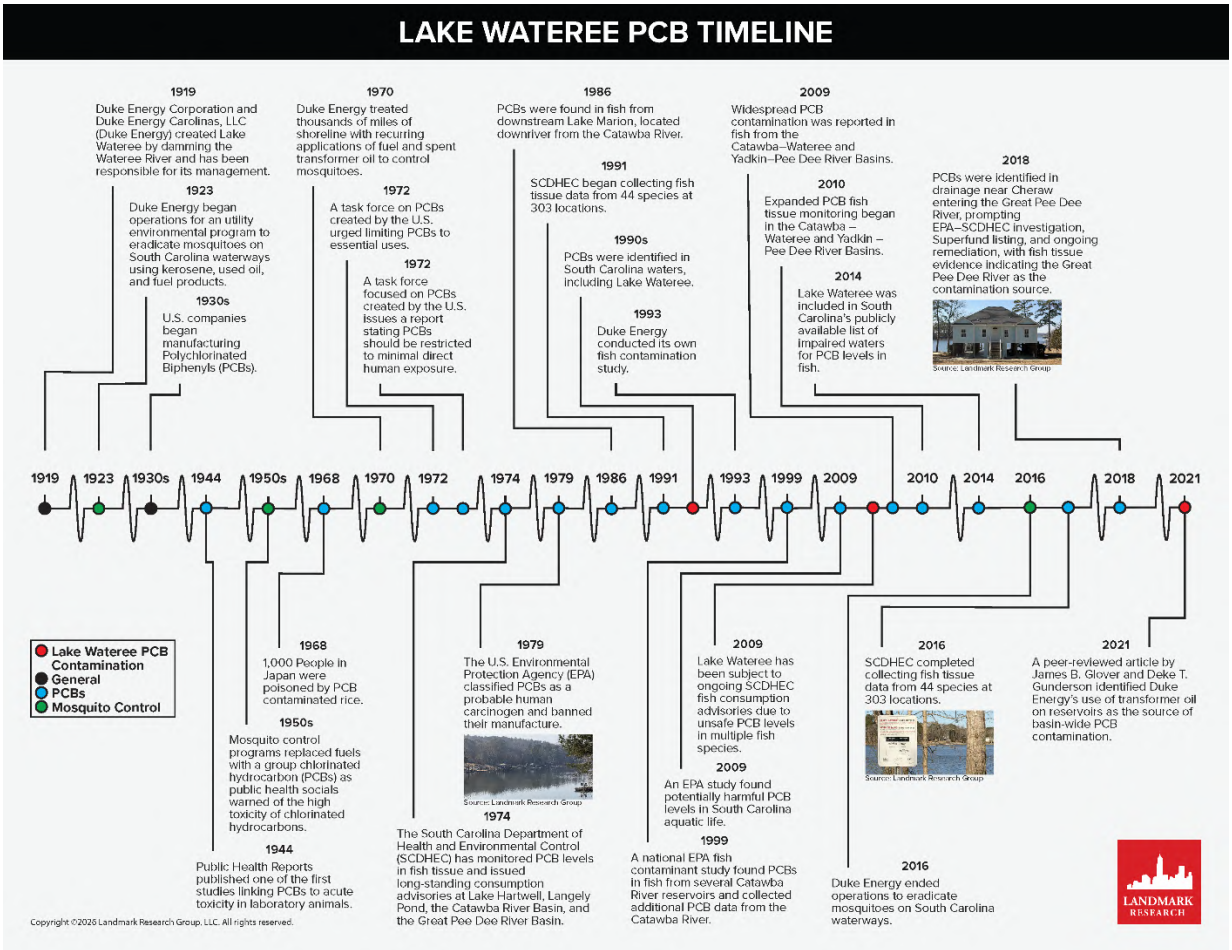


Figure 1: Lake Wateree PCB Timeline

[10] "Lake Wateree Fish Consumption Advisory," SC Department of Environmental Services, accessed, February 9, 2026, https://des.sc.gov/data-tools/fish-consumption-advisories/lake-wateree-fish-consumption-advisory

Water features, such as lakes, are generally considered amenities that buyers will pay more to enjoy such amenities when purchasing a property. In other words, they have a positive effect on property value. There is ample support in the professional appraisal and scholarly literature that supports such an effect; a summary of these articles is set forth in the addenda.

Subject Properties and Proposed Class

The proposed property class definition is "[a]ll persons or entities who currently have ownership of any real waterfront property on Lake Wateree."[11]

The clients provided a list of waterfront properties on Lake Wateree. This list was uploaded onto ArcGIS and merged with public property records.[12] Once merged, the properties were filtered and visually inspected for improved residences, and by owner to remove any properties owned by Duke Energy or government agencies. The following map illustrates the improved residential proposed class properties for which unimpaired market values were determined.

[11] First Amended Class Action Complaint, December 11, 2024, paragraph 121.

[12] Public property records were received from Fairfield County Assessor's Office on January 12, 2026, and from Kershaw County Assessor's Office on January 13, 2026. In addition, to map the parcel shapes, a GIS parcel shapefile was provided by Fairfield County, and for Kershaw County, a shapefile was downloaded on January 7, 2026, from the Kershaw County Data Portal at https://kershawcountydataportal-kershawcounty.hub.arcgis.com/datasets/2c8b2df998404370a1ceaad2a48e107c_0/explore?location=34.342593%2C-80.581503%2C10.

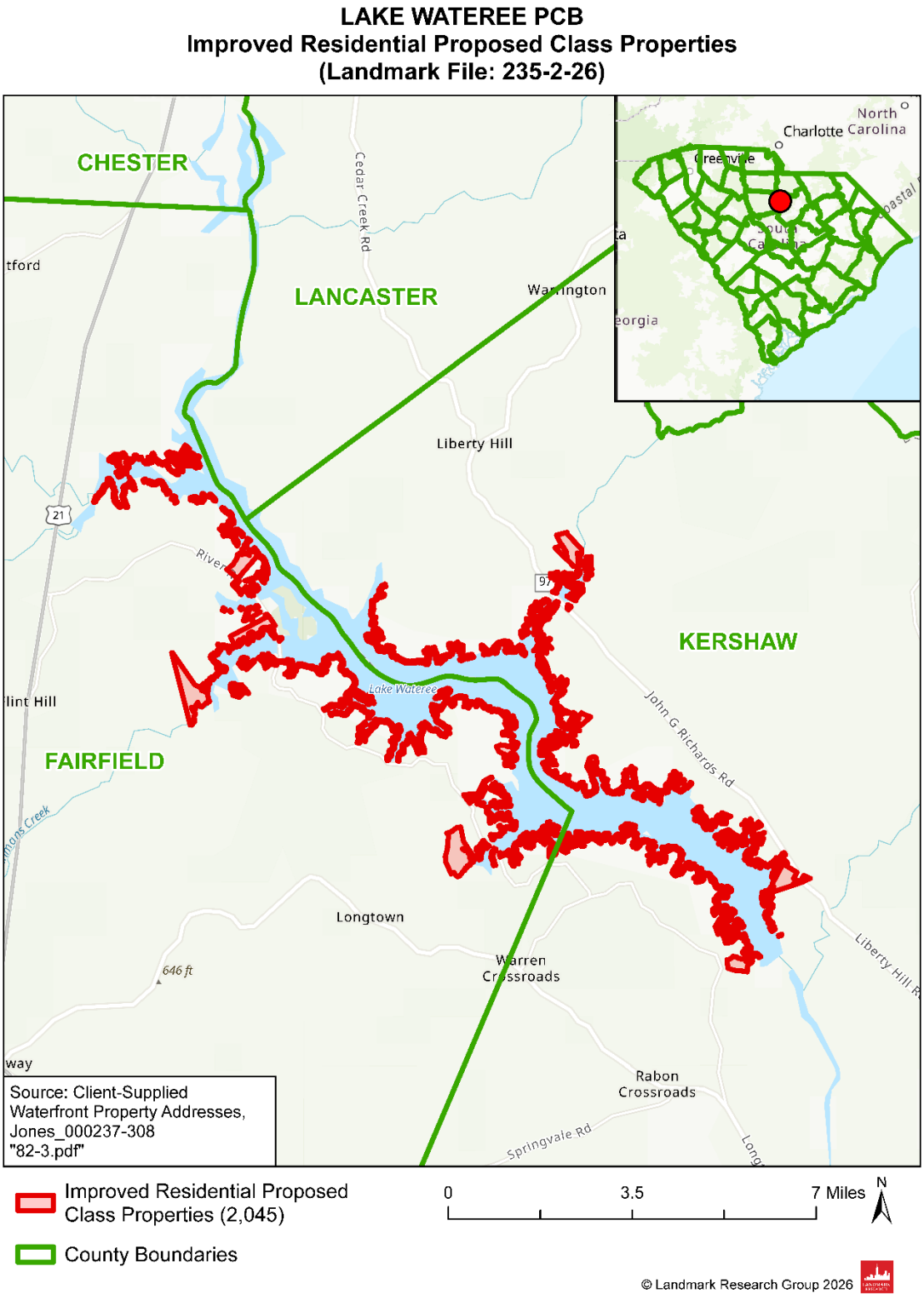


Figure 2: Improved Residential Proposed Class Properties Map

Mass Appraisal

The United States Federal Government guidelines for the valuation profession (Uniform Standards of Professional Appraisal Practice – USPAP) make clear accommodations, standards, and directives for the use of mass appraisal techniques, which includes regression analysis.

Indeed, based upon the USPAP Standards, the appraisal profession's education and training sets forth numerous treatises that apply regression analysis, including (1) The Appraisal of Real Estate 15th Edition, (2) Appendix B of The Appraisal of Real Estate 15th Edition, (3) Appraisal Institute's Quantitative Analysis course, (4) appraisal licensing qualifying education course Statistics, Modeling and Finance, (5) Complex Valuation course, (6) the Appraisal Institute's textbook An Introduction to Statistics for Appraisers, (7) the textbook Introductory Econometrics, (8) the Appraisal Institute's textbook A Guide to Appraisal Valuation Modeling, and (9) the Appraisal Institute's textbook Practical Applications in Appraisal Valuation Modeling. Furthermore, there are hundreds of articles published in various professional and academic journals that utilize multiple regressions and mass appraisal techniques in real estate valuation studies.

We have also reviewed real estate market data from the area and from other contaminated areas. Both property inspections, along with MLS, public records, and other transactional data, indicate that there is ample market data for the development of analyses for the proposed class properties.

"With reasonable similarities in the property, market, and environmental (or detrimental condition) characteristics, property interest defined in a class action can be meaningfully analyzed."[13] From all perspectives, the real estate damages in this case are well-suited for evaluation by mass appraisal techniques and other well-accepted appraisal techniques, as properties in the impacted areas have similar uses, market areas, and detrimental condition impacts.

Unimpaired Market Value Analysis

Based on the USPAP standards, the appraisal profession's education and training, guidance set forth in treatises such as the Appraisal of Real Estate 15th Edition and An Introduction to Statistics for Appraisers, and the mass appraisal methodologies described in this report, we can reliably assess the unimpaired market values of the improved residential proposed class properties using generally accepted appraisal techniques.

Unimpaired market values were determined for the improved residential proposed class properties ("subject properties") using multiple regression analysis, and reconciled with a simple regression and the market values as determined by the assessors.[14] Multiple regressions are

[13] Thomas O. Jackson, "Real Property Valuation Issues in Environmental Class Actions," *The Appraisal Journal* (2010): 149.

[14] There are various options to determine the unimpaired market value of properties, including but not limited to regression analysis (either simple or multiple), utilizing market values as

considered part of the sales comparison approach. While the cost and income approaches were considered, ample data allowed for a sales comparison analysis utilizing multiple regression.

Buyer Knowledge

A fundamental aspect of appraisal is the definition of "market value," which is premised on a knowledgeable buyer and seller, and is defined as follows:

> The most probable price, as of a specified date, in cash, or in terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the **buyer and seller each acting** prudently, **knowledgeably**, and for self-interest, and assuming that neither is under undue duress.
>
> (Appraisal Institute: *The Appraisal of Real Estate 15th Edition*, **Emphasis Added**)

Accordingly, a primary purpose of verifying a sale of real property is to make sure that the sale occurred under conditions that meet the definition of value used in the appraisal.[15] To determine whether the transactions on Lake Wateree used in the regression reflected "unimpaired" market values, buyer knowledge was studied. To verify property-specific buyer awareness of the detrimental condition, MLS remarks and disclosure documents were analyzed to identify any closed residential property transactions in the proposed class townships that sold with knowledge of the detrimental presence of PCBs on Lake Wateree.

If buyers were specifically knowledgeable of PCB contamination on Lake Wateree, they could price it into their purchasing decision, and thus the transactions would reflect "impaired" values. However, if buyers did not know, then they could not account for the detrimental condition in their pricing decision, and thus the transactions would reflect "unimpaired" values.

Closed subject property transactions in the proposed class (on Lake Wateree) from January 1, 2014 (approximate start of market cycle),[16] to January 31, 2026, a total of 981 transactions recorded on the Consolidated MLS were collected and analyzed.[17] Public and private MLS remarks of the closed transactions were analyzed, and when available, South Carolina Residential Property Condition Disclosure Statements were also analyzed. The transactions were categorized into Type 1 (No Known Significant Disclosure of PCB Issues – typically PCBs, Advisories, Fish Consumption, and Duke Energy contamination was not mentioned), Type 2

---

determined by assessors for the properties within a class, utilizing ratio studies, or with individual appraisals.

[15] The Appraisal Institute, *The Appraisal of Real Estate, 15th Edition* (Chicago, IL: Appraisal Institute, 2020), 109.

[16] See the Real Estate Market Trends section of the report.

[17] This analysis encompassed all proposed class properties; it was not limited to improved residential.

(Disclosure of PCB Issues on Lake Wateree [Neutral, Positive, or Ambiguous] – typically PCBs and its related issues on Lake Wateree would be mentioned but in a neutral, positive, or ambiguous manner), or Type 3 (Disclosure of PCB Issues on Lake Wateree [Detrimental] – typically PCBs and its related issues were mentioned without a neutral, positive, or ambiguous spin).[18] **One transaction was determined to be the closest type 3 that disclosed the detrimental presence of PCBs on Lake Wateree.**[19] This sale was not utilized in the unimpaired regression analysis.[20]

Regression Analysis

The summary output table indicated that the regression provided a good indication of value. The outputs are all in the range of the real estate profession, meaning that the regression analysis is a good indicator of value. For example, the R and R-squared are high ("the general rule of thumb is 0.60 or above"),[21] the t stats are >2 or <-2,[22] the standard error is low,[23] the F stat is greater

[18] See, for example, Ranking Analysis. "Ranking analysis is used to sort the comparable data for differences in specific elements of comparison, e.g., size, corner or interior lot, or frontage. The technique can be used to test the specific elements of comparison for their market sensitivities. The comparable sales are ranked according to overall comparability or by some other element of comparison so that the relative position of each comparable sale to the subject property is clear. Specific value trends can thereby be established for elements of comparison that are market-sensitive, and those that show no discernible or reasonable trends will be discarded." The Appraisal Institute, *The Appraisal of Real Estate*, 15th Edition (Chicago, IL: Appraisal Institute, 2020), 376-377.

[19] There were no Type 2 transactions; the remaining transactions were considered Type 1.

[20] The type 3 disclosure sale was analyzed using a paired sales analysis to determine whether the presence of PCBs in Lake Wateree affects the market value of the proposed class properties. In other words, confirming that lakefront property values are influenced by the lake and the use and enjoyment of its amenities, and that those sales used in the regression without disclosure are considered unimpaired. The paired sales indicated a range of -0.7% to -15.2%, an average of -7.5%, and a median of -6.6%. The paired sales reconcile with published literature on the effects of water quality and property values, and with case studies on the impact of PCBs on property values. The paired sales, literature review, and case studies are set forth in the addenda. Furthermore, Gretchen Greene, PhD of Greene Economics LLC has set forth an opinion on the effects of PCBs on the improved residential proposed class properties. In real estate damages, these effects are referred to as Risk Effects (or diminution in value). The Greene Report has quantified the effects by applying them to the unimpaired market values set forth in this report.

[21] Lloyd T. Murphy, "Determining the Appropriate Equation in Multiple Regression Analysis," The Appraisal Journal (October 1989): 502; and as noted for R-square "the general rule of thumb is 0.60 or above" Linne et. al., *A Guide to Valuation Modeling* (Appraisal Institute: 2000), 81.

[22] Lloyd T. Murphy, "Determining the Appropriate Equation in Multiple Regression Analysis," The Appraisal Journal (October 1989): 502; and Appendix B, "Regression Analysis and Statistical Applications" in *The Appraisal of Real Estate*, 15th ed. (Appraisal Institute: 2020), 8.

[23] Lloyd T. Murphy, "Determining the Appropriate Equation in Multiple Regression Analysis," The Appraisal Journal (October 1989): 502; and Ralph J. Brown, "On the Selection of the Best Predictive Model in Multiple Regression Analysis," *The Appraisal Journal* (October 1974): 574.

than 5,[24] and the p-values are <0.05.[25] Multicollinearity was considered and addressed in this analysis by avoiding the duplication of similar variables. The results of the multiple regression are set forth throughout this report and further detailed in the workfile.

In addition, a simple regression was conducted as a point of reconciliation.[26] Nevertheless, the multiple regression was considered a better indicator of unimpaired market value because of the greater statistical outputs, such as the R-squared.

An analysis was also conducted comparing the sale prices of the proposed class properties in 2025 to the 2025 assessor's market values, sometimes referred to as an appraisal-to-sale ratio study. The analysis indicated that there was an average difference of 31.29%, and a median difference 31.95% between the 2025 assessor's market values and the 2025 sale prices.

Similarly, the same calculations were conducted with the multiple regression analysis, by comparing the regression's predicted values to sales prices, which indicated an average difference of 18.96% and a median difference of 14.24%.[27] Thus, the regression analysis is a better indicator of current market value.[28]

Reconciliation and Conclusion

The following figure sets forth general data metrics for the unimpaired market values of the residential proposed class properties; a more detailed summary of each individual property is set forth in the addenda and throughout the workfile.

[24] Lloyd T. Murphy, "Determining the Appropriate Equation in Multiple Regression Analysis," The Appraisal Journal (October 1989): 504; and Appendix B, "Regression Analysis and Statistical Applications" in *The Appraisal of Real Estate*, 15th ed. (Appraisal Institute: 2020), 8.
[25] Appendix B, "Regression Analysis and Statistical Applications" in *The Appraisal of Real Estate*, 15th ed. (Appraisal Institute: 2020), 8.
[26] These calculations are set forth within the workfile.
[27] These calculations are sometimes also referred to as the Mean Absolute Percentage Error and the Median Absolute Percentage Error.
[28] Alternatively, the assessor's market values can be increased by the average or median ratio of the sales prices.

LAKE WATEREE PCB Unimpaired Market Value Multiple Regression (Landmark File: 235-2-26)	
Number of Subject Properties	2,045
Low	$169,757
High	$1,879,635
Average	$590,492
Median	$529,866
Total	**$1,207,555,412**

Figure 3: Unimpaired Market Value Summary

As this matter is ongoing, these analyses may be updated and supplemented at a later date. The analysis and computation can be easily modified to account for any changes to the scope of the proposed class. Landmark Research Group reserves the right to amend the analyses to reflect such changes and any new information and will discount or add interest per the Court's direction.

When any risk effect techniques in mass appraisal assignments are conducted on a percentage basis (e.g., -20% for view impairment), the findings can then be applied to unimpaired values generated by regressions or other techniques on both an individual and aggregate basis.[29]

If buyers are uninformed of the presence of contaminants, that does not mean that real estate damage has not occurred. For example, when an outside party uses a private owner's property, that is considered a taking, whether or not the owner of the property was aware of the existence of contaminants.

[29] Michael Tachovsky, "Stigma: A Case Study Analysis of Long-Term Environmental Risk Effect," *The Appraisal Journal* (Spring 2022): 120.

EXECUTIVE SUMMARY

Landmark Research Group File Identification

Case Number: 235-2-26
"Lake Wateree PCB"

Type of Report

This report is a restricted appraisal report, containing a summary of information. This report may not contain supporting rationale,[30] it can only be understood in combination with the supporting workfile documentation, deposition, and trial testimony. Accordingly, the workfile is considered a part of this report. As discovery may be ongoing in this case, Landmark Research Group reserves the right to revise and supplement this report as we continue to review and analyze the case file, and as more information becomes available.

Client of this Report

Wyche, P.A.
807 Gervais Street, Suite 301
Columbia, South Carolina 29201

Purpose of the Report

The purpose of this report is to set forth an evaluation of the unimpaired market value of the improved residential proposed class properties ("subject properties").

Intended Users of the Report

The clients are the sole intended users of this expert report. No other users are intended or identified. This expert report may not be utilized or relied upon by any other party, nor may it be relied upon by the clients for any purpose other than the stated use.

Intended Use of the Report

The intended use of this expert report is for the legal matter Clyde Marcus Jones, II, et al. v. Duke Energy Corporation and Duke Energy Carolinas, LLC. This report may be presented to the court in this matter.

[30] Appraisal Standards Board of The Appraisal Foundation, *2024 Uniform Standards of Professional Appraisal Practice*, *USPAP Guidance: Advisory Opinion 38* (United States of America, 2024), 115-116.

Scope of Work

The Scope of Work is set forth throughout this expert report, and is summarized as follows:

- Examined various legal documents.
- Examined client supplied documents.
- Researched market data.
- Analyzed public property records and MLS records.
- Examined media pertaining to Lake Wateree PCBs.
- Reviewed USPAP, the Appraisal of Real Estate 15th Edition, Real Estate Damages 3rd Edition, an Introduction to Statistics for Appraisers and other appraisal textbooks and articles relating to mass appraisal and detrimental conditions.
- Performed inspections of the proposed class area on February 6 and 7, 2026. These were exterior property inspections.
- Performed an interior inspection on the Jones class property on February 6, 2026.
- Conducted market trends.
- Conducted an unimpaired market value analysis utilizing multiple regression, simple regression, and assessor-to-sales price ratios.
- Conducted an analysis of buyer knowledge regarding the presence of PCBs on Lake Wateree by examining Multiple Listing Service (MLS) listings and supplemental transaction disclosure documents.
- Conducted a paired sales analysis of the type 3 transaction in the buyer knowledge analysis.
- Conducted a literature review on the effects of water features and water quality on property values.
- Conducted a case study analysis involving other neighborhoods impacted by PCB contamination.
- Considered cost, use, and risk effects; however, developing an opinion of real estate damages was not within the scope of this assignment.
- Prepared this expert report.
- Kristopher Williams performed general market research, including data gathering, data confirmation, regressions, literature review, case studies, and assisted with report drafting.
- Fernando Barraza performed general market research, including data gathering, data confirmation, paired sales, and assisted with report drafting.
- Spencer Thompson performed general market research, including GIS mapping and data confirmation.
- Melanie Levy performed general market research, including data gathering, data confirmation, and assisted with report drafting.
- Daniel Meyers performed general market research, including data gathering and confirmation, development of the timeline, and exhibit preparation.
- Jill Pillsbury performed general project coordination.

Extraordinary Assumptions

The use of any noted extraordinary assumptions or hypothetical conditions might affect assignment results.[31] USPAP requires that an appraiser states all extraordinary assumptions, hypothetical conditions, and jurisdictional exceptions in a report.[32]

It is an extraordinary assumption that the following data, files, and reports are accurate and correct:

- It is an extraordinary assumption that the list of proposed class properties is accurate and correct. This list was initially provided by the client. Landmark Research Group applied its unimpaired analysis to the improved residential properties. Landmark Research Group can amend its analysis by adding or removing properties.
- It is an extraordinary assumption that the environmental modeling and testing set forth by Glover and Gundersen (2021) is accurate and correct.
- It is an extraordinary assumption that the environmental modeling and testing conducted by the South Carolina Department of Health and Environmental Control ("SCDHEC") and any other sources are accurate and correct.

Hypothetical Conditions

It is a hypothetical condition that in the "unimpaired condition," the subject properties are not impacted by the presence of PCBs on Lake Wateree.

Jurisdictional Exceptions

No jurisdictional exceptions were utilized in this report.

Date of Value

February 10, 2026

Date of Report

February 10, 2026

[31] Appraisal Standards Board of The Appraisal Foundation, *2024 Uniform Standards of Professional Appraisal Practice, USPAP Guidance: Advisory Opinion 38* (United States of America, 2024), 115-116.

[32] Appraisal Standards Board of The Appraisal Foundation, *2024 Uniform Standards of Professional Appraisal Practice, Standard 2: Real Property Appraisal, Reporting; Standard 4: Appraisal Review, Reporting; USPAP Guidance Advisory Opinion 38* (United States of America, 2024), 22-25, 31, and 115-116.

Property Rights Appraised

Fee simple estate

Type of Value

Market Value

REAL ESTATE MARKET TRENDS

The division of Economic Research at the Federal Reserve Bank of St. Louis (FRED) is responsible for expanding economic knowledge by producing research in many fields, including applied microeconomics, macroeconomics, and money/banking.[33] The Federal Reserve Bank of St. Louis is a leading, respected resource for economic and financial information.[34] The FRED publishes a house price index in numerous markets across the country, including those markets relevant to this study. While real estate valuation professionals may consider trending prices in a neighborhood(s), using the FRED index is an appropriate approach.[35] Accordingly, the FRED House Price Index for Kershaw and Fairfield Counties, South Carolina were studied. The Kershaw County FRED Index indicated that the current housing cycle started in approximately 2012, while the Fairfield County FRED Index indicated that the current housing cycle started in approximately 2014. To account for slight differences, the data used in the unimpaired analysis were from January 1, 2014, to January 31, 2026.

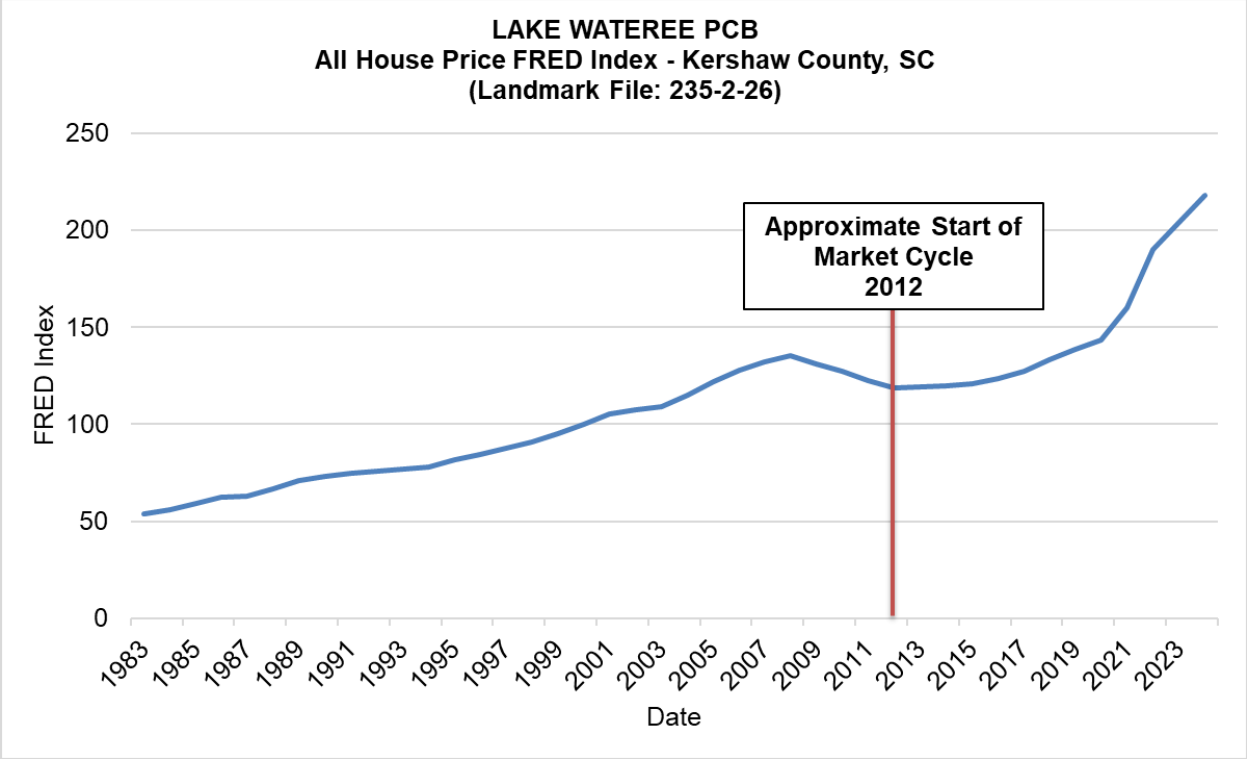


Figure 4: Kershaw County, SC FRED Index Market Trends Graph

[33] "About Economic Research at the St. Louis Fed," Economic Research at the Federal Reserve Bank of St. Louis, accessed December 17, 2019, https://research.stlouisfed.org/about.html.
[34] Dan L. Swango, "Economic Research Resources," *The Appraisal Journal* (Spring 2017): 148.
[35] Michael Tachovsky, "Stigma: A Case Study Analysis of Long-Term Environmental Risk Effect," *The Appraisal Journal* (Spring 2022): 120.

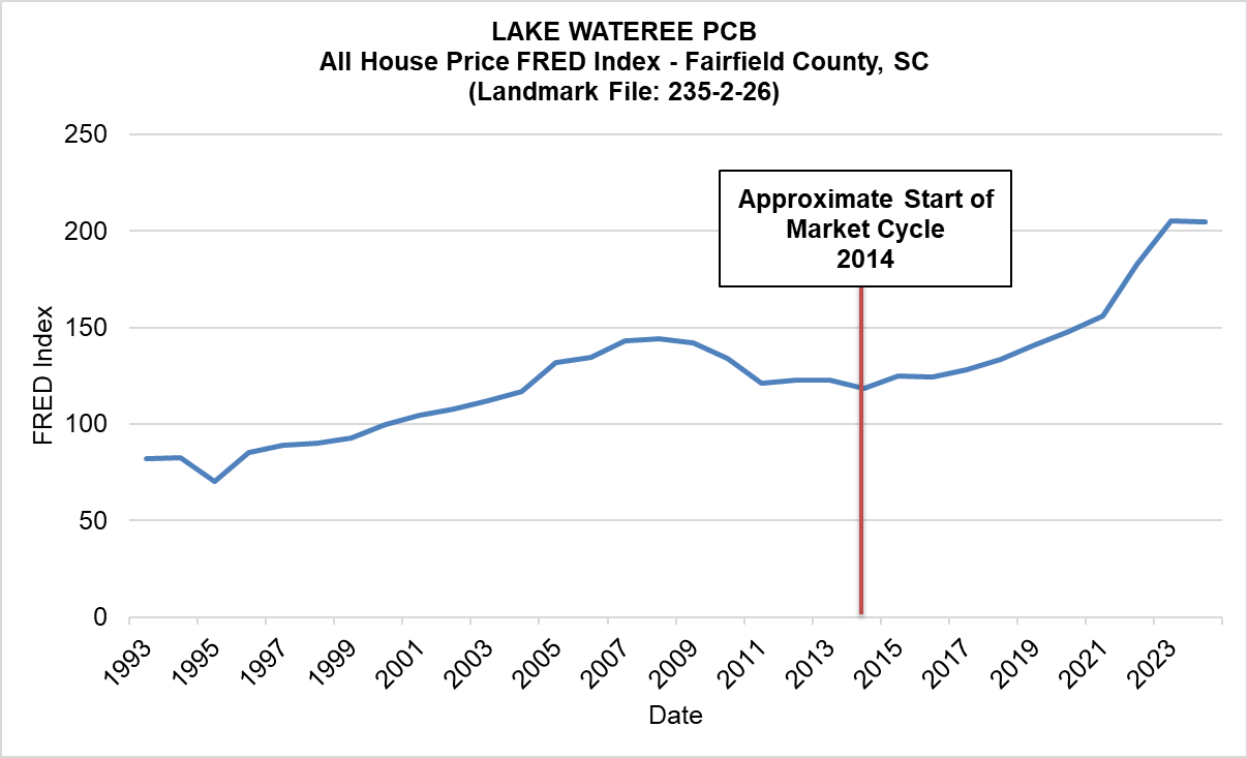


Figure 5: Fairfield County, SC FRED Index Market Trends Graph

MASS APPRAISAL

Mass valuations of real estate have been established in the mainstream of the appraisal profession since at least the 1950s and 60s.[36] Mass appraisal is defined as the process of valuing a universe of properties as of a given date using standard methodology, employing common data, and allowing for statistical testing (USPAP, 2020 – 2021 ed.).[37]

Mass appraisal models were originally developed by property tax assessors to "improve productivity and fairness in non-rural locations where manpower was insufficient to carry out the function of estimating assessed value."[38] The mass appraisal provides for a systematic approach and uniform application of appraisal methods and techniques to obtain estimates of values that allow for statistical review and analysis of results.[39]

Mass appraisals are: 1) the subject of the appraisal is a "universe" of properties, meaning more than one property; and 2) the assignment involves standard methodology employing common data that allows for statistical testing. These models may be based on the cost approach, the income approach, the sales comparison approach or any combination of these approaches to value.[40]

To accommodate mass appraisal assignments, Uniform Standards of Professional Appraisal Practice (USPAP) established Standards 5 and 6. The appraisal profession has also aided in the progression of mass appraisal assignments by requiring statistical analysis as part of the certified general license qualifying education and The Appraisal Institute has developed statistical course requirements to obtain the MAI designation. In addition, Chapter 14, "Statistical Analysis," in The Appraisal of Real Estate, 15th Edition, is dedicated to the use of statistical methodology that can be used in a mass appraisal assignment; in fact, "traditional appraisal techniques have been steeped in statistical analysis."[41] More specifically, the Appraisal of Real Estate, 15th Edition states that "statistical techniques like regression analysis have become accepted tools in the application of the approaches to value."[42]

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[36] Robert A. Blettner, "Mass Appraisal via Multiple Regression," *The Appraisal Journal* (1969): 513-521.
[37] Appraisal Foundation, USPAP Standard 6, and the Standard on Mass Appraisal of Real Property promulgated by the International Association of Assessing Officers.
[38] Appraisal Institute. *The Appraisal of Real Estate*, 15th ed. (Chicago, IL: Appraisal Institute, 2020), 269.
[39] Appraisal Standards Board of The Appraisal Foundation, *2024 Uniform Standards of Professional Appraisal Practice*, *Standard 5: Mass Appraisal, Development* (United States of America, 2024), 35-36
[40] Appraisal Foundation, USPAP Standard 6, and the Standard on Mass Appraisal of Real Property promulgated by the International Association of Assessing Officers.
[41] The Appraisal Institute, *The Appraisal of Real Estate, 15th Edition* (Chicago, IL: Appraisal Institute, 2020): 250.
[42] The Appraisal Institute, *The Appraisal of Real Estate, 15th Edition* (Chicago, IL: Appraisal Institute, 2020), 249.

Regression can also be used to estimate unimpaired values, impaired values, and market rents.[43] As the Appraisal Institute course *Quantitative Analysis* states, "a regression analysis can be used to form the basis for an opinion of value by direct sales comparison. If the data are representative, the resulting regression equation can be seen as a means of estimating market value that is fully consistent with the principle of contribution."[44] With use effect calculations, market rents can be determined using regression or other techniques, and the time period of impact can be applied to the results on both an individual and aggregate basis.[45]

Statistical techniques such as regressions provide useful tools when studying groups of properties, as they are engineered to produce a variety of designs and outputs including, (1) aggregate results, (2) an output that allows damage calculations on a property-by-property basis, or (3) outputs that allow damage calculations on a zone-by-zone or neighborhood-by-neighborhood basis. Also, a regression model can utilize subclasses and they do not have to be used for all properties in a class. For example, if necessary, some class properties can be valued individually.

Mass Appraisal Methodologies

Indeed, mass appraisal techniques are relatively common within the appraisal profession and include, among others, paired sales analysis, case studies, multiple regression analysis,[46] and other types of analyses utilizing property sales and rent data.

As the following figure illustrates, the real estate valuation profession sets forth a variety of accepted quantitative and qualitative methodologies that are applicable to mass appraisals. This applies to both rental (use effects) and sales (risk effects) analyses. Mass appraisals can be completed with various approaches. Specifically, there are eight main pillars for appraisals, any one of which can produce a credible result. The eight main pillars when analyzing sales data are: simple regression, multiple regression, paired sales, sale/resale, case study, literature review, survey, and sale delay. In addition to the eight main pillars, there are other applicable analyses noted in the following figure:

[43] Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago: Appraisal Institute, 2009), 345; Appendix B, "Regression Analysis and Statistical Applications" in *The Appraisal of Real Estate*, 15th ed. (Appraisal Institute: 2020), 8; and Appraisal Institute, *Quantitative Analysis* coursebook, Exercise 3.2 Question 1, Practice Test 6 and 7 Question 11, and Part 12 Question 6.
[44] Appraisal Institute, *Quantitative Analysis* coursebook (Chicago: Appraisal Institute), Part 3-46.
[45] Appendix B, "Regression Analysis and Statistical Applications" in *The Appraisal of Real Estate*, 15th ed. (Appraisal Institute: 2020), 8.
[46] The Appraisal Institute, *The Appraisal of Real Estate, 15th Edition* (Chicago, IL: Appraisal Institute, 2020), 188.

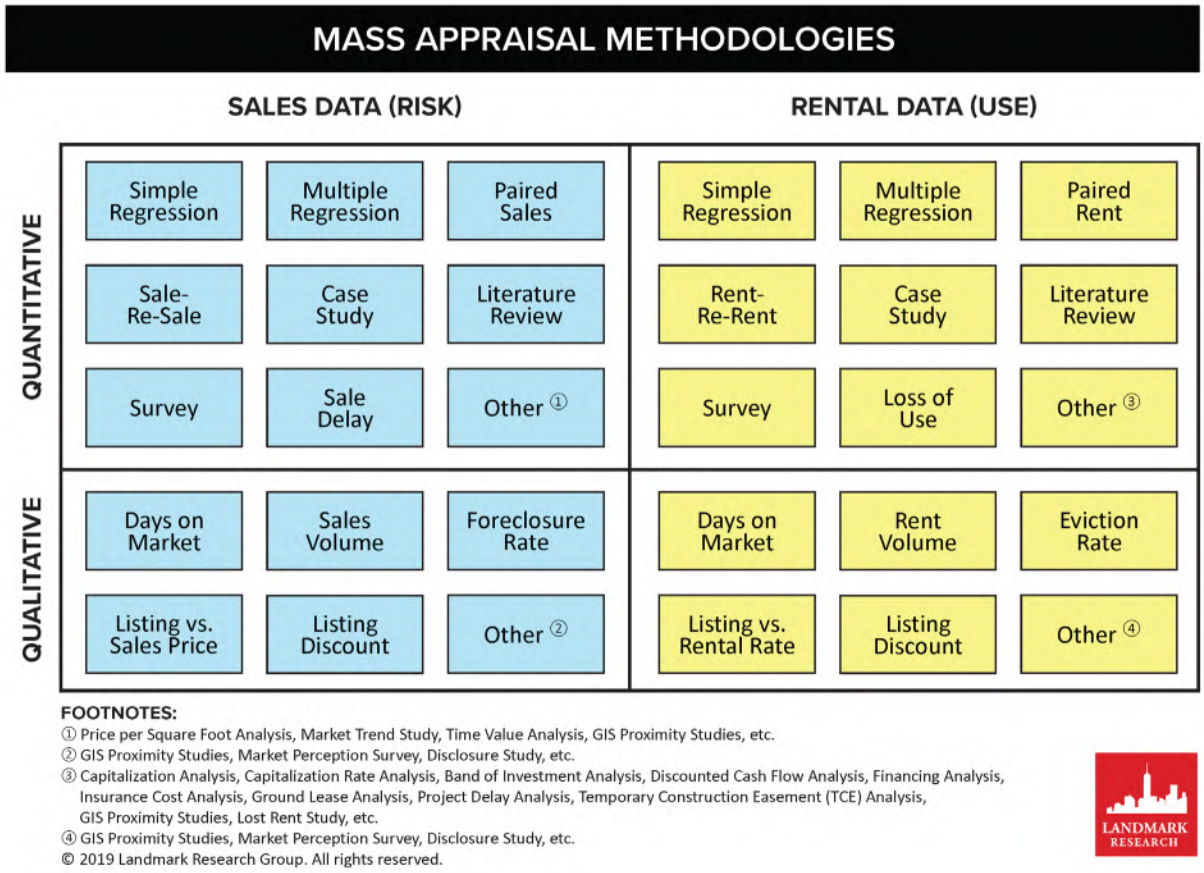


Figure 6: Appraisal Methodologies

While all these techniques are generally accepted, not all of these techniques may be necessary to arrive at a conclusion. These techniques, which are in fact subsets of the three basic valuation techniques (cost approach, income approach, and sale comparison approach), do not ignore individual characteristics of properties such as quality, type, size, and age, but instead take them into account.

In class action lawsuits, mass appraisal techniques can be used to evaluate real estate damages on individual and aggregate bases. As Jackson states, "with reasonable similarities in property, market, and environmental characteristics, property interests defined in a class action can be meaningfully analyzed."[47]

When any risk effect techniques in mass appraisal assignments, such as the regression and paired sales in this case study, are conducted on a percentage basis (e.g., −20% for view impairment), the findings can be then be applied to unimpaired values generated by regressions or other

[47] Thomas O. Jackson, "Real Property Valuation Issues in Environmental Class Actions," *The Appraisal Journal* (2010): 149.

techniques on both an individual and aggregate basis.[48] Likewise, with use effect calculations, market rents can be determined using regression[49] or other techniques, and the time period of impact can be applied to the results on both an individual and aggregate basis.

Furthermore, when real estate damages exist, the application of the described techniques may result in a percentage diminution-in-value. The appropriateness of percentage adjustments, applied to the subject properties, is recognized and established in the appraisal literature.[50]

Based upon the foregoing, the method to determine damages for the proposed class of properties in this case is straightforward. The techniques above can be used individually or in a variety of combinations to determine the extent to which the proposed properties have been damaged.

Without regard to which combination of approaches are used, the common characteristics of the real estate market and that market's reaction to a common detrimental condition can be evaluated on a class-wide basis.

[48] Marvin Wolverton, *An Introduction to Statistics for Appraisers*, 345; Appraisal Institute, *Quantitative Analysis* coursebook, Part 3-46; and Exercise 3.2 Question 1, Practice Test 6 and 7 Question 11, and Part 12 Question 6 in *Quantitative Analysis* coursebook.
[49] Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago: Appraisal Institute, 2009), 345; Appendix B, "Regression Analysis and Statistical Applications" in *The Appraisal of Real Estate*, 15th ed. (Appraisal Institute: 2020), 8; Appraisal Institute, *Quantitative Analysis* coursebook, Exercise 3.2 Question 1, Practice Test 6 and 7 Question 11, and Part 12 Question 6; and Michael Tachovsky, "Stigma: A Case Study Analysis of Long-Term Environmental Risk Effect," *The Appraisal Journal* (Spring 2022): 117.
[50] The Appraisal Institute, *The Appraisal of Real Estate, 15th Edition* (Chicago, IL: Appraisal Institute, 2020), 342.

BUYER KNOWLEDGE

Knowledge is a critical element in economics, including real estate markets. In both the stock and real estate markets, there are mottos such as "knowledge is power" and "information is king." These and other markets are profoundly impacted by the level of knowledge held by individual buyers and sellers. Indeed, a fundamental aspect of appraisal is the definition of "market value," which is premised on a knowledgeable buyer and seller, and is defined as follows:

> The most probable price, as of a specified date, in cash, or in terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the **buyer and seller each acting** prudently, **knowledgeably**, and for self-interest, and assuming that neither is under undue duress.
>
> (Appraisal Institute: *The Appraisal of Real Estate 15th Edition*, **Emphasis Added**)

By definition, market value mandates that both buyers and sellers are acting knowledgeably about the risks and uncertainties associated with a property. If the market or individual buyers are uninformed, partially informed, or misinformed, then that impaired knowledge can affect market transactions and the appraisal process. There are some well-known illustrations of these principles. For example, if properties are sold where the sellers lack knowledge that the site holds significant mineral rights and oil reserves, then the sales price may not reflect its market value. This property could be worth significantly more with the knowledge of the mineral rights.

Similarly, if the property is sold where the buyer is uninformed, partially informed, or misinformed about a material latent defect, such as it being within a flood zone, then the sales price may not reconcile with the market value that would reflect the price paid when a buyer is informed of potential flood risks. If a buyer is uninformed, then the sales price of the property at issue may not reflect the market value. On the other hand, when the buyer and seller are well-informed of the benefits, risks, and uncertainties of owning and occupying the property, then the effects, if any, of a detrimental condition would typically be reflected in the transactional market data.

Buyers must be informed about potential property risks so they can make an informed purchasing decision about the value of the property. Market participants may feel that a property is "contaminated" if there is the presence of contamination, even if it does not exceed government standards. Consistent with this, most property disclosure forms simply ask for knowledge of contamination, not whether the contaminants are above or below a certain level.

Having a contaminant-free property that does not present a question about health risks is generally assumed. If a home is not contaminant-free, this information needs to be disclosed so that a potential buyer can make a knowledgeable, informed, and intelligent decision about the risks and uncertainties of occupying and owning the property.

For purposes of determining the unimpaired values of the improved residential proposed class properties, properties that sell without buyer knowledge of the presence of PCBs on Lake Wateree would be considered "unimpaired."

Media or On-Line Searches

A media analysis was conducted, which indicated a general lack of property-specific buyer awareness and inconsistencies over time regarding coverage of PCB issues surrounding the proposed class area, as further described in the media headlines in the addenda of this report.

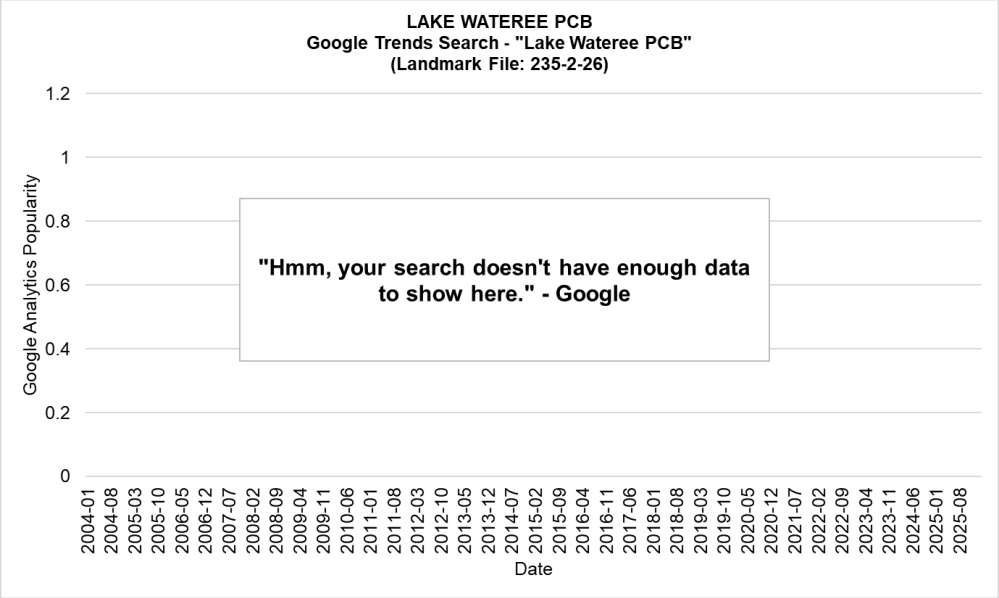


Figure 7: Google Trends Search – "Lake Wateree PCB"

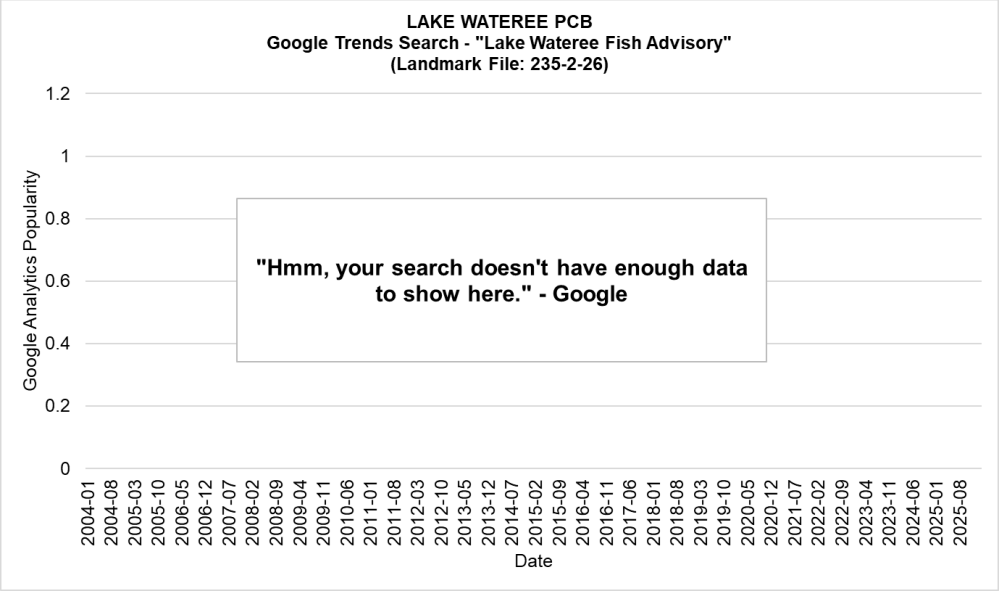


Figure 8: Google Trends Search – "Lake Wateree Fish Advisory"

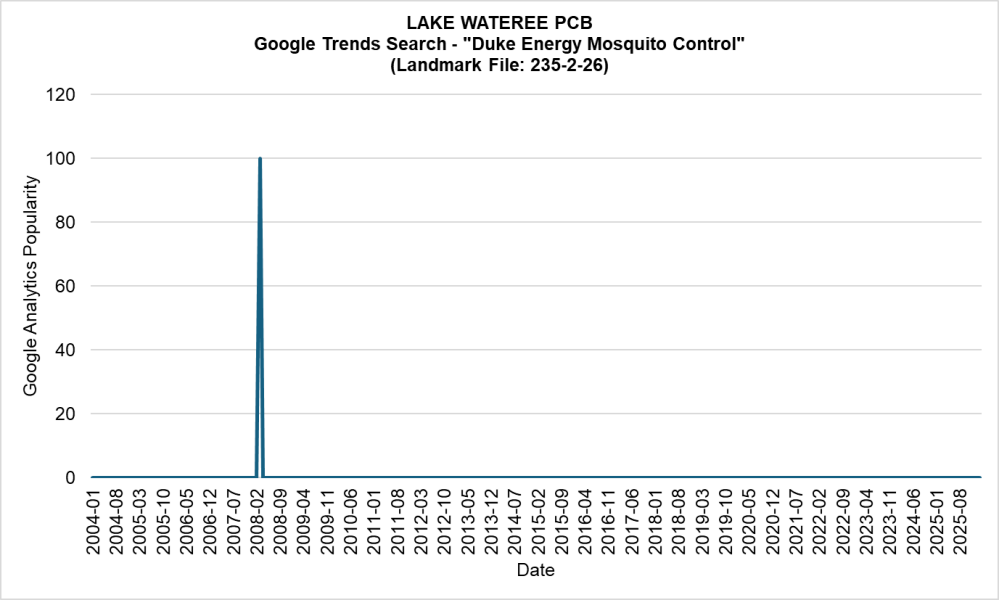


Figure 9: Google Trends Search – "Duke Energy Mosquito Control"

At best, the media has provided some general (non-property-specific) information on the scope of PCB issues on lakefront properties in the proposed class area. Moreover, one should be careful not to assume that the mere existence of media attention indicates widespread public knowledge.[51]

Seller's Property Disclosure Statements

A sometimes-overlooked component of market value is the extent that seller disclosure and buyer knowledge affect property value. Sellers and their intermediaries may have a legal obligation to disclose certain information about a property, but failure to do so is not uncommon. As a result, buyers may unknowingly purchase properties with a serious condition, such as environmental contamination.[52]

When potential data is identified, an analysis of buyer awareness may be necessary to determine whether market participants are knowledgeable of the condition being measured. Making assumptions about buyer or market-wide knowledge can result in an invalid and misleading opinion of value.[53] If buyers lack awareness of a condition, that does not automatically mean that the condition has no impact on market value. An "appraiser cannot use the transaction as an

[51] Rudy R. Robinson III and Scott R. Lucas, "Seller Disclosure and Buyer Knowledge: How They Affect Market Value," *The Appraisal Journal* (Spring 2007): 135.
[52] Robinson and Lucas, "Seller Disclosure and Buyer Knowledge: How They Affect Market Value," *The Appraisal Journal* (Spring 2007): 134.
[53] Robinson and Lucas, "Seller Disclosure and Buyer Knowledge: How they Affect Market Value," *The Appraisal Journal* (Spring 2007): 139.

impaired sale to measure the condition's effect on value" if a buyer lacks awareness of the detrimental condition.[54]

While the local market may have been, at times, *generally* aware of the PCB issues in the area, the essential question is whether potential buyers for specific property transactions were *specifically* made aware as to the condition, risks, and uncertainties, of a specific property. In other words, potential buyers may be generally aware of the potential risks and uncertainties for various latent defects, such as termites, earthquake faults, mold, or radon, but they must either be led to specifically investigate these issues or have that information disclosed to them in order to make an informed purchasing and pricing decision.

"General awareness" does not constitute buyer knowledge that is akin to the definition of market value. For example, "[r]eal estate valuation professionals should be cautious when generalized terms such as 'public awareness' and 'community awareness' are used to describe property-specific awareness. These generalized terms can be misleading. For example, one can be aware as a general member of the public or a community that there was a wildfire in Malibu, California; nevertheless, this is not enough information to inform them if a specific property has burnt in a fire."[55]

Since property inspections in the proposed class area may have, in the rarest of circumstances, indicated a contamination issue, and as contaminants themselves are often colorless and odorless, essentially, the likely means of accurate property-specific knowledge is within the Seller Disclosure documents or MLS statements. In this regard, unless the detrimental PCB issue is specifically and accurately disclosed, real estate buyers lack awareness of it.

Under South Carolina law, sellers of a property are required to complete Residential Property Condition Disclosure Statements. On this form, sellers disclose whether they are aware of various property conditions, including but not limited to land-use restrictions, the presence of hazardous or toxic materials, and other environmental contamination.[56]

Disclosure forms are useful to determine a buyer's knowledge of a certain property condition at the time of sale. Unlike verbal confirmation, which requires a buyer, seller, or third-party agent to recall past information, written disclosures are contemporaneous with the time of the transaction. A sale transaction may not reflect a property's as-is or "impaired" market value if the presence of contaminants is not properly disclosed. For example, if buyers were specifically

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[54] Robinson and Lucas, "Seller Disclosure and Buyer Knowledge: How they Affect Market Value," *The Appraisal Journal* (Spring 2007): 136.
[55] Tachovsky and Williams, "The Role of Buyer Knowledge in Real Estate Valuation," *Canadian Property Valuation* (Book 69, Volume 1, 2025): 45.
[56] South Carolina Legislature, "South Carolina Code of Laws Unannotated – Title 27 Property and Conveyances, Chapter 50 The Residential Property Condition Disclosure Act, Article 1 Residential Property Condition Disclosure Statements," accessed February 2, 2026, https://www.scstatehouse.gov/code/t27c050.php#:~:text=(A)%20An%20owner%20is%20not,as%20described%20in%20subsection%20(B).&text=(3)%20public%20information%20from%20the,in%20Article%207%2C%20Title%2023.

aware of PCB contamination on Lake Wateree, they could price it into their purchasing decision, and thus the transactions would reflect "impaired" values. However, if buyers did not know, then they could not account for the detrimental condition in their pricing decision, and thus the transactions would reflect "unimpaired" values.

To verify property-specific buyer knowledge of the detrimental condition, MLS remarks and disclosure documents were analyzed to identify any closed residential property transactions in the proposed class that sold with knowledge of the detrimental presence of PCBs on Lake Wateree. A primary purpose of verifying a sale of real property is to make sure that the sale occurred under conditions that meet the definition of value used in the appraisal.[57]

Closed subject property transactions in the proposed class (on Lake Wateree) from January 1, 2014 (approximate start of market cycle),[58] to January 31, 2026, a total of 981 transactions recorded on the Consolidated MLS were collected and analyzed.[59] Public and private MLS remarks of the closed transactions were analyzed, and when available, South Carolina Residential Property Condition Disclosure Statements were also analyzed. The transactions were categorized into Type 1 (No Known Significant Disclosure of PCB Issues – typically PCBs, Advisories, Fish Consumption, and Duke Energy contamination was not mentioned), Type 2 (Disclosure of PCB Issues on Lake Wateree [Neutral, Positive, or Ambiguous] – typically PCBs and its related issues on Lake Wateree would be mentioned but in a neutral, positive, or ambiguous manner), or Type 3 (Disclosure of PCB Issues on Lake Wateree [Detrimental] – typically PCBs and its related issues were mentioned without a neutral, positive, or ambiguous spin).[60] **One transaction was determined to be the closest type 3 that disclosed the detrimental presence of PCBs on Lake Wateree.**[61] This sale was not utilized in the unimpaired regression analysis.[62]

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[57] The Appraisal Institute, *The Appraisal of Real Estate, 15th Edition* (Chicago, IL: Appraisal Institute, 2020), 109.
[58] See the Real Estate Market Trends section of the report.
[59] This analysis encompassed all proposed class properties; it was not limited to improved residential.
[60] See, for example, Ranking Analysis. "Ranking analysis is used to sort the comparable data for differences in specific elements of comparison, e.g., size, corner or interior lot, or frontage. The technique can be used to test the specific elements of comparison for their market sensitivities. The comparable sales are ranked according to overall comparability or by some other element of comparison so that the relative position of each comparable sale to the subject property is clear. Specific value trends can thereby be established for elements of comparison that are market-sensitive, and those that show no discernible or reasonable trends will be discarded." The Appraisal Institute, *The Appraisal of Real Estate*, 15th Edition (Chicago, IL: Appraisal Institute, 2020), 376-377.
[61] There were no Type 2 transactions; the remaining transactions were considered Type 1.
[62] The type 3 disclosure sale was analyzed using a paired sales analysis to determine whether the presence of PCBs in Lake Wateree affects the market value of the proposed class properties. In other words, confirming that lakefront property values are influenced by the lake and the use and enjoyment of its amenities, and that those sales used in the regression without disclosure are considered unimpaired. The paired sales indicated a range of -0.7% to -15.2%, an average of

LAKE WATEREE PCB Type 3 Transaction Summary (Landmark File: 235-2-26)			
No.	**Type 3 Property Address & Parcel ID**	**MLS Number (Sale Date) & Remarks**	**South Carolina Residential Property Condition Disclosure Statement**
1	2284 Beaver Creek Road Camden, SC 111-04-00-027	598025 (05/20/2025) None Noted	Under Section VI. Buried, Unburied, or Covered Presence of the Following: Lead Based Paint, Lead Hazards, Asbestos, Radon Gas, Methane Gas, Storage Tanks, Hazardous Material, Toxic Material, or Environmental Contamination, it states, "See SCDES fish advisories for Lake Wateree."

Figure 10: Type 3 Transaction

-7.5%, and a median of -6.6%. The paired sales reconcile with published literature on the effects of water quality and property values, and with case studies on the impact of PCBs on property values. The paired sales, literature review, and case studies are set forth in the addenda. Furthermore, Gretchen Greene, PhD of Greene Economics LLC has set forth an opinion on the effects of PCBs on the improved residential proposed class properties. In real estate damages, these effects are referred to as Risk Effects (or diminution in value). The Greene Report has quantified the effects by applying them to the unimpaired market values set forth in this report.

UNIMPAIRED MARKET VALUE

The regression analysis examined closed sales of the lakefront improved residential proposed class properties.[63] Consolidated Multiple Listing Service (MLS) sales data was used with closed dates ranging from January 1, 2014 (approximate start of the market cycle) to January 31, 2026.

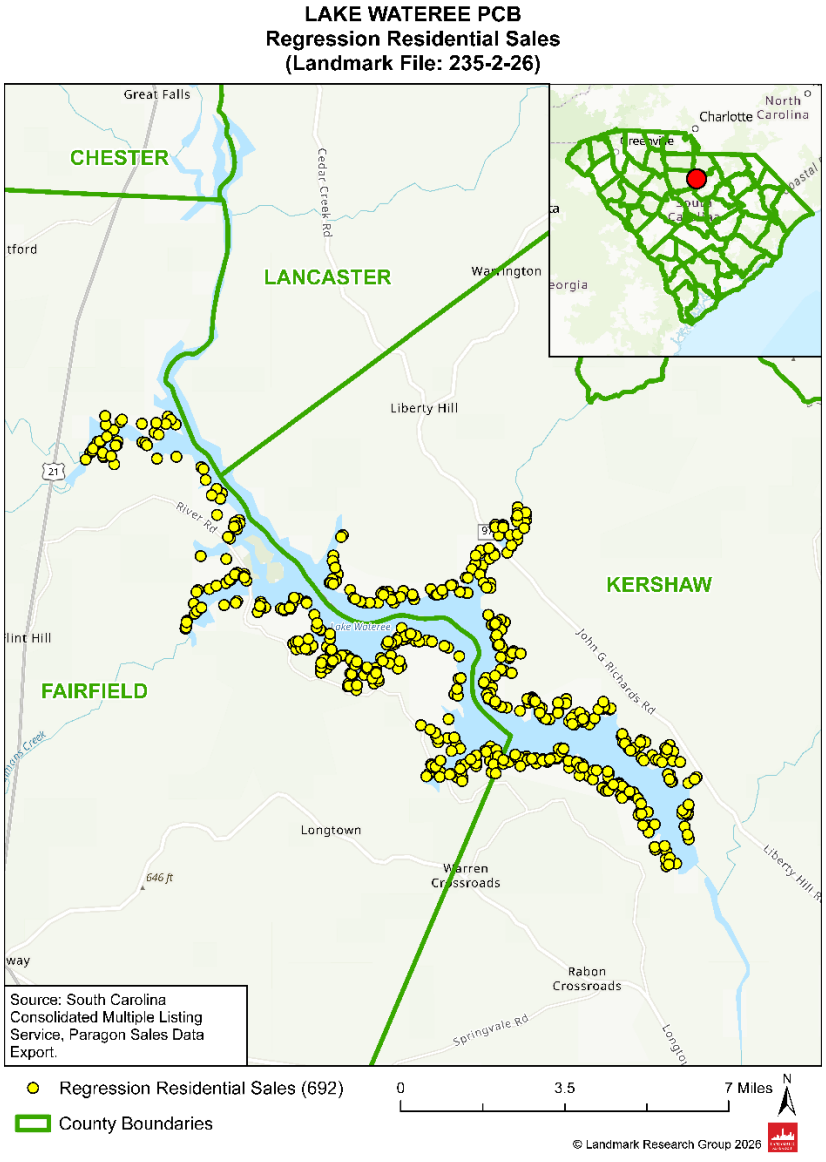


Figure 11: Residential Proposed Class Sales Used in the Regression

[63] The dataset can be expanded to include a wider date range or geographic area; however, the data within the proposed class property area provided meaningful results. MLS remarks and seller disclosure statements were analyzed for the sales utilized in the regression. Type 3 sales were not included in the unimpaired regression. However, due to the lack of type 3 detrimental disclosure of PCBs on Lake Wateree in the remaining sales, those sales were considered "unimpaired" and therefore utilized in the regression.

When analyzed using a multiple regression analysis, the dependent variable was the noted sale price (represented in US dollars). Logarithmic transformations were used for the Closed Price, Living Area, and Lot Area. Natural logs are often used in regression models when applied to real property valuation. The symbol for a natural logarithm is "ln."[64] Furthermore, in regressions, log transformations are often useful for controlling heteroscedasticity[65] and for analyzing data on a percentage basis.[66]

The independent variables considered and used were:

- Sale Date (Time Index Monthly starts at 1/2014 = 0) – This variable accounts for changes in the real estate market over time.
- Living Area (Improved SqFt Ln) – This variable accounts for size.
- Age (As of Sale Date) – This variable accounts for the age of the property.
- Lot Area (Lot Acres Ln) – This variable accounts for size.
- Boathouse, Dock (1 = Yes, 0 = No) – This variable is a binary variable that accounts for properties that have a boathouse or a dock.
- Pool (1 = Yes, 0 = No) – This variable is a binary variable that accounts for properties that have a pool.
- Manufactured (1 = Yes, 0 = No) – This variable is a binary variable that accounts for properties that have manufactured homes.
- Location Camden (1 = Yes, 0 = No) – This variable is a binary variable that is determined by the Town in which a property is located.
- Location Liberty Hill (1 = Yes, 0 = No) – This variable is a binary variable that is determined by the Town in which a property is located.
- Location Ridgeway (1 = Yes, 0 = No) – This variable is a binary variable that is determined by the Town in which a property is located.
- *Location Winnsboro (0 = Yes, 0 = No) – This variable is a binary variable that is determined by the Town in which a property is located. The summary output table does not include a coefficient for Winnsboro because it is considered the baseline location variable. In other words, if a property is not located in Camden, Liberty Hill, or Ridgeway, by default, it is located in Winnsboro.

The regression outputs were credible and generally within the appraisal industry standards.[67] The local market provided good quality market data. Furthermore, all of the baseline independent variables set forth in the "Baseline Real Estate Regression Variables From Professional Textbooks" were considered, and each variable included the minimum number of observations

[64] Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago: Appraisal Institute, 2009), 30.
[65] Appendix B, "Regression Analysis and Statistical Applications" in *The Appraisal of Real Estate*, 15th ed. (Appraisal Institute: 2020), 10.
[66] Michael Tachovsky, "Stigma: A Case Study Analysis of Long-Term Environmental Risk Effect," *The Appraisal Journal* (Spring 2022): 116.
[67] See, for example, but not limited to, the Residuals and Summary Output table.

suggested.[68] Moreover, "[i]mportant explanatory variables usually include improved living area, number of bedrooms, number of bathrooms, and perhaps lot size, among others."[69] Noting this, the improved living area was used in this model rather than the number of bedrooms to reduce multicollinearity, and bathrooms were not included because the public property record data from the County Assessor's Offices did not include that characteristic for all of the proposed class properties.

[68] "A good rule of thumb is to include at least 10 to 15 observations per independent variable. That is, $n/k \geq 10$ to 15. Hair, et al. suggest an absolute minimum of $n/k \geq 4$ and Neter, et al. suggest a minimum of $n/k \geq 6$ to 10." Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago: Appraisal Institute, 2009), 323.

[69] Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago: Appraisal Institute, 2009), 308.

Summary Input Table

The summary input table sets forth an example of the market data utilized in this study. The variables studied are the sale price (the dependent variable) and the independent variables are shown in the following partial summary input table, the full table is set forth in the work file:

LAKE WATEREE PCB Summary Input Table (Landmark File: 235-2-26)										
LRG	LRG	LRG	LRG	LRG	LRG (Google Maps)	LRG	LRG	LRG	LRG	LRG
Sold Price (Ln)	Time Index Monthly starts @ 1/2014 = 0	Improved SqFt (Ln)	Age (As of Sale Date)	Lot Size Acreage (Ln)	Dock/ Boathouse	Pool	Manufactured/Mo dular	Camden	Liberty Hill	Ridgeway
11.29	42.00	6.49	54	-0.92	1	0	1	0	0	0
11.35	22.00	7.20	37	-0.40	1	0	1	0	0	1
11.44	17.00	7.05	20	-0.42	0	0	1	0	0	1
11.65	59.00	6.49	55	-0.92	1	0	1	0	0	0
11.65	43.00	7.22	33	-0.51	1	0	1	0	0	1
11.65	65.00	6.21	60	-0.54	1	0	1	0	0	1
11.69	20.00	6.68	44	-0.40	1	0	1	0	0	1
11.70	63.00	6.35	52	0.53	1	0	1	0	0	1
11.77	39.00	6.75	117	0.00	0	0	0	0	0	1
11.78	8.00	7.05	15	-0.16	0	0	1	0	0	1
11.85	18.00	6.92	26	-0.39	1	0	1	0	0	1
11.85	23.00	7.45	24	-0.25	1	0	1	0	0	0
11.85	52.00	6.63	46	-0.26	1	0	1	0	0	1
11.86	43.00	6.40	48	-0.69	1	0	0	0	0	0
11.90	101.00	6.91	59	-0.54	1	0	1	0	0	0
11.92	14.00	7.16	6	-0.31	1	0	0	0	0	1
11.92	38.00	6.50	52	-0.01	1	0	0	0	0	1
11.95	42.00	7.31	67	-0.45	1	0	1	0	0	1
11.96	55.00	7.01	58	-0.84	1	0	0	0	0	0
11.97	90.00	6.93	71	-0.69	1	0	0	0	0	0
11.98	40.00	6.34	44	-0.29	1	0	1	0	0	1
11.98	78.00	6.68	50	0.72	1	0	0	0	0	0
11.98	11.00	6.86	25	-0.39	1	0	1	0	0	1
11.98	41.00	6.51	37	-0.14	1	0	0	0	0	1
12.00	53.00	7.09	23	0.22	0	0	1	0	0	1
12.01	43.00	6.83	34	-0.42	1	0	1	0	0	1
12.01	63.00	7.42	48	-0.24	1	0	1	0	0	1
12.01	56.00	6.59	48	-0.13	1	0	0	0	0	1
12.01	43.00	6.15	56	-0.60	1	0	0	0	0	0
12.04	62.00	7.57	26	-0.04	1	0	1	0	0	1

Figure 12: Summary Input Table Sample

Descriptive Statistics Table

The summary descriptive statistics table describes the data in the input table using statistical measurements. This table provides a general overview of the data utilized in the analysis, and further details of the analysis results are provided in the Summary Output table.

LAKE WATEREE PCB Descriptive Statistics Table (Landmark File: 235-2-26)												
	Sold Price	Sold Price (Ln)	Time Index Monthly starts @ 1/2014 = 0	Improved SqFt (Ln)	Age (As of Sale Date)	Lot Size Acreage (Ln)	Dock/ Boathouse	Pool	Manufactured/ Modular	Camden	Liberty Hill	Ridgeway
Mean	$418,568	12.8035	79.0592	7.4583	29.8338	-0.1097	0.9133	0.0462	0.1908	0.2659	0.1185	0.4711
Standard Error	9145.7931	0.0202	1.3312	0.0198	0.6864	0.0225	0.0107	0.0080	0.0149	0.0168	0.0123	0.0190
Median	$365,500	12.8090	79.0000	7.4576	26.0000	-0.2485	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mode	$475,000	13.0711	77.0000	7.4955	14.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Standard Deviation	$240,588	0.5304	35.0179	0.5215	18.0571	0.5921	0.2816	0.2102	0.3932	0.4421	0.3234	0.4995
Sample Variance	57882707740.4992	0.2813	1226.2526	0.2720	326.0577	0.3506	0.0793	0.0442	0.1546	0.1955	0.1046	0.2495
Kurtosis	8.0642	-0.0971	-0.8309	-0.3308	1.3076	13.0614	6.6851	16.8033	0.4903	-0.8746	3.6081	-1.9923
Skewness	2.0131	0.0364	0.0098	-0.0406	0.8748	2.5868	-2.9438	4.3307	1.5776	1.0621	2.3659	0.1161
Range	$2,270,000	3.3801	139.0000	2.8668	117.0000	6.3466	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Minimum	$80,000	11.2898	5.0000	5.9915	0.0000	-1.8971	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maximum	$2,350,000	14.6699	144.0000	8.8582	117.0000	4.4495	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Sum	$289,649,102	8859.9957	54709.0000	5161.1584	20645.0000	-75.9448	632.0000	32.0000	132.0000	184.0000	82.0000	326.0000
Count	692	692	692	692	692	692	692	692	692	692	692	692

Figure 13: Descriptive Statistics Table

Residuals Table

The residual table describes the difference between the calculated value of the dependent variable against a predicted value. The mean and the sum of the residuals are always equal to zero, and the value is positive if the data point is above the graph and negative if below it.[70] A partial residual table is presented and the full residual table is provided in the work file. A residual graph is provided in this report presenting all the residual data and a description of the results.

LAKE WATEREE PCB
Residuals Table
(Landmark File: 235-2-26)

Observation	*Predicted Sold Price (Ln)*	*Residuals*	*Standard Residuals*
1	11.5297	-0.2399	-1.0457
2	11.9487	-0.5983	-2.6078
3	11.7709	-0.3305	-1.4407
4	11.6499	0.0028	0.0121
5	12.1247	-0.4720	-2.0573
6	11.6739	-0.0213	-0.0927
7	11.6589	0.0280	0.1220
8	11.8763	-0.1727	-0.7528
9	11.6278	0.1398	0.6092
10	11.7581	0.0172	0.0750
11	11.8515	-0.0021	-0.0092
12	12.0609	-0.2115	-0.9218
13	11.8748	-0.0254	-0.1106
14	11.8817	-0.0252	-0.1096
15	12.1651	-0.2601	-1.1337
16	12.3812	-0.4661	-2.0317
17	12.0337	-0.1153	-0.5025
18	11.9739	-0.0227	-0.0990
19	12.1740	-0.2144	-0.9347
20	12.3396	-0.3661	-1.5955
21	11.6595	0.3222	1.4042
22	12.4023	-0.4193	-1.8276
23	11.7793	0.2036	0.8874
24	12.1302	-0.1472	-0.6417
25	12.1042	-0.0996	-0.4341
26	11.9491	0.0615	0.2682
27	12.3039	-0.2902	-1.2647
28	12.2183	-0.2046	-0.8919
29	11.7333	0.2804	1.2222
30	12.5080	-0.4704	-2.0501

Figure 14: Residuals Table Sample

[70] "What Is a Residual in Statistics?," Reference, accessed October 17, 2018, https://www.reference.com/math/residual-statistics-3ff8643518a63a33.

Residuals Graph

The residual graph is a visual representative of the residual table. The Appraisal Journal sets forth guidance that the acceptable margin of error should be within +/-2 standard deviations.[71] The standardized residuals of this model appeared to have a generally random pattern, with approximately 95% of the data between ±2 standard deviations and approximately 99% between ±3 standard deviations.[72]

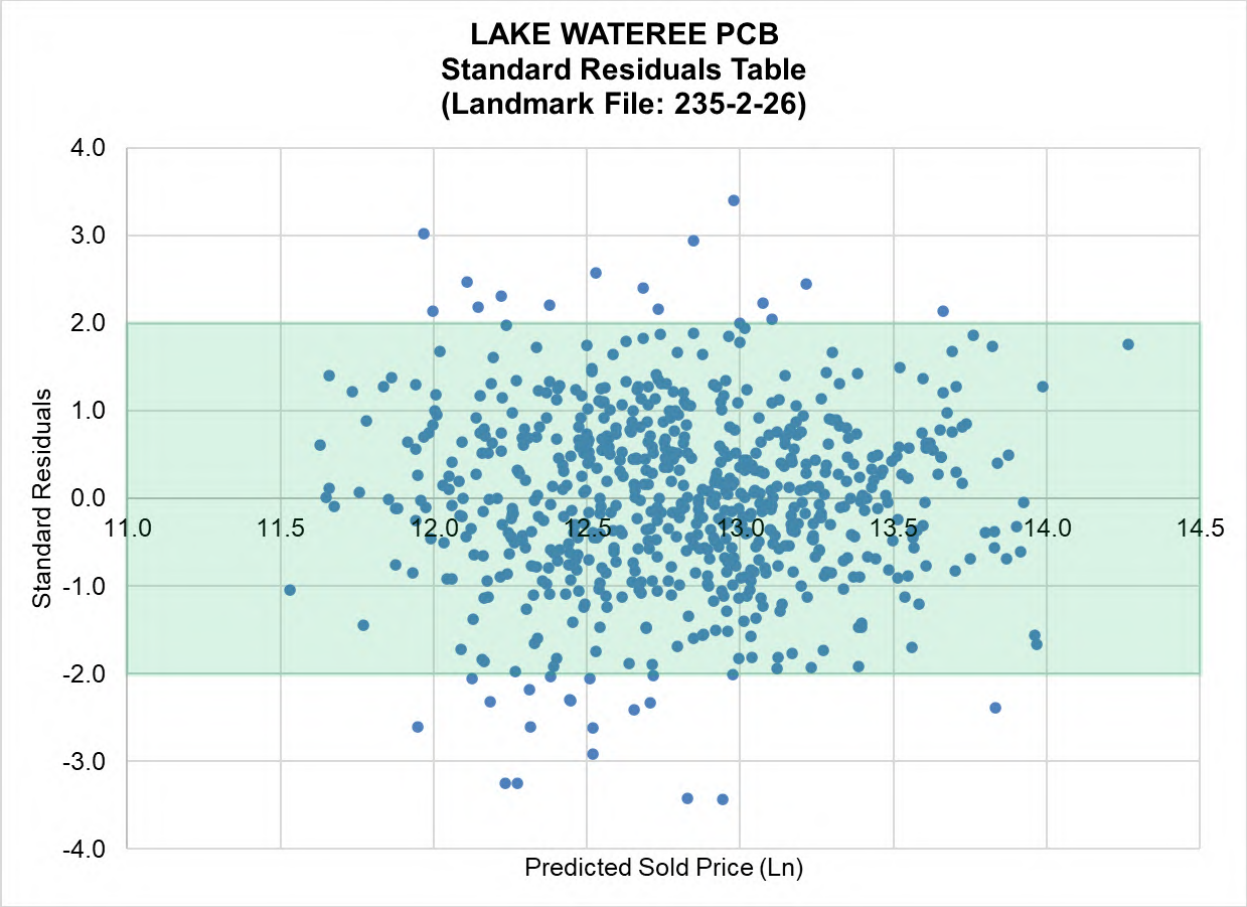


Figure 15: Standard Residuals Graph

[71] Thomas Jackson and Chris Yost-Bremm, "Environmental Risk Premiums and Price Effects in Commercial Real Estate Transactions," *The Appraisal Journal* (Winter 2018): 48-67.
[72] Appraisal Institute, *Quantitative Analysis* coursebook, Part 8–227.

Summary Output Table

The following summary output table indicates that the regression provides a good indication of value. The outputs generally fall within the range of the real estate profession, indicating that the regression analysis is a reliable indicator of value. For example, the R and R-squared are high ("the general rule of thumb is 0.60 or above"),[73] the t stats are >2 or <-2,[74] the standard error is low,[75] the F stat is greater than 5,[76] and the p-values are typically <0.05.[77] Furthermore, variables with p-values greater than 0.05 or 0.10 can still be included in models used for predictive purposes, such as this one.[78]

Multicollinearity was considered and addressed in this analysis by not duplicating similar variables. However, recognizing that some variables include some level of correlation, such as Age and Improved SqFt, and Ridgeway and Camden.[79] Nevertheless, the predictive power of the model increased with the inclusion of these variables; for example, the R-squared increased, and the standard error decreased.[80] The results of the multiple regression analysis are set forth in the following table and further detailed in the workfile.

[73] Lloyd T. Murphy, "Determining the Appropriate Equation in Multiple Regression Analysis," The Appraisal Journal (October 1989): 502; and as noted for R-square "the general rule of thumb is 0.60 or above" Linne et. al., *A Guide to Valuation Modeling* (Appraisal Institute: 2000), 81.
[74] Lloyd T. Murphy, "Determining the Appropriate Equation in Multiple Regression Analysis," The Appraisal Journal (October 1989): 502; and Appendix B, "Regression Analysis and Statistical Applications" in *The Appraisal of Real Estate*, 15th ed. (Appraisal Institute: 2020), 8.
[75] Lloyd T. Murphy, "Determining the Appropriate Equation in Multiple Regression Analysis," The Appraisal Journal (October 1989): 502; and Ralph J. Brown, "On the Selection of the Best Predictive Model in Multiple Regression Analysis," *The Appraisal Journal* (October 1974): 574.
[76] Lloyd T. Murphy, "Determining the Appropriate Equation in Multiple Regression Analysis," The Appraisal Journal (October 1989): 504; and Appendix B, "Regression Analysis and Statistical Applications" in *The Appraisal of Real Estate*, 15th ed. (Appraisal Institute: 2020), 8
[77] Appendix B, "Regression Analysis and Statistical Applications" in *The Appraisal of Real Estate*, 15th ed. (Appraisal Institute: 2020), 8.
[78] See, for example and further discussion, Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago: Appraisal Institute, 2009), 314-315 and 322-323.
[79] See workfile "235 Regression Analysis," Excel tab "Correlation (Pearson) Model 1."
[80] See, for further discussion, Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago: Appraisal Institute, 2009), 308-315; and Appendix B, "Regression Analysis and Statistical Applications" in *The Appraisal of Real Estate*, 15th ed. (Appraisal Institute: 2020), 11.

LAKE WATEREE PCB
Summary Output Table
(Landmark File: 235-2-26)

Regression Statistics	
Multiple R	0.9016
R Square	0.8129
Adjusted R Square	0.8101
Standard Error	0.2311
Observations	692

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	10	158.0047	15.8005	295.8119	0.0000
Residual	681	36.3749	0.0534		
Total	691	194.3796			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	8.8286	0.1696	52.0489	0.0000	8.4955	9.1616
Time Index Monthly starts @ 1/2014 = 0	0.0074	0.0003	28.4556	0.0000	0.0069	0.0079
Improved SqFt (Ln)	0.4545	0.0213	21.3898	0.0000	0.4128	0.4963
Age (As of Sale Date)	-0.0056	0.0006	-9.4145	0.0000	-0.0068	-0.0044
Lot Size Acreage (Ln)	0.1019	0.0156	6.5111	0.0000	0.0712	0.1326
Dock/Boathouse	0.1645	0.0320	5.1467	0.0000	0.1017	0.2273
Pool	0.1984	0.0436	4.5522	0.0000	0.1128	0.2839
Manufactured/Modular	-0.3293	0.0236	-13.9517	0.0000	-0.3756	-0.2829
Camden	0.0754	0.0289	2.6111	0.0092	0.0187	0.1320
Liberty Hill	0.1360	0.0346	3.9337	0.0001	0.0681	0.2039
Ridgeway	0.0960	0.0267	3.5966	0.0003	0.0436	0.1484

Figure 16: Summary Output Table

Indication of Market Value

The regression analysis is considered to offer reliable indicators of the market value of each subject property. The following figure is a descriptive illustration of the unimpaired market value calculation for one of the proposed class properties.[81] As there are thousands of proposed class properties, the detailed calculations for each individual property are set forth in the workfile.

USPAP Standards Rule 5-7, Reconciliation in developing mass appraisal sets forth the comment that "appraisers engaged in mass appraisal have a professional responsibility to ensure that, on an overall basis, models produce value conclusions that meet attainable standards of accuracy. This responsibility requires appraisers to evaluate the performance of models, using techniques that may include but are not limited to, goodness-of-fit statistics, and model performance statistics such as appraisal-to-sale ratio studies, evaluation of hold-out samples, or analysis of residuals."[82]

In this regression, goodness of fit statistics, such as R-squared, were analyzed and set forth in the summary output table, and performance statistics were analyzed, including appraisal-to-sale ratio studies, such as comparing the regression's predicted values to sales prices, which indicated an average difference of 18.96% and a median difference of 14.24%.[83] In addition, an analysis of residuals was conducted. Hold-out sampling was considered; however, it was not utilized in this analysis since all the data utilized in the regression were analyzed through appraisal-to-sale ratio and an analysis of residuals. In other words, there was no need to exclude data through hold-out sampling.

Simple Regression

As an additional point of reconciliation, a simple regression was conducted using sale price per SqFt as the dependent variable (y-axis) and the sale date as the independent variable (x-axis). The results reconciled with the market values of the multiple regression. The simple regression produced the trendline equation y = 0.0501x – 1980.4, which, when the February 10, 2026 (46,063 numerical conversion in Excel) date of value was utilized, and the resulting calculation for "y" was then multiplied by the improved SqFt of the subject properties. Nevertheless, the multiple regression was considered a better indicator of unimpaired market value because of the greater statistical outputs, such as the R-squared.

---

[81] Numerous regression models were run utilizing various variables. Generally, the model utilized had the lowest standard error. The models are set forth in the workfile. One of the models considered but not used had a lower standard error (0.2287) and included bathrooms; however, bath counts were not available for all of the proposed class public property records. Overall, the difference between the standard errors is 0.0024 (0.2311 [without baths] vs. 0.2287 [with baths]).

[82] Appraisal Standards Board of The Appraisal Foundation, *2024 Uniform Standards of Professional Appraisal Practice, Standards Rule 5-7, Reconciliation* (United States of America, 2024), 40.

[83] These calculations are sometimes also referred to as the Mean Absolute Percentage Error and the Median Absolute Percentage Error.

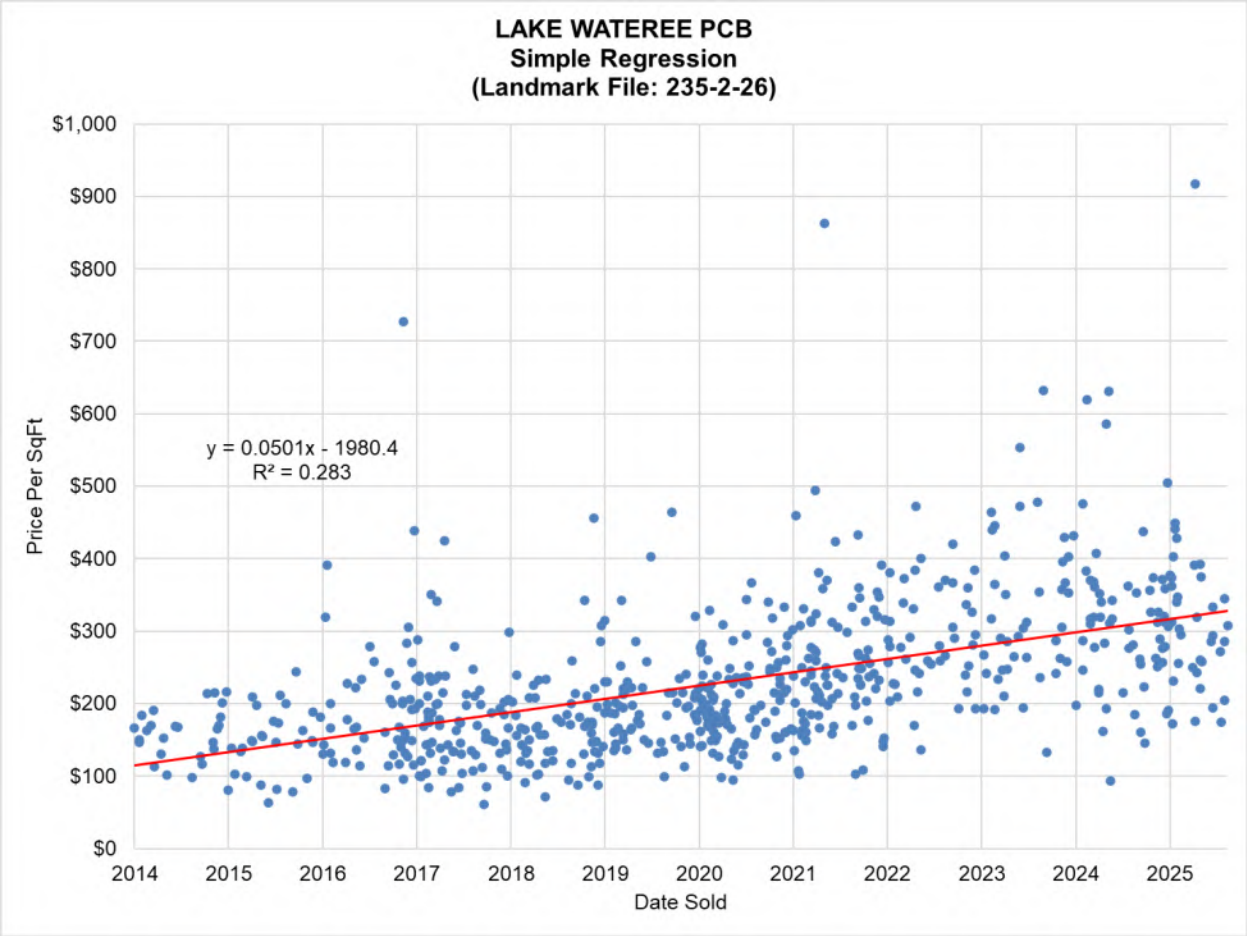


Figure 17: Simple Regression

Assessor Market Values

An analysis was also conducted comparing the sale prices of the proposed class properties in 2025 to the 2025 assessor's market values, sometimes referred to as an appraisal-to-sale ratio study. The analysis indicated that there was an average difference of 31.29%, and a median difference 31.95% between the 2025 assessor's market values and the 2025 sale prices.

Similarly, the same calculations were conducted with the multiple regression analysis, by comparing the regression's predicted values to sales prices, which indicated an average difference of 18.96% and a median difference of 14.24%.[84] Thus, the regression analysis is a better indicator of current market value.[85]

[84] These calculations are sometimes also referred to as the Mean Absolute Percentage Error and the Median Absolute Percentage Error.
[85] Alternatively, the assessor's market values can be increased by the average or median ratio of the sales prices.

RECONCILIATION AND CONCLUSION

This report is a restricted appraisal report, containing a summary of information. This report may not contain supporting rationale,[86] it can only be understood in combination with the supporting workfile documentation, deposition, and trial testimony. Accordingly, the workfile is considered a part of this report. As discovery may be ongoing in this case, Landmark Research Group reserves the right to revise and supplement this report as we continue to review and analyze the case file, and as more information becomes available.

A study was conducted to evaluate the unimpaired market value of the improved residential proposed class properties ("subject properties"). To determine unimpaired market values, a multiple regression analysis was conducted, and a simple regression and the assessors' market values were also used to reconcile the analysis.[87]

In addition, buyer knowledge of the PCB contamination on Lake Wateree was studied through an analysis of MLS and disclosure documents. Closed subject property transactions in the proposed class (on Lake Wateree) from January 1, 2014 (approximate start of market cycle),[88] to January 31, 2026, a total of 981 transactions recorded on the Consolidated MLS were collected and analyzed.[89] Public and private MLS remarks of the closed transactions were analyzed, and when available, South Carolina Residential Property Condition Disclosure Statements were also analyzed. The transactions were categorized into Type 1 (No Known Significant Disclosure of PCB Issues – typically PCBs, Advisories, Fish Consumption, and Duke Energy contamination was not mentioned), Type 2 (Disclosure of PCB Issues on Lake Wateree [Neutral, Positive, or Ambiguous] – typically PCBs and its related issues on Lake Wateree would be mentioned but in a neutral, positive, or ambiguous manner), or Type 3 (Disclosure of PCB Issues on Lake Wateree [Detrimental] – typically PCBs and its related issues were mentioned without a neutral, positive,

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[86] Appraisal Standards Board of The Appraisal Foundation, *2024 Uniform Standards of Professional Appraisal Practice*, *USPAP Guidance: Advisory Opinion 38* (United States of America, 2024), 115-116.

[87] There are various options to determine the unimpaired market value of properties, including but not limited to regression analysis (either simple or multiple), utilizing market values as determined by assessors for the properties within a class, utilizing ratio studies, or with individual appraisals. Regressions do not have to be conducted for every property in the proposed class. If necessary, market values for some properties can be determined using an individual sales comparison approach. The data and calculations can be effectively organized and analyzed using GIS, Excel, and, if needed, other statistical programs.

[88] See the Real Estate Market Trends section of the report.

[89] This analysis encompassed all proposed class properties; it was not limited to improved residential.

or ambiguous spin).[90] **One transaction was determined to be the closest type 3 that disclosed the detrimental presence of PCBs on Lake Wateree.[91]** This sale was not utilized in the unimpaired regression analysis.[92]

The following figure sets forth general data metrics for the unimpaired market values of the residential proposed class properties; a more detailed summary of each individual property is set forth in the addenda and throughout the workfile.

LAKE WATEREE PCB Unimpaired Market Value Multiple Regression (Landmark File: 235-2-26)	
Number of Subject Properties	2,045
Low	$169,757
High	$1,879,635
Average	$590,492
Median	$529,866
Total	**$1,207,555,412**

Figure 18: Unimpaired Market Value Summary

[90] See, for example, Ranking Analysis. "Ranking analysis is used to sort the comparable data for differences in specific elements of comparison, e.g., size, corner or interior lot, or frontage. The technique can be used to test the specific elements of comparison for their market sensitivities. The comparable sales are ranked according to overall comparability or by some other element of comparison so that the relative position of each comparable sale to the subject property is clear. Specific value trends can thereby be established for elements of comparison that are market-sensitive, and those that show no discernible or reasonable trends will be discarded." The Appraisal Institute, *The Appraisal of Real Estate*, 15th Edition (Chicago, IL: Appraisal Institute, 2020), 376-377.

[91] There were no Type 2 transactions; the remaining transactions were considered Type 1.

[92] The type 3 disclosure sale was analyzed using a paired sales analysis to determine whether the presence of PCBs in Lake Wateree affects the market value of the proposed class properties. In other words, confirming that lakefront property values are influenced by the lake and the use and enjoyment of its amenities, and that those sales used in the regression without disclosure are considered unimpaired. The paired sales indicated a range of -0.7% to -15.2%, an average of -7.5%, and a median of -6.6%. The paired sales reconcile with published literature on the effects of water quality and property values, and with case studies on the impact of PCBs on property values. The paired sales, literature review, and case studies are set forth in the addenda. Furthermore, Gretchen Greene, PhD of Greene Economics LLC has set forth an opinion on the effects of PCBs on the improved residential proposed class properties. In real estate damages, these effects are referred to as Risk Effects (or diminution in value). The Greene Report has quantified the effects by applying them to the unimpaired market values set forth in this report.

As this matter is ongoing, these analyses may be updated and supplemented at a later date. The analysis and computation can be easily modified to account for any changes to the scope of the proposed class. Landmark Research Group reserves the right to amend the analyses to reflect such changes and any new information and will discount or add interest per the Court's direction.

When any risk effect techniques in mass appraisal assignments are conducted on a percentage basis (e.g., -20% for view impairment), the findings can then be applied to unimpaired values generated by regressions or other techniques on both an individual and aggregate basis.[93]

If buyers are uninformed of the presence of contaminants, that does not mean that real estate damage has not occurred. For example, when an outside party uses a private owner's property, that is considered a taking, whether or not the owner of the property was aware of the existence of contaminants.

[93] Michael Tachovsky, "Stigma: A Case Study Analysis of Long-Term Environmental Risk Effect," *The Appraisal Journal* (Spring 2022): 120.

ADDENDA

Qualifications of Michael Tachovsky, PhD

Dr. Michael Tachovsky specializes in complex valuation and real estate damage economics; this includes environmental contamination, natural disasters, eminent domain, crime scenes, construction defects, and other conditions involving a wide variety of property types. His professional experience includes complex valuation and diminution-in-value studies for governments, agencies, major corporations, oil and utility companies, developers, and property owners. His experience includes testifying, teaching, developing courses, and publishing articles on these topics.

EDUCATION

Doctoral Degree – PhD, Fielding University, Dissertation: *Environmental Dead Zones: The Socioeconomic Impacts of Contaminated Neighborhoods*

Master's Degree – MA, Fielding University

Bachelor's Degree – BS, University of Oregon

LICENSES MEMBERSHIPS AND PROFESSIONAL AFFILIATIONS

Certified General Appraiser (3005059)

Real Estate Broker - State of California (01975901)

Candidate for Designation of the Appraisal Institute

Southern California Chapter of the Appraisal Institute Branch Advisor

Member of the International Right of Way Association

Forbes Real Estate Council Contributor

Affiliate Member of the American Bar Association

Member of the American Economic Association

Environmental Claims Journal – Peer Review Panel

Board of Directors – Diabetes Camping and Educational Services (Chair)

INDEPENDENT COURSEWORK

Appraisal Principles
Appraisal Procedures
USPAP
Uniform Appraisal Standards for Federal Land Acquisitions (Yellow Book)
Real Estate Finance, Statistics and Valuation Modeling
Quantitative Analysis
Advanced Market Analysis
Advanced Income Approach
Advanced Concepts and Case Studies
General Report Writing and Case Studies
General Appraiser Site Valuation and Cost Approach
General Appraiser Sales Comparison Approach
General Appraiser Analysis Highest and Best Use
General Appraiser Income Approach I & II
Commercial Appraisal Review
Expert Witness for Commercial Appraisers
Liability Issues for Appraisers Performing Litigation
Contamination and the Valuation Process
Supervisory Appraiser
Real Estate Damage Valuation
Business Practice and Ethics
Real Estate Principles
Real Estate Practice
Property Management
California Escrows
Real Estate Economics
Real Estate Finance
Real Estate Appraisal
Legal Aspects of Real Estate
Hundreds of Hours in CE Courses

PROFESSIONAL BACKGROUND

Dr. Tachovsky worked in forex trading with FX Solutions while attending undergraduate school. After his undergraduate, he worked as an analyst with Bell Anderson and Sanders, LLC. He is a licensed real estate appraiser and broker. Dr. Tachovsky has completed considerable research in the field of complex valuation and property damages and has been involved in well over $1 billion in claims over his career across the United States, Canada, Guam, and Australia.

SELECTED ASSIGNMENTS

Sandy Hook Elementary: Assisted in consulting on one of the most notorious mass shootings on a school campus in recent history.

San Jose Regional Wastewater Facility: Determined the fair market value and rents of multiple regional wastewater facility sites.

Maui Fire: Determined the diminution in value and loss of use of properties that burned in the Lahaina Fire. Estimated the typical time for communities to rebuild after widespread disasters and estimated inflation rates for housing and construction costs.

East Palestine Train Derailment: Developed a real estate damages model and studied the impact of the derailment and release of contaminants on surrounding properties.

Hurricane Harvey: Assisted in determining just compensation in one of the largest federal condemnation cases in United States history. Thousands of properties became subject to the taking of a flowage easement after being inundated with floodwaters during Hurricane Harvey.

Porter Ranch Gas Leak: Assisted in determining the diminution in value, if any, as a result of a methane gas leak. It has been cited as the largest gas leak in U.S. history.

Refugio Oil Spill: Assisted in determining the loss of use, if any, from a crude oil spill along the coast of California. It has been cited as one of the largest oil spills along the California coast.

Qualcomm Stadium Contamination: Assisted in determining the diminution in value, if any, resulting from a groundwater plume.

Guam Landfill: Assisted in computing the real estate damages, if any, to a master-planned development resulting from an operational landfill in Guam. Involved cultural and natural resource damage issues.

Shorecliffs Landslides in San Clemente: Assisted in computing real estate damages, if any, caused by the sudden landslide that impacted numerous ocean-view homes.

Environmental Contamination: Determined the fair market value of industrial sites with land use restrictions, and soil and groundwater contamination. Determined the diminution in value of land that was contaminated from rocket propellant and motor production, the analysis included changing market demands for data center development. Determined the diminution in value due to an environmental plume on the market value of an industrial redevelopment site. Determined the diminution in value, if any, to contaminated residential properties. Assisted in computing the diminution in value, if any,

resulting from Superfund sites. Assisted in computing the diminution in value, if any, resulting from a leaking underground storage tank (LUST) in the Los Angeles area. Assisted in computing the diminution in value, if any, resulting from soil contamination for large development land parcels in San Diego. Assisted in computing the diminution in value, if any, resulting from vapor intrusion at an elementary school and multiple mobile home park sites. Assisted in determining the diminution in value, if any, of industrial sites in Hawaii and the fair market value of industrial sites in Canada.

Eminent Domain and Encroachments: Determined the impact to fair market value, if any, of a proposed walkway easement along oceanfront properties. Determined the impact on fair market value for the non-disclosure of an access easement. Assisted in determining the impact, if any, caused by a partial taking of an industrial business park in Anaheim. Assisted in determining the diminution in value, if any, caused by the implementation of a rails-to-trails program in Georgia. Assisted in determining the diminution in the value, if any, posed by an encroachment of a large estate home in Bel Air. Assisted in determining the fair market value for condemnation proceedings of conservation land in Lake Tahoe. Assisted in the valuation of a partial taking of a pipeline corridor across multiple property types including commercial vineyards, agricultural land, and ranches. Assisted in determining the impact to fair market value, if any, of high-voltage transmission lines across residential and industrial properties.

Crime Scene Stigma: Determined the diminution in value, if any, due to the effects of crime scenes on property value.

Trophy Properties: Determined and assisted in determining the unimpaired and impaired values and rents of multiple trophy properties throughout Nevada and California, including ranches and vineyard estates.

Hotel Project Valuation: Determined the highest and best use of a hotel, taking into consideration proposed capital expenditures and alternate redevelopment potential. Assisted in determining the value of an ocean-front hotel in the "as-is" condition and assisted in determining the projected value "as-if" redeveloped. Also assisted in determining the value of a hotel and casino redevelopment project in Las Vegas.

Airport Noise Diminution in Value Studies: Assisted in calculating the diminution in value, if any, caused by the proposed runway expansion at the Seattle airport.

Fire Damage: Calculated real estate damages, if any, caused by widespread wildfires and risk effects associated with real estate post-burn. Widespread wildfires have included the Butte Fire, Camp Fire (Paradise), Dixie Fire, Thomas Fire, Woolsey Fire, and Lahaina Fire (Maui).

Flood Damage: Involved in numerous diminution in value projects that analyzed the effects of flooding. Various property types were analyzed including residential, agricultural, recreational, industrial, and commercial. Mass appraisal techniques, including regressions, paired sales, sale/resales, case studies, and literature reviews were developed.

Title Defect: Assisted in determining the diminution in value, if any, resulting from a loss of access for a proposed master planned community in California. Assisted in determining the value of a self-storage park for a title dispute.

Construction Defect: Determined the diminution in value, if any, from alleged HOA construction defects. Computed loss of use and project delay damages, if any, to oceanfront properties and high-end

construction projects. Determined the diminution in value and loss of use to a luxury condominium project resulting from various construction defects. Assisted in computing the real estate damages, if any, for multiple mid to high-rise condominium and apartment complexes in Los Angeles, San Diego, Irvine, and San Francisco.

Unpermitted Additions: Determined the diminution in value, if any, due to unpermitted additions. Analyzed any impacts from privacy issues, such as a "fishbowl effect."

Geotechnical and Structural Issues: Determined the diminution in value, if any, caused by geotechnical and structural issues. Helped analyze the impact, if any, to the highest and best use of geotechnically compromised properties. Assisted in determining the real estate damage, if any, to properties at risk from geotechnical issues in Los Angeles.

Neighborhood Nuisance: Researched and calculated the diminution in value, if any, caused by neighborhood nuisances such as "party homes" and "residential sober living homes."

Adjacent and Proximate Conditions: Researched and analyzed any impacts to properties adjacent or in proximity to detrimental conditions, including environmental issues and powerlines.

View Impairment: Assisted in determining the diminution in value, if any, caused by view obstructions.

Location Premiums: Determined premiums, if any, for oceanfront properties and properties in proximity to water features.

Cultural Resource Damage: Assisted in computing the diminution in value, if any, caused by the destruction of cultural resources associated with real property.

Partial Interest: Determined the fair market value for a partial ownership interest in various properties, including commercial and residential.

Market Value and Market Rent: Determined the market value and market rent for numerous residential, commercial, and industrial properties.

Reviews and Rebuttals: Reviewed and provided rebuttals of various real estate reports.

ACADEMIC RESEARCH, EXPERIENCE, AND PUBLICATIONS

"Waterfront Land and the Development Process: A Case Study of Beachfront Residential Lots" *International Right of Way Association* (July/August 2025)

"The Role of Buyer Knowledge in Real Estate Valuation" *Appraisal Institute of Canada* (Volume 69, Book 1, 2025)

"Stigma: A Case Study Analysis of Long-Term Environmental Risk Effect" *The Appraisal Journal* (Spring 2022)

"Environmental Dead Zones: The Evaluation of Contaminated Properties" *The Appraisal Journal* (Spring 2021)

"Real Estate Damage Economics: The Impact of PFAS 'Forever Chemicals' on Real Estate Valuation" *Environmental Claims Journal* (May 2021)

"Real Estate Damages: The Appraisal of Properties Impacted by Detrimental Conditions" *Appraisal Institute of Canada* (Volume 64, Book 2, 2020)

"New Pipelines and Prior Easements: Handling Pipeline Easements in Jeopardy" *International Right of Way Association* (July/August 2020)

"When Wildfires Strike: Living with High-Risk Fire Zones" *Urban Land Institute* (March 2019)

"The Impact of Hurricanes on Homeowners and Their Properties" *Forbes* (October 2018)

"The Impact of Wildfires on the Future of California Real Estate" *Forbes* (January 2018)

Seminar Instructor for the Appraisal Institute Hawaii Chapter – "Critical Thinking and Junk Science" (Summer 2025)

Seminar Instructor for the Appraisal Institute Tennessee, Alabama, and Mississippi Chapters – "Critical Thinking and Junk Science" (Spring and Summer 2025)

Seminar Instructor for the Appraisal Institute Ohio Chapter, including credits for the Ohio, Indiana, Kentucky, and West Virginia Appraisal Boards, the Ohio Real Estate, and Appraisal Institute – "Complex Valuation" (Spring 2025)

Seminar Instructor for the Appraisal Institute of Hawaii's 1st Annual Symposium – "Complex Valuation" (Fall 2024)

Seminar Instructor for the Appraisal Institute Georgia and Southern California Chapters – "Complex Valuation" (Summer 2024)

Seminar Instructor for the Appraisal Institute Washington, Oregon, Idaho, and Montana Chapters – "Complex Valuation" (Spring 2024)

Seminar Instructor for the Appraisal Institute Ohio Chapter – Economic Seminar – "Real Estate Damages: Derailments, Disasters, and Destruction" (Winter 2023)

Seminar Instructor for the Appraisal Institute Southern New Jersey Chapter – Seminar at the Shore – "Critical Thinking and Junk Science" (Fall 2023)

Seminar Instructor for the Appraisal Institute Nevada Chapter – "Complex Valuation" (Fall 2023)

Seminar Instructor for the Appraisal Institute Massachusetts, Rhode Island, Maine, Wisconsin, Chicago, Iowa, Bluegrass, Florida, Alabama, Mississippi, and Southern California Chapters – "Complex Valuation" (Spring 2023)

Seminar Instructor for the Appraisal Institute Southern New Jersey, Delaware, Virginia Commonwealth, Hampton Roads, and Tennessee Chapters – "Complex Valuation" (Winter 2022)

Seminar Instructor for the American Society of Appraisers and National Association of Independent Fee Appraisers, Eastern Regional Appraisal Conference "Complex Residential Valuation" (Spring 2022)

Seminar Instructor for the Society of Certified Appraisers and County of San Diego's Assessor's Office, Appraisal Conference "The Valuation of Environmentally Contaminated Properties" (Spring 2022)

Seminar Instructor for the Appraisal Institute Sacramento Sierra Chapter, The Impact of 2020 Conference – "Real Estate Damages and Emerging Detrimental Conditions" (Winter 2020)

Seminar Instructor for the Appraisal Institute Mississippi Chapter – "Real Estate Damages" (Spring 2020)

Speaker – Fielding Graduate University, Winter Session – "When Disaster Strikes" (Winter 2020)

Seminar Instructor at the Appraisal Institute Sacramento Sierra Chapter Conference – "Real Estate Damages: Valuing Real Estate After Disasters" (Fall 2019)

Seminar Instructor at the 48th Annual Appraisal of Communication, Energy, and Transportation Properties – Advanced Concepts – "The Impact of Natural Disasters on Real Estate Valuation" (Summer 2018)

Speaker – Urban Land Institute Fall Meeting at The Boston Convention Center – "The Day After: Rescue, Redevelopment, and Resiliency When Disaster Strikes" (Fall 2018)

Co-Chairperson Market Trends Seminar – Southern California Chapter of the Appraisal Institute (Winter 2014)

CORRESPONDENCE

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Certification

We certify that, to the best of our knowledge and belief:

- The statements of fact contained in this report are true and correct.
- The reported analysis, opinions, and conclusions are limited only by the reported assumptions and limiting conditions and are our personal, impartial, and unbiased professional analysis, opinions, and conclusions.
- I have no present or prospective interest in the properties that are the subject of this report, and I have no (or the specified) personal interest with respect to the parties involved.
- In regard to this report I have performed no services, as an appraiser or in any other capacity, regarding the properties that are the subject of this report within the three-year period immediately preceding acceptance of this assignment.
- I have no bias with respect to any properties that are the subject of this report or to the parties involved with this assignment.
- Our engagement in this assignment was not contingent upon developing or reporting predetermined results.
- My compensation is not contingent on an action or event resulting from the analysis, opinions, or conclusions in this report or from its use.
- My compensation for completing this assignment is not contingent upon the reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value opinion, the attainment of a stipulated result, or the occurrence of a subsequent event directly related to the intended use of this appraisal.
- My analysis, opinions, and conclusions were developed and this report was prepared in conformity with the Uniform Standards of Professional Appraisal Practice.
- I have made a personal inspection of the properties that are the subject of this report.
- Kristopher Williams, Fernando Barraza, Melanie Levy, Spencer Thompson, and Daniel Meyers provided significant real property appraisal assistance to the person signing this certification.
- The reported analysis, opinions, and conclusions were developed, and this report has been prepared, in conformity with the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute.
- The use of this report is subject to the requirements of the Appraisal Institute relating to review by its duly authorized representatives.
- As of the date of this report, Dr. Tachovsky has completed the Standards and Ethics Education Requirements for Candidates of the Appraisal Institute.



Michael Tachovsky, PhD
Certified General Real Estate Appraiser (9013)

General Assumptions and Limiting Conditions

This appraisal has been made with the following general assumptions:

1. Title to the property is assumed to be good and marketable unless otherwise stated.
2. The property is appraised free and clear of any or all liens or encumbrances unless otherwise stated.
3. Responsible ownership and competent property management are assumed.
4. Information furnished by others is believed to be reliable, but no warranty is given for its accuracy.
5. All engineering studies are assumed to be correct. The plot plans and illustrative material in this report are included only to help the reader visualize the property.
6. It is assumed that there are no hidden or unapparent conditions of the property, subsoil, or structures that render it more or less valuable. No responsibility is assumed for such conditions or for obtaining the engineering studies that may be required to discover them.
7. It is assumed that the property is in full compliance with all applicable federal, state, and local environmental regulations and laws unless the lack of compliance is stated in the appraisal report.
8. It is assumed that the property conforms to all applicable zoning and use regulations and restrictions unless a nonconformity has been described in the appraisal report.
9. It is assumed that all required licenses, certificates of occupancy, consents, and other legislative or administrative authority from any local, state, or national government or private entity or organization have been or can be obtained or renewed for any use on which the opinion of value contained in this report is based.
10. It is assumed that the use of the land and improvements is confined within the boundaries or property lines of the property described and that there is no encroachment or trespass unless noted in the report.
11. Unless otherwise stated in this report, the existence of hazardous materials, which may or may not be present on the property, was not observed by the appraiser. The appraiser has no knowledge of the existence of such materials on or in the property. The appraiser, however, is not qualified to detect such substances. The presence of substances such as asbestos, urea-formaldehyde foam insulation, and other potentially hazardous materials may affect the value of the property. The value estimated is predicated on the assumption that there is no such material on or in the property that would cause a loss in value. No responsibility is assumed for such conditions or for any expertise or engineering knowledge required to discover them. The intended user is urged to retain an expert in this field, if desired.
12. The forecasts, projections, or operating estimates contained herein are based on current market conditions, anticipated short-term supply and demand factors, and a continued stable economy. These forecasts are, therefore, subject to changes with future conditions.

This appraisal has been made with the following general limiting conditions:

13. No responsibility is assumed for the legal description provided or for matters pertaining to legal or title considerations.

14. Any allocation of the total value estimated in this report between the land and the improvements applies only under the stated program of utilization. The separate values allocated to the land and buildings must not be used in conjunction with any other appraisal and are invalid if they are.[94]

[94] The Appraisal Institute, *The Appraisal of Real Estate, 15th Edition* (Chicago, IL: Appraisal Institute, 2020), 620.

Rates

Dr. Tachovsky charges $625 per hour for research and $725 per hour for testimony. Staff are billed at lower rates.

Summary of Testimony

1. D&HC Investment v. Machin, Los Angeles Superior Court, California, Arbitration, October 2020.

2. Stewart v. Karimi, Orange County Superior Court, California, Deposition, May 2021.

3. Miura v. Tygh, Orange County Superior Court, California, Deposition, January 2022.

4. Miura v. Tygh, Orange County Superior Court, California, Arbitration, January 2022.

5. Alexander, et al. v. The Woodlands Land Development Company L.P., et al., District Court of Harris County, Texas, Deposition, March 2022.

6. Hobbs v. Apex Land Surveying Inc., et al., Orange County Superior Court, California, Deposition, March 2022.

7. Hermens, et al. v. Textiles Coated Incorporated, Hillsborough County Superior Court, New Hampshire, Deposition, March 2022.

8. Cote v. Cote, Monterey County Superior Court, California, Trial, December 2022.

9. County Sanitation District 2-3, et al. v. City of San Jose, et al. Santa Clara County Superior Court, California, Deposition, February 2023.

10. County Sanitation District 2-3, et al. v. City of San Jose, et al. Santa Clara County Superior Court, California, Hearing, April 2023.

11. County Sanitation District 2-3, et al. v. City of San Jose, et al. Santa Clara County Superior Court, California, Trial, May 2023.

12. Tramonto Land Holdings, LLC v. ETCO Homes, Inc., et al. Los Angeles County Superior Court, California, Deposition, January 2025.

13. Elliott v. Bassaly, et al. Orange County Superior Court, California, Deposition, August 2025.

14. Emygdius Holdings, LLC, et al., v. Kings Mountain Road, LLC, et al. San Mateo County Superior Court, California, Deposition, November 2025.

Documents Relied Upon

1. Any documents referenced or summarized within this report, as well as, documents contained within the workfile are considered part of the documents considered
2. Uniform Appraisal Standards for Federal Land Acquisitions (Yellow Book)
3. 2024 Uniform Standards of Professional Appraisal Practice (USPAP)
4. 2021 Uniform Standards of Professional Appraisal Practice (USPAP)
5. Real Estate Damages 3rd Edition, Randall Bell PhD, MAI
6. The Appraisal of Real Estate 14th Edition, Appraisal Institute
7. The Appraisal of Real Estate 15th Edition, Appraisal Institute
8. The Dictionary of Real Estate Appraisal 6th Edition, Appraisal Institute
9. The Dictionary of Real Estate Appraisal 7th Edition, Appraisal Institute
10. Real Estate Valuation in Litigation, 2nd Edition, Appraisal Institute, by J. D. Eaton, MAI, SRA
11. Federal Rules of Evidence – current edition
12. An Introduction to Statistics for Appraisers, Marvin Wolverton, PhD, MAI
13. IRWA – Principles of Right of Way, Chapter 4, Eminent Domain Theory
14. IRWA – Principles of Right of Way, Chapter 10, The Appraisal of Partial Acquisitions
15. Transfer Methods & Valuation Procedures for Conservation Easements by James Boykin, MAI for IRWA
16. Applications in Litigation Valuation: A Pragmatist's Guide, by Jeffrey A Johnson, MAI and Stephen J. Matonis, MAI, MRICS
17. Black's Law Dictionary 4th Pocket Edition, West
18. Guide Note 10 Development of an Opinion of Market Value in the Aftermath of a Disaster, Appraisal Institute
19. Guide Note 6 Consideration of Hazardous Substances in the Appraisal Process, Appraisal Institute
20. Federal Reserve Economic Data (FRED)
21. Google Earth
22. Google Trends
23. Any documents within the client supplied folder were considered part of the documents considered
24. Clyde Marcus Jones, II, et al., v Duke Energy Corporation and Duke Energy Carolinas, LLC, "Plaintiffs' Memorandum in Support of Motion for Class Certification," Entry Numbers 82-1 through 82-14, 2025
25. Jason Marsik, "Lake Wateree Fish Habitat Enhancement Project," Duke Energy and South Carolina Department of Natural Resources
26. Clyde Marcus Jones, II, et al., v. Duke Energy Corporation and Duke Energy Carolinas, LLC, "Duke Energy Defendants' Memorandum Opposition to Plaintiff's Motion for Class Certification," 2025
27. DUK_00003386 (2), "Aquatic Plant and Mosquito Control Services: Overview"
28. DUK_00024295, "Interoffice Memo to Dave Coughlan," 1995
29. Clyde Marcus Jones, II, et al., v Duke Energy Corporation and Duke Energy Carolinas, LLC, "First Amended Class Action Complaint and Demand for Jury Trial," 2024
30. Plaintiffs' Memorandum in Support of Class Certification
31. Unredacted Exhibits to Plaintiffs' Memorandum in Support of Class Certification

32. Jones Production 06
33. Glover and Gundersen, "Widespread Contamination of Polychlorinated Biphenyls in South Carolina and North Carolina (USA): A Legacy of Malarial Eradication and Mosquito Control," 2021
34. South Carolina Consolidated Multiple Listing Service CMLS and accompanying property records
35. MLS Tax Suite Powered by Courthouse Retrieval System (CRS) Data
36. All MLS and property records contained within this report and work file
37. New York Times, "$700Million Settlement in Alabama PCB Lawsuit," 2003
38. Israel, "Pollution, Poverty and People of Color: Dirty Soil and Diabetes," 2012
39. Kail, "Compelling Photos Reveal the Legacy of America's Most Hated Corporation," 2014
40. Agency for Toxic Substance and Disease Registry, "PCBS in Anniston," 2015
41. Environmental Protection Agency, "Fact Sheet for RESIDENTIAL SOIL OU1/OU2 of the Anniston PCB Superfund Site," 2017
42. Environmental Protection Agency, "Anniston PCB Site (OU1/OU2)," 2017
43. Pinkney, "EPA Announces Record of Decision for Cleanup of PCB Site in Anniston, AL," 2017
44. McCreless, "EPA approves next plan to clean up PCBs in Anniston," 2017
45. The Guardian, "Toxic neighbour: Monsanto and the poisoned town," 2018
46. Washington, "Monsanto Poisoned This Alabama Town—And People Are Still Sick," 2019
47. Environmental Protection Agency, "Anniston PCB Site (Monsanto Co) Anniston, AL–Cleanup Activities"
48. Environmental Protection Agency, "Fifth Five-Year Review Report for Escambia Wood–Pensacola Superfund Site, Escambia County, Florida," 2022
49. EJ Atlas, "Mount Dioxin at Pensacola, FL, USA," 2020
50. Warren-Hicks, "Escambia Wood led to third largest Superfund relocation in U.S. history. Final cleanup begins soon." 2021
51. Collins, "A Tale of Two Cities: The Need for Greater Federal Involvement to Ensure Proper Notification, Medical Monitoring and Treatment, and Successful Relocation for Tallevast, Florida and Other Environmental Justice Communities," 2014
52. Environmental Protection Agency, "Superfund Site: Escambia Wood–Pensacola, FL"
53. Environmental Protection Agency, "Final Closeout Report: Times Beach Site, St. Louis County, Missouri," 1999
54. Environmental Protection Agency, "A Town, a Flood, and Superfund: Looking Back at the Times Beach Disaster Nearly 40 Years Later," 2020
55. Environmental Protection Agency, "Times Beach, Times Beach, MO–Cleanup Activities"
56. Benson, Hansen, Schwartz, Jr., and Smersh, "The Influence of Canadian Investment on U.S. Residential Property Values," 1997
57. Benson, Hansen, Schwartz, Jr., and Smersh, "Pricing Residential Amenities: The Value of a Viw," 1998
58. Benson, Hansen, and Schwartz, Jr., "Water Views and Residential Property Values," 2000
59. Bond, Seiler, and Seiler, "Residential Real Estate Prices: A Room with a View," 2002

60. Darling, "Measuring Benefits Generated by Urban Water Parks," 1973
61. Hamilton and Morgan, "Integrating lidar, GIS and hedonic price modeling to measure amenity values in urban beach residential property markets," 2010
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Real Estate Damages

In any real estate valuation scenario, damages, or impairment to market value, are determined by considering cost, use, and risk effects.[95]

The evaluation of detrimental conditions (DCs) on the valuation of properties is an area of special study in the appraisal profession. A DC can interfere with the bundle of rights that comes with property ownership. There are many types of DCs and many of them can create valuation challenges; however, the appraisal methodologies that can be used to determine impacts, if any, are all extensions of the three traditional approaches to value.[96]

Real Estate Economics	
Unimpaired Traditional Appraisal Methods	**Impaired** Real Estate Damage Analysis
Cost Approach	Cost Effects
Income Approach	Use Effects
Sales Comparison Approach	Risk Effects

Figure 19: Real Estate Damage Economics

An analysis of DCs indicates that they can all be classified into one of 10 basic categories. Included below is a recreated excerpt from the Bell Chart, which summarizes ten classes of detrimental conditions as well as their potential impacts on value.

[95] Appraisal Standards Board of The Appraisal Foundation, *2024 Uniform Standards of Professional Appraisal Practice, USPAP Guidance: Advisory Opinion 9* (United States of America, 2024), 18-22; The Appraisal Institute, *Guide Note 6: Consideration of Hazardous Substances in the Appraisal Process* (Chicago, IL: Appraisal Institute, 2013); Randall Bell, *Real Estate Damages*, 3rd ed. (Chicago: Appraisal Institute, 2016); and Appraisal Institute, *The Appraisal of Real Estate*, 15th ed. (Chicago, IL: Appraisal Institute, 2020), 186-189.

[96] The Appraisal Institute, *The Appraisal of Real Estate, 15th Edition* (Chicago, IL: Appraisal Institute, 2020), 188.

The Bell Chart: 10 Categories of Detrimental Conditions		
DC Class	**Name**	**Description**
I	General Conditions	**Baseline description and general market issues** - Real estate, franchise, business, FF&E, goodwill, personal property, products, services, etc.
II	Transactional Conditions	**Unique sales or transfer issues** - Motivation, option, assemblage, distress, financing, bankruptcy, foreclosure, etc.
III	Distress and Sociological Conditions	**Human loss and tragedy issues** - Crime, war, terrorism, accident, car crash, air disaster, train derailment, shipwreck, death, disability, illness, injury, etc.
IV	Legal Conditions	**Legal issues** - Eminent domain, contract, tort, insurance claim, title, lot line, CC&R, lien, bond, lease, historic, moratorium, zoning, easement, etc.
V	External Conditions	**Neighborhood issues** - Nuisance, proximity, noise, odor, hazard, power lines, airport, privacy, view, etc.
VI	Building and Manufacturing Conditions	**Construction, equipment, and mechanical issues** Defects, engineering, repairs required, design, code, architecture, infestation, regulations, permits, etc.
VII	Site and Infrastructure Conditions	**Soils, geotechnical, and right-of-way issues** - Drainage, grading, fill, cracking, subsidence, slides, roads, corrosive soils, compaction, groundwater, utilities, etc.
VIII	Environmental and Biomedical Conditions	**Contamination, health, and toxicity issues** - Spills, hazmat, asbestos (1979), lead paint (1978), mold, radioactive, metals, solvents, biological, hydrocarbons, plague, epidemic, etc.
IX	Conservation Conditions	**Cultural and natural resource issues** - Habitat, endangered species, natural and cultural resources, archaeological, shoreland, wetland, overpopulation, etc.
X	Natural and Climate Conditions	**Natural disaster and weather issues** - Flood, hurricane, typhoon, wildfire, seismic, volcano, tornado, global warming, tsunami, famine, drought, storms, etc.

Figure 20: Excerpt from the Bell Chart

The professional real estate appraisal and economics literature concerning impaired property valuation methodologies is the basis for the methodologies used today. Much of the early literature has been developed in the context of environmental contamination but may have relevance to any type of property damage.[97] These earlier articles outline the evolution which eventually led to the current methodologies and standards.

[97] Michael Tachovsky, "Environmental Dead Zones: The Evaluation of Contaminated Properties," *The Appraisal Journal* (Spring 2021), 115.

One of the earliest articles on the topic of detrimental conditions is entitled "Valuation of Contaminated Properties."[98] In this article, Peter Patchin noted that stigma damages are related to "increased risks of ownership, difficulties in financing, and so forth" and that "a valuation tool that utilizes all of these factors is the capitalization rate. Consequently, with its mortgage-equity measurement techniques the capitalization rate appears to offer a means of valuing contaminated property."[99] In "Contaminated Properties - Stigma Revisited," Patchin notes, "the inability to obtain financing, either for the sale of the property or its future development, is one of the most frequent causes of stigma-related value loss."[100]

In an analysis of industrial properties, Patchin noted that the increasing flow of market data (as of 1994) has made the sales comparison approach more viable.[101] Prior to this, the sales comparison approach had generally been completely dismissed for detrimental condition analyses. Patchin noted "while income techniques are still valid and frequently provide the most accurate indication of value, the sales comparison approach now provides a valuable back-up for the income approach conclusions".[102] Thus, the income approach, with capitalization rate adjustments, was the primary approach according to Patchin, but the sales comparison approach could be a secondary method in estimating stigma (risk) effects. He did not suggest that the sales approach be the sole method; however, as he notes, "while market data have not yet developed to the extent that this approach (sales comparison/case study) can be used as a primary indicator of value in most cases, it has become useful as a confirming approach (to the income approach)."[103] This general approach is supported in "Estimating Value Diminution by the Income Approach" in which Richard Neustein demonstrated that the overall capitalization rate reflects the increased risk premium required by investors to offset the condition impacting the property.[104]

The articles show an evolution of thought in the appraisal profession relating to the valuation of damaged real estate.

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[98] Peter Patchin, "Valuation of Contaminated Property," *The Appraisal Journal* (January 1988), 7-16.

[99] Peter Patchin, "Valuation of Contaminated Property," *The Appraisal Journal* (January 1988), 13.

[100] Peter Patchin, "Contaminated Properties - Stigma Revisited," *The Appraisal Journal* (April 1991), 169.

[101] Peter Patchin, "Contaminated Properties and the Sales Comparison Approach," *The Appraisal Journal* (July 1994), 402-409.

[102] Peter Patchin, "Contaminated Properties and the Sales Comparison Approach," *The Appraisal Journal* (July 1994), 403.

[103] Peter Patchin, "Contaminated Properties and the Sales Comparison Approach," *The Appraisal Journal* (July 1994), 403.

[104] Richard A. Neustein, "Estimating Value Diminution by the Income Approach," *The Appraisal Journal* (April 1992), 283-287.

Today, the contemporary basic framework for valuing any real estate damage allegation is set forth with the Detrimental Conditions Matrix.[105] This matrix was first published in 1998 and is the basis for fundamental changes of the Uniform Standards of Professional Appraisal Practice (USPAP) that were published in 2002 and made effective January 1, 2003. The detrimental condition matrix remains in effect as of the date of this expert report.

		Detrimental Condition Stages		
		Assessment	Repair	Ongoing
Detrimental Conditions Issues	Cost	Cost to assess and responsibility Engineering Phase I, II, III studies	Repair costs and responsibility Repairs Remediation Contingencies	Ongoing costs and responsibility Operations and maintenance (O&M) monitoring
	Use	All loss of utility while assessed Disruptions Safety concerns Use restrictions	All loss of utility while repaired Income loss Expense increase Use restrictions	Ongoing use disruptions Alterations to highest and best use
	Risk	Uncertainty factor Discount, if any, where extent of damage is unknown	Project incentive Financial incentive, if any, to complete repairs	Market resistance Residual resistance, if any, due to situation

Figure 21: Detrimental Condition Matrix

USPAP Advisory Opinion 9 sets forth the "cost, use, and risk" elements, as follows:

Satisfying SR 1-4 Requirements:

When the appraiser addresses the diminution in value of a contaminated property and/or its impaired value, the appraiser must recognize that the value of an interest in impacted or contaminated real estate may not be measurable simply by deducting the remediation or compliance cost estimate from the opinion of the value as if unaffected (unimpaired value).

Rather, ***cost, use*** and ***risk*** effects can potentially impact the value of contaminated property. ***Cost effects*** primarily represent deductions for costs to remediate a contaminated property. These

[105] Randall Bell, *Real Estate Damages, 3rd edition* (Chicago, IL: Appraisal Institute, 2016): 20-27.

costs are usually estimated by someone other than the appraiser, and should include consideration of any increased operating costs due to property remediation. The appraiser should also be aware that the market might not recognize all estimated costs as having an effect on value. ***Use effects*** reflect impacts on the utility of the site as a result of the contamination. If the contamination and/or its cleanup rendered a portion of the site unusable, or limited the future highest and best use of the property, then there could be a use effect on value. ***Risk effects*** are typically estimated by the appraiser and often represent the most challenging part of the appraisal assignment. These effects are derived from the market's perception of increased environmental risk and uncertainty. The analysis of the effects of increased environmental risk and uncertainty on property value (environmental stigma) must be based on market data, rather than unsupported opinion or judgment.

In general, an opinion of the subject property's unimpaired value can be developed using the sales comparison approach [SR 1-4(a)], cost approach [SR 1-4(b)], and income approach [SR 1-4(c)]. Estimating the effects of environmental contamination on real property value usually involves the application of one or more specialized valuation methods. These methods should be consistent with the requirements related to the valuation approaches in USPAP.[106]

[106] Appraisal Standards Board of The Appraisal Foundation, *2024 Uniform Standards of Professional Appraisal Practice, USPAP Guidance: Advisory Opinion 9* (United States of America, 2024), 18-22.

Bell Chart

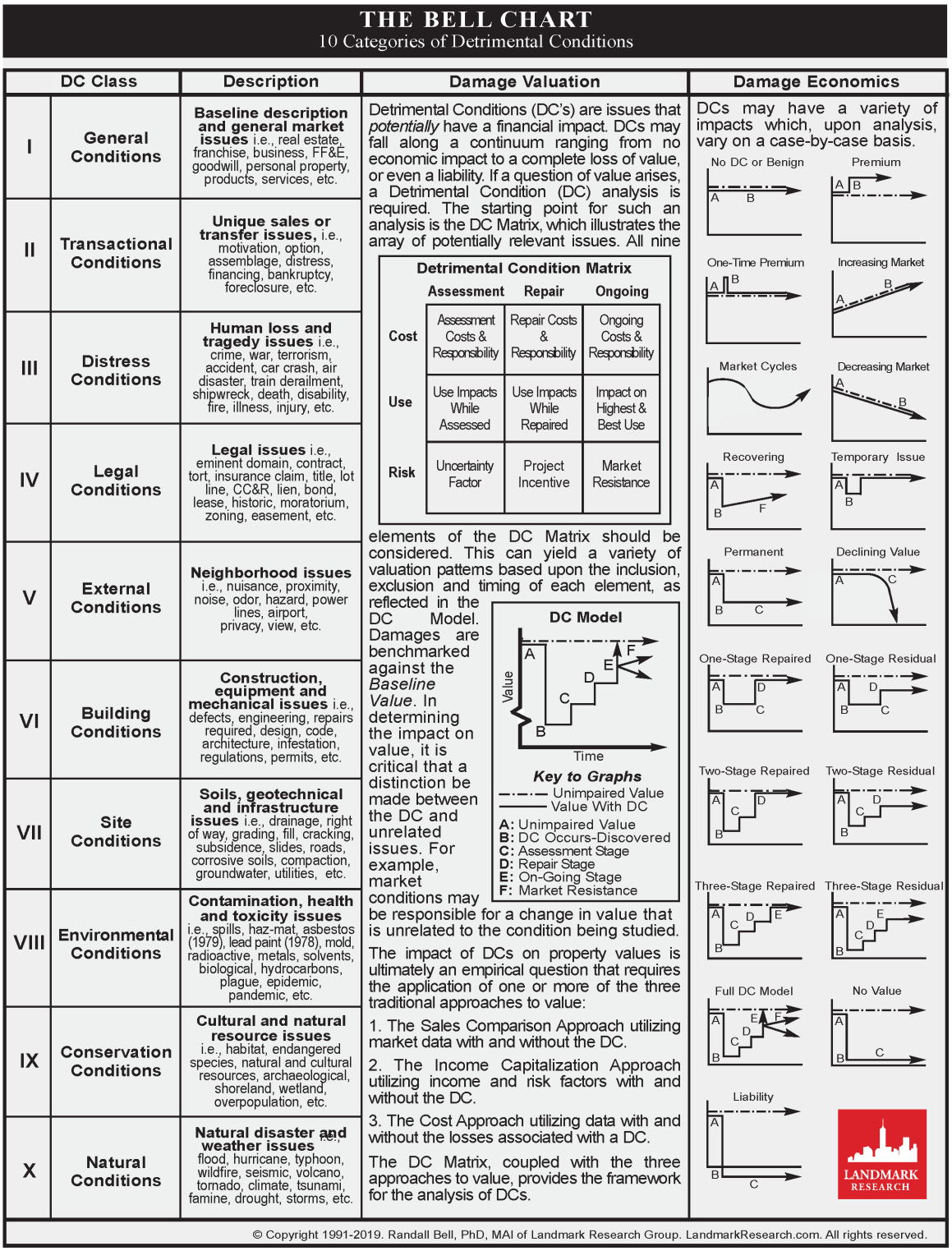


Figure 22: Bell Chart

Damage Economics: A Comparative Illustration

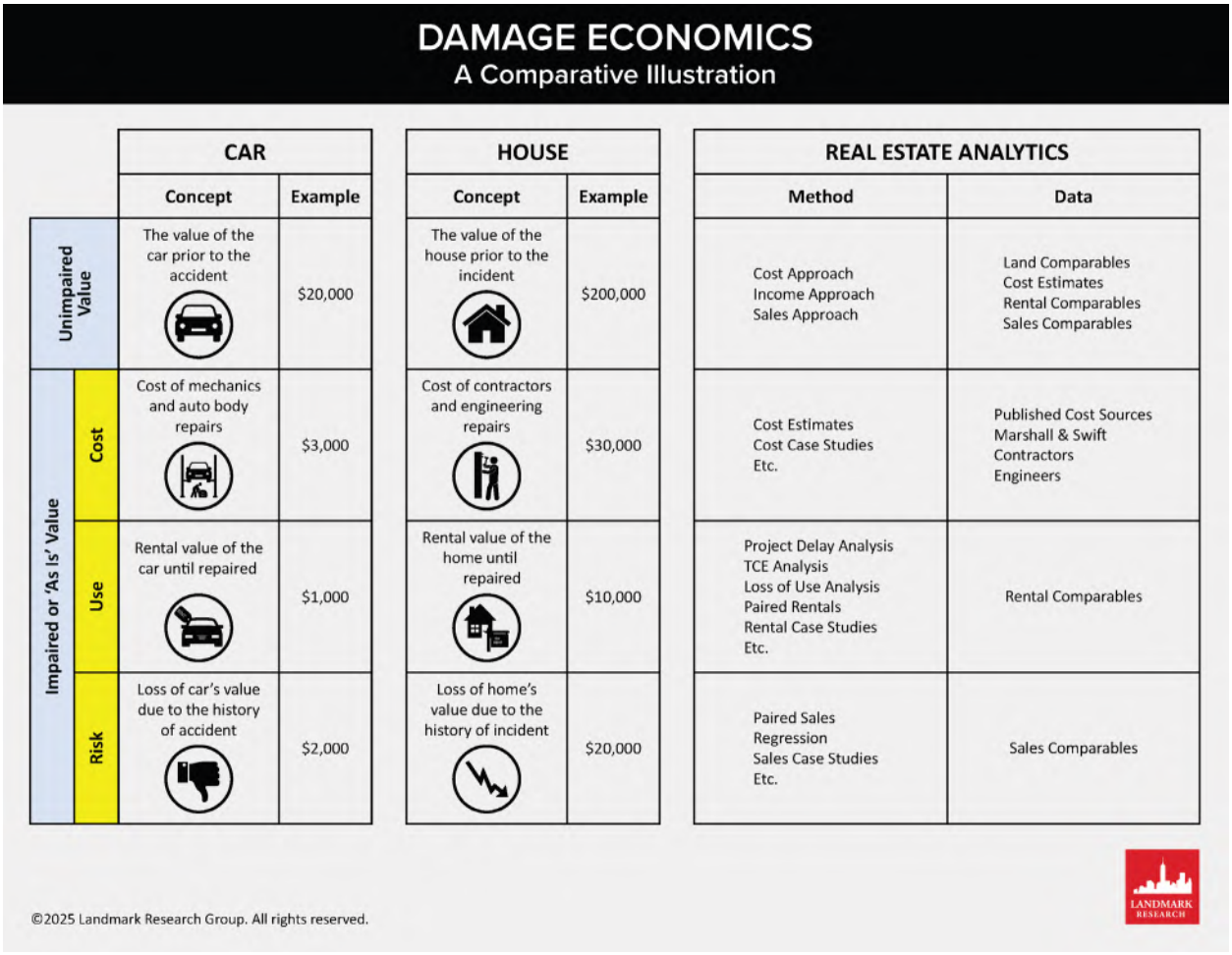


Figure 23: Real Estate Damage Economics: A Comparative Illustration

Environmental Exposure Pathways (SNAP)

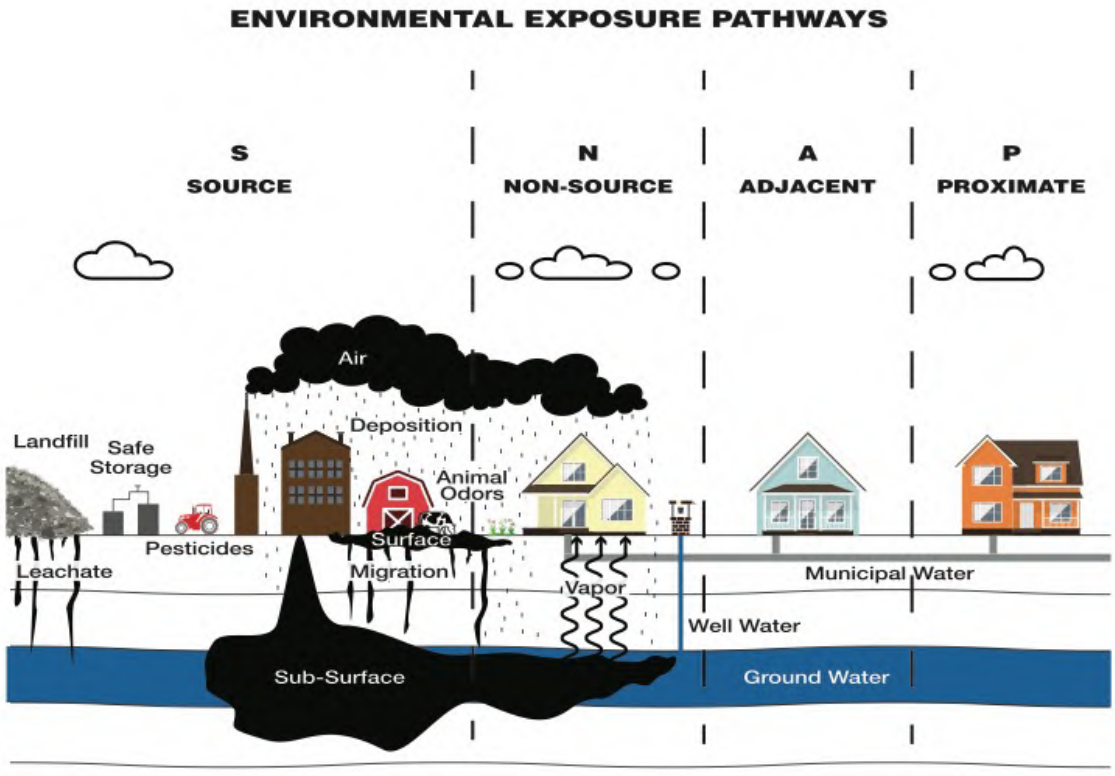
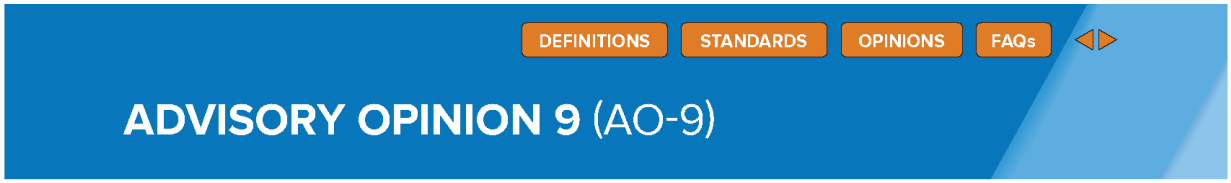


Figure 24: Environmental Exposure Pathways (SNAP)

USPAP AO9



This communication by the Appraisal Standards Board (ASB) does not establish new standards or interpret existing standards. Advisory Opinions are issued to illustrate the applicability of appraisal standards in specific situations and to offer advice from the ASB for the resolution of appraisal issues and problems.

SUBJECT: The Appraisal of Real Property That May Be Impacted by Environmental Contamination
APPLICATION: Real Property

THE ISSUE:

Appraisals of contaminated properties, or properties suspected of being contaminated, are sometimes developed using either a hypothetical condition or an extraordinary assumption that the property is free of the contamination. While this is acceptable practice under certain conditions and for certain intended uses, there are assignments that require an appraisal of the "as-is" condition of the property, with full consideration of the effects of environmental contamination. In these assignments, the appraiser is asked to analyze the effects of known environmental contamination on the value of the subject property.

How does an appraiser comply with USPAP when appraising properties that may be impacted by environmental contamination?

ADVICE FROM THE ASB ON THE ISSUE:

Relevant USPAP & Advisory References

- DEFINITIONS, specifically the definitions of
  - *Extraordinary Assumption: an assignment-specific assumption as of the effective date regarding uncertain information used in an analysis which, if found to be false, could alter the appraiser's opinions or conclusions.*

    Comment: Uncertain information might include physical, legal, or economic characteristics of the subject property; or conditions external to the property, such as market conditions or trends; or the integrity of data used in an analysis.
  - *Hypothetical Condition: a condition, directly related to a specific assignment, which is contrary to what is known by the appraiser to exist on the effective date of the assignment results, but is used for the purpose of analysis.*

    Comment: Hypothetical conditions are contrary to known facts about physical, legal, or economic characteristics of the subject property; or about conditions external to the property, such as market conditions or trends; or about the integrity of data used in an analysis.
- ETHICS RULE, particularly:

  Conduct: An appraiser must perform assignments with impartiality, objectivity, and independence, and without accommodation of personal interests .... An appraiser must not communicate assignment results with the intent to mislead or to defraud.
- COMPETENCY RULE:

  An appraiser must: (1) be competent to perform the assignment; (2) acquire the necessary competency to perform the assignment; or (3) decline or withdraw from the assignment. In all cases, the appraiser must perform competently when completing the assignment.

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Figure 25: USPAP AO9, page 18

- Standards Rule 1-1(a):

  In developing a real property appraisal, an appraiser must: (a) be aware of, understand, and correctly employ those recognized methods and techniques that are necessary to produce a credible appraisal;

- Standards Rule 1-2(e):

  In developing a real property appraisal, an appraiser must: (e) identify, from sources the appraiser reasonably believes to be reliable, the characteristics of the property that are relevant to the type and definition of value and intended use of the appraisal....

- Standards Rule 1-2(f) and (g):

  In developing a real property appraisal, an appraiser must: (f) identify any extraordinary assumptions necessary in the assignment; and (g) identify any hypothetical conditions necessary in the assignment.

- Standards Rule 1-3(b):

  When necessary for credible assignment results in developing a market value opinion, an appraiser must: (b) develop an opinion of the highest and best use of the real estate.

- Standards Rule 1-4:

  In developing a real property appraisal, an appraiser must collect, verify, and analyze all information necessary for credible assignment results.

Competency and Related Issues

Consistent with Standards Rule 1-1(a): in the appraisal of a property as impacted by environmental contamination, an appraiser must *be aware of, understand, and correctly employ those recognized methods and techniques necessary to produce a credible appraisal*. Accordingly, an appraiser must have the requisite knowledge about appropriate methods, and be able to assemble the required information. An appraiser who lacks knowledge and experience in analyzing the impact of environmental contamination on the value of real property must take the steps necessary to complete the assignment competently, as required by the COMPETENCY RULE. However, an appraiser need not be an expert on the scientific aspects of environmental contamination, and in most situations the appraiser will utilize scientific and other technical data prepared by others, such as environmental engineers. In these situations, the appraiser should utilize an extraordinary assumption regarding the information obtained from other experts that is used in the appraisal.[1] Examples of such information include items (1) to (10) under the header titled "Relevant Property Characteristics" later in this Advisory Opinion. This is especially important in situations where there is conflicting information about such information.

Specialized Terms and Definitions

The appraisal of properties that may be impacted by environmental contamination involves specialized terms and definitions that might not be used in an appraisal assignment in which the effect of the property's environmental condition is not analyzed, or when the property is not contaminated. Though it is recognized that there are other valid definitions of these and similar terms, for purposes of this Advisory Opinion, the following definitions apply:

Diminution in Value (Property Value Diminution): The difference between the unimpaired and impaired values of the property being appraised. This difference can be due to the increased risk and/or costs attributable to the property's environmental condition.

Environmental Contamination: Adverse environmental conditions resulting from the release of hazardous substances into the air, surface water, groundwater or soil. Generally, the concentrations of these substances would exceed regulatory limits established by the appropriate federal, state, and/or local agencies.

1 In USPAP publication see Standards Rule 1-2(f).

Figure 26: USPAP AO9, page 19

Environmental Risk: The additional or incremental risk of investing in, financing, buying and/or owning property attributable to its environmental condition. This risk is derived from perceived uncertainties concerning:

1) the nature and extent of the contamination;
2) estimates of future remediation costs and their timing;
3) potential for changes in regulatory requirements;
4) liabilities for cleanup (buyer, seller, third party);
5) potential for off-site impacts; and
6) other environmental risk factors, as may be relevant.

Environmental Stigma: An adverse effect on property value produced by the market's perception of increased environmental risk due to contamination. (See Environmental Risk.)

Impaired Value: The market value of the property being appraised with full consideration of the effects of its environmental condition and the presence of environmental contamination on, adjacent to, or proximate to the property. Conceptually, this could be considered the "as-is" value of a contaminated property.

Remediation Cost: The cost to cleanup (or remediate) a contaminated property to the appropriate regulatory standards. These costs can be for the cleanup of on-site contamination as well as mitigation of off-site impacts due to migrating contamination.

Remediation Lifecycle: A cycle consisting of three stages of cleanup of a contaminated site: before remediation or cleanup; during remediation; and after remediation. A contaminated property's remediation lifecycle stage is an important determinant of the risk associated with environmental contamination. Environmental risk can be expected to vary with the remediation lifecycle stage of the property.

Source, Non-source, Adjacent and Proximate Sites: Source sites are the sites on which contamination is, or has been, generated. Non-source sites are sites onto which contamination, generated from a source site, has migrated. An adjacent site is not contaminated, but shares a common property line with a source site. Proximate sites are not contaminated and not adjacent to a source site, but are in close proximity to the source site.

Unimpaired Value: The market value of a contaminated property developed under the hypothetical condition that the property is not contaminated.

Relevant Property Characteristics

The appraisal of a property that includes the effects of environmental contamination on its value usually requires data not typically used in an appraisal of an otherwise similar but uncontaminated property or an appraisal of a potentially impacted property using either a hypothetical condition or an extraordinary assumption that it is uncontaminated or not impacted. The inclusion of these additional relevant property characteristics is consistent with Standards Rule 1-2(e). The relevant property characteristics may include, but are not limited to:

1) whether the contamination discharge was accidental or permitted;
2) the status of the property with respect to regulatory compliance requirements;
3) the remediation lifecycle stage (before, during or after cleanup) of the property as of the appraisal date;
4) the contamination constituents (petroleum hydrocarbons, chlorinated solvents, etc.);
5) the contamination conveyance (air, groundwater, soil, etc.);
6) whether the property is a source, non-source, adjacent or proximate site;
7) the cost and timing of any site remediation plans;
8) liabilities and potential liabilities for site cleanup;

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Figure 27: USPAP AO9, page 20

9) potential limitations on the use of the property due to the contamination and its remediation; and

10) potential or actual off-site impacts due to contaminant migration (for source sites).

Since the appraiser is usually not an expert on the scientific aspects of contamination, experts from other fields will typically provide this information. Appropriate regulatory authorities should also be consulted to confirm the presence or absence of contamination. The appraiser should consider the use of extraordinary assumptions when this information serves as a basis for an opinion of value. The appraiser should also collect similar data for any comparable sales used in the analysis.

Valuation Issues – As If Unimpaired

In some assignments, the appraiser may be asked to appraise a property known to be contaminated under the hypothetical condition that the real estate is free of contamination. In these assignments, an appraiser may appraise interests in real estate that is known to be contaminated under the hypothetical condition that the real estate is free of contamination when:

1) the resulting appraisal report is not misleading,

2) the client has been advised of the limitation, and

3) all the requirements of the ETHICS RULE have been satisfied.

To avoid confusion in the marketplace, the appraiser should disclose available information about the contamination problem, explain the purpose of the *hypothetical condition* that the real estate is not contaminated, and state that the use of the hypothetical condition might have affected the assignment results in accordance with Standards Rule 2-2(a)(xiii) and (b)(xv).

In other situations, the appraiser may be asked to appraise a property believed to be free of contamination or for which the environmental status is uncertain due to the lack of information or conflicting information. For these assignments, the property may be appraised under the *extraordinary assumption* concerning assumed factual information about its environmental condition and status. Indeed, since an appraiser is usually not an expert in detecting contamination, or confirming its absence, extraordinary assumptions regarding environmental condition may be necessary in many assignments.

Valuation Issues - As Impaired

Highest and Best Use Issues: The appraisal of properties that may be impacted by environmental contamination usually involves extensive highest and best use analysis. In accordance with Standards Rules 1-2(e) and 1-3(b), the appraiser must consider relevant factors in developing an opinion of the highest and best use of the property in its impaired condition. The valuation of properties impacted by environmental contamination usually involves the estimate of two values: the unimpaired value and the impaired. As such, two highest and best use analyses are typically required. The first does not consider any limitations on the property due to the environmental contamination. The second does consider any limitations due to the contamination, its remediation, and any legal use restrictions associated with the cleanup of the contamination source. Environmental contamination and its remediation to appropriate regulatory standards may affect the feasibility of site development or redevelopment, use of the site during remediation, use of the site after remediation, marketability of the site, and other economic and physical characteristics of a contaminated property. The appraiser should consider the possibility that site remediation and any remaining limitations on the use of the site following remediation may alter or limit its highest and best use in the impaired condition. In addition, excessive environmental risk and stigma may deter site development or redevelopment and thereby limit the highest and best use until the property's environmental risk is reduced to levels acceptable to the relevant market participants.

Figure 28: USPAP AO9, page 21

Satisfying Standards Rule 1-4 Requirements: When the appraiser addresses the diminution in value of a contaminated property and/or its impaired value, the appraiser must recognize that the value of an interest in impacted or contaminated real estate may not be measurable simply by deducting the remediation or compliance cost estimate from the opinion of the value as if unaffected (unimpaired value). Rather, *cost, use* and *risk* effects can potentially impact the value of contaminated property. *Cost effects* primarily represent deductions for costs to remediate a contaminated property. These costs are usually estimated by someone other than the appraiser, and should include consideration of any increased operating costs due to property remediation. The appraiser should also be aware that the market might not recognize all estimated costs as having an effect on value. *Use effects* reflect impacts on the utility of the site as a result of the contamination. If the contamination and/or its cleanup rendered a portion of the site unusable, or limited the future highest and best use of the property, then there could be a use effect on value. *Risk effects* are typically estimated by the appraiser and often represent the most challenging part of the appraisal assignment. These effects are derived from the market's perception of increased environmental risk and uncertainty. The analysis of the effects of increased environmental risk and uncertainty on property value (environmental stigma) must be based on market data, rather than unsupported opinion or judgment.

In general, an opinion of the subject property's unimpaired value can be developed using the sales comparison approach [Standards Rule 1-4(a)], cost approach [Standards Rule 1-4(b)], and income approach [Standards Rule 1-4(c)]. Estimating the effects of environmental contamination on real property value usually involves the application of one or more specialized valuation methods. These methods should be consistent with the requirements related to the valuation approaches in USPAP.

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Figure 29: USPAP AO9, page 22

Appraisal Institute Guide Note 6

Guide Note 6
Consideration of Hazardous Substances in the Appraisal Process

Appraisal Institute®
Professionals Providing Real Estate Solutions



Introduction

The consideration of environmental conditions along with social, economic, and governmental conditions is fundamental to the appraisal of real property. Although appraisal literature has recognized environmental conditions can affect property value, the focus has been on the consideration of climatic conditions, topography and soil, the surrounding neighborhood, accessibility, and proximity to points of attraction. These more general environmental conditions might be apparent to a member of the general public who is not specifically trained as an expert in observing these forces. There is, however, a growing need to give special consideration to the specific impacts of hazardous substances on the valuation of real property. Consistent with accepted guidance on this topic and as incorporated herein, "hazardous substances"

Figure 30: Appraisal Institute Guide Note 6, page 1

GUIDE NOTE 6

Introduction (continued)

would be considered "environmental contamination" when their concentrations exceed appropriate regulatory standards. (See Definitions below).

The purpose of this Guide Note is to provide guidance in the application of the *Standards of Valuation Practice* (SVP) and the *Uniform Standards of Professional Appraisal Practice* (USPAP) to the appraisal of real property affected by or potentially affected by environmental contamination and, in particular, to the consideration of environmental contamination in the appraisal process. It is not the purpose of this Guide Note to provide technical instructions or explanations concerning the detection or measurement of the effect of hazardous substances.

Competency

The Competency Rule of the USPAP, for example[1], requires the appraiser to either:

a) properly identify the problem to be addressed, and have the knowledge and experience necessary to complete the assignment competently, and recognize and comply with laws and regulations that apply to the appraiser or to the assignment; or

b) disclose the appraiser's lack of knowledge and/or experience to the client before accepting the assignment, take all steps necessary or appropriate to complete the assignment competently, and describe the lack of knowledge and/or experience and the steps taken to complete the assignment competently in the report; or

c) decline or withdraw from the assignment.

The competency provisions of valuation Standards and Ethical Rules are of particular importance in the appraisal of real property that may be affected by hazardous substances. Most appraisers do not have the knowledge or experience required to detect the presence of hazardous substances or to measure the quantities of such material. The appraiser, like the buyers and sellers in the open market, typically relies on the advice of others in matters that require special expertise.

There is nothing to prevent a professional appraiser from becoming an expert in other fields but the real estate appraiser is neither required, nor expected, to be an expert in the special field of the detection and measurement of hazardous substances. This Guide Note therefore addresses the problem of hazardous substances from the viewpoint of the appraiser who is not qualified to detect or measure the quantities and concentrations of hazardous substances. If an appraiser is qualified to detect or measure hazardous substances, a different set of standards would apply.

In appraisal assignments in which the appraised value is to take into account the effects on value of hazardous substances, most appraisers require the professional assistance of others. In appraisal assignments in which the appraised value does not take into account the possible effects on value of known hazardous substances (i.e. the unimpaired value, see below), the appraiser would not require the professional assistance of others.

The appraiser may accept an assignment involving the consideration of hazardous substances without having the required knowledge and experience in this special field, provided the appraiser discloses such lack of knowledge and experience to the client prior to acceptance of the assignment, arranges to complete the assignment competently and describes the lack of knowledge or experience and the steps taken to competently complete the assignment in the report. This may require association with others who possess the required knowledge and experience or reliance on professional reports prepared by others who are reasonably believed to have the necessary knowledge and experience. If the appraiser draws conclusions based upon the advice or findings of others, the appraiser must have a reasonable basis for believing that the advice or findings are made by persons who are competent. (See Guide Note 4: Reliance on Reports Prepared by Others and the USPAP Comment to SR 2-3.)

[1] Ethical Rule 1-3 of the *Code of Professional Ethics* of the Appraisal Institute and paragraph 50 of the IVS Framework of the *International Valuation Standards* (IVS) contain similar provisions.

Figure 31: Appraisal Institute Guide Note 6, page 2

Scope of Work

The SVP's Standards Rule A-3: Scope of Work requires the valuer to "determine the scope of work necessary to develop an appraisal that is credible given its intended use."

The USPAP SCOPE OF WORK RULE requires that, in any assignment, the appraiser establish the appropriate scope of work necessary to complete that assignment. Part of the scope of work decision includes how, and to what extent, the appraisal problem will address known or suspected hazardous materials that may impact the property. Both the SVP and USPAP provide two tests for the acceptability of the scope of work decision; the intent and meaning is the same in both the SVP and USPAP. The Comment to the USPAP Scope of Work Acceptability section states:

> The scope of work is acceptable when it meets or exceeds:
> - the expectations of parties who are regularly intended users for similar assignments; and
> - what an appraiser's peers' actions would be in performing the same or a similar assignment.
>
> ...An appraiser must be prepared to support the decision to exclude any investigation, information, method or technique that would appear relevant to the client, another intended user, or the appraiser's peers.

The USPAP Scope of Work Acceptability section includes two more major provisions:

- An appraiser must not allow assignment conditions to limit the scope of work to such a degree that the assignment results are not credible in the context of the intended use.
- An appraiser must not allow the intended use of an assignment or a client's objectives to cause the assignment results to be biased.

The disclosure obligations of the USPAP SCOPE OF WORK RULE and USPAP SR 2-2(a)(vii) and (b)(vii) and the SVP's C-2(Xii) require that the scope of work performed be disclosed in the appraisal report.

Depending on the intended use, the appraisal may be prepared so that the value opinion reflects no known or suspected environmental contamination that may impact the property, or it may be prepared so that the value opinion does reflect known contamination. In either case, the appraiser must take special precautions in the development and reporting process to ensure that the results of the assignment are credible and that the report is not misleading.

Extraordinary/Special Assumptions and Hypothetical Conditions

In assignments involving contaminated properties or properties that may be adversely impacted by environmental contamination (contaminated property assignment), the appraisal will likely be premised on one or more Extraordinary/Special Assumptions and/or Hypothetical Conditions. Typically in these types of assignments, Extraordinary/Special Assumptions are used when relying on the work of others, such as environmental engineers or other technical specialists, while Hypothetical Conditions are used when the appraiser estimates the value of a property known to be contaminated in an unimpaired or uncontaminated condition[1]

[1] The Appraisal Institute *Standards of Valuation Practice* (SVP) address assumptions and hypothetical conditions in the Definitions section (definitions of hypothetical condition and special assumption), SR A-2(g), SR B-2(e), SR C-2(a)(xvi) and SR C-2(b)(xiii). Portions of the Appraisal Institute *Code of Professional Ethics* (CPE) that relate to this topic include ER 3-4 and ER 3-5. Applicable sections of the *Uniform Standards of Professional Appraisal Practice* (USPAP) include the Definitions section (definitions of hypothetical condition and extraordinary assumption); SR 1-2(f) and (g), SR 2-1(c), SR 2-2(a) and (b)(xi); and SR 3-2(f) and 4-2(f). Applicable sections of the *International Valuation Standards* (IVS) include the Definitions section (definition of special assumption); IVS 101 Scope of Work, 20.3 (k); IVS 103 Reporting 10.2, and Bases of Value, 200.4 and 200.5.

Figure 32: Appraisal Institute Guide Note 6, page 3

Assignments prepared under USPAP

USPAP provides the following definition for "extraordinary assumption."

> An assumption, directly related to a specific assignment, as of the effective date of the assignment results, which, if found to be false, could alter the appraiser's opinions or conclusions.
>
> Comment: Extraordinary assumptions presume as fact otherwise uncertain information about physical, legal, or economic characteristics of the subject property; or about conditions external to the property, such as market conditions or trends; or about the integrity of data used in an analysis.

In addition, it may be appropriate to premise the appraisal on an extraordinary assumption in the event there is suspected but not confirmed contamination. An environmental assessment by a qualified environmental professional would be required for such conclusions or determinations.

USPAP Standards Rule 1-2(f) requires that in developing an appraisal the appraiser identify "any extraordinary assumptions necessary in the assignment." The Comment states:

> "An extraordinary assumption may be used in an assignment only if:
> - it is required to properly develop credible opinions and conclusions;
> - the appraiser has a reasonable basis for the extraordinary assumption;
> - use of the assumption results in a credible analysis; and
> - the appraiser complies with the disclosure requirements set forth in USPAP for extraordinary assumptions."

USPAP Standards Rules 2-2(a) and (b)(xi) require the appraiser to clearly and conspicuously state in the appraisal report all extraordinary assumptions upon which the value opinion is premised. These reporting Standards Rules also require a clear and conspicuous statement that the use of these extraordinary assumptions "might have affected the assignment results."

USPAP Standards Rule 2-1 requires the report to "clearly and accurately disclose all ... extraordinary assumptions ... used in the assignment."

USPAP provides the following definition for "hypothetical condition":

> "A condition, directly related to a specific assignment, which is contrary to what is known by the appraiser to exist on the effective date of the assignment results, but is used for the purpose of analysis.
>
> Comment: Hypothetical conditions are contrary to known facts about physical, legal, or economic characteristics of the subject property; or about conditions external to the property, such as market conditions or trends; or about the integrity of data used in the analysis."

USPAP Standards Rule 1-2(g) requires that in developing an opinion of value the appraiser identify "any hypothetical conditions necessary in the assignment." The Comment states:

> "A hypothetical condition may be used in an assignment only if:
> - use of the hypothetical condition is clearly required for legal purposes, for purposes of reasonable analysis, or for purposes of comparison;
> - use of the hypothetical condition results in a credible analysis; and
> - the appraiser complies with the disclosure requirements set forth in USPAP for hypothetical conditions."

USPAP Standards Rule 2-1(c) requires the report to "clearly and accurately disclose all ... extraordinary assumptions, hypothetical conditions ... used in the assignment."

Figure 33: Appraisal Institute Guide Note 6, page 4

USPAP SR 2-2(a)(xi) and (b)(xi) require the appraisal to "clearly and conspicuously" state all extraordinary assumptions and hypothetical conditions and state that their use "might have affected the assignment results." These USPAP Standards Rules do not require that the appraiser quantify the impact on value, such as by both valuing the property subject to the hypothetical condition and valuing it not subject to the hypothetical condition.

Assignments prepared under SVP

SVP provides the following definition for "special assumption":

> An assumption, directly applicable to a specific service, which, if found to be false, could alter the opinions or conclusions in an appraisal or review.

In addition, it may be appropriate to premise the appraisal on a special assumption in the event there is suspected but not confirmed contamination. An environmental assessment by a qualified environmental professional would be required for such conclusions or determinations.

SVP Standards Rule A-2(g) requires that the valuer must identify the appraisal problem to be solved at the time of engagement. To identify the appraisal problem, the valuer must ascertain any special assumptions necessary in the appraisal.

SVP Standards Rule C-2(a)(xvi) requires the report to "clearly and conspicuously state all special assumptions ..., and that their use might have affected the valuer's opinion(s) and conclusion(s)"

SVP provides the following definition for "hypothetical condition:"

> "A condition that is presumed to be true when it is known to be false."

SVP Standards Rule A-2(h) requires the valuer to identify the appraisal problem to be solved at the time of engagement. To identify the appraisal problem, the valuer must ascertain any hypothetical conditions necessary in the appraisal.

SVP Standards Rule C-2(a)(xvi) requires the report to "clearly and conspicuously state all ...hypothetical conditions, and that their use might have affected the valuer's opinion(s) and conclusion(s)." This Standards Rule does not require that the appraiser quantify the impact on value, such as by both valuing the property subject to the hypothetical condition and valuing it not subject to the hypothetical condition.

Example of the Disclosure of a Hypothetical Condition under SVP or USPAP

An example of the disclosure of such a hypothetical condition is:

> ***It is reported that groundwater contamination is present beneath the subject property. In accordance with the client's instructions and consistent with the intended use of this appraisal report, the value opinion is based on the hypothetical condition that the subject property is not impacted by groundwater contamination. The appraiser cautions against the use of this appraisal report for any use other than the intended use stated herein.***

When such disclosure is required it may be placed anywhere in the appraisal report (provided that is clear and conspicuous) including but not limited to the letter of transmittal, scope of work disclosure, or general comments section, depending on the type and length of report prepared. In an oral report, the appraiser should present the same information, if possible.

Figure 34: Appraisal Institute Guide Note 6, page 5

Over the past few years, a common and generally accepted set of definitions related to the appraisal of properties that may be impacted by contamination have emerged. These are as follows:

Diminution in Value (Property Value Diminution): The difference between the unimpaired and impaired values of the property being appraised. This difference can be due to the increased risk and/or costs attributable to the property's environmental condition.

Environmental Contamination: Adverse environmental conditions resulting from the release of hazardous substances into the air, surface water, groundwater or soil. Generally, the concentrations of these substances would exceed regulatory limits established by the appropriate federal, state and/or local agencies.

Environmental Risk: The additional or incremental risk of investing in, financing, buying and/or owning property attributable to its environmental condition. This risk is derived from perceived uncertainties concerning: (1) the nature and extent of the contamination; (2) estimates of future remediation costs and their timing; (3) potential for changes in regulatory requirements; (4) liabilities for cleanup (buyer, seller, third party); (5) potential for off-site impacts; and (6) other environmental risk factors, as may be relevant.

Environmental Stigma: An adverse effect on property value produced by the market's perception of increased environmental risk due to contamination. (see Environmental Risk, above).

Impaired Value: The market value of the property being appraised with full consideration of the effects of its environmental condition and the presence of environmental contamination on, adjacent to, or proximate to the property. Conceptually, this could be considered the "as-is" value of a contaminated property.

Remediation Cost: The cost to cleanup (or remediate) a contaminated property to the appropriate regulatory standards. These costs can be for the cleanup of on-site contamination as well as mitigation of off-site impacts due to migrating contamination.

Remediation Lifecycle: A cycle consisting of three stages of cleanup of a contaminated site: before remediation or cleanup; during remediation; and after remediation. A contaminated property's remediation lifecycle stage is an important determinant of the risk associated with environmental contamination. Environmental risk can be expected to vary with the remediation lifecycle stage of the property.

CONTAMINATED PROPERTY VALUATION - SPECIALIZED TERMS AND DEFINITIONS

Source, Non-source, Adjacent and Proximate Sites: Source sites are the sites on which contamination is, or has been, generated. Non-source sites are sites onto which contamination, generated from a source site, has migrated. An adjacent site is not contaminated, but shares a common property line with a source site. Proximate sites are not contaminated and not adjacent to a source site, but are in close proximity to the source site.

Unimpaired Value: The market value of a contaminated property developed under the hypothetical condition that the property is not contaminated.

[2]Sources: *The Appraisal of Real Estate,* 14th Edition, *The Dictionary of Real Estate Appraisal, Environmental Contamination Glossary,* 6th Edition, both published by the Appraisal Institute; USPAP Advisory Opinion 9: The Appraisal of Real Property That May Be Impacted by Environmental Contamination, by The Appraisal Foundation.

Figure 35: Appraisal Institute Guide Note 6, page 6

Basis for Proper Valuation

The specialized terms and definitions are an important part of the valuation framework for appraising properties that may be impacted by environmental contamination. This framework begins with the following formulae or equations:

Impaired Value = Unimpaired Value - Cost Effects (Remediation and Related Costs) - Use Effects (Effects on Site Usability) - Risk Effects (Environmental Risk/Stigma)

Property Value = Cost Effects (Remediation and Related Costs) + Use Effects (Effects on Site Usability) + Risk Effects (Environmental Risk/Stigma)

Diminution

Impaired Value = Unimpaired Value - Property Value Diminution

These equations set forth the relationships between the key elements of the valuation framework, and highlight the steps to be taken by the appraiser in such assignments. Three general steps are typically taken. The first involves the estimation of the unimpaired value, as defined above. This estimate is usually undertaken with a Hypothetical Condition that the property is being appraised as if uncontaminated (See section on Hypothetical Conditions, above). The second general step involves the estimation of property value diminution. Property value diminution can have three forms: cost effects, use effects and risk effects. The third step involves the estimation of the impaired value of the subject property. This value can usually be derived by deducting an estimate of diminution from the unimpaired value. These estimates must be appropriate and well supported by market data typically involving actual transactions by market participants. As noted in The Dictionary of Real Estate Appraisal, 6th Edition, "market participants" are "individuals actively engaged in transactions." Thus, non-market participants and related non-market and non-transactional data would not establish an appropriate basis for estimating property value diminution.

Cost Effects

There are several considerations in analyzing the three effects comprising property value diminution. Cost effects involve deductions for costs to remediate a contaminated property by reducing concentrations of contamination to below appropriate regulatory standards. Accordingly, prerequisites for such a deduction would be: (1) that the property was contaminated, with concentrations of hazardous materials above appropriate regulatory standards; (2) that the costs were necessary for remediation of the property; and (3) that the costs would be borne by a prospective purchaser of the property rather than by a third party such as the current owner or the owner of adjacent property or some other third party responsible for the remediation. The market may not recognize any and all potential costs but only those costs necessary to achieve regulatory compliance and reduce concentrations of hazardous materials to below the appropriate regulatory standard. Regulatory standards are those established by the appropriate state, local or federal authority. The appraiser should rely on those entities to establish this threshold. Other thresholds and cleanup objectives desired by landowners or others would not establish an appropriate basis for a market based cost effects deduction.

Use Effects

Use effects involve limitations on the utility of a site due to contamination and its remediation. In some situations, these effects may result in a limitation on the highest and best use of a property and this potential effect should be analyzed by the appraiser. For example, at the conclusion of some approved remedial action plans, especially those utilizing risk-based standards, subsurface contamination may remain in place so long as certain conditions are met. These conditions, which may have a deed recordation, could limit site utility or the use of the site for alternative future uses. However, the appraiser should be aware that not all site use limitations will have an effect on market value and it is the market and its reaction, as borne out in actual market data, to these limitations that should be the primary focus of the appraiser's work in estimating use effects.

Figure 36: Appraisal Institute Guide Note 6, page 7

Risk Effects

Lastly, risk effects can result from uncertainties concerning the contamination and its remediation and other factors (see Definitions). If the uncertainties and perceptions of the market result in reductions in property value (property value diminution) then the appraiser might conclude that the subject property suffers from environmental stigma. Environmental stigma for the appraisal profession is the product of uncertainty and adverse perceptions of the market but is always measured on the basis of actual market data and transactions that reflect these perceptions. The appraiser is cautioned that not all uncertainty and increased concern and perceptions in the market may reduce property values, and that any analysis of risk effects and stigma must be based on actual data from the relevant market or submarket and should not be assumed to occur without such evidence. Further, the appraiser should employ relevant and generally accepted methods and techniques to analyze the relevant and reliable market data in order to develop an opinion concerning the existence and extent of any risk and stigma that may exist before applying such a deduction to the subject property or properties. Lastly, important considerations in the estimation of risk effects are the subject property's stage in the remediation lifecycle (before, during or after cleanup) and the whether the subject and any sales comparables are source, non-source, adjacent or proximate sites as these factors can and do influence the extent to which a property will suffer from environmental risk and stigma.

1. Disclose to the client the appraiser's lack of knowledge and experience with respect to the detection and measurement of hazardous substances (CPE Ethical Rule 1-3, USPAP Competency Rule).

2. Take the necessary steps to complete the assignment competently such as personal study by the appraiser, association with another appraiser who has the required knowledge and experience, or obtaining the professional assistance of others who possess the required knowledge and experience ((CPE Ethical Rule 1-3, USPAP Competency Rule).

3. Identify as an extraordinary/special assumption reliance on any third party reports or obtained expert association that may have contributed to the valuation beyond the appraiser's own competence.

4. Under USPAP

- Identify in the appraisal process and state in the report if the appraisal is based on an extraordinary assumption or hypothetical condition that the property is appraised as if unaffected by hazardous substances (USPAP SR 1-2(f) and/or (g), SR 2-1(c), and SR 2-2(a)(xi) and 2-2(b)(xi).
- Identify in the appraisal process the environmental condition of the subject property and surrounding properties, and the existence of documented instances of environmental contamination that may affect the value of the property. (USPAP SR 1-2(e)(i)).
- Identify the scope of work necessary to complete the assignment, including the manner and degree to which the existence of environmental contamination will be addressed (USPAP SCOPE OF WORK RULE).
- Consistent with the USPAP SCOPE OF WORK RULE, develop an opinion of unimpaired value of the subject property using an appropriate Hypothetical Condition clearly disclosed in the report.

Under SVP

- Identify in the appraisal process and state in the report if the appraisal is based on a special assumption or hypothetical condition that the property is appraised as if unaffected by hazardous substances (SVP A-2(g) and/or (h), and C-2(a)(xvi)).
- Identify in the appraisal process the environmental condition of the subject property and surrounding properties, and the existence of documented instances of environmental contamination that may affect the value of the property. (SVP A-2(f)).
- Identify the scope of work necessary to complete the assignment, including the manner and degree to which the existence of environmental contamination will be addressed (SVP A-3).
- Consistent with the SVP A-3, develop an opinion of unimpaired value of the subject property using an appropriate Hypothetical Condition clearly disclosed in the report.

Figure 37: Appraisal Institute Guide Note 6, page 8

5. Where and if appropriate, apply the estimates of cost, use and risk effects (property value diminution) to estimate the value of the subject property in its impaired condition.

(Please Note: The purpose of this Guide Note to the Standards of Professional Practice is to provide Members, Candidates, Practicing Affiliates and Affiliates with guidance as to how the requirements of the Standards may apply in specific situations.)

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Figure 38: Appraisal Institute Guide Note 6, page 9

Regression Analysis Overview

Mass appraisal techniques, which include regression analyses, are standard valuation methodologies.[107] There are two types of statistical studies, "inferential" statistics and "descriptive" statistics. Inferential statistics draw inferences or conclusions about a population based on observations from a smaller sample. Inferential statistics is defined as, "[t]he process of drawing conclusions about population characteristics through analysis of sample data."[108] Historically, much of statistics dealt with inferential statistics as, prior to the computer age, it was difficult to collect complete data sets. Accordingly, it was necessary to collect samples of a population from which conclusions could be inferred. In this case, complete data sets were available, so descriptive statistics were utilized.

Descriptive statistics, as the name implies, describe or summarize data. Descriptive statistics is defined as, "[a] branch of statistics concerned only with characterizing, or describing, a set of numbers. The measures used to characterize a set of data (e.g., average, maximum, coefficient of dispersion) or charts and tables depicting the data."[109] In the context of descriptive statistics and real estate valuation, there are three fundamental categories of descriptive statistical studies,

1. Single variable studies, such as pie charts, histograms or bar charts;
2. Simple linear regression analyses, which includes two variable graphs or scatter diagrams, typically on an "x" axis and "y" axis that demonstrate the relationship between two variables; and
3. Multiple regressions, which involve three or more variables and utilize more advanced studies. Graphing three or more variables requires multiple dimensions; it is impossible to visualize these analyses on a table or a chart and requires the use of statistical techniques and charts.

Simple linear regression models may be utilized as trend studies. These are often "time-value" models where a single independent variable "time" is graphed on the "x-axis" and the dependent variable "value" is graphed on the "y-axis". Multiple regressions use tables, as shown in the figure that follows:

[107] Thomas O. Jackson, "Evaluating Environmental Stigma with Multiple Regression Analysis," *The Appraisal Journal* (Fall 2005): 363-369.
[108] Appraisal Institute, *The Dictionary of Real Estate Appraisal,* 7th ed. (Chicago, IL: Appraisal Institute, 2022), 294.
[109] Appraisal Institute, *The Dictionary of Real Estate Appraisal,* 7th ed. (Chicago, IL: Appraisal Institute, 2022), 292.

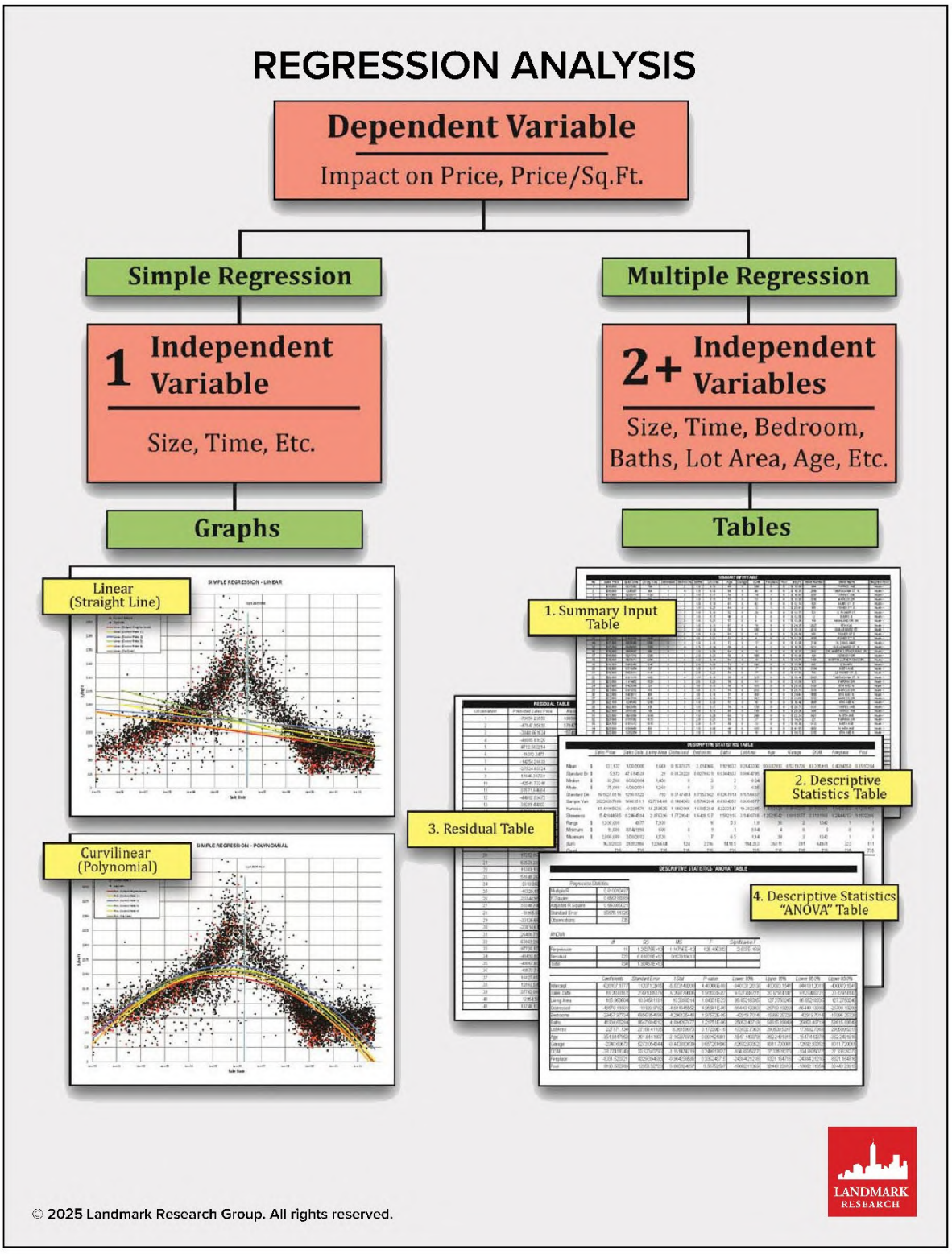


Figure 39: Regression Analysis Overview

Two-Variable Statistics (Simple Linear Regression)

Simple linear regression analyses are relatively straight-forward statistical models that can be highly effective in setting forth the relationship of two variables, such as price and time, price and size, or other relationships. Because they use two variables, they are commonly graphed on an "x" axis and a "y" axis that shows the relationship between these two variables. The dependent variable, usually price, typically goes on the "y-axis", whereas the independent variable, often time or size, typically goes on the "x" axis. Correlation is defined as, "[a] general term for interdependence between pairs of variables."[110] When two variables move together, then they are said to be "correlated."[111]

Analysis of continuous or discrete data, usually shown graphically in a scatter diagram, can be greatly enhanced by using a trend line, which is a simple linear regression. Standard software, such as Excel, will facilitate a simple regression analysis.[112]

Multiple-Variable Statistics

In contrast to simple regression, a multiple regression is considered a multivariate model, which analyzes the relationship between several independent variables at the same time.[113] Multiple regression analysis is a statistical model that expresses the value of a dependent variable, usually price in a real estate context, as a function of two or more independent variables, such as location, site area, age, building size, views, pools and so forth.[114]

Mathematically, the objective of a multiple regression is to minimize the sum of the squared residuals relative to the data input into the study. Stated simply, the objective of a multiple regression is to find the relationship, if indeed it exists, between the dependent variable and the independent variables, and if it does exist, to what extent they are correlated. In other words, in the context of real estate damage economics, the objective is to determine if the price (the dependent variable) is affected by some factor within the marketplace. While regression modeling can be used to estimate the value of individual properties, its use in a detrimental condition analysis tends to focus on the coefficients relating to specific independent variables associated with some detrimental condition, such as airport noise, airport zones, environmental

[110] B.S. Everitt and A. Skrondal, *The Cambridge Dictionary of Statistics,* 4th ed. (New York, NY: Cambridge University Press, 2010), 107.
[111] Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago, IL: Appraisal Institute, 2009), 52.
[112] Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago, IL: Appraisal Institute, 2009), 5.
[113] Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago, IL: Appraisal Institute, 2009), 292.
[114] Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago, IL: Appraisal Institute, 2009), 291.

contaminants and so forth. Coefficient is defined as, "[a] statistic used as a measure of change, association, or dispersion."[115]

Variables

Statistics involves the study of issues or "variables." There are several types of numerical variables that are most relevant to real estate economics. Not all statistic literature utilizes the same names and descriptions, but more modern statistical references cite variables coming under one of four categories; specifically, these include the following:

1. Nominal variables, meaning that they have a name, such as waterfront, impact windows, and central air-conditioning.
2. Ordinal variables, a categorical variable indicating rank order, such as small, medium, and large; contrasts with nominal, categorical variables, which do not indicate rank order.[116] Ordinal variables also include a number of bedrooms or bathrooms[117], or binary or "dummy" variables are those that are simple "yes" or "no" questions, or "have" or "not have" features. For example, a house has or does not have a pool. Dummy variables are a numerical variable that has two integer values, usually 1 and 0. Dummy variables are used in statistics to convert categorical information into numerical data.[118]
3. Interval or Continuous variables are a measure based on a numerical scale that does not have a true zero point, with meaningful information limited to differences between measures (intervals).[119] For example, in this study, this would include the home size.
4. Ratio Variables have a real zero point, such as the percentage of yard area or percentage of building to land ratios. No ratio variables were required in this study.

Not all variables can be used for the same mathematical functions. For example, a zip code (a nominal variable) cannot be added or multiplied to produce a meaningful number.

Variables can generally be placed into two categories, dependent variables and, independent variables. Dependent variables "depend" upon independent variables. With real estate statistical analyses, there is one dependent variable, usual price per unit or price per square foot, where there can be one or more independent variables. The dependent variable is defined as "[t]he variable being estimated."[120] For example, the value of a house (a dependent variable) can depend upon the

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[115] Appraisal Institute, *The Dictionary of Real Estate Appraisal*, 7th ed. (Chicago, IL: Appraisal Institute, 2022), 289.
[116] Appraisal Institute, *The Dictionary of Real Estate Appraisal*, 7th ed. (Chicago, IL: Appraisal Institute, 2022), 298.
[117] Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago, IL: Appraisal Institute, 2009), 39.
[118] Appraisal Institute, *The Dictionary of Real Estate Appraisal*, 7th ed. (Chicago, IL: Appraisal Institute, 2022), 292.
[119] Appraisal Institute, *The Dictionary of Real Estate Appraisal*, 7th ed. (Chicago, IL: Appraisal Institute, 2022), 295.
[120] Appraisal Institute, *The Dictionary of Real Estate Appraisal*, 7th ed. (Chicago, IL: Appraisal Institute, 2022), 292.

date of sale, the square footage, the number of bedrooms, the number of bathrooms and the quality, which are all potential independent variables.

In this study, the dependent variable is home "price." In other words, a home's price depends upon the independent variables.

The chart shows that there is a collection of baseline real estate regression variables, which are price (as a dependent variable), time, living area, and lot area.

Baseline Real Estate Regression Variables
From Professional Textbooks[1]

	Statistics for Appraisers[2]	Practical Application in Appraisal Valuation Modeling[3]	A Guide to Appraisal Valuation Modeling[4]	Introductory Econometrics[5]	Appraisal of Real Estate[6]	Real Estate Damages[7]	**Baseline Variables from Professional Textbooks**
Dependent Variable							
Sale / Rent Price	X	X	X	X	X	X	**X**
Independent Variables							
Time / Sale Date[8]	X	X	X	X		X	**X**
Days on Market[9]	X						
Distressed Sale Data						X	
Living Area[10]	X	X		X	X	X	**X**
Baths[11]	X	X		X	X		
Bedrooms[12]	X				X		
Number of Rooms				X			
Basement Square Feet		X					
Central Air Conditioning						X	
Fireplaces	X	X					
Pool/Spa/Exercise					X	X	
Age[13]	X	X		X		X	
Garage[14]	X	X					
Lot Area[15, 16]	X	X	X	X		X	**X**
Amenity, Amenity Frontage, or Amenity Proximity[17]			X	X		X	
Location[18]			X	X		X	
Detrimental Condition (DC)[19]				X		X	
Distance from DC[20]				X			
Test vs. Control[21]						X	

Figure 40: Baseline Real Estate Regression Variables

References:

(1) These are the textbooks within the appraisal profession. In addition, an example from the *Introductory Econometrics: A modern Approach* is presented.
(2) Marvin Wolverton, *An Introduction to Statistics for Appraisers,* (Chicago, IL: Appraisal Institute, 2009), 336.
(3) Steven M. Kane, Mark Linne, Jeffrey Johnson, *Practical Applications in Appraisal Valuation Modeling Statistical Methods for Real Estate Practitioners* (Chicago, IL: Appraisal Institute, 2004), 154.
(4) Mark Linne, Steven M. Kane, George Dell, *A Guide to Appraisal Valuation Modeling* (Chicago: IL, Appraisal Institute, 2000), 79.
(5) Referenced in *Introductory Econometrics: A modern Approach:* Katherine A. Kiel, and Katherine T. Mcclain. "House Prices during Siting Decision Stages: The Case of an Incinerator from Rumor through Operation," *Journal of Environmental Economics and Management* 28, no. 2 (March 1995): 241–55.
(6) The Appraisal Institute. *The Appraisal of Real Estate,* 14th ed. (Chicago, IL: Appraisal Institute, 2013), 739.
(7) Randall Bell. *Real Estate Damages,* 3rd ed. (Chicago, IL: Appraisal Institute, 2016), 50, 159-160.
(8) Time can be measured monthly, bi-monthly, semiannually, etc. The data can also be converted into a market index beginning at period 0.
(9) The book *Statistics for Appraisers* states: "Days on Market variable lost significance in the final model and was dropped." (Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago, IL: Appraisal Institute, 2009), 342).
(10) The book *Statistics for Appraisers* states: "In an ideal world regression coefficients on each explanatory variable would fully and independently reflect the relationship between the explanatory variable and the response variable. This ideal is seldom achieved, however. Consider housing price models. Important explanatory variables usually include improved living area, number of bedrooms, number of bathrooms, and perhaps lot size, among others. Larger homes tend to have more bedrooms, more bathrooms, and often occupy larger lots. These explanatory variables can be highly correlated with each other. Together they capture a latent construct we could call "home size." Individually they tend to "speak for each other" in a linear regression model. Strong correlation among independent variables and the tendency for groups of variables to share explanatory power is referred to as multicollinearity in regression analysis" (Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago, IL: Appraisal Institute, 2009), 308). When multicollinearity exists, it may be proper to remove one independent variable to allow the model to perform an analysis.
(11) See footnote 10 on Living Area.
(12) See footnote 10 on Living Area.
(13) Age can be calculated from the year of construction.
(14) Parking can include garage stalls, parking spaces, garage SqFt, etc.
(15) See footnote 10 on Living Area.
(16) Lot area can be considered in the analysis as SqFt or acres. The measurement utilized needs to be consistent throughout the analysis.
(17) Amenities can include open space, walk-out, water frontage, docks, etc. These variables can be considered as a binary (yes or no), or measured in degrees for a view, or

square footage for water frontage.
(18) Location can include a neighborhood, city, region, or state, as well as a gated community. This can also include distances to an interstate or central business district (CBD).
(19) Detrimental condition variables can be binary (yes/no), measurements and distances, both, or in a combination of independent variables.
(20) These are specialized methodologies for real estate damage scenarios which are also set forth in numerous published articles and studies.
(21) See footnote 19 on Distance from DC.

Descriptive Statistics Table

The descriptive statistics table sets forth a summary of the key statistics for the multiple regressions.

Central Tendency (Mean, Median and Mode): The first three indicators are mean, median and mode, and are different ways of describing "central tendency." Central tendency asks the question "[i]s there a single number that best represents the variable in question?"[121] These are often called the typical or average number. The mean is the most commonly used measurement where the variables are totaled and divided by the number of the population. The mean is the same as the arithmetic average of the data. The median is the midpoint between the lowest and highest variable. The mode is the most frequently occurring variable.

Standard Deviation (Variance): The standard deviation is a measurement of dispersion, which essentially states how far the data sits away from the typical or the mean. Mathematically, it is the positive square root of the variance. But unlike the variance, which is a mathematical factor, it is expressed in terms of the units defined. In this case, it is simply expressed as dollars. The standard deviation is a measure of variability from the mean. Measures of variance generally describe the dispersion of the data, while the standard deviation, though complicated to calculate manually, is often preferred in situations requiring more sophisticated analyses.[122]

If data is normally distributed (represented by a bell-shaped curve), there is a 68% probability that a predicted value will be within one standard deviation of the mean, a 95% probability that a predicated value will be within two standard deviations of the mean, and a probability in excess of 99% that a predicated value will be within three standard deviations of the mean. This information is often used to construct confidence intervals around point estimates.

Range: The range simply expresses the highest and lowest variable. The range indicator is the difference between the maximum and the minimum price. [123]

Count: The count is simply the number of transactions analyzed in this analysis.

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[121] Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago, IL: Appraisal Institute, 2009), 70.
[122] Randall Bell, *Real Estate Damages,* 3rd ed. (Chicago, IL: Appraisal Institute, 2016), 164.
[123] Randall Bell, *Real Estate Damages,* 3rd ed. (Chicago, IL: Appraisal Institute, 2016), 164.

Residuals

"Residual" in statistics refers to the difference between the calculated value of the dependent variable against a predicted value. The mean and the sum of the residuals are always equal to zero, and the value is positive if the data point is above the graph and negative if below it.[124]

Summary Output Table

Excel produces an "Analysis of Variance" (ANOVA) summary output table using a mathematical model that essentially does two things, (1) provides the "answer" to the question, and (2) provides statistical indicators that relate to the reliability of the "answer".

Sample Summary Output Table

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.911492714
R Square	0.830818967
Adjusted R Square	0.83039766
Standard Error	0.129128558
Observations	6442

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	16	526.1050408	32.88156505	1972.0044	0
Residual	6425	107.1316349	0.016674184		
Total	6441	633.2366757			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	8.6371730	0.0655518	131.7611293	0.0000000	8.5086697	8.7656763
Coefficient 1	0.0067858	0.0001237	54.8694448	0.0000000	0.0065434	0.0070283
Coefficient 2	0.4283522	0.0089903	47.6461387	0.0000000	0.4107282	0.4459761
Coefficient 3	0.0944939	0.0041839	22.5850204	0.0000000	0.0862921	0.1026958
Coefficient 4	0.0332711	0.0033131	10.0424413	0.0000000	0.0267764	0.0397658
Coefficient 5	-0.1848281	0.0361000	-5.1198901	0.0000003	-0.2555962	-0.1140601
Coefficient 6	0.0900792	0.0066651	13.5151444	0.0000000	0.0770135	0.1031450
Coefficient 7	0.3217936	0.0161288	19.9514629	0.0000000	0.2901757	0.3534115
Coefficient 8	0.1665368	0.0105470	15.7900175	0.0000000	0.1458612	0.1872123
Coefficient 9	-0.0857193	0.0225893	-3.7946800	0.0001492	-0.1300019	-0.0414367
Coefficient 10	-0.0476463	0.0185204	-2.5726296	0.0101152	-0.0839525	-0.0113400

Figure 41: Sample Summary Output Table

[124] "What Is a Residual in Statistics?," Reference, accessed October 17, 2018, https://www.reference.com/math/residual-statistics-3ff8643518a63a33.

Indicators

The objective of a multiple regression is to find the relationship, if it exists, between the dependent variable and the independent variables; and if it does exist, to what extent they are correlated:

Coefficients: Other coefficients are calculated for each independent variable, reflecting a marginal rate of change. Coefficients are normally reviewed for expected magnitude and signage. [125]

R-Squared and Adjusted R-Squared: The coefficient of determination (r^2) ranges from 0% to 100%, reflecting the amount of price variation explained by the model. An alternative calculation is adjusted r^2 which adjusts the coefficient of determination for the number of independent variables, assisting in the identification of extraneous or redundant independent variables. In multiple regression analysis, a low r^2 will normally indicate a significant amount of unexplained variation.

Significance F: Significance F measures the probability that the results were obtained purely by chance. [126]

T-Statistic: T-statistics (t-stats) are also calculated for each independent variable and reflect the difference between a sample mean and a hypothesized value of the population mean divided by an estimate of the standard error of the mean. The larger the t-stat, the more one can be confident that the coefficient is meaningful. [127]

P-Value: The P-value measures the probability that the true value of the coefficient is zero (the significance level). An acceptable significance level for coefficients in most applications is 10%, or a P-value of 0.10 or less. [128]

Standard Error: The standard deviation of a regression coefficient estimate. Also, the standard deviation of regression errors (residuals). [129]

Observations: The words or numbers that characterize a particular item or case in a data set. For example, in a home price data set, each sale price and the property characteristics associated with it is a separate observation. [130]

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[125] Randall Bell, *Real Estate Damages,* 3rd ed. (Chicago, IL: Appraisal Institute, 2016), 165
[126] Randall Bell, *Real Estate Damages*, 3rd ed. (Chicago, IL: Appraisal Institute, 2016), 49.
[127] Randall Bell, *Real Estate Damages,* 3rd ed. (Chicago, IL: Appraisal Institute, 2016), 166.
[128] Randall Bell, *Real Estate Damages,* 3rd ed. (Chicago, IL: Appraisal Institute, 2016), 166.
[129] Appraisal Institute, *The Dictionary of Real Estate Appraisal*, 7th ed. (Chicago, IL: Appraisal Institute, 2022), 302.
[130] Appraisal Institute, *The Dictionary of Real Estate Appraisal*, 7th ed. (Chicago, IL: Appraisal Institute, 2022), 298.

Calculating Values

Once the analysis has been completed, the resulting coefficients and standard error in the summary output table are utilized to build the formula(s) for valuing the subject properties. This analysis is completed to determine an overall property value or an overall rental rate. The standard error and coefficients are identified in yellow in the following figure:

Sample Summary Output Table

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.911492714
R Square	0.830818967
Adjusted R Square	0.83039766
Standard Error	0.129128558
Observations	6442

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	16	526.1050408	32.88156505	1972.0044	0
Residual	6425	107.1316349	0.016674184		
Total	6441	633.2366757			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	8.6371730	0.0655518	131.7611293	0.0000000	8.5086697	8.7656763
Coefficient 1	0.0067858	0.0001237	54.8694448	0.0000000	0.0065434	0.0070283
Coefficient 2	0.4283522	0.0089903	47.6461387	0.0000000	0.4107282	0.4459761
Coefficient 3	0.0944939	0.0041839	22.5850204	0.0000000	0.0862921	0.1026958
Coefficient 4	0.0332711	0.0033131	10.0424413	0.0000000	0.0267764	0.0397658
Coefficient 5	-0.1848281	0.0361000	-5.1198901	0.0000003	-0.2555962	-0.1140601
Coefficient 6	0.0900792	0.0066651	13.5151444	0.0000000	0.0770135	0.1031450
Coefficient 7	0.3217936	0.0161288	19.9514629	0.0000000	0.2901757	0.3534115

Coefficient 8	0.1665368	0.0105470	15.7900175	0.0000000	0.1458612	0.1872123
Coefficient 9	-0.0857193	0.0225893	-3.7946800	0.0001492	-0.1300019	-0.0414367
Coefficient 10	-0.0476463	0.0185204	-2.5726296	0.0101152	-0.0839525	-0.0113400

Figure 42: Sample Summary Output Table Standard Error and Coefficients

These analysis results are then mathematically applied to a list of subject properties:

Sample Subject Property Public Record Table										
Subject Property Identifier	Coefficient 1	Coefficient 2	Coefficient 3	Coefficient 4	Coefficient 5	Coefficient 6	Coefficient 7	Coefficient 8	Coefficient 9	Coefficient 10
1	49	6.784457063	8.657302899	1	0.024976668	0	0	0	0	0
2	52	7.061334367	9.3615152	1	0.278885933	0	0	1	0	0
3	48	7.459338895	8.798152718	3	0.092618151	0	0	0	0	0

Figure 43: Sample Subject Properties Public Record List

The resulting formula, as applied to sample property 1, is written as:

Sample Application of Formula							
Standard Error	0.129128558		(Standard Error^2)/2	=	0.008337092		
				EXP	0.008337092	=	1.008371943
	Coefficients				**Property 1**		
Intercept	8.637173008		=		8.637173008		
Coefficient 1	0.006785846	x	49	=	0.332506451		
Coefficient 2	0.428352153	x	6.784457063	=	2.906136787		
Coefficient 3	0.094493942	x	8.657302899	=	0.818062682		
Coefficient 4	0.03327113	x	1	=	0.03327113		
Coefficient 5	-0.18482814	x	0.024976668	=	-0.004616391		
Coefficient 6	0.090079231	x	0	=	0		
Coefficient 7	0.321793594	x	0	=	0		
Coefficient 8	0.166536768	x	0	=	0		
Coefficient 9	-0.08571927	x	0	=	0		
Coefficient 10	-0.04764625	x	0	=	0		
				Sum	12.72253367		
				EXP	12.72253367	=	335217.1017

← Multiply these results →

Value
338023.52

Rounded
$ 338,024

Figure 44: Sample Application of Regression Formula

The final step is to solve the formula for each subject property in the analysis. This application is utilized for both the unimpaired and use effect calculations.

Logarithmic Calculations

In regressions, log transformations are often useful for controlling heteroscedasticity.[131] They can also be applied to Sale Price [or Rent], so that the coefficients in the summary output table are presented as percentages, whereas an unlogged regression would present the summary output coefficients as dollar amounts. If the coefficients in a logged regression are being used to estimate property values or market rents, they can be unlogged after running the analysis to convert any indicated values to dollar amounts.[132]

Logarithms and exponents are related. Two commonly used logarithmic bases are 10 and *e*. These two bases have special names. A base 10 logarithm is called a *common logarithm*. A base *e* logarithm is called a *natural logarithm*.[133]

Natural logs are often used in regression models when applied to real property valuation. The symbol for a natural logarithm is "ln." In other words, ln *x* is a shorthand way of writing log*ex*. Like π, the base number *e* has an infinite number of decimal places, and the "approximate value" of *e* is 2.718281828459.[134] Fortunately, the value of *e* is programmed into most calculators. For instance, the HP-12C financial calculator popular with appraisers has two blue keys labeled "*e*^*x*" and "LN." These keys calculate natural logs (LN) and allow the user to reverse the process (*e*^*x*), which is called an *antilogarithm*.[135]

[131] Appendix B, "Regression Analysis and Statistical Applications" in *The Appraisal of Real Estate*, 15th ed. (Appraisal Institute: 2020), 10.
[132] Michael Tachovsky, "Stigma: A Case Study Analysis of Long-Term Environmental Risk Effect," *The Appraisal Journal* (Spring 2022): 116.
[133] Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago: Appraisal Institute, 2009), 30.
[134] "Base *e* has convenient properties for financial calculations. It is derived from the compound interest equation and is the amount $1 will grow to in a year at an interest rate of 100% compounded continuously." Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago: Appraisal Institute, 2009), 30.
[135] Marvin Wolverton, *An Introduction to Statistics for Appraisers* (Chicago: Appraisal Institute, 2009), 30.

Geographic Information System (GIS)

A Geographic Information System (GIS) is a tool that allows the user to analyze, interpret, and display data that is associated with a specific location on the earth. It begins with a blank model of Earth which provides a space to store, display, and compare two or more types of data on the same plane. Its use is essential when needing to understand how data is distributed, to display geospatial data, and to identify data based on spatial characteristics, among other capabilities.

Types of Data

GIS data represents features of the real world in two ways: as a vector or a raster. Vectors are files of data that exist in discrete dimensions whereas rasters are files that contain continuous data, existing in all areas that the data represents. Rasters usually look like an image because the data does not stop as vectors do. Each pixel in a raster contains a value that is itself a data point. An example of a raster is a digital elevation model (DEM). DEM's often look like a grayscale aerial image because each pixel in the file has a value that is represented by the median elevation of the location represented by the raster.

Vectors can be in the form of points, lines, or polygons. Points are associated with one specific latitude and longitude and has no dimension. Lines are one dimensional data, and polygons are data of two dimensions. An example of a feature represented by a point is the source of a detrimental condition. Examples of a line are roads or rivers, and examples of polygons are land parcels or lakes. Additionally, non-spatial data in the form of a table can be joined to spatial data to add information to the features represented in the GIS project.

Data Sources

A GIS allows its user to spatially compare data from different sources. Data is sourced from various reliable agencies. For example, sales data could be obtained from a multiple listing service (MLS), parcel data in the form of polygon vectors from the county tax assessor, contaminated zones from an environmental scientist, and population data from the U.S. Census Bureau.

What it Does

When a table of sales data is joined to parcel vectors, the user can identify the locations of all sales in the study and compare their spatial relationship to the source of the detrimental condition.

GIS software allows the user to analyze spatial relationships, determine distances between two types of data, display these relationships as they relate to each other, and communicate data in a visual way that is easy to understand. Additionally, GIS software is used to verify that the data used is where it is expected to be.

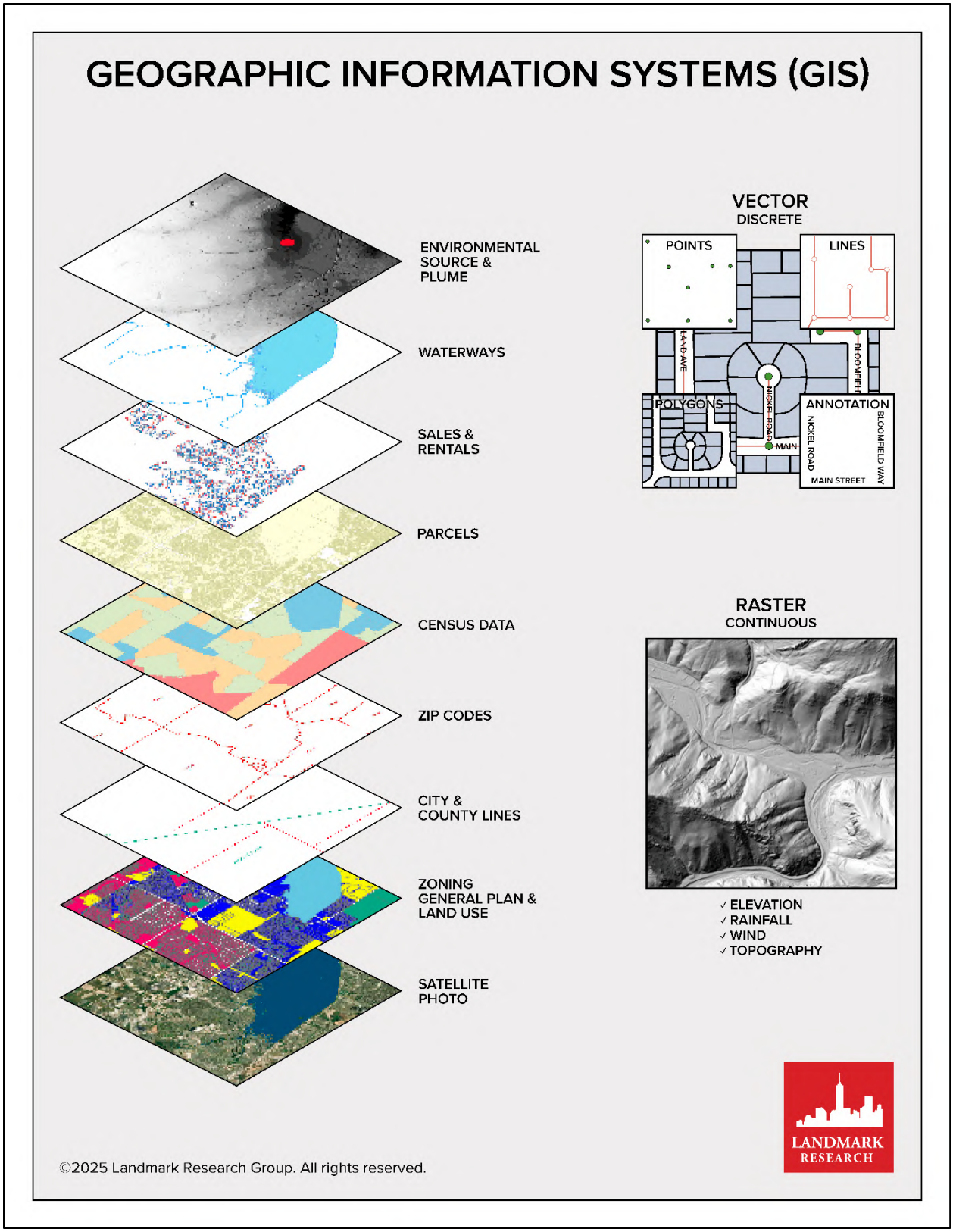


Figure 45: Geographic Information Systems (GIS) Overview

A geographic information system using line data allows an appraiser to analyze information on traffic analysis zones, acreage available for development, zone densities, and other physical characteristics and geographical relationships in a market area. Other GIS databases contain information about local taxes (e.g., property assessments, school levies) and infrastructure (e.g., gas lines). Geographic information system technology facilitates the addition of geographic reference data to individual items in real estate databases. Personal computers and larger, networked computer workstations can draw on this information to map or model the spatial referents and show the spatial relationships among the data points. Equally important, spreadsheets or tabular grids can be produced in written formats, which can help the user better understand these relationships.[136]

In addition, it is noted that data used to generate these maps is typically found in computer databases that include referents to a specific point on the earth's surface (i.e., latitude and longitude) or a specific area (e.g., city, zip code area, census tract). Given sufficient information, the system can quickly pinpoint properties with specific characteristics.[137]

Applicability

GIS technology allows for the organization of the property, market, and detrimental condition data. With this proposed class, GIS technology can be utilized to locate the latitude and longitude of each individual subject property. Data for the subject properties can be gathered from various sources, including public records, client supplied documents, other experts in this case, and MLS. By assigning a GIS coordinate to each property, the information from various data sources can be properly matched and combined for confirmation and analysis. In other words, GIS technology was a part of the data collection and confirmation process.

[136] Appraisal Institute, *The Appraisal of Real Estate*, 15th ed. (Chicago, IL: Appraisal Institute, 2020), 104.
[137] Appraisal Institute, *The Appraisal of Real Estate*, 15th ed. (Chicago, IL: Appraisal Institute, 2020), 104.

Definitions

Market Value

The most probable price, as of a specified date, in cash, or in terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress. (Appraisal Institute: The Appraisal of Real Estate 15th Edition)

Market Rent

The most probable rent that a property should bring in a competitive and open market under all conditions requisite to a fair lease transaction, the lessee and lessor each acting prudently and knowledgeably, and assuming the rent is not affected by undue stimulus. Implicit in this definition is the execution of a lease as of a specified date under conditions whereby lessee and lessor are typically motivated; both parties are well informed or well advised, and acting in what they consider their best interests; payment is made in terms of cash or in terms of financial arrangements comparable thereto; and the rent reflects specified terms and conditions typically found in that market, such as permitted uses, use restrictions, expense obligations, duration, concessions, rental adjustments and revaluations, renewal and purchase options, frequency of payments (annual, monthly, etc.), and tenant improvements (TIs). (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Benefits

In eminent domain valuation, the advantageous factors that arise from a public improvement for which private property has been taken. The law in some jurisdictions makes a distinction between general benefits and special benefits because only special benefits are considered in determining the value of the remainder in a partial acquisition. The distinction between special benefits and general benefits is both a factual and a legal question, so appraisers may need to consult legal counsel to resolve questions about the classification of benefits. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Change

The result of the cause and effect relationship among the forces that influence real property values. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Class

A set of items defined by a common characteristic. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 6th Edition)

Conventional

A generally accepted rule or practice; usage or custom. (Black's Law Dictionary, 4th Edition)

Count

Frequency. (Appraisal Institute: The Appraisal of Real Estate 15th Edition)

Data

Unprocessed observations and descriptions about real property and the markets in which real property is bought and sold. These raw observations fall into two categories: (1) qualitative data, which descriptive in nature, and (2) quantitative data, which has to do with numbers. (Appraisal Institute: The Appraisal of Real Estate 15th Edition)

Days on Market

The length of time between the date a property is listed and advertised for sale and the date it is sold or removed from the market; commonly used as a measure of the marketability of a property and as an indication of the general health of the market. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Delta (Δ)

In mathematics, change in a variable, symbolized by the upper case Greek letter delta. For example, Δx means "change in the variable x." In calculus, the lower case Greek letter delta refers to a partial derivative. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Detrimental Condition

Any issue or condition that may cause a diminution-in-value to real estate. (Appraisal Institute: Real Estate Damages 3rd Edition).

Diminution-in-value (Property Value Diminution)

The difference between the unimpaired and impaired values of the property being appraised. This difference can be due to the increased risk and/or costs attributable to the property's environmental condition. (The Appraisal Foundation: Uniform Standards of Professional Appraisal Practice 2020-2021, Advisory Opinion 9)

Easement

The right to use another's land for a stated purpose. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Excess Land

Land that is not needed to serve or support the existing use. The highest and best use of the excess land may or may not be the same as the highest and best use of the improved parcel. Excess land has the potential to be sold separately and is valued separately. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Exposure Time

1 The time a property remains on the market.
2. An opinion, based on supporting market data, of the length of time that the property interest being appraised would have been offered on the market prior to the hypothetical consummation of a sale at market value on the effective date of the appraisal. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Extraordinary Assumptions

An assignment-specific assumption as of the effective date regarding uncertain information used in an analysis which, if found to be false, could alter the appraiser's opinions or conclusions. (The Appraisal Foundation: Uniform Standards of Professional Appraisal Practice 2020-2021)

Fee Simple Estate

Absolute ownership unencumbered by any other interest or estate, subject only to the limitations imposed by the governmental powers of taxation, eminent domain, police power, and escheat. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Ground Lease

A lease that grants the right to use and occupy land. Improvements made by the ground lessee typically revert to the ground lessor at the end of the lease term. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Ground Rent

The rent paid for the right to use and occupy land according to the terms of a ground lease; the portion of the total rent allocated to the underlying land. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Highest & Best Use

This may be defined as "the reasonably probable and legal use of vacant land or an improved property that is physically possible, appropriately supported, financially feasible, and that results in the highest value. The four criteria the highest and best use must meet are legal permissibility, physical possibility, financial feasibility, and maximum productivity." (Appraisal Institute: The Appraisal of Real Estate 15th Edition)

Hypothetical Conditions

A condition, directly related to a specific assignment, which is contrary to what is known by the appraiser to exist on the effective date of the assignment results, but is used for the purpose of analysis. (The Appraisal Foundation: Uniform Standards of Professional Appraisal Practice 2020-2021)

Impaired Value

The market value of the property being appraised with full consideration of the effects of its environmental condition and the presence of environmental contamination on, adjacent to, or proximate to the property. Conceptually, this could be considered the "as-is" value of a contaminated property. (The Appraisal Foundation: Uniform Standards of Professional Appraisal Practice 2020-2021, Advisory Opinion 9)

Jurisdictional Exceptions

An assignment condition established by applicable law or regulation, which precludes an appraiser from complying with a part of USPAP. (The Appraisal Foundation: Uniform Standards of Professional Appraisal Practice 2020-2021)

Just Compensation

In condemnation, the amount of loss for which a property owner is compensated when his or her property is taken. Just compensation should put the owner in as good a position pecuniarily as he or she would have been if the property had not been taken. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Kurtosis

A statistical term that refers to the "peakedness" of the data distribution. A normal distribution has a kurtosis of 3 and is moderately peaked, while a distribution with a kurtosis higher than 3 is leptokurtic, and one with a kurtosis of less than 3 is platykurtic. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Leased Fee Estate

The ownership interest held by the lessor, which includes the right to receive the contract rent specified in the lease plus the reversionary right when the lease expires. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Leasehold Estate

The right held by the lessee to use and occupy real estate for a stated term and under the conditions specified in the lease. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Linear Regression

A type of statistical analysis used to investigate a linear relationship between a dependent variable and one or more independent variables; used to predict the value of the dependent variable on the basis of the values of the independent variables and to develop an understanding of how a unit change in an independent variable relates to change in the dependent variable. Linear regression models employing a single independent variable are called simple linear regression models. Those employing more than one independent variable are called multiple linear regression models. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Market

A set of arrangements in which buyers and sellers are brought together through the price mechanism; the aggregate of possible buyers and sellers and the transactions between them. A gathering of people for the buying and selling of things; by extension, the people gathered for this purpose. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Market Participants

Individuals actively engaged in transactions. In real property markets, primary market participants invest in real property or use real estate, such as buyers, sellers, owners, lenders, and tenants. Secondary market participants include those who advise primary market participants, such as agents and brokers, advisors, counselors, underwriters, and appraisers. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Market Resistance

The risk, if any, associated with the ongoing stage of a detrimental condition analysis. Market resistance includes the reluctance on part of the real estate market to buy a property that has historically been damaged or tainted. Sometimes called *stigma*. (Appraisal Institute: Real Estate Damages 3rd Edition)

Mass Appraisal

The process of valuing a universe of properties as of a given date using standard methodology, employing common data, and allowing for statistical testing. (USPAP, 2020-2021 ed.) Often associated with real property tax assessment valuation. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Mean

A measure of central tendency. The sum of values for a variable in a sample or population divided by the number of items in the sample or population. The arithmetic average. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Median

A measure of central tendency identified as the middle value in an ordered array of numerical values, e.g., 7 is the median of (1, 4, 6, 6, 7, 9, 11, 22, 41). If the ordered array contains an even number of values, then the median is the mean of the two values on either side of the middle. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Mode

A measure of central tendency consisting of the numerical value or categorical characteristic that occurs most frequently in a sample or population. For example, the mode of the data set (2, 4, 5, 6, 6, 7, 7, 8, 8, 8, 8, 10, 12) is 8, and the mode of (poor, poor, below average, average, average, average, average, good, good, excellent) is average. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Nuisance

Something that interferes with the use and enjoyment of property or is a source of discomfort and annoyance to others; legally divided into two classes: public, or common, nuisances, which touch the public interest, and private nuisances, which destroy or injure an individual's property, interfere with its lawful use and enjoyment, or deny an individual common rights. (Appraisal Institute, 6th Edition)

Permanent Easement

An easement that lasts forever. Sometimes referred to as a perpetual easement. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Personal Property

1. Tangible or intangible objects that are considered personal, as opposed to real property. Examples of tangible personal property include furniture, vehicles, jewelry, collectibles, machinery and equipment, and computer hardware. Examples of intangible personal property include contracts, patents, licenses, computer software, and intellectual property. See also trade fixtures.
2. Any tangible or intangible article that is subject to ownership and classified as real property, including identifiable tangible objects that are considered by the general public as being "personal," such as furnishings, artwork, antiques, gems and jewelry, collectibles, machinery and equipment, and intangible property that is created and stored electronically such as plans for installation art, choreography, emails, or designs for digital tokens. (USPAP, 2020-2021 ed.) (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Range

In statistics, the difference between the highest and lowest values in a set of numbers. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Regression Analysis

A statistical method that examines the relationship between one or more independent variables and a dependent variable. Regression models can be used to examine the structure of a relationship or to forecast dependent variable values. Simple linear regression has one independent variable, whereas multiple linear regression includes more than one independent variable. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Remediation Cost

The cost to cleanup (or remediate) a contaminated property to the appropriate regulatory standards. These costs can be for the cleanup of on-site contamination as well as mitigation of off-site impacts due to migrating contamination. (The Appraisal Foundation: Uniform Standards of Professional Appraisal Practice 2020-2021, Advisory Opinion 9)

Remediation Lifecycle

A cycle consisting of three stages of cleanup of a contaminated site: before remediation or cleanup; during remediation; and after remediation. A contaminated property's remediation lifecycle stage is an important determinant of the risk associated with environmental contamination. Environmental risk can be expected to vary with the remediation lifecycle stage of the property. (The Appraisal Foundation: Uniform Standards of Professional Appraisal Practice 2020-2021, Advisory Opinion 9)

Retrospective Value Opinion

A value opinion effective as of a specified historical date. The term *retrospective* does not define a type of value. Instead, it identifies a value opinion as being effective at some specific prior date. Value as of a historical date is frequently sought in connection with property tax appeals, damage models, lease renegotiation, deficiency judgments, estate tax, and condemnation. Inclusion of the type of value with this term is appropriate, e.g., "retrospective market value opinion." (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Sample Variance

Sample variance equals S^2, where S is the sample standard deviation. (Appraisal Institute: The Appraisal of Real Estate 15th Edition)

Severance Damages

In condemnation, the loss in value to the remainder in a partial taking of property. Generally, the difference between the value of the whole property before the taking and the value of the remainder after the taking is the measure of the value of the part taken and the damages to the remainder. Note that different regions of the country and different courts may use terms such as consequential damages and severance damages differently. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Skewness

The degree of deviation from symmetry in a statistical distribution. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Source, Non-source, Adjacent and Proximate Sites (SNAP)

Source sites are the sites on which contamination is, or has been, generated. Non-source sites are sites onto which contamination, generated from a source site, has migrated. An adjacent is not contaminated, but shares a common property line with a source site. Proximate sites are not contaminated and not adjacent to a source site, but are in close proximity to the source site. (The Appraisal Foundation: Uniform Standards of Professional Appraisal Practice 2020-2021, Advisory Opinion 9)

Standard Deviation

The square root of the variance. The sample standard deviation is the square root of the sample variance and the population standard deviation is the square root of the population variance, i.e., the square root of the sum of the squared deviations from the mean divided by either the population size or by the sample size minus 1. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Standard Error

The standard deviation of a regression coefficient estimate. Also, the standard deviation of regression errors (residuals). (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Stigma

Stigma is essentially jargon, or a slang term given to “risk” or “market resistance”.

An adverse public perception regarding a property, commonly the identification of a property with a condition such as environmental contamination or other detrimental condition, such as a violent crime, that penalizes the marketability of the property and may also result in a diminution in value. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Sum

Add up what follows. (Appraisal Institute: An Introduction to Statistics for Appraisers)

Surplus Land

Land that is not currently needed to support the existing use but cannot be separated from the property and sold off for another use. Surplus land does not have an independent highest and best use and may or may not contribute value to the improved parcel. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Survey

1. The process in which the quantity or location of a piece of land is scientifically ascertained; may reflect the physical features of land, e.g., grades, contours, structures.
2. A map or plot that describes the courses, distances, and quantity of land and shows the lines of possession.
3. A market analysis procedure used to identify consumer preferences. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Temporary Construction Easement (TCE)

An easement granted for a specific purpose and applicable for a specific time period. A construction easement, for example, is terminated after the construction of the improvement and the unencumbered fee interest in the land reverts to the owner. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Unimpaired Value

A value estimate that does not include any adjustments for detrimental conditions. (Appraisal Institute: Real Estate Damages 3rd Edition)

Unit of Value

The market value of the whole reduced to a value per unit of measurement. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 6th Edition)

Units of Comparison

The components into which a property may be divided for purposes of comparison, e.g., price per SqFt, front foot, cubic foot, room, bed, seat, apartment unit. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Unit Rule

A valuation premise often applicable in condemnation appraisals. The unit rule has two aspects, the first dealing with ownership interests and the second dealing with physical components. The first aspect of the rule, also referred to as the undivided fee rule, requires that property be valued as a whole rather than by the sum of the values of the various interests into which it may have been carved (such as lessor and lessee, life tenant and remainderman, and mortgagor and mortgagee, etc.). This is an application of the principle that it is the property, not the interests, that is being acquired. The second aspect of the rule is that different physical elements or components of a tract of land (such as the value of timber and the value of minerals on the same land) are not to be separately valued and added together. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Whole Property

Or "larger parcel" is in governmental land acquisitions and in valuation of charitable donations of partial interests in property such as easements, the tract or tracts of land that are under the beneficial control of a single individual or entity and have the same, or an integrated, highest and best use. Elements for consideration by the appraiser in making a determination in this regard are contiguity, or proximity, as it bears on the highest and best use of the property, unity of ownership, and unity of highest and best use. In most states, unity of ownership, contiguity, and unity of use are the three conditions that establish the larger parcel for the consideration of severance damages. In federal and some state cases, however, contiguity is sometimes subordinated to unitary use. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Zoning

Public regulation of the use of private land through application of police power; accomplished by establishing districts or areas with uniform requirements relating to lot coverage, setbacks, type of improvement, permitted activities, signage, structure height, minimum lot area, density, landscaping, and other aspects of land use and development. Zoning regulations are established by enactment of a local (city, town, or county) zoning ordinance. (Appraisal Institute: The Dictionary of Real Estate Appraisal, 7th Edition)

Media Headlines

LAKE WATEREE PCB Media Summary (Landmark File: 235-2-26)			
No.	**Date**	**Article Title Publisher**	**Citations**
1	12/13/2009	State Will Test for PCBs in Lake Wateree Fish thestate.com	"State biologists will begin testing fish at Lake Wateree next year for PCBs, a suspected cancer-causing pollutant that federal data show has tainted predator species in the popular reservoir." "Wateree was one of the 17 percent of lakes tested nationally in which fish registered PCB levels above a federal health safety standard this decade, according to data released last month by the U.S. Environmental Protection Agency." "Lake Wateree is the second major reservoir in the Midlands found by the EPA to have elevated levels of a contaminant in fish tested, according data used to compile the Nov. 10 baseline study." "Like Lake Murray northwest of Columbia, Wateree is filled with weekend boaters, anglers and swimmers during the summer. Thousands of people also live or own weekend homes along its 242-mile shoreline, which touches Kershaw, Fairfield and Lancaster counties." "'In this report, Wateree has some really high readings; they are quite drastic,' [David] Merryman said.' DHEC [Department of Health and Environmental Control] needs to get in there and find out what these concentrations are. If those levels the EPA found are true, we need fish advisories.'" "[Thom] Berry said he didn't know why PCBs would have shown up in Lake Wateree's fish. But some reports have indicated the toxic chemical was dumped into the lake during the 1940s as part of an effort to kill mosquitoes, The State reported in 1997."
2	8/25/2010	Signs Will Soon Warn of PCB Contaminated Fish at Lake Wateree wistv.com	"Certain species of fish in Lake Wateree have been identified as having high PCB levels in their tissue and Department of Health and Environmental Control officials will soon be posting signs to warn fishermen of the dangers of consuming those fish." "In May, DHEC [Department of Health and Environmental Control] added several species of fish to this year's fish consumption advisory due to high PCB levels in their tissue." "David Wilson, chief of DHEC's Bureau of Water said, 'We're looking into potential sources of PCB contamination in the Catawba River Watershed and conducting additional fish tissue testing for PCBs throughout the watershed and will update the advisory information as needed.'"
3	9/2/2010	S.C. Tests Fish for PCBs in Lake Wylie heraldonline.com	"Unsafe carcinogen levels in fish caught Lake Wateree have led the state to issue fish consumption advisories. It has also tested Lake Wylie and three other upstream sites to find the cause." "'We ended up focusing more of our attention on the Catawba basin,' state official Chuck Gorman told the Catawba-Wateree River Basin Advisory Commission last week in Rock Hill. 'A lot of people are interested in what we find out upstream.'" "'PCBs can remain in the environment for many years, and they can get into the tissue of the fish,' Gorman said. 'They actually move with the sediment down the river system.'" "Gary Faulkenberry, who represents the Wateree Homeowners Association on the commission, said the finding of unsafe levels of PCBs in Wateree are curious since there aren't large manufacturers there. Wateree and Lake Hartwell are the only two lakes in South Carolina under fishing advisories because of PCB content."
4	10/6/2023	State Advises Against Eating Fish Polluted by Forever Chemicals thestate.com	"The S.C. Department of Health and Environmental Control recently found about a dozen species in 18 waterways across the state contained forever chemicals, but the agency initially declined to issue advisories against eating the fish until further studies are conducted." "Rivers and lakes where forever-chemical tainted fish have been found include the Broad River near Gaffney and Columbia; the Congaree River at Columbia; the Ashley River near Charleston; Lake Greenwood west of Lexington; Lake Marion southeast of Columbia; the Great Pee Dee River near Florence; the Savannah River near Augusta, Ga.; the Wateree River near Camden; the Pocotaligo River near Manning; Lake Conestee south of Greenville; and the Waccamaw River southwest of Myrtle Beach." "DHEC's recent testing found fish from some rivers and lakes with mercury and PCB advisories also had PFAS contamination, including the Wateree."

Figure 46: Media Summary – Articles 1 to 4

LAKE WATEREE PCB Media Summary (Landmark File: 235-2-26)			
No.	**Date**	**Article Title Publisher**	**Citations**
5	2/21/2024	Here's Why This South Carolina Lake Has Reportedly Been Polluted country1037fm.com	"Here's why this South Carolina lake has reportedly been polluted. According to The Charlotte Observer, a few residents living at Lake Wateree are suing Duke Power and are reportedly seeking millions in compensation." "They are claiming the chemicals used to control mosquitos in the area also spread cancer causing material. They reportedly believe those chemicals polluted fish in the Catawba River and many of the basin's lakes. The lawsuit was filed last week in Kershaw county. The center of the suit claims Duke Power used a mosquito killing oil that contained strong long lasting toxins. Those toxins they believe are tied to liver damage, cancer and other ailments." "Here's why this South Carolina lake has reportedly been polluted. In a direct quote from the Charlotte Observer, 'The residents say Duke should have known it's spraying would spread hazardous PCB's. But the company continued to conduct the program. And it concealed the fact the oily substance it spread on the lakes including Wateree contained the toxic chemical'."
6	2/21/2024	Utility's Mosquito Control Effort Polluted SC Lake, Suit Says thestate.com	"For more than 90 years, a power company took pride in the mosquito control program it used to fight malaria around a string of lakes the utility oversees from north of Charlotte to Lake Wateree near Camden." "Unfortunately, some of the concoctions used to kill mosquitoes also spread cancer-causing material that polluted fish in the Catawba River and many of the basins lakes, according to a 2021 scientific research paper." "Now, a handful of Lake Wateree residents are suing Duke Energy, seeking potentially millions of dollars in compensation. They say pollution from mosquito spraying has hurt their property values and tainted fish at levels that make some popular species unsafe to eat." "Through the years, DHEC has been hesitant to point the finger at a specific source of PCB pollution in Lake Wateree and the Catawba River basin, which extends through Charlotte, North Carolina's largest city, to central South Carolina." "But a research paper, written by a former DHEC [Department of Health and Environmental Control] scientist and a colleague, said PCB pollution in Catawba River lakes, as well as in the Yadkin-Pee Dee river basin, was caused, in part, by the 'direct application of used transformer oils" in mosquito control efforts. Transformer oils contain PCBs. Duke relied at least partially on used transformer oils to fight mosquitoes on lakes it managed along the Catawba River, according to the study."
7	9/10/2025	Common Law Action/PCBs: Federal Court Addresses Lakefront Property Owners Damage Claim mitchellwilliamslaw.com	"A federal court in South Carolina addressed in an August 6th Opinion issues arising out of a putative class action filed by lakefront property owners alleging contamination due to the dissemination of motor and transformer oil into the lake." "The oils are alleged to have contained polychlorinated biphenyls ('PCBs')." "Duke Energy Corporation and Duke Energy Carolinas, LLC (collectively, 'Duke Energy'), created Lake Wateree in 1919. It encompasses portions of Kershaw, Fairfield, and Lancaster counties in South Carolina." "Duke Energy developed a reservoir mosquito control program ('MCP') in 1923 to abate the threat of malaria presented by the lake. As part of the MCP, Duke Energy is alleged to have disseminated into Lake Wateree a mixture of motor and transformer oil containing PCBs." "The plaintiffs own waterfront properties along the lake's shoreline (collectively, 'Property Owners').They allege Duke Energy continued administering the MCP despite evidence linking PCB exposure to adverse health effects and the United States Environmental Protection Agency's ('EPA') ban on PCB production in 1979. This included an allegation that they hid the use of PCBs and mislead the public into believing contamination was not an issue." "The Property Owners further contended Lake Wateree has been subject to restrictive consumption guidance by the South Carolina Department of Health and Environmental Control since 2009 due to unsafe levels of PCBs found in the lake's fish."

Figure 47: Media Summary – Articles 5 to 7

USPAP AO9 in Context of the Subject Properties

Source, Non-Source, Adjacent, Proximal (SNAP)

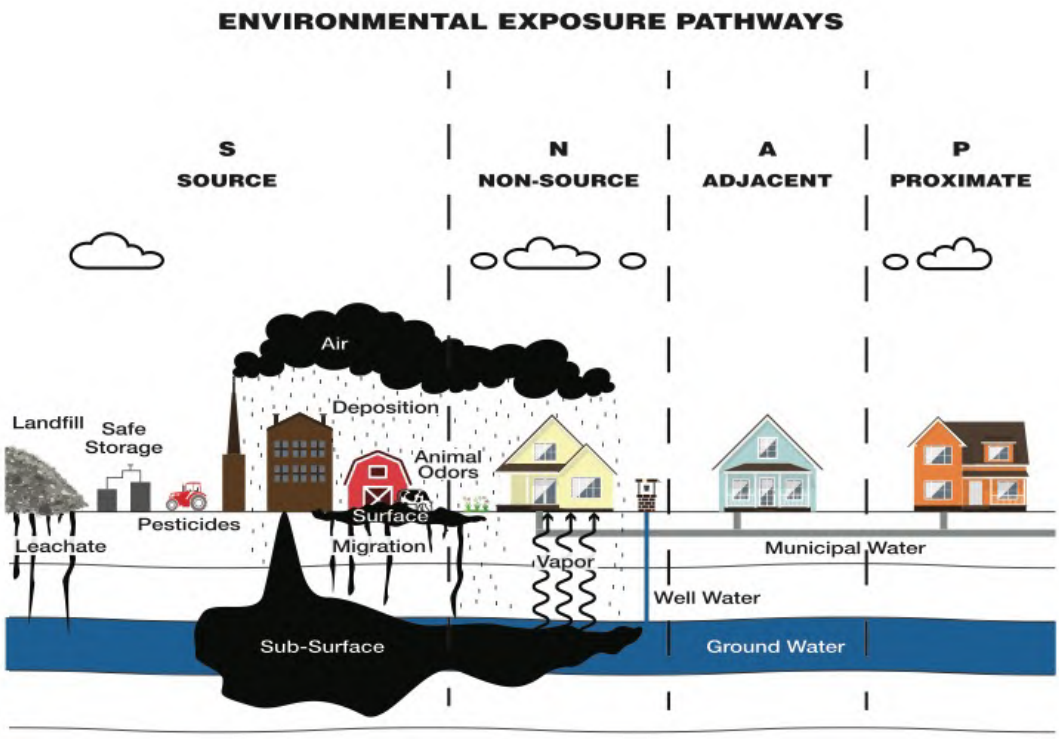


Figure 48: Environmental Exposure Pathways (SNAP)

Source

The source is understood to be Duke Energy's mosquito control program on Lake Wateree.

Non-Source

The subject properties are considered non-source and adjacent.

Adjacent

The subject properties are considered non-source and adjacent.

Proximate

There are no proximate properties; however, Landmark Research Group reserves the right to update this information.

Exposure

In this report, waterways are the pathways that are being considered.

The Environmental Protection Agency ("EPA") defines environmental contaminants as:

> Any physical, chemical, biological, or radiological substance found in air, water, soil or biological matter that has a harmful effect on plants or animals; harmful or hazardous matter introduced into the environment.[138]

Detrimental Condition Class

The subject properties are impaired by a Class VIII (Environmental and Biomedical Conditions) detrimental condition.

Remediation Lifecycle Phase

Assessment phase

Accidental or Permitted Discharge

To be determined

Regulatory Compliance

Regulatory compliance issues are not in the scope of an unimpaired analysis; other experts may be addressing such issues.

Constituents

PCBs

Conveyance

The conveyance was by water, specifically lakes and rivers.

[138] "Ecological Risk Assessment Glossary of Terms," U.S. Environmental Protection Agency, accessed March 26, 2025, https://sor.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=Eco%20Risk%20Assessment%20Glossary#:~:text=plants%20and%20animals.-,Contaminant,matter%20introduced%20into%20the%20environment.

Remediation Costs and Timing

Remediation cost and timing issues are not in the scope of an unimpaired analysis; other experts may be addressing such issues.

Liability

Liability issues are not in the scope of an unimpaired analysis; other experts may be addressing such issues.

Limitations on Use

Limitations on use include, but are not limited to, those set forth by the South Carolina Department of Health and Environmental Control. Limitations include advisories for fish consumption.

Off-site / Migration

Off-site / migration issues are not in the scope of an unimpaired analysis; other experts may be addressing such issues.

Subject Properties Highest and Best Use

Highest and best use is the reasonably probable and legal use of vacant land or an improved property that is physically possible, appropriately supported, financially feasible, and that results in the highest value.[139] The four criteria the highest and best use must meet are:

- Legally permissible;
- Physically possible;
- Financially feasible; and
- Maximally productive.

As Vacant

Legally Permissible: The legally permissible use of the subject sites are generally residential in nature. The subject property sites are consistent with others in the area, and there are no indications that a zoning change is being sought or considered. Therefore, the legal use that the site would accommodate, given the current zoning, is generally residential.

Physically Possible: The subject property sites are generally sloping and level, at street grade, and generally irregular in shape. The subject sites are served by residential feeder, secondary, and arterial streets. Utilities were reported to be sufficient to service the properties to their highest and best use. The sites allow for an array of physically possible uses.

Financially Feasible: Similarly featured sites in the surrounding competitive market area are generally developed as residential single-family properties, indicating that development as such is financially feasible.

Maximally Productive: In consideration of the physical, legal, and financial factors discussed, the maximally productive use of the sites is for general residential development.

The highest and best use of the subject properties, as vacant, would be to develop the sites with general residential use that conforms to the individual site's zoning standards and would precipitate the highest return to the individual site. Market conditions noted as of the effective date suggest that immediate development would be warranted, and the most probable buyer would be a developer.

As Improved

The subject properties are currently improved as single-family and manufactured residences, which are uses that are physically possible, legally permissible, financially feasible, and maximally productive. The highest and best use of the subject properties, as improved, is for continued use as single-family residences. The timing of the uses would be current, and the most likely buyer would be owner-user or investor.

[139] Appraisal Institute, *The Appraisal of Real Estate*, 15th ed. (Chicago, IL: Appraisal Institute, 2020), 306.

Sample Class Area Photographs



Figure 49: Sample Class Area Photograph



Figure 50: Sample Class Area Photograph



Figure 51: Sample Class Area Photograph



Figure 52: Sample Class Area Photograph



Figure 53: Sample Class Area Photograph



Figure 54: Sample Class Area Photograph



Figure 55: Sample Class Area Photograph



Figure 56: Sample Class Area Photograph



Figure 57: Sample Class Area Photograph

Literature Review – Water Features

LAKE WATEREE PCB Water Feature Literature Review (Landmark File: 235-2-26)					
No.	**Source Article Author (Year Published)**	**Property Type**	**Water Body**	**Overview**	**Findings**
1	The Coastal Business Journal The Value Of A Water View: Variability Over 25 Years In A Costal Housing Market Hansen and Benson (2013)	Single-Family Residential	Ocean	The article reviews 20,000 transactional sales in Bellingham, Washington over 25 years with different quality of views of Bellingham Bay or Lake Whatcom to determine the value of a water view amenity. Determines that water view premiums rise and fall with housing cycles.	Ocean View 0.5% to 31.6% Lake View 3.8% to 28.3%
2	Auckland Council Impact of Hauraki Gulf Amenity on the Land Price of Neighborhood Properties Rohani (2012)	Single-Family Residential	Ocean	Analyzes 8,500 properties in 12 census areas located at Haurakai Gulf, New Zealand to determine water view premiums on land values. Also finds that greater distance from the beach and variances in view quality show a decrease in premiums.	Wide View - 50% / Moderate View - 30% Slight View - 15% Coastline Properties 43%
3	Computers, Environment and Urban Systems Integrating lidar, GIS and hedonic price modeling to measure amenity values in urban beach residential property markets Hamilton and Morgan (2010)	Single-Family Residential	Ocean	Studies 101 houses in Pensacola Beach, Florida to estimate the premium of a water view. Results show that households are willing to pay a premium for living close to the water.	Every 1 Meter Closer To Shoreline $1119 Every 1 Degree Increase In View $1627
4	The Appraisal Journal The Influence of Artificial Water Canals on Residential Sale Prices Nelson, Hansz, and Cypher (2005)	Single-Family Residential	Man-made Canal	The article looks at 793 sales in Arlington, Texas from 1998 to 2003 in order to see if canal-front properties receive a premium. Concludes that canal frontages does result in a positive price increase.	11%
5	Journal of Real Estate Research Residential Real Estate Prices: A Room with a View Bond, Seiler, and Seiler (2002)	Single-Family Residential	Lake	The study uses transactional data over a 30 month period of homes with a view or without a view of Lake Erie in order to examine the impact of a lake view on property values. Controlling for a view resulted in a premium for homes with a view over non-view properties.	89.9%
6	The Appraisal Journal The Impact of World Class Great Lakes Water Views On Residential Property Values Seiler, Bond, and Seiler (2001)	Single-Family Residential	Lake	Uses tax assessment values from 1998 to study the impact of properties with a view of Lake Erie to adjacent properties without a view of the lake. While the study would prefer transactional data it concludes that properties with a view receive a premium.	56%

Figure 58: Water Feature Literature Summary, Articles 1-6

LAKE WATEREE PCB Water Feature Literature Review (Landmark File: 235-2-26)					
No.	**Source Article Author (Year Published)**	**Property Type**	**Water Body**	**Overview**	**Findings**
7	The Appraisal Journal Water Views and Residential Property Values Benson, Hansen, and Schwartz, Jr. (2000)	Single-Family Residential	Ocean and Lake	Looks at 4,931 sales in Bellingham, Washington during 1993 with a view of Bellingham Bay to research the significance of a water views and location on residential property values. In addition, the study also looks at distance as a variable of view quality. An increase in distance from the water led to a decrease in premium regardless of the view quality.	Ocean View 8% to 59% Lake Frontage 127% Lake View 18%
8	The Appraisal Journal The Value of Ocean Proximity on Barrier Island Houses Rush and Bruggink (2000)	Single-Family Residential	Ocean and Bay	Develops an empirical model with 100 sale transactions from 21 towns of Long Beach, New Jersey in 1997. Starts with using a regression model to conclude an overall value for a non-waterfront property. Once a baseline value is developed the non-waterfront property is used to estimate the values of properties with different proximity to the ocean.	Standard House Away From Ocean $174,335 First House With 50 Feet Ocean Frontage $350,114 Second House With No Ocean Frontage $274,986 Third House With No Ocean Frontage $266,179
9	Journal of Real Estate Finance and Economics Pricing Residential Amenities: The Value of a View Benson, Hansen, Schwartz, Jr., and Smersh (1998)	Single-Family Residential	Ocean and Lake	The article looks at 5,095 residential sales from 1984 to 1994 and develops seven categories for each property depending on the view. Using the sales data a regression is applied to conclude water premiums for properties in 1993. Results indicate a range that is conditional to the quality of a view. In addition, greater distance from the water resulted in a decrease in all view premiums.	Ocean View 8.2% to 58.9% Lake Frontage 126.7% 0.1 Miles To 2 Miles 4.3% to 68.31%
10	Journal of Real Estate Research The Influence of Canadian Investment on U.S. Residential Property Values Benson, Hansen, Schwartz, Jr., and Smersh (1997)	Single-Family Residential	Ocean	Analyzes 397 sale transactions in Point Roberts, Washington in order to find the impact of a water views and proximity on property values. Results reveal that the greatest premium is attributed to ocean front properties followed by properties with an ocean view and then partial ocean view properties.	Oceanfront 147.2% Ocean View 32% Partial Ocean View 10.3%
11	The Appraisal Journal Oceanfront Appraisals Yorshis (1968)	Residential Lots	Ocean	The article discusses applying a subdivision study of beach frontage by categorizing beachfront lots as 100% value and subsequent categories with lesser views and proximity decrease in value.	Inland Lot With Ocean View 65% to 70% Inland Lots With Beach Rights But No View 40% to 50% Single-Family Residential Lots With No View or Proximity 25%
12	The Appraisal Journal Beach Proximity and the Distribution of Property Values in Shore Communities Major and Lusht (2004)	Single-Family Residential	Ocean and Bay	The study looks at 249 residential sales from 2002 through 2003 in Stone Harbor and Avalon, New Jersey in order to analyze the impact of water proximity on property values. Finds that proximity is greatest for waterfront properties, and as the distance from waterfront increases, premiums decrease.	Beachfront - 206.8% / Bayfront - 73.2% Beach Block 73.1% Second Beach Block 29.9%

Figure 59: Water Feature Literature Summary, Articles 7-12

LAKE WATEREE PCB Water Feature Literature Review (Landmark File: 235-2-26)					
No.	**Source Article Author (Year Published)**	**Property Type**	**Water Body**	**Overview**	**Findings**
13	The Appraisal Journal Adjusting the Market Value of Coastal Property for Beach Quality Rinehart and Pompe (1994)	Single-Family Residential	Ocean	Preforms a study to isolate the value of beachfront width on property values. 385 single-family homes sold between 1983 and 1991 in Garden City and Surfside Beach, South Carolina are used. Finds that an increase in beach width does increase property values.	10% Increase In Beach Width = 2.6%
14	The Real Estate Appraiser Characteristics that Affect the Market Value of Beach Lot Property Wertheim, Jividen, Chatterjee, and Capen (1992)	Residential Lots	Ocean	Preforms a regression using 115 residential beach front lots in Emerald Isle, North Carolina to analyze different property characteristics that could potentially influence property values. View of a ocean, distance to the beach, and the amount of beach frontage were considered significant in creating property value premiums.	A greater increase in distance from the beach results in a decrease in property value.
15	The Appraisal Journal The Study of the Effect of Water View on Site Value Plattner and Campbell (1978)	Condominiums	Lake	Analyzes sales located in Knollsbrook Village, and Farrar Pond, Massachusetts from 1973 to 1976. Based on the results, the data showed a premium for condominiums with a view verses condominiums without a view.	Knollsbrook Village Study 5.4% to 11.7% Farrar Pond Study 4.1% to 11.1%
16	Land Economics Measuring Benefits Generated by Urban Water Parks Darling (1973)	Single Family Residential, Multi-Family Residential, and Vacant Lots	Lake	Looks at three lakes, Lake Merritt, Lake Murray, and Santee Lakes in California to assess the value of a water amenity on real estate values. Suggests that while the calculations should be questioned, a water amenity adds value.	Water amenities add value
17	The Appraisal Journal Appraisal of Residential Water View Properties Mothorpe and Wyman (2017)	Single-Family Residential	Lake	The article uses 7,501 transactional sales in neighborhoods around Lake Lanier, Georgia to measure the impact of a water amenity on property values. Finds that a water amenity increases values for both properties with views and properties with access. The greater the proximity and view the greater the increase in value.	Lakefront Properties 67% Waterfront Properties With a 1% Increase In View Quality 3.85%
18	International Right of Way Journal Waterfront Land and the Development Process A Case Study of Beachfront Residential Lots Tachovsky and Williams (2025)	Residential Land	Ocean	The article analyzed the effects of beachfrontage and proximity on residential lot sales. A case study was developed using multiple regression, finding that beachfrontage and proximity are beneficial conditions that enhance property values.	Beachfront Lots 137% Proximity to Beachfront, but Not Beachfront 49%

Figure 60: Water Feature Literature Summary, Articles 13-18

Literature Review – Water Quality

LAKE WATEREE PCB Water Quality Literature Review (Landmark File: 235-2-26)				
No.	**Source Article Title Author (Year Published)**	**Property Type Methodology**	**Citations**	**Findings**
1	Journal of Environmental Economics and Management Measuring Hazardous Waste Damages with Panel Models Mendelsohn, Hellerstein, Huguenin, Unsworth, Brazee (1991)	Single-Family Residential Panel Regression Model	"In this paper, we briefly review the theory underlying the repeat sales model. We then discuss a data set and analysis designed to measure the effect of PCB pollution in the New Bedford, Massachusetts, harbor on residential property values. Various methods to analyze panel data including the first differencing model and the fixed effect model are compared." "The data used in this study come from an analysis of single family home sales in the harbor area surrounding New Bedford, Massachusetts. The sediments of New Bedford harbor are alleged to contain significant quantities of PCBs from pollution which has occurred for many decades." "The pollution appears to be most strongly concentrated in the inner harbor (PCBZone I), where regulations prohibit swimming, fishing, and lobstering. The next most polluted zone is the proximate outer harbor (PCBZone 2), where there are restrictions on bottom fishing and lobstering. The remaining PCBZones (3 and 4) are relatively remote from the harbor, and only trace amounts of PCBs have been found in these waters." Assuming that the pollution event is 1982, all panel data approaches find negative pollution effects for properties near both the inner (EVPCBZONEl) and outer harbor (EVPCBZONE2). As seen in Table II, the pollution effect in PCBZONEl is around 8% or $9000, and the pollution effect in PCBZONE2 is around 3 to 7% or almost $7000."	-3% to -8%
2	U.S. Department of Agriculture The Influence of Water Quality on the Value of Recreational Properties Adjacent to St. Albans Bay, Vermont Young, Teti (1984)	Residential Hedonic Model	"This study estimates the economic damage due to water pollution on shoreline residential properties located adjacent to St. Albans Bay, Vermont ." "The bay, until recent years, has been a major recreational resource to the area, providing swimming, boating, and fishing opportunities. The decline in annual day use of St. Albans Bay State Park from 1960 to 1978 is depicted in figure 1. The apparent decline in park use (and also bay use) is due to water pollution." "Data on all sales of residential shoreline property along Lake Champlain within St. Albans and Georgia were collected in cooperation with the Franklin County Natural Resource Conservation District." "A shoreline characteristics evaluation was conducted in the St. Albans Bay area. The objective of the evaluation was to subjectively evaluate the desirability (that is, scenic beauty, water quality) of various locations along the shoreline of Lake Champlain." "Degraded water quality of the bay had depressed adjacent property values by $4,500 on the average, or about 20 percent, compared with similar nearby properties on the larger but cleaner lake."	-20%

Figure 61: Water Quality Literature Summary, Articles 1-2

LAKE WATEREE PCB Water Quality Literature Review (Landmark File: 235-2-26)				
No.	**Source Article Title Author (Year Published)**	**Property Type Methodology**	**Citations**	**Findings**
3	Department of Agricultural and Resource Economics Evidence of the Effects of Water Quality on Residential Land Prices Leggett and Bockstael (1998)	Residential Land Hedonic Model	"In this paper we attempt to provide evidence of a phenomenon that has been rarely supported in the literature - that water quality has an effect on residential property values." "In addition, to the extent possible, we account for the possibility that the emitters of pollution may themselves be disamenities." "Using the results from the OLS or spatial autocorrelation-corrected model, a change of one fecal coliform count per mL produced approximately 1.4% change in property prices or a change of about $5000 for the mean priced property."	"a change of one fecal coliform count per mL produced approximately 1.4% change in property prices"
4	American Journal of Agricultural Economics The Effect of Water Quality on Rural Nonfarm Residential Property Values Epp and Al-Ani (1979)	Single-Family Residential Hedonic Model	"The study reported here used real estate prices to determine value of improvements in water quality in small rivers and streams in Pennsylvania." "For some purposes, pH was transformed into a dummy variable equal to zero if pH was 5.5 or lower, otherwise equal to one. The pH of 5.5 was chosen for this purpose because water with a pH of less than 5.5 has severe limitations for recreational use." "A one point increase in pH represents a 17.5% increase from the mean value of pH. Using the regression coefficient for pH from table 1, one would expect a 5.95% increase in the mean sales value of residential properties." "On the other hand, variation in pH in polluted streams has no significant effect on property value." "One explanation of this finding is that increases in pH within the normal range (6.5-8.5) has increased value to property owners because it permits additional recreational activities, such as trout fishing. Increases in pH below the normal range (i.e., 3.7-5.5 in this study), however, permit no additional recreational activities and therefore, have no value."	1 point increase in pH (within normal range): +5.95%
5	The University of Maine MR398: Water Quality Affects Property Prices: A Case Study of Selected Maine Lakes Michael, Boyle, Bouchard (1996)	Single-Family Residential & Unimproved Land Hedonic Model	"The objective of this study is to estimate the effect of water clarity on lakefront property prices for selected Maine lakes using a hedonic property-price model." "Lake-front property owners are potentially the recipients of the greatest economic gains from improved lake-water quality because the benefits of water quality can be capitalized in the price of lake-front properties. These same lake-front owners may also directly affect lake-water quality through the actions they take on their properties." "The results of this study show that water clarity significantly affects property prices around Maine lakes." "Controlling for both the current and historical water clarity of the lake in the implicit price equations, a 1 m improvement in lake water clarity results in changes in average property prices ranging from $11 per foot frontage for Echo Lake in the Augusta area (Group 2) to $200 per foot frontage for Sabbattus Lake in the Auburn area (Group 1)."	1m improvement in lake water clarity: +$11 to +$200 (per foot frontage)

Figure 62: Water Quality Literature Summary, Articles 3-5

LAKE WATEREE PCB Water Quality Literature Review (Landmark File: 235-2-26)				
No.	**Source Article Title Author (Year Published)**	**Property Type Methodology**	**Citations**	**Findings**
6	American Journal of Agricultural Economics Impact of Water Recreational Development on Rural Property Values Schutjer and Hallberg (1968)	Does not specify Multiple Regression	"This article presents the results of research designed to evaluate the impact of a specific recreational park development on property assets in the nearby rural area." "The findings of this study support the hypothesis that public investment in water-based recreational areas can significantly influence the value of rural property." "Moreover, an analysis of the location of properties with respect to the park and of subdivision activity on surrounding properties suggests that (1) the nature of the impact of the park varies among different properties, and (2) the park has a significant impact on the structure of the land market surrounding the park."	"The findings of this study support the hypothesis that public investment in water-based recreational areas can significantly influence the value of rural property."
7	Journal of Agriculture and Applied Economics Marginal Price of Lake Recreation and Aesthetics: An Hedonic Approach Lansford, Jr. and Jones (July-1995)	Single-Family Residence Hedonic Model (Box-Cox Transformation)	"This study employs a hedonic price approach to examine components of the recreational and aesthetic (RA) value of a lake in the central Texas chain called the 'Highland Lakes.'" "The presence of relatively clean, freshwater lakes and their associated amenities are considered important to RA value." "Those marginal prices related to recreational value of the lakes are shown to be significant components of total property market price." "On average, RA price is estimated to be 22 percent of the current location price. Although these prices and the RA component of the price may appear to be relatively high, they are not believed to be unreasonable considering the setting."	"The presence of relatively clean, freshwater lakes and their associated amenities are considered important to RA value."
8	Lakes & Reservoirs: Science, Policy and Management for Sustainable Use The contribution of scenic views of, and proximity to, lakes and reservoirs to property values Nicholls and Crompton (2018)	Multiple Literature Review	"This study reviews the evidence to date regarding the value of areal bodies of water as aesthetic and recreational resources to nearby residents." "Much nature-based tourism is also based on, in or near water resources such as lakes and reservoirs, and in the United States, paddle sports, including stand-up paddle boarding and kayaking, are some of the fastest growing outdoor recreation activities (Outdoor Foundation, 2016)." "Factors influencing the magnitude of the premium include lake size, depth and access (i.e., whether or not the frontage allows the owner to install a dock or otherwise access the lake for recreational purposes)." "The studies reviewed here, therefore, demonstrated that recreational and aesthetic factors—and the associated cultural, spiritual and emotional benefits that water access and view can also provide—can be a major source of land value increases around water-based features."	"recreational and aesthetic factors—and the associated cultural, spiritual and emotional benefits that water access and view can also provide—can be a major source of land value increases around water-based features":

Figure 63: Water Quality Literature Summary, Articles 6-8

LAKE WATEREE PCB Water Quality Literature Review (Landmark File: 235-2-26)				
No.	**Source Article Title Author (Year Published)**	**Property Type Methodology**	**Citations**	**Findings**
9	Journal of Agricultural and Resource Economics Recreational and Aesthetic Value of Water Using Hedonic Price Analysis Lansford, Jr. and Jones (Dec-1995)	Single-Family Residence Hedonic Model (Box-Cox Transformation)	"The hedonic price approach is used to determine components of the recreational and aesthetic (RA) value of a lake in the central Texas chain called the 'Highland Lakes.'" "The estimated residential price equation indicates several statistically significant characteristics of housing, among which are distance to the lake, scenic view, waterfront location, and water level. Analysis of marginal values indicates that proximity to the lake is the most important component of recreational and aesthetic value." "An aggregation of RA prices for all homes within 2,000 feet of the lake indicates 75% of total RA price resides in lakefront property and composes 15% of the total market price of housing."	"Consumer preference for higher water levels is indicated by the significant, positive relationship with sale prices. This finding allows estimation of homeowners' marginal RA value of lake water. The marginal RA value estimates ranged from $110 to $136 per acre-foot, depending on lake level."
10	Journal of Agricultural and Resource Economics Modeling the Property Price Impact of Water Quality in 14 Chesapeake Bay Counties Walsh, Griffiths, Guignet, Klemick (2015)	Single-Family Residence, Townhouse Hedonic Analysis	"This paper explores the value of water quality on homes near the waterfront, which should reflect several categories of recreational and aesthetic amenities." "Data on all residential transactions in Maryland from 1996 to 2008 were obtained from Maryland Property View (MDPV), which is a compilation of the tax assessment and sales databases from the tax assessor's office in each county." "Utilizing our sizable dataset, we find significant price impacts for water quality across multiple property markets in Maryland."	"Overall, results indicate that water quality improvements in the Bay, such as those required by EPA's Total Maximum Daily Load, could yield significant benefits to waterfront and near-waterfront homeowners."
11	Google Scholar Estimating the Real Estate Price Premium of Two Northwest Montana Lakes – Flathead Lake and Whitefish Lake Nelson, Curtis, Whited, Meirer (None Noted)	Residential Hedonic Analysis	"Here, we present the benefits that two northwest Montana lakes – Whitefish and Flathead – impart to home values in the form of price premiums for lakefront and nearby real estate located within Flathead County and Lake County." "In these two lakes where water quality has been essentially stable over the period of real estate transactions used in the study, our analysis relies on the variation in distance to the lake to estimate the premium property owners are willing to pay for proximity to the lake." "This premium can be roughly interpreted as the aesthetic benefit landowners derive from living on or near lakes with exceptional water quality. Lakes can also supply landowners with other benefits such as opportunities for boating, swimming, and fishing or from supplying water for household use." "Our study used data on 7,029 residential home sales that transpired between January 2004 to June 2018 in Flathead and Lake Counties in northwest Montana." "Property values were also influenced by access to the water. For homes not on the lake, we estimated a price premium of 30% and 33% for homes that have deeded access to Flathead or Whitefish, respectively, compared to homes without access to the water."	"In this study we provided estimates of aesthetic benefit residential land owners derived from living on or nearby two northwest Montana lakes – Flathead and Whitefish – that exhibit exceptional water quality as evidenced by water clarity measures of 9 m deep, on average. We have shown that Flathead and Whitefish contributed a significant price premium for homes on the lake."

Figure 64: Water Quality Literature Summary, Articles 9-11

LAKE WATEREE PCB Water Quality Literature Review (Landmark File: 235-2-26)				
No.	**Source Article Title Author (Year Published)**	**Property Type Methodology**	**Citations**	**Findings**
12	The 10th European real Estate Society (ERES) Conference Presence of water in residential environments – value for money? Kauko, Goetgeluk, Straub, Priemus (2003)	Does not specify Literature Review	"In this contribution, we focus mainly on the recreational-functional and aesthetic attributes of having access to water in ones vicinity, with the cost aspect (related to development, flooding or external impacts) incorporated as a balancing factor." "Poor et al. (2001) compared objective, scientific measures of water quality with subjective measures of individuals' perceptions, when used as independent variables in hedonic models and concluded that the former type provide at least as valid explanation of the variation in sales prices as the latter." "Melissa Boyle and Kiel (2001) cited seven US-based hedonic studies on water quality (1968-2000)"... "-rural, non-farm communities perceive water quality (and flood hazard) to have a significant effect on value: one point increase in pH brings a 5.9% increase in mean price; - water quality has an interaction effect with population growth; - location within the [polluted] bay reduced the value by an average of 20%; - improvement in clarity increases sales price significantly, when measured with Secchidisk readings (number of feet below the surface that a device which is 8 inches in diameter can be observed) - homes whose nearest waters were affected by PCB were substantially lower in value [-20% to -30%]; - increase of fecal coliform (100 count/100mL) caused a 1.5% reduction in property value." "Kevin Boyle and Taylor (2001) conducted a comparison between recorded tax-assessor data and perceived/survey data from purchasers of properties with frontage on 34 freshwater lakes and ponds in Maine (threatened by organic enrichment)." "the impact varied $ 2,000-8,000 per meter of clarity depending on the segment." "Peltola's (1998) study concerned the price factors of large shore-parcels (unbuilt, no town plan, use as holiday site). The results showed that not only the quality of the water, but also the quality of the shoreline/beach (i.e. suitability for building, shape and length) matters for the price formation of nearby properties."	"Based on the literature, we report the composite effect for water quality, proximity and view as follows: the range for price premium is up to ca 60% for seaside property, 25% for lakeside property, and up to 40% for a variety of other inland water bodies."

Figure 65: Water Quality Literature Summary, Article 12

LAKE WATEREE PCB Water Quality Literature Review (Landmark File: 235-2-26)				
No.	**Source Article Title Author (Year Published)**	**Property Type Methodology**	**Citations**	**Findings**
13	River Research and Applications The Effects of Rivers, Streams, and Canals on Property Values Nicholls, Compton (2017)	Residential Literature Review	"The purpose of this paper is to provide the first known synthesis of the evidence to date regarding the value of linear water features as aesthetic and recreational resources to adjacent and nearby residents as measured using the hedonic pricing method (HPM)." "More specifically, empirical findings relating to the effects of views of, and access to, rivers, streams, and canals on surrounding residential property values are discussed." "Tapsuwan, MacDonald, King, and Poudyal (2012) showed" ... "A river recreation index was also incorporated, to account for the variety of activities available. The average house enjoyed an additional increase in value of $27,000 if in an area of high river recreation attractiveness, but a decrease of $14,000 if attractiveness was deemed to be low." "Several studies have demonstrated the positive relationship between improvements in river quality and hedonic proximity effects (Epp & Al Ani, 1979 for houses near rivers and streams in rural Pennsylvania; Bin & Czajkowski, 2013 for waterfront properties in Martin County, Florida; Chen, 2017 for apartments with Pearl River view in Guangzhou, southern China), though another resulted in more mixed and inconclusive results for rivers and streams in North Carolina and Tennessee (Cho, Roberts, & Kim, 2011)."	"Overall, the studies reviewed demonstrate that recreational and aesthetic amenity can be a major source of land value increase along linear water features."
14	The Annals of Regional Science The Case of Lakeshore Land Steinnes (1992)	Land Hedonic Model	"This paper will attempt to measure the effect of water quality on lakeshore land values using a hedonic approach." "The basis of the data used was an appraisal done by the Minnesota Department of Natural Resources of lots on 53 lakes in the state." "The objective measures of water quality considered were: LITT, the percentage littoral (shallow water); CLARITY, measure based on suspended material in water, higher value indicates more clarity; and WSCD, number of feet below surface disc reading can be observed." "WSCD was the only water quality variable to be consistently significant. Consequently, the regression equation results in Table 2-4 only use this measure of water quality." "For example, Run 1 indicates each additional foot of WSCD will raise the value of a lot $206 or the value of a front foot $1.99. If the $1.99 in Run 3 is multiplied by the average front feet per lot (121), the result ($240 per lot) is comparable to the result in Run 1."	"Viewed together, the results in Tables 2-4 provide evidence that the measure of water quality tested, WSCD, has a definite effect on land values regardless of how these values are measured."

Figure 66: Water Quality Literature Summary, Articles 13-14

LAKE WATEREE PCB Water Quality Literature Review (Landmark File: 235-2-26)				
No.	**Source Article Title Author (Year Published)**	**Property Type Methodology**	**Citations**	**Findings**
15	Land Economics The Spatial Extent of Water Quality Benefits in Urban Housing Markets Walsh, Milon, Scrogin (2010)	Single-Family Residential Hedonic Model	"This study focuses on the relationship between water quality in lakes and the related property price effects in the metropolitan Orange County, FL housing market." "Hybrid specifications of hedonic price models employed in water quality and proximity valuation studies are estimated, and several hypotheses about the implicit value of water quality are tested." "The sales data were obtained from the Orange County Property Appraiser (OCPA) and were restricted to single-family residences." "The water quality data were obtained from the OCEDP and three municipalities. The data contain annual average concentrations of nitrogen, phosphorous, and dissolved oxygen and the Secchi depth of the lakes." "First, a waterfront edge effect supported previous studies that identified an increasing price premium for residing next to a water body with cleaner water." "Second, the proximity effect established that property prices around a water body reflect both the value of residing closer to the water body and to water with a higher quality." "Third, the area of a lake also affects the implicit price, with water quality in larger lakes valued more than water quality in smaller lakes."	"Beginning with the edge effect in Table 4 [Estimated Mean Marginal Implicit Prices of Increased Water Clarity (2000 Dollars)], the results indicate that a unit increase in Secchi depth is associated with about a $5,500 (or 1.2%) increase in the price of the mean lakefront property versus about a $700 (or 0.3%) increase in the price of the mean non-lakefront 16 sale."

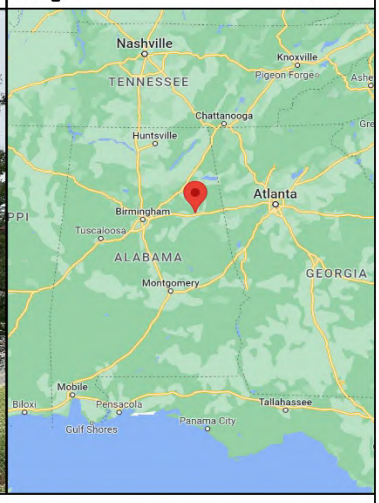
Figure 67: Water Quality Literature Summary, Article 15

PCB Case Study RED Reports

REDReport Anniston **No: 1**

Use:	Residential	**Date of Incident:**	1999-2000
Address:	Multiple	**Class:**	VIII
City:	Anniston	**Type:**	Environmental
State:	Alabama	**Issue:**	Contamination
APN:	Multiple	**Stage:**	Ongoing





Case Overview:
From 1929 to 1971, Monsanto produced Polychlorinated biphenyls (PCB's) at its Anniston facility. Between 1999 and 2000, the EPA discovered PCBs in residential soil around the Monsanto Facility.

Case Research:
In 2003, the EPA negotiated a Partial Consent Decree (PCD) with Pharmacia Corporation and Solutia Inc. to perform a Non-Time Critical (NTC) removal action on contaminated residential properties.

By 2014, a Remedial Investigation (RI) identified that approximately 7,600 properties had been sampled for contamination. Of the 7,600 sampled properties, PCBs were detected in 4,322 properties.

The EPA announced a Record of Decision (ROD) in 2017. The ROD identified remedial plans for Operable Unit 1 (residential areas) and Operable Unit 2 (nonresidential areas). Cleanup included the complete removal of contaminated soil from residential properties, removing dredge spoil piles, capping unapproved waste disposal areas, removing contaminated soil in nonresidential areas, and more.

Many properties were abandoned. Market resistance showed a discount of 15% for surrounding homes compared to areas with less environmental concern. Market resistance ranged from -15% to -60%, typically -55%. Total settlements were $700 million. Additionally, Richard Maloy a real estate expert testified that by "the most conservative estimates" "homes and land in West Anniston were valued at 50 percent below the appropriate figure." (Baptized in PCBs, 2014, pg. 254)

"In recent years, Monsanto has bought and demolished around 100 PCB-contaminated houses and businesses in the area, turning the neighborhood into a virtual ghost town." (Feature Shoot, 2014)

Site Overview:
The sites were residential properties that were abandoned and/or demolished.

Building Overview:
Improvements consisted of residential properties before they were demolished.

Environmental:

Agency:	EPA
SNAP:	Non-Source
PRP:	Pharmacia and Solutia
Constituents:	PCBs
Media:	Soil

Case Findings:
Cost: Not determined
Use: Not determined
Risk: -15% to -60% (typically -55%)

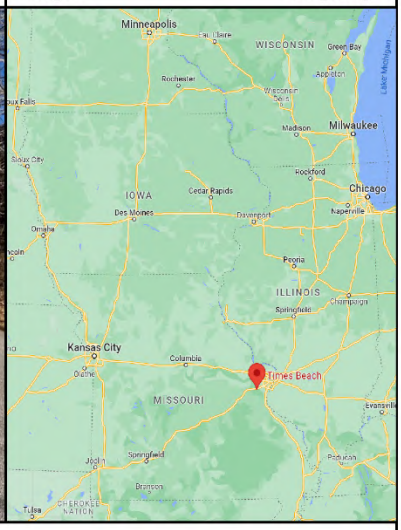
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Figure 68: RED Report - Anniston, Alabama

REDReport **Times Beach** **No:** 2

Use:	Residential, Commercial	**Date of Incident:**	1982
Address:	Mulitple	**Class:**	VIII
City:	Times Beach	**Type:**	Environmental
State:	Missouri	**Issue:**	Contamination
APN:	Multiple	**Stage:**	Ongoing





Case Overview:
In 1982, the Center for Disease Control recommended permanently relocating residents in Times Beach after dioxin contamination was discovered to have spread across the town in a flood. Times Beach was placed on the National Priorities List in 1983 and removed in 2001.

Case Research:
Starting in the early 1970s, Times Beach used waste oil as a dust control measure for unpaved roads in the town. An investigation by the EPA in 1982 discovered that the town used dioxin-contaminated oil. Shortly after, the Meramec River flooded the town and residents evacuated.

In response to a health advisory issued by the Center for Disease Control, the EPA announced in February 1983 the permanent relocation of 800 residential properties and 30 businesses in Times Beach due to contamination.

The EPA funded the remediation of the town. The remediation involved demolishing and incinerating hazardous materials and constructing a ring levee to protect against future floods. The cleanup was completed in 1997.

As of 1999, the area is now Route 66 State Park.

Site Overview:
The sites were residential and commercial properties that were demolished.

Building Overview:
Improvements consisted of residential and commercial properties before they were demolished.

Environmental:

Agency:	EPA
SNAP:	Non-Source
PRP:	City of Times Beach
Constituents:	Dioxins
Media:	Soil

Case Findings:
Cost: Not determined
Use: Not determined
Risk: -100% (Demolished)

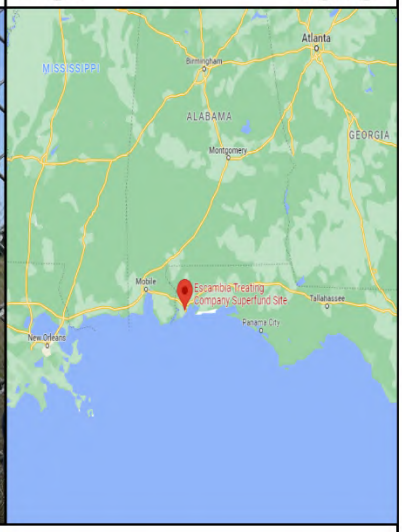
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Figure 69: RED Report – Times Beach, Missouri

REDReport **Mount Dioxin** **No:** 3

Use:	Residential	**Date of Incident:**	1995
Address:	Multiple	**Class:**	VIII
City:	Pensacola	**Type:**	Environmental
State:	Florida	**Issue:**	Contamination
APN:	Multiple	**Stage:**	Ongoing





Case Overview:
In 1995, soil samples from neighboring properties to the Escambia Wood Treating Facility revealed dioxin, arsenic, and lead contamination. The Escambia Wood Treating Facility was placed on the National Priorities List in 1994.

Case Research:
From 1942 to 1982, the Escambia Wood Treating Company (ETC) created pressure-treated wood products. In 1991, the Escambia Wood Treating Company abandoned the facility leaving approximately 120 acres of soil contamination and a 1.5 mile long plume of groundwater contamination.

By 1992, the EPA evacuated and stockpiled approximately 225,000 cubic yards of contaminated materials with a liner cap. The mound of contaminated material became known as "Mt. Dioxin."

In 1997 the EPA released a Record of Decision (ROD) to permanently relocate 358 residents from the Rosewood Terrace, Oak Park, Herman & Pearl/Goulding subdivision, and Escambia Arms Apartments. In 2006, the EPA included the permanent relocation of the Clarinda Triangle Neighborhood.

Relocation and demolition of the former residential neighborhoods ended in 2008 and included more than 400 households. Land use of the former residential homes was restricted to commercial and industrial uses.

As of 2018, "the EPA transferred the 70-acre parcel of land and placed it under the control of Escambia County for the development of a new commercial, and potentially industrial, facility intended to bring new life to the previously-abandoned residential neighborhoods on North Palafox." (PNJ, 2021)

Site Overview:
The sites were residential properties that were demolished.

Building Overview:
Improvements consisted of residential properties before they were demolished.

Environmental:

Agency:	EPA
SNAP:	Non-Source
PRP:	ETC
Constituents:	See Case Research
Media:	Soil, Groundwater

Case Findings:
Cost & Use: Not determined
Risk: -100% (Demolished)

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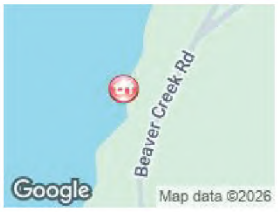
Figure 70: RED Report – Mount Dioxin, Florida

Type 3 Disclosure Documents – 2284 Beaver Creek Road, Camden, SC

LISTING INFORMATION



Class	RESIDENTIAL
MLS #	598025
Area	Kershaw County East - Camden, Bethune
List Price	$650,000
Original Price	$675,000
Type	Single Family
TMS	111-04-00-027
County	Kershaw
Address	2284 Beaver Creek Road
Subdivision	LAKE WATEREE
City	Camden
State	SC
Zip	29020
Status	CLOSED
Lot Size	.4
Acreage	0.400
Picture Count	64



AGENT / OFFICE INFORMATION

List Agent	Mindy M Player - Ofc: 803-600-6652	**Listing Office**	Home & Land Pros LLC - Ofc: 803-600-6652
Transaction Broker Accepted	Yes	**Listing Type Agreement**	Exclusive Right to Sell
Owner Name	Dennis Lane Phillips Jr.	**Listing Date**	12/4/2024
Power On	Yes	**Property Disclosure?**	Yes
Rollback Tax (Y/N)	No	**Publish to Internet Y/N**	Yes
VOW Address	Yes	**VOW AVM**	Yes
VOW Comment	Yes	**VOW Include**	Yes
IDX Include	Y	**HOA Y/N**	N
Cumulative DOM	160	**Price Per SQFT**	$255.84
Sold Price Per SQFT	$255.84	**Input Date**	12/4/2024 8:37 PM
Video Count	0	**Floor Plans Count**	0

PROPERTY INFORMATION

Main Structure Heated SqFt	2482	**Other Heated SqFt**	0
Total Heated SqFt	2,482	**List Price Tot SqFt**	$261.89
# of Bedrooms	4	**# of Stories**	1.5
Baths Full	3	**Baths Part**	1
Baths	4	**Baths Combo**	3 / 1
Year Built	1981	**New/Resale**	Resale
Interior # of Fireplaces	1	**Garage Spaces**	2
Garage	Garage Attached, Rear Entry	**Parking Spaces**	6
Garage Level	Main	**Full Baths: Main**	2
Full Baths: 2nd	1	**Half Baths: Main**	1
Level: Formal Dining Room	Main	**Level: Great Room**	Main
Level: Kitchen	Main	**Level: Washer Dryer**	Main
Level: Other Room	Main	**Level: Master Bedroom**	Second
Level: Bedroom 2	Main	**Level: Bedroom 3**	Main
Level: Bedroom 4	Main		

SCHOOL INFORMATION

School District	Kershaw County	**Elementary School**	Midway(Kershaw)
Middle School	North Central	**High School**	North Central

GENERAL INFORMATION

Water Frontage	128	**Days On Market**	160
HotSheet Date	5/22/2025	**Input Date**	12/4/2024 8:37 PM
Off Market Date	5/13/2025	**Price Date**	5/22/2025
Status Date	5/22/2025	**Update Date**	5/22/2025
Associated Document Count	3		

Figure 71: 2284 Beaver Creek Road, Camden, SC – MLS 598025: Page 1 of 5

REMARKS

Public Remarks Beautiful home located in popular Beaver Creek at Lake Wateree. Home features a spacious great room with wood burning fireplace and hardwood floors. Upper owners suite highlights tree house views, bay window, private bath with separate shower, garden tub, huge walk in closet and double vanity. Main level entertains 3 bedrooms, 2 baths with a second owners suite option. For entertainment, home has a spacious sun room with bar and uncovered deck for outdoor grilling and sunshine! Enjoy great views and natural lighting through out with beautiful landscapes. Attached garage contains half bath with plenty of storage, extra storage under sun room and lake fed irrigation. Sunset views, sandy beach front, covered dock with boat lift and quick access to big water. Location is a golf cart ride to dining, marina and convenience store. Disclaimer: CMLS has not reviewed and, therefore, does not endorse vendors who may appear in listings.

AGENT REMARKS

Agent Remarks All information subject to buyer/ agent verification. Disclaimer: CMLS has not reviewed and, therefore, does not endorse vendors who may appear in listings. UNDER CONTRACT - sellers wish to remain on market until due diligence expires on May 10th.

DIRECTIONS

Directions From Hwy 97, take left onto Fort Rd. Right onto Beaver Creek Rd, destination is on left.

FEATURES

Style
Traditional
Exterior Finish
Stucco - Synthetic
Vinyl
Foundation
Crawl Space
Water Frontage Type
On Lake Wateree
House Faces
Northwest
Location
On Water
Exterior
Dock
Gutters - Partial
Front Porch - Covered
Other Porch - Uncovered
Lake Fed Irrigation
Road Type
Paved

Formal Dining Room
Area
Great Room
Fireplace
Floors-Hardwood
Ceiling Fan
Kitchen
Bar
Pantry
Counter Tops-Formica
Floors-Vinyl
Cabinets-Painted
Range
Free-standing
Equipment
Dishwasher
Dryer
Refrigerator
Washer
Laundry
Common
Electric
Heated Space
Other Rooms
Sun Room

Master Bedroom
Bay Window
Double Vanity
Tub-Garden
Bath-Private
Separate Shower
Closet-Walk in
Ceilings-Tray
Ceiling Fan
Closet-Private
Floors - Carpet
Floors - Tile
2nd Bedroom
Bath-Private
Ceiling Fan
Closet-Private
Floors - Carpet
3rd Bedroom
Bath-Shared
Ceiling Fan
Closet-Private
Floors - Carpet
4th Bedroom
Bath-Shared
Ceiling Fan
Closet-Private
Floors - Carpet
Basement
No Basement

Fireplace
Wood Burning
Interior
BookCase
Ceiling Fan
Garage Opener
Heating
Central
Heat Pump 1st Lvl
Heat Pump 2nd Lvl
Cooling
Central
Water
Public
Sewer
Septic
Possession
Closing
Showing
Appointment
Sign
ShowingTime

SOLD STATUS

How Sold	VA	**Contract Date**	5/13/2025
Closing Date	5/20/2025	**Sold Price**	$635,000
Selling Agent	Mindy M Player - Ofc: 803-600-6652	**Selling Office 1**	Home & Land Pros LLC - Ofc: 803-600-6652
Sale Price Tot SqFt	$255.84		

ADDITIONAL PICTURES






Figure 72: 2284 Beaver Creek Road, Camden, SC – MLS 598025: Page 2 of 5

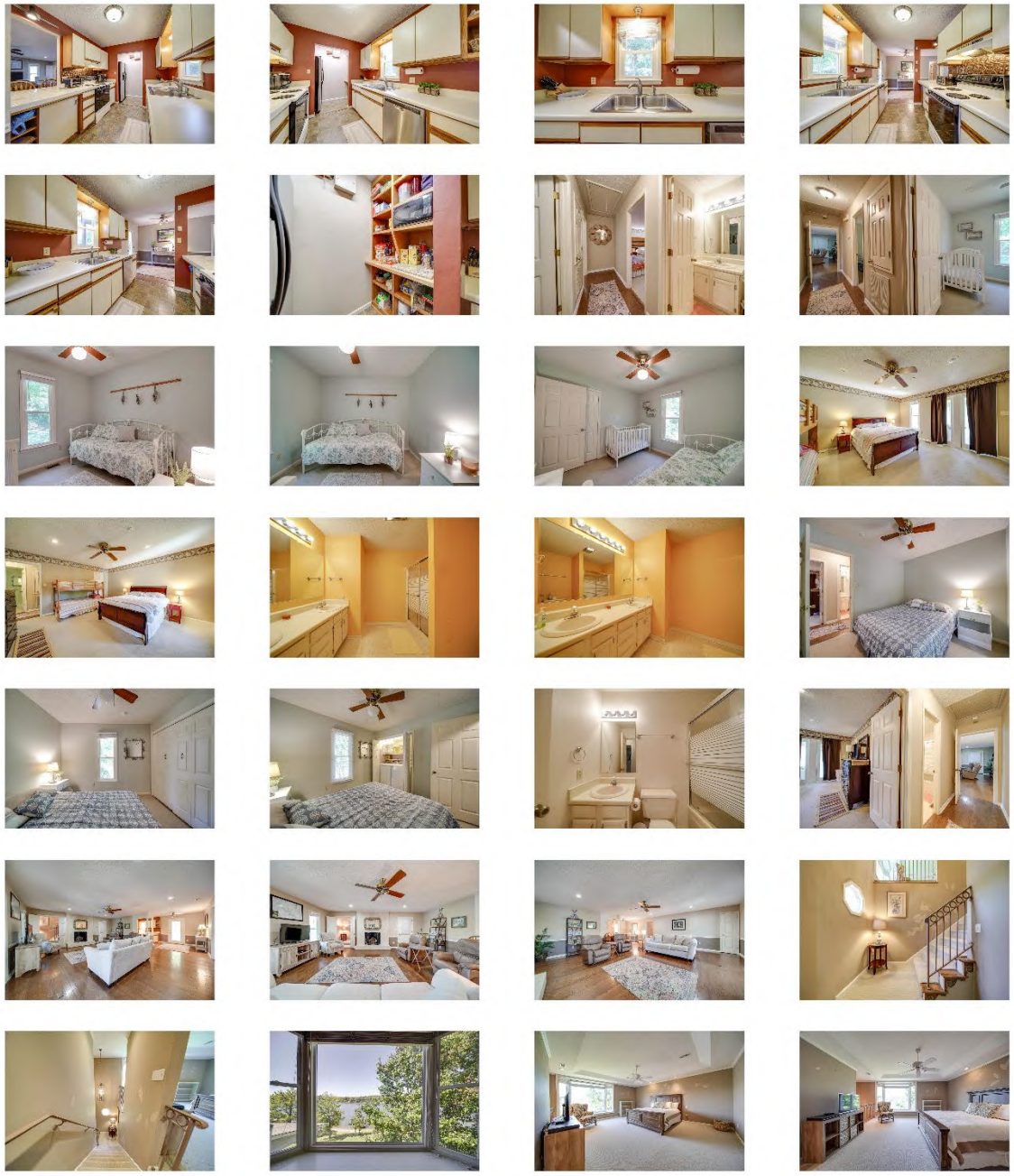


Figure 73: 2284 Beaver Creek Road, Camden, SC – MLS 598025: Page 3 of 5

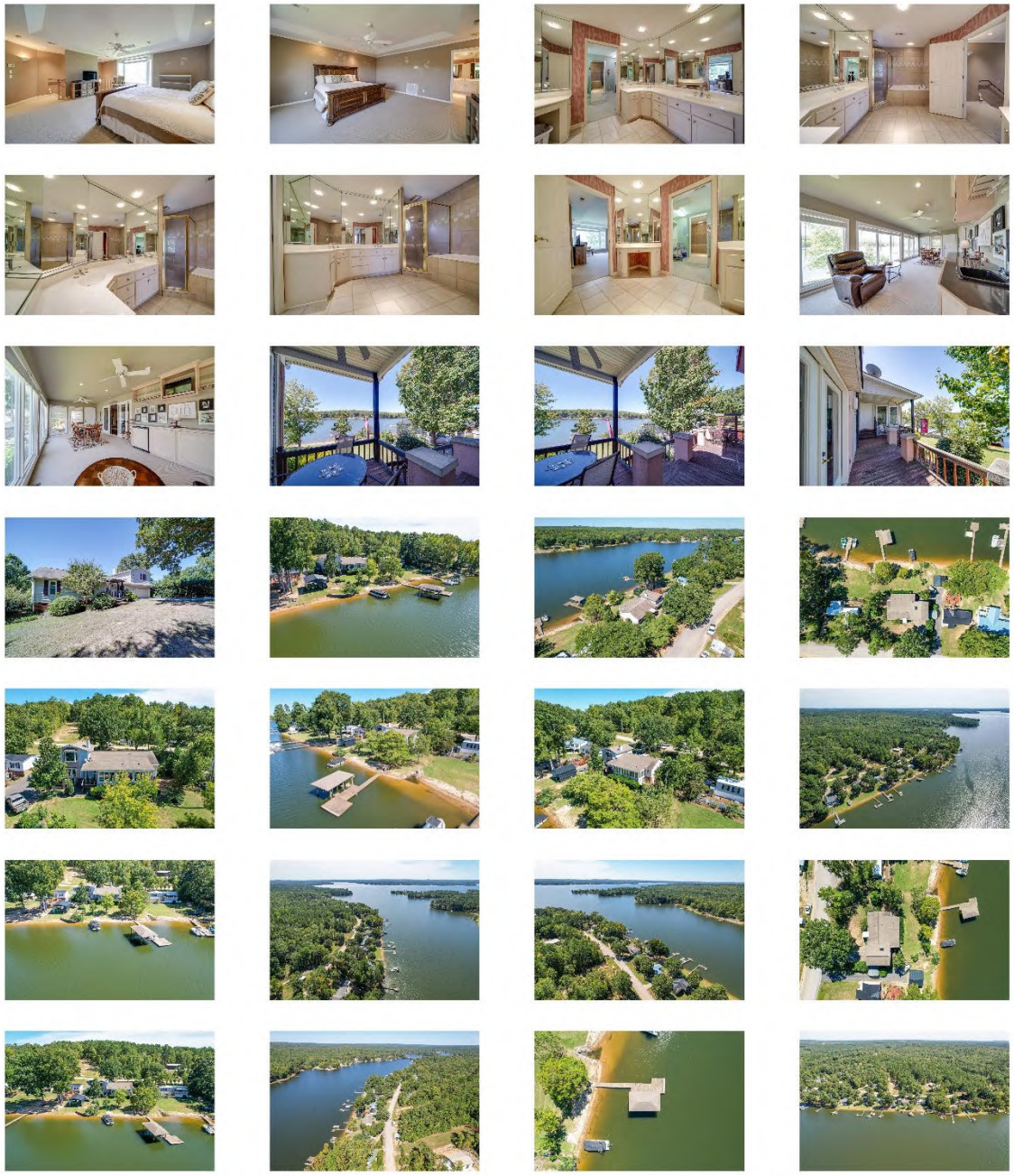


Figure 74: 2284 Beaver Creek Road, Camden, SC – MLS 598025: Page 4 of 5





DISCLAIMER

This information is deemed reliable, but not guaranteed.

Figure 75: 2284 Beaver Creek Road, Camden, SC – MLS 598025: Page 5 of 5

LLR LABOR LICENSING REGULATION

STATE OF SOUTH CAROLINA
RESIDENTIAL PROPERTY CONDITION
DISCLOSURE STATEMENT

The South Carolina Code of Laws (Title 27, Chapter 50, Article 1) requires that an owner of residential real property (single family dwelling unit or a single transaction involving transfer of four dwelling units or less) shall provide to a purchaser this completed and signed disclosure statement prior to forming a real estate contract. This disclosure must be provided in connection with any sale, exchange, installment land sale, and lease with an option to purchase contract. This disclosure statement is not required in connection with transactions listed and exempted by South Carolina Code § 27-50-30.

Owners should answer the questions fully, honestly, and appropriately by attaching documents, checking a box for each check box question, and writing in the blanks on this disclosure statement.

If a question is answered "Yes" or asks for a description, then owner must explain or describe the issue or attach a descriptive report from an engineer, contractor, pest control operator, expert, or public agency. If owner attaches a report, owner shall not be liable for inaccurate or incomplete information in the report unless owner was grossly negligent in obtaining or transmitting the information. If owner fails to check "Yes" or make a disclosure and owner knows there is a problem, owner may be liable for making an intentional or negligent misrepresentation and may owe the purchaser actual damages, court costs, and attorney fees. If a question is answered "No" for any question, the owner is stating that owner has no actual knowledge of any problem.

By answering "No Representation" on this disclosure statement, the owner is acknowledging that they do not have the current knowledge necessary to answer the questions with either a "Yes" or "No" response. Owner still has a duty to disclose information that is known at the time of the disclosure statement. "No Representation" should not be selected if the owner simply wishes to not disclose information or answer the question. Selecting "No Representation" does not waive liability if owner is aware or subsequently becomes aware.

If a question is answered and subsequently new information is obtained or something changes to render the owner's answer incorrect, inaccurate, or misleading (example: roof begins to leak), owner must promptly correct the disclosure. In some situations, the owner may notify the purchaser of the correction. In some situations, the owner may correct or repair the issue.

The owner shall deliver to the purchaser this disclosure before a real estate contract is signed by the purchaser and owner, or as otherwise agreed in the real estate contract. The real estate licensee must disclose material adverse facts about the property if actually known by the licensee about the issue, regardless of owner responses on this disclosure. Owner is solely responsible to complete this disclosure as truthfully and fully as possible. Owner and purchaser are solely responsible to consult with their attorneys regarding any disclosure issues. By signing below, owners acknowledge their duties and that failure to disclose known material information about the property may result in owner liability.

Owner must provide the completed disclosure statement to the purchaser prior to the time the owner and purchaser sign a real estate contract unless the real estate contract states otherwise. Owner should provide a signed copy to the purchaser and keep a copy signed by the purchaser.

A real estate contract, not this disclosure, controls what property transfers from owner to purchaser.

Owner: ( ) ( ) Purchaser ( ) ( ) acknowledge receipt of a copy of this page which is Page 1 of 6.
Effective 6/1/2023

Home & Land Pros LLC, P.O. Box 2253 Camden SC 29020 Phone: 8036006652 Fax:
Mindy Melinda Player Produced with Lone Wolf Transactions (zipForm Edition) 717 N Harwood St, Suite 2200, Dallas, TX 75201 www.lwolf.com

Figure 76: 2284 Beaver Creek Road, Camden, SC – SC Residential Property Condition Disclosure Statement: Page 1 of 7

Property Address (including unit # or identifier) **2284 Beaver Creek Road, Camden, 29020**

Apply this question below and the three answer choices to the numbered issues (1-14) on this disclosure.
As owner, do you have any actual knowledge of any problem(s)* concerning?
*Problem(s) include present defects, malfunctions, damages, conditions, or characteristics.

I. WATER SUPPLY AND SANITARY SEWAGE DISPOSAL SYSTEM	Yes	No	No Representation
1. Water supply	☐	☑	☐
2. Water quality	☐	☑	☐
3. Water pressure	☐	☑	☐
4. Sanitary sewage disposal system for any waste water	☐	☑	☐

A. Describe water supply:	☐ County	☐ Private	☐ Community	☐ Other:
	☐ City	☑ Corporate	☐ Well	
B. Describe water disposal:	☑ Septic	☐ Private	☐ Other:	
	☐ Sewer	☐ Corporate	☐ Government	
C. Describe water pipes:	☐ PEX	☐ PVC/CPVC	☑ Other/Unknown:	
	☐ Copper	☐ Polybutylene	☐ Steel	

II. ROOF, CHIMNEYS, FLOORS, FOUNDATION, BASEMENT, AND OTHER STRUCTURAL COMPONENTS AND MODIFICATIONS OF THESE STRUCTURAL COMPONENTS	Yes	No	No Representation
5. Roof systems A. Approximate year that current roof system was installed: unknown B. During your ownership, describe any known roof system leaks, repairs and/or modifications with date(s): repaired roof leak in 2019	☐	☑	☐
6. Gutter systems	☐	☑	☐
7. Foundation, slab, fireplaces, chimneys, wood stoves, floors, basement, windows, driveway, storm windows/screens, doors, ceilings, interior walls, exterior walls, sheds, attached garage, carport, patio, deck, walkways, fencing, or other structural components including modifications A. Approximate year structure was built: unknown B. During your ownership, describe any structural repairs and/or modifications to the items identified in Question 7 with date(s):	☐	☑	☐

III. PLUMBING, ELECTRICAL, HEATING, COOLING, AND OTHER MECHANICAL SYSTEMS	Yes	No	No Representation
8. Plumbing system (pipes, fixtures, water heater, disposal, softener, plumbing components)	☐	☑	☐

Owner: (DB) (DBH) Purchaser (_____) (_____) acknowledge receipt of a copy of this page which is Page 2 of 6.
Effective 6/1/2023

Figure 77: 2284 Beaver Creek Road, Camden, SC – SC Residential Property Condition Disclosure Statement: Page 2 of 7

9. Electrical system (wiring, panel, fixtures, A/V wiring, outlets, switches, electrical components)				☐	☑ ☐
10. Appliances (range, stove, ovens, dishwasher, refrigerator, washer, dryer, other appliances)				☐	☑ ☐
11. Built-in systems and fixtures (fans, irrigation, pool, security, lighting, A/V, other)				☐	☑ ☐
12. Mechanical systems (pumps, garage door opener, filtration, energy equipment, safety, other)				☐	☑ ☐
13. Heating system(s) (HVAC components)				☐	☑ ☐
14. Cooling system(s) (HVAC components)				☐	☑ ☐
A. Describe Cooling System:	☑ Central	☐ Ductless	☐ Heat Pump	☐ Window	☐ Other _____
B. Describe Heating System:	☑ Central	☐ Ductless	☐ Heat Pump	☐ Furnace	☐ Other _____
C. Describe HVAC Power:	☐ Oil	☐ Gas	☑ Electric	☐ Solar	☐ Other _____
D. Describe HVAC system approximate age and any other HVAC system(s): unknown					

IV. PRESENT OR PAST INFESTATION OF WOOD DESTROYING INSECTS OR ORGANISMS OR DRY ROT OR FUNGUS, THE DAMAGE FROM WHICH HAS NOT BEEN REPAIRED, OR OTHER PEST INFESTATIONS

A. Describe any known present wood problems caused by termites, insects, wood destroying organisms, dry rot or fungus:
none

B. Describe any termite/pest treatment, coverage to property, name of provider, and termite bond (if any):
none

C. Describe any known present pest infestations:
none

V. THE ZONING LAWS, RESTRICTIVE COVENANTS, BUILDING CODES, AND OTHER LAND USE RESTRICTIONS AFFECTING THE REAL PROPERTY, ANY ENCROACHMENTS OF THE REAL PROPERTY FROM OR TO ADJACENT REAL PROPERTY, AND NOTICE FROM A GOVERNMENTAL AGENCY AFFECTING THIS REAL PROPERTY

Apply this question below and the three answer choices to the numbered issues (15-28) on this disclosure. **As owner, do you have any actual knowledge or notice concerning the following:**			
	Yes	**No**	**No Representation**
15. Violations or variances of the following: zoning laws, restrictive covenants, building codes, permits or other land use restrictions affecting the real property.	☐	☑	☐
16. Designation as a historic building, landmark, site or location within a local historic or other restrictive district, which may limit changes, improvements of demolition of the property.	☐	☑	☐
17. Easements (access, conservation, utility, other), party walls, shared private driveway, private roads, released mineral rights, or encroachments from or to adjacent real property.	☐	☑	☐

Owner: ( ) ( ) Purchaser ( ) ( ) acknowledge receipt of a copy of this page which is Page 3 of 6.
Effective 6/1/2023

Figure 78: 2284 Beaver Creek Road, Camden, SC – SC Residential Property Condition Disclosure Statement: Page 3 of 7

18. Legal actions, claims, foreclosures, bankruptcies, tenancies, judgments, tax liens, other liens, first rights of refusal, insurance issues, or governmental actions that could affect title to the property.	[ ]	[✓]	[ ]
19. Room additions or structural changes to the property during your ownership.	[ ]	[✓]	[ ]
20. Problems caused by fire, smoke, or water (including whether any structure on the property has flooded from rising water, water intrusion, or otherwise) to the property during your ownership.	[ ]	[✓]	[ ]
21. Drainage, soil stability, atmosphere, or underground problems affecting the property.	[ ]	[✓]	[ ]
22. Erosion, erosion control, or erosion control structure, such as a bulkhead, rock revetment, seawall, or buried sandbags, affecting the property. If "Yes" to Question 22, provide a general description including material, location on the property, approximate size, etc.	[ ]	[✓]	[ ]
23. Flood hazards, wetlands, flood hazard designations, flood zones, or flood risk affecting the property.	[✓]	[ ]	[ ]
24. Whether the property is currently insured through public (e.g., National Flood Insurance Program) or private flood insurance.	[ ]	[✓]	[ ]
25. Private or public flood insurance (e.g., Federal Emergency Management Agency (FEMA)) claims filed on the property during your ownership. If "Yes" to Question 25, list the approximate date(s), general description of event(s), nature of any repair(s), and amounts of all claim(s).	[ ]	[✓]	[ ]
26. Repairs made to the property as a result of flood events that were NOT filed with private or public insurance during your ownership. If "Yes" to Question 26, list the approximate date(s), general description of event(s), nature of any repair(s), and amounts of all flood-related repairs.	[ ]	[✓]	[ ]
27. Has federal flood disaster assistance (e.g., from FEMA, Small Business Administration, HUD) been previously received during your ownership? If "Yes" to Question 27, what was the amount received and the purpose of the assistance (elevation, mitigation, restoration, etc.)?	[ ]	[✓]	[ ]
28. Whether the property has been assessed for a beach nourishment project during your ownership.	[ ]	[✓]	[ ]

A. Describe any green energy, recycling, sustainability or disability features for the property:

B. Describe any Department of Motor Vehicles titled manufactured housing on the property:

VI. BURIED, UNBURIED, OR COVERED PRESENCE OF THE FOLLOWING: LEAD BASED PAINT, LEAD HAZARDS, ASBESTOS, RADON GAS, METHANE GAS, STORAGE TANKS, HAZARDOUS MATERIALS, TOXIC MATERIALS, OR ENVIRONMENTAL CONTAMINATION

A. Describe any known property environmental contamination problems from construction, repair, cleaning, furnishing, intrusion, operating, toxic mold, methamphetamine production, lead based paint, lead hazards, asbestos, radon gas, methane gas, formaldehyde, corrosion-causing sheetrock, storage tanks, hazardous materials, toxic materials, environmental contamination, or other: See SCDES fish advisories for Lake Wateree

Owner: ( ) ( ) Purchaser ( ) ( ) acknowledge receipt of a copy of this page which is Page 4 of 6. Effective 6/1/2023

Figure 79: 2284 Beaver Creek Road, Camden, SC – SC Residential Property Condition Disclosure Statement: Page 4 of 7

VII. EXISTENCE OF A RENTAL, RENTAL MANAGEMENT, VACATION RENTAL, OR OTHER LEASE CONTRACT ANTICIPATED TO BE IN PLACE ON THE PROPERTY AT THE TIME OF CLOSING

A. Describe the rental/lease terms, to include any vacation rental periods that reasonably may begin no later than ninety days after the date the purchaser's interest is recorded in the office of the register of deeds, and any rental/leasing problems, if any: _____

B. State the name and contact information for any property management company involved (if any): _____

C. Describe known outstanding charges owed by tenant for gas, electric, water, sewer, and garbage: _____

VIII. EXISTENCE OF A METER CONSERVATION CHARGE, AS PERMITTED BY SECTION 58-37-50 THAT APPLIES TO ELECTRICITY OR NATURAL GAS SERVICE TO THE PROPERTY

A. Describe any utility company financed or leased property on the real property: Lynches River outside light

B. Describe known delinquent charges for real property's gas, electric, water, sewer, and garbage: _____

IX. WHETHER THE PROPERTY IS SUBJECT TO GOVERNANCE OF A HOMEOWNERS ASSOCIATION WHICH CARRIES CERTAIN RIGHTS AND OBLIGATIONS THAT MAY LIMIT THE USE OF THIS PROPERTY AND INVOLVE FINANCIAL OBLIGATIONS

	Yes*	No	No Representation
If **Yes**, owner must complete the attached Residential Property Disclosure Statement Addendum.	☐	☑	☐

X. PLEASE USE THE SPACE BELOW FOR "YES" ANSWER EXPLANATIONS AND ATTACH ANY ADDITIONAL SHEETS OR RELEVANT DOCUMENTS AS NEEDED

#23 On Lake Wateree

Owner: ( ) ( ) Purchaser ( ) ( ) acknowledge receipt of a copy of this page which is Page 5 of 6.
Effective 6/1/2023

Figure 80: 2284 Beaver Creek Road, Camden, SC – SC Residential Property Condition Disclosure Statement: Page 5 of 7

This disclosure does not limit the obligation of the purchaser to inspect the property and improvements which are the subject of the real estate contract. Purchaser is solely responsible for conducting their own offsite condition inspections and psychologically affected property inspections prior to entering into a real estate contract. The real estate licensees (acting as listing or selling agents, or other) have no duty to inspect the onsite or offsite conditions of the property and improvements. Purchaser should review all applicable documents (covenants, conditions, restrictions, bylaws, deeds, and similar documents) prior to entering into any legal agreements including any contract. The South Carolina Code of Laws describes the Residential Property Condition Disclosure Statement requirements and exemptions at § 27-50-10 (and following) which can be read online (www.scstatehouse.gov or other websites).

Current status of property or factors which may affect the closing:

[✓] Owner occupied [ ] Short sale [ ] Bankruptcy [ ] Vacant (How long vacant?) _____
[ ] Leased [ ] Foreclosure [ ] Estate [ ] Other: _____
[ ] Subject to Vacation/Short Term Rental

A Residential Property Condition Disclosure Statement Addendum [ ] is [✓] is not completed and attached. This addendum should be attached if the property is subject to covenants, conditions, restrictions, bylaws, rules, or is a condominium.

Owner acknowledges having read, completed, and received a copy of this Residential Property Condition Disclosure Statement before signing and that all information is true and correct as of the date signed.

Owner Signature: Dennis L. Phillips Date: 12/4/24 Time: _____
Owner Printed Name: **Dennis Lane Phillips Jr**
Owner Signature: Deborah S. Phillips Date: 12-4-24 Time: _____
Owner Printed Name: **Deborah S Phillips**

Purchaser acknowledges prior to signing this disclosure:

- Receipt of a copy of this disclosure
- Purchaser has examined disclosure
- Purchaser had time and opportunity for legal counsel
- This disclosure is not a warranty by the real estate licensees
- This disclosure is not a substitute for obtaining inspections of onsite and offsite conditions
- This disclosure is not a warranty by the owner
- Representations are made by the owner and not by the owner's agents or subagents
- Purchaser has sole responsibility for obtaining inspection reports from licensed home inspectors, surveyors, engineers, or other qualified professionals
- Purchaser has sole responsibility for investigating offsite conditions of the property including, but not limited to, adjacent properties being used for agricultural purposes

Purchaser Signature: _____ Date: _____ Time: _____
Purchaser Printed Name: _____
Purchaser Signature: _____ Date: _____ Time: _____
Purchaser Printed Name: _____

Owner: (DLP) (DSP) Purchaser (____) (____) acknowledge receipt of a copy of this page which is Page 6 of 6.
Effective 6/1/2023

Figure 81: 2284 Beaver Creek Road, Camden, SC – SC Residential Property Condition Disclosure Statement: Page 6 of 7

REALTOR® EQUAL HOUSING OPPORTUNITY

EARNEST MONEY DISCLOSURE

PARTIES understand that sometimes unfortunately, a transaction may fail to close for a variety of reasons.

PARTIES understand that a Broker-in-Charge holding an earnest money deposit must handle that earnest money deposit in accordance with SC real estate license laws paraphrased below:

Buyers and Sellers agree that if a transaction fails to close, a Broker-in-Charge acting as an escrow agent shall hold the earnest money in safe keeping in accordance with SC laws and shall not disburse the earnest money to anyone until:

- **All the Buyers and Sellers sign a disbursement agreement stating who gets what amount of earnest money, or**
- **A judge in a court of competent jurisdiction issues a disbursement order.**

Only when all parties sign a disbursement agreement or a disbursement order is obtained from the court, the Broker-in-Charge will properly disburse the earnest money within a reasonable amount of time in accordance with SC laws.

If Parties are using a lawyer to hold the earnest money in trust, Parties should consider signing a written escrow agreement with that lawyer that details how the earnest money is held and how the earnest money is disbursed by the lawyer.

Buyers and Sellers are encouraged to obtain legal counsel prior to signing any legal documents.

BUYER: _____ **Date:** _____ **Time:** _____

BUYER: _____ **Date:** _____ **Time:** _____

_____ **Date:** _____ **Time:** _____

_____ **Date:** _____ **Time:** _____

SELLER: _____ **Date:** 12-4-24 **Time:** _____
Dennis Lane Phillips Jr

SELLER: _____ **Date:** 12-4-24 **Time:** _____
Deborah S Phillips

_____ **Date:** _____ **Time:** _____

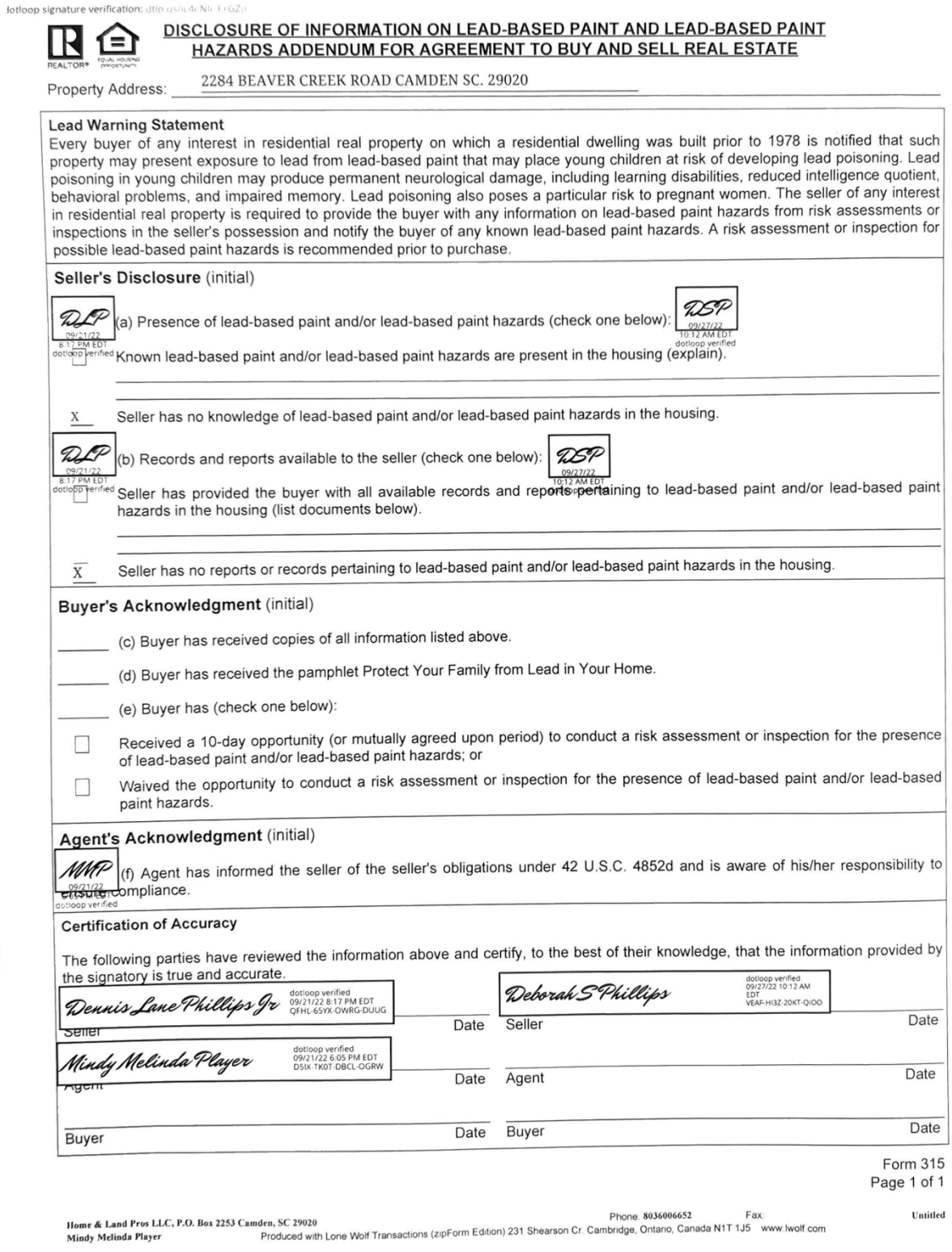
_____ **Date:** _____ **Time:** _____

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Home & Land Pros LLC, P.O. Box 2253 Camden SC 29020 Phone: 8036006652 Fax:
Mindy Melinda Player
Produced with Lone Wolf Transactions (zipForm Edition) 717 N Harwood St, Suite 2200, Dallas, TX 75201 www.lwolf.com

Figure 82: 2284 Beaver Creek Road, Camden, SC – SC Residential Property Condition Disclosure Statement: Page 7 of 7



dotloop signature verification:

REALTOR® EQUAL HOUSING OPPORTUNITY

DISCLOSURE OF INFORMATION ON LEAD-BASED PAINT AND LEAD-BASED PAINT HAZARDS ADDENDUM FOR AGREEMENT TO BUY AND SELL REAL ESTATE

Property Address: 2284 BEAVER CREEK ROAD CAMDEN SC. 29020

Lead Warning Statement

Every buyer of any interest in residential real property on which a residential dwelling was built prior to 1978 is notified that such property may present exposure to lead from lead-based paint that may place young children at risk of developing lead poisoning. Lead poisoning in young children may produce permanent neurological damage, including learning disabilities, reduced intelligence quotient, behavioral problems, and impaired memory. Lead poisoning also poses a particular risk to pregnant women. The seller of any interest in residential real property is required to provide the buyer with any information on lead-based paint hazards from risk assessments or inspections in the seller's possession and notify the buyer of any known lead-based paint hazards. A risk assessment or inspection for possible lead-based paint hazards is recommended prior to purchase.

Seller's Disclosure (initial)

DLP 09/21/22 8:17 PM EDT dotloop verified (a) Presence of lead-based paint and/or lead-based paint hazards (check one below): DSP 09/27/22 10:12 AM EDT dotloop verified

☐ Known lead-based paint and/or lead-based paint hazards are present in the housing (explain).

X Seller has no knowledge of lead-based paint and/or lead-based paint hazards in the housing.

DLP 09/21/22 8:17 PM EDT dotloop verified (b) Records and reports available to the seller (check one below): DSP 09/27/22 10:12 AM EDT dotloop verified

☐ Seller has provided the buyer with all available records and reports pertaining to lead-based paint and/or lead-based paint hazards in the housing (list documents below).

X Seller has no reports or records pertaining to lead-based paint and/or lead-based paint hazards in the housing.

Buyer's Acknowledgment (initial)

_____ (c) Buyer has received copies of all information listed above.

_____ (d) Buyer has received the pamphlet Protect Your Family from Lead in Your Home.

_____ (e) Buyer has (check one below):

☐ Received a 10-day opportunity (or mutually agreed upon period) to conduct a risk assessment or inspection for the presence of lead-based paint and/or lead-based paint hazards; or

☐ Waived the opportunity to conduct a risk assessment or inspection for the presence of lead-based paint and/or lead-based paint hazards.

Agent's Acknowledgment (initial)

MMP 09/21/22 dotloop verified (f) Agent has informed the seller of the seller's obligations under 42 U.S.C. 4852d and is aware of his/her responsibility to ensure compliance.

Certification of Accuracy

The following parties have reviewed the information above and certify, to the best of their knowledge, that the information provided by the signatory is true and accurate.

Dennis Lane Phillips Jr dotloop verified 09/21/22 8:17 PM EDT QFHL-65YX-OWRG-DUUG — Seller — Date

Deborah S Phillips dotloop verified 09/27/22 10:12 AM EDT VEAF-HI3Z-20KT-QIOO — Seller — Date

Mindy Melinda Player dotloop verified 09/21/22 6:05 PM EDT D5IX-TK0T-DBCL-OGRW — Agent — Date

Agent — Date

Buyer — Date

Buyer — Date

Form 315
Page 1 of 1

Home & Land Pros LLC, P.O. Box 2253 Camden, SC 29020 Phone: 8036006652 Fax: Untitled
Mindy Melinda Player Produced with Lone Wolf Transactions (zipForm Edition) 231 Shearson Cr. Cambridge, Ontario, Canada N1T 1J5 www.lwolf.com

Figure 83: 2284 Beaver Creek Road, Camden, SC – Lead-Based Paint Disclosure Statement: Page 1 of 1

Paired Sales

Analysis Overview

There are several techniques available to quantify adjustments to the sale prices of comparable properties, including data analysis techniques such as paired data analysis. The paired sales analysis is the basis of the sales comparison approach. It is typically used by appraisers to account for adjustments when comparing properties with different features. A paired sales analysis compares the sale price of a property with a feature of interest (here, a detrimental condition) to the price of a similar property sold recently without the feature.[140]

Paired sales analysis, as it relates to detrimental conditions analysis, involves comparing the sale or listing of properties that are affected by a detrimental condition to the sales or listings of properties that are not affected by a detrimental condition, but are otherwise similar and comparable to the affected property. When market adjustments are considered in the analysis, price is adjusted based on the change in market index value.[141] The difference between the two values can be attributed to the detrimental condition. This is an analysis utilized in both mass appraisals and individual appraisal assignments.

Application of Paired Sales

The type 3 transactions were analyzed using a paired sales analysis. To develop the analysis, the transactions of the type 3 properties are compared to otherwise similar properties that transacted without a type 3 disclosure.

Comparable property transactions without a Type 3 disclosure were identified by searching for arm's-length transactions on the Consolidated MLS with similar property characteristics. The paired sales are summarized in the following table. The table includes property characteristics, adjustments for market conditions, and indicated risk effects.

[140] Sandra K. Adomatis and Ben Hoen, "An Analysis of Solar Home Paired Sales across Six States," *The Appraisal Journal*, (Winter 2016), 29.
[141] Market index value is typically derived from the Case Shiller or FRED index.

LAKE WATEREE PCB
Paired Sales
Type 3 Sale with Detrimental Fish Advisory Disclosure
(Landmark File: 235-2-26)

No.	Address	County	Bed	Bath	Total Heated SqFt	Year Built	Lot Acres	Sale Date	Sale Price	FRED Index	Sale Price (FRED Adj.)	Price/SqFt (FRED Adj.)	Risk (Adj. Price/SqFt)	LRG Comments
Type 3 with Detrimental Fish Advisory Disclosure														
Impaired Sale	**2284 Beaver Creek Road Camden, SC**	**Kershaw**	**4**	**4**	**2,482**	**1981**	**0.40**	**5/20/2025**	**$635,000**	**217.83**	**$635,000**	**$256**	**-**	**Disclosure Statement states "See SCDES fish advisories for Lake Wateree." No basement. 2 car garage.**
Unimpaired Sales with No Disclosure														
1	1742 Atoka Trail Camden, SC	Kershaw	4	4	2,600	1992	1.15	9/27/2019	$425,500	138.40	$669,701	$258	-0.7%	No basement. 2 car garage.
2	1848 Lake Road Ridgeway, SC	Kershaw	4	3	2,500	1996	0.72	4/15/2019	$435,000	138.40	$684,654	$274	-6.6%	No basement. Carport.
3	2150 Lake Road Ridgeway, SC	Kershaw	4	3	2,650	1999	0.91	1/10/2025	$799,950	217.83	$799,950	$302	-15.2%	Finished basement. 2 car garage.

Data Metrics		
	Low	**-0.7%**
	High	**-15.2%**
	Average	**-7.5%**
	Median	**-6.6%**

Figure 84: Paired Sales Summary

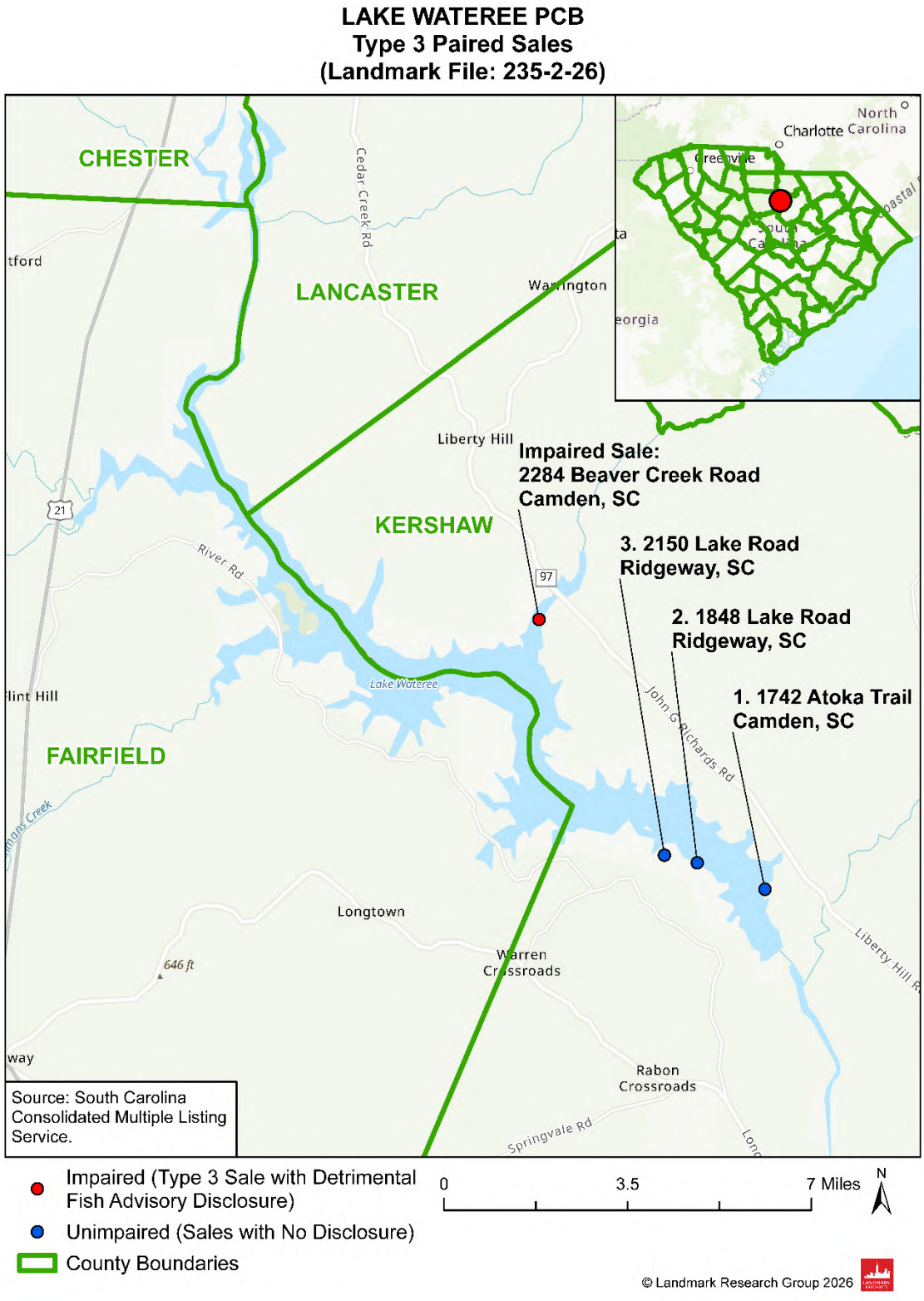


Figure 85: Paired Sales Map

Example Unimpaired Value Calculation

LAKE WATEREE PCB Regression Market Value Clyde Marcus Jones - 1778 Sailing Club Road, Camden, SC (Landmark File: 235-2-26)						
Calculation 1	**Data from Summary Output Table**			**Calculation**		
	Standard Error	0.2311		(Standard Error²) ÷ 2	=	0.0267
Calculation 2	**Variables**	**Coefficients**		**Subject Property Characteristics**		
	Intercept	8.8286	=			8.8286
	Sale Date (Time Index Monthly starts @ 1/2014 = 0)	0.0074	x	145 (Time Index @ 12/2025)	=	1.0732
	Improved SqFt (Ln)	0.4545	x	7.65 (2,107 SqFt***)	=	3.4786
	Age (As of Date of Value)	-0.0056	x	23 (2026-2003)	=	-0.1289
	Lot Size Acreage (Ln**)	0.1019	x	0.28 (1.33 Acres***)	=	0.0288
	Dock/Boathouse	0.1645	x	1	=	0.1645
	Pool	0.1984	x	0	=	0.0000
	Manufactured	-0.3293	x	0	=	0.0000
	Camden	0.0754	x	1	=	0.0754
	Liberty Hill	0.1360	x	0	=	0.0000
	Ridgeway	0.0960	x	0	=	0.0000
					Sum	13.5201
Calculation 3	**Euler's Number 'e' (numerical constant)***			**Calculation 1**		
	2.718281828459045…		^	0.0267	=	1.0271
Calculation 4	**Euler's Number 'e' (numerical constant)***			**Calculation 2 Sum**		
	2.718281828459045…		^	13.5201	=	744257.1937
Preliminary Indication of Market Value	**Calculation 3**			**Calculation 4**		**Market Value**
	1.0271		x	744257.1937	=	**$764,402**

*Euler's number 'e' is a numerical constant, like pi (π). Logarithmic transformations often useful for controlling heteroskedasticity, when used the results need to be "unlogged" to determine a dollar ($) amount. To "unlog" numbers, they can be run through the exponential function 'e' raised to the power (^) of a "logged" number (e^ln#). This reversal process is also referred to as an antilogarithm.
**The symbol "ln" refers to natural logs. Ln is a logarithm to the base 'e', whereas common logarithms "log" generally refers to a logarithm to the base 10. In other words, "ln x" is a shorthand way of writing "logex".
***Natural logs (ln) are used in regressions and are programmed in calculators. For example, the HP-12C financial calculator popular with appraisers has two blue keys labeled “e^x” and “LN.” These keys calculate natural logs (LN) and allow the user to reverse the process (e^x), which is called the antilogarithm. To convert a number to its natural log (ln), the HP-12C keystrokes are X [Blue LN]. For example, if the square footage of a house is 2,131 SqFt [Blue LN] = 7.66. To reverse the process, the keystrokes would be 7.66 [Blue e^x] = 2,131 SqFt.

Figure 86: Example Unimpaired Value Calculation

Unimpaired Market Value Summary

LAKE WATEREE PCB Unimpaired Market Value Summary Improved Residential Proposed Class Properties (Landmark File: 235-2-26)												
No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1	KISTNER WILLIAM A & KENDRA L JTROS	060-03-01-002-000	2103 WATEREE RD SEC LOT 11	Winnsboro	Fairfield	2,945	1950	5.03	Yes	No	No	$702,563
2	DEJA PROPERTIES LLC	060-03-01-004-000	1961 WATEREE RD	Winnsboro	Fairfield	2,935	1950	4.37	Yes	No	No	$691,518
3	TRESSLER ANDREW	060-03-01-005-000	1919 WATEREE RD	Winnsboro	Fairfield	1,818	2003	2.63	Yes	Yes	No	$866,937
4	GUYETTE DEAN & SANDRA	060-03-01-006-000	1879 WATEREE	Winnsboro	Fairfield	1,938	2020	2.02	Yes	No	No	$783,758
5	MARVIN KEITH & SUSAN JTROS	077-01-00-062-000	101 INLET HARBOUR CT LOT 4 INLET HARBOU	Winnsboro	Fairfield	1,728	2022	1.11	Yes	No	No	$707,452
6	HOADLEY FRANCES C	077-01-00-065-000	59 INLET HARBOUR COURT LOT 2	Winnsboro	Fairfield	1,824	2005	2.38	Yes	No	No	$712,609
7	SMITH JOHN M III	077-01-00-066-000	1743 WATEREE RD	Winnsboro	Fairfield	2,748	2016	3.48	Yes	No	No	$949,232
8	CATOE JAMES C & SANDRA L LIFE ESTATE	060-03-02-009-000	233 CEDAR POINT	Winnsboro	Fairfield	1,296	1950	0.73	Yes	No	Yes	$286,056
9	CLARY POLLY ANN	060-03-02-008-000	219 CEDAR POINT	Winnsboro	Fairfield	1,340	1950	0.68	Yes	No	Yes	$288,108
10	HOVIS STEVEN O & MARTHA A	060-03-02-007-000	197 CEDAR POINT RD 4% SPARTANBUR	Winnsboro	Fairfield	1,422	1950	0.63	Yes	No	No	$408,234
11	HALL JASON	060-03-02-006-000	167 CLEMMER	Winnsboro	Fairfield	2,215	1950	1.97	No	No	No	$475,806
12	HOVIS BRIAN	060-04-01-001-000	299 LAKE SHORE ROAD	Winnsboro	Fairfield	1,350	1950	0.78	Yes	No	No	$407,603
13	COOK BOBBY V & DELYNN A AS TRUSTEES	060-04-01-002-000	269 LAKE SHORE	Winnsboro	Fairfield	1,721	1991	0.77	Yes	No	Yes	$411,253
14	HYMAN MICHAEL LEWIS & JENNIFER K JTROS	060-04-01-003-000	235 LAKE SHORE	Winnsboro	Fairfield	2,020	2000	1.85	Yes	Yes	No	$862,457
15	LANEY HARRISON CLAY	060-04-01-005-000	76 INLET VIEW	Winnsboro	Fairfield	792	1950	0.85	Yes	No	Yes	$232,232
16	GLADDEN GARY L & DEBORAH L	060-04-01-007-000	89 BLUE BIRD LANE	Winnsboro	Fairfield	1,050	1950	0.65	Yes	No	No	$356,921
17	LONG LARRY B ETAL	060-04-01-008-000	47 BLUE BIRD LANE	Winnsboro	Fairfield	1,863	1950	0.68	Yes	No	No	$464,924
18	LEITNER WILLIS HOLDING	061-03-01-019-000	1567 WOODSIDE DRIVE	Winnsboro	Fairfield	574	1950	2.74	Yes	No	No	$314,054
19	LEITNER SIMMS M	061-03-02-009-000	1566 WOODSIDE	Winnsboro	Fairfield	1,824	1950	0.92	No	No	No	$403,103
20	HILL SUSAN	061-03-01-003-000	1213 WOODSIDE DRIVE	Winnsboro	Fairfield	3,296	1950	2.31	Yes	No	No	$682,949
21	SHEALY J DARRELL & ROBIN E	061-03-01-005-000	1257 WOODSIDE DRIVE	Winnsboro	Fairfield	1,920	1950	2.42	Yes	No	No	$536,870
22	GOLDBACH DONALD C JR & KATHY L JTROS	061-03-01-006-000	1271 WOODSIDE DRIVE	Winnsboro	Fairfield	2,457	1950	2.54	Yes	No	No	$603,538
23	HOSAFLOOK RUSSELL C & DONNA R	061-03-01-007-000	1287 WOODSIDE DRIVE	Winnsboro	Fairfield	2,640	1950	2.25	Yes	No	No	$615,846
24	YAGER RICK ANDERSON & HEATHER LYN	061-03-01-008-000	1303 WOODSIDE DRIVE	Winnsboro	Fairfield	1,065	1995	2.02	Yes	No	No	$518,785
25	FERGUSON JAMES A ET AL	061-03-01-009-000	1319 WOODSIDE DRIVE	Winnsboro	Fairfield	1,890	2012	1.66	Yes	No	No	$725,892
26	STEELE DARWIN WAYNE &	061-03-01-012-000	1347 WOODSIDE DRIVE	Winnsboro	Fairfield	2,583	1950	1.62	Yes	No	No	$589,850
27	ADCOCK JIMMIE W	061-03-01-013-000	1375 WOODSIDE	Winnsboro	Fairfield	2,437	1950	1.78	Yes	No	No	$579,844
28	MORRISON JOHNNY D & JANA B	061-03-01-014-000	1379 WOODSIDE DRIVE	Winnsboro	Fairfield	2,198	1950	1.80	Yes	No	No	$553,860
29	REX JAMES H &	061-03-01-016-000	1445 WOODSIDE DRIVE	Winnsboro	Fairfield	3,624	1950	10.61	Yes	No	No	$833,029
30	CORDIER RANDEEN L &	061-03-01-017-000	1541 WOODSIDE	Winnsboro	Fairfield	3,216	1995	2.60	Yes	No	No	$879,755
31	MURPHY SHARON	060-04-04-008-000	WOODSIDE	Winnsboro	Fairfield	1,665	2023	8.55	No	No	No	$730,853
32	MCQUEEN CHRISTOPHER A & TRICIA JTROS	061-03-02-002-000	1222 WOODSIDE DR SEC WH LOT 44	Winnsboro	Fairfield	1,794	1950	3.10	Yes	No	No	$533,905
33	MASSEY SCOTT DEREK & KRISTY ANN	061-03-02-004-000	1280 WOODSIDE DRIVE	Winnsboro	Fairfield	1,940	2000	2.26	No	No	No	$601,320
34	PAULUS DAWN L & DANIEL J	061-03-02-005-000	1344 WOODSIDE	Winnsboro	Fairfield	1,740	1950	2.72	No	No	No	$440,729
35	MORRELL BILLY L & PAMELA E TRUSTEES	061-03-02-006-000	1408 WOODSIDE DRIVE	Winnsboro	Fairfield	2,664	1950	2.83	No	No	No	$537,018
36	MOORE CAROLYN J	061-03-02-007-000	1562 WOODSIDE	Winnsboro	Fairfield	4,430	1950	0.90	No	No	No	$601,988
37	SMITH KENNETH M	061-03-02-008-000	1564 WOODSIDE DRIVE	Winnsboro	Fairfield	1,302	2004	0.95	No	No	No	$469,611
38	KERR ERIC & EMILY B JTROS	060-04-04-006-000	1012 WOODSIDE	Winnsboro	Fairfield	5,806	2002	18.42	No	Yes	No	$1,511,441
39	TENNYSON-HALLIDAY HEATHER J & SARAH J	061-03-02-003-000	1258 WOODSIDE DR LOT 43	Winnsboro	Fairfield	1,794	1950	2.75	No	No	No	$447,392
40	DILLER STEVE E & LAURA L	060-04-01-009-000	35 BLUE BIRD LANE	Winnsboro	Fairfield	3,545	1950	0.70	Yes	No	No	$625,030

Figure 87: Unimpaired Market Value Summary 1-40

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
41	GIBSON MARVIN W JR	060-04-01-014-000	865 WATEREE CREEK ROAD	Winnsboro	Fairfield	600	1950	0.70	Yes	No	No	$278,831
42	MARTIN RUSSELL LEE	060-04-01-013-000	WATEREE CREEK VALLEY	Winnsboro	Fairfield	1,120	1950	0.78	Yes	No	No	$374,518
43	FIELDS BRENDA KAY	060-04-01-012-000	821 WATEREE CREEK VALLEY	Winnsboro	Fairfield	1,300	1950	0.79	Yes	No	No	$401,419
44	LAWSON KENNETH G, RICHARD E & ROBERT T	060-04-01-011-000	793 WATEREE CREEK VALLEY	Winnsboro	Fairfield	1,910	2014	0.74	Yes	No	No	$679,309
45	KNUTSON ALAN D	060-04-02-005-000	284 GUNSITE	Winnsboro	Fairfield	1,742	1950	1.18	No	No	Yes	$291,452
46	GRAEF WAYNE A ET AL	060-04-02-006-000	286 GUNSITE	Winnsboro	Fairfield	1,104	1997	0.91	Yes	No	Yes	$353,718
47	RUSS DARRYN A & KAREN C	060-04-02-008-000	304 GUNSITE	Winnsboro	Fairfield	960	1950	0.72	Yes	No	No	$346,445
48	BOWMAN JAMES E &	060-04-02-009-000	324 GUNSITE	Winnsboro	Fairfield	1,269	1978	0.62	Yes	No	No	$453,099
49	PRICE RYAN MATTHEW	060-04-02-010-000	360 GUNSITE	Winnsboro	Fairfield	1,728	1985	0.68	Yes	No	No	$547,331
50	FORT LAURENS W IIII TRUSTEE	060-04-02-011-000	380 GUNSITE	Winnsboro	Fairfield	1,260	1950	0.90	Yes	No	No	$400,604
51	WILLIAMS CAROL ANN & JOSEPH M	060-04-02-012-000	420 GUNSITE RD SEC 26 LOT 64	Winnsboro	Fairfield	1,960	1950	0.85	Yes	No	No	$486,948
52	STEELE MARC STANLEY &	060-04-02-013-000	434 GUNSITE	Winnsboro	Fairfield	2,120	1950	0.98	Yes	No	No	$512,434
53	FORT LAURENS W III TRUSTEE	060-04-02-014-000	464 GUNSITE	Winnsboro	Fairfield	1,094	1950	0.86	Yes	No	No	$374,164
54	SMITH TORRENCE JR	060-04-02-015-000	500 GUNSITE	Winnsboro	Fairfield	700	1950	1.07	Yes	No	No	$312,423
55	PORTER DONALD JR & JENNIFER	060-04-02-016-000	604 GUNSITE	Winnsboro	Fairfield	2,102	2017	0.70	Yes	Yes	No	$874,626
56	THE LALLI LAKE PROPERTY TRUST	060-04-02-017-000	622 GUNSITE	Winnsboro	Fairfield	2,176	1950	0.61	Yes	No	No	$493,949
57	HIGGINBOTHAM J HENRY AS TRUSTEE ETAL	060-04-02-018-000	640 GUNSITE	Winnsboro	Fairfield	1,245	1950	0.65	Yes	No	No	$385,423
58	BATES DEREK L	060-04-02-019-000	674 GUNSITE	Winnsboro	Fairfield	1,497	1950	0.66	Yes	No	No	$419,977
59	MACE MARTIN DAVID	077-01-00-039-000	586 VALLEY 1 DRIVE	Winnsboro	Fairfield	2,400	2008	0.61	Yes	No	No	$714,774
60	MATTHEWS STEPHEN M & CONNIE S JTROS	077-01-00-038-000	2721 GREAT NORTH ROAD SEC 23 LOT 26	Winnsboro	Fairfield	732	1975	0.89	Yes	No	Yes	$258,782
61	OAKES CHRISTOPHER G	077-01-00-003-000	1765 GREAT NORTH RD SEC 23 LOT 62	Winnsboro	Fairfield	1,106	2009	0.66	Yes	No	No	$509,183
62	BRANDON LEIGH GEORGE & DENICE SHELLY	077-01-00-040-000	558 VALLEY 1 DRIVE	Winnsboro	Fairfield	1,560	2012	0.74	Yes	No	No	$612,544
63	KOZIEL REBECCA J & MELVIN W JACKSON	077-02-00-040-000	LOTS 4-A & 4-B ON WATEREE ROAD	Winnsboro	Fairfield	2,320	2008	4.40	No	No	No	$730,137
64	FRANCISCO MICHAEL FREDERICK	077-01-00-021-000	2213 GREAT NORTH RD SEC 23 LOT 43	Winnsboro	Fairfield	2,364	1996	0.77	Yes	No	No	$679,209
65	CASTLES PAUL E JR & EVALIELANIA S	077-01-00-020-000	2211 GREAT NORTH RD SEC 23 LOT 44	Winnsboro	Fairfield	720	2011	0.71	Yes	No	Yes	$307,047
66	CASTLES PAUL E & EVALIELANIA V JTROS	077-01-00-019-000	2209 GREAT NORTH RD SEC 23 LOT 45	Winnsboro	Fairfield	2,452	1950	0.65	Yes	Yes	No	$640,074
67	JONES NILE JAMES JR & TRISHA ANN	077-01-00-018-000	2199 GREAT NORTH RD SEC 23 LOT 46	Winnsboro	Fairfield	4,038	2004	0.85	Yes	No	No	$915,882
68	LAM TRUST	060-03-02-011-000	251 CEDAR POINT RD SEC 26 LOT 23	Winnsboro	Fairfield	1,296	1999	0.61	Yes	No	Yes	$369,663
69	OVERHOLT RICHARD E JR ETAL	060-03-02-010-000	253 CEDAR POINT RD SEC 26 LOT 22	Winnsboro	Fairfield	1,976	1992	0.76	Yes	No	Yes	$439,801
70	HENDRIX MELISSA A	077-01-00-067-000	1688 WATEREE RD SEC 26 LOT 1	Winnsboro	Fairfield	920	1950	0.34	Yes	Yes	No	$384,090
71	REDFERN ROBERT S JR & GAIL A JTROS	077-01-00-063-000	95 INLET HARBOUR CT S-26;L-15 & LOT 4	Winnsboro	Fairfield	1,512	2005	1.02	No	No	No	$509,323
72	SC LAKEFRONT LANDING LLC	077-02-00-039-000	1613 WATEREE RD SEC 23 LOT 1	Winnsboro	Fairfield	820	1970	2.03	Yes	No	No	$400,664
73	BRILL ALAN H & SUSAN A	077-02-00-012-000	309 & 307 SHANGRI-LA DR SEC 22	Winnsboro	Fairfield	3,080	1950	1.44	Yes	No	No	$631,030
74	MATTHEWS CONNIE S & STEPHEN M JTROS	077-01-00-036-000	2669 GREAT NORTH ROAD SEC 23 LOT 28	Winnsboro	Fairfield	1,416	1950	0.82	Yes	No	No	$418,526
75	WESA STEVE A	077-01-00-035-000	2627 GREAT NORTH ROAD SEC 23 LOT 29	Winnsboro	Fairfield	1,296	1950	0.88	Yes	No	Yes	$291,264
76	HEGELE PETER E & DIANE	077-01-00-034-000	2597 GREAT NORTH ROAD SEC 23 LOT 30	Winnsboro	Fairfield	1,012	1950	0.61	Yes	No	Yes	$251,054
77	MONTGOMERY LEROY I & JUDY S	077-01-00-033-000	2559 GREAT NORTH ROAD SEC 23 LOT 31	Winnsboro	Fairfield	1,564	1950	0.84	Yes	No	Yes	$268,137
78	HENN MICHAEL & SUSAN JTROS	077-01-00-032-000	2557 GREAT NORTH ROAD SEC 23 LOT 32	Winnsboro	Fairfield	1,044	1980	0.97	Yes	No	No	$438,454
79	GOAD BENJAMIN E & RHONDA L	077-01-00-031-000	2503 GREAT NORTH ROAD SEC 23 LOT 32	Winnsboro	Fairfield	2,064	1999	0.85	Yes	No	No	$656,200
80	OSWALT CRAIG N & ALLISON M WINGATE	077-01-00-030-000	2457 GREAT NORTH RD SEC 23 LOT 34	Winnsboro	Fairfield	1,040	1950	0.76	Yes	No	No	$361,141

Figure 88: Unimpaired Market Value Summary 41-80

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
81	BARE WENDI LILLY & BLAKE	077-01-00-029-000	2427 GREAT NORTH ROAD SEC 23 LOT 35	Winnsboro	Fairfield	1,819	2017	0.57	Yes	No	No	$558,629
82	E.Z. SMITH PROPERTIES LLC	077-01-00-028-000	2391 GREAT NORTH ROAD SEC 23 LOT 36	Winnsboro	Fairfield	1,504	2016	0.77	Yes	No	No	$619,146
83	SMITH DAVID & DONNA JTROS	077-01-00-027-000	2321 GREAT NORTH ROAD SEC 23 LOT 37	Winnsboro	Fairfield	1,326	1996	0.68	Yes	No	Yes	$371,353
84	MCKENZIE GERALD C	077-01-00-026-000	2271 GREAT NORTH ROAD SEC 23 LOT 38	Winnsboro	Fairfield	1,840	1950	0.77	Yes	No	No	$468,787
85	CALDWELL JOAN LEE	077-01-00-025-000	2265 GREAT NORTH ROAD SEC 23 LOT 39	Winnsboro	Fairfield	1,738	1950	0.55	Yes	No	Yes	$317,149
86	WORKMAN MARK B	077-01-00-024-000	2247 GREAT NORTH ROAD SEC 23 LOT 40	Winnsboro	Fairfield	566	1950	0.54	Yes	No	Yes	$190,353
87	STEVENSON HELEN E. TRUSTEE OF THE	077-01-00-023-000	2227 GREAT NORTH ROAD SEC 23 LOT 41	Winnsboro	Fairfield	1,027	1950	0.79	Yes	No	No	$360,213
88	MCKEOWN LARRY & CHERYL	077-01-00-022-000	2217 GREAT NORTH ROAD SEC 23 LOT 42	Winnsboro	Fairfield	1,362	2019	0.70	Yes	No	No	$596,177
89	KINCAID JUSTIN & LAUREN	077-01-00-017-000	2165 GREAT NORTH ROAD SEC 23 LOT 47	Winnsboro	Fairfield	3,173	2001	0.67	Yes	No	No	$787,054
90	FRAZIER DEBRAH	077-01-00-016-000	2111 GREAT NORTH RD SEC 23 LOT 48	Winnsboro	Fairfield	1,988	1998	0.78	Yes	No	Yes	$457,805
91	NEALY DEWANA M	077-01-00-015-000	2103 GREAT NORTH RD SEC 23 LOT 49	Winnsboro	Fairfield	1,888	2003	0.94	Yes	No	No	$650,844
92	BRASWELL WILLIAM J JR	077-01-00-014-000	2097 GREAT NORTH ROAD SEC 23 LOT 50	Winnsboro	Fairfield	456	1950	0.93	Yes	No	No	$253,321
93	KEITT MARIE C	077-01-00-013-000	2081 GREAT NORTH ROAD SEC 23 LOT 51	Winnsboro	Fairfield	2,702	1950	0.80	No	No	No	$475,031
94	REYES LISA RENEE &	077-01-00-012-000	2075 GREAT NORTH RD SEC 23 LOT 52-A	Winnsboro	Fairfield	1,152	1997	0.73	Yes	No	Yes	$352,551
95	WALLACE WILLIAM H & RUTH ANN JTROS	077-01-00-010-000	2037 GREAT NORTH RD SEC 23 LOT 55	Winnsboro	Fairfield	924	1950	0.83	Yes	No	No	$345,407
96	TN VENTURES LLC	077-01-00-009-000	2007 GREAT NORTH RD SEC 23 LOT 56	Winnsboro	Fairfield	2,046	1996	0.85	No	No	No	$545,346
97	WILLIAMS THOMAS L	077-01-00-007-000	1863 GREAT NORTH RD SEC 23 LOT 58	Winnsboro	Fairfield	2,450	2012	1.04	Yes	No	No	$778,903
98	RUSSELL AGNES M	077-01-00-006-000	1851 GREAT NORTH RD SEC 23 LOT 59	Winnsboro	Fairfield	672	1989	0.90	No	No	Yes	$228,851
99	DORONY LINDA S	077-01-00-005-000	1849 GREAT NORTH RD SEC 23 LOT 60	Winnsboro	Fairfield	1,442	1950	0.78	No	No	No	$356,457
100	BAUM CYNTHIA M	077-01-00-004-000	1795 GREAT NORTH RD SEC 23 LOT 61	Winnsboro	Fairfield	1,100	1950	0.53	No	No	No	$303,058
101	HALL KRISTA H	077-01-00-011-000	2051 GREAT NORTH RD SEC 23 LOT 54A	Winnsboro	Fairfield	1,700	2015	0.61	Yes	No	No	$635,909
102	GEHRET STEPHEN P & CAROLE J	077-01-00-068-000	2063 GREAT NORTH ROAD LOT 53A	Winnsboro	Fairfield	2,170	1950	0.63	No	No	No	$419,929
103	REA KEVIN DEAN & WENDY ERIN TUCKER REA ROS	077-01-00-053-000	214 VALLEY 1 DRIVE SEC 23 LOT 8	Winnsboro	Fairfield	672	1972	0.64	No	No	Yes	$200,713
104	TUCKER WENDY ERIN	077-01-00-052-000	216 VALLEY 1 DR SEC 23 LOT 9	Winnsboro	Fairfield	960	1950	0.75	No	No	No	$294,807
105	BLACK BILLY R & GRACE K JTROS	077-01-00-051-000	240 VALLEY 1 DR SEC 23 LOT 10	Winnsboro	Fairfield	1,456	1950	0.78	Yes	No	No	$421,689
106	STRICKLAND TIMOTHY L & JULIA F	077-01-00-049-000	300 VALLEY 1 DR SEC 23 LOT 12	Winnsboro	Fairfield	1,168	1950	0.61	Yes	No	No	$372,419
107	MCCONNELL SHERYL K	077-01-00-048-000	326 VALLEY 1 DR SEC 23 LOT 13	Winnsboro	Fairfield	480	1965	0.68	Yes	No	Yes	$196,651
108	STEPHENSON MELANIE SHORT	077-01-00-047-000	VALLEY 1 DR SEC 23 LOT 14	Winnsboro	Fairfield	1,412	1950	0.74	Yes	No	No	$413,719
109	SMITH CHESLEY STEWART & NANCY JOLLY	077-01-00-046-000	396 VALLEY 1 DR SEC 23 LOT 15	Winnsboro	Fairfield	2,776	1950	0.79	Yes	No	No	$566,450
110	DEATON RENAE & TERRY JTROS	077-01-00-045-000	408 VALLEY 1 DRIVE SEC 23 LOT 16	Winnsboro	Fairfield	2,430	2000	0.65	Yes	No	No	$691,207
111	MCMASTER KAYE P &	077-01-00-044-000	428 VALLEY 1 DR	Winnsboro	Fairfield	1,728	2008	0.70	Yes	No	No	$624,376
112	ARANT WALTER LEE & LINDA P	077-01-00-043-000	462 VALLEY 1 DRIVE SEC 23 LOT 18	Winnsboro	Fairfield	1,248	1950	0.72	Yes	No	Yes	$280,566
113	HARDIN ROGER S, RANDY G. & TRACY L	077-01-00-042-000	518 VALLEY 1 DR SEC 23 LOT 19	Winnsboro	Fairfield	1,200	1950	0.68	Yes	No	No	$380,864
114	MENDENHALL FAMILY TRUST	077-01-00-041-000	528 & 531 VALLEY 1 DR SEC 23 L	Winnsboro	Fairfield	2,172	2019	0.72	Yes	No	No	$739,178
115	DONNELLY JASON & CATHERINE R	077-01-00-055-000	186 VALLEY 1 DR	Winnsboro	Fairfield	1,367	2005	0.87	Yes	No	No	$563,934
116	WHITESIDES GEORGE PATRICK III TRUSTEE	077-01-00-050-000	260 VALLEY 1 DRIVE	Winnsboro	Fairfield	2,096	1950	0.62	Yes	No	No	$486,091
117	SMITH EDGAR T II & KIMBERLY E JTROS	077-01-00-056-000	128 VALLEY 1 DR LOT	Winnsboro	Fairfield	1,414	2008	1.06	Yes	No	No	$594,411
118	ROBINSON SHANNON G TRUSTEE	078-04-01-011-000	214 TRINITY DRIVE SEC 22 LOT 95	Winnsboro	Fairfield	3,977	1950	1.75	Yes	No	No	$723,308
119	MATTHEWS TOMMY & PAMELA	077-02-00-002-000	772 GUNSITE	Winnsboro	Fairfield	1,008	1963	0.57	Yes	No	Yes	$267,454
120	BELL KATHY H	077-02-00-003-000	792 GUNSITE	Winnsboro	Fairfield	1,208	1950	0.66	Yes	No	No	$381,226

Figure 89: Unimpaired Market Value Summary 81-120

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
121	HUDSON LOREN E SR & SALLIE G H	077-02-00-004-000	832 GUNSITE	Winnsboro	Fairfield	3,891	1950	0.63	Yes	No	No	$644,843
122	CRUZ SAUL A SOSA & DEBORAH MULERO SOSA	077-02-00-005-000	856 GUNSITE	Winnsboro	Fairfield	672	1980	0.70	Yes	No	No	$347,502
123	MORRIS EMILY P & KEITH H	077-02-00-006-000	860 GUNSITE	Winnsboro	Fairfield	1,944	1950	0.71	Yes	No	No	$476,592
124	FULMER DEBRA M	077-02-00-007-000	861 GUNSITE	Winnsboro	Fairfield	1,728	2016	0.76	Yes	No	No	$658,153
125	LAMBERT DAVID W	077-02-00-014-000	465 SHANGRI LA DR SEC 22 LOT 1	Winnsboro	Fairfield	3,712	2014	0.92	Yes	Yes	No	$1,145,894
126	PATTON JOHN & TARA	077-02-00-015-000	467 SHANGRI-LA DRIVE SEC 22 LOT 1	Winnsboro	Fairfield	1,446	1950	1.58	Yes	Yes	No	$551,131
127	HORTON E MARIE A/K/A E MARIE HORTON	077-02-00-016-000	547 SHANGRI-LA DR SEC 22 LOT 1	Winnsboro	Fairfield	852	1950	0.87	Yes	No	No	$334,373
128	DAVIDGE SCOTT & LINDA AS TRUSTEES	077-02-00-017-000	571 SHANGRI-LA DR SEC 22 LOT 1	Winnsboro	Fairfield	1,117	1950	0.95	Yes	No	No	$381,431
129	SANDERS MICHELLE	077-02-00-018-000	615 SHANGRI-LA DR SEC 22 LOT 1	Winnsboro	Fairfield	696	1950	0.94	Yes	No	No	$307,237
130	ALEXANDER CARLOS H II &	077-02-00-019-000	655 SHANGRI-LA DR SEC 22 LOT 1	Winnsboro	Fairfield	2,027	2013	0.76	Yes	No	No	$696,353
131	GOVER JAMES D & SUE OWEN	077-02-00-020-000	661 SHANGRI-LA DR SEC 22 LOT 1	Winnsboro	Fairfield	1,343	1980	0.67	Yes	No	No	$473,455
132	KESSINGER RANDALL K & VICKIE B	077-02-00-021-000	681 SHANGRI-LA DR SEC 22 LOT 1	Winnsboro	Fairfield	1,118	1950	0.62	Yes	No	No	$365,582
133	DASSARO MICHAEL D & DONNA R	077-02-00-022-000	687 SHANGRI-LA DR SEC 22 LOT 1	Winnsboro	Fairfield	1,758	2014	0.72	Yes	No	No	$652,280
134	BOONE KEITH L & REBECCA B JTROS	077-02-00-023-000	719 SHANGRI-LA DR SEC 22 LOT 18	Winnsboro	Fairfield	1,560	1975	0.80	Yes	No	No	$502,063
135	HEDGPATH WILLIAM T III & ELISA H	077-02-00-024-000	725 SHANGRI-LA	Winnsboro	Fairfield	750	1950	0.90	Yes	No	No	$316,777
136	MCKEOWN LINDA ALEXANDER	077-02-00-025-000	749 SHANGRI-LA DR SEC 22 LOT 2	Winnsboro	Fairfield	1,792	2003	0.88	Yes	No	No	$631,850
137	ELLIOTT MARTHA MOORE	077-02-00-026-000	779 SHANGRI-LA DR SEC 22 LOT 2	Winnsboro	Fairfield	2,009	2021	0.65	Yes	No	No	$713,764
138	BICKETT ROBERT MCIIWAIN & LEIGHANNE BROWN JTROS	077-02-00-027-000	789 SHANGRI-LA DR SEC 22 LOT 2	Winnsboro	Fairfield	1,400	2022	1.43	Yes	Yes	No	$804,844
139	PAGE WESLEY ANDREW & JENNIFER LYNN	077-02-00-028-000	889 SHANGRI-LA DR SEC 22 LOT 2	Winnsboro	Fairfield	1,402	1950	2.34	Yes	Yes	Yes	$406,937
140	TYSON EUGENIA P	077-02-00-029-000	933 SHANGRI-LA DR SEC 22 LOT 2	Winnsboro	Fairfield	2,224	1950	1.61	Yes	Yes	No	$671,289
141	NORD GEORGE O LIFE ESTATE ETAL	077-02-00-031-000	1173 SHANGRI-LA DR SEC 22 LOT 27	Winnsboro	Fairfield	1,766	1950	1.37	Yes	No	No	$487,858
142	PORTER JAMES ROY JR	077-02-00-032-000	1179 SHANGRI LA DRIVE	Winnsboro	Fairfield	3,286	1950	0.81	No	No	No	$520,121
143	HITT ROBERT M III AS TRUSTEE	077-02-00-035-000	1231 SHANGRI-LA DR SEC 22 LOT 31	Winnsboro	Fairfield	2,970	1950	0.95	Yes	No	No	$595,263
144	MCLEAN JAMES HARRIS SR &	077-02-00-034-000	1225 SHANGRI-LA DR SEC 22 LOT 30	Winnsboro	Fairfield	1,268	2007	0.62	Yes	No	No	$532,769
145	HOWARD REVOCABLE TRUST	077-02-00-033-000	1183 SHANGRI-LA DR SEC 22 LOT	Winnsboro	Fairfield	1,296	1950	0.59	Yes	No	No	$389,017
146	GLENN JERRY NOLAN & CORRINE P	078-01-00-002-000	1847 SHANGRI-LA DR SEC 22 LOT 40	Winnsboro	Fairfield	1,122	1950	1.23	No	No	No	$333,092
147	AVALLONE MICHAEL & THERESA	078-01-00-004-000	1881 SHANGRA-LA DR SEC 22 LOT 41	Winnsboro	Fairfield	2,186	1950	1.51	Yes	No	No	$542,934
148	BLARNEY BLUFF HOLDINGS LLC	078-01-00-005-000	1883 SHANGRI-LA DR SEC 22 LOT 42	Winnsboro	Fairfield	748	1950	1.44	Yes	No	No	$331,835
149	JONES LARRY RICHARD JR & VANESSA JANE KIRKLEY	078-01-00-006-000	1887 SHANGRI LA DR SEC 22 LOT 43	Winnsboro	Fairfield	1,671	1990	0.70	Yes	No	No	$555,651
150	KESSINGER VICKIE B AS TRUSTEE	078-01-00-009-000	2003 SHANGRI-LA DR SEC 22 LOT 45	Winnsboro	Fairfield	1,400	1950	0.84	Yes	No	No	$417,473
151	FLEMING GEORGE R	078-01-00-010-000	2093 SHANGRI-LA DR SEC 22 LOT 46	Winnsboro	Fairfield	1,030	1950	1.82	No	No	No	$333,243
152	STARNES HENRY C III	078-01-00-012-000	2155 SHANGRI-LA DR SEC 22 LOT 48	Winnsboro	Fairfield	480	1964	0.56	Yes	No	Yes	$191,527
153	STARNES HENRY C IV ETAL	078-01-00-013-000	2157 SHANGRI-LA DR SEC 22 LOT 49	Winnsboro	Fairfield	952	1950	1.50	Yes	No	No	$371,738
154	GARCHER WILLIAM J, SANDRA L & JENNIFER ANN GARCHER BARBER	078-01-00-007-000	1905 SHANGRI-LA DR SEC 22	Winnsboro	Fairfield	2,520	2007	1.64	Yes	No	No	$803,701
155	MENDENHALL MARTHA A LIFE ESTATE	078-01-00-015-000	2231 SHANGRI-LA DR SEC 22 LOT 52	Winnsboro	Fairfield	1,852	2011	0.98	Yes	No	No	$677,769
156	ARCHIE JIMMY DEAN	078-01-00-016-000	2233 SHANGRI-LA DR SEC 22 LOT 53	Winnsboro	Fairfield	1,728	2021	0.73	Yes	No	No	$674,033
157	STARNES HENRY C III	078-01-00-019-000	2279 SHANGRI-LA DR SEC 22 LOT 56	Winnsboro	Fairfield	798	1950	0.88	Yes	No	No	$324,938
158	MITCHELL DIANE G LIFE ESTATE	078-01-00-018-000	2277 SHANGRI-LA DR SEC 22 LOT 55	Winnsboro	Fairfield	2,128	2010	0.86	Yes	No	No	$708,728
159	RACHELS PATRICK E & WILLIAM M RACHELS	078-01-00-022-000	82 SAINTS DR SEC 22 LOT	Winnsboro	Fairfield	1,804	2002	0.75	Yes	No	No	$619,494
160	COOPER IRA D	078-01-00-023-000	60 SAINTS DR SEC 22 LOT	Winnsboro	Fairfield	1,152	2021	0.61	Yes	No	Yes	$396,071

Figure 90: Unimpaired Market Value Summary 121-160

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
161	ANDERSON MARY R	078-01-00-024-000	20 SAINTS DR SEC 22 LOT	Winnsboro	Fairfield	612	1950	0.86	Yes	No	No	$287,376
162	SABOL KENNETH A & MARYBETH AS TRUSTEES	078-01-00-025-000	936 TIMBERLANE CIRCLE SEC 22 LOT 69	Winnsboro	Fairfield	2,319	2013	0.74	Yes	Yes	No	$900,080
163	MASON ROBERT S SR & PATRA H	078-01-00-026-000	900 TIMBERLANE CIRCLE SEC 22 LOT 70	Winnsboro	Fairfield	2,949	2008	1.13	Yes	No	No	$835,919
164	MORRISON IRA T & DEBORAH B	078-02-00-001-000	858 TIMBERLANE CIRCLE SEC 22 LOT 71	Winnsboro	Fairfield	2,002	2015	0.78	Yes	Yes	No	$856,126
165	CHARRON KEVIN G & STEFANIE A	078-02-00-002-000	848 TIMBERLANE CIRCLE SEC 22 LOT 72	Winnsboro	Fairfield	1,296	1950	1.04	Yes	No	No	$411,953
166	LEHNHOFF RICHARD A &	078-02-00-003-000	818 TIMBERLANE CIRCLE SEC 22 LOT 73	Winnsboro	Fairfield	1,400	1950	0.96	Yes	No	No	$423,457
167	BOOTH GAYLE R	078-04-01-003-000	43 ORLANDO LANE SEC 22 LOT 75	Winnsboro	Fairfield	556	1950	0.74	Yes	No	No	$270,949
168	GWIN JAMES E & JUDITH C	078-04-01-002-000	792 TIMBERLANE CIRCLE SEC 22 LOT 74	Winnsboro	Fairfield	1,560	1950	0.93	Yes	No	No	$443,195
169	ZAPACK ZACHARY J TRUSTEE	078-04-01-004-000	81 ORLANDO LANE SEC 22 LOT 76	Winnsboro	Fairfield	961	1950	0.82	Yes	No	No	$351,016
170	BACKWARDS C LLC	078-04-01-001-000	80 ORLANDO LANE SEC 22 LOT 77	Winnsboro	Fairfield	1,560	1950	2.52	Yes	No	No	$490,573
171	DAVIDSON SHANNON D & KIMBERLY M JTROS	078-03-00-007-000	730 TIMBERLANE CIRCLE SEC 22 LOT 78	Winnsboro	Fairfield	1,698	1993	0.65	Yes	No	No	$564,708
172	MCWATERS DAVID W & BURNETTE M LIFE ESTATE	078-03-00-006-000	728 TIMBERLANE CIRCLE SEC 22 LOT	Winnsboro	Fairfield	864	1950	0.54	Yes	No	No	$320,805
173	OWEN NANCY G	078-03-00-005-000	726 TIMBERLANE CIRCLE	Winnsboro	Fairfield	1,296	1950	0.60	Yes	No	No	$389,656
174	HENSLEY GUERRY L & KAY G JTROS	078-03-00-003-000	550 TIMBERLANE CIRCLE SEC 22 LOT 83	Winnsboro	Fairfield	888	1950	1.16	Yes	No	No	$350,720
175	BONE RICHARD A & LYNN G	078-03-00-002-000	510 TIMBERLANE CIRCLE SEC 22 LOT 84	Winnsboro	Fairfield	2,360	1950	1.51	Yes	No	No	$561,992
176	MORRIS NANCY A	078-03-00-001-000	476 TIMBERLANE CIRCLE SEC 22 LOT 85	Winnsboro	Fairfield	2,841	2011	1.77	Yes	No	No	$874,873
177	ROBERT E CHRISTENBERY JR & KAREN ANN LIVING TRUST	078-03-00-008-000	944 PINEHURST RD SEC 22 LOT 8	Winnsboro	Fairfield	2,607	2010	1.23	Yes	Yes	No	$983,238
178	ATKINS CHARLES DAVID & JANEL E JTROS	078-03-00-009-000	904 PINEHURST RA SEC 22 LOT 8	Winnsboro	Fairfield	1,004	1950	1.49	Yes	No	No	$380,567
179	BAILEY JIMMY W & CANDICE C	078-03-00-010-000	858 PINEHURST RD SEC 22 LOT 8	Winnsboro	Fairfield	1,038	1950	1.23	Yes	No	No	$378,940
180	KEISTLER JAMES W JR	078-04-01-005-000	TRINITY DRIVE SEC 22 LOT 90	Winnsboro	Fairfield	480	1950	1.54	No	No	No	$231,564
181	DAVIS KENNETH D. & NANCY M. DAVIS	078-04-01-006-000	69 TRINITY DRIVE SEC 22 LOT 91	Winnsboro	Fairfield	2,934	2005	0.95	Yes	No	No	$805,586
182	CLAXTON CAROL ANN	078-04-01-008-000	145 TRINITY DRIVE SEC 22 LOT 93	Winnsboro	Fairfield	1,971	1950	1.95	Yes	No	No	$531,507
183	STEPHENSON KEITH H TRUSTEE	078-04-01-010-000	175 TRINITY DRIVE SEC 22 LOT 94	Winnsboro	Fairfield	768	1950	0.68	Yes	No	No	$311,138
184	ELLISON ROBERT B	078-04-01-009-000	150 TRINITY DRIVE SEC 22 LOT 94	Winnsboro	Fairfield	1,188	1950	0.79	Yes	No	No	$385,196
185	WATERBUGS LLC	078-04-01-013-000	758 PINEHURST RD SEC 22 LOT 10	Winnsboro	Fairfield	1,536	1950	1.29	Yes	No	No	$454,916
186	HUGHES DANIEL ROPER &	078-04-01-014-000	702 PINEHURST RD SEC 22 LOT 10	Winnsboro	Fairfield	1,799	1950	0.75	Yes	No	No	$462,579
187	SHELMIRE RAMONA	078-04-01-012-000	816 PINEHURST RD	Winnsboro	Fairfield	1,280	2024	2.37	No	No	No	$572,172
188	HEFNER CAROL A	095-02-01-024-000	4518 RIVER ROAD S 21 L 1 + EXTRA LOTS	Winnsboro	Fairfield	1,736	1950	3.02	Yes	No	Yes	$377,364
189	PINTO MARCOS HUBERTO ACOSTA	078-04-02-001-000	300 PINEHURST RD	Winnsboro	Fairfield	1,828	2001	89.25	Yes	No	No	$1,009,078
190	BOUTWELL DANA AS TRUSTEE	095-02-01-029-000	4184 RIVER	Winnsboro	Fairfield	4,490	2022	10.23	Yes	No	No	$1,369,492
191	SCOTT DOUGLAS W	095-02-01-026-000	4402 RIVER	Winnsboro	Fairfield	5,124	2012	3.68	Yes	No	No	$1,239,072
192	GRAY VIRGINIA	095-02-01-025-000	4472 RIVER	Winnsboro	Fairfield	5,124	2011	1.42	Yes	No	No	$1,118,401
193	BRAND DIRECT PROPERTIES LLC	078-04-01-015-000	686 PINEHURST RD SEC 22 LOT 10	Winnsboro	Fairfield	864	1987	1.10	Yes	No	No	$424,041
194	SEARS RANDY P	078-04-01-016-000	676 PINEHURST RD SEC 22 LOT 10	Winnsboro	Fairfield	2,204	1950	1.74	Yes	No	No	$552,608
195	BRUGH RHONDA H & REX	078-04-01-019-000	500 PINEHURST RD SEC 22 LOT 11	Winnsboro	Fairfield	2,229	1950	0.79	Yes	No	No	$512,540
196	BEASLEY KENNETH D & CLARA JTROS	078-04-01-020-000	120 DUCK COVE LANE SEC 22 LOT 105	Winnsboro	Fairfield	1,090	2012	0.78	Yes	No	No	$523,382
197	STEPHENSON JOE J	078-04-01-021-000	190 DUCK COVE LANE SEC 22 LOT 106	Winnsboro	Fairfield	1,496	1950	0.68	Yes	No	No	$421,350
198	HOOD ALEXANDER LEE	078-04-01-023-000	241 DUCK COVE LANE SEC 22 LOT 107	Winnsboro	Fairfield	1,008	1952	0.42	Yes	No	No	$338,937
199	STEPHENSON JAMES W III	078-04-01-022-000	242 DUCK COVE LANE SEC 22 LOT 108	Winnsboro	Fairfield	1,680	1950	0.94	Yes	No	No	$458,791
200	MCQUEENEY F R & CARLEEN E	078-04-02-002-000	116 N WATERS EDGE DR SEC 22 LOT 118	Winnsboro	Fairfield	3,546	2018	1.70	Yes	No	No	$1,002,135

Figure 91: Unimpaired Market Value Summary 161-200

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
201	CALDWELL ROBERT C JR ETAL	078-04-02-005-000	6 N WATERS EDGE DRIVE SEC 22 LOT 121	Winnsboro	Fairfield	1,242	1950	0.71	Yes	No	No	$388,759
202	JEFFCOAT GLENN BERNIE & LILLY BOULWARE	078-04-02-006-000	4 N WATERS EDGE DRIVE SEC 22 LOT 123	Winnsboro	Fairfield	1,736	1950	1.69	Yes	No	No	$494,397
203	PRICE W D JR & KAYE H	078-04-02-004-000	90 N WATERS EDGE DRIVE SEC 22 LOT 121	Winnsboro	Fairfield	3,123	1950	0.67	Yes	No	No	$587,657
204	BAGLEY KELLY MINCEY ETAL	078-04-02-007-000	71 S WATERS EDGE DRIVE SEC 22 LOT 127	Winnsboro	Fairfield	1,400	1950	0.97	Yes	No	No	$423,894
205	SINGLETON JOANN H	078-04-02-008-000	109 S WATERS EDGE DRIVE SEC 22 LOT 125	Winnsboro	Fairfield	786	1950	0.97	Yes	No	No	$325,871
206	BYRUM SHIRLEY W	078-04-02-009-000	163 S WATERS EDGE DRIVE SEC 22 LOT 127	Winnsboro	Fairfield	3,182	1950	1.33	Yes	No	No	$635,687
207	WARD SUSAN & RICK HARVEY	078-04-02-010-000	229 S WATERS EDGE DRIVE SEC 22 LOT 128	Winnsboro	Fairfield	2,360	1950	0.94	Yes	No	No	$535,509
208	HUBBARD JARROD M & KAREN L JTROS	078-04-02-011-000	243 SOUTH WATERS EDGE DRIVE	Winnsboro	Fairfield	1,906	1950	0.66	Yes	No	No	$468,486
209	STARNES BRIAN DOUGLAS ETAL	095-02-02-029-000	291 S WATERS EDGE DRIVE SEC 22 LOT 130	Winnsboro	Fairfield	1,476	1960	0.72	Yes	Yes	No	$543,132
210	MAHER MICHAEL LEE & LISA MICHELLE	095-02-02-027-000	355 S WATERS EDGE DRIVE SEC 22 LOT 131	Winnsboro	Fairfield	1,216	2004	0.73	Yes	No	Yes	$375,896
211	JOHNSON BENJAMIN D ETAL JTROS	095-02-02-025-000	179 MORNINGLOW DRIVE SEC 22 LOT 134	Winnsboro	Fairfield	2,228	1990	0.63	Yes	No	No	$626,486
212	MORNINGLOW LLC	095-02-02-024-000	183 MORNINGLOW DRIVE SEC 22 LOT 135	Winnsboro	Fairfield	1,288	2015	0.62	Yes	No	No	$560,640
213	RICE CLAUDE S JR & LAVERNE J CO-TRUSTEES	095-02-02-023-000	237 MORNINGLOW DRIVE SEC 22 LOT 136	Winnsboro	Fairfield	2,444	1950	0.75	Yes	No	No	$531,601
214	LAWRENCE KIMBERLY FRAZIER	095-02-02-022-000	247 MORNINGLOW DRIVE SEC 22 LOT 137	Winnsboro	Fairfield	2,432	1979	0.52	Yes	No	No	$600,973
215	YOUNG MARSHALL J JR	095-02-02-028-000	346 S WATERS EDGE DRIVE SEC 22 LOT	Winnsboro	Fairfield	1,847	1950	0.56	Yes	Yes	No	$554,561
216	HASELDEN MICHAEL & MARSHA	095-02-02-026-000	344 S WATERS EDGE DRIVE LOT 1	Winnsboro	Fairfield	4,836	2000	1.16	Yes	No	Yes	$721,947
217	CORRAO JACK & ANN	095-02-02-015-000	228 WHITE PINE RD	Winnsboro	Fairfield	2,266	2009	2.64	Yes	No	No	$812,950
218	DEMETER HOLDINGS LLC	095-02-02-021-000	295 MORNINGLOW DRIVE SEC 22 LOT 138	Winnsboro	Fairfield	1,632	1950	0.82	Yes	No	No	$446,681
219	FIELD RICHARD E & GLORIA W	095-02-02-020-000	301 MORNINGLOW DRIVE SEC 22 LOT 13	Winnsboro	Fairfield	3,720	2011	0.59	Yes	No	No	$884,234
220	WENDLAND JASON & PAMELA	095-02-02-019-000	311 MORNINGLOW DRIVE SEC 22 LOT 140	Winnsboro	Fairfield	774	1960	0.63	Yes	No	No	$327,438
221	WOODRUFF WARREN E & DEBRA TIMMS JTROS	095-02-02-018-000	319 MORNINGLOW DRIVE	Winnsboro	Fairfield	2,015	1950	1.02	Yes	No	No	$502,298
222	TUDERS JOHN F AND LISA	095-02-02-016-000	242 MORNINGLOW DR SEC 22 LOT 146	Winnsboro	Fairfield	2,486	2004	1.93	Yes	No	No	$798,510
223	BIGHAM BILLY JOE & EUNICE P	095-02-02-017-000	314 MORNINGLOW DRIVE SEC 22 LOT 2	Winnsboro	Fairfield	1,508	1950	1.10	Yes	No	No	$444,084
224	RICHARDSON JEREMY & CHRISTINA LEE JTROS	095-02-02-011-000	259 WINDEMERE DR SEC 22 LOT 14	Winnsboro	Fairfield	2,742	2014	0.83	Yes	Yes	No	$988,441
225	WILSON JOHNNY RAY	095-02-02-010-000	261 WINDEMERE DRIVE SEC 22 LOT 148	Winnsboro	Fairfield	1,104	1950	2.32	Yes	No	Yes	$299,058
226	PAYNE JEFFREY L	095-02-02-009-000	369 WINDEMERE DRIVE SEC 22 LOT 149	Winnsboro	Fairfield	1,326	1950	1.23	Yes	No	No	$423,633
227	BROWN RALPH W & JULIA HARRIET CO TRUSTEES	095-02-02-008-000	379 WINDEMERE DRIVE SEC 22 LOT 150	Winnsboro	Fairfield	3,486	1950	0.82	Yes	Yes	No	$769,268
228	QULIA HELEN H AS TRUSTEE	095-02-02-007-000	407 WINDEMERE DRIVE SEC 22 LOT 151	Winnsboro	Fairfield	1,705	1950	0.68	Yes	Yes	No	$545,197
229	BOYT JAMES A & LORI JTROS	095-02-02-006-000	410 WINDEMERE ROAD SEC 22 LOT 152	Winnsboro	Fairfield	990	1960	0.69	Yes	No	No	$369,813
230	DAVIS CAROLL WAYNE	095-02-02-005-000	402 WINDEMERE DRIVE SEC 22 LOT 153	Winnsboro	Fairfield	1,647	1950	0.67	Yes	No	No	$439,015
231	DAVIS CHRISTINE R ETAL	095-02-02-004-000	368 WINDEMERE DRIVE SEC 22 LOT 154	Winnsboro	Fairfield	1,614	1970	0.54	No	No	Yes	$290,856
232	WILLIAMS JAMES B & JILL C JTROS	095-02-02-013-000	155 WINDEMERE DR	Winnsboro	Fairfield	1,800	2024	1.67	No	No	No	$644,872
233	LINDAUER ROBERT G JR ETAL	095-02-01-002-000	531 WILD DOGWOOD ROAD	Winnsboro	Fairfield	1,056	1950	0.42	Yes	No	No	$342,555
234	NEELY GEORGE H & GENEVA S	095-02-01-020-000	4722 RIVER RD SEC 20 LOT 1	Winnsboro	Fairfield	832	1950	0.75	Yes	No	No	$325,975
235	MULLIS GARREN S & MARISA	095-01-00-002-000	414 WILD DOGWOOD LANE	Winnsboro	Fairfield	2,784	2018	1.30	Yes	No	No	$873,666
236	BUTTS MADELYN BOURGEOIS	095-02-01-009-000	484 WATEREE ESTATES	Winnsboro	Fairfield	2,869	1950	8.01	Yes	No	No	$727,996
237	RENWICK JOHN C JR & PAMELA W JTROS ET AL	095-04-02-037-000	998 DUTCHMAN LANE	Winnsboro	Fairfield	420	1950	94.15	Yes	No	No	$390,691
238	LORICK COLBY	095-04-03-029-000	187 & 75 DUTCHMAN LANE	Winnsboro	Fairfield	2,201	1950	1.52	Yes	No	No	$544,721
239	BOWEN CLINTON AMMON IV	095-02-01-010-000	312 WATEREE ESTATES	Winnsboro	Fairfield	2,184	1996	17.94	Yes	No	No	$903,426
240	SULLIVAN KEITH A & DEBORAH A	095-04-03-066-000	60 PLANTATION POINTE	Ridgeway	Fairfield	1,848	2011	10.47	Yes	No	No	$949,032

Figure 92: Unimpaired Market Value Summary 201-240

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
241	130 PLANTATION POINTE ROAD LLC	095-04-03-065-000	130 PLANTATION POINT RD TRACT 2-	Ridgeway	Fairfield	3,200	2009	3.82	Yes	No	No	$1,086,853
242	COBB DEAN R & LORI M	095-04-03-061-000	226 PLANTATION POINTE RD TRACTS 4A	Ridgeway	Fairfield	2,848	2007	5.82	Yes	No	No	$1,063,898
243	BIERER WALTER & BILLIE	095-04-03-052-000	227 N DUTCHMAN CREEK RD 9B-PLANT POINT	Ridgeway	Fairfield	2,128	2010	4.13	Yes	No	No	$915,204
244	ROLLINGS LOUIS MATTHEW & SANDR	113-02-00-012-000	625 S DUTCHMAN CREEK RD 17-PLANT POINT	Ridgeway	Fairfield	4,623	2018	8.36	Yes	No	No	$1,463,439
245	PLANTE PORTIA D & KENNETH TYLER YOUNGBLOOD JTROS	095-02-01-005-000	651 WILD DOGWOOD ROAD	Winnsboro	Fairfield	1,431	2018	1.00	No	No	No	$533,106
246	HESSLER CHRISTOPHER T &	095-04-03-053-000	236 N DUTCHMAN CREEK RD 9	Ridgeway	Fairfield	3,662	2024	4.55	Yes	No	No	$1,279,579
247	SPANG SCOTT ALAN & ELIZABETH TRENT	095-04-03-051-000	201 N DUTCHMAN CREEK RD LOT 10A	Ridgeway	Fairfield	8,617	1950	5.00	Yes	No	No	$1,259,048
248	ARCHIE DEAN & SUZANNE JTROS	113-02-00-011-000	620 S DUTCHMAN CREEK RD 16C-PLANT POINT	Ridgeway	Fairfield	2,964	1950	4.20	Yes	No	No	$761,443
249	WATEREE HOUSE LLC	095-04-03-062-000	192 PLANTATION POINTE	Ridgeway	Fairfield	2,541	2003	5.00	Yes	No	No	$972,670
250	WHITMAN STEPHEN H & KIMBERLY B	095-04-03-056-000	182 N DUTCHMAN CREEK RD 7B-PLANT POINT	Ridgeway	Fairfield	2,917	2009	5.58	Yes	Yes	No	$1,320,548
251	KIRKLAND CATHERINE C & THOMAS JEFFERSON KIRKLAND	113-02-00-009-000	DUTCHMAN CREEK RD TRACT 15-B	Ridgeway	Fairfield	2,471	1950	5.69	Yes	No	No	$723,019
252	HOLMES BRYAN D & DEBRA JTROS	095-04-03-001-000	1021 DUTCHMAN LANE SEC 20 LOT 54	Winnsboro	Fairfield	2,172	1950	0.68	Yes	No	No	$499,055
253	RENWICK JOHN C JR & PAMELA W	095-04-03-002-000	995 DUTCHMAN LANE SEC 20 LOT 53	Winnsboro	Fairfield	2,235	1950	0.67	Yes	No	No	$504,541
254	MULLER WILLIAM L	095-04-03-003-000	977 DUTCHMAN LANE SEC 20 LOT 52	Winnsboro	Fairfield	1,050	1989	0.62	Yes	No	Yes	$318,084
255	MARTIN ROGER & SVETLANA MEENACHAN JTROS	095-04-03-004-000	967 DUTCHMAN LANE SEC 20 LOT 5	Winnsboro	Fairfield	3,099	2006	0.67	Yes	No	No	$801,413
256	RENWICK CHARLES R & WILLIAM MCGILL JTROS	095-04-03-005-000	923 DUTCHMAN LANE SEC 20 LOT 50	Winnsboro	Fairfield	1,851	1950	0.59	Yes	No	No	$457,573
257	RAFFALDT LEE R & BRENDA C	095-04-03-007-000	819 DUTCHMAN LANE SEC 20 LOT 46	Winnsboro	Fairfield	2,652	2009	0.69	Yes	No	Yes	$547,936
258	PLATTS DAVID T & MAXIE M COX JR	095-04-03-008-000	793 DUTCHMAN LANE SEC 20 LOT 45	Winnsboro	Fairfield	750	1950	0.92	Yes	No	Yes	$228,318
259	SMOLLAR JOHN DAVID JR &	095-04-03-009-000	775 DUTCHMAN LANE SEC 20 LOT 44	Winnsboro	Fairfield	4,832	2014	0.73	Yes	No	Yes	$744,415
260	OSSOWSKI PATRICK A &	095-04-03-010-000	737 DUTCHMAN LANE SEC 20 LOT 43	Winnsboro	Fairfield	1,184	1950	0.81	Yes	No	No	$385,720
261	SHAMBLIN TIMMY J & GLADYS L	095-04-03-011-000	735 DUTCHMAN LANE SEC 20 LOT 42	Winnsboro	Fairfield	1,440	1976	0.66	Yes	No	Yes	$343,509
262	THREATT ROBERT W JR & VERA J	095-04-03-012-000	721 DUTCHMAN LANE SEC 20 LOT 41	Winnsboro	Fairfield	1,792	1950	0.82	Yes	No	Yes	$335,319
263	DRAUGHON ALENE C	095-04-03-013-000	701 DUTCHMAN LANE SEC 20 LOT 40	Winnsboro	Fairfield	2,356	2000	0.72	Yes	No	Yes	$495,877
264	CAIL WILLIAM GALEN	095-04-03-014-000	669 DUTCHMAN LANE SEC 20 LOT 39	Winnsboro	Fairfield	624	1950	1.60	Yes	No	No	$308,742
265	CRAINER KEVIN M & SUSAN M	095-04-03-016-000	529 DUTCHMAN LANE SEC 20 LOT 36	Winnsboro	Fairfield	1,408	2008	0.71	Yes	No	No	$569,587
266	JENERETTE BRYAN A & DEBORAH D	095-04-03-018-000	483 DUTCHMAN LANE SEC 20 LOT 34	Winnsboro	Fairfield	1,176	1979	0.76	Yes	No	No	$449,452
267	HELMS JEFFREY S & MELISSA T JTROS	095-04-03-019-000	477 DUTCHMAN LANE SEC 20 LOT 33	Winnsboro	Fairfield	2,180	1990	0.75	Yes	No	No	$631,704
268	DEER POND LLC	095-04-03-020-000	473 DUTCHMAN LANE SEC 20 LOT 32	Winnsboro	Fairfield	924	1968	0.61	Yes	No	Yes	$266,191
269	JONES JAMES PAUL JR & CAROLYN FREEMAN	095-04-03-021-000	457 DUTCHMAN LANE SEC 20 LOT 31	Winnsboro	Fairfield	1,104	1950	0.74	Yes	No	Yes	$266,011
270	ROBILLARD STEVEN L & JANE M JTROS	095-04-03-023-000	387 DUTCHMAN LANE	Winnsboro	Fairfield	1,560	1980	0.67	Yes	No	No	$507,220
271	SIMPSON SIMON DOUGLAS & VALERIE JOAN	095-04-03-024-000	375 DUTCHMAN LANE SEC 20 LOT 2	Winnsboro	Fairfield	2,108	2008	0.68	Yes	No	No	$681,103
272	MONTGOMERY TIMOTHY D & LINDA D	095-04-03-025-000	359 DUTCHMAN LANE SEC 20 LOT 25	Winnsboro	Fairfield	1,216	1950	0.76	Yes	Yes	No	$472,924
273	SCHWARTZ STEVEN K & RACHEL E JTROS	095-04-03-026-000	325 DUTCHMAN LANE SEC 20 LOT 24	Winnsboro	Fairfield	1,782	2001	0.57	Yes	No	Yes	$429,159
274	OSBORNE JAMES R SR & LORAYE JOAN	095-04-03-028-000	213 DUTCHMAN LANE SEC 20 LOT 22	Winnsboro	Fairfield	1,464	1950	0.74	Yes	No	Yes	$302,552
275	ROBILLAD JANE M LIFE ESTATE	095-04-03-022-000	397 DUTCHMAN LANE	Winnsboro	Fairfield	432	1950	1.60	No	No	No	$221,626
276	KENDALL EVERETT A II & NANCY M	095-04-03-006-000	883 DUTCHMAN LANE SEC 20 LOT 46-B	Winnsboro	Fairfield	1,866	2000	0.75	Yes	No	Yes	$447,800
277	GUISSINGER JANE W & JOHN	095-03-02-023-000	1709 WATEREE ESTATES	Winnsboro	Fairfield	1,248	1950	0.64	Yes	No	No	$385,474
278	BONNETTE DEREK R & JULIE M JTROS	095-03-02-022-000	1703 WATEREE ESTATES	Winnsboro	Fairfield	1,725	1991	0.49	Yes	No	No	$547,373
279	NEVES MARY JANE T	095-03-02-020-000	1525 WATEREE ESTATES	Winnsboro	Fairfield	1,898	1950	0.89	Yes	No	No	$482,429
280	CHRISTIANSON VERNON D ETAL	095-03-02-018-000	1489 WATEREE ESTATES	Winnsboro	Fairfield	1,584	1950	1.36	Yes	No	No	$464,020

Figure 93: Unimpaired Market Value Summary 241-280

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
281	GADDY JAMES CHRISTOPHER	095-03-02-015-000	49 RUNIC	Winnsboro	Fairfield	1,768	2014	0.87	Yes	No	No	$667,085
282	MYERS JEFFEREY & JIMMIE C	095-03-02-014-000	5 RUNIC	Winnsboro	Fairfield	1,788	1950	0.81	Yes	No	No	$465,178
283	OVERSTREET LARRY L	095-03-02-013-000	1325 WATEREE ESTATES	Winnsboro	Fairfield	1,104	2000	0.54	Yes	No	Yes	$341,051
284	SMITH KEVIN & DONNA J	095-03-02-012-000	1317 WATEREE ESTATES	Winnsboro	Fairfield	2,333	2012	0.50	Yes	Yes	No	$862,273
285	ANDERSON MICHAEL A & VICKI T	095-03-02-009-000	1233 WATEREE EST	Winnsboro	Fairfield	1,584	1950	0.71	Yes	No	No	$433,870
286	AYCOTH MICHAEL & ANN	095-03-02-008-000	1221 WATEREE ESTATES	Winnsboro	Fairfield	1,344	1950	1.31	Yes	No	No	$428,688
287	HINSON CHRIS & SUSAN	095-03-02-007-000	1141 WATEREE ESTATES RD SEC WE LOT 6	Winnsboro	Fairfield	1,802	2014	0.69	Yes	No	No	$657,495
288	HINSON JOSEPH MATTHEW	095-03-02-006-000	1109 WATEREE ESTATES	Winnsboro	Fairfield	905	1950	0.49	Yes	No	No	$324,018
289	JEWELL JACK D & PEGGY J	095-03-02-005-000	26 COPPER LANE	Winnsboro	Fairfield	1,296	2014	0.33	Yes	No	No	$524,844
290	CLEMENT ERNEST ROY	095-03-02-004-000	80 & 92 COPPER LANE	Winnsboro	Fairfield	1,371	1950	0.61	Yes	No	No	$400,477
291	JONES DONALD B & NELL N	095-04-02-002-000	20 RUMBLE	Winnsboro	Fairfield	1,140	1950	1.08	Yes	No	No	$390,082
292	COURTNEY LARRY BRITTON &	095-04-02-003-000	78 RUMBLE	Winnsboro	Fairfield	2,048	1950	0.56	Yes	No	No	$476,066
293	COOKE JIM & ARDEN JTROS	095-04-02-004-000	124 RUMBLE DR (MH DETITLED)	Winnsboro	Fairfield	2,432	2000	0.39	Yes	No	Yes	$473,157
294	TOLEN CAROL A	095-04-02-005-000	160 RUMBLE	Winnsboro	Fairfield	1,118	1950	0.43	Yes	No	No	$352,455
295	JACK & MARTHA WILKES TRUST	095-03-02-017-000	1419 WATEREE ESTATES	Winnsboro	Fairfield	1,572	2011	1.67	Yes	No	No	$664,230
296	ALLISON CHRISTIAN J	095-03-02-011-000	1295 WATEREE ESTATES ROAD	Winnsboro	Fairfield	2,495	1950	1.20	Yes	No	Yes	$405,233
297	NESBITT MARY FRANCES	095-03-02-010-000	1273 WATEREE ESTATES	Winnsboro	Fairfield	1,296	1950	0.76	Yes	No	No	$398,904
298	BONNETTE DEREK R & JULIE M	113-01-02-014-000	2031 WATEREE ESTATES RD SEC WE LOT 44	Winnsboro	Fairfield	1,150	1950	0.63	Yes	No	Yes	$266,827
299	LEGRAND LUCY VIRGINIA W B	113-01-02-015-000	2027 WATEREE ESTATES	Winnsboro	Fairfield	1,616	1986	1.14	Yes	No	Yes	$404,623
300	MUNGO MARY BOSWELL	113-01-02-016-000	1993 WATEREE ESTATES	Winnsboro	Fairfield	640	1950	0.72	Yes	No	No	$287,778
301	WILKES COLETTE D & RODNEY A ROS	095-03-02-024-000	1725 WATEREE ESTATES	Winnsboro	Fairfield	904	1950	1.17	Yes	No	No	$353,947
302	MARTIN STEVEN J & JOYCE A JTROS	095-03-02-025-000	1737 WATEREE ESTATES	Winnsboro	Fairfield	1,328	1950	0.86	Yes	No	No	$408,619
303	DELK THOMAS E III	113-01-02-019-000	1905 WATEREE ESTATES	Winnsboro	Fairfield	1,408	2011	0.49	Yes	No	No	$558,039
304	ARMSTEAD RONALD E & KAREN J	113-01-02-020-000	1895 WATEREE ESTATES RD LOT 36	Winnsboro	Fairfield	660	1961	0.53	Yes	No	No	$300,810
305	PATRICK ROBERT E JR & PRISCILLA G PATRICKS AS TRUSTEES	113-01-02-022-000	1867 WATEREE ESTATES	Winnsboro	Fairfield	2,622	1950	0.54	Yes	No	No	$530,708
306	TANT PAUL E & MARY A	113-01-02-023-000	1855 WATEREE ESTATES RD SEC WE LOT 33	Winnsboro	Fairfield	3,605	1950	0.55	Yes	No	No	$614,483
307	MURPHY CHARLES T & SANDRA R	095-03-02-026-000	49 RION	Winnsboro	Fairfield	1,734	1950	3.23	Yes	No	No	$527,878
308	CROSSLAND PAUL DAVID & MARIE VITALI ROS	095-03-02-027-000	79 RION	Winnsboro	Fairfield	624	1950	0.27	Yes	No	No	$257,662
309	DALE TARRANT T & JANICE M JTROS	095-03-02-028-000	109 RION	Winnsboro	Fairfield	680	1950	0.31	Yes	No	No	$271,647
310	VAUGHAN AMY CAROLINE &	095-03-02-029-000	121 RION	Winnsboro	Fairfield	4,200	2000	0.33	Yes	No	No	$828,362
311	TAYLOR MICHAEL L & LEA BARNES JTROS	095-03-02-030-000	127 RION CR SEC WE LOT 8	Winnsboro	Fairfield	2,320	1950	0.31	Yes	Yes	No	$577,962
312	HEDGEPATH MIRIAM L	113-01-02-032-000	147 RION CR SEC WE LOT 11	Winnsboro	Fairfield	3,052	2016	0.58	Yes	No	No	$828,753
313	HALIBUT BUSTERS PARTNERSHIP	113-01-02-031-000	155 RION CR SEC WE LOT 12A & 13	Winnsboro	Fairfield	1,030	1950	0.44	Yes	No	No	$339,699
314	ELIZABETH MATTOX AS TRUSTEE OF THE MATTOX FAMILY TRUST	113-01-02-027-000	64 RION	Winnsboro	Fairfield	1,288	1950	0.37	Yes	No	No	$369,466
315	HOLLAND CHERYL R	113-01-02-026-000	46 RION CR SEC WE LOT 17	Winnsboro	Fairfield	660	1963	0.39	Yes	No	Yes	$212,250
316	PAYNE REBECCA ANN &	113-01-02-028-000	207 RION	Winnsboro	Fairfield	1,200	1950	0.45	Yes	No	No	$365,059
317	BRANHAM JOEL R & HELEN S	113-01-02-025-000	44 RION CR SEC LOTS 31 & 3	Winnsboro	Fairfield	1,056	1950	0.55	Yes	No	No	$351,802
318	SMITH CLARENCE A JR &	113-01-02-024-000	26 RION	Winnsboro	Fairfield	2,522	2001	0.67	Yes	No	No	$709,831
319	WOOD GEORGE EDWARD	096-03-00-002-000	5555 RIVER RD SEC 20 LOT 11	Winnsboro	Fairfield	336	1950	0.56	Yes	No	No	$209,351
320	LEGRAND CHARLES MICHAEL & KATHERINE GUNTER LEGRAND LIFE ESTATE	096-03-00-001-000	5525 RIVER RD SEC 20 LOT 10	Winnsboro	Fairfield	2,152	1950	0.80	Yes	No	No	$505,357

Figure 94: Unimpaired Market Value Summary 281-320

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
321	FORNESS COLLEEN M	095-04-03-041-000	136 PALMETTO PLACE LN LOT 1	Winnsboro	Fairfield	3,024	2008	0.43	Yes	No	No	$765,618
322	WHITFIELD SWAIN E & AMY M	095-04-03-040-000	124 PALMETTO PLACE LN LOT 2	Winnsboro	Fairfield	3,024	1950	0.36	Yes	No	No	$543,807
323	KREESE GEORGE EUGENE	095-04-03-039-000	110 PALMETTO PLACE LN LOT 3	Winnsboro	Fairfield	3,024	1950	0.34	Yes	Yes	No	$658,175
324	INGLE JOHN RICHARD JR & TERESA	095-04-03-038-000	98 PALMETTO PLACE LN LOT 4	Winnsboro	Fairfield	3,024	1950	0.30	Yes	No	No	$533,876
325	SMITH DAVID R	095-04-03-037-000	86 PALMETTO PLACE LN LOT 5	Winnsboro	Fairfield	3,024	1950	0.44	Yes	No	No	$554,209
326	PAYTES NORMAN & LESLIE S	095-04-03-036-000	74 PALMETTO PL LN LOT 6	Winnsboro	Fairfield	2,880	1950	0.52	Yes	No	No	$551,941
327	LLOYD PAUL J & ALLYSON FAYE JTROS	095-04-03-035-000	62 PALMETTO PL LN LOT 7	Winnsboro	Fairfield	3,600	2006	0.54	Yes	No	No	$838,882
328	KING CHARLES ARTHUR & JANET	095-04-03-034-000	50 PALMETTO PL LN LOT 8	Winnsboro	Fairfield	2,880	1950	0.58	Yes	No	No	$557,646
329	HINES NATHANIEL & JENNIFER JTROS	095-04-03-033-000	38 PALMETTO PLACE LANE	Winnsboro	Fairfield	2,880	1950	0.55	Yes	No	No	$554,853
330	NORKETT CHARLES C III & KELLY S JTROS	095-04-03-032-000	26 PALMETTO PLACE LN LOT 10	Winnsboro	Fairfield	3,024	1950	0.56	Yes	No	No	$568,545
331	WINGARD DEBORAH C & PHILIP M	095-04-03-031-000	18 PALMETTO PLACE LN LOT 11	Winnsboro	Fairfield	3,024	1950	0.52	Yes	No	No	$564,716
332	HIGGINS ANDY C JR & ELLEN L	095-04-03-030-000	10 PALMETTO PLACE LN LOT 12	Winnsboro	Fairfield	3,024	2010	0.59	No	No	No	$678,489
333	SHOEMAKE FARRELL & SHEILA LIFE ESTATE	096-03-00-008-000	57 DEER RUN ROAD SEC 17 LOT 159	Ridgeway	Fairfield	1,183	1950	0.72	Yes	No	No	$419,313
334	MORGAN SANDRA M	096-03-00-011-000	175 DEER RUN ROAD SEC 17 LOT 156	Ridgeway	Fairfield	1,008	1950	0.68	Yes	No	No	$387,320
335	GANDY SHANE Q & BRENDA N	096-03-00-012-000	211 DEER RUN ROAD SEC 17 LOT 155	Ridgeway	Fairfield	8,010	2008	1.70	Yes	No	No	$1,509,841
336	FRAZER JOHN R &	096-03-00-013-000	237 DEER RUN ROAD SEC 17 LOT 154	Ridgeway	Fairfield	1,560	1950	0.61	Yes	No	No	$467,466
337	ANDERSON ROBERT JOHN HALVOR &	096-03-00-014-000	255 DEER RUN ROAD SEC 17 LOT 153	Ridgeway	Fairfield	824	1950	0.60	Yes	No	No	$348,753
338	RENWICK JOHN C JR ETAL	096-03-00-015-000	283 DEER RUN ROAD SEC 17 LOT 152	Ridgeway	Fairfield	960	1978	0.73	Yes	No	Yes	$321,361
339	HALL VICTOR ALLEN IV & LISA MARIE TRUSTEES	096-03-00-017-000	295 DEER RUN ROAD SEC 17 LOT 150	Ridgeway	Fairfield	576	1970	0.76	Yes	No	No	$339,786
340	BRITTON JANENE H & JULIE WILLIAMS RHODES	096-03-00-018-000	335 DEER RUN ROAD SEC 17 LOT 149	Ridgeway	Fairfield	1,056	1950	0.69	Yes	No	No	$396,463
341	MCCANN BRYAN S & ASHLEY M JTROS	096-03-00-019-000	379 DEER RUN ROAD SEC 17 LOT 148	Ridgeway	Fairfield	1,056	1985	0.82	Yes	No	Yes	$352,980
342	PATTISON DANA H	096-03-00-020-000	397 DEER RUN ROAD SEC 17 LOT 147	Ridgeway	Fairfield	1,344	1950	0.81	Yes	No	Yes	$323,263
343	CLARKSON WYLIE W & ANDREA M JTROS	096-03-00-035-000	1745 DEER RUN ROAD SEC 17 LOT 106	Ridgeway	Fairfield	1,400	2019	0.82	Yes	No	No	$675,246
344	BICKETT GLENN A JR	096-03-00-036-000	1795 DEER RUN ROAD SEC 17 LOT 105	Ridgeway	Fairfield	1,368	2020	0.68	Yes	No	No	$659,333
345	HIOTT HAROLD M & CARLA	096-03-00-037-000	1797 DEER RUN ROAD SEC 17 LOT 104	Ridgeway	Fairfield	1,344	1950	0.39	Yes	No	No	$417,094
346	FOUGEROUSSE DAVID & JANICE	096-03-00-038-000	1801 DEER RUN RD SEC 17 LOT 103	Ridgeway	Fairfield	1,288	2017	0.77	Yes	No	No	$638,558
347	WELSH JEROME T & ANNE B	096-03-00-039-000	1827 DEER RUN ROAD SEC 17 LOT 102	Ridgeway	Fairfield	2,176	2014	4.35	Yes	No	No	$950,479
348	SINCLAIR RONALD M & PAMELA R	096-03-00-041-000	1873 DEER RUN ROAD SEC 17 LOT 100	Ridgeway	Fairfield	1,824	1950	1.75	Yes	No	Yes	$401,935
349	TALBERT JOHNNIE RAY & TERESA W	096-03-00-042-000	1891 DEER RUN ROAD SEC 17 LOT 97	Ridgeway	Fairfield	1,426	1950	0.90	Yes	No	No	$466,636
350	WILLIAMS MICHAEL TODD & SANDRA HICKMAN JTROS	096-03-00-043-000	1909 DEER RUN ROAD SEC 17 LOT 96	Ridgeway	Fairfield	3,820	1968	0.76	Yes	No	No	$793,730
351	JONES TERRY M & PATRICIA R	096-04-00-001-000	1919 DEER RUN ROAD SEC 17 LOTS 94 & 95	Ridgeway	Fairfield	2,208	1950	1.76	Yes	No	No	$609,745
352	BOLAND ROBERT T & ALLIE G	096-04-00-002-000	1931 DEER RUN ROAD SEC 17 LOT 93	Ridgeway	Fairfield	780	1963	0.85	No	No	No	$321,871
353	STEELE ROY C & BRENDA R	096-04-00-003-000	1999 DEER RUN ROAD SEC 17 LOT 92	Ridgeway	Fairfield	1,152	1950	0.67	Yes	No	No	$411,077
354	WORTHINGTON MORRIS W & BRENDA T JTROS	096-04-00-007-000	2069 DEER RUN ROAD SEC 17 LOT 87	Ridgeway	Fairfield	672	1950	0.85	Yes	No	No	$329,767
355	WELSH JAMES D & SHEREE L	096-04-00-008-000	2145 DEER RUN ROAD SEC 17 LOT 86	Ridgeway	Fairfield	2,369	1950	0.63	Yes	No	No	$567,026
356	DOOLITTLE RUBY D	096-04-00-009-000	2149 DEER RUN ROAD SEC 17 LOT 85	Ridgeway	Fairfield	1,464	1950	0.69	Yes	No	Yes	$330,967
357	MANBECK CHRISTINE & RONALD	096-04-00-010-000	2169 DEER RUN ROAD SEC 17 LOT 84	Ridgeway	Fairfield	672	1969	0.66	Yes	No	No	$357,540
358	SERRANO MONICA MARIA & DOMENICO ANTONIO JTROS	096-04-00-011-000	2191 DEER RUN ROAD SEC 17 LOT 83	Ridgeway	Fairfield	1,634	2022	0.67	Yes	No	No	$720,750
359	PARRISH ELEANOR T & JAMES E JR	096-04-00-012-000	2207 DEER RUN ROAD SEC 17 LOT 82	Ridgeway	Fairfield	1,260	1950	0.77	Yes	No	No	$434,200
360	TURNER DONNA FOUSHEE	096-04-00-014-000	2237 DEER RUN ROAD SEC 17 LOT 80	Ridgeway	Fairfield	1,500	1950	0.79	Yes	No	No	$471,156

Figure 95: Unimpaired Market Value Summary 321-360

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
361	WORTHINGTON MORRIS W & BRENDA T	096-04-00-006-000	2065 DEER RUN ROAD SEC 17 LOT 89-C	Ridgeway	Fairfield	2,053	1950	3.19	Yes	No	No	$626,565
362	CESTARI PETER & CINDY JTROS	114-01-01-001-000	429 DEER RUN ROAD SEC 17 LOT 146	Ridgeway	Fairfield	1,392	1980	0.69	Yes	No	No	$531,444
363	FOOTE RICHARD D & PEARL E	114-01-01-002-000	437 DEER RUN ROAD SEC 17 LOT 145	Ridgeway	Fairfield	1,408	1950	0.67	Yes	No	No	$450,224
364	SCHOOLER ROBERT E 50% AND	114-01-01-003-000	463 DEER RUN ROAD SEC 17 LOT 144	Ridgeway	Fairfield	2,212	1950	0.58	Yes	No	No	$545,124
365	RECORD DONALD & BILLIEBETH	114-01-01-004-000	495 DEER RUN ROAD SEC 17 LOT 143	Ridgeway	Fairfield	2,516	2007	0.65	Yes	No	No	$804,767
366	JEANDHEUR GEORGE	114-01-01-007-000	705 DEER RUN ROAD SEC 17 LOT 139	Ridgeway	Fairfield	1,722	1950	0.60	Yes	No	No	$487,642
367	WILLIAMSON MASON H JR	114-01-01-008-000	713 DEER RUN ROAD SEC 17 LOT 138	Ridgeway	Fairfield	470	1963	0.70	Yes	No	Yes	$212,620
368	DAVIS TED E III & STEPHANIE	114-01-01-010-000	817 DEER RUN ROAD SEC 17 LOT 136	Ridgeway	Fairfield	1,496	1950	0.59	Yes	No	No	$456,667
369	SMITH GERALDINE AS TRUSTEE	114-01-01-012-000	927 DEER RUN ROAD SEC 17 LOT 133	Ridgeway	Fairfield	2,106	1950	0.71	Yes	No	No	$544,154
370	MILLER BONNIE L	114-01-01-013-000	935 DEER RUN ROAD SEC 17 LOT 132	Ridgeway	Fairfield	924	1975	0.70	Yes	No	Yes	$308,949
371	BDET PROPERTIES INC	096-03-00-023-000	969 DEER RUN ROAD SEC 17 LOT 131	Ridgeway	Fairfield	1,800	1980	0.70	Yes	No	No	$598,574
372	HESS LEONARD A	096-03-00-024-000	1001 DEER RUN ROAD SEC 17 LOT 130	Ridgeway	Fairfield	1,664	1950	0.74	Yes	No	No	$490,794
373	KNIGHT RICKY G	114-01-01-005-000	SEC 17 LOT 525-DEER RUN RD	Ridgeway	Fairfield	1,404	1950	0.68	Yes	Yes	Yes	$395,238
374	PRESTON FRANK BLAIR III & ELIZABETH GOVER TRUSTEES	096-03-00-025-000	1023 DEER RUN ROAD SEC 17 LOT 129	Ridgeway	Fairfield	1,120	1950	0.75	Yes	No	No	$410,640
375	GREENE JAMES L & SHIRLEY M	096-03-00-026-000	1037 DEER RUN ROAD SEC 17 LOT 128	Ridgeway	Fairfield	4,438	1950	0.73	Yes	No	No	$764,947
376	SHEPPARD CHARLES H JR	096-03-00-027-000	1101 DEER RUN ROAD SEC 17 LOT 127	Ridgeway	Fairfield	2,642	1950	0.69	Yes	No	No	$601,367
377	KINSEY VICTORIA Q ETAL	096-03-00-029-000	1151 DEER RUN ROAD SEC 17 LOT 125	Ridgeway	Fairfield	1,408	1950	0.66	Yes	No	No	$449,866
378	JORDAN STEVEN HOWARD & BETTY MASSIE REVOCABLE TRUST	096-03-00-030-000	1193 DEER RUN ROAD SEC 17 LOT 124	Ridgeway	Fairfield	1,188	1994	0.68	Yes	No	Yes	$384,133
379	SUTHERLAND WILLIAM E & NADINE M JTROS	096-03-00-031-000	1231 DEER RUN ROAD SEC 17 LOT 123	Ridgeway	Fairfield	2,080	1950	0.62	Yes	No	No	$533,501
380	NICHOLSON ELLEN M	096-03-00-032-000	1239 DEER RUN SEC 17 LOT 122	Ridgeway	Fairfield	1,456	1950	0.63	Yes	No	No	$454,272
381	CLENDENEN JAMES III AKA JIM &	096-03-00-033-000	1245 DEER RUN ROAD SEC 17 LOT 121	Ridgeway	Fairfield	1,367	1987	0.67	Yes	No	No	$546,276
382	WILSON BRENDA K & HAROLD G	096-03-00-034-000	1309 DEER RUN ROAD SEC 17 LOT 120	Ridgeway	Fairfield	1,728	1995	0.78	Yes	No	Yes	$464,858
383	FROCK BARBARA & CLARENCE JOSEPH JR. & MICHAEL JOSEPH JTROS	114-01-01-017-000	1329 DEER RUN ROAD SEC 17 LOT 119	Ridgeway	Fairfield	1,840	2014	0.52	Yes	No	No	$709,610
384	ALLISON EDWARD C JR & KIMBERLY DAWN JTROS	114-01-01-018-000	1337 DEER RUN ROAD SEC 17 LOT 118	Ridgeway	Fairfield	684	1967	0.78	Yes	No	Yes	$260,765
385	BURDEN JEFFREY & ELLEN C JTROS	114-01-01-019-000	1363 DEER RUN ROAD SEC 17 LOT 117	Ridgeway	Fairfield	1,280	1980	0.78	Yes	No	No	$517,918
386	TERYY & ASHLEY BUCHMANN REV LIVING TRUST	114-01-01-020-000	1405 DEER RUN ROAD SEC 17 LOT 116	Ridgeway	Fairfield	720	1950	0.71	Yes	No	No	$333,847
387	HENDRIX DOUGLAS & SANDRA	114-01-01-021-000	1423 DEER RUN ROAD SEC 17 LOT 115	Ridgeway	Fairfield	3,280	2021	0.50	Yes	No	No	$956,081
388	CAMPBELL STONEY III & CYNTHIA	114-01-01-022-000	1439 DEER RUN ROAD SEC 17 LOT 114	Ridgeway	Fairfield	1,680	1950	1.40	Yes	No	No	$526,086
389	LANGFORD WILLIAM D II	114-01-01-023-000	1553 DEER RUN ROAD SEC 17 LOT 111	Ridgeway	Fairfield	1,680	1950	1.05	Yes	No	Yes	$367,409
390	DUNKIN MARY LOU	114-01-01-024-000	1643 DEER RUN ROAD SEC 17 LOT 110	Ridgeway	Fairfield	1,296	1950	0.71	Yes	No	No	$436,397
391	MILLER ROBERT S & PATTI S JTROS ETAL	114-01-01-025-000	1711 DEER RUN RD S 17 L 108 & ADD LOT	Ridgeway	Fairfield	1,982	1950	0.99	Yes	No	No	$547,416
392	WALKER KIMBERLY C	114-01-01-026-000	1731 DEER RUN ROAD SEC 17 LOT 107	Ridgeway	Fairfield	1,920	1980	0.62	Yes	No	No	$608,322
393	GASTON JAMES M & CATHERINE C	114-02-02-001-000	2305 DEER RUN ROAD SEC 17 LOT 78	Ridgeway	Fairfield	1,260	1950	0.86	Yes	No	No	$438,907
394	WILKINS JOHNNY DEAN ET AL	114-02-02-002-000	2339 DEER RUN ROAD SEC 17 LOT 77	Ridgeway	Fairfield	1,808	1950	0.56	Yes	No	No	$495,691
395	WATTS LYNNE D TRUSTEE OF THE LYNNE D WATTS REVOCABLE LIVING TRUST DATED 4/18/17	114-02-02-003-000	2403 DEER RUN ROAD SEC 17 LOT 76	Ridgeway	Fairfield	1,557	1950	0.67	Yes	No	No	$471,646
396	SINGH DION	114-02-02-004-000	2415 DEER RUN ROAD SEC 17 LOT 75	Ridgeway	Fairfield	3,526	1950	0.83	Yes	No	No	$698,903
397	HUMPHRIES JEFFREY SCOTT & KIMBERLY JTROS	114-02-02-005-000	2425 DEER RUN ROAD SEC 17 LOT 74	Ridgeway	Fairfield	1,376	2014	0.80	Yes	No	No	$649,475
398	BRANHAM TALLEY JULIAN & JOYCE J JTROS	114-02-02-006-000	2497 DEER RUN ROAD SEC 17 LOT 73	Ridgeway	Fairfield	1,950	1950	0.59	Yes	No	Yes	$370,896
399	THOMPSON WILLIAM M & GEORGANN D	114-02-02-007-000	2529 DEER RUN ROAD SEC 17 LOT 72	Ridgeway	Fairfield	2,797	2014	0.85	Yes	No	No	$902,271
400	ORR LINDSAY ROBERT & SUSAN K JTROS	114-02-02-008-000	2563 DEER RUN ROAD SEC 17 LOT 71	Ridgeway	Fairfield	1,848	1950	0.71	Yes	No	No	$512,458

Figure 96: Unimpaired Market Value Summary 361-400

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
401	DUBISZ EDWARD	114-02-02-009-000	2569 DEER RUN ROAD SEC 17 LOT 70	Ridgeway	Fairfield	1,788	1987	0.63	Yes	No	No	$613,517
402	SLOAN BRENDA JEAN AS TRUSTEE	114-02-02-010-000	2615 DEER RUN ROAD SEC 17 LOT 69	Ridgeway	Fairfield	1,596	1950	0.70	Yes	No	No	$478,604
403	DUNPHY BRIAN P & MICHELE L	114-02-02-012-000	2669 DEER RUN ROAD SEC 17 LOT 67	Ridgeway	Fairfield	4,282	2022	0.67	Yes	No	No	$1,118,266
404	CORDUM NIC ROLAND & STEPHANIE ESTEP	114-02-02-013-000	2685 DEER RUN ROAD SEC 17 LOT 66	Ridgeway	Fairfield	3,160	1950	0.69	Yes	No	No	$652,311
405	FLINT HILL FARMS LLC	113-01-01-001-000	WATEREE EST RD TRACTS A&B&CONCERV	Winnsboro	Fairfield	3,800	2017	200.87	Yes	No	No	$1,671,924
406	COOLMAN JAMES & ELLEN	113-02-00-020-000	585 DUTCHMAN CREEK	Ridgeway	Fairfield	2,488	1950	7.58	Yes	No	No	$746,853
407	RUARK DARREN L & MEGAN WARD	113-01-02-010-000	2103 WATEREE ESTATES	Winnsboro	Fairfield	910	1980	0.49	Yes	No	No	$384,516
408	CALDWELL DELIA & DENISE G. KEATING	113-01-02-009-000	2109 WATEREE ESTATES	Winnsboro	Fairfield	850	1959	0.75	Yes	No	No	$345,983
409	BAKER JENNIFER MARY ETAL JTROS	113-01-02-008-000	2139 WATEREE ESTATES	Winnsboro	Fairfield	1,886	1988	0.64	Yes	No	No	$574,976
410	CONNORS MICHAEL & LESLIE	113-01-02-007-000	2153 WATEREE ESTATES	Winnsboro	Fairfield	1,030	1950	0.59	Yes	No	No	$350,431
411	CONNERS MICHAEL AS TRUSTEE	113-01-02-006-000	2171 WATEREE ESTATES	Winnsboro	Fairfield	1,440	1950	0.52	Yes	No	No	$402,707
412	GLADDEN THEODORE LIFE ESTATE	113-01-02-005-000	2199 WATEREE ESTATES RD SEC WE LOT 53	Winnsboro	Fairfield	1,824	1950	0.52	Yes	No	No	$448,343
413	CROWDER RICHARD JACOB	113-01-02-004-000	2233 WATEREE ESTATES RD SEC WE LOT 54	Winnsboro	Fairfield	768	1960	0.43	Yes	No	No	$313,666
414	MCEWEN SILAS P SR	113-01-02-003-000	2237 WATEREE ESTATES RD LOT 55	Winnsboro	Fairfield	938	1950	0.30	Yes	No	No	$313,194
415	GIBBS MATTHEW LEE	113-01-02-002-000	2241 WATEREE ESTATES RD SEC WE LOT 55	Winnsboro	Fairfield	1,536	2007	0.26	Yes	No	No	$532,670
416	CHANDLER CANAAN & AMANDA	113-01-02-001-000	2243 WATEREE ESTATES RD SEC WE LOT 122	Winnsboro	Fairfield	1,280	1986	0.90	Yes	No	No	$493,836
417	COSTELLO CHRISTOPHER SCOTT	114-02-03-011-000	3141 DEER RUN ROAD SEC 17 LOT 17	Ridgeway	Fairfield	1,280	2009	0.77	Yes	No	No	$609,104
418	TYNER JAMES E & DOROTHY L	114-02-03-012-000	18 GREEN ACRES ROAD SEC 17 LOT 18	Ridgeway	Fairfield	5,020	1950	0.78	Yes	No	No	$815,389
419	TRAPP FRANCES C	114-02-03-013-000	64 GREEN ACRES ROAD SEC 17 LOT 19	Ridgeway	Fairfield	4,292	1950	0.81	Yes	No	No	$762,162
420	LYONS FRANKLIN BRENT & ASHLEY DILL JTROS	114-02-03-014-000	78 GREEN ACRES ROAD SEC 17 LOT 18	Ridgeway	Fairfield	1,025	1950	0.80	Yes	No	No	$397,130
421	SLAPPEY WILLIAM F & CHRISTINE	114-02-03-015-000	84 GREEN ACRES ROAD SEC 17 LOT 21	Ridgeway	Fairfield	3,619	1950	0.84	Yes	No	No	$707,749
422	HUBACH FAMILY TRUST	114-02-03-016-000	85 GREEN ACRES ROAD SEC 17 LOT 22	Ridgeway	Fairfield	2,164	1950	0.78	Yes	No	No	$555,999
423	REYNOLDS STEVE L JR	114-02-03-018-000	3063 DEER RUN ROAD SEC 17 LOT 23	Ridgeway	Fairfield	868	1950	0.61	Yes	No	No	$358,141
424	MATTHEWS CAROLYN D & RUSSELL E JTROS	114-02-03-019-000	3023 DEER RUN ROAD SEC 17 LOT 24	Ridgeway	Fairfield	3,468	2008	0.90	Yes	No	No	$967,649
425	HOGAN MICHAEL & STEPHANIE JTROS	114-02-03-020-000	2977 DEER RUN ROAD SEC 17 LOT 25	Ridgeway	Fairfield	1,056	2022	0.90	Yes	No	No	$609,270
426	HILL DAWN M	114-02-03-021-000	2945 DEER RUN ROAD SEC 17 LOT 26	Ridgeway	Fairfield	1,368	1950	0.58	Yes	Yes	No	$533,995
427	NOTTOLI JAMES SCOTT & TRACI FLOYD	114-02-03-024-000	88 WINDY COVE LANE	Ridgeway	Fairfield	4,059	1950	2.48	Yes	Yes	No	$1,015,372
428	MURRAY LYNN S & CHRISTOPHER Y	114-02-03-025-000	122 WINDY COVE LANE	Ridgeway	Fairfield	1,787	2015	0.76	Yes	No	No	$731,926
429	SMITH DONALD J & SARAH F AS TRUSTEES	114-02-03-026-000	WINDY COVE LANE SEC 17 LOT 32	Ridgeway	Fairfield	1,344	1950	0.83	Yes	No	No	$450,430
430	INGLE JOHN R &	114-02-03-027-000	192 WINDY COVE LANE SEC 17 LOT 33	Ridgeway	Fairfield	2,860	2014	0.91	Yes	No	No	$917,455
431	KIRK JAMES E & BARBARA R	114-02-03-028-000	214 WINDY COVE LANE SEC 17 LOT 34	Ridgeway	Fairfield	1,476	1950	0.95	Yes	No	Yes	$342,896
432	GAINEY THOMAS L JR ETAL	114-02-02-021-000	149 WINDY COVE LANE SEC 17 LOTS 57 & 5	Ridgeway	Fairfield	1,144	1960	1.00	Yes	No	No	$451,449
433	GARDNER JAMES C & DEBORAH E JTROS	114-02-02-020-000	93 WINDY COVE LANE	Ridgeway	Fairfield	3,190	2010	2.03	Yes	Yes	No	$1,247,857
434	MAGLIOLO JERRY L & STELLA F JTROS	114-02-02-017-000	2753 DEER RUN ROAD SEC 17 LOT 62	Ridgeway	Fairfield	3,416	1950	0.67	Yes	No	No	$673,910
435	MCCANN AMANDA	114-02-02-016-000	2735 DEER RUN ROAD SEC 17 LOT 63	Ridgeway	Fairfield	3,219	2019	0.59	Yes	No	No	$953,391
436	BRANHAM MARY ETAL WITH RIGHT O	114-02-02-014-000	2697 DEER RUN ROAD SEC 17 LOT 65	Ridgeway	Fairfield	624	1950	0.59	Yes	No	No	$307,232
437	KRAMBER JOANN E TRUSTEE	114-02-02-015-000	2707 DEER RUN ROAD SEC 17 LOT 64	Ridgeway	Fairfield	2,246	2002	0.60	Yes	No	No	$737,101
438	YARBOROUGH TODD W & KAREN B	114-02-01-008-000	3196 DEER RUN RD	Ridgeway	Fairfield	1,754	2015	3.36	Yes	No	No	$844,036
439	RANKIN GWENDOLYN	114-02-03-029-000	238 WINDY COVE LANE SEC 17 LOT 35	Ridgeway	Fairfield	1,752	1950	1.03	Yes	No	No	$519,700
440	BELLINGER JOHN N JR	114-02-03-031-000	290 WINDY COVE LANE SEC 17 LOT 37	Ridgeway	Fairfield	1,176	1950	0.96	Yes	No	No	$430,474

Figure 97: Unimpaired Market Value Summary 401-440

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
441	JONES ELIZABETH A	114-02-03-032-000	314 WINDY COVE LANE SEC 17 LOT 38	Ridgeway	Fairfield	924	1979	0.77	No	No	Yes	$270,807
442	BARBER CECIL E & JEANETTE	114-02-03-033-000	338 WINDY COVE LANE SEC 17 LOT 39	Ridgeway	Fairfield	1,976	1950	0.85	Yes	No	No	$538,471
443	MORSE JIMMY R & CHRIS B	114-02-03-034-000	374 WINDY COVE LANE SEC 17 LOT 40	Ridgeway	Fairfield	2,301	1950	1.17	Yes	No	No	$595,727
444	RUDELL ROGER A & CHERYL	114-02-03-035-000	402 WINDY COVE LANE SEC 17 LOT 41	Ridgeway	Fairfield	2,304	1950	1.24	Yes	No	No	$599,738
445	SNAVELY JACOB R	114-02-03-036-000	428 WINDY COVE LANE SEC 17 LOT 42	Ridgeway	Fairfield	1,638	2003	0.95	Yes	No	No	$672,867
446	ALBIZA LUIS & EMMA	114-02-02-034-000	431 WINDY COVE LANE SEC 17 LOT 44	Ridgeway	Fairfield	864	1950	0.37	Yes	No	Yes	$244,123
447	JORDAN JOHN C & WENDY B JTROS	114-02-02-033-000	421 WINDY COVE LANE	Ridgeway	Fairfield	1,356	2021	0.79	Yes	No	No	$670,315
448	DIVERS ANNE P & DANIEL J JTROS	114-02-02-032-000	413 WINDY COVE LANE SEC 17 LOT 46	Ridgeway	Fairfield	2,848	1950	0.84	Yes	No	No	$634,684
449	MCLEOD JULIA S & PHIL R	114-02-02-031-000	395 WINDY COVE LANE SEC 17 LOT 47	Ridgeway	Fairfield	2,211	2023	0.93	Yes	No	No	$860,697
450	WATSON MICHAEL H & KELLEY B	114-02-02-030-000	377 WINDY COVE LANE SEC 17 LOT 48	Ridgeway	Fairfield	2,315	1950	1.19	Yes	No	Yes	$430,523
451	JEFFERY RADTKE LIVING TRUST	114-02-02-029-000	363 WINDY COVE LANE SEC 17 LOT 49	Ridgeway	Fairfield	4,175	1980	1.06	Yes	Yes	No	$1,115,518
452	TALLEY MICHAEL HOLT TRUSTEE ETAL	114-02-02-028-000	353 WINDY COVE LANE SEC 17 LOT 50	Ridgeway	Fairfield	1,872	2021	1.10	Yes	No	No	$802,381
453	LOWE WILLIAM T & CAROL P	114-02-02-027-000	327 WINDY COVE LANE	Ridgeway	Fairfield	5,240	2011	0.97	Yes	No	No	$1,195,766
454	CAMERON LARRY C ETAL JTROS	114-02-02-026-000	313 WINDY COVE LANE SEC 17 LOT 5	Ridgeway	Fairfield	2,397	1950	0.86	Yes	No	No	$588,561
455	COX MILES P & JULIA B JTROS	114-02-02-025-000	259 WINDY COVE LANE SEC 17 LOT 53	Ridgeway	Fairfield	1,116	1950	1.02	Yes	No	No	$422,718
456	NEWTON GEORGE B SR & ROBIN S	114-02-02-024-000	219 WINDY COVE LANE SEC 17 LOT 54	Ridgeway	Fairfield	1,272	1950	1.08	Yes	No	Yes	$324,722
457	TETTMAR CHRISTOPHER JAMES & JULIE CHRISTINE JTROS	114-02-02-022-000	177 WINDY COVE LANE SEC 17 LOT 56	Ridgeway	Fairfield	400	1971	1.02	Yes	No	No	$298,372
458	FOREMAN JAY A	114-02-03-001-000	3417 DEER RUN ROAD SEC 17 LOT 7	Ridgeway	Fairfield	1,421	2009	0.81	Yes	No	No	$641,984
459	CORN JULIA F	114-02-03-002-000	3397 DEER RUN ROAD SEC 17 LOT 8	Ridgeway	Fairfield	1,613	1950	0.71	Yes	No	Yes	$346,772
460	GAUSE THOMAS & WANDA	114-02-03-003-000	3355 DEER RUN ROAD SEC 17 LOT 9	Ridgeway	Fairfield	1,584	1986	0.75	Yes	No	Yes	$423,291
461	PLYLER TERRY & ROBYN JTROS	114-02-03-004-000	3333 DEER RUN RD SEC 17 LOT 10	Ridgeway	Fairfield	1,054	1950	0.66	Yes	No	No	$393,857
462	KEOGH EILEEN M & PETER J	114-02-03-005-000	3311 DEER RUN ROAD SEC 17 LOT 11	Ridgeway	Fairfield	2,560	1950	0.62	Yes	No	No	$586,373
463	THE CORLEY COMPOUND FAMILY TRUST	114-02-03-006-000	3279 DEER RUN ROAD SEC 17 LOT 12	Ridgeway	Fairfield	1,376	2014	0.68	Yes	No	No	$638,372
464	WILLIAMS MICHAEL L	114-02-03-007-000	3277 DEER RUN ROAD SEC 17 LOT 13	Ridgeway	Fairfield	1,204	1950	0.81	Yes	No	No	$427,580
465	LEGRAND RITA C	114-02-03-009-000	3195 DEER RUN ROAD SEC 17 LOT 15	Ridgeway	Fairfield	1,212	1950	0.68	Yes	No	No	$421,016
466	BOOZER JOSEPH R JR & OLIVIA P JTROS	114-02-03-010-000	3193 DEER RUN ROAD SEC 17 LOT 16	Ridgeway	Fairfield	666	1965	1.04	Yes	No	No	$364,458
467	FELTON JAMES H JR	114-01-02-004-000	3527 DEER RUN ROAD SEC 17 LOT 4	Ridgeway	Fairfield	1,601	1950	0.69	No	No	No	$406,030
468	COGGINS COVE LLC	114-01-02-005-000	3507 DEER RUN ROAD SEC 17 LOT 5	Ridgeway	Fairfield	1,716	1988	0.82	Yes	No	Yes	$447,835
469	TUCKER JEFFREY RYAN	114-01-02-003-000	3541 DEER RUN ROAD SEC 17 LOT 3	Ridgeway	Fairfield	1,296	1992	0.64	No	No	Yes	$333,116
470	GETHERS WENDELL E AND AUDREY JTROS	114-02-04-002-000	169 WESTSHORE DR SEC 14 LOT 125	Ridgeway	Fairfield	1,100	1950	0.78	Yes	No	No	$408,767
471	MCCANN PATRICK & AMANDA S	114-02-04-006-000	331 WESTSHORE DR SEC 14 LOTS 120 & 12	Ridgeway	Fairfield	2,115	2001	0.60	Yes	No	No	$712,813
472	TILLETT TERESA CALDWELL	114-02-04-008-000	363 WESTSHORE DR SEC 14 LOT 119	Ridgeway	Fairfield	1,344	1950	0.65	Yes	No	No	$439,320
473	HANNA HENRY F & BRENDA JTROS	114-02-04-009-000	387 WESTSHORE DR SEC 14 LOT 11	Ridgeway	Fairfield	1,188	1983	0.67	Yes	No	Yes	$360,972
474	BRUNEAU BRUCE F	114-02-04-010-000	427 WESTSHORE DR SEC 14 LOT 117	Ridgeway	Fairfield	2,240	1950	0.63	Yes	No	No	$552,855
475	SMITH CHRISTOPHER J & CHRISJON M JTROS	114-02-04-011-000	441 WESTSHORE DR SEC 14 LOT 11	Ridgeway	Fairfield	3,231	2006	0.58	Yes	No	No	$886,534
476	MINTON VANESSA	114-02-04-013-000	499 WESTSHORE DR SEC 14 LOT 113	Ridgeway	Fairfield	1,572	1950	0.68	Yes	No	No	$474,325
477	PHILBRICK TERRENCE WADE SR ET AL	114-02-04-015-000	559 WESTSHORE DR SEC 14 LOT 111	Ridgeway	Fairfield	2,520	1993	0.77	Yes	No	No	$757,032
478	THOMAS ALVIN B JR & LISA M	114-02-04-016-000	627 WESTSHORE DR SEC 14 LOT 110	Ridgeway	Fairfield	1,758	1950	0.69	Yes	No	No	$499,694
479	BUSH PHLLIP M & AMY	114-02-04-017-000	639 WESTSHORE DR SEC 14 LOT 109	Ridgeway	Fairfield	2,268	2014	0.79	Yes	No	No	$813,688
480	CRAWFORD ELIZABETH H & GEORGE JTROS	114-02-04-018-000	657 WESTSHORE DR SEC 14 LOT 108	Ridgeway	Fairfield	1,680	2021	0.74	Yes	No	No	$733,905

Figure 98: Unimpaired Market Value Summary 441-480

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
481	SETTY AMANDA P & ROHIT B JTROS	114-02-04-020-000	695 WESTSHORE	Ridgeway	Fairfield	768	1950	1.38	Yes	No	No	$367,896
482	WATTERSON THOMAS S ETAL	114-02-04-021-000	715 WESTSHORE DR SEC 14 LOT 105	Ridgeway	Fairfield	1,959	1950	0.81	Yes	No	No	$533,466
483	HONEYCUTT RODNEY LEE	114-02-04-022-000	747 WESTSHORE DR SEC 14 LOT 104	Ridgeway	Fairfield	2,448	1950	0.65	Yes	No	Yes	$415,308
484	ODOM WILBUR LEE SR	114-02-04-012-000	477 WESTSHORE DR SEC 14 LOT 11	Ridgeway	Fairfield	2,740	2011	0.88	Yes	No	Yes	$634,612
485	REYNOLDS ROBERT T LIFE ESTATE	114-02-04-005-000	239 WESTSHORE DR SEC 14 LOT 122	Ridgeway	Fairfield	2,027	2015	0.85	Yes	No	No	$783,614
486	BOST LAURA	114-02-04-026-000	851 WESTSHORE DR SEC 14 LOT 99	Ridgeway	Fairfield	1,305	1950	0.81	Yes	No	No	$443,549
487	WATSON JERRY E & JENNIFER H	114-02-04-027-000	893 WESTSHORE DR SEC 14 LOT 98	Ridgeway	Fairfield	1,104	1950	0.62	Yes	No	Yes	$287,993
488	GILMORE JOSEPH LEE & MOLLY K JTROS	114-02-04-028-000	919 WESTSHORE DR SEC 14 LOT 97	Ridgeway	Fairfield	984	2023	0.61	Yes	No	No	$570,921
489	STRICKLAND PAUL M & CHERRY W JTROS	114-02-04-029-000	955 WESTSHORE DR SEC 14 LOT 9	Ridgeway	Fairfield	1,680	1950	0.65	Yes	No	No	$486,799
490	TRIPLE WING PLANTATION LLC	114-02-04-030-000	WESTSHORE DRIVE SEC 14 LOT 95	Ridgeway	Fairfield	612	1971	0.68	Yes	No	Yes	$249,760
491	HARTNESS JOHN M & CHERYL B JTROS	114-02-04-032-000	57 HICKORY NUT LANE SEC 14 LOT 93	Ridgeway	Fairfield	2,559	1950	0.74	Yes	No	No	$596,738
492	PITTMAN JOHN R JR & WINTER J	114-02-04-033-000	58 HICKORY NUT LANE SEC 14 LOT 92	Ridgeway	Fairfield	2,131	2021	0.65	Yes	No	No	$807,354
493	ROBINSON VANESSA DALE	114-02-04-034-000	1011 WESTSHORE DRIVE SEC 14 LOT 91	Ridgeway	Fairfield	2,936	1989	0.74	Yes	No	No	$790,798
494	HOLLAND JUSTIN & SHARON	114-02-04-035-000	1043 WESTSHORE DRIVE SEC 14 LOT 90	Ridgeway	Fairfield	1,248	1950	0.70	Yes	No	No	$428,005
495	SUMOSKI DAVID A & JENNIFER B JROS	114-02-04-025-000	845 WESTSHORE DR SEC 14 LOT 100	Ridgeway	Fairfield	6,632	1950	1.05	Yes	No	No	$953,171
496	SCOTT JUDY B	114-04-01-003-000	1171 WESTSHORE DRIVE SEC 14 LOT 85	Ridgeway	Fairfield	1,512	1950	1.02	Yes	No	No	$485,705
497	DOWLIN WILLIAM ALEXANDER & HEATHER JTROS	114-04-01-004-000	1177 WESTSHORE DRIVE SEC 14 LOT 84	Ridgeway	Fairfield	1,712	1950	0.60	Yes	No	No	$486,354
498	PATTERSON KERMIT H JR	114-04-01-005-000	1237 WESTSHORE DRIVE SEC 14 LOT 83	Ridgeway	Fairfield	1,515	1980	0.66	Yes	No	No	$549,677
499	JONES ALAN E TRUSTEE	114-04-01-006-000	1253 WESTSHORE DRIVE SEC 14 LOT 82	Ridgeway	Fairfield	3,244	1950	0.79	Yes	No	No	$669,381
500	ROBERTS RONALD P & DARLENE H JTROS	114-04-01-008-000	1375 WESTSHORE DRIVE SEC 14 LOT 79	Ridgeway	Fairfield	4,655	1950	1.20	Yes	No	No	$822,973
501	DANIEL BARCLAY LEHMAN REVOCABLE LIVING TRUST ETAL	114-04-01-009-000	1387 WESTSHORE DRIVE SEC 14 LOT 78	Ridgeway	Fairfield	1,656	1950	0.62	Yes	No	Yes	$345,769
502	LATTANZI JO-AN	114-04-01-010-000	1403 WESTSHORE DRIVE SEC 14 LOT 77	Ridgeway	Fairfield	756	1950	0.83	Yes	No	Yes	$249,484
503	FREEMAN JERROLD & JEANNE JTROS	114-04-01-011-000	1419 WESTSHORE DRIVE SEC 14 LOT 76	Ridgeway	Fairfield	1,512	2004	0.98	Yes	No	No	$654,276
504	LANGUERAND ALFRED J & PATRICIA A BLOCK JTROS	114-04-01-012-000	1505 WESTSHORE DR SEC 14 LOT 74 &.70 AC	Ridgeway	Fairfield	1,112	1978	1.38	Yes	No	No	$509,396
505	MONTGOMERY JANE B & STANTON Y	114-04-01-013-000	1559 WESTSHORE DRIVE SEC 14 LOT 73	Ridgeway	Fairfield	2,078	2011	0.62	Yes	No	No	$750,125
506	WHITFIELD SHARON P	114-04-01-015-000	1607 WESTSHORE DRIVE SEC 14 LOT 71	Ridgeway	Fairfield	1,522	1950	0.81	Yes	No	No	$475,652
507	INSTONE SASCHA & CHARLES	114-04-02-002-000	183 KINGFISHER DRIVE SEC 14 LOT 68	Ridgeway	Fairfield	1,404	1998	0.83	Yes	No	Yes	$432,591
508	MATHIS LINDA W	114-04-02-003-000	185 KINGFISHER DRIVE SEC 14 LOT 67	Ridgeway	Fairfield	1,792	1950	0.74	Yes	No	No	$507,853
509	JOYNER JAMES WAYNE & JULIE DEESE	114-04-02-005-000	251 KINGFISHER DRIVE SEC 14 LOT 65	Ridgeway	Fairfield	924	1980	0.83	Yes	No	Yes	$323,282
510	WALKER PEGGY D	114-04-02-006-000	275 KINGFISHER DRIVE SEC 14 LOT 64	Ridgeway	Fairfield	624	1950	0.79	Yes	No	No	$316,350
511	FULMER DAVID W & SUSAN SHULL FULMER JTROS	114-04-02-007-000	321 KINGFISHER DRIVE SEC 14 LOT 63	Ridgeway	Fairfield	744	1950	1.26	Yes	No	No	$359,464
512	LYNN RODNEY M & BETH B ETAL	114-04-02-008-000	335 KINGFISHER DRIVE SEC 14 LOT 62	Ridgeway	Fairfield	1,821	2017	0.81	Yes	No	No	$750,706
513	CARTER CHRISTOPHER BRENT & LAUREN EVE JTROS	114-04-02-009-000	411 KINGFISHER DRIVE SEC 14 LOT 61	Ridgeway	Fairfield	552	1971	0.67	Yes	No	Yes	$238,228
514	FISHER RONALD L & KAREN V	114-04-02-010-000	453 KINGFISHER DRIVE SEC 14 LOT 60	Ridgeway	Fairfield	1,708	2007	0.57	Yes	No	No	$665,001
515	JACKSON LAUREN M	114-04-02-011-000	455 KINGFISHER DRIVE SEC 14 LOT 59	Ridgeway	Fairfield	938	1983	0.71	Yes	No	Yes	$325,754
516	LISHA L WATTS MAXWELL FAMILY TRUST	114-04-02-012-000	477 KINGFISHER DRIVE SEC 14 LOT 5	Ridgeway	Fairfield	1,729	2007	0.81	Yes	No	No	$693,857
517	BIGGER SUZANNE & ANDREW C	114-04-02-013-000	479 KINGFISHER DRIVE SEC 14 LOT 57	Ridgeway	Fairfield	1,620	1950	0.89	Yes	Yes	Yes	$433,443
518	JENERETTE BRYAN A & DEBORAH D JTROS	114-04-02-014-000	481 KINGFISHER DRIVE SEC 14 LOT 56	Ridgeway	Fairfield	868	1980	1.05	No	No	Yes	$273,128
519	TRUESDALE ANGELA ASHE	114-04-02-015-000	533 KINGFISHER DRIVE SEC 14 LOT 54	Ridgeway	Fairfield	520	1950	1.03	No	No	No	$253,665
520	HUNSINGER SCOTT & STEPHANIE M JTROS	114-04-02-017-000	66 WINDWARD LANE SEC 14 LOT 53	Ridgeway	Fairfield	1,861	2008	0.82	Yes	No	No	$722,073

Figure 99: Unimpaired Market Value Summary 441-480

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
521	PORTER NANCY W	114-04-02-018-000	WINDWARD LANE SEC 14 LOT 52	Ridgeway	Fairfield	2,274	1950	0.83	Yes	No	No	$571,943
522	MCDONALD WILLIAM S	114-04-02-019-000	54 WINDWARD LANE SEC 14 LOT 51	Ridgeway	Fairfield	2,647	1950	0.84	Yes	No	No	$613,744
523	WILLIAMS MITCHELL J & JO S JTROS ETAL	115-03-01-001-000	22 WINDWARD LANE SEC 14 LOT 49	Ridgeway	Fairfield	3,386	1950	0.82	Yes	No	No	$685,000
524	CLAUDE W BURNS III FAMILY PARTNERSHIP "A"	115-03-01-002-000	639 KINGFISHER DRIVE SEC 14 LOT 48	Ridgeway	Fairfield	3,176	2010	0.66	Yes	No	No	$911,328
525	FUNDERBURK GLENN T & SUZANNE H REVOC TRUST	115-03-01-003-000	681 KINGFISHER DR SEC 14 LOT 47	Ridgeway	Fairfield	1,935	2017	0.66	Yes	Yes	No	$922,675
526	ANTONUCCI CHARLES MICHAEL	115-03-01-004-000	697 KINGFISHER DR S 14 L 46 & 1/2 OF 45	Ridgeway	Fairfield	704	1978	1.01	No	No	No	$340,193
527	BURNS ARTHUR ETAL	115-03-01-005-000	755 KINGFISHER DR S 14 L 44 & 1/2 OF 45	Ridgeway	Fairfield	960	1980	1.17	Yes	No	No	$473,793
528	KIKER ZACHARY P	115-03-01-006-000	781 KINGFISHER DRIVE SEC 14 LOT 43	Ridgeway	Fairfield	1,178	2008	0.76	Yes	No	No	$581,778
529	KIRSCH DAVID EUGENE & ANDREA JTROS	114-04-01-014-000	1561 WESTSHORE DR SEC 14 LOT 72	Ridgeway	Fairfield	3,855	1950	0.59	Yes	No	No	$702,960
530	DEESE JASON & HEATHER JTROS	115-03-01-042-000	1643 KINGFISHER DRIVE SEC 14 LOT 3	Ridgeway	Fairfield	715	1950	0.88	Yes	No	No	$340,078
531	WISE JOSH L & KERI H	115-03-02-002-000	125 ROCKY POINT CI SEC 11 LOT	Ridgeway	Fairfield	1,570	1987	0.48	Yes	No	Yes	$404,416
532	MYLOCK JEFFREY A & JENNIFER M	115-03-02-003-000	159 ROCKY POINT CI SEC 11 LOT	Ridgeway	Fairfield	1,012	1987	0.61	Yes	No	Yes	$339,883
533	GUFFEY ROBERT DEAN & JONATHAN KYLE STURGEON	116-01-00-015-000	3801 ROCKBRIDGE	Ridgeway	Fairfield	3,882	2005	2.41	Yes	No	No	$1,107,131
534	CARMODY TIMOTHY ETAL JTROS	115-02-02-019-000	2125 ROCKBRIDGE RD SEC 11 LOT 121	Ridgeway	Fairfield	1,344	1984	0.55	Yes	No	Yes	$375,994
535	DUBE DAVID & AMANDA VAN PELT	115-02-02-020-000	2143 ROCKBRIDGE RD SEC 11 LOT 145	Ridgeway	Fairfield	2,776	2023	0.69	Yes	No	No	$926,170
536	COOK DANA C	115-02-02-021-000	2145 ROCKBRIDGE RD SEC 11 LOT 146	Ridgeway	Fairfield	796	1965	0.76	Yes	No	No	$382,578
537	MARPLE GLENN ROSCOE	115-02-01-017-000	45 W BIRD ISLAND RD SEC 11 LOT 124+EXT	Ridgeway	Fairfield	1,881	1950	1.00	Yes	No	No	$535,119
538	ARDEN MARK T	115-02-01-001-000	96 W BIRD ISLAND ROAD SEC 11 LOT 1	Ridgeway	Fairfield	2,602	2000	0.41	Yes	No	No	$749,623
539	GRANT WILBUR GILL JR	115-02-01-002-000	60 W BIRD ISLAND ROAD SEC 11 LOT 127	Ridgeway	Fairfield	2,340	1950	0.56	Yes	No	No	$557,155
540	PROVEAUX NANCY V BIERER	115-02-01-003-000	36 W BIRD ISLAND ROAD SEC 11 LOT 128	Ridgeway	Fairfield	2,100	1950	0.66	Yes	No	No	$539,201
541	DICKSON JOYCE R	115-02-01-004-000	20 W BIRD ISLAND RD SEC 11 LOT 1	Ridgeway	Fairfield	1,520	1950	0.77	Yes	No	No	$472,782
542	CAMPBELL CHERYL E	115-02-01-005-000	191 BIRD ISLAND RD SEC 11 LOT 130 & 13	Ridgeway	Fairfield	4,176	1950	1.99	Yes	No	No	$824,816
543	DILLING FAMILY REVOCABLE TRUST	115-02-01-006-000	223 BIRD ISLAND ROAD SEC 11 LOT 132	Ridgeway	Fairfield	1,160	1950	1.09	Yes	No	No	$433,381
544	MCFADDEN ELIZABETH O	115-02-01-007-000	263 BIRD ISLAND ROAD SEC 11 LOT 133	Ridgeway	Fairfield	4,152	1950	1.04	Yes	No	No	$770,134
545	MATTOX JEFFREY L & KAREN D	115-02-01-008-000	285 BIRD ISLAND ROAD SEC 11 LOT 134	Ridgeway	Fairfield	934	1950	0.88	Yes	No	No	$384,305
546	LICATA STEVEN B & SHARON COLLINGS	115-02-01-009-000	311 BIRD ISLAND ROAD SEC 11 LOT 135	Ridgeway	Fairfield	4,660	1950	0.81	Yes	No	No	$790,640
547	CHERRY JOSEPH TREVOR	115-02-01-012-000	330 BIRD ISLAND ROAD SEC 11 LOT 138	Ridgeway	Fairfield	2,100	1950	0.80	Yes	No	No	$549,993
548	LONG PEGGY W	115-02-01-013-000	306 BIRD ISLAND RD SEC 11 LOT 139	Ridgeway	Fairfield	2,356	2023	0.92	Yes	No	No	$884,903
549	YARBOROUGH TROY L & LORI P	115-02-01-015-000	258 BIRD ISLAND ROAD SEC 11 LOT 141	Ridgeway	Fairfield	1,508	1950	0.99	Yes	No	No	$483,281
550	PARDUE ARTHUR J LIFE ESTATE	115-02-01-016-000	228 BIRD ISLAND RD S-11 L-142 & .64 AC	Ridgeway	Fairfield	2,240	1984	1.59	Yes	No	No	$734,893
551	ROCKY TIMES LLC	115-02-01-010-000	319 BIRD ISLAND RD SEC 11 LOTS 13	Ridgeway	Fairfield	1,620	1950	0.74	Yes	No	No	$484,811
552	CHERRY TREVOR & CATHERINE JTROS	115-02-01-011-000	338 BIRD ISLAND	Ridgeway	Fairfield	1,484	2006	0.66	Yes	No	No	$630,059
553	BROWN LORI R AND NATHAN S JTROS	115-02-02-031-000	2459 ROCKBRIDGE	Ridgeway	Fairfield	1,700	2011	0.67	Yes	No	No	$690,143
554	PHILLIPS BRENDEN CLIFFORD & SARA SHARAR JTROS	115-02-02-033-000	2493 ROCKBRIDGE RD SEC 11 LOT 159	Ridgeway	Fairfield	1,400	1978	0.61	Yes	No	No	$520,313
555	MURPHY CHARLES DENNIS & REBECCA W	115-02-02-034-000	2575 ROCKBRIDGE	Ridgeway	Fairfield	1,680	2016	0.64	Yes	No	No	$703,251
556	SMITH GLEN T, GLENDA S GRIFFITH & GLEN T SMITH JR JTROS	115-02-02-036-000	2605 ROCKBRIDGE RD SEC 11 LOT 163	Ridgeway	Fairfield	758	1950	0.61	Yes	No	Yes	$242,323
557	GUIREY RICHARD JOSEPH III	115-02-02-037-000	2617 ROCKBRIDGE RD SEC 11 LOT 164	Ridgeway	Fairfield	1,500	1950	0.54	Yes	No	No	$453,762
558	PORTER RUTH & RICHARD JTROS	115-02-02-038-000	2623 ROCKBRIDGE RD SEC 11 LOT 165	Ridgeway	Fairfield	2,750	2005	0.71	Yes	No	No	$835,577
559	HERRINGTON WILLIAM C III & NAN	115-02-02-035-000	2583 ROCKBRIDGE	Ridgeway	Fairfield	2,005	2015	0.62	Yes	No	No	$755,282
560	AQUADRY AMERICA INC	115-02-02-032-000	2485 ROCKBRIDGE RD LOT 158 SEC 11	Ridgeway	Fairfield	1,196	1950	0.64	Yes	No	No	$416,283

Figure 100: Unimpaired Market Value Summary 521-560

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
561	MYERS DAVID JR & KELLEY	115-04-00-026-000	1721 ROCKBRIDGE RD SEC 11 LOT 95	Ridgeway	Fairfield	880	1963	0.73	Yes	No	No	$394,604
562	BUCKLEY ROGER N ETAL	115-04-00-027-000	1733 ROCKBRIDGE RD SEC 11 LOT 96	Ridgeway	Fairfield	2,150	1950	0.68	Yes	No	No	$546,281
563	GHASSEMI SHAHROKH & LESLIE H	115-04-00-028-000	1755 ROCKBRIDGE RD SEC 11 LOT 97	Ridgeway	Fairfield	1,488	1950	0.57	Yes	No	No	$454,227
564	SANDOW DOUGLAS K 25%	115-02-02-001-000	1785 ROCKBRIDGE RD SEC 11 LOT 98	Ridgeway	Fairfield	924	1950	0.58	No	No	No	$310,671
565	WOLFE CAROLYN COGDILL & JOHN	115-02-02-002-000	1795 ROCKBRIDGE RD SEC 11 LOT 99	Ridgeway	Fairfield	1,124	1950	0.64	Yes	No	Yes	$290,971
566	LOTRUGLIO JAMES R	115-02-02-003-000	1837 ROCKBRIDGE	Ridgeway	Fairfield	2,108	2010	0.70	Yes	No	No	$760,389
567	YATES FAMILY LIVING TRUST	115-02-02-004-000	1851 ROCKBRIDGE RD SEC 11 LOT 102	Ridgeway	Fairfield	1,274	1950	0.80	Yes	No	No	$438,313
568	SMITH ROBIN E & DONNA K	115-02-02-005-000	1883 ROCKBRIDGE RD SEC 11 LOT 104	Ridgeway	Fairfield	1,902	1950	0.61	Yes	No	Yes	$367,862
569	MCELHANEY FAMILY TRUST	115-02-02-007-000	204 LITTLE POINT LANE SEC 11 LOT 108	Ridgeway	Fairfield	2,412	1950	0.45	Yes	No	No	$552,210
570	CARTER JOHNNY L & HELEN W	115-02-02-009-000	154 LITTLE POINT LN SEC 11 LOT 109	Ridgeway	Fairfield	1,120	1950	0.85	Yes	No	No	$415,912
571	ROCKY TIMES LLC	115-02-02-013-000	1927 ROCKBRIDGE RD SEC 11 LOT 114	Ridgeway	Fairfield	1,932	1950	0.93	Yes	No	Yes	$386,751
572	PAISANT ROSS M & ANA C JTROS	115-02-02-014-000	1995 ROCKBRIDGE	Ridgeway	Fairfield	1,662	1971	0.75	Yes	No	Yes	$397,721
573	KOUNS RANA WEED & LEA MEADOR WEED	115-02-02-015-000	2005 ROCKBRIDGE RD SEC 11 LOT 117	Ridgeway	Fairfield	1,248	1984	0.74	Yes	No	No	$520,797
574	SMITH TROY W & TAMMY RUTH	115-02-02-016-000	2035 ROCKBRIDGE RD SEC 11 LOT 118	Ridgeway	Fairfield	1,692	1992	0.55	Yes	No	Yes	$436,932
575	DAVIS STEPHEN & WILLIAM JOHN ADAMS IV JTROS	115-02-02-017-000	2063 ROCKBRIDGE RD SEC 11 LOT 119	Ridgeway	Fairfield	1,980	1982	0.57	Yes	No	No	$618,457
576	LETTERHOS JOHN & NICOLE JTROS	115-02-02-011-000	150 LITTLE POINT LANE SEC 11 LOT 111	Ridgeway	Fairfield	2,016	2001	0.71	Yes	No	No	$710,114
577	TAYLOR SCOTT R	115-02-02-012-000	60 LITTLE POINT LANE SEC 11 LOT 107	Ridgeway	Fairfield	1,404	2023	1.15	Yes	No	No	$715,375
578	JOHNSON ELIZABETH LEE	115-02-02-008-000	200 LITTLE POINT LANE SEC 11 LOT 108	Ridgeway	Fairfield	3,185	2007	0.65	Yes	No	No	$894,758
579	EUBANKS FRANK D & DEBRA	115-02-02-010-000	152 LITTLE POINTE LANE SEC 11 LOT 110	Ridgeway	Fairfield	2,564	2006	0.61	Yes	No	No	$801,830
580	WALDEN TIMOTHY & HELEN K	115-02-02-022-000	2153 ROCKBRIDGE RD SEC 11 LOT 147	Ridgeway	Fairfield	2,023	1950	0.62	Yes	No	No	$526,627
581	JOHNSON JEANNETTE W ETAL	115-02-02-023-000	2167 ROCKBRIDGE RD SEC 11 LOT 148	Ridgeway	Fairfield	1,112	1950	0.51	Yes	No	Yes	$283,210
582	CARMICHAEL PETER	115-02-02-024-000	2187 ROCKBRIDGE RD SEC 11 LOT 149	Ridgeway	Fairfield	1,600	1994	0.54	Yes	No	No	$597,399
583	HORNE JERRY PAUL	115-02-02-026-000	2335 ROCKBRIDGE RD SEC 11 LOT 152	Ridgeway	Fairfield	1,541	1950	1.22	Yes	No	No	$498,542
584	JARRELL CARL W	115-02-02-027-000	2395 ROCKBRIDGE RD SEC 11 LOT 153	Ridgeway	Fairfield	1,456	2000	0.69	Yes	No	No	$606,946
585	REASE GWENDOLYN MARLIN TRUSTEE	115-02-02-028-000	2427 ROCKBRIDGE RD SEC 11 LOT 154	Ridgeway	Fairfield	952	1989	0.70	Yes	No	Yes	$338,947
586	CANNELLA JOSHUA LLOYD ETAL JTROS	115-02-02-029-000	2433 ROCKBRIDGE RD SEC 11 LOT 155	Ridgeway	Fairfield	1,150	1950	0.71	Yes	No	No	$413,035
587	TILLIS MICHELLE PATRICK	115-02-02-039-000	2653 ROCKBRIDGE RD SEC 11 LOT 166	Ridgeway	Fairfield	1,583	1966	0.63	Yes	No	Yes	$371,378
588	ADAMS DIANE S & GERALD WAYNE	115-02-02-042-000	2761 ROCKBRIDGE RD SEC 11 LOTS 168 & 169	Ridgeway	Fairfield	1,200	1995	1.26	No	No	Yes	$350,847
589	PRICE CLAYTON G & LISA E	115-02-02-045-000	2953 ROCKBRIDGE RD SEC 11 LOT 173	Ridgeway	Fairfield	2,553	2008	0.67	Yes	No	No	$817,026
590	POWELL DANIEL WAYNE & JACKIE MICHELE JTROS	115-02-02-046-000	2983 ROCKBRIDGE RD SEC 11 LOT 174	Ridgeway	Fairfield	1,650	2024	0.76	Yes	No	No	$742,573
591	TEAL-BRITT NOVELLA ANN TRUSTEE	115-02-02-047-000	27 SUEDE LANE SEC 11 LOT 175	Ridgeway	Fairfield	1,632	1950	0.81	Yes	No	No	$490,832
592	CAULDER PHILLIP A & ELIZABETH ETAL	115-02-02-048-000	SUEDE LANE SEC 11 LOT 176	Ridgeway	Fairfield	1,782	1950	0.78	Yes	No	Yes	$365,990
593	MALDONADO JR GERARDO & TANYA LYNN MALDONADO JTROS	115-02-02-049-000	45 SUEDE LANE SEC 11 LOT 177	Ridgeway	Fairfield	3,259	2021	0.75	Yes	Yes	No	$1,211,093
594	RENWICK PROPERTIES LLC	115-02-02-050-000	SUEDE LANE SEC 11 LOT 178	Ridgeway	Fairfield	1,722	1950	0.71	Yes	No	No	$496,683
595	KWIECINSKI CHRIS & RANI RICHARDSON JTROS	115-02-02-054-000	3121 ROCKBRIDGE RD SEC 11 LOT 183	Ridgeway	Fairfield	1,931	1973	0.73	Yes	No	No	$596,147
596	POWELL TRACY K & JASON B	115-02-02-056-000	3183 ROCKBRIDGE RD SEC 11 LOT 185	Ridgeway	Fairfield	953	1950	0.86	Yes	No	No	$386,685
597	CROOKS WILLIAM M	115-02-02-053-000	3105 ROCKBRIDGE RD SEC 11 LOT 182	Ridgeway	Fairfield	1,665	1950	0.90	Yes	No	No	$500,525
598	PANKOW JEFFREY A & KAREN T	116-01-00-002-000	3213 ROCKBRIDGE RD SEC 11 LOT 187	Ridgeway	Fairfield	2,220	1985	0.82	Yes	No	No	$687,807
599	SMYTH GWENDOLYN S TRUSTEE	116-01-00-003-000	3245 ROCKBRIDGE RD SEC 11 LOT 188	Ridgeway	Fairfield	2,284	2016	1.38	Yes	No	No	$874,438
600	FINLAYSON FAMILY TRUST	116-01-00-004-000	3293 ROCKBRIDGE RD SEC 11 LOT 190	Ridgeway	Fairfield	2,142	2004	0.99	Yes	No	No	$767,188

Figure 101: Unimpaired Market Value Summary 561-600

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
601	CARTER RYAN	116-01-00-005-000	3329 ROCKBRIDGE RD SEC 11 LOT 192	Ridgeway	Fairfield	2,268	1950	1.31	Yes	No	No	$598,567
602	DOTY CATHERINE CLARKE ET AL	116-01-00-006-000	3413 ROCKBRIDGE RD SEC 11 LOT 193	Ridgeway	Fairfield	864	1950	1.22	Yes	No	No	$383,312
603	BROWER STEVEN & KATHLEEN	116-01-00-008-000	3557 ROCKBRIDGE RD SEC 11 LOT 195	Ridgeway	Fairfield	4,641	2020	0.87	Yes	No	No	$1,177,708
604	CASE DOUGLAS C JR	116-01-00-009-000	3585 ROCKBRIDGE RD SEC 11 LOT 196	Ridgeway	Fairfield	540	1950	0.68	Yes	No	No	$291,853
605	WEBB KENNETH L & WANDA H	116-01-00-010-000	3613 ROCKBRIDGE RD SEC 11 LOT 197	Ridgeway	Fairfield	1,728	1990	0.64	Yes	No	No	$615,690
606	HUCKS GRACE	116-01-00-012-000	3675 ROCKBRIDGE RD SEC 11 LOTS 199&200	Ridgeway	Fairfield	5,743	2009	1.52	Yes	No	No	$1,290,613
607	MAHAFFEY BRIAN & STEPHANIE FISHER JTROS	116-01-00-013-000	3713 ROCKBRIDGE RD SEC 11 LOT 201	Ridgeway	Fairfield	960	1986	0.87	Yes	No	No	$475,343
608	WILLIAMSON ALAN B & MITZI R	116-01-00-001-000	3201 ROCKBRIDGE RD SEC 11 LOT 186	Ridgeway	Fairfield	3,108	2004	0.73	Yes	No	No	$881,409
609	FLEETWOOD PETER P & PAMELA S	116-01-00-011-000	3637 ROCKBRIDGE	Ridgeway	Fairfield	2,160	2014	0.81	Yes	No	No	$798,005
610	CARLTON JOHN FARRELL ETAL	115-03-01-007-000	795 KINGFISHER DRIVE SEC 14 LOT 42	Ridgeway	Fairfield	1,356	1950	0.72	Yes	No	No	$445,825
611	BEATY FAMILY TRUST	115-03-01-008-000	821 KINGFISHER DR SEC 14 LOT 41	Ridgeway	Fairfield	2,582	1950	0.68	Yes	No	No	$594,360
612	GREENLAW THOMAS J &JUNE H JTROS	115-03-01-009-000	837 KINGFISHER DRIVE SEC 14 LOT 40	Ridgeway	Fairfield	2,788	1990	0.67	Yes	No	No	$768,978
613	FENTON FORREST F III & PAMELA J JTROS	115-03-01-010-000	841 KINGFISHER DRIVE SEC 14 LOT 39	Ridgeway	Fairfield	1,536	1983	0.69	Yes	No	Yes	$406,683
614	CARROLL RENEE MOORE	115-03-01-011-000	867 KINGFISHER DRIVE SEC 14 LOT 38	Ridgeway	Fairfield	1,600	1950	0.62	Yes	No	No	$473,388
615	GRIFFIN CHARLES R SR LIFE ESTATE ETAL	115-03-01-012-000	887 KINGFISHER DRIVE SEC 14 LOT 37	Ridgeway	Fairfield	1,410	1950	0.56	Yes	No	No	$442,440
616	COLON RUTH INEZ BARNHOUSE TRUSTEE	115-03-01-014-000	93 LAZY LANE SEC 14 LOT 35	Ridgeway	Fairfield	1,431	1980	0.69	Yes	No	No	$538,588
617	LACKEY MARVIN C JR & LEISA D	115-03-01-015-000	95 LAZY LANE SEC 14 LOT 33	Ridgeway	Fairfield	2,090	1950	1.17	Yes	No	No	$570,177
618	MESSERSMITH DAVID R ETAL JTROS	115-03-01-016-000	131 LAZY LN S14 L32 & S17 AREAS 3&4	Ridgeway	Fairfield	2,130	2000	1.15	Yes	Yes	No	$926,558
619	WOODS DAVISON D & ANGELA W	115-03-01-017-000	62 LAZY	Ridgeway	Fairfield	639	1950	1.07	Yes	No	No	$329,701
620	WINGO LAMAR & KAREN	115-03-01-019-000	48 LAZY LANE SEC 14 LOT	Ridgeway	Fairfield	3,472	2009	2.20	Yes	Yes	No	$1,300,277
621	PRICE GLENN W III & KATHERN A	115-03-01-020-000	1031 KINGFISHER DR SEC 14 LOT 28	Ridgeway	Fairfield	1,568	2014	0.88	Yes	No	No	$696,076
622	SKRABAK RICHARD W & WANDA A	115-03-01-021-000	1057 KINGFISHER DRIVE SEC 14 LOT 27	Ridgeway	Fairfield	2,895	1950	1.16	Yes	No	No	$660,528
623	PRESSLEY DAVID E & MARCIA B	115-03-01-022-000	1059 KINGFISHER DR SEC 14 LOT 26+EX LOT	Ridgeway	Fairfield	2,430	2014	1.27	Yes	No	No	$881,531
624	MARTIN WILLIAM ALAN & DEBORAH	115-03-01-023-000	1069 KINGFISHER DRIVE SEC 14 LOT 25	Ridgeway	Fairfield	2,348	2002	0.62	Yes	No	No	$754,517
625	JORDAN ERNEST WILLARD &	115-03-01-024-000	1071 KINGFISHER DRIVE SEC 14 LOT 24	Ridgeway	Fairfield	2,548	1950	0.55	Yes	No	No	$577,438
626	LEITNER CLAUDE RILEY	115-03-01-026-000	1111 KINGFISHER DRIVE SEC 14 LOT 22	Ridgeway	Fairfield	450	1957	0.67	Yes	No	Yes	$200,464
627	IVY RALPH D III	115-03-02-018-000	613 ROCKY POINT CR SEC 11 LOT 27	Ridgeway	Fairfield	1,242	2021	0.53	No	No	No	$524,703
628	OUTLAW TONY M & JHO R	115-03-02-019-000	633 ROCKY POINT CR SEC 11 LOT 27	Ridgeway	Fairfield	1,204	1950	0.80	Yes	No	No	$426,780
629	KRANZ JANA DELYNNE & MICOL ROY JTROS	115-03-02-020-000	51 RAINBOW COVE RD SEC 11 LOT 23 &	Ridgeway	Fairfield	2,480	2001	0.64	Yes	No	No	$770,986
630	GEIGER FREDDIE L & RENITTA B JTROS	115-03-02-022-000	70 RAINBOW COVE RD SEC 11 LOT	Ridgeway	Fairfield	1,258	1955	0.66	Yes	No	No	$439,408
631	BOLTON WILLIAM RANDOLPH & VALERIE E JTROS	115-03-02-023-000	34 RAINBOW COVE RD SEC 11 LOT	Ridgeway	Fairfield	1,250	1950	0.67	Yes	No	No	$426,520
632	SNOW JASON K & ALICA A	115-03-02-024-000	659 ROCKY POINT CIRCLE	Ridgeway	Fairfield	2,962	2004	1.33	Yes	No	No	$916,008
633	FILIOS ERIC	115-03-01-013-000	67 LAZY LANE	Ridgeway	Fairfield	1,836	2014	2.19	No	No	Yes	$500,793
634	JANNACE MICHAEL PAUL	115-03-03-010-000	405 ROCKBRIDGE RD SEC 11 LOT 4	Ridgeway	Fairfield	756	1989	0.66	Yes	No	No	$421,418
635	REYNOLDS BOBBY W JR	115-03-03-011-000	439 ROCKBRIDGE RD S 11 L 50 & .29 A	Ridgeway	Fairfield	1,930	1950	0.93	Yes	No	No	$537,239
636	WYNNE MARTIN & PATRICIA M	115-03-03-013-000	483 ROCKBRIDGE RD SEC 11 LOT 5	Ridgeway	Fairfield	1,056	2001	0.81	Yes	No	Yes	$385,722
637	AUSTIN MEGAN & DANIEL	115-03-03-014-000	497 ROCKBRIDGE RD SEC 11 LOT 5	Ridgeway	Fairfield	1,317	1950	0.72	Yes	No	No	$440,148
638	SKAGGS RODNEY C JR ET AL	115-03-03-015-000	531 ROCKBRIDGE RD SEC 11 LOT 5	Ridgeway	Fairfield	5,912	2017	0.63	Yes	No	No	$1,249,564
639	BURNS JULIAN R	115-03-03-016-000	553 ROCKBRIDGE RD SEC 11 LOT 5	Ridgeway	Fairfield	1,258	1950	0.68	Yes	No	No	$428,157
640	FEASTER CHARLES S SR & DIANE D	115-03-03-017-000	603 ROCKBRIDGE RD SEC 11 LOT 5	Ridgeway	Fairfield	3,360	1950	0.72	Yes	No	No	$673,178

Figure 102: Unimpaired Market Value Summary 601-640

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
641	STEPHENS MICHAEL SCOTT	115-03-03-018-000	647 ROCKBRIDGE RD SEC 11 LOT 5	Ridgeway	Fairfield	1,178	1950	0.46	Yes	No	Yes	$287,406
642	DIXON LAVONNE D LIFE ESTATE	115-03-03-019-000	655 ROCKBRIDGE RD SEC 11 LOT 5	Ridgeway	Fairfield	1,929	1950	0.79	Yes	No	No	$528,506
643	HUDSON FAMILY TRUST	115-03-03-020-000	659 ROCKBRIDGE	Ridgeway	Fairfield	1,280	1950	0.70	Yes	No	No	$433,091
644	TUTTLE SHEILA H	115-03-03-021-000	685 ROCKBRIDGE RD SEC 11 LOT 69	Ridgeway	Fairfield	2,240	1950	0.75	Yes	Yes	No	$685,641
645	TUTTLE SHEILA H	115-03-03-023-000	707 ROCKBRIDGE RD SEC 11 LOT 69	Ridgeway	Fairfield	3,256	1999	0.73	Yes	No	No	$874,798
646	JUMPER CHRISTOPHER LAVERN	115-03-03-024-000	729 ROCKBRIDGE RD SEC 11 LOT 69	Ridgeway	Fairfield	2,178	1990	0.73	Yes	Yes	No	$844,760
647	ROBERTS BENJAMIN LEE	115-03-03-025-000	751 ROCKBRIDGE RD SEC 11 LOT 69	Ridgeway	Fairfield	1,216	1950	0.70	Yes	No	No	$423,383
648	AUSTIN CHADFORD	115-03-03-026-000	789 ROCKBRIDGE RD SEC 11 LOT 69	Ridgeway	Fairfield	660	1973	0.61	Yes	No	Yes	$258,859
649	IRBY PAUL E SR & KIMBERLY K	115-04-00-001-000	803 ROCKBRIDGE RD SEC 11 LOT 69	Ridgeway	Fairfield	1,680	2024	0.55	Yes	No	No	$724,336
650	BURRIS JAMES WARREN JR & ANGELIENA JTROS	115-04-00-002-000	831 ROCKBRIDGE	Ridgeway	Fairfield	760	1968	0.66	Yes	No	Yes	$270,162
651	JASADATRA LLC	115-04-00-003-000	897 ROCKBRIDGE RD SEC 11 LOT 69	Ridgeway	Fairfield	1,327	1950	0.62	Yes	No	Yes	$312,729
652	MORSE SHAWN A	115-04-00-004-000	931 ROCKBRIDGE RD SEC 11 LOT 71	Ridgeway	Fairfield	864	1950	0.63	Yes	No	No	$358,210
653	PAMELA P PERRY & STEPHEN G PERRY SR TRUST	115-04-00-005-000	957 ROCKBRIDGE RD SEC 11 LOT 71	Ridgeway	Fairfield	3,354	2022	0.73	Yes	No	No	$1,009,220
654	ROARK DONALD ALAN & MITCHELL ALLEN POPE	115-04-00-006-000	973 ROCKBRIDGE	Ridgeway	Fairfield	1,300	1950	0.62	Yes	No	No	$430,531
655	WELLS DONALD L & BETH W	115-04-00-008-000	1027 ROCKBRIDGE RD SEC 11 LOT 74	Ridgeway	Fairfield	1,428	1950	0.61	Yes	No	Yes	$322,846
656	STEPHENS DONALD ALEXANDER ETAL	115-04-00-009-000	1085 ROCKBRIDGE RD SEC 11 LOT 75	Ridgeway	Fairfield	684	1969	0.62	Yes	No	Yes	$257,347
657	BRIAN F PAUL & CELESTE B	115-04-00-010-000	1099 ROCKBRIDGE RD SEC 11 LOT 76	Ridgeway	Fairfield	1,584	1950	0.71	Yes	No	No	$478,081
658	SIMPSON KIMBERLY ANNE PAUL	115-04-00-011-000	1135 ROCKBRIDGE RD SEC 11 LOT 77	Ridgeway	Fairfield	1,647	2006	0.59	Yes	No	Yes	$470,216
659	ELLIOTT TANYA LUCILLE ET AL	115-04-00-012-000	1173 ROCKBRIDGE RD SEC 11 LOT 78	Ridgeway	Fairfield	1,576	2011	0.69	Yes	No	Yes	$481,751
660	BLANTON SANDRA K & DAVID S MORGAN JTROS	115-04-00-014-000	1329 ROCKBRIDGE RD SEC 11 LOT 82	Ridgeway	Fairfield	684	1955	0.62	Yes	No	Yes	$237,966
661	BEGLEY FREDRICK KARL ETAL JTROS	115-04-00-015-000	1359 ROCKBRIDGE RD SEC 11 LOT 83	Ridgeway	Fairfield	2,334	2008	0.59	Yes	No	No	$774,732
662	SMITH JANICE S	115-04-00-016-000	1361 ROCKBRIDGE RD SEC 11 LOT 84	Ridgeway	Fairfield	1,404	1950	0.61	Yes	No	Yes	$320,394
663	WATKINS CARL L III & BETTY L	115-04-00-017-000	1469 ROCKBRIDGE RD SEC 11 LOT 86	Ridgeway	Fairfield	560	1950	0.43	Yes	No	No	$283,049
664	CARLAND CHARLES A JR & TERESA	115-04-00-018-000	1513 ROCKBRIDGE RD SEC 11 LOT 87	Ridgeway	Fairfield	2,829	2003	0.50	Yes	No	No	$807,755
665	WATERS DAVID L & ANITA A TARLTON	115-04-00-019-000	1533 ROCKBRIDGE RD SEC 11 LOT 88	Ridgeway	Fairfield	2,367	1985	0.56	Yes	No	No	$681,701
666	NUZZOLO JEFFREY A & LINDA S	115-04-00-020-000	1563 ROCKBRIDGE RD SEC 11 LOT 89	Ridgeway	Fairfield	600	1950	0.63	Yes	No	No	$303,777
667	DILTS G SCOT & ANNA M	115-04-00-021-000	1569 ROCKBRIDGE RD SEC 11 LOT 90	Ridgeway	Fairfield	1,780	1999	0.44	Yes	No	No	$631,106
668	WARRINGTON JAN A	115-04-00-022-000	1627 ROCKBRIDGE RD SEC 11 LOT 91	Ridgeway	Fairfield	1,932	1950	0.66	Yes	No	No	$519,235
669	CRUMPTON HENRY LOGAN JR & MARCIA KAY JTROS	115-04-00-025-000	1689 ROCKBRIDGE ROAD SEC 11 LOT 94	Ridgeway	Fairfield	1,862	1950	0.64	Yes	No	No	$508,741
670	WILKINS FREDRICK & TANJA H	115-03-01-028-000	1245 KINGFISHER DRIVE	Ridgeway	Fairfield	1,692	2017	0.81	No	No	No	$616,077
671	ADAMS CRAIG A & KATHRYN G JTROS	115-03-01-029-000	1267 KINGFISHER SEC 14 LOT 18	Ridgeway	Fairfield	1,170	1986	0.70	Yes	No	No	$508,932
672	LIGON ANN B & ROBERT LAINE JTROS	115-03-01-030-000	1293 KINGFISHER DRIVE SEC 14 LOT 17	Ridgeway	Fairfield	2,592	2016	0.81	Yes	No	No	$877,361
673	HAZEWINKEL FRANCES LOUISE	115-03-01-031-000	1297 KINGFISHER DRIVE SEC 14 LOT 16	Ridgeway	Fairfield	1,920	2001	0.75	Yes	No	Yes	$502,117
674	CLARK MARY DAWN & CHRISTOPHER S JTROS	115-03-01-032-000	1317 KINGFISHER DR SEC 14 LOT 15	Ridgeway	Fairfield	2,335	1950	0.72	Yes	No	No	$570,513
675	ANTOLOCK SHERYL	115-03-01-033-000	1339 KINGFISHER DRIVE SEC 14 LOT 14	Ridgeway	Fairfield	2,531	1950	0.73	Yes	No	No	$593,097
676	HORINE CATHERINE C	115-03-01-034-000	1365 KINGFISHER DRIVE SEC 14 LOT 13	Ridgeway	Fairfield	1,580	1950	0.65	Yes	No	No	$473,278
677	FAULKENBERRY WILLIAM K JR	115-03-01-035-000	1373 KINGFISHER DRIVE SEC 14 LOT 12	Ridgeway	Fairfield	336	1950	0.70	Yes	No	Yes	$169,757
678	WOLFE WALTER DOUGLAS	115-03-01-036-000	1383 KINGFISHER DRIVE SEC 14 LOT 11	Ridgeway	Fairfield	1,792	1995	0.78	Yes	No	No	$656,802
679	MCJUNKIN RHETT P	115-03-01-037-000	1487 KINGFISHER DRIVE SEC 14 LOT 9	Ridgeway	Fairfield	1,000	1985	0.92	Yes	No	No	$484,156
680	ANDERSON TROY & KRIS	115-03-01-038-000	1501 KINGFISHER DRIVE SEC 14 LOT 8	Ridgeway	Fairfield	1,624	1950	0.87	Yes	No	No	$493,363

Figure 103: Unimpaired Market Value Summary 641-680

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
681	GUARINO JOSEPH VINCENT	115-03-01-039-000	1507 KINGFISHER DRIVE SEC 14 LOT 7	Ridgeway	Fairfield	1,232	2014	0.70	Yes	No	Yes	$438,341
682	JAVIER JOHN P & HAN N TRAN JTROS	115-03-01-040-000	1515 KINGFISHER DRIVE SEC 14 LOT 6	Ridgeway	Fairfield	216	1982	1.12	Yes	No	No	$242,201
683	HOOD JEAN K	115-03-02-004-000	185 ROCKY POINTE CR SEC 11 LOT	Ridgeway	Fairfield	1,559	1950	0.57	Yes	No	No	$464,265
684	ROBINSON EDWIN T	115-03-02-005-000	213 ROCKY POINT CR SEC 11 LOT	Ridgeway	Fairfield	3,196	2005	0.70	Yes	No	No	$893,046
685	HUNTLEY NANCY B REVOC TRUST	115-03-02-006-000	227 ROCKY POINT CR SEC 11 LOT	Ridgeway	Fairfield	1,744	1950	0.67	Yes	No	Yes	$357,077
686	BRIERE FRANCIS A ETAL	115-03-02-007-000	253 ROCKY POINT CR SEC 11 LOT 1	Ridgeway	Fairfield	792	1950	0.66	Yes	No	Yes	$249,070
687	MICHAEL V JONES REV TRUST &	115-03-02-008-000	333 ROCKY POINT CR SEC 11 LOT 1	Ridgeway	Fairfield	2,693	2018	0.92	Yes	No	No	$914,278
688	MCKEITHAN DAVID & JOAN JTROS	115-03-02-009-000	361 ROCKY POINT CIRCLE	Ridgeway	Fairfield	1,092	1950	0.63	Yes	No	No	$398,658
689	RABON J KEITH & PARRISH G	115-03-02-010-000	401 ROCKY POINT CR SEC 11 LOT 1	Ridgeway	Fairfield	1,056	1950	0.74	Yes	No	No	$398,847
690	SIKES ALLEN N	115-03-02-011-000	415 ROCKY POINT CR SEC 11 LOT 1	Ridgeway	Fairfield	1,152	1986	0.63	Yes	No	Yes	$359,536
691	WOOD CARLYLE D	115-03-02-012-000	447 ROCKY POINT CR SEC 11 LOT 1	Ridgeway	Fairfield	1,933	2014	0.77	Yes	No	No	$754,644
692	THOMAS JAMES LEE JR &	115-03-02-013-000	465 ROCKY POINT CR SEC 11 LOT 1	Ridgeway	Fairfield	2,835	1950	0.65	Yes	No	No	$617,109
693	WRIGHT WILLIAM F	115-03-02-014-000	493 ROCKY POINT CR SEC 11 LOT 1	Ridgeway	Fairfield	1,984	1950	0.60	Yes	No	No	$520,652
694	BYRD MICHAEL J & DEBORAH B JTROS	115-03-02-015-000	531 ROCKY POINT CR SEC 11 LOT 1	Ridgeway	Fairfield	2,214	2008	0.66	Yes	No	No	$764,427
695	PUCKETT KIMBERLY L & DAVID B	115-03-02-017-000	599 ROCKY POINT CR SEC 11 LOT 27	Ridgeway	Fairfield	1,536	1950	0.67	Yes	No	Yes	$336,836
696	WILKINS DONNA S AS TRUSTEE ETAL	115-03-02-025-000	679 ROCKY POINT CR SEC 11 LOT 27	Ridgeway	Fairfield	854	1950	0.77	Yes	No	No	$364,074
697	YOUNGBLOOD JERRY LYNN	115-03-02-026-000	717 ROCKY POINT CR SEC 11 LOT 36	Ridgeway	Fairfield	1,633	2016	0.61	Yes	No	No	$690,925
698	NORMAN MARC & SHANNON	115-03-02-027-000	729 ROCKY POINT CR SEC 11 LOT 36	Ridgeway	Fairfield	2,478	1950	0.68	Yes	No	No	$582,843
699	VARNS WILLIAM D A TRUSTEE	115-03-02-028-000	763 ROCKY POINT CR SEC 11 LOT 36	Ridgeway	Fairfield	2,741	2008	0.52	Yes	No	No	$822,447
700	GLASSCOCK MARION S SR & MARION S JR JTROS	115-03-02-029-000	807 ROCKY POINT CR SEC 11 LOT 36	Ridgeway	Fairfield	713	1950	0.58	Yes	No	No	$325,811
701	CLIBORNE JERRY & SYLVIA JTROS	115-03-02-030-000	829 ROCKY POINT CR SEC 11 LOT 36	Ridgeway	Fairfield	1,908	1959	0.60	Yes	No	No	$537,510
702	GUY EDDIE L & BRENDA H	115-03-02-031-000	877 ROCKY POINT CR SEC 11 LOT 35	Ridgeway	Fairfield	879	1950	0.53	Yes	No	Yes	$255,487
703	LEWIS MICHAEL K & DEBRA C	115-03-02-032-000	899 ROCKY POINT CR SEC 11 LOT 36	Ridgeway	Fairfield	1,638	1950	0.59	Yes	No	No	$476,418
704	ELEAZER GEORGE A & ALANE W (JOINT TENTANTS	115-03-02-033-000	931 ROCKY POINT CR SEC 11 LOT 36	Ridgeway	Fairfield	1,901	1994	0.54	Yes	No	No	$645,998
705	HENDERSON NELSON E & DEBBIE M	115-03-02-016-000	553 ROCKY POINT CR SEC 11 LOT 1	Ridgeway	Fairfield	1,460	1950	0.75	Yes	No	No	$462,989
706	MELANDJIM HOMES LLC	115-03-02-034-000	957 ROCKY POINT CR SEC 11 LOT 36	Ridgeway	Fairfield	1,344	1978	0.69	Yes	No	Yes	$372,031
707	WHITNEY MARGARET L	115-03-03-002-000	165 ROCKBRIDGE RD SEC 11 LOT 4	Ridgeway	Fairfield	1,716	1950	0.67	No	No	No	$417,745
708	SEGEAR JASON L & MELISSA S	115-03-03-003-000	177 ROCKBRIDGE RD SEC 11 LOT 4	Ridgeway	Fairfield	1,653	2005	0.45	Yes	No	No	$633,344
709	MULLINS VICTOR F & KATHY S	115-03-03-004-000	231 ROCKBRIDGE RD SEC 11 LOT 4	Ridgeway	Fairfield	2,657	1950	0.55	Yes	No	No	$588,775
710	SENICK PETER D & SAMANTHA JTROS	115-03-03-005-000	253 ROCKBRIDGE RD SEC 11 LOT 4	Ridgeway	Fairfield	840	1975	0.64	Yes	No	No	$407,894
711	CARLSON WALTER R & LAURA JTROS	115-03-03-006-000	297 ROCKBRIDGE RD SEC 11 LOT 4	Ridgeway	Fairfield	2,136	2017	0.66	Yes	No	No	$791,021
712	DANIELS RAYMOND D & MERRY C JTROS	115-03-03-007-000	321 ROCKBRIDGE RD SEC 11 LOT 4	Ridgeway	Fairfield	1,730	2005	0.63	Yes	No	No	$669,276
713	AMMONS JAMES M	115-03-03-008-000	343 ROCKBRIDGE RD SEC 11 LOT 4	Ridgeway	Fairfield	2,242	1950	0.72	Yes	No	No	$560,449
714	TOWNSEND LINDA B & BRUCE W JTROS	115-03-03-009-000	373 ROCKBRIDGE RD SEC 11 LOT 4	Ridgeway	Fairfield	2,370	2008	0.64	Yes	No	No	$785,817
715	LADSON RICHARD & LISA JTROS	116-01-00-016-000	3803 ROCKBRIDGE RD SEC 11 LOT 206	Ridgeway	Fairfield	864	1950	1.75	No	No	No	$337,457
716	UNITED PROPERTIES GROUP LLC	116-03-01-005-000	197 SMOOTH ROCK PT SEC 11 LOT 21	Ridgeway	Fairfield	5,594	2007	2.93	Yes	No	No	$1,348,365
717	PROPST FLOYD ERNEST III	116-03-01-011-000	247 SMOOTH ROCK PT SEC 11 LOT 221+LOT	Ridgeway	Fairfield	5,052	2009	7.71	Yes	No	No	$1,436,741
718	MORGAN DONALD W	116-03-01-014-000	74 SMOOTH ROCK POINT SEC 11 LOT 224	Ridgeway	Fairfield	2,256	1950	0.92	Yes	No	No	$576,211
719	MCSWAIN JOHN M	116-03-01-018-000	379 RATTLESNAKE RD SEC 11 LOT 228+5 LOT	Ridgeway	Fairfield	1,318	1950	5.94	Yes	No	No	$545,770
720	DUBOSE SARAH J	116-03-01-019-000	433 RATTLESNAKE RD SEC 11 LOT 23	Ridgeway	Fairfield	800	1950	0.97	Yes	No	No	$361,502

Figure 104: Unimpaired Market Value Summary 681-720

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
721	ESTRIDGE EDWARD	116-03-01-002-000	113 SMOOTH ROCK POINT	Ridgeway	Fairfield	2,735	2018	1.53	Yes	No	No	$969,911
722	HARTNETT ROBERT E & LYNN JTROS	116-01-00-018-000	119 SMOOTH ROCK POINT	Ridgeway	Fairfield	3,043	2024	0.72	Yes	No	No	$974,960
723	LEMAY RICKIE G	116-03-01-003-000	115 SMOOTH ROCK PT LOT	Ridgeway	Fairfield	2,380	1950	0.99	Yes	No	No	$595,036
724	GEORGE NORMAN C & MONICA A	116-03-01-007-000	219 SMOOTH ROCK PT LOT	Ridgeway	Fairfield	4,396	2015	0.73	Yes	No	No	$1,097,650
725	LEONARD LARRY L & JEAN S	116-01-00-019-000	117 SMOOTH ROCK PT SEC 11 LOT 21	Ridgeway	Fairfield	2,031	1950	0.85	Yes	No	No	$544,734
726	WOOD FAMILY TRUST	116-03-01-021-000	3929 ROCKBRIDGE	Ridgeway	Fairfield	3,954	1950	4.27	Yes	No	No	$869,441
727	FURR LESTER A III	116-03-01-020-000	251 TALLOW ROAD SEC 11 LOT 240	Ridgeway	Fairfield	735	1950	0.70	Yes	No	No	$336,532
728	MCSWAIN REBECCA M AS TRUSTEE	116-03-02-003-000	299 TALLOW ROAD SEC 11 LOT 243	Ridgeway	Fairfield	1,399	1950	2.89	Yes	No	No	$521,009
729	D & S WATEREE LLC	116-03-02-004-000	349 TALLOW ROAD SEC 11 LOT 244	Ridgeway	Fairfield	640	1982	1.01	Yes	No	No	$392,727
730	395 TALLOW LLC	116-03-02-005-000	395 TALLOW ROAD SEC 11 LOT 247	Ridgeway	Fairfield	1,512	2008	2.47	Yes	No	No	$735,162
731	HINOJOSA ELISA LANE	134-02-00-035-000	109 MOLLY CREEK CIRCLE SEC 10 LOT 76	Ridgeway	Fairfield	2,072	1950	0.87	Yes	No	Yes	$396,426
732	LANGER DAVID L & M GEORGETTE	135-01-00-001-000	129 MOLLY CREEK CIRCLE SEC 10 LOT 75	Ridgeway	Fairfield	700	1950	0.72	Yes	No	No	$330,146
733	BLACKMAN L SHAW & ANN MARIE JTROS	135-01-00-004-000	229 MOLLY CREEK CIRCLE SEC 10 LOT 72	Ridgeway	Fairfield	720	1972	0.78	No	No	Yes	$232,664
734	BORLAND DOUGLAS PAUL ETAL	135-01-00-008-000	315 MOLLY CREEK CR SEC 10 LOT 68	Ridgeway	Fairfield	1,728	1986	0.71	Yes	No	Yes	$437,424
735	COOK MAC DAVID &	135-01-00-003-000	203 MOLLY CREEK CIRLCE SEC 10 LOT 73	Ridgeway	Fairfield	1,320	2020	0.83	Yes	No	No	$661,626
736	NORRIS JACKIE DAVIS	135-01-00-009-000	345 MOLLY CREEK CIRCLE SEC 10 LOT 67	Ridgeway	Fairfield	720	1950	0.67	Yes	No	No	$332,063
737	YAGODA TODD MATTHEW & LAURA JEAN JTROS	135-01-00-011-000	413 MOLLY CREEK CIRCLE SEC 10 LOT 65	Ridgeway	Fairfield	961	1979	0.83	Yes	No	No	$454,885
738	BANKS JAMES GREGORY & GENA S JTROS	135-01-00-012-000	437 MOLLY CREEK CIRCLE	Ridgeway	Fairfield	1,972	1950	0.71	Yes	No	No	$528,137
739	THOMAS IRENE M	135-01-00-013-000	469 MOLLY CREEK CIRCLE SEC 10 LOT 63	Ridgeway	Fairfield	3,089	2008	0.89	Yes	No	No	$916,899
740	MACK JOHN EDWARD JR & JAIDA ASHLEI JTROS	135-01-00-014-000	491 MOLLY CREEK CIR SEC 10 LOT 62	Ridgeway	Fairfield	727	1968	0.96	Yes	No	Yes	$275,120
741	JOLLY BRIAN PHILLIP & KATHRYN JTROS	135-01-00-015-000	511 MOLLY CREEK CR S 10 L 61 #5806-51	Ridgeway	Fairfield	1,024	1950	0.82	Yes	No	Yes	$286,140
742	BREWER MARK DAMON & JOY BRAGG	135-03-01-003-000	573 MOLLY CREEK CIRCLE SEC 10 LOT 60	Ridgeway	Fairfield	1,589	1996	0.71	Yes	No	Yes	$445,795
743	SOLOWAY MARTHA D	135-03-01-004-000	591 MOLLY CREEK CIRCLE SEC 10 LOT 59	Ridgeway	Fairfield	2,190	1950	1.34	Yes	No	No	$590,685
744	WILLIAMSON DAVID G & KAREN B	135-03-01-008-000	781 MOLLY CREEK CR SEC 10 LOT 54	Ridgeway	Fairfield	1,535	1990	0.62	Yes	No	Yes	$418,208
745	ZETTARAY LLC	135-03-01-009-000	805 MOLLY CREEK CIRCLE SEC 10 LOT 53	Ridgeway	Fairfield	1,350	1950	0.96	Yes	No	No	$458,412
746	SZWEC ROBERT & KATHY B PONTON JTROS	135-01-00-016-000	41 WANDERING LANE SEC 10 LOT 51	Ridgeway	Fairfield	1,782	1950	0.98	Yes	No	No	$520,858
747	KIRK JAMES L	135-01-00-017-000	63 WANDERING LANE SEC 10 LOT 50	Ridgeway	Fairfield	2,471	2022	0.75	Yes	No	No	$881,031
748	ELLIOT JOYCE K AS TRUSTEE	135-01-00-018-000	85 WANDERING LANE SEC 10 LOT 49	Ridgeway	Fairfield	1,524	1950	0.74	Yes	No	No	$471,524
749	PIERCE VICKIE K JTROS ETAL	135-01-00-019-000	109 WANDERING LANE SEC 10 LOT 48	Ridgeway	Fairfield	1,404	1986	0.84	Yes	No	No	$562,967
750	LAURA`S OF ELGIN LLC	135-01-00-020-000	WANDERING LANE SEC 10 LOT 47	Ridgeway	Fairfield	912	1950	0.65	Yes	No	No	$368,321
751	HINOJOSA HENRY D B & ELISA LANE HINOJOSA	135-01-00-022-000	135 WANDERING LANE SEC 10 LOT 45	Ridgeway	Fairfield	1,780	1950	0.68	Yes	No	No	$501,672
752	MOORE CAROLYN B &	135-03-01-010-000	923 MOLLY CREEK CIRCLE SEC 10 LOT 44	Ridgeway	Fairfield	1,392	1950	0.83	Yes	No	Yes	$329,377
753	RABON P WAYNE & JENNY L PARKER	135-03-01-007-000	761 MOLLY CREEK CIRCLE SEC 10 LOT 55	Ridgeway	Fairfield	1,514	1950	0.59	Yes	No	No	$459,538
754	GANESH JENNIFER	116-03-02-010-000	676 GOAT HILL ROAD SEC 11 LOT 258	Ridgeway	Fairfield	2,433	2014	1.70	Yes	No	No	$908,629
755	SMITH MARY F & ELIZABETH ANN CADY ROS	116-03-02-009-000	706 GOAT HILL ROAD SEC 11 LOT 257	Ridgeway	Fairfield	1,560	2016	1.11	Yes	No	No	$718,677
756	BELL MAX K	116-03-02-006-000	735 GOAT HILL ROAD SEC 11 LOT 255	Ridgeway	Fairfield	1,434	1950	3.03	Yes	No	No	$529,452
757	PALMER PATRICIA COLE F/K/A MATTHEWS F/K/A MATTOX	116-03-02-007-000	749 GOAT HILL ROAD SEC 11 LOT 255	Ridgeway	Fairfield	1,400	1950	0.99	Yes	No	No	$467,114
758	HARTMAN PAULA M	116-03-02-011-000	801 ISLAND ROAD SEC 11 LOT 267	Ridgeway	Fairfield	1,656	1950	1.77	Yes	No	No	$535,238
759	TANTILLO MARK DOUGLAS &	116-03-02-012-000	855 ISLAND ROAD SEC 11 LOT 269	Ridgeway	Fairfield	1,880	1970	1.52	Yes	No	No	$624,430
760	MORGAN DONALD LIFE ESTATE	116-03-02-013-000	877 ISLAND RD	Ridgeway	Fairfield	864	1950	0.74	Yes	No	No	$364,512

Figure 105: Unimpaired Market Value Summary 721-760

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
761	LANKFORD JANICE C	116-03-02-014-000	898 ISLAND ROAD SEC 11 LOT 271	Ridgeway	Fairfield	1,656	1979	0.50	Yes	No	No	$553,999
762	JONES JUDY F	116-03-02-008-000	857 GOAT HILL ROAD SEC 11 LOT 256	Ridgeway	Fairfield	1,809	1994	0.95	Yes	No	No	$669,254
763	KELLY PATRICIA E LIFE ESTATE	135-03-01-011-000	983 MOLLY CREEK CIRCLE SEC 10 LOT 43	Ridgeway	Fairfield	2,134	1950	1.27	Yes	No	Yes	$417,723
764	GRANGER WILLIAM VAUGHN & DEBORAH W	135-01-00-024-000	53 POINT LN SEC 10 LOT	Ridgeway	Fairfield	2,171	1950	0.69	Yes	No	No	$549,915
765	GRIGG REGGIE R ETAL	135-01-00-025-000	79 POINT LN SEC 10 LOT	Ridgeway	Fairfield	2,582	2024	0.66	Yes	No	No	$896,941
766	LULL SIDNEY M	135-01-00-026-000	122 POINT LN SEC 10 LOT 4	Ridgeway	Fairfield	2,017	1986	0.62	Yes	No	No	$643,167
767	JONES WILLIAM L & DAGMAR R	135-01-00-027-000	82 POINT LN SEC 10 LOT	Ridgeway	Fairfield	1,080	1950	0.71	Yes	No	No	$401,276
768	BATEMAN LARRY RICHARD	135-01-00-028-000	54 POINT LN SEC 10 LOT	Ridgeway	Fairfield	2,326	1950	0.63	Yes	No	No	$562,243
769	HANNA DANNIE BYRON JR & MAY VOKATY JTROS	135-03-01-013-000	1033 MOLLY CREEK CIRCLE SEC 10 LOT 36	Ridgeway	Fairfield	920	1987	0.75	Yes	No	Yes	$332,524
770	HORNE RAE W	135-03-01-015-000	1147 MOLLY CREEK CR SEC 10 LOT 34	Ridgeway	Fairfield	2,130	1950	0.61	No	No	No	$456,508
771	WRIGHT ROSEMARIE SINISI TRUSTE	135-03-01-016-000	1149 MOLLY CREEK CR SEC 10 LOT 33	Ridgeway	Fairfield	1,836	2003	1.02	Yes	No	No	$713,973
772	MINCEY MICHAEL J & DIANE S JTROS	135-03-01-017-000	1169 MOLLY CREEK CR SEC 10 LOT 32	Ridgeway	Fairfield	2,582	2021	0.49	Yes	No	No	$855,273
773	ROUNTREE TAMMY T & ISAAC W III JTROS	135-03-01-018-000	1171 MOLLY CREEK CIRCLE SEC 10 LOT 31	Ridgeway	Fairfield	1,344	1986	0.47	Yes	No	Yes	$374,335
774	HOUSTON SAMUEL CHRISTOPHER	135-03-01-014-000	1119 MOLLY CREEK CR SEC 10 LOT 35	Ridgeway	Fairfield	2,144	1950	0.66	Yes	No	No	$544,605
775	SARA S H BALLARD REVOCABLE TRUST	135-04-00-028-000	29 HIDDEN CIRCLE LANE	Ridgeway	Fairfield	1,024	1999	1.05	Yes	No	No	$536,812
776	PARKER ASHLEY & CALEB M	135-03-02-004-000	12166 RIVER RD LOT 1	Ridgeway	Fairfield	1,512	1997	2.64	Yes	No	Yes	$500,722
777	LAKE WATEREE FAMILY PROPERTY LLC	134-04-01-003-000	1200 ANTIOCH CEMETERY ROAD	Ridgeway	Fairfield	315	1950	194.89	Yes	No	No	$406,366
778	CORNOR CHRISTOPHER C & JULIE ANN MULLINS JTROS	135-03-01-038-000	71 CENTURY DRIVE SEC 10 LOT 11	Ridgeway	Fairfield	5,421	2009	0.56	Yes	No	No	$1,134,760
779	MOSS THOMAS P & GLORIA LYNN	135-03-01-037-000	41 CENTURY DRIVE SEC 10 LOT	Ridgeway	Fairfield	1,248	1950	0.56	Yes	No	Yes	$301,397
780	LEE ROBERT L & KATHY B	135-03-01-035-000	1605 MOLLY CREEK CIRCLE SEC 10 LOT 14	Ridgeway	Fairfield	1,377	2003	0.67	Yes	No	Yes	$431,928
781	THE MARY CAMERON LANGSTON TRUST	135-03-01-033-000	1545 MOLLY CREEK CIRCLE SEC 10 LOT 16	Ridgeway	Fairfield	1,664	1991	0.65	Yes	No	No	$609,111
782	SCHMALZEL JOEL	135-03-01-031-000	1489 MOLLY CREEK DRIVE SEC 10 LOT 18	Ridgeway	Fairfield	1,800	2019	0.63	Yes	No	No	$736,588
783	LOCKLEAR JAMES E & DIANE D	135-03-01-030-000	1449 MOLLY CREEK CIRCLE SEC 10 LOT 19	Ridgeway	Fairfield	2,516	2008	2.81	Yes	No	No	$939,007
784	CRANFORD MARGARET GARRISON A/K/A JOY G	135-03-01-029-000	1423 MOLLY CREEK DRIVE SEC 10 LOT 20	Ridgeway	Fairfield	1,079	1950	0.61	No	No	No	$335,138
785	SMITH DAVID SCOTT & MICHELE LIEBELT JTROS	135-03-01-032-000	1513 MOLLY CREEK CIRCLE SEC 10 LOT 16B	Ridgeway	Fairfield	2,104	1987	0.72	Yes	No	No	$669,971
786	DELAUGHTER CHARLES A & LINDA D	135-03-03-002-000	84 COLONELS CREEK DRIVE SEC 8 LOT 3	Ridgeway	Fairfield	1,902	1994	0.64	Yes	No	No	$657,760
787	WHITLEY WILLIAM J	135-03-03-004-000	132 COLONELS CREEK DRIVE SEC 8 LOT 6	Ridgeway	Fairfield	1,512	1950	0.99	Yes	No	No	$483,965
788	THOMPSON MARK & MEMORY JTROS	135-03-03-005-000	160 COLONELS CREEK DR S 8 LOTS 7 & 127	Ridgeway	Fairfield	1,804	1991	0.77	Yes	No	No	$643,390
789	TURNER PAUL & BARBARA W	134-04-01-018-000	602 COLONELS CIRCLE LOT 1	Ridgeway	Fairfield	2,261	1950	0.94	No	No	Yes	$352,888
790	BONENBERGER JASON T & DANA LOUISE JTROS	134-04-01-019-000	634 COLONELS CIRCLE LOT 13	Ridgeway	Fairfield	2,206	2003	0.97	Yes	No	No	$771,658
791	MUSE JULIAN HILL III & ROBIN G	135-03-02-018-000	658 COLONELS CIRCLE LOT 11	Ridgeway	Fairfield	1,680	1950	0.99	Yes	No	No	$507,528
792	ROGERS DENNIS GENE JR & AVIS K AS TRUSTEES	135-03-02-016-000	631 COLONELS CIRCLE LOT 9	Ridgeway	Fairfield	4,392	2023	1.00	Yes	No	No	$1,183,836
793	WELSH JAMES D & SHEREE L AS TRUSTEES	135-03-02-015-000	611 COLONELS CIRCLE LOT 8	Ridgeway	Fairfield	1,932	1993	0.96	Yes	No	Yes	$493,805
794	HINSON SAMUEL R & KATIE B	135-03-02-013-000	589 COLONELS CIRCLE	Ridgeway	Fairfield	1,836	1950	1.01	Yes	No	No	$529,866
795	FRENCH TANYA D &	135-03-02-012-000	577 COLONELS CIRCLE LOT 5	Ridgeway	Fairfield	1,596	1950	0.95	Yes	Yes	Yes	$433,188
796	FRADY C RAY	135-03-02-010-000	549 COLONELS CIRCLE LOT 3	Ridgeway	Fairfield	960	1970	0.97	No	No	Yes	$268,251
797	DAYHOFF JAMES & MARGARET TRUSTEES	134-04-02-016-000	521 COLONELS CIRCLE	Ridgeway	Fairfield	2,228	2017	1.92	Yes	No	No	$899,066
798	GOETTSCH HENDRIK B & CYNTHIA S	135-03-03-006-000	242 COLONELS CREEK DR SEC 8 LOT 128	Ridgeway	Fairfield	2,135	2009	0.65	Yes	No	No	$755,137
799	TOBIAS JOHN WESLEY	135-03-02-005-000	12224 RIVER	Ridgeway	Fairfield	1,856	2003	1.74	Yes	No	Yes	$544,825
800	MICHAEL CHARLES & KERRY	135-03-02-006-000	12246 RIVER RD LOT 3	Ridgeway	Fairfield	2,548	2005	1.61	Yes	No	No	$877,457

Figure 106: Unimpaired Market Value Summary 761-800

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
801	RICKENBAKER MELISSA ELLEN ETAL	135-03-02-007-000	12266 RIVER ROAD LOT 4	Ridgeway	Fairfield	1,512	2002	1.53	Yes	No	No	$676,900
802	HUSE ROGER A & ELLEN B JTROS	135-03-02-009-000	12300 RIVER RD LOT 6	Ridgeway	Fairfield	1,800	2002	1.23	Yes	No	No	$716,777
803	HARRISON CHARLES & JAMES HARRISON CO TRUSTEES	135-03-02-008-000	12278 RIVER RD LOT 5	Ridgeway	Fairfield	160	1950	1.03	Yes	No	No	$175,051
804	LECLAIR JERRY E & ROBIN J	135-03-03-003-000	106 COLONELS CREEK DR S 8 L 4 + .33 A	Ridgeway	Fairfield	1,847	2006	1.02	Yes	No	No	$727,907
805	SOLTIS DAVID J & MARTHA	135-03-05-004-000	105 ROLLING HILLS RD PARCELS	Ridgeway	Fairfield	2,376	2003	0.67	Yes	No	No	$768,864
806	STAMPER FRANKLIN B & AMAND L JTROS	135-03-03-001-000	30 COLONELS CREEK DR LOT 125 125A & 12	Ridgeway	Fairfield	2,208	2018	1.13	Yes	No	No	$852,804
807	BRIDGECREEK HOLDINGS LLC	135-03-05-002-000	21 ROLLING HILLS RD SEC 6 LOT	Ridgeway	Fairfield	2,047	1950	1.97	Yes	No	No	$595,686
808	DEBORDE GARY P & DEBORAH JTROS	135-03-05-003-000	63 ROLLING HILLS RD SEC 6 LOT	Ridgeway	Fairfield	3,281	2004	0.82	Yes	No	No	$913,238
809	TALBERT CHARLES & KIMBERLY JTROS	135-03-05-006-000	145 ROLLING HILLS	Ridgeway	Fairfield	2,157	2022	1.10	Yes	No	No	$861,122
810	WALL DENISE A	135-03-03-009-000	302 COLONELS CREEK DRIVE SEC 8 LOT 12	Ridgeway	Fairfield	2,504	1997	0.75	Yes	No	No	$770,061
811	GRANT WILLIAM E JR	135-03-01-027-000	1343 MOLLY CREEK CIRCLE SEC 10 LOT 22	Ridgeway	Fairfield	500	1965	0.64	Yes	No	Yes	$218,961
812	DOUGLASS G GREGG JR	135-03-01-026-000	1313 MOLLY CREEK CIRCLE SEC 10 LOT 23	Ridgeway	Fairfield	1,397	1950	0.69	Yes	No	No	$449,903
813	DINKINS BYRON O & SUSAN H	135-03-01-024-000	1249 MOLLY CREEK CIRCLE SEC 10 LOT 25	Ridgeway	Fairfield	1,744	1950	0.59	Yes	No	No	$489,906
814	DAVIS DONALD W & PAMELA COMER JTROS	135-03-01-023-000	1211 MOLLY CREEK CIRCLE SEC 10 LOT 26	Ridgeway	Fairfield	1,772	2022	0.60	Yes	No	No	$739,487
815	POPE PATSY B	135-03-01-022-000	1201 MOLLY CREEK CIRCLE SEC 10 LOT 27	Ridgeway	Fairfield	1,124	1986	0.65	Yes	No	Yes	$356,976
816	CLIFF FAMILY PROPERTIES LLC	135-03-01-021-000	1199 MOLLY CREEK CIRCLE SEC 10 LOT 28	Ridgeway	Fairfield	891	1950	0.40	Yes	No	No	$347,254
817	DINKINS MARSHALL D & LINDSAY M	135-03-01-020-000	1197 MOLLY CREEK CIRCLE	Ridgeway	Fairfield	2,100	2015	0.81	Yes	No	No	$792,274
818	TUK KATHY E & ANTHONY F JTROS	135-03-01-019-000	1195 MOLLY CREEK CIRCLE SEC 10 LOT 30	Ridgeway	Fairfield	1,624	2009	0.82	Yes	No	No	$682,392
819	BELL DEBRA C	135-03-05-037-000	957 ROLLING HILLS RD SEC 6 LOT 28	Ridgeway	Fairfield	1,996	2016	0.77	Yes	No	No	$774,648
820	STASCZAK NANCY M	135-03-05-038-000	997 ROLLING HILLS RD SEC 6 LOT 28	Ridgeway	Fairfield	1,221	1950	0.69	Yes	No	No	$423,030
821	MAJOR FRANCES S	135-03-05-039-000	1037 ROLLING HILLS RD SEC 6 LOT 283	Ridgeway	Fairfield	2,209	2023	1.01	Yes	No	No	$867,059
822	HENDRICKS LAKE HOUSE LLC	135-03-05-041-000	1157 ROLLING HILLS RD SEC 6 LOT 281	Ridgeway	Fairfield	1,240	1950	1.49	Yes	No	No	$461,164
823	JORDAN MICHAEL D	135-03-05-043-000	1223 ROLLING HILLS RD SEC 6 LOT 278	Ridgeway	Fairfield	1,896	2019	0.81	Yes	No	No	$773,885
824	ODOM TONI P TRUSTEE &	135-03-05-045-000	1261 ROLLING HILLS RD-S 6;L 274 275 109	Ridgeway	Fairfield	3,536	1950	2.36	Yes	No	No	$777,969
825	POOL OTHO S III & JOANNE H	135-03-05-047-000	47 LONGVIEW LANE SEC 6 LOT 271	Ridgeway	Fairfield	2,166	1950	1.86	Yes	No	No	$607,875
826	HOLLIS DAISY B	135-03-05-048-000	93 LONGVIEW LANE SEC 6 LOT 270	Ridgeway	Fairfield	3,082	1950	0.83	Yes	No	No	$656,733
827	JACKSON AARON D & BRIDGET B JTROS	135-03-05-049-000	38 LONGVIEW LANE SEC 6 LOT 269	Ridgeway	Fairfield	1,323	2022	0.67	Yes	No	No	$655,442
828	PRICE KAREN LANDIS & DARREN JAMES	135-03-05-050-000	12 LONGVIEW LANE SEC 6 LOT 268	Ridgeway	Fairfield	2,044	1950	0.78	Yes	No	No	$541,608
829	MADEWELL TERRY L & JACQUELINE	135-03-05-052-000	1309 ROLLING HILLS RD SEC 6 LOT 266	Ridgeway	Fairfield	1,772	1950	0.53	Yes	No	No	$488,485
830	FRIIHAUF MICHAEL & VICKIE	135-04-00-001-000	1499 ROLLING HILLS RD SEC 6 LOT 259	Ridgeway	Fairfield	1,875	2019	1.41	No	No	No	$690,854
831	XU QING & LIPING LIU JTROS	135-04-00-003-000	1645 ROLLING HILLS RD SEC 6 LOT 257	Ridgeway	Fairfield	1,056	1966	0.63	Yes	No	No	$429,304
832	SPROUSE KATHERINE & ROBERT A JTROS	135-04-00-007-000	1709 ROLLING HILLS RD SEC 6 LOT 254	Ridgeway	Fairfield	672	1980	0.88	Yes	No	No	$391,491
833	VERNON JAMES HEIRS JR ET AL	135-04-00-008-000	1785 ROLLING HILLS RD SEC 6 LOT 253	Ridgeway	Fairfield	1,140	1950	0.62	Yes	No	No	$405,646
834	PHIFER JEFF C & STACY A	135-04-00-009-000	1821 ROLLING HILLS RD SEC 6 LOT 252	Ridgeway	Fairfield	1,900	1950	0.88	Yes	No	No	$530,453
835	SHELLEY LEVI G JR & HELI H	135-04-00-010-000	31 HIDEAWAY PT SEC 6 LOT 251	Ridgeway	Fairfield	1,782	1950	0.92	Yes	No	No	$517,710
836	HELMS STEVEN K & LAURA L JTROS	135-04-00-011-000	82 HIDEAWAY POINT SEC 6 LOT 250	Ridgeway	Fairfield	1,520	1989	0.73	Yes	No	No	$584,984
837	MARTIN DEBRA A LIFE ESTATE	135-04-00-012-000	28 HIDEAWAY POINT SEC 6 LOT 249	Ridgeway	Fairfield	1,575	1950	0.82	Yes	No	No	$483,786
838	CLARE JOHN JOSEPH TRUSTEE	135-04-00-013-000	1845 ROLLING HILLS RD S-6;L-248 + 1 LOT	Ridgeway	Fairfield	2,008	1950	1.25	Yes	No	No	$563,787
839	DONAHUE CHRISTOPHER SCOTT & SUMMER HUFFSTETLER JTROS	135-03-05-054-000	1399 ROLLING HILLS RD SEC 6 LOT 263	Ridgeway	Fairfield	1,512	1950	1.93	Yes	No	No	$517,969
840	RANGEL BRUCE M & CYNTHIA C JTROS	135-03-05-042-000	1199 ROLLING HILLS RD SEC 6 LOT 110	Ridgeway	Fairfield	3,495	2006	0.72	Yes	No	No	$938,568

Figure 107: Unimpaired Market Value Summary 801-840

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
841	NEWTON ANDREW L & JENNY L AS TRUSTEES	135-03-05-051-000	1305 ROLLING HILLS RD SEC 6 LOT 108	Ridgeway	Fairfield	2,193	2021	0.69	Yes	No	No	$821,968
842	SCHAEFFNER SEAN P & MARY G JTROS	135-03-05-053-000	1363 ROLLING HILLS RD S-6;LOTS 106 & 107	Ridgeway	Fairfield	2,278	1997	0.61	Yes	No	No	$722,417
843	WILLIAMSON LARRY K & GERI B	135-04-00-005-000	1683 ROLLING HILLS RD SEC 6 LOT 103	Ridgeway	Fairfield	1,296	1996	0.84	Yes	No	No	$574,569
844	GAINEY JAMES T & HARRIET B JTROS	135-04-00-006-000	1697 ROLLING HILLS RD SEC 6 LOT 102	Ridgeway	Fairfield	1,544	2000	0.81	Yes	No	No	$633,949
845	L3P LLC	135-04-00-068-000	2733 ROLLING HILLS RD SEC 6 LOT 190	Ridgeway	Fairfield	3,734	2013	0.76	Yes	No	No	$1,011,882
846	SPRAGUE GEORGE B	135-04-00-067-000	2709 ROLLING HILLS RD SEC 6 LOT 191	Ridgeway	Fairfield	1,980	2006	0.76	Yes	No	No	$728,556
847	BROWN ROBERT D & BERNARD B	135-04-00-065-000	2701 ROLLING HILLS RD SEC 6 LOT 194	Ridgeway	Fairfield	720	1967	1.00	Yes	No	Yes	$273,564
848	HILL PERRY T JR & FRANCES E LIFE ESTATE	135-04-00-064-000	2689 ROLLING HILLS RD SEC 6 LOT 195	Ridgeway	Fairfield	1,057	1950	1.15	Yes	No	No	$417,544
849	HODGE HOWARD B & JODIE H AS TRUSTEES	135-04-00-059-000	2651 ROLLING HILLS RD SEC 6 LOT 200	Ridgeway	Fairfield	850	1950	0.57	No	No	Yes	$214,955
850	MARVIN ROBERT S JR &	135-04-00-054-000	2361 ROLLING HILLS RD SEC 6 LOT 205	Ridgeway	Fairfield	1,680	2000	0.71	No	No	Yes	$396,504
851	DAVID JO ANN	135-04-00-052-000	2265 ROLLING HILLS RD SEC 6 LOT 207	Ridgeway	Fairfield	994	1950	0.73	Yes	No	No	$388,001
852	ALTUS MARY W & DAVID M	135-04-00-050-000	2177 ROLLING HILLS RD S 6-L 210 & 94	Ridgeway	Fairfield	4,013	2018	0.87	Yes	No	No	$1,089,375
853	CLARK W NEAL & DELISA C	135-04-00-048-000	2153 ROLLING HILLS RD SEC 6 LOT 212	Ridgeway	Fairfield	2,684	1950	0.72	Yes	No	No	$607,871
854	WRAY DAVID A & CATHY S JTROS	135-04-00-046-000	2147 ROLLING HILLS RD SEC 6 LOT 214	Ridgeway	Fairfield	2,024	1992	0.81	Yes	No	No	$685,503
855	MERRITT CHRISTOPHER S & SYRRA SAGAYSAY JTROS	135-04-00-040-000	182 HIDDEN CIRCLE LANE	Ridgeway	Fairfield	5,122	2007	0.72	Yes	No	No	$1,123,009
856	MOORE EVERETT K & LACHELLE H JTROS	135-04-00-032-000	294 HIDDEN CIRCLE LANE SEC 6 LOT 226	Ridgeway	Fairfield	3,079	1983	0.72	Yes	No	Yes	$560,247
857	SANDERS CAROLYN H	135-04-00-031-000	314 HIDDEN CIRCLE LANE SEC 6 LOT 228	Ridgeway	Fairfield	2,094	1950	1.32	Yes	No	No	$577,886
858	WILCOX WILLIAM C & DEBRA L JTROS	135-04-00-025-000	2103 ROLLING HILLS RD SEC 6 LOT 237	Ridgeway	Fairfield	1,080	1999	0.65	Yes	No	Yes	$376,663
859	GOFF ASSOCIATES LLC	135-04-00-023-000	2079 ROLLING HILLS RD SEC 6 LOT 239	Ridgeway	Fairfield	2,786	2022	0.73	No	No	No	$786,550
860	LONGFORD CATRIONA MARIE	135-04-00-021-000	2075 ROLLING HILLS ROAD	Ridgeway	Fairfield	1,588	1986	0.93	Yes	No	No	$601,404
861	HUNTER GRADY M JR	135-04-00-019-000	2005 ROLLING HILLS ROAD SEC 6 LOT 243	Ridgeway	Fairfield	1,634	1950	0.93	Yes	No	No	$498,143
862	HUMPHRIES RANDALL G & ALYSSA D JTROS	135-04-00-018-000	1977 ROLLING HILLS RD SEC 6 LOT 244	Ridgeway	Fairfield	2,111	1950	0.78	Yes	No	Yes	$395,353
863	WILKINSON JAY T & ANNYS Q AS TRUSTEES	135-04-00-016-000	1941 & 1939 ROLLING HILLS RD S 6 L	Ridgeway	Fairfield	2,591	1950	1.48	Yes	No	No	$644,305
864	ELLIOTT RALPH CURTIS ETAL	135-04-00-043-000	136 HIDDEN CIRCLE LANE SEC 6 LOT 217	Ridgeway	Fairfield	2,058	1950	0.70	Yes	No	No	$537,375
865	MILLER BILLY E & BETTY M	135-04-00-062-000	2677 ROLLING HILLS RD SEC 6 LOT 197	Ridgeway	Fairfield	1,920	1950	0.78	Yes	No	No	$526,274
866	FEDERAL NATIONAL HOME LOAN MORTGAGE CORP	135-04-00-061-000	2675 ROLLING HILLS RD SEC 6 LOT 198	Ridgeway	Fairfield	2,106	2015	1.08	Yes	No	No	$817,382
867	LLOYD STEPEHN D & PAULA S	135-04-00-034-000	266 HIDDEN CIRCLE LANE	Ridgeway	Fairfield	1,118	1950	0.72	Yes	No	No	$408,278
868	HAID CHRISTOPHER PETER & LAURA PATRICIA JTROS	135-04-00-042-000	156 HIDDEN CIRCLE LANE SEC 6 LOT 218	Ridgeway	Fairfield	1,377	2016	0.89	Yes	No	Yes	$477,892
869	COOK MARK A & KIMBERLY C JTROS	135-04-00-047-000	2149 ROLLING HILLS RD SEC 6 LOT 213	Ridgeway	Fairfield	1,620	2014	0.90	Yes	No	No	$707,567
870	HORSEFLY REVOCABLE TRUST	135-04-00-063-000	2679 ROLLING HILL RD SEC 6 LOT 196	Ridgeway	Fairfield	3,586	2018	0.70	Yes	Yes	No	$1,235,083
871	TUK EDWARD F JR & MARY ELIZABETH	135-04-00-049-000	2165 ROLLING HILLS RD SEC 6 LOT 95	Ridgeway	Fairfield	1,809	1950	0.74	Yes	No	No	$509,485
872	BONNIVILLE JOHN & SHARON JTROS	135-03-05-035-000	953 ROLLING HILLS RD SEC 6 LOT 28	Ridgeway	Fairfield	1,836	2001	0.88	Yes	No	Yes	$500,226
873	NEAL MICHAEL D & SHEILA M	135-03-05-033-000	889 ROLLING HILLS RD SEC 6 LOT 28	Ridgeway	Fairfield	1,696	2001	0.58	Yes	No	No	$642,647
874	KONDRACKI JOHN ANDREW & HELEN DILLARD JTROS	135-03-05-029-000	843 ROLLING HILLS RD SEC 6 LOT 28	Ridgeway	Fairfield	1,620	1991	0.82	Yes	No	Yes	$443,263
875	BURGESS ROGER DALE & LINDA C	135-03-05-027-000	831 ROLLING HILLS RD SEC 6 LOT 29	Ridgeway	Fairfield	728	1994	0.83	Yes	No	Yes	$313,886
876	CASEY HELEN CHARLENE	135-03-05-025-000	813 ROLLING HILLS RD SEC 6 LOT 29	Ridgeway	Fairfield	3,159	1950	0.65	Yes	No	No	$647,755
877	KING BARRY	135-03-05-023-000	691 ROLLING HILLS RD SEC 6 LOT 29	Ridgeway	Fairfield	2,016	2009	1.04	Yes	No	Yes	$555,157
878	SL PLAZA LLC	135-03-05-022-000	661 ROLLING HILLS RD SEC 6 LOT 29	Ridgeway	Fairfield	1,008	1989	0.68	Yes	No	Yes	$346,821
879	NOWAK W KEITH	135-03-05-021-000	651 ROLLING HILLS RD SEC 6 LOT 29	Ridgeway	Fairfield	1,618	1950	0.74	Yes	No	Yes	$348,382
880	MORRIS MATTHEW H & MARYANN JTROS	135-03-05-020-000	615 ROLLING HILLS RD SEC 6 LOT 29	Ridgeway	Fairfield	500	1994	1.44	Yes	No	No	$388,973

Figure 108: Unimpaired Market Value Summary 841-880

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
881	BEDNARIK JOSEPH & KATHRYN S JTROS	135-03-05-018-000	509 ROLLING HILLS RD SEC 6 LOT 30	Ridgeway	Fairfield	828	2023	0.72	Yes	No	No	$536,718
882	LAUSI MICHEL J & CHERYL	135-03-05-016-000	431 ROLLING HILLS RD SEC 6 LOT 30	Ridgeway	Fairfield	1,424	1950	0.50	Yes	No	Yes	$315,807
883	BLACKERBY HERSCHEL S	135-03-05-014-000	273 ROLLING HILLS RD SEC 6 LOT 304	Ridgeway	Fairfield	1,716	1950	0.68	Yes	No	Yes	$355,186
884	DAVIS THOMAS W & CHRISTINE A JTROS	135-03-05-013-000	265 ROLLING HILLS RD SEC 6 LOT 30	Ridgeway	Fairfield	1,064	1992	0.69	Yes	No	Yes	$362,204
885	COLLINS STEVEN KEITH	135-03-05-012-000	251 ROLLING HILLS RD SEC 6 LOT 30	Ridgeway	Fairfield	1,296	1950	0.77	Yes	No	Yes	$316,252
886	JOHNSON KIMBERLY M & MICHAEL S	135-03-05-011-000	201 ROLLING HILLS RD SEC 6 LOT 30	Ridgeway	Fairfield	1,416	2023	0.83	Yes	No	No	$694,397
887	HANCOCK BRIAN N & ANGELIKA P E	135-03-05-010-000	36 FLAT ROCK LANE SEC 6 LOT 309	Ridgeway	Fairfield	2,459	1950	0.77	Yes	Yes	No	$717,683
888	PEREZ MARCELLA	135-03-05-009-000	50 FLAT ROCK LANE SEC 6 LOT 310	Ridgeway	Fairfield	717	1950	0.61	Yes	No	No	$328,309
889	PADGETT EDWARD & SYLVIA	135-03-05-008-000	58 FLAT ROCK LANE SEC 6 LOT 311	Ridgeway	Fairfield	2,266	2018	0.82	Yes	No	No	$835,605
890	HANCHEY CHARLES B & MARGARET S	135-03-05-007-000	49 FLAT ROCK LANE SEC 6 LOT 312	Ridgeway	Fairfield	2,240	1971	0.76	Yes	Yes	No	$772,863
891	TURBEVILLE JIMMY L & DEBRA D	135-03-05-015-000	331 ROLLING HILLS RD S 6 L 304 S PAR	Ridgeway	Fairfield	970	1993	0.82	Yes	No	Yes	$355,117
892	DIEHL RICHARD	135-03-05-030-000	855 ROLLING HILLS RD SEC 6 LOT 11	Ridgeway	Fairfield	1,878	2002	0.67	Yes	No	No	$687,294
893	HYNES TAMIA C CONNELLA AS TRUSTEE	135-04-00-069-000	2787 ROLLING HILLS RD SEC 6 LOT 188	Ridgeway	Fairfield	1,709	2014	1.70	Yes	No	No	$774,119
894	DANNER GLORIA G	135-04-00-071-000	2895 ROLLING HILLS RD SEC 6 OT 186	Ridgeway	Fairfield	1,710	1950	0.79	Yes	Yes	No	$609,578
895	STANLEY VICTORIA M & KEVIN D JTROS	135-04-00-072-000	2919 ROLLING HILLS RD SEC 6 LOT 185	Ridgeway	Fairfield	1,152	1999	0.85	No	No	Yes	$338,050
896	ANTHOS JAMES R & CATHERINE E	135-04-00-074-000	2975 ROLLING HILLS	Ridgeway	Fairfield	1,056	1950	1.07	Yes	No	No	$414,466
897	MARLEY MILTON D & LUANN G	135-04-00-073-000	2947 ROLLING HILLS RD SEC 6 LOT 185	Ridgeway	Fairfield	1,766	1950	0.88	Yes	No	No	$513,134
898	KEIL GERARD C & BETSY P	060-03-02-020-000	WATEREE ROAD	Winnsboro	Fairfield	3,113	2009	4.17	Yes	No	No	$983,880
899	MOODY ROBERT L & LINDA J	135-01-00-035-000	304 BIG WATER VIEW	Ridgeway	Fairfield	3,150	2015	0.85	Yes	No	No	$957,354
900	BENTON CARLEEN L	135-01-00-034-000	294 BIG WATER VIEW	Ridgeway	Fairfield	2,016	2017	1.10	Yes	No	No	$811,987
901	DAWKINS KAREN & ROBERT JR	135-01-00-039-000	251 BIG WATER VIEW	Ridgeway	Fairfield	2,521	2016	1.47	Yes	No	No	$919,886
902	CUNNINGHAM MARK R & LAURA L	135-01-00-040-000	227 BIG WATER VIEW	Ridgeway	Fairfield	3,148	2023	1.43	Yes	No	No	$1,055,632
903	CARNELL RICKY G & NINA D	135-01-00-041-000	197 BIG WATER VIEW	Ridgeway	Fairfield	2,960	2023	1.19	Yes	No	No	$1,007,244
904	SMOLKO RICHARD & JOYCE L	135-01-00-042-000	173 BIG WATER VIEW	Ridgeway	Fairfield	2,942	2013	1.08	Yes	No	No	$941,037
905	BOARDMAN GREGORY	135-01-00-043-000	149 BIG WATER VIEW	Ridgeway	Fairfield	4,034	2018	1.36	Yes	No	No	$1,142,796
906	SMITH DAVID N & VIRGINIA J	135-01-00-044-000	125 BIG WATER VIEW	Ridgeway	Fairfield	3,068	2014	2.36	Yes	No	No	$1,043,779
907	REILLY WILLIAM PAUL & SHARON M	135-01-00-046-000	79 BIG WATER VIEW	Ridgeway	Fairfield	2,883	2018	1.29	Yes	No	No	$975,899
908	ANDERSON LORI HOCUTT	135-01-00-047-000	55 BIG WATER VIEW	Ridgeway	Fairfield	3,462	2015	1.23	Yes	No	No	$1,038,075
909	FITZGERALD WALTER G & LINDA SUSAN JTROS	135-01-00-048-000	17 BIG WATER VIEW	Ridgeway	Fairfield	3,562	2015	0.78	Yes	No	No	$1,003,997
910	LEE RONNIE & SHNITA	135-01-00-050-000	42 BIG WATER VIEW	Ridgeway	Fairfield	2,784	2022	1.09	Yes	No	No	$965,532
911	JAMES LISA L & LARRY L JTROS	135-01-00-051-000	1279 RETREAT	Ridgeway	Fairfield	2,848	2020	1.40	Yes	No	No	$989,567
912	MORRIS SHERMAN & RITA M	135-01-00-052-000	1265 RETREAT	Ridgeway	Fairfield	2,539	2024	1.13	Yes	No	No	$940,066
913	GRAVES WESLEY SCOTT &	134-02-00-041-000	11303 RIVER	Ridgeway	Fairfield	1,776	2015	6.33	Yes	Yes	No	$1,104,145
914	TEAGARDEN JOSEPH E & CHRISTINA L	134-02-00-044-000	11225 RIVER	Ridgeway	Fairfield	2,308	1950	3.03	Yes	No	No	$657,495
915	BRANSON ROSEMARY D	116-03-02-017-000	174 TALLOW ROAD	Ridgeway	Fairfield	2,718	2018	28.18	Yes	No	No	$1,301,008
916	EVANS PAUL & BELINDA	115-02-02-057-000	2533 ROCKBRIDGE	Ridgeway	Fairfield	1,705	2013	0.61	Yes	No	No	$692,286
917	FRYE WALTER & VERONICA C JTROS	135-01-00-064-000	1199 RETREAT	Ridgeway	Fairfield	1,477	2020	2.31	Yes	No	No	$772,684
918	LAUGHNER CHAD C & KIM BREEZE JTROS	135-01-00-066-000	1177 RETREAT	Ridgeway	Fairfield	2,703	2020	2.32	Yes	No	No	$1,017,404
919	CECIL JOSEPH KENNEDY JR REV TRUST	135-01-00-067-000	1099 RETREAT	Ridgeway	Fairfield	2,469	2021	1.44	Yes	No	No	$935,261
920	SHULER PATRICIA JACQUELINE LIFE ESTATE	135-04-00-086-000	HIDDEN CIRCLE LANE SEC 6 LOT 228	Ridgeway	Fairfield	1,066	2014	0.66	Yes	No	No	$567,167

Figure 109: Unimpaired Market Value Summary 881-920

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
921	ROBINSON JODY M & LADONNA CHARLENE	135-01-00-072-000	937 RETREAT	Ridgeway	Fairfield	2,010	2022	4.71	Yes	No	No	$966,690
922	HUNTER PAMELA H & JAMES L	135-01-00-073-000	707 RETREAT	Ridgeway	Fairfield	2,548	2022	2.23	Yes	Yes	No	$1,216,529
923	BRANHAM JEFFERY K & LISA H JTROS	135-01-00-078-000	1015 RETREAT	Ridgeway	Fairfield	1,788	2021	1.73	Yes	No	No	$822,923
924	KNIGHT JEFFREY L & LORI A	135-01-00-087-000	8 BIG WATER VIEW	Ridgeway	Fairfield	5,043	2023	1.20	Yes	No	No	$1,284,915
925	CHEIFER RANDOLPH S & TRACY A JTROS	078-04-02-013-000	275 SOUTH WATERS EDGE DRIVE	Winnsboro	Fairfield	990	1950	0.73	Yes	No	No	$351,843
926	YOUNG MARSHALL JAMES JR & TERESA HOPE	078-04-02-014-000	MORNINGLOW DRIVE	Winnsboro	Fairfield	1,120	2019	0.77	No	No	No	$466,789
927	HALL BRIAN ALEXANDER & DANIELLE BETH	135-01-00-090-000	1075 RETREAT	Ridgeway	Fairfield	2,892	2022	3.43	Yes	No	No	$1,104,285
928	CONNER RUSSELL D & JANA D	135-01-00-093-000	710 RETREAT	Ridgeway	Fairfield	2,903	2022	7.18	Yes	No	No	$1,192,602
929	BISHOP ALAN D & LISA H	135-01-00-094-000	760 RETREAT	Ridgeway	Fairfield	3,140	2022	7.90	Yes	No	No	$1,247,987
930	K NEWMAN PROPERTIES 2 LLC	135-04-00-087-000	2077 ROLLING HILLS ROAD	Ridgeway	Fairfield	576	1995	0.61	Yes	No	No	$382,463
931	LESSARD THERESA M & JOHN L RUCKER JTROS	135-03-03-011-000	206 COLONELS CREEK	Ridgeway	Fairfield	1,806	2021	0.72	Yes	No	No	$756,629
932	GAGLIARDI JOHN & KIMBERLY JTROS	135-03-01-068-000	MOLLY CREEK CIRCLE	Ridgeway	Fairfield	1,620	2022	1.10	Yes	No	No	$755,530
933	ASMER CHERRY KATHERINE ETAL	095-03-02-038-000	1605 WATEREE ESTATES	Winnsboro	Fairfield	2,016	1950	0.97	No	No	No	$424,056
934	WOODALL ROBERT V & LORI J	116-03-02-025-000	668 GOAT HILL	Ridgeway	Fairfield	1,350	2024	1.12	No	No	No	$597,670
935	POKORNEY STANLEY J	093-00-00-020	2526 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,836	1950	110.03	Yes	No	No	$889,202
936	ASKINS KEITH B, JR	094-03-00-001B	2454 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	714	1950	0.14	Yes	No	No	$294,455
937	JONES JONATHAN ELLIS	094-03-00-001C	2456 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	800	1950	0.13	Yes	No	No	$306,969
938	MORTON JULIA T	094-03-00-001D	2458 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	676	1950	0.17	Yes	No	No	$292,680
939	HUMPHRIES ROGER KENNETH &	094-03-00-001E	2460 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	976	1950	0.26	Yes	No	No	$360,529
940	TYSON FRANKLIN ALEXANDER	094-03-00-001F	2462 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,460	1950	0.26	Yes	No	No	$432,511
941	HINSON ERIC	094-03-00-001G	2466 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	672	1950	0.24	Yes	No	No	$301,199
942	PARKER DONALD SHANE	094-03-00-001H	2470 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	672	1950	0.23	Yes	No	No	$300,540
943	BECKHAM PATRICIA H L/E	094-03-00-001J	2472 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	840	1950	0.26	Yes	No	No	$285,495
944	CAMEO COTTAGE, LLC	094-03-00-001K	2474 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	798	1962	0.36	Yes	No	No	$363,214
945	GREEN ANNA LAUREN	094-03-00-001L	2478 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	520	1950	0.30	Yes	No	No	$274,746
946	MOORE WALLACE W &	094-03-00-001M	2484 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,088	1950	0.33	Yes	No	No	$388,309
947	SPINKS JAMES L &	094-03-00-001N	2488 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,196	1950	0.31	Yes	No	No	$401,772
948	PIERCE ALBERT R & GAIL S	094-03-00-001R	2498 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,438	1950	0.52	Yes	No	No	$460,985
949	FINUCANE BRIAN PATRICK	094-03-00-001U	2518 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,260	1950	0.63	Yes	Yes	No	$540,005
950	PATTERSON CARL THOMAS JR ET A	094-03-00-001V	2504 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,407	2003	0.48	Yes	No	No	$777,767
951	NEWELL JERRY RICHARD JR	094-03-00-001W	2490 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,104	1984	0.34	Yes	No	No	$474,144
952	THOMAS RALPH E SR & CRYSTAL C	094-03-00-005	1954 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	560	2012	1.28	Yes	Yes	No	$534,697
953	PARDUE JANET	094-03-00-005A	1958 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	834	1950	1.03	Yes	No	No	$363,155
954	CORNOR CHRISTOPHER CRAIG	094-03-00-005I	1964 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,538	2009	1.13	Yes	No	No	$983,939
955	POOLE CHARLES SCOTT &	094-03-00-005M	1976 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,662	1984	2.26	Yes	No	No	$651,350
956	LAMBERT SAMANTHA NICOLE	094-03-00-006	2480 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,006	1950	0.38	Yes	No	No	$519,960
957	HONEYCUTT JANE WALTERS	094-03-00-007	2450 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,240	1950	1.23	Yes	No	No	$615,837
958	STARNES CHARLES D	094-03-00-008	2448 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	850	1950	0.76	Yes	No	No	$377,344
959	JACKSON EPHRAIM MICHAEL	094-03-00-009	2444 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	840	1950	0.60	Yes	No	No	$366,596
960	MILLS JOHN R ET AL	094-03-00-010	2442 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	768	1950	0.61	Yes	No	No	$352,178

Figure 110: Unimpaired Market Value Summary 921-960

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
961	WINCHESTER CINDY F	094-03-00-011	2440 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,000	1950	0.37	Yes	No	No	$377,490
962	HARPER MARK E & RENE` V	094-03-00-012	2438 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	600	1950	0.43	Yes	No	No	$304,252
963	HARPER RONALD G	094-03-00-013	2436 COTTAGE LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,028	1950	0.37	Yes	No	No	$382,644
964	BRATTON JAMES GREGORY	094-03-00-015A	1900 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,236	1950	1.21	Yes	No	No	$441,457
965	DIGGS DENZIL &	094-03-00-016	1928 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,456	2001	1.17	Yes	No	No	$630,855
966	STAUDE KENT A &	094-03-00-017A	1918 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,440	1950	3.88	Yes	No	No	$533,018
967	HALLOCK TIMOTHY J	094-03-00-017B	1924 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,444	1950	1.34	Yes	No	No	$478,746
968	HILLIARD HUNTER C	094-03-00-018	1938 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,372	1950	1.64	Yes	No	No	$477,602
969	BOURDEAU RENEE S	094-03-00-019	1944 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,344	1984	0.84	Yes	No	Yes	$384,522
970	MILES JERRY B	094-03-00-020	1908 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,598	2004	1.13	Yes	No	No	$964,687
971	PARKER TONY J	094-03-00-021	1904 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,203	1950	0.68	Yes	No	No	$541,261
972	STURKIE ROSEMARIE R & DAVE S	094-03-00-022	1930 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,916	2006	2.63	Yes	Yes	No	$1,347,354
973	WOODS RONALD E	094-03-00-026	1960 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,381	2000	0.99	Yes	No	No	$602,211
974	MCDOUGALD LESLIE E	094-03-00-027	1952 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,224	2001	1.21	Yes	No	No	$584,815
975	FORSYTHE BRADLEY ET AL	094-03-00-028	1969 WHITE RD CAMDEN , SC 29020	CAMDEN	Kershaw	4,128	2007	1.62	Yes	Yes	No	$1,320,945
976	HOWINGTON BETTY H	109-02-36-107	2246 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,841	1950	0.78	No	No	No	$456,449
977	EDWARDS ROBERT M & SANDRA L	109-02-36-108	2242 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,098	2008	0.86	Yes	No	No	$594,425
978	JONES RICHARD C	109-02-36-111	2224 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,728	1950	0.79	No	No	No	$443,802
979	KINNEY WILLIAM LEE III	109-02-36-112	2218 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	768	1950	0.83	Yes	No	No	$363,452
980	KINNEY WILLIAM L III & MARY F	109-02-36-113	2214 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,948	2015	0.79	Yes	No	Yes	$690,443
981	REYNOLDS CHARLES EDWARD	109-02-36-114	2208 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	778	1950	0.80	Yes	No	No	$364,397
982	FEATHERSTONE ROBERT R	109-02-36-115	2200 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,080	1950	1.77	No	No	No	$389,221
983	MARSHALL RICHARD G &	109-02-36-117	2168 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,616	1992	1.58	Yes	No	Yes	$495,907
984	GREENE TERRY M & TERESA W	109-02-36-118	2162 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	899	1950	0.91	Yes	No	No	$394,445
985	CRUMPTON TOM	109-02-36-119	2158 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,754	1995	0.72	Yes	No	No	$671,724
986	PARDUE EARL FRANKLIN III &	109-02-36-120	2154 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,551	1950	0.82	Yes	No	No	$499,797
987	ONKEN RICHARD D	109-02-36-121	2148 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,480	2020	0.73	Yes	No	No	$904,919
988	MCCOY KATHY L	109-02-36-123	2138 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	460	1965	0.71	Yes	No	Yes	$221,877
989	WESTALL HARRY CODY	109-02-36-124	2134 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,736	1950	0.83	Yes	No	No	$527,137
990	ROBINSON FRANK M & JEANETTE M	109-04-36-056	2419 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,552	1950	1.27	Yes	No	No	$522,692
991	PAULA SUE W TRUESDALE ET AL	109-04-36-057	2425 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,040	1950	1.29	Yes	No	No	$592,875
992	CURRIE ANDREW W	109-04-36-058	2429 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,888	2003	1.08	Yes	No	No	$1,050,639
993	HAMRIC JOHN II	109-04-36-060	2439 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	4,114	2003	1.23	Yes	No	No	$1,092,800
994	CATOE CECIL L JR	109-04-36-061	2443 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,066	1950	1.00	Yes	No	No	$430,189
995	COUICK WILLIAM NELSON	109-04-36-062	2447 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,224	1950	0.90	Yes	No	No	$453,371
996	SMITH CLAUDETTE H L/E	109-04-36-063	2449 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	620	1950	1.40	Yes	No	No	$348,088
997	SOWDER LISA DIANE	109-04-36-065	2452 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	896	1950	1.17	Yes	No	No	$404,113
998	MILLER NICKEY L	109-04-36-066	2448 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	4,472	2017	1.14	Yes	No	No	$1,217,781
999	FRETWELL TIMOTHY D	109-04-36-067	2442 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,809	1950	1.29	Yes	No	No	$561,560
1,000	HARPER JAMES S	109-04-36-068	2438 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,632	1950	1.24	Yes	No	No	$533,778

Figure 111: Unimpaired Market Value Summary 961-1,000

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,001	PAYNE TODD A	109-04-36-069	2432 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,620	2013	0.95	Yes	No	Yes	$529,941
1,002	OUTLAW MICHAEL W JR	109-04-36-070	2426 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	910	1950	1.14	Yes	No	No	$405,593
1,003	MCNEELY MARIAN L	109-04-36-071	2420 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,456	2013	0.91	No	No	Yes	$426,434
1,004	WEISE HAYLEY C	109-04-36-072	2412 SINGLETON PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	4,906	2008	0.70	Yes	No	No	$1,149,988
1,005	SCHUMANN PAUL E, JR	109-04-36-076	2430 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	976	1969	0.80	No	No	No	$381,264
1,006	BRELAND DAVID GLEN	109-04-36-078	2414 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,236	1950	1.79	Yes	No	No	$488,370
1,007	STEELE LEDELL B	109-04-36-080	2404 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	864	1950	0.83	Yes	No	No	$383,737
1,008	ROBINSON CARL LEONARD JR	109-04-36-081	2400 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	886	1950	1.03	Yes	No	No	$396,617
1,009	LALONE LAURA	109-04-36-082	2392 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	840	1969	0.99	Yes	No	Yes	$308,628
1,010	HOUGH CHRISTOPHER G	109-04-36-084	2384 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,200	1950	0.90	Yes	No	No	$449,306
1,011	ROBINSON JUDITH P	109-04-36-085	2378 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	576	1950	0.84	Yes	No	No	$319,299
1,012	ROLLINS JOHNNY RAY	109-04-36-089	2360 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	768	1950	0.98	Yes	No	No	$369,898
1,013	STABLEY SARAH ELIZABETH	109-04-36-090	2356 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,080	1950	0.99	Yes	No	No	$432,484
1,014	BRIGHAM BRIAN	109-04-36-091	2350 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,332	1950	0.66	Yes	No	No	$456,609
1,015	JR BUILDER HOMES, LLC	109-04-36-096	2308 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,653	1988	0.87	Yes	No	No	$640,827
1,016	CAUTHEN H CLAY	109-04-36-097	2304 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,349	2006	0.74	Yes	No	No	$635,086
1,017	JC WATTS LLC	109-04-36-098	2298 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,440	1950	0.69	Yes	No	No	$475,057
1,018	MCCULLEY DARYL J &	109-04-36-099	2294 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,371	2004	0.68	Yes	No	No	$804,570
1,019	BRITTON ROGER R	109-04-36-100	2288 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,425	1950	0.74	Yes	No	No	$476,060
1,020	SMALL ROY III	109-04-36-102	2276 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	920	1997	1.06	No	No	No	$446,703
1,021	BLIZZARD JOSEPH C &	109-04-36-103	2268 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	660	2017	0.86	Yes	No	No	$496,171
1,022	GLOVER MILEY W & JAN M	109-04-36-104	2262 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	4,160	2005	0.74	Yes	No	No	$1,054,860
1,023	DUNGAN GARY	109-04-36-105	2256 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,288	1968	0.73	Yes	No	No	$502,522
1,024	TRUESDALE CANSTON FOSTER III	111-02-00-002A	2467 BOWDEN RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,794	2007	2.29	Yes	No	No	$768,061
1,025	HART HENRY CHARLES &	111-02-00-004	2471 BOWDEN RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,556	1950	4.72	Yes	No	No	$820,031
1,026	COUCH MELISSA BAKER	111-02-00-007A	2463 BOWDEN RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,946	1950	2.06	No	No	No	$486,161
1,027	HATCH ROBERT WILLIAM	111-02-00-009	3402 JOHN G RICHARDS RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,296	1950	0.35	Yes	No	No	$397,811
1,028	HAYES THOMAS E, JR	111-02-00-010	2477 BOWDEN RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,016	1987	0.55	Yes	No	No	$625,961
1,029	DELLINGER THEODORE C	111-02-00-012	2515 BOWDEN RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,930	1950	1.69	No	No	No	$474,489
1,030	MCDONALD JAMES R III	111-02-00-013	2525 BOWDEN RD CAMDEN , SC 29020	CAMDEN	Kershaw	560	1950	0.46	Yes	No	No	$279,421
1,031	MOBLEY REID M	111-02-00-014	2529 BOWDEN RD CAMDEN , SC 29020	CAMDEN	Kershaw	816	1950	1.34	Yes	No	No	$369,467
1,032	CAULDER JAMES R	111-02-00-015	2507 BOWDEN RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,744	1950	2.01	Yes	No	No	$668,198
1,033	WHITE WILLIAM FRANCIS JR &	111-02-00-016B	2499 BOWDEN RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,464	1950	1.72	Yes	No	No	$494,238
1,034	WATEREE MARINA INC	111-02-00-017	3396 JOHN G RICHARDS RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,300	1950	2.22	Yes	No	No	$480,723
1,035	BRICE WILLIAM JAMISON	111-02-00-019	2493 BOWDEN RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,499	1950	1.08	Yes	No	No	$476,366
1,036	BRASINGTON JAMES F &	111-02-00-020	2533 BOWDEN RD CAMDEN , SC 29020	CAMDEN	Kershaw	624	1950	1.53	Yes	No	No	$331,481
1,037	HINSON CONNIE BURGESS	111-02-00-021	2521 BOWDEN RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,528	1950	1.75	Yes	No	No	$504,765
1,038	HAYES JAMES E	111-02-00-024A	2341 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,052	1950	0.71	Yes	No	No	$559,835
1,039	SMITH BONAHUE TINA MARIE	111-02-00-025	2414 MCWHIRTER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,400	1950	2.05	Yes	No	No	$524,005
1,040	GREER RICHARD HAROLD	111-02-00-025A	2418 MCWHIRTER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,744	1982	0.55	Yes	No	No	$605,855

Figure 112: Unimpaired Market Value Summary 1,001-1,040

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,041	DEESE CHARLES	111-02-00-026A	2422 MCWHIRTER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,264	1950	0.51	Yes	No	No	$434,280
1,042	MCWHIRTER GARY B	111-02-00-027	2426 MCWHIRTER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,904	1950	0.68	Yes	No	No	$652,719
1,043	GRAINGER BRIAN	111-02-00-028	2430 MCWHIRTER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,904	1950	0.50	Yes	No	No	$521,753
1,044	JENNINGS JOHN	111-02-00-029	2434 MCWHIRTER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,672	1950	0.78	Yes	No	No	$514,977
1,045	MILLER FRED G	111-02-00-030	2442 MCWHIRTER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,280	1950	0.67	Yes	No	No	$448,638
1,046	THOMAS LOU C &	111-02-00-031	2444 MCWHIRTER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,381	1950	0.62	Yes	No	No	$460,809
1,047	GHENT CRAWFORD G JR &	111-02-00-032	2448 MCWHIRTER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,102	1950	0.53	Yes	No	No	$409,448
1,048	HELMS BILLY JOHN SR	111-02-00-033	2452 MCWHIRTER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	576	1950	0.98	Yes	No	No	$324,650
1,049	LANEY JOSEPH LENDON	111-02-00-034	2351 DOLAN LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	782	1950	0.68	Yes	No	No	$359,196
1,050	TYSON ARCHIE A JR	111-02-00-035	2357 DOLAN LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,200	1950	0.72	Yes	No	No	$438,848
1,051	HENDLEY CHERRY R L/E	111-02-00-036	2438 MCWHIRTER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	872	1950	0.38	No	No	No	$301,858
1,052	HORNSBY DIANA H	111-02-00-038	2335 DOLAN LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,276	1950	0.72	No	No	No	$382,839
1,053	BYRD VIRGINIA	111-02-00-041	2369 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,406	2021	1.78	Yes	No	No	$770,182
1,054	DEAS ALICIA	111-02-00-042	2345 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,106	1950	0.94	Yes	No	No	$434,878
1,055	FARM LAKE HOUSE LLC	111-02-00-045	2361 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,000	1950	2.26	Yes	No	No	$454,028
1,056	PLYLER MILDRED MCELWEE	111-02-00-046	2357 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,823	1988	2.31	Yes	No	No	$739,819
1,057	BLACKMON ALLEN N & JANE B	111-02-00-047	2343 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	792	1981	0.95	No	No	No	$377,260
1,058	SHEARER RANDALL J	111-02-00-049	2347 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,176	1950	1.24	Yes	No	No	$460,003
1,059	CASANOVA TIFFANY	111-02-00-055	50 IVORY GULL LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,128	1984	2.89	No	No	No	$504,811
1,060	BURTNER KENNETH MARTIN	111-02-00-057	2458 MCWHIRTER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,524	2024	2.00	Yes	No	No	$1,034,280
1,061	PARDUE JOSEPH M, JR.	111-02-00-062	2351 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,862	1950	1.21	Yes	No	No	$565,287
1,062	JOHNSON TERRY &	111-02-00-064	2339 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,600	1984	1.15	Yes	No	No	$635,276
1,063	KINARD MICHAEL P	111-02-00-066	2253 WATERFRONT RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,408	1999	5.73	No	No	No	$973,082
1,064	JAMIESON TERRI L & JEFFREY L	111-02-00-067	2340 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,340	1950	1.01	Yes	No	No	$615,515
1,065	BRANHAM CHADWICK G &	111-02-00-084	2344 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,540	1950	0.92	Yes	No	No	$504,153
1,066	MARTIN JOHN H	111-02-00-085	2387 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,240	1950	2.30	No	No	No	$556,689
1,067	STARNES WALTER TODD	111-02-00-086	2377 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,984	2020	1.30	Yes	No	No	$867,275
1,068	PARDUE JOSEPH M JR	111-02-00-088	2381 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,247	1950	2.19	Yes	No	No	$654,107
1,069	BROCK PAMELA ANN	111-02-00-089	2386 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,676	1950	3.07	Yes	No	No	$592,467
1,070	CARTER KENNETH TODD	111-02-00-090	2352 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,365	2000	0.80	Yes	No	No	$622,804
1,071	RIBELIN SIDNEY THOMAS, III	111-02-00-091	2356 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,204	2024	1.03	No	No	No	$770,821
1,072	MCDONALD JAMES R JR &	111-02-00-092	2372 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	5,271	1950	1.36	Yes	No	No	$917,904
1,073	AWB & ASSOCIATES LLC	111-02-00-097	2385 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,344	2017	0.84	Yes	No	No	$683,159
1,074	FORRESTER LINDA H	111-02-00-098	2382 LITTLE CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,757	2000	2.86	Yes	No	No	$975,878
1,075	KENNINGTON DAVID C & CYNTHIA N	111-02-00-101	2347 DOLAN LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,607	2011	0.55	Yes	No	No	$856,179
1,076	LOVE DAVID A & LETHA R	111-02-00-103	2297 DOLAN LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	896	1950	0.99	Yes	No	No	$397,308
1,077	PURE GREEN INC	111-02-00-105	2365 DOLAN LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,832	2005	1.27	Yes	No	No	$935,161
1,078	KENNINGTON DAVID C	111-02-00-106	2314 DOLAN LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	952	1950	1.12	No	No	No	$350,786
1,079	INGRAM RONNIE J & WANDA M	111-02-00-107	2319 DOLAN LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	900	1950	0.61	Yes	No	No	$378,494
1,080	HYATT ZACHARY L	111-02-00-108	2303 DOLAN LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	448	1950	0.83	Yes	No	No	$284,775

Figure 113: Unimpaired Market Value Summary 1,041-1,080

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,081	HUDSON MONTEITH BARRON, III	111-02-00-111	2324 DOLAN LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,564	1950	1.36	Yes	No	No	$528,279
1,082	KENNINGTON CHRISTOPHER JOHN	111-02-00-113	2341 DOLAN LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,590	1973	0.44	Yes	No	No	$539,546
1,083	COX & WATSON AG	111-02-00-114	2307 DOLAN LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,248	1989	0.54	Yes	No	Yes	$388,214
1,084	COX JOHN ROBERT & RUTH C	111-02-00-123	2313 DOLAN LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,184	2003	0.52	Yes	No	No	$890,746
1,085	WHITESIDES BERNARD STEVEN &	111-04-00-001	2386 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	858	1950	0.83	Yes	No	No	$360,115
1,086	MURRAY LILLIE J	111-04-00-003	2380 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,525	1950	0.73	Yes	No	No	$461,217
1,087	MULLIS DANNY RAY	111-04-00-004-B01	2376 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,320	2021	0.75	Yes	No	No	$645,303
1,088	CHAMPAN RONALD M	111-04-00-006	2370 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,296	1950	0.60	No	No	No	$356,061
1,089	MAJOR NORMAN E	111-04-00-007	2362 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,272	2010	2.21	Yes	No	No	$1,023,094
1,090	WEIR WILLIAM RAWLINGS	111-04-00-009	2358 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,949	2008	0.93	Yes	No	No	$732,189
1,091	DEASE J LARRY	111-04-00-009-TEM	2354 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,494	2008	1.58	No	No	No	$580,648
1,092	MCCOY RANDY &	111-04-00-012-B01	2346 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,600	1950	2.12	Yes	No	No	$525,811
1,093	COYLE DANA T	111-04-00-014	2332 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	640	1950	0.93	Yes	No	No	$318,881
1,094	TAYLOR KAYLA	111-04-00-015	2330 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	768	1950	1.27	No	No	No	$303,326
1,095	COX MARION F & DELANO S	111-04-00-017A	2320 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,850	2002	3.70	Yes	No	No	$968,199
1,096	STEWART DOUGLAS A &	111-04-00-018	2318 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,600	1997	2.00	Yes	No	No	$847,961
1,097	SMITH KELLY Q	111-04-00-019	2314 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,827	2019	1.44	Yes	No	No	$963,434
1,098	NORTON RAYMOND KEITH	111-04-00-019A	2312 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,524	1950	1.30	Yes	No	No	$489,304
1,099	BAKER JOHN T	111-04-00-021	2306 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,496	1950	1.86	Yes	No	Yes	$456,726
1,100	MELTON JAMES DAVID	111-04-00-023	2300 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,664	1950	1.41	Yes	No	No	$513,436
1,101	LUCAS HOWARD RUSSELL &	111-04-00-024	2296 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,698	1950	2.21	Yes	No	No	$542,293
1,102	COLEY RAY A	111-04-00-025	2292 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,792	1996	1.07	Yes	No	No	$668,146
1,103	VARNADORE MICHELLE L	111-04-00-026	2288 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,156	1989	1.51	Yes	No	Yes	$392,298
1,104	JAILLETTE BURTON KEITH	111-04-00-027	2284 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,070	1950	1.42	Yes	No	No	$567,267
1,105	HENDERSON STEVEN K	111-04-00-030	2274 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	980	1950	1.49	Yes	No	No	$405,804
1,106	HENDERSON STEVEN K	111-04-00-031	2270 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,595	1950	1.26	Yes	No	No	$497,660
1,107	ELLIOTT JOHN K & DEBBIE S	111-04-00-033	2258 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,102	2007	2.64	Yes	No	No	$837,585
1,108	BITETTI KRISTI LOUISE	111-04-00-033A	2262 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	768	1950	3.72	Yes	No	No	$398,762
1,109	WILLIAMS JAMES PHILLIP	111-04-00-034	2250 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,152	2012	2.25	Yes	No	No	$644,684
1,110	SULLIVAN JAMES A	111-04-00-035A	2246 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,920	1994	0.55	Yes	No	No	$636,834
1,111	PLAYER RONALD E	111-04-00-036	2244 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	868	1950	1.37	Yes	No	No	$380,764
1,112	PLAYER RONALD E	111-04-00-036A	2240 BEAVER CREEK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,376	2002	1.94	Yes	No	No	$651,037
1,113	HARPER WILLIAM L	111-04-40-029	2400 HAMMOND RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,066	1950	0.96	No	No	No	$491,014
1,114	EDWARDS BRYAN DOUGLAS ETAL	111-04-40-030	2406 HAMMOND RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	783	1950	1.14	Yes	No	No	$379,058
1,115	THE CABIN AT BEAVER CREEK, LLC	111-04-40-031	2410 HAMMOND RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	450	1950	1.33	Yes	No	No	$299,250
1,116	BAXLEY KAREN M	111-04-40-032	2418 HAMMOND RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,392	1950	2.41	Yes	No	No	$531,165
1,117	WILLIS STEPHEN PERRY	111-04-40-033	2426 HAMMOND RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,508	1950	0.80	Yes	No	No	$492,521
1,118	SOLMON DEVER EDWARD JR	111-04-40-034	2432 HAMMOND RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,456	2010	1.04	Yes	No	No	$696,601
1,119	SIMPSON JOE P JR ET AL	111-04-40-035	2438 HAMMOND RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	624	1950	0.95	Yes	No	No	$335,492
1,120	REINOVSKY PAULA H ET AL	111-04-40-036	2450 HAMMOND RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,050	1950	1.95	Yes	No	No	$457,270

Figure 114: Unimpaired Market Value Summary 1,081-1,120

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,121	WARDLAW KENNETH M &	111-04-40-037	2460 ARROWHEAD RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,470	1950	5.79	Yes	No	No	$879,750
1,122	REICHER TIMOTHY W	111-04-40-048	2464 DARBY RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,684	2023	1.01	No	No	No	$677,295
1,123	DARBY ROBERT A JR	111-04-40-049	2460 DARBY RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,184	1950	1.00	Yes	No	No	$451,368
1,124	BEAVER CREEK FAMILY LIMITED PR	111-04-40-050	2454 DARBY RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	676	1950	1.10	Yes	No	No	$353,118
1,125	HAMMOND ROAD PROPERTIES LLC	111-04-40-052	2372 HAMMOND RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,008	1997	0.72	Yes	No	No	$527,567
1,126	CADY RICHARD ALLEN	111-04-40-053	2380 HAMMOND RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,314	1950	1.83	Yes	No	No	$503,173
1,127	JPN PROPERTIES LLC	111-04-40-054	2468 DARBY RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,359	2002	1.34	Yes	No	No	$662,551
1,128	FLOYD MONTY JOHN SR	111-04-40-055	2472 DARBY RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,296	1997	0.75	No	No	No	$503,796
1,129	RAY ROBERT MICHAEL	111-04-40-056	2474 DARBY RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,488	1950	0.87	Yes	No	No	$493,361
1,130	KNIGHT LISA M &	127-01-36-002	2716 JUTTY PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,312	1950	1.13	Yes	No	No	$478,794
1,131	MUNN JOSEPH	127-01-36-003	2712 JUTTY PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,346	1950	0.72	Yes	No	No	$595,604
1,132	SPRAWLS CECELIA CAUTHEN	127-01-36-004	2708 JUTTY PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	704	1950	0.74	Yes	No	No	$345,502
1,133	FOWLER KEVIN &	127-01-36-005	2704 JUTTY PT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	874	1950	0.73	Yes	No	No	$380,788
1,134	JORDAN DONNIE B	127-01-36-006	2700 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,095	1983	0.92	Yes	No	No	$698,028
1,135	JORDAN SANDRA KAY	127-01-36-007	2692 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,400	2005	0.76	Yes	No	No	$823,933
1,136	SLACK MAYNARD W & SARAH J	127-01-36-008	2686 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,232	1950	0.78	Yes	No	No	$447,999
1,137	HINSON PAUL B & ARMA LEE	127-01-36-009	2680 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,234	2006	0.73	Yes	No	No	$943,982
1,138	CRIMMINGER MILDRED G	127-01-36-010	2674 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	960	1981	0.76	Yes	No	No	$474,270
1,139	BOWYER BRUCE T	127-01-36-011	2668 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,292	1997	0.76	Yes	No	No	$771,385
1,140	GLOVER DONALD T	127-01-36-012	2662 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	912	1950	0.75	Yes	No	No	$389,292
1,141	WILLIAMS GAIL C &	127-01-36-015	2644 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,242	1981	0.79	Yes	No	No	$535,430
1,142	ROGERS CHARLES M	127-01-36-016	2638 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,488	1999	0.88	Yes	No	No	$650,259
1,143	BOWERS GERALD F & EUGENIA M	127-01-36-017	2632 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,811	2000	0.73	Yes	No	No	$701,928
1,144	PUTNAM JUDITH	127-01-36-018	2628 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	960	1987	0.71	Yes	No	No	$487,669
1,145	ROLLINGS JAMES EDISON &	127-01-36-019	2622 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,920	1950	0.76	Yes	No	No	$546,396
1,146	ROBINSON KEITH	127-01-36-020	2618 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,438	2001	0.71	Yes	No	No	$633,407
1,147	BRANHAM KIMBERLY	127-01-36-021	2612 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	870	2020	0.67	Yes	No	No	$557,590
1,148	IVEY MITCHELL R	127-01-36-022	2606 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,296	1980	1.66	Yes	No	No	$585,666
1,149	MELTON JODI P	127-01-36-025	2592 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,862	1950	1.21	Yes	No	No	$787,503
1,150	BIERMANN GERHARD STEPHAN &	127-01-36-026	2588 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,568	1996	0.79	Yes	No	No	$647,326
1,151	MILHORN KARLA SISTARE	127-01-36-027	2586 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,704	1950	0.87	Yes	No	No	$524,912
1,152	RIGGAN BETTY S	127-01-36-028	2582 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,408	1988	1.28	Yes	No	No	$619,572
1,153	LILLEY ANTHONY EVAN &	127-01-36-030	2578 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,584	1991	0.93	Yes	No	No	$643,150
1,154	MULLIS ROBERT &	127-01-36-031	2574 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	800	1950	0.99	Yes	No	No	$377,016
1,155	MAYORYK STEPHEN	127-01-36-037	2540 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	515	1950	0.96	Yes	No	No	$307,856
1,156	GAGLIANO MICHAEL W	127-01-36-038	2534 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,000	1950	0.91	Yes	No	No	$413,980
1,157	ZAMIELA CYNTHIA WHALEY &	127-01-36-039	2528 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,080	1950	0.73	No	No	No	$478,662
1,158	L & M WATEREE LAKE HOUSE LLC	127-01-36-042	2512 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,664	2011	1.31	Yes	No	No	$762,019
1,159	YOUNG WILLARD G & ROBBIE J	127-01-36-043	2504 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,997	2020	0.90	Yes	No	No	$1,008,108
1,160	KNIGHT KEVIN	127-01-36-044	2502 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,440	2008	0.88	Yes	No	No	$674,066

Figure 115: Unimpaired Market Value Summary 1,121-1,160

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,161	WILLIAMS JOHN B	127-01-36-045	2500 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	800	1950	0.76	No	No	No	$311,632
1,162	TREXLER DOROTHY S	127-01-36-046	2498 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	784	1950	0.89	Yes	No	No	$369,741
1,163	GRAY JAMES V	127-01-36-047	2494 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,120	1950	1.01	No	No	No	$373,793
1,164	ANDERSON NORMAN F &	127-01-36-048	2486 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,008	1989	1.52	Yes	No	Yes	$391,875
1,165	LOVEJOY LAKE HOUSE LLC	127-01-36-050	2484 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,025	1950	0.93	Yes	No	No	$419,409
1,166	STARNES ANTHONY	127-01-36-051	2480 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,364	1950	0.73	Yes	No	No	$598,565
1,167	WHITLEY RONNIE MAX & JUDY H	127-01-36-052	2478 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,554	1950	0.80	Yes	No	No	$498,923
1,168	NASH JUDY H	127-01-36-053	2474 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	780	1950	0.84	Yes	No	No	$366,612
1,169	WEIR THOMAS	127-02-00-009-SGZ	2950 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,138	2006	0.88	No	No	No	$805,084
1,170	ELLIS STEPHANIE L	127-02-00-010-SGZ	2954 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,630	2005	0.94	Yes	No	No	$706,058
1,171	MCBRIDE J WAYNE	127-02-00-013-SGZ	2968 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,546	2005	1.50	No	No	No	$613,033
1,172	BEAUCHEMIN RICHARD A &	127-02-00-014-SGZ	2972 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,986	1950	1.93	Yes	No	No	$734,638
1,173	KNIGHT WARREN	127-02-00-015-SGZ	7 RETREAT LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,000	2007	1.85	Yes	No	No	$839,024
1,174	SAIN LARRY GENE	127-02-00-017-SGZ	49 RETREAT LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,112	2005	1.17	Yes	No	No	$811,796
1,175	REID LELAND H	127-02-00-018-SGZ	45 RETREAT LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	5,376	2023	1.89	Yes	No	No	$1,441,876
1,176	PURSER JOY FURR	127-02-00-019-SGZ	19 RETREAT LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,174	2008	1.16	Yes	No	No	$993,040
1,177	BINGAMAN ERIC ALLEN	127-02-00-020-SGZ	27 RETREAT LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,999	2016	0.77	Yes	No	No	$970,464
1,178	TRIMNAL BRIAN O	127-02-00-021-SGZ	83 RETREAT LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	4,819	2017	1.19	Yes	No	No	$1,265,824
1,179	PORTER RICHARD E & VICKI V	127-02-00-022-SGZ	71 RETREAT LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,180	2007	0.79	Yes	No	No	$800,422
1,180	NICKELS KRISTINA	127-02-00-023-SGZ	67 RETREAT LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	5,280	2014	0.89	Yes	No	No	$1,258,850
1,181	KUHLMANN JOSEPH F III	127-02-00-025-SGZ	75 RETREAT LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,108	2023	0.65	Yes	No	No	$845,249
1,182	NEWTON CAROL G L/E	127-02-00-028-SGZ	63 RETREAT LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,978	2012	1.51	Yes	No	No	$1,012,740
1,183	SELYAVO SERGEY	127-02-00-029-SGZ	35 RETREAT LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,238	2007	0.94	Yes	No	No	$824,059
1,184	SIMPSON ELIZABETH J	127-02-37-053	2242 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	744	1950	0.76	Yes	No	No	$355,046
1,185	MARTIN DENNIS	127-02-37-054	2248 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,773	2002	0.58	Yes	Yes	No	$837,565
1,186	TURNER TERENCE E &	127-02-37-055	2254 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,425	2008	0.75	Yes	No	No	$839,751
1,187	BERGERON RICHARD J &	127-02-37-056	2260 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,248	1995	0.79	Yes	No	No	$580,349
1,188	HINSON BRYANT W JR	127-02-37-057	2266 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	780	1950	0.85	Yes	No	No	$367,183
1,189	WESTALL CHARLES S & DAWN C	127-02-37-058	2272 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	640	1950	0.70	Yes	No	No	$328,953
1,190	HUDSON DAVID P	127-02-37-059	2276 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,302	2015	0.65	Yes	No	No	$649,188
1,191	PRICE RICHARD L & NANCY S	127-02-37-061	2284 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,767	1950	0.75	Yes	No	No	$644,353
1,192	SCHLOSSER RONALD J C	127-02-37-062	2290 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,490	1991	0.68	Yes	No	No	$605,719
1,193	WATTS CHRISTOPHER B	127-02-37-063	2296 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,924	1999	0.79	Yes	No	No	$722,587
1,194	GRIFFITH JENNIFER LYNN	127-02-37-064	2302 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,120	1950	0.72	Yes	No	No	$568,370
1,195	DOWNS DAVID ET AL	127-02-37-065	2308 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,428	1970	0.68	Yes	No	No	$528,327
1,196	MACDONALD DOUGLAS P & NANCY K	127-02-37-067	2310 WHITE HERON LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,760	1950	1.23	No	No	No	$468,099
1,197	TURNER JENNIFER LYNN	127-02-37-068	2312 WHITE HERON LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	900	1950	0.71	Yes	No	No	$384,931
1,198	CAUTHEN TOMMY B	127-02-37-069	2314 WHITE HERON LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,080	1950	0.67	Yes	No	No	$415,483
1,199	WISE MICHAEL JEFFREY	127-02-37-070	2316 WHITE HERON LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	564	1950	0.71	Yes	No	No	$311,269
1,200	YOUNG ROGER A	127-02-37-073	2322 WHITE HERON LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,812	1950	0.92	Yes	No	No	$542,779

Figure 116: Unimpaired Market Value Summary 1,161-1,200

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,201	SALYERS BOBBY	127-02-37-074	2324 WHITE HERON LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,264	1950	1.72	Yes	No	No	$491,387
1,202	BATSON CLIFFTON R	127-02-37-075	2328 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,350	1950	1.03	Yes	No	No	$480,292
1,203	MUNN C BRAD	127-02-37-076	2334 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,456	1950	0.94	Yes	No	No	$492,826
1,204	GOODMAN JEFFREY JEROME	127-02-37-077	2336 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	980	1950	0.77	Yes	No	No	$403,268
1,205	SMITH SCOTT ALAN	127-02-37-078	2342 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,225	1950	0.72	Yes	No	No	$443,392
1,206	DUNLAP RICK B & DENISE	127-02-37-079	2348 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,476	2015	0.74	Yes	No	No	$696,749
1,207	WATEREE PROPERTIES LLC	127-02-37-080	2354 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,888	1950	0.75	Yes	No	No	$657,103
1,208	YOUNG JAMES RANDALL	127-02-37-081	2360 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	816	1950	0.66	No	No	No	$309,801
1,209	DEATON W R JR &	127-02-37-082	2366 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	864	1950	0.83	Yes	No	No	$383,731
1,210	DOETSCH CHARLES	127-02-37-083	2372 WHITE HERON RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	4,892	2007	0.77	Yes	No	No	$1,153,176
1,211	BODENHEIMER DUSTY S	127-02-37-088	2760 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	864	1981	0.75	Yes	No	No	$452,035
1,212	TERRILL MELISSA C	127-02-37-089	2754 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	912	1979	0.79	Yes	No	No	$460,221
1,213	WELLS AARON R &	127-02-37-090	2748 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,260	2006	2.06	Yes	No	No	$683,933
1,214	BRATTON GARY CHARLES	127-02-37-091	2742 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,540	1950	0.76	Yes	No	No	$494,375
1,215	KOHLHAGEN DENIS C ET AL	127-02-37-092	2736 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,362	2000	0.74	Yes	No	No	$617,200
1,216	BERRY JOSEPH KELVIN	127-02-37-095	2724 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	5,484	2012	0.84	Yes	No	No	$1,260,156
1,217	REEVES JAMES B	127-02-37-096	2722 SINGLETON CREEK RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	864	1993	0.71	Yes	No	No	$480,799
1,218	STEINER ROBERT SCOTT	128-01-0A-010-S59	2254 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,205	2003	1.31	Yes	No	No	$828,359
1,219	KELLY STEPHEN S JR	128-01-0A-012-S59	2266 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	4,340	2007	1.05	Yes	No	No	$1,126,033
1,220	MUNN FREDERICK N SR	128-01-0A-013-S59	2270 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,384	2004	0.57	No	No	No	$788,123
1,221	ALLEN BRENT B	128-01-0A-014-S59	2276 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	4,080	1950	0.79	Yes	No	No	$772,744
1,222	VINSON RALPH M & VIVIAN H	128-01-0A-015-S59	2394 ANNS LOOP LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,456	1950	0.86	Yes	No	No	$488,432
1,223	LARRABEE BRUCE M III &	128-01-0A-016-S59	2388 ANNS LOOP LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,400	2003	0.63	Yes	No	No	$798,889
1,224	NICHOLS FAMILY LIMITED	128-01-0A-017-S59	2382 ANNS LOOP LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,280	1950	0.94	Yes	No	No	$464,581
1,225	NICHOLS FAMILY LTD PRTSHP	128-01-0A-020-S59	2376 ANNS LOOP LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,365	1950	0.54	Yes	No	No	$452,261
1,226	BELK MATTHEW BLAKE &	128-01-0A-021-S59	2370 ANNS LOOP LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,595	1997	0.69	Yes	No	No	$936,160
1,227	GEHRIS RYAN KEN ET AL	128-01-0A-022-S59	2364 ANNS LOOP LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	6,876	2009	0.57	Yes	No	No	$1,320,473
1,228	SOWELL KEVIN W & KIMBERLY S	128-01-0A-023-S59	2290 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,176	1985	0.74	Yes	No	No	$530,893
1,229	MONTGOMERY BRYON SCOTT &	128-01-0A-024-S59	5 BEAVER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,104	1950	1.03	Yes	No	No	$438,391
1,230	BAKER GRETA S	128-01-0A-025-S59	11 BEAVER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,456	1950	0.57	No	No	No	$397,376
1,231	ROLLINS BRENT DARREN	128-01-0A-026-S59	18 BEAVER LN LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,694	1950	1.91	Yes	No	No	$567,187
1,232	COLLINS GARY E	128-01-0A-030-S59	2314 JOHNS CT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,425	1950	1.55	Yes	No	No	$513,283
1,233	HUNTER KIMBERLY RAPE	128-01-0A-031-S59	2316 JOHNS CT LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,200	1950	1.18	Yes	No	No	$461,528
1,234	LANEY CHADWICK W	128-01-0A-033-S59	2322 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,170	1950	0.72	No	No	No	$487,722
1,235	BAILEY KAREN FRANCES	128-01-0A-035-S59	2334 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,778	1950	1.43	Yes	No	No	$562,822
1,236	WATEREE DEALERS CHOICE LLC	128-01-0A-036-S59	2340 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,824	1994	0.94	Yes	No	No	$977,293
1,237	MCCOY BARBARA FAULK ETAL	128-01-0A-038-S59	2348 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,950	1950	0.74	Yes	No	No	$549,240
1,238	HAMMOND ROBERT LARRY	128-01-0A-039-S59	2354 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,755	1950	0.83	Yes	No	No	$529,388
1,239	MEC LIMITED LLC	128-01-0A-040-S59	2358 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,680	1950	0.82	Yes	No	No	$518,638
1,240	SAGAYSAY SYRRA A TRUSTEE	128-01-0A-041-S59	2364 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,536	1950	0.76	Yes	No	No	$493,729

Figure 117: Unimpaired Market Value Summary 1,201-1,240

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,241	MILLER JEFFREY C	128-01-0A-042-S59	2368 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,008	1950	0.64	Yes	No	No	$400,467
1,242	WITT ROBERT LEE	128-01-0A-043-S59	2374 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,080	1950	0.62	Yes	No	No	$412,199
1,243	MAREE KENNETH W & ELAINE S	128-01-0A-044-S59	2380 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,280	1950	0.86	Yes	No	No	$460,338
1,244	PORTER LINDA D	128-01-0A-045-S59	2388 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,131	1950	0.83	Yes	No	No	$578,132
1,245	JOHNSON JOHN C	128-01-0A-046-S59	2392 LAKESIDE DR LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,152	1950	0.82	Yes	No	No	$436,929
1,246	GREGORY C D JR & SHERRI C TRUS	128-01-40-001-B02	2354 LITTLE GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,593	1998	0.60	Yes	No	No	$801,189
1,247	LOFLIN JOSEPH MELTON JR	128-01-40-001A	2355 LITTLE GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,736	1999	1.06	Yes	No	Yes	$511,304
1,248	BRACKETT NANCY L	128-01-40-002-B01	2356 LITTLE GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,698	2004	0.94	Yes	No	No	$882,133
1,249	CAUTHEN C FARRIS	128-01-40-004	2366 LITTLE GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,604	1950	0.50	Yes	No	No	$482,319
1,250	EAKER CAROL W	128-01-40-005	2368 LITTLE GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,160	1950	0.48	Yes	No	No	$653,656
1,251	LANGLEY JEFFERY	128-01-40-006	2370 LITTLE GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,552	1950	0.44	Yes	No	No	$469,289
1,252	BRACKETT JOSEPH E JR &	128-01-40-007-B01	2372 LITTLE GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,746	1950	1.79	Yes	No	No	$571,172
1,253	WALTERS SUNNI L	128-01-40-008-B01	2374 LITTLE GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,024	1950	0.64	Yes	No	No	$403,599
1,254	BUNDRICK CARRIE A	128-01-40-009	2376 LITTLE GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,296	1950	0.70	Yes	No	No	$453,110
1,255	KNIGHT DANIEL BOYD	128-01-40-010	2380 LITTLE GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,092	1950	0.74	Yes	No	No	$421,976
1,256	MCLEOD JOHN S JR	128-01-40-011	2345 GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,717	1950	0.58	Yes	No	No	$622,956
1,257	CARD PAULA	128-01-40-012-B01	2339 GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,141	1950	0.54	No	No	No	$353,484
1,258	MYERS G T JR	128-01-40-013	2333 GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,472	1950	0.46	Yes	No	No	$460,336
1,259	FARLEY TIMOTHY A	128-01-40-014	2327 GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,679	2013	0.41	Yes	No	No	$982,928
1,260	ZIMMERMAN JOHN &	128-01-40-015-B01	2321 GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,425	1950	0.42	Yes	No	No	$449,840
1,261	MERRITT JAMES M	128-01-40-016	2315 GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,497	1950	0.37	No	No	No	$384,983
1,262	PURSER HOMER E	128-01-40-017	2312 GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,096	2003	1.20	Yes	No	No	$957,988
1,263	COX SUE P L/E	128-01-40-018-B01	2316 GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	2,496	1950	0.91	Yes	No	No	$626,946
1,264	CONSOLI ROBERT J	128-01-40-019	2322 GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	3,888	1950	0.67	Yes	No	No	$743,317
1,265	ROPER JO SITTON MARSHALL	128-01-40-021	2332 GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	984	1950	0.65	Yes	No	No	$397,303
1,266	KHOURY COREEN B &	128-01-40-022-B01	2338 GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,600	1950	0.82	Yes	No	No	$506,953
1,267	TOMLIN BARBARA C	128-01-40-023	2346 GULL RD LIBERTY HILL , SC 29074	LIBERTY HILL	Kershaw	1,335	1950	0.73	No	No	No	$391,554
1,268	SHEHEEN ROBERT J TRUSTEE	128-02-00-006-S15	2242 ROUND TOP LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,461	1950	2.86	Yes	No	No	$519,998
1,269	JOSEPH PAUL T	128-02-00-009-S15	2238 ROUND TOP LN CAMDEN , SC 29020	CAMDEN	Kershaw	4,912	1950	1.46	Yes	No	No	$842,737
1,270	SOTTILE VINCENT N JR & SHARON	128-02-00-010-S15	2236 ROUND TOP LN CAMDEN , SC 29020	CAMDEN	Kershaw	4,294	2023	0.94	Yes	No	No	$1,140,722
1,271	BROUGHTON BRIAN W	128-02-00-011-S15	2234 ROUND TOP LN CAMDEN , SC 29020	CAMDEN	Kershaw	3,391	2022	3.23	Yes	No	No	$1,155,708
1,272	BRIAN LAWRENCE D JR	128-02-00-012-S15	2228 ROUND TOP LN CAMDEN , SC 29020	CAMDEN	Kershaw	4,044	1950	0.99	Yes	No	No	$741,482
1,273	THEOS JERRY N	128-02-00-013-S15	2222 ROUND TOP LN CAMDEN , SC 29020	CAMDEN	Kershaw	3,948	2021	1.26	Yes	No	No	$1,119,145
1,274	WOOD RUBY P & PAUL SR TRUSTEE	128-02-00-014-S15	2214 ROUND TOP LN CAMDEN , SC 29020	CAMDEN	Kershaw	630	1950	1.31	Yes	No	No	$327,778
1,275	JACKSON CHESLEY CARLYLE &	128-02-00-015-S15	2210 ROUND TOP LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,490	1950	1.20	Yes	No	No	$480,125
1,276	SHEHEEN VINCENT A	128-02-00-024-S15	2241 ROUND TOP LN CAMDEN , SC 29020	CAMDEN	Kershaw	2,145	1965	4.97	No	No	No	$604,522
1,277	SHEHEEN AMANDA K	128-02-00-025-S15	2246 ROUND TOP LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,953	1950	2.06	Yes	No	No	$574,024
1,278	CARROLL VICTORIA	128-02-00-037	2254 M WEST RD CAMDEN , SC 29020	CAMDEN	Kershaw	936	1950	2.96	Yes	No	No	$426,326
1,279	TIMMONS KEITH W & BRONWENN	128-02-00-037A	2250 M WEST RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,088	2023	2.82	Yes	No	No	$919,435
1,280	SHUGART SCOTT CORBY	128-02-00-038	2252 M WEST RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,848	1950	1.89	Yes	No	No	$554,715

Figure 118: Unimpaired Market Value Summary 1,241-1,280

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,281	SMITH SISTARE GINNY TRUSTEE	128-02-00-039	2248 M WEST RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,680	1950	1.52	Yes	No	No	$519,536
1,282	BAKER STACEY DEAN &	128-02-00-040	2246 M WEST RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,912	1950	2.06	Yes	No	No	$568,383
1,283	WHITAKER JERRY D ETAL	128-02-00-041	2244 M WEST RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,440	1950	2.95	Yes	No	No	$518,282
1,284	COUICK CAROLEENE H	128-02-00-042	2242 M WEST RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,143	1950	1.86	Yes	No	No	$592,312
1,285	SPENCER GREGORY P & CAROL A	128-02-00-043	2240 M WEST RD CAMDEN , SC 29020	CAMDEN	Kershaw	576	1950	0.74	Yes	No	No	$296,705
1,286	MOSER KARL A	128-02-00-045	2064 FORT LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,980	2006	1.02	Yes	No	No	$735,997
1,287	BEAVER CREEK LAKE HOUSE LLC	128-02-00-046	2062 FORT LN CAMDEN , SC 29020	CAMDEN	Kershaw	3,952	2007	1.57	Yes	No	No	$1,058,761
1,288	GARDNER LOUISE C	128-02-00-048	2154 FORT TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,256	1950	2.70	Yes	No	No	$482,771
1,289	ADAMS ROBERT EARL & CYNTHIA T	128-02-00-049	2160 FORT TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,512	2002	2.90	Yes	No	No	$707,853
1,290	BURNS JOHN M	128-02-00-050	2164 FORT TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,296	2014	1.41	Yes	No	No	$656,153
1,291	MOLINA GORDON	128-02-00-052	2060 FORT LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,734	1950	0.28	No	No	No	$376,902
1,292	MARSHALL CLIFFORD W	128-02-00-054	2066 FORT LN CAMDEN , SC 29020	CAMDEN	Kershaw	536	1950	0.75	Yes	No	No	$287,652
1,293	CROTHERS ALLEN &	128-02-00-056	2056 FORT LN CAMDEN , SC 29020	CAMDEN	Kershaw	2,892	2014	1.66	No	No	No	$815,037
1,294	RICHARDSON THOMAS W	128-02-00-057	2238 M WEST RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,282	1994	1.06	No	No	Yes	$449,784
1,295	TOWERY MARILYN KERRY MCCUE	128-02-00-058	2044 FORT LN CAMDEN , SC 29020	CAMDEN	Kershaw	960	1997	1.11	No	No	No	$430,562
1,296	WITT PHILIP E &	128-04-00-002-S15	2225 SAILING CLUB LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,693	2022	0.87	No	No	No	$625,740
1,297	WITT PHILLIP E & RITA M	128-04-00-002B-S15	2225A SAILING CLUB LN CAMDEN , SC 29020	CAMDEN	Kershaw	780	1950	3.60	Yes	No	No	$400,301
1,298	ALDERSON MITCHELL TODD	128-04-00-003-S15	2234 SAILING CLUB LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,089	1984	1.02	No	No	No	$420,334
1,299	WELLS WILLIAM RICHARD &	128-04-00-004-S15	2240 SAILING CLUB LN CAMDEN , SC 29020	CAMDEN	Kershaw	2,077	1950	6.95	No	No	No	$566,720
1,300	FATA PAUL M &	128-04-00-007-SJP	58 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	3,262	2018	0.95	Yes	No	No	$980,599
1,301	WALKER ANDREW JACKSON JR	128-04-00-008-SJP	64 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,815	2006	0.62	Yes	No	No	$820,109
1,302	HOOKS G STUART	128-04-00-008A-SJP	62 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,428	1950	0.68	Yes	No	No	$566,270
1,303	WALKER ROBERT D & PAMELA H	128-04-00-009-SJP	71 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	4,056	2007	0.61	No	No	No	$824,641
1,304	ROYALTY KENNETH MACK &	128-04-00-009A-SJP	66 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,941	2007	0.48	Yes	Yes	No	$1,000,534
1,305	CAROLINA PIPING & RIGGING MGT	128-04-00-010-SJP	69 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	3,362	1950	0.84	No	No	No	$568,681
1,306	WATEREE HOUSE LLC	128-04-00-010B-SJP	69A NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,301	2006	0.68	Yes	No	No	$756,398
1,307	DAVIS CLARENCE S	128-04-00-012-SJP	63 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,176	2006	0.64	Yes	No	No	$732,722
1,308	NEWMAN JASON	128-04-00-013-SJP	59 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,337	2006	0.70	Yes	No	No	$763,976
1,309	FORE LARRY B & MAURICE P	128-04-00-014-SJP	53 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	1,908	2006	0.90	Yes	No	No	$713,985
1,310	HARRIS EDWARD WAYNE	128-04-00-015-SJP	47 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,623	2013	0.89	Yes	Yes	No	$1,046,248
1,311	GAUSE DAVID GREGG &	128-04-00-016-SJP	41 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,360	2023	1.26	Yes	No	No	$895,352
1,312	JONES DAVID W. W.	128-04-00-017-SJP	37 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,100	2007	0.79	Yes	No	No	$740,312
1,313	LEIDINGER STEVEN P & ANGELA E	128-04-00-018-SJP	33 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,117	2010	0.89	Yes	No	No	$764,956
1,314	SPROUSE JAMES T JR	128-04-00-019-SJP	29 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	3,049	2006	0.91	Yes	No	No	$884,705
1,315	HALL VICTOR ALLEN IV	128-04-00-020-SJP	25 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,137	2008	0.95	Yes	No	No	$764,438
1,316	LINEBERGER EARL L & CHARLENE F	128-04-00-021-S15	2226 SAILING CLUB LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,026	1950	0.89	Yes	No	No	$393,129
1,317	BENNETT OLLIE K	128-04-00-022-SJP	15 NAUTICAL DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,700	2021	1.47	Yes	No	No	$956,561
1,318	ROLLINS EUGENE C & LINDA C	128-04-41-034	1748 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,880	1950	1.95	Yes	No	No	$680,947
1,319	BRIDGES RICHARD V III	128-04-41-035	1750 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,575	1950	0.94	No	No	No	$407,368
1,320	STARNES SAMUEL O, JR	128-04-41-036	1756 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,945	1988	0.90	Yes	Yes	No	$959,458

Figure 119: Unimpaired Market Value Summary 1,281-1,320

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,321	LOWMAN WILLIAM MARK	128-04-41-037	1762 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,737	2009	0.75	Yes	Yes	No	$1,180,741
1,322	KLEINSCHMIDT JEFFREY JOHN	128-04-41-038	1768 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,372	2017	0.77	Yes	No	No	$644,061
1,323	COCHRANE EMILY	128-04-41-039	1772 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,008	1950	0.83	No	No	No	$328,526
1,324	JONES CLYDE M, II	128-04-41-040	1778 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,107	2003	1.33	Yes	No	No	$764,402
1,325	HAYES PAUL R & MARY J	128-04-41-041	1784 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,458	2007	1.09	Yes	No	No	$822,004
1,326	GRIFFIN ROBERT GORDON III	128-04-41-042	1792 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,045	1950	1.63	Yes	No	Yes	$411,797
1,327	SMITH HAROLD LEE III &	128-04-41-044	1802 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,428	2023	0.80	Yes	Yes	No	$1,055,639
1,328	KINARD VIVIAN B ETAL	128-04-41-045	1806 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,639	1950	0.96	Yes	No	No	$490,395
1,329	PAUL JOHN D & JANET B	128-04-41-047	1816 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	4,622	2009	0.72	Yes	Yes	No	$1,294,015
1,330	WALTERS JAMES DAVID	128-04-41-049	1828 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,192	2006	1.03	Yes	Yes	No	$1,115,852
1,331	WEATHERFORD CHARLES B JR &	128-04-41-050	1834 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,620	2019	1.37	Yes	No	No	$744,430
1,332	TINSLEY HEATH PURVIS	144-02-00-001-SED	1595 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,360	1950	0.76	Yes	No	No	$440,097
1,333	RODDEY TERRY A	144-02-00-002-SED	1597 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,680	2000	0.78	Yes	No	Yes	$462,100
1,334	FUNDERBURK JOSEPH E JR	144-02-00-003-SED	1599 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,449	2002	0.73	Yes	No	No	$765,929
1,335	FIELDS WAYMON L	144-02-00-004-SED	1603 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,344	1998	0.70	Yes	No	Yes	$408,214
1,336	AYCOCK JOHN DAVID	144-02-00-005-SED	1607 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	4,474	1950	0.67	Yes	No	No	$745,511
1,337	KEEBLER DAVID	144-02-00-006-SED	1611 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,643	2005	0.75	Yes	No	No	$651,024
1,338	STARNES BAXTER W &	144-02-00-008-SED	1619 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,120	2003	0.81	Yes	No	No	$728,710
1,339	FOX CLARENCE R	144-02-00-011-SED	1631 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,800	2000	0.95	Yes	No	No	$676,513
1,340	CAMPBELL MICHAEL	144-02-00-012-SED	1635 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,400	2003	1.11	Yes	No	No	$796,751
1,341	HUCKS GLENDA FAYE	144-02-00-013-SED	1639 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,818	1950	1.12	No	No	No	$443,040
1,342	PATE GARY K &	144-02-00-014-SED	1643 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,392	2008	2.26	Yes	No	No	$879,410
1,343	MCDOW WILLIAM C	144-02-41-001	1808 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,024	1950	0.75	Yes	No	No	$385,892
1,344	GLASS JENNIFER R	144-02-41-016	46 MERRY WAY CAMDEN , SC 29020	CAMDEN	Kershaw	1,776	1950	1.74	Yes	No	No	$540,111
1,345	CAMPBELL JAMES A & MELISSA L	144-02-41-019	1601 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,680	1950	0.79	Yes	No	No	$485,867
1,346	MULLIS JAMES MARVIN III	144-02-41-020	1591 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,200	1950	1.31	No	No	No	$372,434
1,347	MULLIS SARAH R ET AL	144-02-41-021	1583 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	864	1950	1.05	No	No	No	$313,861
1,348	GHENT DELLA C	144-02-41-022	1579 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,064	2002	1.19	No	No	No	$467,312
1,349	HARPER MICHAEL B &	144-02-41-024	1573 SAILING CLUB RD CAMDEN , SC 29020	CAMDEN	Kershaw	4,070	2001	2.95	Yes	No	No	$1,105,972
1,350	AUSTIN JAMES F	144-02-41-026	70 MERRY WAY CAMDEN , SC 29020	CAMDEN	Kershaw	650	1950	1.72	No	No	No	$289,810
1,351	HUIETT TODD A	144-02-41-027	42 MERRY WAY CAMDEN , SC 29020	CAMDEN	Kershaw	4,636	2008	2.41	Yes	No	No	$1,195,445
1,352	WEBB TIMOTHY L &	144-02-41-028	38 MERRY WAY CAMDEN , SC 29020	CAMDEN	Kershaw	1,374	2004	3.81	Yes	No	No	$704,870
1,353	AUSTIN JAMES F &	144-02-41-029	52 MERRY WAY CAMDEN , SC 29020	CAMDEN	Kershaw	3,583	2008	7.79	Yes	No	No	$1,198,550
1,354	MCROBERTS PAUL ANTHONY	144-04-00-001	2332 HORTON LN CAMDEN , SC 29020	CAMDEN	Kershaw	2,952	2007	4.23	Yes	No	No	$1,025,442
1,355	MCGUIRE GERALD	144-04-00-002	2342 HORTON LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,210	1950	5.27	Yes	No	No	$508,070
1,356	OFFORD STEVE J	144-04-00-002-SGQ	2207B HORTON COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	6,040	2002	8.69	Yes	Yes	No	$1,811,840
1,357	NOONKESTER MATTHEW DONNELL	144-04-00-003-SGQ	2207C HORTON COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,700	2023	4.34	Yes	Yes	No	$1,316,899
1,358	CHAMBERS SCOTT R &	144-04-00-005-SGQ	2221B HORTON COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,474	2010	4.08	Yes	Yes	No	$1,169,276
1,359	CUMMINGS MICHAEL J SR	144-04-00-006-SGQ	2243A HORTON COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	7,644	2007	6.06	Yes	No	No	$1,639,331
1,360	MCKAY ROSS K & SHELLEY L	144-04-00-008-SGQ	2273A HORTON COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,838	2007	8.66	Yes	No	No	$1,083,582

Figure 120: Unimpaired Market Value Summary 1,321-1,360

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,361	EFROS APRIL S	144-04-00-010-SGQ	2273C HORTON COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,055	2013	9.38	Yes	No	No	$1,168,281
1,362	EFROS JAMES H & APRIL S	144-04-00-012-SGQ	2273E HORTON COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,600	1950	5.33	No	No	No	$610,804
1,363	CLOSE ERIC DAVID ET AL	144-04-0A-018	1479 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	692	1950	0.66	Yes	No	No	$318,884
1,364	HOWARD HENRY C ET AL	144-04-0A-019	1477 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	480	1950	0.68	Yes	No	No	$271,028
1,365	CATO BRANDI	144-04-0A-022	1471A CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	900	1950	0.86	Yes	No	No	$369,208
1,366	TIDWELL JOHN R &	144-04-0A-023	1471 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	840	2014	0.84	Yes	No	No	$510,749
1,367	BEASLEY TRACY H	144-04-0A-025	1467 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,728	1950	1.55	No	No	No	$447,243
1,368	JEFFERS KATHERINE S	144-04-0B-006	2273 HORTON ACRES LN CAMDEN , SC 29020	CAMDEN	Kershaw	890	1950	0.76	No	No	No	$307,562
1,369	GORDON BARRY	144-04-0B-009	2279 HORTON ACRES LN CAMDEN , SC 29020	CAMDEN	Kershaw	556	1950	0.90	Yes	No	No	$298,051
1,370	PEREKSTA ROBERT F	144-04-0B-011	2291 HORTON ACRES LN CAMDEN , SC 29020	CAMDEN	Kershaw	780	1950	0.76	Yes	No	No	$341,511
1,371	WILLIAMS RICHARD D	144-04-0B-012	2293 HORTON ACRES LN CAMDEN , SC 29020	CAMDEN	Kershaw	673	1950	0.86	Yes	No	No	$323,517
1,372	KINCAID WILLIAM R	144-04-0B-013	2295 HORTON ACRES LN CAMDEN , SC 29020	CAMDEN	Kershaw	704	1950	0.70	Yes	No	No	$323,554
1,373	WATTS HENRY L II	144-04-0B-014	2299 HORTON ACRES LN CAMDEN , SC 29020	CAMDEN	Kershaw	832	1950	0.50	Yes	No	No	$337,174
1,374	RICHARDS DUSTIN T	144-04-0B-015	2168 HORTON COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,983	2023	0.65	Yes	No	No	$773,906
1,375	KRUSE DAVID J	144-04-0B-017	2160 HORTON COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	480	1950	0.67	Yes	No	No	$270,619
1,376	CRISP RICHARD LAWRENCE	144-04-0B-018	2158 HORTON COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	498	1950	1.15	Yes	No	No	$290,632
1,377	BLYTHE ROBIN SCOTT	144-04-0B-105	2287 HORTON ACRES LN CAMDEN , SC 29020	CAMDEN	Kershaw	768	1950	0.84	No	No	No	$290,704
1,378	HORTON-CROMER FAMILY LTD	144-04-0C-006	2380 HORTON TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,596	1950	0.95	Yes	No	No	$484,113
1,379	ANDERSON KIMBERLY LYNN	145-00-00-003	1818 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	4,270	2002	6.78	Yes	Yes	No	$1,509,055
1,380	HORTON-CROMER FAMILY LIMITED P	145-00-00-004	1902A CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	700	1950	20.15	No	No	No	$385,264
1,381	MOON DAVID LEE	160-02-43-192	2525 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,836	1950	1.07	Yes	No	No	$521,894
1,382	NOWLEN CAROLYN D & WILLIAM H	160-02-43-193	2533 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,520	2011	0.71	No	No	No	$689,907
1,383	CARROLL CHARLES E	160-02-43-194	2539 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,924	1950	0.80	Yes	No	No	$517,787
1,384	B&O, LLC	160-02-43-195	2543 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,085	1950	0.75	No	No	No	$452,221
1,385	QUIRK CONSTANCE A &	160-02-43-196	2547 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	800	1950	1.10	No	No	No	$304,297
1,386	LOYD EDWARD H	160-02-43-198	2553 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	840	1950	0.77	No	No	No	$300,252
1,387	HUGHES DEBORAH RASH &	160-02-43-199	2559 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,272	1950	0.78	Yes	No	No	$427,837
1,388	VALENTINE EDWARD D &	160-02-43-202	2577 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,688	1999	0.86	Yes	No	No	$798,471
1,389	WOOLCOCK ADRIAN &	160-02-43-203	2581 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,083	2002	0.88	Yes	No	No	$866,309
1,390	VOGEL MARK D & BEVERLY A	160-02-43-204	2587 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	775	1950	0.85	Yes	No	No	$344,459
1,391	WARD JOHN BRYAN	160-02-43-205	2591 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	864	1950	0.70	Yes	No	No	$354,863
1,392	WILLIAMS SHAUN	160-02-43-206	2597 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	980	1950	0.76	No	No	No	$321,442
1,393	WILLIAMS LANSDALE B &	160-02-43-207	2605 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	912	1950	0.96	Yes	No	No	$375,682
1,394	REUWER DAVID PAUL	160-02-43-211	2637 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,686	2024	0.64	Yes	No	No	$721,377
1,395	ENGLISH GORDON B JR & ELIZ	160-02-43-214	2651 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	480	1950	0.87	Yes	No	No	$277,633
1,396	HEGLER ROBERT S & PATRICIA H	160-02-43-214A	2653 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	948	1950	0.70	Yes	No	No	$370,365
1,397	ROSS DAVID A	160-02-43-215	2655 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,484	1950	0.85	Yes	No	No	$462,847
1,398	HARKINS GEORGE W & ALEXANDRIA	160-02-43-218	2671 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,683	2009	0.66	Yes	No	No	$821,951
1,399	STORK LINDSEY K &	160-02-43-219	2679 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,536	1984	0.72	Yes	No	Yes	$402,378
1,400	HOOD RICHARD	160-02-43-220	2683 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,279	1950	0.70	Yes	No	No	$551,427

Figure 121: Unimpaired Market Value Summary 1,361-1,400

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,401	CAMPBELL CHARLES RICHARD	160-03-00-002	1509 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,666	1950	0.55	Yes	No	No	$467,012
1,402	HOECHSTER JOHN H &	160-03-00-003	1529 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,600	1950	0.53	Yes	No	No	$456,709
1,403	BAIR DAVID WAYNE	160-03-00-004	1505 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	961	1950	0.71	Yes	No	No	$372,882
1,404	FRITH HORACE W JR &	160-03-00-006	1543 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	580	1950	0.58	Yes	No	No	$290,640
1,405	BLACKWELL FAITH IVY	160-03-00-008	1533 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,160	1950	0.45	Yes	No	No	$388,278
1,406	AGEE KYLE &	160-03-00-009	1525 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,000	1950	0.66	Yes	No	No	$376,946
1,407	GARR ALFRED B	160-03-00-010	1523 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,990	2019	0.41	Yes	No	No	$723,496
1,408	TINSLEY DAVID S &	160-03-00-012	1491 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,518	1950	1.18	Yes	No	No	$483,656
1,409	FERGUSON JOHN J, JR	160-03-00-013	1497 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	910	1950	0.73	Yes	No	No	$364,705
1,410	PARKER CHRISTOPHER C	161-01-43-112	2005 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,049	2008	0.86	Yes	No	No	$743,112
1,411	STOKES HUBERT T JR &	161-01-43-114	2017 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,387	2011	0.93	No	No	No	$692,417
1,412	NORWOOD MICHAEL B & TINA C	161-01-43-115	2025 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,640	1950	0.89	No	No	No	$412,655
1,413	SIMPSON BAXTER G	161-01-43-116	2033 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,240	1950	1.17	No	No	No	$373,877
1,414	WILLIAMS HARRIETT STEVENS	161-01-43-117	2041 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,360	1950	0.93	No	No	No	$380,957
1,415	GROWTHNAV, LLC	161-01-43-118	2045 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	972	1950	0.82	No	No	No	$322,618
1,416	RONDEAU JOHN RENE	161-01-43-119	2049 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,729	1950	0.88	Yes	No	No	$497,738
1,417	HERN JAMES L	161-01-43-122	2063 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,938	2010	0.81	Yes	No	No	$1,004,944
1,418	COCKFIELD LMT PARTNERSHIP	161-01-43-123	2067 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	992	1950	0.78	Yes	No	No	$382,030
1,419	TILLER RICHARD C	161-01-43-124	2071 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,456	2009	0.87	Yes	No	No	$948,796
1,420	WILSON DONNIE W	161-01-43-126	2079 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	948	1950	1.85	Yes	No	No	$408,711
1,421	SMITH WILLIAM L &	161-01-43-127	2081 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,568	1950	0.65	Yes	No	No	$461,746
1,422	MARSHALL JOAN L	161-01-43-129	2089 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,200	1950	1.01	Yes	No	No	$427,805
1,423	SIMLER SUSAN L	161-01-43-130	2095 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,584	1950	0.82	Yes	No	No	$474,980
1,424	LOTT JENNIFER EY	161-01-43-131	2101 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,940	2008	0.74	Yes	No	No	$713,418
1,425	LAFOY ELIZABETH LINDSAY	161-01-43-132	2105 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,428	1950	0.79	Yes	No	No	$451,339
1,426	MM2, LLC	161-01-43-134	2115 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	711	1950	0.90	Yes	No	No	$333,269
1,427	SPIVEY CHRISTOPHER K &	161-01-43-135	2121 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,959	2015	0.80	Yes	No	No	$751,413
1,428	WINDHAM RUFUS TRAVIS	161-01-43-136	2125 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,560	1950	1.07	No	No	No	$411,221
1,429	MCCASKILL CRANE CREEK LLC	161-01-43-137	9 CRANE CREEK DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,367	2009	0.92	Yes	No	No	$802,555
1,430	CURTIS KARYANN	161-01-43-138	10 CRANE CREEK DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,924	1986	0.96	No	No	No	$662,311
1,431	WILLIAMS LANE S ET AL	161-01-43-139	2131 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	936	1950	1.14	No	Yes	No	$400,092
1,432	SWEENEY DANIEL F	161-01-43-144	2169 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,014	2000	0.77	No	No	No	$591,113
1,433	WINN ELIZABETH CROSS	161-01-43-145	2175 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,377	1950	0.92	No	No	No	$490,164
1,434	PEIRSON PAMELA DENESE ET AL	161-01-43-146	2179 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,737	2006	0.94	No	Yes	No	$1,007,630
1,435	BILLINGS MICHAEL T	161-01-43-147	2183 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,076	1950	0.81	Yes	No	No	$536,594
1,436	WRIGHT FRED D & MELISSA M J/S	161-01-43-148	2187 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,910	1950	0.92	No	No	No	$443,752
1,437	BURT JAMES PHILLIP JR ET AL	161-01-43-149	2193 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,011	1950	0.81	Yes	No	No	$528,863
1,438	MUNDY WILLIAM J & LINDA	161-01-43-150	2205 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,232	2002	1.37	No	No	No	$507,076
1,439	GIBSON GLADYS T	161-01-43-152	2219 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,314	1950	0.93	Yes	No	No	$441,772
1,440	CHAPOY ANGELA	161-01-43-153	2223 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,539	1950	1.20	Yes	No	No	$611,928

Figure 122: Unimpaired Market Value Summary 1,401-1,440

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,441	SCHRIFT RYAN JOHN	161-01-43-154	2227 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,296	1950	0.95	Yes	No	No	$440,388
1,442	COLLINS JOHNNY W	161-01-43-155	2233 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,464	1950	0.89	Yes	No	No	$462,186
1,443	MARTIN DENNIS ANDREW	161-01-43-156	2237 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,512	1950	0.84	Yes	No	Yes	$335,439
1,444	PRESSLEY COLIN ARTHUR JR	161-01-43-157	2243 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,100	1950	0.72	Yes	No	No	$397,225
1,445	SANDOVAL ALBERTO	161-01-43-163	2361 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,002	1984	1.00	Yes	No	No	$476,285
1,446	YOUNG RICHARD & HOLLY	161-01-43-164	2369 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,800	2002	0.90	Yes	No	No	$680,340
1,447	KINLAW HUBERT III	161-01-43-165	2375 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,272	1950	0.79	Yes	No	No	$428,245
1,448	PLYLER ROBBIE G	161-01-43-166	2381 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,152	1950	0.80	Yes	No	No	$410,028
1,449	JONES MARY E L/E	161-01-43-167	2387 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,280	2017	0.71	No	No	Yes	$490,833
1,450	MYERS RICHARD C JR & SUSAN R	161-01-43-168	2393 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,956	2017	0.66	Yes	No	No	$898,290
1,451	FELDER FRANCIS P	161-01-43-170	2405 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,152	2021	0.80	No	No	No	$687,793
1,452	WILLIAMSON LONDA SUE	161-01-43-172	2419 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,848	1950	0.79	Yes	No	No	$507,408
1,453	GODWIN LAWRENCE F JR ET AL	161-01-43-173	2425 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,836	1950	0.80	No	No	No	$429,777
1,454	LAPLANTE LONI	161-01-43-175	2437 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,384	1950	0.96	No	No	No	$578,491
1,455	CROSS ALFRED BIGGART &	161-01-43-176	2441 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	782	1950	0.95	No	No	No	$296,882
1,456	OLD BLUE JEAN REAL ESTATE LLC	161-01-43-177	2445 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,200	1950	0.84	No	No	No	$356,168
1,457	CREED HOWARD R AND	161-01-43-178	2449 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,674	1950	0.84	Yes	No	No	$488,052
1,458	SMITH THOMAS C &	161-01-43-180	2457 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,217	1950	0.83	Yes	No	No	$421,909
1,459	ROLL MERILYN C L/E	161-01-43-181	2465 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,468	1950	1.25	No	No	No	$514,442
1,460	TRAXLER WILLIAM D	161-01-43-182	2471 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	856	1950	0.97	Yes	No	No	$365,382
1,461	TRUST ROBERTSON EUGENE DUNLEY	161-01-43-183	2473 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,260	1950	0.91	Yes	No	No	$432,674
1,462	HUBBARD JOEL M II	161-01-43-185	2477 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,198	1999	0.86	Yes	No	No	$728,775
1,463	HUTCHINSON VALERIE A	161-01-43-186	2481 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,260	1950	0.69	Yes	No	No	$420,447
1,464	RICHARDS JOHN W JR	161-01-43-188	2493 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	945	1950	0.68	No	No	No	$312,758
1,465	GARRIS BILLY A SR & GLORIA W	161-01-43-189	2499 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,280	1950	0.74	No	No	No	$361,900
1,466	RABON BENJAMIN J	161-02-43-010	1633 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	609	1950	0.78	Yes	No	No	$306,017
1,467	SMOAK GLADY S & STEPHEN R	161-02-43-011	1641 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,840	1950	0.74	Yes	No	No	$503,124
1,468	DUPREE DONNY A	161-02-43-015	1677 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,888	1950	0.70	No	No	No	$429,501
1,469	MORRISON LARRY M	161-02-43-016	1681 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,568	1950	0.74	Yes	No	No	$467,722
1,470	SIKES DAVID LEE & MELISSA C	161-02-43-017	1687 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	800	1950	0.72	Yes	No	No	$343,698
1,471	COLE PRESTON	161-02-43-018	1691 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,244	2007	0.77	Yes	No	No	$760,770
1,472	STINNETT ESTELLE M	161-02-43-019	1697 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,161	2002	0.81	Yes	No	No	$731,498
1,473	JORDAN ROBERT B JR	161-02-43-020	1703 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,537	2013	0.85	Yes	No	No	$669,736
1,474	GLASGOW MARGUERITE E	161-02-43-021	1709 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,440	1950	0.96	Yes	No	No	$462,127
1,475	CHAMBERS THOMAS P SR &	161-02-43-022	1717 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,800	1950	0.87	Yes	No	No	$506,246
1,476	KENDRICK CLIFFORD A	161-02-43-024	1727 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	704	1950	0.95	Yes	No	No	$333,469
1,477	BROWN W FRANK & JANET B	161-02-43-027	1739 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,758	1950	0.81	Yes	No	No	$497,314
1,478	BASS JAMES D	161-02-43-028	1741 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	720	1950	0.60	Yes	No	No	$321,342
1,479	WILKINS MARION J	161-02-43-029	1743 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	600	1950	0.87	Yes	No	No	$307,523
1,480	PETTUS GARY A &	161-02-43-031	1753 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,440	1950	2.25	Yes	No	No	$504,144

Figure 123: Unimpaired Market Value Summary 1,441-1,480

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,481	FLOWERS JOHN W JR & JOYCE G	161-02-43-033	2186 LEISURE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,868	1950	0.80	Yes	No	No	$510,925
1,482	MOORE GEORGE F JR	161-02-43-034	2180 LEISURE RD CAMDEN , SC 29020	CAMDEN	Kershaw	800	1950	0.81	Yes	No	No	$347,703
1,483	KAHLER GUY B	161-02-43-035	2174 LEISURE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,920	1950	0.69	Yes	No	No	$509,332
1,484	HILL SEAN &	161-02-43-036	2168 LEISURE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,408	2023	0.82	Yes	No	No	$864,613
1,485	JOHNSON RONALD K &	161-02-43-053	1781 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,760	1950	0.70	Yes	No	No	$490,208
1,486	BARFIELD DOUGLAS A & LYNNE L	161-02-43-054	1787 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,088	1950	0.80	Yes	No	No	$399,695
1,487	MYERS CAROLYN C	161-02-43-056	1799 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,104	1992	0.87	Yes	No	No	$687,814
1,488	METHENEY CHRISTOPHER D	161-02-43-057	1805 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	992	1950	0.81	Yes	No	No	$383,543
1,489	HERNANDEZ VIRGINIA	161-02-43-059	1823 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,986	1950	0.96	Yes	No	No	$535,071
1,490	DEVOE PHILLIP	161-02-43-061	1839 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,838	1997	0.80	Yes	No	Yes	$578,053
1,491	LOMAS TERRY L &	161-02-43-062	1841 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,279	1950	0.97	Yes	No	No	$672,997
1,492	MORRIS DEBORAH H	161-02-43-064	2196 MALLARD LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,053	1957	0.79	Yes	No	No	$408,624
1,493	EISENBACK TIMOTHY S	161-02-43-065	2194 MALLARD LN CAMDEN , SC 29020	CAMDEN	Kershaw	2,898	1950	0.82	Yes	No	No	$624,903
1,494	WHETSTONE WD III	161-02-43-066	2188 MALLARD LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,944	1950	0.86	Yes	No	No	$523,850
1,495	YOUNG WILLIS L	161-02-43-068	2178 MALLARD LN CAMDEN , SC 29020	CAMDEN	Kershaw	2,152	1950	0.71	No	No	No	$456,456
1,496	ZION ARIC	161-02-43-070	2170 MALLARD LN CAMDEN , SC 29020	CAMDEN	Kershaw	4,553	1950	1.62	Yes	No	No	$822,566
1,497	LAKESIDE BLUES LLC	161-02-43-071	2171 MALLARD LN CAMDEN , SC 29020	CAMDEN	Kershaw	2,779	1950	0.79	Yes	Yes	No	$745,524
1,498	LAROCHE RIPON, III	161-02-43-072	2166 MALLARD RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,424	1950	0.77	Yes	No	No	$449,851
1,499	HALL DOUGLAS J & MICHAEL R	161-02-43-073	2160 MALLARD RD CAMDEN , SC 29020	CAMDEN	Kershaw	896	1950	0.74	Yes	No	No	$362,834
1,500	MOORE KATIE J	161-02-43-074	2154 MALLARD RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,164	1950	0.67	Yes	No	No	$404,611
1,501	SMALL JUNE L (LIFE)	161-02-43-075	2148 MALLARD RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,916	1950	0.70	Yes	No	No	$509,688
1,502	MERCURY FUNDING, LLC	161-02-43-076	2149 MALLARD RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,352	2006	0.68	No	No	No	$648,067
1,503	BIGHAM MARY M	161-02-43-077	2153 MALLARD RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,120	1996	0.77	No	No	No	$442,417
1,504	MAGNER THERESA M	161-02-43-078	2167 MALLARD RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,344	2022	0.86	No	No	Yes	$404,857
1,505	TOMLJANOVIC ANTHONY &	161-02-43-079	2173 MALLARD RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,748	1950	0.73	Yes	No	No	$491,018
1,506	FREEMAN JOHN L JR	161-02-43-080	2181 MALLARD RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,568	1993	0.86	No	No	Yes	$369,228
1,507	NEWSOM ANDREW RAY	161-02-43-082	1849 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	752	1988	0.81	No	No	No	$355,056
1,508	CRAM WILLIAM W	161-02-43-083	1853 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,626	1950	0.82	Yes	No	No	$480,598
1,509	HILL BRADFORD JAY	161-02-43-085	1865 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,353	1950	0.74	Yes	No	No	$562,417
1,510	GRAHAM ARTHUR E JR &	161-02-43-086	1869 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,964	1950	0.90	Yes	No	No	$637,908
1,511	HOOD CHERYL J	161-02-43-087	5 GIN HOUSE LN CAMDEN , SC 29020	CAMDEN	Kershaw	840	1950	0.84	Yes	No	No	$357,115
1,512	DOUGLAS LLOYD E & MARY E	161-02-43-090	17 GIN HOUSE LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,918	1950	0.81	Yes	No	No	$517,742
1,513	BASS CHERYL H	161-02-43-091	19 GIN HOUSE LN CAMDEN , SC 29020	CAMDEN	Kershaw	840	1950	0.70	Yes	No	No	$350,615
1,514	RICHARDSON THOMAS GLENN &	161-02-43-092	10 GIN HOUSE LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,548	1950	1.05	Yes	No	No	$481,947
1,515	SCHLAPPICH PATRICK TODD	161-02-43-094	1877 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,435	2023	1.29	No	No	No	$607,403
1,516	BOSWELL THOMAS E AND	161-02-43-097	1903 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,350	1950	0.75	Yes	No	No	$437,912
1,517	WEST JERRY M	161-02-43-098	1909 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,000	1950	0.76	Yes	No	No	$382,464
1,518	FOSTER GEORGE	161-02-43-099	1915 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,392	1997	0.78	Yes	No	Yes	$533,599
1,519	FOX PETER R & SHERYL S FOX	161-02-43-100	1919 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,446	1950	0.71	Yes	No	No	$570,411
1,520	MORRISON JOSEPH W	161-02-43-101	1927 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,212	1950	0.83	Yes	No	No	$421,020

Figure 124: Unimpaired Market Value Summary 1,481-1,520

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,521	DEASE LISA GOOD	161-02-43-102	1935 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	740	1950	0.95	No	No	No	$289,496
1,522	TODD ARCHIE LEE III & GAYLE Y	161-02-43-105	1967 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	756	1950	0.70	Yes	No	No	$334,053
1,523	STANGEL LOUISA I	161-02-43-106	1975 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	712	1950	0.73	Yes	No	No	$326,385
1,524	BRYANT TED D JR	161-02-43-107	1979 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,964	1950	0.86	Yes	No	No	$526,084
1,525	HAMER GREG	161-02-43-108	1981 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,971	1999	0.87	Yes	No	No	$694,784
1,526	TRUESDALE NANCY	161-02-43-109	1987 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	4,896	2000	1.59	Yes	Yes	No	$1,369,492
1,527	YARBOROUGH ANTHONY J	161-04-43-037	2162 LEISURE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,400	1950	0.86	No	No	No	$382,815
1,528	WILLIAMS PATSY S	161-04-43-038	2160 LEISURE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,798	1950	1.43	Yes	No	No	$532,585
1,529	BOYKIN ANTHONY E	161-04-43-039	2161 LEISURE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,120	1950	0.87	Yes	No	No	$408,409
1,530	YOUNG MICHAEL K	161-04-43-040	2173 LEISURE RD CAMDEN , SC 29020	CAMDEN	Kershaw	6,346	2024	2.65	Yes	No	No	$1,522,796
1,531	PITTMAN JAMES JETTER	161-04-43-042	2183 DUCK COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,500	1950	1.11	Yes	No	No	$477,862
1,532	CORNWELL TOMMY	161-04-43-042A	2179 DUCK COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,043	2000	0.88	Yes	No	No	$710,764
1,533	SHEORN JOAN ELLA N	161-04-43-043	2167 DUCK COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,344	1950	0.90	Yes	No	No	$444,812
1,534	LUCAS BEN F & DEAN H TRUSTEE	161-04-43-045	2168 DUCK COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,344	1950	0.92	No	No	No	$378,421
1,535	TIGERS DEN II, LLC	161-04-43-046	2170 DUCK COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,256	1950	0.77	Yes	No	No	$424,936
1,536	ROWE ASHLEY LYNN	161-04-43-048	2178 DUCK COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,600	1950	0.86	No	No	No	$406,641
1,537	DUNLAP SANDRA ROBERTS	161-04-43-049	2184 DUCK COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,104	1950	0.77	No	No	No	$339,826
1,538	GREEN HENRY D III &	161-04-43-088	2185 DUCK COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,448	1950	0.67	Yes	No	No	$567,613
1,539	MCCOY FAMILY PARTNERSHIP	162-00-00-040	1264 WOOD DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,126	1950	0.63	Yes	No	No	$396,241
1,540	BOWEN LAURA A	162-00-00-041	1262 WOOD DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	864	1950	1.50	Yes	No	No	$383,639
1,541	HODGES HORACE D & MARILYN E	162-00-00-087	1272 WOOD DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,756	1950	0.87	Yes	No	No	$500,871
1,542	LOWERY ROBERT B W &	162-01-43-007	1617 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,120	1950	1.21	Yes	No	No	$422,097
1,543	HAM E J	162-01-43-008	1621 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	560	1950	0.85	Yes	No	No	$297,358
1,544	CLEMENTS PHYLLIS ANN ETAL	162-01-45-108	2091 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	792	1950	0.65	Yes	No	No	$338,330
1,545	RODGERS LINDA H	162-01-45-109	2085 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,344	1950	0.62	Yes	No	No	$428,560
1,546	PAYNE ROGER D	162-01-45-110	2079 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,413	1950	0.68	Yes	No	No	$442,493
1,547	DOBBINS ANDREW STEPHEN ET AL	162-01-45-112	2067 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	924	1986	0.65	Yes	No	Yes	$319,709
1,548	ZIMMERMAN LEE P & NANCY P	162-01-45-113	2059 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,716	1950	0.75	Yes	No	No	$488,401
1,549	SHEORN DOUGLAS B	162-01-45-114	2053 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,260	1950	0.71	Yes	No	No	$422,052
1,550	WOOLARD DAVID L	162-01-45-115	2047 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,176	1950	0.72	Yes	No	No	$409,641
1,551	WATEREE LAKE LLC	162-01-45-116	2043 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,990	1950	0.77	Yes	No	No	$523,481
1,552	LAAS, LLC	162-01-45-117	2039 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,328	1950	0.60	Yes	No	No	$424,393
1,553	MURPHEY MARY STEWART	162-01-45-118	2033 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,152	2007	0.58	Yes	No	No	$546,552
1,554	CHEEK NANCY WATSON &	162-01-45-120	2027 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,209	1950	1.26	Yes	No	No	$438,862
1,555	GAULIN EUGENE H &	162-01-45-122	2013 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,568	1950	0.64	Yes	No	No	$461,266
1,556	WILLIAMS RICHARD D &	162-01-45-123	2007 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,072	1950	2.07	Yes	No	No	$589,809
1,557	SEMPLE PAUL O JR & LISA A	162-01-45-124	2003 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	975	1950	0.48	Yes	No	No	$361,022
1,558	PATTERSON JASON M &	162-01-45-125	1997 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,680	1950	0.84	Yes	No	No	$489,145
1,559	GRAHAM BARBARA LEE ETAL	162-01-45-126	1995 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	972	1950	0.81	Yes	No	No	$379,843
1,560	HOGAN ALLEN W	162-01-45-127	1993 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,204	1986	0.71	Yes	No	Yes	$363,595

Figure 125: Unimpaired Market Value Summary 1,521-1,560

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,561	ALBRIGHT JOSEPH PETER SR	162-01-45-128	1989 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,056	1986	0.54	Yes	No	Yes	$333,516
1,562	MCLEOD MICHAEL O'NEAL	162-01-45-129	1981 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	504	1950	0.63	Yes	No	No	$274,910
1,563	EHLINGER ROBERT C	162-01-45-131	1961 WHITE OAK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,728	1994	0.92	Yes	No	Yes	$460,409
1,564	MOYA MENDEZ JAMES	162-01-45-132	2207 WHITE OAK LN CAMDEN , SC 29020	CAMDEN	Kershaw	560	1950	0.58	Yes	No	No	$286,109
1,565	CONFROY MARK T & PATRICIA A	162-03-00-003	2171 METHODIST CAMP RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,580	2006	7.41	Yes	Yes	No	$1,238,425
1,566	BUTLER ROBERT C	162-03-00-004	2161 METHODIST CAMP RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,790	2006	1.83	Yes	No	No	$912,412
1,567	BIRDCOVE #1, LLC	162-03-45-057	2113 CRESCENT RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,344	1950	1.05	Yes	No	No	$451,921
1,568	GARDNER RICHARD J JR	162-03-45-058	2172 QUAIL RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,014	2001	1.06	Yes	No	No	$529,716
1,569	THOMAS JOHN L &	162-03-45-065	2164 MOHAWK DR CAMDEN , SC 29020	CAMDEN	Kershaw	1,680	1950	0.82	Yes	No	No	$487,726
1,570	WOOD MARION GORDON	162-03-45-066	2154 MOHAWK DR CAMDEN , SC 29020	CAMDEN	Kershaw	1,560	1950	0.69	Yes	No	No	$463,833
1,571	SMALLL JR FAMILY CHILDREN LLC	162-03-45-067	2146 MOHAWK DR CAMDEN , SC 29020	CAMDEN	Kershaw	2,838	2020	1.41	Yes	No	No	$968,828
1,572	KISTLER GEORGE A	162-03-45-068	2156 MOHAWK DR CAMDEN , SC 29020	CAMDEN	Kershaw	1,496	1950	1.27	Yes	No	No	$484,125
1,573	SPRENKLE H EDWARD	162-03-45-069	2157 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	2,496	1984	1.13	Yes	No	No	$730,378
1,574	BLUE HERON LANE LLC	162-03-45-070	2141 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,576	1950	1.59	Yes	No	No	$507,109
1,575	BESTERFELDT EDWARD A & LINDA W	162-03-45-071	2145 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	2,580	1950	0.51	Yes	No	No	$565,024
1,576	DEAN EDWARD REGINALD	162-03-45-072	2149 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	3,225	2018	0.83	Yes	No	No	$962,402
1,577	IRICK MATTHEW C	162-03-45-073	2151 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	960	1950	0.63	Yes	No	No	$368,262
1,578	GIBBS RUBY D	162-03-45-074	2159 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,541	1950	0.65	Yes	No	No	$457,821
1,579	NUNNERY PAMELA D & KENNETH RAY	162-03-45-075	2173 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,711	1950	0.91	Yes	Yes	No	$606,432
1,580	KOUMAS GEORGE PETER	162-03-45-076A	2189 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,840	1950	1.10	Yes	No	No	$524,051
1,581	DENTON MOSE M	162-03-45-077	2185 CLEARWATER LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,512	1982	0.87	Yes	No	No	$559,515
1,582	PARKER DAVID D JR	162-03-45-078	2180 CLEARWATER LN CAMDEN , SC 29020	CAMDEN	Kershaw	2,064	1950	1.39	Yes	No	No	$565,269
1,583	SOMERS CHARLES R &	162-03-45-079	2173 CLEARWATER LN CAMDEN , SC 29020	CAMDEN	Kershaw	3,054	1950	1.03	Yes	No	No	$655,399
1,584	MORANOS SCOTT A	162-03-45-080	2167 CLEARWATER LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,972	1992	0.69	Yes	No	No	$652,472
1,585	GILL EDWARD A	162-03-45-081	2160 CLEARWATER LN CAMDEN , SC 29020	CAMDEN	Kershaw	3,487	1950	1.13	Yes	Yes	No	$856,783
1,586	SWEAT CHRISTOPHER TODD &	162-03-45-082	2168 CLEARWATER LN CAMDEN , SC 29020	CAMDEN	Kershaw	3,665	2023	0.60	Yes	Yes	No	$1,237,766
1,587	MONTGOMERY SANDBAR LLC	162-03-45-083	2174 CLEARWATER LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,838	1950	0.79	No	No	No	$429,349
1,588	BRYSON HENRY L &	162-03-45-083A	2192 CLEARWATER LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,232	2014	1.78	Yes	No	No	$656,602
1,589	DILLMAN JEFFREY N	162-03-45-084	2217 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	4,532	1985	2.83	Yes	No	No	$1,057,438
1,590	DILLMAN JEFFERY N	162-03-45-085	2243 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,050	1950	0.63	Yes	No	No	$383,649
1,591	CHAMBERS GREGORY S &	162-03-45-086	2248 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	3,488	1950	1.24	Yes	Yes	No	$864,934
1,592	DAVIS MARGARET P	162-03-45-087	2240 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,086	1950	0.54	No	No	No	$325,246
1,593	HAMPEL STEVEN W	162-03-45-088	2234 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	3,023	1950	0.86	Yes	No	No	$640,667
1,594	STARNES BARBARA DESHIELDS	162-03-45-089	2230 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,448	1950	1.06	Yes	No	No	$468,053
1,595	ALLEN SHARON PEOPLES	162-03-45-090	2226 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,246	1950	1.01	Yes	No	No	$435,289
1,596	CANTEY WILLIAM O & CATHERINE	162-03-45-098	2203 BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	2,043	2007	2.44	Yes	No	No	$820,141
1,597	WACHTER BRET	176-02-06-148	2840 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,446	2003	1.05	Yes	No	No	$642,292
1,598	JACKSON LARRY J	176-02-06-149	2846 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,424	1950	0.87	Yes	No	No	$464,713
1,599	MAY JOHN MICHAEL	176-02-06-153	2017 COTTONWOOD DR RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,294	2013	0.94	Yes	No	No	$1,101,313
1,600	WILSON E WOODROW &	176-02-06-154	2015 COTTONWOOD DR RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,826	1950	0.83	Yes	No	No	$631,950

Figure 126: Unimpaired Market Value Summary 1,561-1,600

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,601	LEE JON TIMOTHY & LISA I	176-02-06-155	2007 COTTONWOOD DR RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,572	1950	0.82	Yes	No	No	$483,429
1,602	UNDERWOOD HORACE H	176-02-06-156	2003 COTTONWOOD DR RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,881	1997	0.91	Yes	No	No	$689,457
1,603	EASON HEATHER ROARK	176-02-06-157	2868 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	5,348	2006	0.99	No	No	No	$998,004
1,604	LAVAL JOYCE STRODE	176-02-06-158	2874 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,740	2010	0.96	Yes	No	No	$719,524
1,605	AYCOCK NORMAN S JR AND	176-02-06-159	2876 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,242	1950	0.98	Yes	No	No	$578,183
1,606	GILLESPIE DAVID Y &	176-02-06-160	2880 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,275	1997	0.82	Yes	No	No	$572,133
1,607	UPCHURCH DONNA W	176-02-06-161	2884 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,172	2005	0.90	Yes	No	No	$913,814
1,608	BRADLEY JAMES & NANCY J	176-02-06-162	2890 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,399	2005	0.82	Yes	No	No	$797,225
1,609	SPIVEY JONATHAN &	176-02-06-163	2896 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,658	2006	0.81	Yes	No	No	$676,882
1,610	SMITH JAMES W JR	176-02-06-168	2938 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,320	1997	1.74	Yes	No	No	$626,985
1,611	MORRIS RONALD L & KAREN B	176-02-06-169	2944 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	960	1950	0.82	Yes	No	No	$386,359
1,612	HARLEY SANDRA J	176-02-06-170	2950 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	720	1950	0.85	Yes	No	No	$340,082
1,613	BROWN THOMAS H & PHYLLIS D	176-02-06-171	2956 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,146	1950	0.86	Yes	No	No	$559,483
1,614	TAYLOR BILLY JOE & EULA JEAN	176-02-06-172	2964 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	720	1950	0.90	No	No	No	$290,280
1,615	MINCEY PATRICIA A	176-02-06-173	2966 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,078	1950	0.89	No	No	No	$348,420
1,616	JEDRAS MICHAEL	176-02-06-174	2968 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,136	1950	1.18	Yes	No	No	$576,280
1,617	ORMAN DALE L & SANDRA S TRUSTE	176-02-06-175	2970 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,456	1983	1.13	Yes	No	Yes	$417,284
1,618	BOONE TIMOTHY R L/E	176-02-06-176	2974 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	432	1950	1.11	Yes	No	No	$277,049
1,619	HILTON DAVID E II	176-02-06-177	2978 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	704	1950	1.04	No	No	No	$291,544
1,620	LARSEN THOMAS M &	176-02-06-179	2990 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,848	1950	0.74	Yes	No	No	$514,640
1,621	CHINCHILLA LUIS G & SUSAN A J	177-01-06-044	1814 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,454	1977	1.03	Yes	No	Yes	$399,583
1,622	INGRAM HOLLIS E JR &	177-01-06-045	1818 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,140	1982	1.17	Yes	No	No	$518,230
1,623	CAMPBELL BARRY C	177-01-06-046	1822 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,526	2018	0.90	Yes	No	No	$886,041
1,624	BRYANT NICHOLAS	177-01-06-047	1828 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,853	2006	1.25	Yes	No	No	$904,943
1,625	CADY MATTHEW &	177-01-06-048	1832 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,968	1950	1.06	Yes	No	Yes	$395,289
1,626	AUNG AYE PHYU	177-01-06-049	1836 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,533	1950	0.97	Yes	Yes	No	$744,689
1,627	HUMPHRIES ROBERT N	177-01-06-050	1840 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,904	1993	0.99	Yes	Yes	No	$834,060
1,628	KEMPKA JEREMY C	177-01-06-051	1844 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,663	2007	1.34	Yes	Yes	No	$1,397,881
1,629	ROLL STEVEN W	177-01-06-053	1850 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,932	2019	0.98	Yes	No	No	$1,099,524
1,630	L`HEUREAUX MARC ROGER &	177-01-06-054	1854 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	950	1968	0.85	Yes	No	No	$426,706
1,631	TYNER PATRICK & HOPE	177-01-06-055	1847 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,754	2019	1.00	Yes	No	No	$936,935
1,632	BEAVER DANIEL R	177-01-06-056	1841 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,228	2005	1.06	Yes	No	No	$790,806
1,633	LESHER LEE WINFIELD &	177-01-06-057	1835 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,120	2000	1.27	Yes	No	No	$766,050
1,634	ANDREWS WILLIAM O JR	177-01-06-058	1827 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,560	1950	1.13	Yes	No	No	$497,442
1,635	HUBBARD JAMES	177-01-06-060	1806 HORSE CHESTNUT TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,152	2000	0.97	No	No	Yes	$344,881
1,636	HINO RICHARD DALE	177-01-06-061	2516 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	668	1950	0.92	No	No	No	$281,250
1,637	MONTGOMERY JOHN A & SHEILA J	177-01-06-062	2524 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	988	1950	0.96	Yes	No	No	$397,712
1,638	BROOME JACKIE L	177-01-06-064	2534 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,589	1999	1.00	Yes	No	No	$814,288
1,639	SMITH SCOTT A	177-01-06-065	2536 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,771	2007	0.97	Yes	No	No	$875,898
1,640	2540 LAKE ROAD LLC	177-01-06-066	2540 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,348	2021	0.91	Yes	No	Yes	$627,841

Figure 127: Unimpaired Market Value Summary 1,601-1,640

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,641	FIEDLER MARK DEE TRUSTEE	177-01-06-067	2550 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,685	2008	1.04	Yes	No	No	$1,009,489
1,642	BROWN MICHAEL LAYNE &	177-01-06-068	2562 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,152	1994	1.78	Yes	No	Yes	$418,146
1,643	HOOFNAGLE CHAD MICHAEL	177-01-06-071	2580 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	640	1950	0.86	Yes	No	No	$322,928
1,644	ARNOLD HUGH RUSSELL &	177-01-06-072	2582 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,164	1997	0.95	Yes	No	No	$738,115
1,645	COSBY JOHN C JR	177-01-06-073	2584 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,772	2001	0.78	Yes	No	No	$952,087
1,646	VAN TINE RONALD &	177-01-06-074	2586 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,236	1950	1.54	Yes	No	No	$604,770
1,647	ANDERSON CARLA RAE	177-01-06-075	2592 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,224	1950	0.79	Yes	No	No	$429,697
1,648	MORAN HARRY J & RITA M	177-01-06-076	2598 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,112	1950	1.01	Yes	No	No	$673,617
1,649	QUICK ELIZABETH K	177-01-06-077	2602 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,867	2003	0.79	Yes	No	No	$700,454
1,650	QUICK DAVID R	177-01-06-078	2606 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,170	1950	1.11	Yes	No	No	$435,983
1,651	STANLEY GEORGE D ET AL	177-01-06-079	2614 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,333	1950	1.20	No	No	No	$395,375
1,652	HODGENS BRYAN E	177-01-06-086	1826 BUCKWHEAT LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,690	1950	1.05	Yes	No	No	$632,719
1,653	ROMANYZYN DANIEL I	177-01-06-087	1830 BUCKWHEAT LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,802	1950	1.03	Yes	No	No	$526,535
1,654	PITTS JAMES B	177-01-06-088	1836 BUCKWHEAT LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,963	1950	1.55	Yes	No	No	$570,600
1,655	RABON VASTINE C SR	177-01-06-089	1840 BUCKWHEAT LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,583	2013	1.63	Yes	No	No	$740,202
1,656	SMITH JAMES K	177-01-06-091	1829 BUCKWHEAT LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,464	1950	0.90	No	No	No	$400,529
1,657	ANTHONY STEFANIE	177-01-06-092	1819 BUCKWHEAT LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	728	1990	1.12	Yes	No	Yes	$316,364
1,658	BAILEY ROBERT G	177-01-06-096	2668 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	980	1950	1.12	Yes	No	No	$402,453
1,659	SHAW R LEWIS	177-01-06-097	2680 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,582	2010	2.27	Yes	No	No	$1,091,163
1,660	WETMORE RICHARD STANLEY	177-01-06-099	1814 INKBUSH TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,664	2015	0.96	Yes	No	No	$725,117
1,661	HOFFMAN ALLEN EUGENE JR	177-01-06-100	1820 INKBUSH TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,448	1950	0.69	Yes	No	No	$457,276
1,662	SLOAN MARK D	177-01-06-101	1822 INKBUSH TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,260	1950	0.84	Yes	No	No	$438,271
1,663	WRIGHT JEFFREY HOSTETTER	177-01-06-102	1809 INKBUSH TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,486	1950	1.03	Yes	No	No	$482,369
1,664	BURAKIEWICZ PETER ALAN	177-01-06-103	1803 INKBUSH TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,153	2023	0.75	Yes	No	No	$831,894
1,665	JACOBS FRANK JR & JUDY H	177-01-06-104	2696 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,024	1950	1.15	Yes	No	No	$411,764
1,666	SCHROTH MARK R, JR	177-01-06-106	2710 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,485	2003	1.22	Yes	No	No	$660,078
1,667	OAKLEY BARBARA A	177-01-06-107	1928 ELDERBERRY LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,639	2003	0.72	Yes	No	No	$654,251
1,668	STARNES BETTY L ETAL	177-01-06-109	1934 ELDERBERRY LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,653	1950	0.86	Yes	No	No	$496,551
1,669	TODD MITCHELL &	177-01-06-111	1925 ELDERBERRY LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,234	2001	0.89	Yes	No	No	$761,141
1,670	HOLLIS BOBBY R & CASSANDRA F	177-01-06-112	1921 ELDERBERRY LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,248	1950	0.89	Yes	No	No	$438,844
1,671	HERMESCH JON A	177-01-06-113	1917 ELDERBERRY LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,850	2000	0.96	Yes	No	No	$700,029
1,672	PRITCHARD DENNIS C	177-01-06-114	1913 ELDERBERRY LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,216	1979	0.87	Yes	No	No	$508,796
1,673	HARPSTER LEON J &	177-01-06-115	1907 ELDERBERRY LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,184	2010	0.79	Yes	No	No	$782,955
1,674	MABRY ROBERT SAMUEL JR	177-01-06-116	1901 ELDERBERRY LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,820	2002	0.97	Yes	No	No	$703,277
1,675	KREBECK KENT	177-01-06-119	1916 BOXELDER TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,441	1998	0.70	Yes	No	No	$598,136
1,676	DAVIS ROBERT B & GLENDA M	177-01-06-120	1924 BOXELDER TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,653	1950	0.77	No	No	No	$416,618
1,677	VENN ALAN F	177-01-06-122	1936 BOXELDER TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,698	1950	1.02	Yes	No	No	$812,899
1,678	CORDER LINDA B &	177-01-06-123	1944 BOXELDER TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,304	2007	1.17	Yes	No	No	$966,806
1,679	BRINSON KARON C	177-01-06-125	1954 BOXELDER TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,220	1950	1.67	Yes	No	No	$719,611
1,680	LIPMAN STUART G	177-01-06-126	1958 BOXELDER TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,046	2019	0.79	Yes	No	No	$957,779

Figure 128: Unimpaired Market Value Summary 1,641-1,680

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,681	ANDERSON THOMAS L	177-01-06-127	1957 BOXELDER TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,432	2014	0.90	Yes	No	No	$995,322
1,682	BARWICK ROBERT E	177-01-06-129	1941 BOXELDER TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,200	2007	0.82	Yes	No	No	$774,867
1,683	WARREN JAMES R	177-01-06-130	1933 BOXELDER TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,404	1950	0.81	Yes	No	No	$458,518
1,684	BUCHANAN WILLIAM DAVIS	177-01-06-131	1923 BOXELDER TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,120	1950	0.82	Yes	No	No	$414,225
1,685	WELLS TERRY LOU ETAL	177-01-06-132	1915 BOXELDER TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,056	1950	0.88	Yes	No	No	$406,119
1,686	BAKER GARY F	177-01-06-134	2748 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,298	1950	1.25	Yes	Yes	No	$731,271
1,687	JACKSON ADRIAN P SR	177-01-06-144	2822 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,376	1950	9.55	No	No	No	$495,546
1,688	WILSON SYLVIA S	177-01-06-145	2830 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,592	1950	1.06	Yes	No	No	$499,159
1,689	HOLLEY CLIFFORD D & SHARON L	177-01-06-146	2834 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,264	2008	0.86	No	No	No	$672,634
1,690	EBELING DARWIN D	177-02-03-106	2052 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	5,318	2022	1.01	Yes	Yes	No	$1,568,262
1,691	BELUE DEBRA WARREN	177-02-03-108	2058 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	732	1974	0.95	Yes	No	No	$396,414
1,692	POWERS JOHN W JR	177-02-03-109	2064 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,060	1950	0.84	Yes	No	No	$404,953
1,693	KOON CHARLES R	177-02-03-110	2068 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,191	1997	0.78	Yes	No	No	$727,176
1,694	FARMER JUNIUS C III &	177-02-03-111	2074 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,112	2000	1.04	Yes	No	No	$749,672
1,695	OBLAK THOMAS H &	177-02-03-112	2078 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,958	2015	0.99	Yes	Yes	No	$1,315,481
1,696	TURNAGE MICHAEL U	177-02-03-114	2090 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,910	2018	1.11	Yes	No	No	$797,015
1,697	GOODON ANNE W	177-02-03-115	2092 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,376	1950	0.82	Yes	No	No	$454,667
1,698	YOUNG JIMMIE JO L/E	177-02-03-116	2094 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,321	1950	0.95	Yes	No	No	$585,327
1,699	MOORE THOMAS H	177-02-03-118	2102 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,446	2007	0.81	Yes	No	No	$1,065,262
1,700	PONDISH JAMES (JIM) &	177-02-03-119	2108 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,810	1999	0.86	Yes	No	No	$832,078
1,701	BEVERLY SHEILA M	177-02-03-120	2112A LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,886	2009	1.43	Yes	No	No	$938,542
1,702	WAGNER ROBERT S	177-02-03-121	2112 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,368	1950	0.83	Yes	No	No	$769,890
1,703	BRAZELL WADE F &	177-02-03-122	2116 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,944	2017	0.96	Yes	No	No	$787,546
1,704	SEGARS EDWARD N L/E	177-02-03-125	2132 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,422	1950	1.13	Yes	No	No	$477,266
1,705	FORTSON SCOTT C & E BROOKS	177-02-03-126	2142 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,175	2005	1.09	Yes	No	No	$592,932
1,706	DANIEL JAMES A &	177-02-03-135	1708 HOLLY TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	640	1950	0.88	Yes	No	No	$323,650
1,707	PARK ROBERT A JR &	177-02-03-136	1716 HOLLY TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,904	1950	0.96	Yes	No	No	$535,915
1,708	RUTLEDGE FRANCIS QUAY	177-02-03-140	1715 HOLLY TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,070	1950	0.66	Yes	No	No	$535,976
1,709	CHILD MEGAN	177-02-06-005	2316 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,371	1986	0.83	Yes	No	No	$556,217
1,710	2322 LAKE ROAD LLC	177-02-06-006	2322 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	744	1969	0.88	Yes	No	No	$385,569
1,711	HORTON JEFFREY TODD	177-02-06-007	2326 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,290	1950	0.77	Yes	No	No	$438,739
1,712	AIKEN DORA LOU WITHERSPOON	177-02-06-008	2332 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,728	1950	1.35	Yes	No	No	$530,860
1,713	WRIGHT STEPHEN &	177-02-06-010	2334 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,770	2020	2.31	Yes	No	No	$1,028,569
1,714	TURNER WILLIAM CHRISTOPHER	177-02-06-012	2356 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,120	1950	1.09	Yes	No	No	$569,992
1,715	JOHNSON C CHRIS	177-02-06-013	2364 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,399	1950	1.14	Yes	No	No	$605,813
1,716	MOSLEY ROBERT L	177-02-06-014	1711 BLACKWOOD LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,904	1950	0.71	Yes	No	No	$629,149
1,717	BOLIN GRETCHEN J	177-02-06-015	1715 BLACKWOOD LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,548	1950	0.79	Yes	No	No	$599,566
1,718	WOOD CYNTHIA M	177-02-06-018	1716 BLACKWOOD LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,348	1985	1.15	Yes	No	No	$730,411
1,719	ROTH ROBERT JOHN	177-02-06-019	1708 BLACKWOOD LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,624	1950	1.12	Yes	No	No	$506,321
1,720	DUNN RICHARD A	177-02-06-020	2368 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,047	1950	1.51	Yes	Yes	No	$707,040

Figure 129: Unimpaired Market Value Summary 1,681-1,720

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,721	WILSON DAVID Y	177-02-06-023	2382 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,078	1999	0.80	Yes	No	No	$861,171
1,722	HERNDON JEFFREY S	177-02-06-024	2388 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,396	1950	0.85	Yes	No	No	$587,415
1,723	ROBINSON SCOTT PATRICK &	177-02-06-025	2394 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,740	1950	1.04	Yes	No	No	$518,306
1,724	BLACKMON JULIAN CURTIS &	177-02-06-026	2398 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,334	1950	1.78	Yes	No	No	$625,751
1,725	LYELL DEBORAH G	177-02-06-028	2410 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,046	1950	1.20	Yes	No	No	$772,301
1,726	BARRETT LISA C	177-02-06-029	2418 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,390	2007	1.13	No	No	No	$705,337
1,727	MARTIN VICTOR A &	177-02-06-031	2436 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,529	1950	1.12	Yes	No	No	$492,498
1,728	TRUSTY TREVOR ASHTON	177-02-06-032	2452 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,900	1950	1.49	Yes	No	No	$559,894
1,729	BERTHELETTE J P	177-02-06-035	2472 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,339	1950	1.04	No	No	No	$390,284
1,730	KENT GARRETT C	177-02-06-037	2480 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,245	1950	1.07	Yes	No	No	$446,631
1,731	SEABORN DAVID ALAN	177-02-06-038	2486 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,100	2003	0.87	Yes	No	No	$890,618
1,732	MCKENDRICK VICKI D &	177-02-06-040	2496 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,355	1984	0.78	Yes	No	No	$699,318
1,733	HOBENSACK JAMES A &	177-02-06-041	2498 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,220	2015	1.03	Yes	Yes	No	$1,202,794
1,734	HOLMBERG JOHN O & SARAH G	177-02-06-042	2504 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,927	2006	0.91	Yes	No	No	$886,975
1,735	HUBBARD JAMES C & JUDY ALL	177-02-06-043	2508 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,609	1950	0.93	Yes	No	No	$616,023
1,736	NORWOOD FRANKLIN ETAL	177-04-03-127	2150 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,832	1999	0.95	Yes	No	No	$692,011
1,737	THIGPEN DONNIE R JR	177-04-03-133	2204 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	816	1968	1.68	Yes	No	Yes	$307,076
1,738	RICHARDSON BILLY G & CAROLYN E	177-04-03-134	2210 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,506	2013	1.28	Yes	No	No	$889,805
1,739	RIDDICK DANIEL D & JOAN H	177-04-03-143	2224 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,620	1950	0.77	Yes	No	No	$486,553
1,740	CHARDUKIAN VENTURES LLC	177-04-03-146	2248 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,584	1950	1.62	Yes	No	No	$519,692
1,741	FOGNER ROBERT S	178-00-00-004	1253A MILLER RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,912	2015	2.09	Yes	No	No	$819,540
1,742	JENKINS MARILYN GRIGGS	178-00-00-006	1253 MILLER RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,982	1950	2.83	Yes	No	No	$718,414
1,743	MILLER WILLIAM T	178-00-00-008	1716 EAGLES NEST RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,804	2006	15.40	No	No	No	$788,909
1,744	REEVES TIMOTHY R	178-01-45-029	1989 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	364	1950	1.07	Yes	No	No	$250,194
1,745	REDFEARN W TOWNLEY II	178-01-45-030	1979 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,232	1950	1.90	Yes	No	No	$461,626
1,746	STEVENSON SUSAN W	178-01-45-031	1969 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,067	1950	2.83	Yes	No	No	$608,334
1,747	DOUGLAS RONALD W	178-01-45-033	1963 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,116	1950	1.64	Yes	No	No	$693,348
1,748	STEVENSON J LESLIE & CECILIA L	178-01-45-035A	1961 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,960	1950	1.57	Yes	No	No	$559,067
1,749	ATKINSON MICHAEL F	178-01-45-035B	1962 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,156	2004	0.78	Yes	No	Yes	$529,141
1,750	FULTON JEANETTE K	178-01-45-036A	1959 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,725	1950	0.83	Yes	No	No	$494,561
1,751	LAFFITTE REBECCA	178-01-45-036C	1958 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,280	1950	0.91	Yes	No	No	$435,756
1,752	FELLERS BEVERLY N	178-01-45-036D	1960 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,232	1950	1.04	Yes	No	No	$434,310
1,753	HUTTO JAMES D JR	178-01-45-041	1974 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,498	2002	1.07	Yes	No	No	$936,316
1,754	MOORE JOHN L	178-01-45-043	1994 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	856	1950	1.19	Yes	No	No	$372,861
1,755	THOMAS JAMES M JR & NANCY H	178-01-45-043A	1984 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,017	1996	1.53	Yes	No	No	$878,120
1,756	WATTS EUGENE M	178-01-45-045	2099 METHODIST CAMP RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,701	1950	0.86	Yes	No	No	$492,938
1,757	BATCAVE PROPRTIES LLC	178-01-45-046	2097 METHODIST CAMP RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,301	2016	1.60	Yes	No	No	$872,137
1,758	EVANS ELIZABETH J &	178-01-45-059	2170 QUAIL RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,519	2024	0.77	Yes	No	No	$701,072
1,759	HUTTO CURTIS &	178-01-45-060	2168 QUAIL RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,232	1992	0.92	Yes	No	Yes	$390,164
1,760	SWEAT JAMES W	178-01-45-061	2166 QUAIL RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,318	2002	0.60	Yes	No	No	$731,978

Figure 130: Unimpaired Market Value Summary 1,721-1,760

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,761	BALDWIN WILLIAM WESLEY &	178-01-45-062	2164 QUAIL RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,952	1950	1.18	Yes	No	No	$542,020
1,762	SMALL FAMILY CHILDRENS LLC	178-01-45-063	2162 QUAIL RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,040	2023	0.70	Yes	No	No	$945,955
1,763	PLATT CHARLES W JR	178-01-45-064	2160 QUAIL RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,778	1950	0.79	Yes	No	No	$499,070
1,764	LACKEY ROBERT H	178-01-45-065	2115 METHODIST CAMP RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,500	2003	2.05	Yes	No	No	$684,829
1,765	HINSON TIMOTHY A & DEBRA G	178-01-45-067	2014 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,830	2002	1.80	Yes	No	No	$735,301
1,766	GOODWIN FRANCES MILLER	178-01-45-068	2024 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,419	2004	2.51	Yes	No	No	$685,445
1,767	VILLARREAL JOSEPH PERRY	178-01-45-070	2002 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,326	2005	1.10	Yes	No	No	$793,388
1,768	MAJKOWSKI THAD M	178-01-45-071	2141 METHODIST CAMP RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,758	2023	1.58	Yes	Yes	No	$1,199,272
1,769	PRICE CRISTINA	178-01-45-073	2143 METHODIST CAMP RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,710	2023	1.96	Yes	No	No	$809,379
1,770	SCHEMINE MARK	178-02-45-001	1260 WOOD DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,180	1950	0.91	No	No	No	$471,002
1,771	PARTIN DAVID A	178-02-45-003	1256 WOOD DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,353	1950	0.97	Yes	No	No	$449,645
1,772	FRAZIER ANNA KATHERINE L/E	178-02-45-004	1254 WOOD DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,512	2007	1.90	Yes	No	No	$697,497
1,773	LANGE MICHAEL C &	178-02-45-005	2147 FISHING LN CAMDEN , SC 29020	CAMDEN	Kershaw	2,748	1950	1.66	Yes	No	No	$655,803
1,774	FRAZIER CLARENCE EDWARD, JR	178-02-45-006	2062 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,974	1993	1.13	Yes	No	No	$690,592
1,775	BOBZIEN NIKI LYNN	178-02-45-008	1285 BLACK DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,411	2021	4.08	No	Yes	No	$1,042,649
1,776	MELTON BRIAN GENE	178-02-45-009	1270 BLACK DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,751	1950	1.43	Yes	No	No	$526,091
1,777	SHIVER JUDIE S BAXLEY	178-02-45-010	1268 BLACK DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,332	1950	0.81	Yes	No	No	$438,431
1,778	OGLE LYNN S ET AL	178-02-45-011	1266 BLACK DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	800	1950	1.15	Yes	No	No	$360,482
1,779	MCKENZIE EDDIE LAVERNE &	178-02-45-012	1264 BLACK DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,800	1950	0.99	Yes	No	No	$513,460
1,780	MYERS BENJAMIN CANTEY	178-02-45-013	1265 BLACK DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,440	1950	2.00	Yes	No	No	$498,173
1,781	BRIDGES MARY BOYKIN M	178-02-45-014	1269 BLACK DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,396	1950	1.18	Yes	No	No	$465,442
1,782	PALMER THOMAS SAMUEL TRUSTEE	178-02-45-015	1271 BLACK DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,244	2007	0.68	Yes	No	No	$888,078
1,783	SPAGNOLO MICHAEL J	178-02-45-015A	1273 BLACK DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	4,040	2006	0.79	Yes	No	No	$991,106
1,784	SMITH MARY DEAN & CHARLES M	178-02-45-016	1275 BLACK DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,472	1999	0.84	Yes	No	No	$605,888
1,785	VERDESCHI GREGG M &	178-02-45-017	1277 BLACK DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,232	1998	1.05	Yes	No	No	$568,831
1,786	JACOBS & ASSOCIATES, INC	178-02-45-018	1276 RUDDY DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,598	2002	5.38	Yes	No	No	$1,118,150
1,787	DENTON JOE A & JOSH A	178-02-45-019	1274 RUDDY DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,022	1950	0.75	Yes	No	No	$385,608
1,788	FARMER BRYAN C ETAL	178-02-45-020	1272 RUDDY DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,888	1950	0.61	Yes	No	No	$498,838
1,789	MCCASLIN ALSTON J VI	178-02-45-021	1270 RUDDY DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,566	1950	0.71	Yes	No	No	$465,430
1,790	SHEALY ROBIN	178-02-45-022	1268 RUDDY DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,776	1950	0.96	Yes	No	No	$716,296
1,791	ODONNELL JOSEPH W	178-02-45-023	1266 RUDDY DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	4,796	2017	1.94	Yes	No	No	$1,248,816
1,792	BRADY CHRISTOPHER J &	178-02-45-024	1264 RUDDY DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,214	1950	1.30	Yes	No	No	$579,614
1,793	BEARD JAMES A ET AL	178-02-45-025	1262 RUDDY DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,922	1950	1.33	Yes	No	No	$544,928
1,794	PARATORE ROY P &	178-02-45-027	1258 RUDDY DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,917	1950	0.82	No	No	No	$439,751
1,795	PRICE DAVID	178-02-45-028	1256 RUDDY DUCK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,643	1995	1.00	Yes	No	No	$634,219
1,796	BYARS CAMILLE L	178-02-46-029	1322 CEDAR COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,230	2010	0.97	Yes	No	No	$790,006
1,797	WILEY APRIL DAWN	178-02-46-029A	1326 CEDAR COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,345	2000	0.96	Yes	No	No	$763,165
1,798	DEMBY ROBERT E &	178-02-46-030	1310 CEDAR COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,344	2011	1.47	Yes	No	No	$658,492
1,799	HUDSON PHILLIP E & ROBBIE C	178-02-46-032	10 HAWKWOOD DR CAMDEN , SC 29020	CAMDEN	Kershaw	1,484	1999	0.60	Yes	No	No	$587,784
1,800	JOHNSON CLEATUS F JR	178-02-46-033	41 NAVAHO TRL CAMDEN , SC 29020	CAMDEN	Kershaw	2,730	2009	2.34	Yes	Yes	No	$1,148,823

Figure 131: Unimpaired Market Value Summary 1,761-1,800

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,801	SISK DANIEL	178-02-46-034	40 NAVAHO TRL CAMDEN , SC 29020	CAMDEN	Kershaw	720	2014	0.65	Yes	No	No	$464,215
1,802	EARLE STEVEN E	178-02-46-034B	40A NAVAHO TRL CAMDEN , SC 29020	CAMDEN	Kershaw	2,088	1950	0.62	Yes	No	No	$523,624
1,803	TWITTY RANDALL MITCHELL	178-02-46-035	12A NAVAHO TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,512	1997	0.95	Yes	No	No	$614,675
1,804	WILLIAMS CATHY G	178-02-46-036	1260 MILLER RD CAMDEN , SC 29020	CAMDEN	Kershaw	4,181	1950	1.71	Yes	No	No	$795,848
1,805	CLYBURN JAMES L	178-02-46-037	1262 MILLER RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,392	2003	0.94	Yes	No	No	$611,128
1,806	CLYBURN LOUIS S JR & SHARON C	178-02-46-037A	1262A MILLER RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,265	2005	0.89	Yes	No	No	$766,874
1,807	LEWIS LINDA L & DOYLE D	178-02-46-038	1264 MILLER RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,500	1988	0.91	Yes	No	No	$579,530
1,808	ARLEDGE DENNIS G, SR	178-02-46-039	1266 MILLER RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,660	1950	1.00	Yes	No	No	$495,153
1,809	OLDS SHANNON	178-02-46-040	1270 MILLER RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,470	2018	4.71	Yes	No	No	$803,230
1,810	WILLIAMS S SHERRILL	178-02-46-041	1837 MARSH HAWK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,360	1950	2.52	Yes	No	No	$497,034
1,811	KELLY DEBORAH M	178-02-46-042	1841 MARSH HAWK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,517	1950	1.01	Yes	No	No	$475,632
1,812	STOKES WILLIAM A JR	178-02-46-043	1847 MARSH HAWK RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,258	1950	1.44	Yes	No	No	$453,185
1,813	MUNN ROBERT MALCOLM SR &	178-02-46-044	1853 MARSH HAWK RD CAMDEN , SC 29020	CAMDEN	Kershaw	644	1950	0.78	Yes	No	No	$313,914
1,814	BARKER DANIEL R	178-02-46-045	34 ACORN LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,879	1985	0.53	Yes	No	No	$597,816
1,815	SARTIN WILLIAM & JOAN	178-02-46-046	30 ACORN LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,152	1950	0.83	Yes	No	No	$411,690
1,816	BROWN GRETCHEN D	178-02-46-048	2335 JOHN G RICHARDS RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,492	2023	1.60	Yes	No	No	$745,138
1,817	FRAZIER CLARENCE EDWARD, JR	178-02-46-054	2129 FISHING LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,000	1950	0.80	Yes	No	No	$384,611
1,818	FISHING LANE FAMILY LTD PRTSHP	178-02-46-055	2133 FISHING LN CAMDEN , SC 29020	CAMDEN	Kershaw	880	1950	0.71	Yes	No	No	$358,429
1,819	BRADY MICHAEL P & KATHY H	178-02-46-056	2135 FISHING LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,440	1950	1.09	Yes	No	No	$468,107
1,820	DAVIS HAROLD S & PATSY E	178-03-03-030	1628 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,678	1950	0.90	No	No	No	$527,016
1,821	FOSTER BEVERLY JEAN TRUSTEE	178-03-03-031	1634 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,492	1986	1.75	Yes	No	No	$787,605
1,822	ALDRICH GAIL LUNN TRUSTEE	178-03-03-033	1642 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,265	2005	0.97	Yes	No	No	$1,053,589
1,823	VAN NORT JASON B	178-03-03-035	1654 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,536	1968	0.69	Yes	No	No	$519,464
1,824	COOPER THOMAS EDWARD	178-03-03-036	1662 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,064	1950	1.31	Yes	No	No	$424,393
1,825	MCKINNEY GARFIELD F JR &	178-03-03-037	1672 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,440	1980	0.80	Yes	No	No	$547,676
1,826	BOYKIN ERVIN W & AMANDA C	178-03-03-038	1678 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,640	1984	0.73	Yes	No	No	$588,978
1,827	CARLO RAYMOND	178-03-03-039	1684 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,559	2001	0.88	Yes	No	No	$939,543
1,828	BOWERS RYAN A ETAL	178-03-03-040	1688 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	700	1950	0.89	Yes	No	No	$337,546
1,829	ENGLERT MICHAEL J	178-03-03-043	1704 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,568	1997	2.22	Yes	No	Yes	$500,217
1,830	MUBARAK DAVID PHILIP	178-03-03-045	1714 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,254	1950	0.76	Yes	No	No	$432,931
1,831	TODD ALBERT C III TRUSTEE	178-03-03-046	1720 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,110	2000	0.78	Yes	No	No	$867,275
1,832	ROY JAMES F	178-03-03-047	1724 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,345	1995	0.71	Yes	No	No	$570,510
1,833	SMITH JOHN PAUL	178-03-03-048	1728 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,992	1950	0.74	Yes	No	No	$640,616
1,834	MATHIS RICHARD C &	178-03-03-049	1732 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,594	1990	0.87	Yes	No	No	$763,732
1,835	MCGANN JAMES MICHAEL	178-03-03-050	1736 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,250	1989	0.98	Yes	No	No	$720,407
1,836	WHITING GEORGE WAYNE	178-03-03-051	1742 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,112	2021	0.90	Yes	Yes	No	$1,012,752
1,837	MARSHALL J PHILLIP	178-03-03-052	1750 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,615	2002	1.31	Yes	No	No	$854,869
1,838	COLBY KENNETH C & CATHERINE E	178-03-03-054	1766 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	5,177	1989	0.95	Yes	No	No	$1,049,064
1,839	BELK LOLA G ET AL	178-03-03-055	1772 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,115	2023	0.73	No	No	No	$697,896
1,840	GUERARD PINCKNEY H JR.	178-03-03-056	1780 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,960	2007	0.95	Yes	No	No	$1,138,880

Figure 132: Unimpaired Market Value Summary 1,801-1,840

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,841	COX KELLY LYNN	178-03-03-058	1806 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,152	2002	0.96	Yes	No	No	$570,857
1,842	HUGHEY DARYL M &	178-03-03-059	1814 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,296	1999	0.91	Yes	No	Yes	$423,636
1,843	HOOGSTRAAT BRYON LARRY	178-03-03-060	1820 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,344	1950	0.81	Yes	No	No	$449,643
1,844	HALTER MICHAEL L & KATHLEEN A	178-03-03-061	1824 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,604	2011	0.85	Yes	No	No	$689,361
1,845	SMALL JOEY A	178-03-03-062	1830 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,339	2006	0.71	Yes	No	No	$917,577
1,846	SEAY JOHN H & THERESA E	178-03-03-063	1834 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,620	1950	0.79	Yes	No	No	$488,257
1,847	BLACKWELL BRIAN	178-03-03-064	1838 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,564	1950	0.76	Yes	No	No	$478,607
1,848	MCCRACKIN JAMES F	178-03-03-065-B01	1838A LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,577	2006	0.60	Yes	No	No	$802,530
1,849	WEEKS ERNEST M III	178-03-03-066	1842 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,961	1950	0.76	Yes	No	No	$530,388
1,850	REGGANIE RICHARD J	178-03-03-067	1848 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,352	1950	0.69	Yes	No	No	$570,674
1,851	ESPIRITU CONCHITA C L/E	178-03-03-068	1852 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	768	1950	0.73	Yes	No	No	$345,002
1,852	THOMAS DENNIS C &	178-03-03-069	1858 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,346	2007	0.98	Yes	No	No	$812,433
1,853	HELMS MILES N	178-03-03-070	1860A LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,120	1950	0.68	Yes	No	No	$406,356
1,854	CHILD JEREMY P	178-03-03-071	1860 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,547	1950	0.75	Yes	No	No	$595,959
1,855	COUSINEAU WILLIAM	178-03-03-072	1866 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	935	1950	1.21	Yes	No	No	$397,055
1,856	MUNN AARON D	178-03-03-073	1876 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,276	1950	1.06	Yes	No	No	$451,031
1,857	WATTS RONALD E	178-03-03-076	24 DOE TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,009	1950	0.59	Yes	No	No	$522,782
1,858	HEWITT JONATHAN ERIC	178-03-03-077	23 DOE TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,910	2022	0.77	Yes	No	No	$950,942
1,859	1886 LAKE ROAD, LLC	178-03-03-078	1886 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,404	1950	1.19	Yes	No	No	$476,729
1,860	COLE DENNIS R & CYNTHIA T	178-03-03-079	1890 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,875	1950	0.79	Yes	No	No	$521,474
1,861	MATTHEWS STEVEN J	178-03-03-080	1896 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,488	1986	0.71	Yes	No	Yes	$408,800
1,862	JOHNSON ANDREW KENDRID &	178-03-03-081	1902 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,432	1950	1.10	Yes	No	No	$607,180
1,863	PEARSALL KENNETH NEELY	178-03-03-082	1908 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,556	1950	0.79	Yes	No	No	$479,237
1,864	SPILKER BRIAN CHARLES &	178-03-03-083	1914 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,168	2004	0.66	Yes	No	No	$740,170
1,865	HAWK FREDERICK	178-03-03-084	1920 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,990	2005	0.63	Yes	No	No	$712,264
1,866	ROBERSON ARTHUR JR	178-03-03-085	1926 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,776	1950	0.78	Yes	No	No	$508,334
1,867	SHEPHERD CHARLES KEVIN &	178-03-03-086	1932 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,805	1950	1.03	Yes	No	No	$643,357
1,868	INGRAM GLENDA C	178-03-03-088	1946 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,320	1950	1.18	No	No	No	$393,058
1,869	GOETZ KENNETH A & JANICE M	178-03-03-090	1962 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	576	1950	0.93	Yes	No	No	$309,999
1,870	BERRIOS PABLO A	178-03-03-092	1978 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,260	1950	0.90	Yes	No	No	$441,135
1,871	STOKES BARNEY M, JR	178-03-03-093	1982 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,860	1950	0.94	No	No	No	$448,558
1,872	JOHNSON WAYNE EMERSON	178-03-03-094	1986 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,752	1996	1.00	Yes	No	No	$670,564
1,873	ROLLINGS ERNEST W JR	178-03-03-095	1988 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,428	1950	1.01	Yes	No	No	$472,754
1,874	WHITECOTTON DANNY JAMES	178-03-03-098	2010 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,291	2007	0.91	Yes	No	No	$797,724
1,875	BOWLING JAMES D &	178-03-03-099	2016 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,435	1984	0.72	Yes	No	No	$704,463
1,876	WINDERS JAMES D	178-03-03-101	2028 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,912	1983	0.85	Yes	No	No	$771,884
1,877	BERRY RONALD A	178-03-03-102	2032 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,507	1950	0.75	Yes	No	No	$772,710
1,878	BATES BONNIE H	178-03-03-103	2038 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,183	2000	0.87	Yes	No	No	$746,864
1,879	SMITH JAMES R	178-03-03-104	2044 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,531	1950	1.11	Yes	No	No	$618,765
1,880	HINRICHS ROBERT A &	178-03-03-105	2048 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	512	2005	0.84	Yes	No	No	$395,901

Figure 133: Unimpaired Market Value Summary 1,841-1,880

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,881	MEHM KEVIN EVERETT	178-04-46-002	1166 WHIPPOORWILL RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,485	1950	0.79	Yes	No	No	$459,340
1,882	MCCOLLUM ANNA REBECCA	178-04-46-002A	1174 WHIPPOORWILL RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,625	1998	1.27	Yes	No	No	$817,717
1,883	FISHBURNE BARRON C	178-04-46-003	1158 WHIPPOORWILL RD CAMDEN , SC 29020	CAMDEN	Kershaw	5,443	2022	1.49	Yes	No	No	$1,324,313
1,884	DIEDRICH KELLY A	178-04-46-004	1156 WHIPPOORWILL RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,744	2007	0.91	Yes	No	No	$690,287
1,885	LEWIS LAWSON W JR REVOCABLE	178-04-46-006	1255 SCREECH OWL RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,287	1950	1.15	Yes	No	No	$581,130
1,886	GRECO SAVIO R &	178-04-46-007	1257 SCREECH OWL RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,696	2011	0.95	Yes	No	No	$699,995
1,887	BARN OWL ROAD LLC	178-04-46-010	1177 BARN OWL RD CAMDEN , SC 29020	CAMDEN	Kershaw	900	1950	1.26	Yes	No	No	$383,779
1,888	CREED D J II &	178-04-46-011	1175 BARN OWL RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,156	1950	1.32	Yes	No	No	$432,051
1,889	SNOWY OWL LAKEHOUSE CO, LLC	178-04-46-012	1181 SNOWY OWL RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,882	1950	5.83	Yes	No	No	$627,425
1,890	KERFOOT HENRY D III & MARY B	178-04-46-015	1183 SNOWY OWL RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,534	1950	2.67	Yes	No	No	$663,416
1,891	PETERSON JAMES W & MINCY C	178-04-46-015B	1172 SNOWY OWL RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,696	2003	1.27	Yes	Yes	No	$840,816
1,892	STEELE AARON B & LYNELL P	178-04-46-016	1173 SNOWY OWL RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,274	1998	1.30	Yes	No	No	$768,210
1,893	DOMINICK JOHN CROUCH	178-04-46-017	1167 SNOWY OWL RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,652	1998	1.18	Yes	No	No	$815,794
1,894	AITCHISON MICHAEL TRUSTEE	178-04-46-018	1163 SNOWY OWL RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,459	2001	0.70	Yes	No	No	$759,534
1,895	LAUFER LUCY ANNE L/E	178-04-46-019	1165 SNOWY OWL RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,781	1998	0.78	Yes	No	No	$652,735
1,896	LAWHON PHILIP ARON	178-04-46-020	1166 SNOWY OWL RD CAMDEN , SC 29020	CAMDEN	Kershaw	5,116	2011	1.02	Yes	No	No	$1,164,603
1,897	TRAPP CHRISTOPHER A &	178-04-46-021	1168 SNOWY OWL RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,950	2006	0.90	Yes	No	No	$870,561
1,898	DELOZIER JAMES E & PATSY J	178-04-46-024	1342 CEDAR COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,383	1950	0.43	Yes	No	No	$535,111
1,899	PRESTAGE RONALD W & CYNTHIA	178-04-46-025	1350 CEDAR COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,010	1950	0.56	Yes	No	No	$509,504
1,900	DUNAWAY JANE D	178-04-46-026	1356 CEDAR COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,234	1998	0.69	Yes	No	No	$714,140
1,901	CAIN VICTOR H JR	178-04-46-028	1360 CEDAR COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,638	2013	1.48	Yes	No	No	$905,552
1,902	BLUM PATRICK ORWELL	178-04-46-032	1162 WHIPPOORWILL RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,740	2003	1.04	Yes	No	No	$683,622
1,903	SHIELDS GREGORY S	178-04-46-033	1336 CEDAR COVE RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,854	2012	0.69	No	No	Yes	$433,166
1,904	BARFIELD MILDRED L (LIFE EST)	179-00-00-016	2151 JOHN G RICHARDS RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,272	1950	2.86	No	No	No	$414,231
1,905	MILLER WILLIAM T	179-00-00-024	1724 EAGLES NEST RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,500	1950	102.40	Yes	No	No	$757,835
1,906	YARBOROUGH WILLIAM H	179-03-46-001	2183 JOHN G RICHARDS RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,320	1950	1.78	No	No	No	$401,510
1,907	BAUM ZANE L &	179-03-47-063	2171A JOHN G RICHARDS RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,120	1950	0.60	Yes	No	No	$393,008
1,908	TAYLOR BARRY KYLE	179-03-47-064	2171 JOHN G RICHARDS RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,396	1950	0.78	No	No	No	$378,464
1,909	MCCUTCHEON RANDY D &	194-01-02-094	1718 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,500	1950	0.63	Yes	No	No	$460,893
1,910	KIRKLAND WILLIAM D, JR	194-01-02-096	1752 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,200	1950	0.82	Yes	No	No	$427,374
1,911	BAKER ROBERT M & BRENDA H	194-01-02-098	1760 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,800	1950	0.92	Yes	No	No	$520,225
1,912	DOOLITTLE MITZI MICKLE	194-01-02-099	1764 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,114	1950	0.88	Yes	Yes	No	$678,790
1,913	MCLEOD DALTON L III	194-01-02-102	1776 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,050	1950	0.88	Yes	No	No	$405,383
1,914	MICKLE ROETTA D L/E	194-01-02-103	1780 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,120	1950	0.73	Yes	No	No	$409,538
1,915	MCDONALD DAVID TODD	194-01-02-104	1784 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,072	2000	0.84	Yes	Yes	No	$886,767
1,916	CARTER W B & SHARI	194-01-02-109	1516 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,780	2009	1.47	Yes	No	No	$755,131
1,917	KREH SALLY	194-01-02-110	1524 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,294	1950	1.26	Yes	No	No	$797,278
1,918	JORDAN DEBRA & JEFFERSON	194-01-03-001	1544 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,270	2008	2.25	Yes	No	No	$1,034,214
1,919	SHULL MICHAEL E	194-01-03-002	1550 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,705	1950	0.93	Yes	No	No	$507,737
1,920	DASHO VICKI WEATHERFORD	194-01-03-003	1554 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,062	1950	0.84	Yes	No	No	$548,326

Figure 134: Unimpaired Market Value Summary 1,881-1,920

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,921	WACTOR MELANIE H	194-01-03-004	1558 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,536	1950	0.97	Yes	No	No	$486,544
1,922	NEWMAN GREGORY S	194-01-03-005-LSE	1562 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	528	1964	0.90	Yes	No	No	$321,429
1,923	MCNEELY TRACY E	194-01-03-006	1566 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,056	1979	0.87	Yes	No	No	$477,460
1,924	KIRKLEY MICHAEL R &	194-01-03-007	1574 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,444	1981	1.07	Yes	No	No	$843,988
1,925	BRADLEY AARON PAUL &	194-01-03-008	1586 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,240	1950	0.98	Yes	No	No	$577,990
1,926	MESSER JEFFERY WAYNE	194-01-03-010	1592 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,440	1979	0.78	Yes	No	No	$543,901
1,927	FERGUSON PATRICK J	194-01-03-011	1594 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,597	1950	0.87	Yes	No	No	$489,810
1,928	SMITH THOMAS E JR	194-01-03-012	1602 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,123	1950	0.84	Yes	No	No	$661,652
1,929	THIGPEN DONNIE R	194-01-03-014	1612 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,007	2016	1.04	Yes	No	No	$962,785
1,930	DEMBIK KEVIN &	194-01-03-015	1602 BLACKGUM LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,232	1950	0.86	Yes	No	No	$434,714
1,931	BIRDSALL ADRIANA LIMA	194-01-03-016	1608 BLACKGUM LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,248	1950	0.74	Yes	No	No	$430,772
1,932	CAMPBELL JEANENE L	194-01-03-017	1612 BLACKGUM LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,014	2002	0.69	Yes	No	No	$973,671
1,933	HALL DALE ALLEN	194-01-03-018	1618 BLACKGUM LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,304	1950	0.88	Yes	No	No	$579,361
1,934	THOMAS MICHAEL K & VICKI	194-01-03-019	1622 BLACKGUM LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,160	1950	0.92	Yes	Yes	No	$688,546
1,935	HARD MITEVA B	194-01-03-020	1626 BLACKGUM LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,958	1993	1.05	Yes	No	No	$840,879
1,936	VANVOLKENBURG SHAWN A	194-01-03-023	1634 BLACKGUM LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,176	1950	1.20	Yes	No	No	$582,226
1,937	BRANHAM PATRICK D	194-01-03-024	1638 BLACKGUM LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,150	1950	0.76	Yes	No	No	$552,907
1,938	LIQUORI CAROL A	194-01-03-025	1642 BLACKGUM LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,905	2021	0.79	No	No	No	$663,685
1,939	LANG KEVIN P &	194-01-03-026	1646 BLACKGUM LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,981	1950	0.87	Yes	No	No	$540,157
1,940	ALBOWICZ GARY R	194-01-03-027	1650 BLACKGUM LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,096	1950	0.77	Yes	No	No	$547,382
1,941	DAVIS PRINTING CO INC	194-02-01-001-S18	1704 ATOKA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,582	1950	0.53	Yes	No	No	$454,051
1,942	GILL PROPERTIES, LLC	194-02-01-003-S18	1708 ATOKA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,440	1950	0.59	No	No	No	$372,946
1,943	MYERS SARAH U	194-02-01-004-S18	1714 ATOKA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	2,720	1950	0.64	Yes	Yes	No	$722,499
1,944	LOCKE HENRIETTA S ET AL	194-02-01-005-S18	1718 ATOKA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,105	1950	0.53	Yes	No	No	$385,670
1,945	CARGES BETSEY	194-02-01-006-S18	1722 ATOKA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	936	1950	0.75	Yes	No	No	$370,515
1,946	HUGHES RAYMOND E	194-02-02-086	1666 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,552	1950	0.87	Yes	No	No	$483,152
1,947	FALLER MONICA N & THEODORE G	194-02-02-088	1674 MALLARD POINT LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,035	1950	1.26	Yes	Yes	No	$692,329
1,948	HINES FREDERICK M	194-02-02-089	1684 MALLARD POINT LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,788	2002	0.98	Yes	No	No	$854,892
1,949	MASSEY HENRY RION	194-02-02-090	1688 MALLARD POINT LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,521	1950	0.78	Yes	No	No	$473,404
1,950	MANN MARCUS D JR &	194-02-02-091	1694 MALLARD POINT LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,192	1986	0.91	Yes	No	No	$824,921
1,951	1700 MALLARD POINT, LLC	194-02-02-092	1700 MALLARD POINT LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,092	1950	0.82	Yes	No	No	$409,256
1,952	THACKSTON ERIC	194-02-04-003-S18	1785 KIOWA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,598	1950	1.47	Yes	No	No	$506,275
1,953	JENKINS MICHAEL CHAD	194-02-04-006-S18	1782 KANAWHA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,258	1950	0.59	Yes	No	No	$413,443
1,954	SIEFERT WAYNE H	194-02-04-008-S18	1596 CHICORA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,107	1950	0.51	Yes	No	No	$384,385
1,955	HINSON CORLISS	194-02-04-009-S18	1590 CHICORA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	3,192	1950	0.76	Yes	No	No	$647,759
1,956	ZAVODNY KENT	194-02-04-010-S18	1586 CHICORA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,320	1950	0.68	No	No	No	$364,005
1,957	ASNIP LYNN B	194-02-47-021	1771 WILD TURKEY RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,434	1950	1.57	Yes	No	No	$485,223
1,958	GODBOLD ASA S	194-02-47-021A	1773 WILD TURKEY RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,700	1950	0.94	Yes	No	No	$614,012
1,959	HUIETT TAMMY M	194-02-47-023	1777 WILD TURKEY RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,778	1979	1.03	Yes	No	No	$603,066
1,960	DAVID ROBERT E JR	194-02-47-024	1783 WILD TURKEY RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,617	1950	0.71	Yes	No	No	$472,333

Figure 135: Unimpaired Market Value Summary 1,921-1,960

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
1,961	TETTERTON JOHN SAMUEL	194-02-47-026	1795 WILD TURKEY RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,500	2007	0.70	Yes	No	No	$627,324
1,962	BROWN ROY HAROLD JR L/E	194-02-47-029	1782A KANAWHA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,532	1950	3.00	Yes	No	No	$534,029
1,963	PAVY JOAN H	194-02-47-031	1749 ATOKA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,246	1950	1.01	Yes	No	No	$435,111
1,964	BARRICK DANIEL F	194-02-47-032	1753 ATOKA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,617	1950	0.97	Yes	No	No	$487,748
1,965	BLOUNT PHILIP C ET AL TRUSTEES	194-02-47-033	1761 ATOKA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	2,607	1950	1.76	Yes	No	No	$643,994
1,966	EAGERTON DAVID HENRY	194-02-47-034	1756 ATOKA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	2,117	2023	0.77	Yes	No	No	$810,976
1,967	VAIL DEBORAH G	194-02-47-035	1742 ATOKA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	2,830	2008	1.37	Yes	No	No	$901,938
1,968	AWAD MICHAEL D	194-02-47-036	1807 KIOWA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	2,642	2008	0.76	Yes	No	No	$823,086
1,969	EPPS TIMOTHY W & CATHY C	194-02-47-037	1812 KIOWA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	768	1950	0.90	Yes	No	No	$345,215
1,970	GRUMBACH DELBERT T &	194-02-47-038	1735 ATOKA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	1,990	2002	2.87	Yes	No	No	$801,273
1,971	KELLEY HILL PROPERTIES LLC	194-02-47-039	1781 WILD TURKEY RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,220	2024	0.83	Yes	No	No	$838,966
1,972	EPPS TIMOTHY R	194-02-47-040	1811 KIOWA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	2,063	1975	0.78	Yes	No	No	$613,286
1,973	TREMAINE FAMILY TRUST	194-02-47-041	1736 ATOKA TRL CAMDEN , SC 29020	CAMDEN	Kershaw	2,920	2008	0.72	Yes	No	No	$857,333
1,974	RHODES PHILLIP K & RHONDA R	194-04-02-001-SJG	1476 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,355	2004	4.81	Yes	Yes	No	$1,147,740
1,975	ALEXANDER ALVIN M & CHARLES H	194-04-02-002A-SJG	1468 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,136	2007	4.84	Yes	No	No	$916,268
1,976	PADGETT EDWARD E JR & SHERRY J	194-04-02-003-SJG	1460 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	6,756	2006	4.96	Yes	Yes	No	$1,879,635
1,977	THOMPSON LEWIS E	194-04-02-004-SJG	1450 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	5,181	2007	5.01	Yes	No	No	$1,375,418
1,978	HOLMAN CHRISTOPHER M &	194-04-02-005-SJG	1438 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,918	2016	4.93	Yes	No	No	$1,271,845
1,979	WOLFE KIP H &	194-04-02-006A-SJG	1430 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,074	2007	5.20	Yes	No	No	$1,237,713
1,980	COBB RUSSELL CLEMSON	194-04-02-007-SJG	1424 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	5,585	2016	5.09	Yes	Yes	No	$1,828,000
1,981	TENNEY CHARLES E	194-04-02-008-SJG	1418 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,013	2020	5.01	Yes	Yes	No	$1,409,922
1,982	FAILE MARK ANDREW	194-04-02-009-SJG	1408 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,024	2007	5.53	Yes	No	No	$1,238,613
1,983	KEMP MICHAEL CLIFFORD JR	194-04-02-010-SJG	1406 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,732	2005	5.48	Yes	No	No	$1,317,272
1,984	MAZZA JACQUELINE	194-04-02-012-SJG	1402 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,742	2014	4.31	Yes	No	No	$1,054,826
1,985	AMERSON LEON TIMOTHY	194-04-02-013-SJG	1414 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,953	2005	4.19	Yes	Yes	No	$1,440,205
1,986	TRUETT TERRY L	194-04-02-016-SJG	1416 LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,207	2014	2.58	Yes	No	No	$907,149
1,987	BOWEN PAULA F & JIMMY C	194-04-02-017-SJG	1412A LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	5,105	2006	5.98	Yes	Yes	No	$1,686,893
1,988	BRICKLEY MATTHEW & BARBARA L	194-04-02-019-SJG	1410B LAKE RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,989	1950	1.33	Yes	No	No	$858,204
1,989	FRAZIER BRET H	194-04-02-035	1622 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,743	1950	0.71	Yes	No	No	$498,812
1,990	JOYNER SUSAN H	194-04-02-036	1626 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,068	1950	0.82	Yes	No	No	$405,275
1,991	BOROSKI SHAWN	194-04-02-037	1632 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,806	1950	1.01	Yes	No	No	$525,949
1,992	BEATTY CHAD	194-04-02-038	1634 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,587	1950	0.68	Yes	No	No	$476,487
1,993	ROBINSON DOUGLAS J	194-04-02-039	1636 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,497	1950	0.99	Yes	No	No	$481,872
1,994	GUIDOMAN LLC	194-04-02-040	1640 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	5,580	2007	0.76	Yes	No	No	$1,174,566
1,995	CALCUTT DOUGLAS DR SR &	194-04-02-041	1646 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,562	1950	0.87	Yes	No	No	$606,810
1,996	ADAMS GREGORY	194-04-02-042	1652 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,298	2024	0.82	Yes	No	No	$869,762
1,997	CANTERBURY JOAN L	194-04-02-043	1658 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,440	1996	0.84	Yes	No	No	$602,581
1,998	PETERS GEORGE THOMAS ET AL	194-04-02-044	1662 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	726	1996	0.76	Yes	No	No	$437,003
1,999	HOLLAND LEANDER JAN &	194-04-02-047	1688 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,296	1950	0.78	Yes	No	No	$570,783
2,000	FIKE JONATHAN D &	194-04-02-048	1690 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	5,469	2008	0.87	Yes	Yes	No	$1,446,337

Figure 136: Unimpaired Market Value Summary 1,961-2,000

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
2,001	HUNT DONALD T & CORINNE D	194-04-02-049	1685 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	650	1950	0.75	Yes	No	No	$320,398
2,002	WELSH BRYAN W	194-04-02-050	1681 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,795	2022	1.22	Yes	No	No	$800,134
2,003	NORMAN JARRET S	194-04-02-076	1600 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,256	1982	1.06	No	No	No	$701,033
2,004	ELLIS ALICE C (LIFE ESTATE)	194-04-02-077	1608 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,430	1950	0.98	Yes	No	No	$471,501
2,005	PRICE CHARLES D &	194-04-02-078	1610 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,945	1950	0.93	No	No	No	$552,523
2,006	HOBBY LINDA W	194-04-02-079	1622 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	4,656	1997	2.86	Yes	No	No	$1,169,834
2,007	JOHNSTON BRIAN P	194-04-02-080	1630 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,954	1950	0.91	Yes	No	No	$539,351
2,008	HINSON WILLIAM E &	194-04-02-081	1634 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,472	2019	0.84	Yes	No	No	$692,174
2,009	WARDLAW SANDRA C & WILLIAM C	194-04-02-082	1640 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,927	1950	0.86	Yes	No	No	$532,396
2,010	MOORE LYNN CATOE &	194-04-02-083	1644 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,355	1950	0.83	Yes	No	No	$581,138
2,011	CASSADY DAVID H &	194-04-02-084	1648 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,810	1950	0.74	Yes	Yes	No	$621,662
2,012	WILLIAMS GREGORY MARK	194-04-02-085	1652 CATCLAW LN RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,948	2000	0.78	Yes	No	No	$846,764
2,013	CAUTHEN MIRIAM P	194-04-47-019	1573 WILD TURKEY RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,920	1986	1.17	No	No	No	$557,951
2,014	DENIS RAUL E	195-03-0A-002-SDU	1559 WILD TURKEY RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,765	2001	0.80	Yes	No	No	$812,011
2,015	RIBELIN DAVID T &	195-03-0A-003-SDU	1553 WILD TURKEY RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,807	2021	0.66	Yes	No	No	$733,945
2,016	GARCIA RAYMOND G &	195-03-0A-008-SDU	1537 WILD TURKEY RD CAMDEN , SC 29020	CAMDEN	Kershaw	3,048	2004	0.77	Yes	No	No	$860,601
2,017	POLLARD WILLIAM BROOKS &	195-03-0A-009-SDU	1535 WILD TURKEY RD CAMDEN , SC 29020	CAMDEN	Kershaw	168	2004	0.77	No	No	No	$195,440
2,018	CLARK KELLY E JR	195-03-0B-012-SDU	1958 EAGLES NEST RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,395	2024	0.75	Yes	No	No	$672,681
2,019	LONG MICHAEL R & HEATHER L	195-03-0C-001A-SDU	1531 WILD TURKEY RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,624	1996	1.32	Yes	No	No	$652,402
2,020	BUSCH JOSEPH JAMES &	209-00-00-027	1427 BUCK HILL LANDING RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,298	2020	60.48	Yes	No	No	$1,317,645
2,021	FORT THOMAS WILSON JR &	209-02-02-013	1494 BUCK HILL LANDING RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,540	2018	0.54	Yes	No	No	$671,602
2,022	COVINGTON MICHAEL D	209-02-02-015	1504 BUCK HILL LANDING RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,790	2007	0.64	Yes	No	No	$688,167
2,023	SMITH WILLIAM DOUGLAS	209-02-02-017	1512 BUCK HILL LANDING RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,071	2021	0.78	Yes	No	No	$970,665
2,024	TAYLOR LEROY &	209-02-02-018	1518 BUCK HILL LANDING RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,192	1950	0.71	Yes	No	No	$553,576
2,025	DAVIS CRAIG K	209-02-02-019	1524 BUCK HILL LANDING RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	3,481	2005	0.80	Yes	No	No	$942,031
2,026	TODD ARCHIE L III & GAYLE T	209-02-02-020	1528 BUCK HILL LANDING RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,868	1950	0.82	Yes	No	No	$522,660
2,027	CATOE KATHRYN G	209-02-02-021	1534 BUCK HILL LANDING RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,113	2007	0.71	Yes	No	No	$749,477
2,028	COUCH CHARLES W JR	209-02-02-022	1540 BUCK HILL LANDING RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,135	2014	0.66	Yes	No	No	$583,573
2,029	DERRICK SYLVIA L/E	209-02-02-024	1552 BUCK HILL LANDING RD RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,456	2002	0.93	Yes	No	Yes	$455,372
2,030	JARRETT STEVEN H	209-02-02-027	1568 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	2,081	2006	0.72	Yes	No	No	$741,958
2,031	WHITE SHARON	209-02-02-028	1576 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	934	2000	0.53	Yes	No	No	$482,702
2,032	SADIES RENTALS LLC	209-02-02-029	1582 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	952	1950	0.45	Yes	No	No	$361,801
2,033	SPEEDY GEORGE W	209-02-02-030	1588 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,576	1950	0.58	Yes	Yes	No	$569,801
2,034	SPEEDY GEORGE W	209-02-02-031	1594 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	1,554	2024	0.69	Yes	No	No	$714,777
2,035	JONES WILLIAM MICHAEL SR L/E	209-02-02-032	1602 GINKGO TRL RIDGEWAY , SC 29130	RIDGEWAY	Kershaw	691	1950	0.41	Yes	No	No	$310,072
2,036	KIOROGLO VITALIY	160-03-00-005	2700 HARBOR VIEW RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,861	2013	2.86	Yes	No	No	$826,416
2,037	DILLMAN JEFFERY N	162-03-45-099	2217A BLUE HERON LN CAMDEN , SC 29020	CAMDEN	Kershaw	840	1950	1.40	No	No	No	$319,071
2,038	BELL DOUGLAS	144-04-0A-020	1475 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	960	2014	0.58	Yes	No	No	$523,020
2,039	BROUGHTON LANA P &	178-02-46-058	2323 JOHN G RICHARDS RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,571	2015	1.81	Yes	No	No	$923,881
2,040	KREBS WAYNE R	161-01-43-161	2301 LAKESHORE RD CAMDEN , SC 29020	CAMDEN	Kershaw	2,416	2022	16.10	No	No	No	$989,949

Figure 137: Unimpaired Market Value Summary 2,001-2,040

LAKE WATEREE PCB
Unimpaired Market Value Summary
Improved Residential Proposed Class Properties
(Landmark File: 235-2-26)

No.	Owner Name	Parcel ID	Address	City	County	SqFt	Year Built	Lot Size (Acres)	Dock	Pool	Manufactured/ Modular	Unimpaired Market Values (2/10/2026)
2,041	CROOKES BRUCE A	160-03-00-011	1519 CARL A HORTON RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,034	2020	0.52	Yes	No	No	$552,504
2,042	FAUST CARRIE	178-01-45-076	1995 LYSTRA RD CAMDEN , SC 29020	CAMDEN	Kershaw	1,907	2024	3.23	No	No	No	$763,262
2,043	BAUCOM RALPH E	144-04-0B-007A	2277 HORTON ACRES LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,500	2024	2.01	Yes	No	No	$768,599
2,044	MCINTYRE PATRICK K	178-04-46-034	1253 SCREECH OWL RD CAMDEN , SC 29020	CAMDEN	Kershaw	727	1950	0.68	Yes	No	No	$327,175
2,045	LONG DAVID LEE	144-04-0B-023	2285 HORTON ACRES LN CAMDEN , SC 29020	CAMDEN	Kershaw	1,128	1950	0.97	Yes	No	No	$414,068

Figure 138: Unimpaired Market Value Summary 2,041-2,045

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