



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365



4WD-WPB

Bobby Lutfy
Solid Waste Management Division
North Carolina Department of Environment,
Health and Natural Resources
P.O. Box 2091
Raleigh, NC 27602-2091

Dear Mr. Lutfy:

Per your request, please find enclosed a copy of the Screening Site Investigation, Phase II final report for the Bladen County Landfill.

If you have any questions regarding this matter, please contact me at (404) 347-5065.

Sincerely yours,

A handwritten signature in cursive script, appearing to read "Earl L. Bozeman, Jr.".

Earl L. Bozeman, Jr.
Environmental Scientist

Enclosure

FINAL REPORT

**SCREENING SITE INSPECTION, PHASE II
BLADEN COUNTY LANDFILL
ELIZABETHTOWN, BLADEN COUNTY, NORTH CAROLINA
EPA ID #: NCD980502819**

Prepared Under
TDD No. F4-8902-69
CONTRACT NO. 68-01-7346

Revision 0

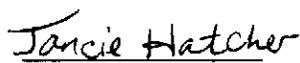
FOR THE

WASTE MANAGEMENT DIVISION
U.S. ENVIRONMENTAL PROTECTION AGENCY

DECEMBER 7, 1990

NUS CORPORATION
SUPERFUND DIVISION

Prepared By


Jancie Hatcher
Project Manager

Reviewed By


Bob Donaghue
Assistant Regional
Project Manager

Approved By

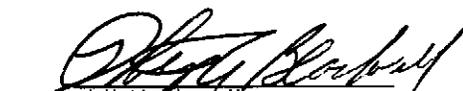

Phil Blackwell
Regional Project Manager

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EXECUTIVE SUMMARY

The Bladen County Landfill is a 30-acre facility located 1 mile south of Elizabethtown, North Carolina. The facility is currently active and is owned and operated by Bladen County.

The landfill has been active since 1972 and accepted a variety of industrial wastes. Bags, cans, waste lacquer dust, wood debris, fly ash waste, and 5 tons of sludge from an offsite waste treatment pond were all disposed of in the landfill. The total amount of waste accepted is unknown. State monitoring of groundwater beneath the landfill detected iron and manganese at levels exceeding groundwater standards.

The landfill is located in the south-central portion of the Atlantic Coastal Plain Physiographic Province. This area is underlain by three aquifers: the surficial Waccamaw, Black Creek, and Tuscaloosa. The Black Creek is the primary source for potable water in the area.

The groundwater and onsite migration pathways are of greatest concern. Groundwater is the source of drinking water for both customers served by a community water system and for those with private wells. The facility is not fenced, so it is easily accessible to the surrounding population.

The field investigation and sampling showed the presence of various heavy metals, including barium, iron, copper, manganese, and zinc. Toluene was found at elevated concentrations in sediment, groundwater, and waste samples from exposed fly ash piles. Based on this information and available file data, FIT 4 recommends that Phase I of a Listing Site Inspection (LSI) be conducted at the Bladen County Landfill.

1.0 INTRODUCTION

The NUS Corporation Region 4 Field Investigation Team (FIT) was tasked by the U.S. Environmental Protection Agency (EPA), Waste Management Division to conduct a Screening Site Inspection (SSI) at the Bladen County Landfill site in Elizabethtown, Bladen County, North Carolina. The investigation was performed under the authority of the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA). The task was performed to satisfy the requirements stated in Technical Directive Document (TDD) number F4-8902-69. The field investigation was conducted during the week of March 28-30, 1989.

1.1 OBJECTIVES

The objectives of this inspection were to determine the nature of contaminants present at the site and to determine if a release of these substances has occurred or may occur. Further, this inspection sought to determine the possible pathways by which contamination could migrate from the site and the populations and environments it would potentially affect. Through these objectives, a recommendation was made regarding future activities at the site.

1.2 SCOPE OF WORK

The objectives were achieved through the completion of a number of specific tasks. These activities were to:

- Obtain and review relevant background materials.
- Obtain maps of site.
- Obtain information on local water systems.
- Evaluate target populations associated with the groundwater, surface water, air, and onsite exposure pathways.
- Conduct a survey of private wells.

- Determine location and distance to nearest potable well.
- Develop a site sketch.
- Collect 19 environmental samples.

2.0 SITE CHARACTERIZATION

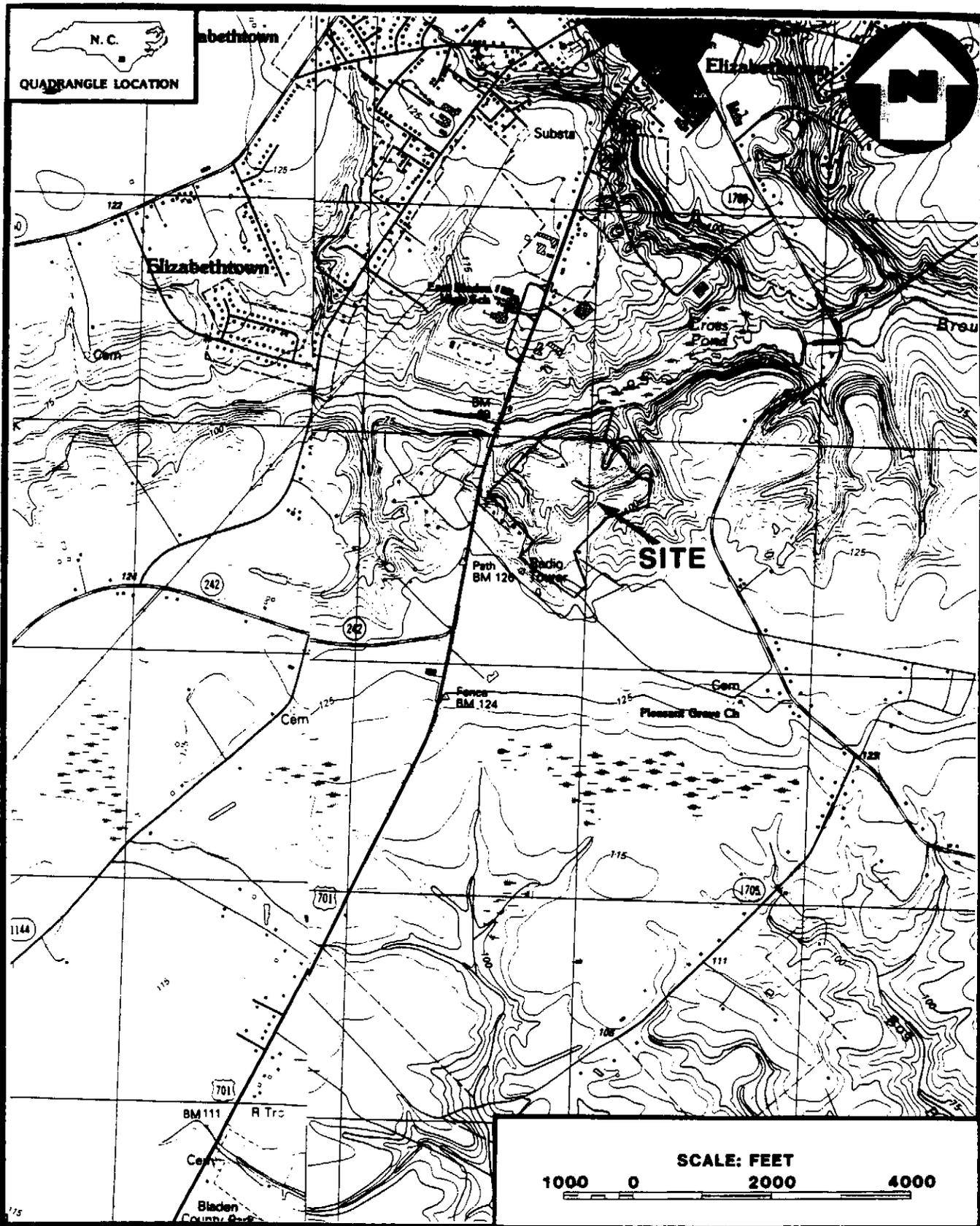
2.1 SITE BACKGROUND AND HISTORY

The Bladen County Landfill is located on the eastern side of U.S. Highway 701 South approximately 1 mile south of the Elizabethtown city limits. Geographically the landfill is located at 34°36'05" N latitude and 78°37'01" W longitude (Figure 1) (Ref. 1).

This facility is a sanitary landfill that has been in operation since 1972 (Refs. 1, 2). The landfill is owned and operated by Bladen County, under Solid Waste Permit No. 0901 from the North Carolina Department of Environment, Health, and Natural Resources, Solid Waste Section (Refs. 2, 3). The trench method is used for disposal of wastes. Trenches are excavated to an approximate depth of 10 to 11 feet (Ref. 1). Cogentrics, a utility company that burns coal to generate electricity, has disposed of fly ash wastes at the landfill since 1986 (Ref. 4). Other industrial wastes accepted at the landfill have included trash, paper, split bags, and cans from the Cape Fear Chemical Company, a manufacturer of lawn and garden products. Also accepted were waste lacquer dust, wood debris, and picture frames from Cape Craftsman, a furniture manufacturer (Refs. 5, 6, 7).

In 1973, an oil-like film was found in the dam area of Cross Pond, located within 1 mile downstream from the landfill. The pond's owner thought the film might be related to the landfill. However, a nonsampling investigation of the area by North Carolina state and county health officials indicated that a more likely source was overflow from an upstream slaughterhouse waste lagoon (Ref. 8).

The North Carolina Solid and Hazardous Waste Management Branch has monitored general water quality parameters of the groundwater at the Bladen County Landfill and nearby surface water since at least 1979. In July 1979, a surface water sample from a stream downgradient from the landfill was found to contain arsenic, chromium, copper, lead, and zinc. The sample was very turbid and had a low pH (Ref. 9). However, surface water samples collected during the period from August 1979, to February 1984, had a more neutral pH, and the metals were either present in lower concentrations or not present above the detection limits (Refs. 10, 11, 12). In June 1987, Bladen County contracted Soil and Material Engineers, Inc. (S & ME) to collect a surface water sample downgradient from the landfill at the confluence of an unnamed intermittent stream and Brown's Creek. The sample was analyzed for volatile organic compounds, iron, manganese, and sulfate. No volatile organics were detected. The iron concentration slightly exceeded the North Carolina surface water standard (Ref. 13).



BASE MAP IS A PORTION OF THE U.S.G.S. 7.5 MINUTE QUADRANGLE ABBOTTSBURG, ELIZABETHTOWN SOUTH, 1987, NORTH CAROLINA.

**SITE LOCATION MAP
BLADEN COUNTY LANDFILL
ELIZABETHTOWN, NORTH CAROLINA**

FIGURE 1



Since at least 1982, three wells were used to monitor groundwater at the landfill. One well consistently had low pH, high conductivity, and high total dissolved solids (Refs. 11, 12, 14). In May 1986, Bladen County was issued a Notice of Violation by the North Carolina Division of Environmental Management (DEM) for violating groundwater standards at the landfill (Ref. 15). The Notice of Violation was based upon elevated concentrations of iron, manganese, and total dissolved solids (Ref. 14). In response to the Notice of Violation, Bladen County contracted S & ME to conduct a hydrogeologic assessment of the landfill. In August 1986, six additional permanent monitoring wells were installed; groundwater was sampled and tested for volatile organics, sulfate, iron, and manganese.

Concentrations were found to be within groundwater standards or within naturally occurring concentration ranges for the Elizabethtown area. S & ME determined that the initial three monitoring wells were improperly constructed; therefore, previous groundwater samples were not truly representative of groundwater conditions at the Bladen County Landfill (Ref. 16). After reviewing the report and Bladen County's response to reported deficiencies in the document, DEM stated that the only apparent chemical of concern in the groundwater in the eastern portion of the landfill was iron, which might be present in large amounts simply because of naturally high iron concentrations. DEM recommended evaluation of groundwater in one more portion of the landfill (Ref. 15). Bladen County subsequently contracted Aquaterra, Inc. to conduct additional groundwater sampling at the western side of the landfill. Samples were analyzed for iron, manganese, sulfate, and total organic carbon. Iron concentrations were again found to be elevated (Ref. 17).

2.2 SITE DESCRIPTION

2.2.1 Site Features

The Bladen County Landfill encompasses an area of approximately 30 acres (Figure 1). An access road leads from the highway to the landfill (Figure 2). There is a gate across the road, but the landfill is not fenced. The road passes a trailer and a steel shed, then continues to the eastern side of the landfill. A dirt road runs along the landfill's eastern border. The northern portion of the landfill appears to be inactive; only tree stumps were noted in the area (Ref. 18). The eastern portion of the landfill is active. Metal debris is located in a central portion, and enclosed fly ash is located in the southwestern area (Ref. 19).

The central portion of the landfill is relatively flat, and its inactive areas are grassy. The landfill's periphery is sloping and wooded. Intermittent streams drain the northeastern portion of the landfill, leading into a silt basin (Refs. 7, 16). Intermittent streams are also located on the western border of

**SITE LAYOUT MAP
 BLADEN COUNTY LANDFILL
 ELIZABETHTOWN, NORTH CAROLINA**

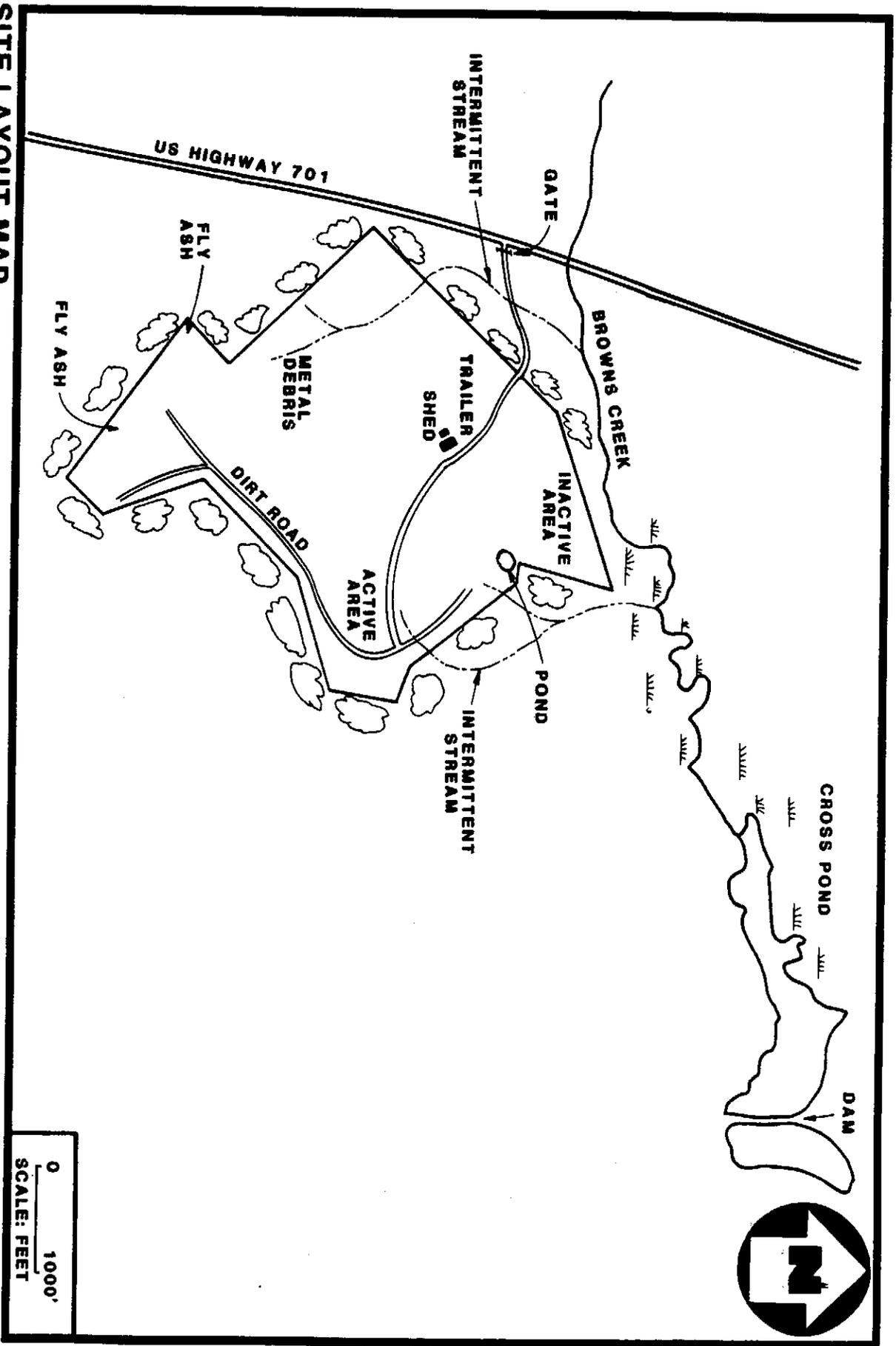


FIGURE 2

the landfill (Figure 2). A small pond, located between the active and inactive areas on the eastern side, appears to be a retention pond for surface water runoff (Refs. 18, 19). An overflow pipe directs water into an intermittent stream (Ref. 19).

2.2.2 Waste Characteristics

Both domestic and industrial wastes have been disposed in the landfill. Wastes from the Cape Fear Chemical Company include trash and paper as well as split bags and cans; the original contents of the bags and cans were not documented (Refs. 6, 7). Wastes from Cape Craftsman include wood debris, picture frames, and waste lacquer dust, but it is not documented whether the lacquer dust is considered hazardous (Refs. 5, 7). Cogentrics has disposed of fly ash at the landfill since 1986 (Ref. 1). In 1987, approximately 500 tons of fly ash were disposed of weekly (Ref. 20). Approximately 5 tons of sludge from a Cogentrics waste treatment pond were also disposed of in the landfill in 1987, under a permit from the state of North Carolina (Ref. 1). Laboratory analysis of the sludge found no chemical contaminants present above RCRA Extraction Procedure (EP) toxicity levels (Ref. 1).

Wastes at the landfill were buried in trenches 10 to 20 feet deep, then covered with a layer of fine, silty clay about 18 to 24 inches thick (Ref. 7). Because landfill operations began in 1972, it is likely that the landfill is unlined (Ref. 2).

3.0 REGIONAL POPULATIONS AND ENVIRONMENTS

3.1 POPULATION AND LAND USE

3.1.1 Demography

The area within 4 miles of the landfill is primarily rural (Appendix A). The town of Elizabethtown, located approximately 1 mile north of the landfill, had a population of 4,100 in 1980 (Ref. 20). Based upon a topographic house count (assuming 3.8 persons per house), the population within a 1-mile radius is 1,300 (Appendix A). The population within a 4-mile radius is 5,978, based upon 1980 census figures (Ref. 21). The nearest residence is located approximately 100 feet from the landfill's southwestern boundary. The nearest school is East Bladen High School, located approximately 1,700 feet northwest of the landfill (Appendix A).

3.1.2 Land Use

Within 4 miles of the landfill, the greatest concentration of residences, businesses, and industries is found in Elizabethtown. The rural areas outside the city limits contain scattered residences and commercial/industrial areas. Although much of the area within 4 miles of the landfill is rural, the only agricultural land verified was a pecan grove northeast of the landfill, on the opposite side of the ravine (Appendix A, Ref. 22). A picnic area is located approximately 2.3 miles northeast of the landfill, and Bladen County Park is located approximately 2.3 miles to the southwest (Appendix A).

Freshwater wetlands are scattered throughout the 4-mile radius, with the nearest wetland located approximately 200 feet from the landfill's northeastern border (Appendix A). The red-cockaded woodpecker (Picoides borealis), a federally designated endangered species, is found in Bladen County (Ref. 23). The endangered pondberry plant (Lindera melissifolia) is found in Bladen County. Additionally, the threatened eastern cougar (Felis concolor cougar) is found in the state of North Carolina (Ref. 24). Although many other sensitive natural areas are located in Bladen County, none appear to be located within 4 miles of the landfill (Ref. 25, Appendix A).

3.2 SURFACE WATER

3.2.1 Climatology

The climate of the Elizabethtown area is generally humid. Summers are long and hot, while winters are short and chilly (Ref. 26, p. 4). The average annual precipitation and lake evaporation for the area are 47 and 42.5 inches, respectively, resulting in a net precipitation of 4.5 inches (Ref. 27, pp. 37, 63). The 1-year, 24-hour rainfall for the area is approximately 3.4 inches (Ref. 28, p. 93).

3.2.2 Overland Drainage

Surface water runoff from the northwestern area of the landfill drains into an intermittent stream, which enters Browns Creek approximately 900 feet from the landfill. Runoff from the northeastern area of the landfill drains into two branches of an intermittent stream. The stream enters a freshwater wetland approximately 700 feet from the landfill, then continues approximately 200 feet to Browns Creek. Browns Creek continues approximately 1,900 feet northeastward to Cross Pond. The pond is approximately 1,900 feet in length and is formed by an earthen dam across the creek (Appendix A, Ref. 29). Browns Creek continues beyond the dam, reaching the Cape Fear River approximately 3.2 miles downstream (Appendix A). The river continues beyond 15 miles downstream from the landfill.

3.2.3 Potentially Affected Water Bodies

The nearest downstream surface water intake is located at Riegelwood, more than 15 miles downstream on the Cape Fear River (Ref. 30). Browns Creek and Cross Pond may be used for recreational fishing; according to a local resident, bass spawn in Cross Pond (Ref. 7). Two boat ramps, located north and northeast of Elizabethtown, provide access to the Cape Fear River for recreational use (Appendix A). Although catfish are caught commercially in the Cape Fear River from Elizabethtown upstream to Lillington, apparently no commercial fishing occurs in the river from U.S. Lock and Dam No. 2 at Elizabethtown downstream to U.S. Lock and Dam No. 1 (Ref. 30). The Bladen Lakes State Forest, additional wetlands, and Walkers Bluff, a North Carolina Registered Natural Area, are located along the Cape Fear River, within 15 miles downstream from the landfill (Appendix A, Ref. 25). The American alligator (Alligator mississippiensis) and the anhinga (Anhinga anhinga), a wetlands bird species, are state-designated threatened species found in Bladen County (Ref. 23).

3.3 GROUNDWATER

3.3.1 Hydrogeology

The Bladen County Landfill is located in the south-central Atlantic Coastal Plain Physiographic Province and Hydrogeologic setting of North Carolina (Ref. 31, pp. 270, 271). The area is characterized by relatively low-lying, flat land with a moderate ridge and valley system cut by streams. Local elevations are 75 to 100 feet above sea level. The Cape Fear River, the main stream in the area, is located within 3 miles east of the site and drains most of central Bladen County (Appendix A).

The site is underlain by about 700 feet of sediments described as layers of sand, sandy clay, and clay. These sediments rest on crystalline bedrock composed of gneiss, schist, granite, and metavolcanics. The slope of the bedrock surface and overlying sediments is about 20 feet per mile southeast toward the coast. The various formations within the sediments are, in descending order, the Waccamaw Formation, Black Creek Formation, and the Tuscaloosa (Middendorf) Formation (Refs. 16, pp. 4, 5; 32, pp. 4-6, 11-13).

The Waccamaw Formation is a surficial layer of sediments consisting of white, tan, orange-tan or gray, well-graded fossiliferous sands to sandy clays. In the area of the landfill, the formation is known to have a thickness of 10 to 42 feet below land surface (bls). This is an unconfined, water-table aquifer with depth to groundwater only a few feet bls to 20 or 30 feet bls, depending on topographic location. Recharge is by rainfall on the land surface which percolates down to the water table (Ref. 16, pp. 4, 5, Figures 4, 5). Clays found in the Waccamaw Formation have hydraulic conductivities in the range of 1×10^{-2} to 1×10^{-5} cm/sec (Ref. 33, p. 29).

Directly underlying the Waccamaw Formation is the Black Creek Formation. This formation consists of crossbedded layers of dark-gray, fine-grained, sandy clay and thin to massive beds of fine to coarse sand. The sand beds in this formation contain fresh water and are considered to be the primary source for potable water in the area. The sand occurs in layers ranging from a few inches to 20 feet in thickness, confined by clay in layers of a few inches to 50 feet in thickness. The Black Creek Formation is several hundred feet thick in central Bladen County (Ref. 32, pp. 11, 13). The layer of lowest hydraulic conductivity between this aquifer and the surface would be the confining clay units within the formation. The hydraulic conductivity for clay is 1×10^{-7} to 1×10^{-10} cm/sec (Ref. 33, p. 29).

The Tuscaloosa (Middendorf) Formation is the oldest formation that yields water in the area. The Tuscaloosa consists of interbedded sands and clays that lie unconformably on basement crystalline

rock. The sand beds are poorly sorted and arkosic, have a micaceous clay matrix, and are lenticular. The clay beds are massive and less lenticular than the sands. The Tuscaloosa is recognized by its red, gray, and yellow color, and arkosic character (Ref. 32, p. 4).

3.3.2 Aquifer Use

Groundwater is used as the water supply source for both municipal and private users within 4 miles of the landfill. The city of Elizabethtown has four municipal wells located between 0.8 and 1.9 miles from the landfill (Appendix A). The wells are approximately 150 feet deep. Water from the wells is combined prior to distribution (Ref. 34). This system serves 3,731 persons (Ref. 35).

Areas not served by the city of Elizabethtown are assumed to use smaller public water system wells or private wells. A well at Baldwin Branch Church, approximately 2.3 miles southwest of the landfill, serves 75 people. U.S. Lock and Dam No. 2 (2.4 miles northeast of the landfill) has a well serving 25 people (Ref. 35). A house count on a topographic map (assuming 3.8 persons per house) yielded a total of 1,459 persons utilizing private wells within 3 miles and an additional 1,204 persons between 3 and 4 miles. The nearest private well is located approximately 200 feet south of the landfill (Appendix A). At least 20 private wells in the area are completed at a depth of 80 feet bls (Ref. 34). The above information produced a total of 5,290 groundwater targets within a 3-mile radius, with an additional 1,204 targets between 3 and 4 miles from the landfill.

4.0 FIELD INVESTIGATION

4.1 SAMPLE COLLECTION

4.1.1 Sample Collection Methodology

All sample collection, sample preservation, and chain-of-custody procedures used during this investigation were in accordance with the standard operating procedures as specified in Sections 3 and 4 of the Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual; United States Environmental Protection Agency, Region IV, Environmental Services, Division, April 1, 1986.

4.1.2 Split Samples

Split samples were offered to and declined by Hilda Britt, a representative of Bladen County, and Esther B. Inman, a private well owner.

4.1.3 Description of Samples and Sample Locations

The field investigation included the collection of 19 environmental samples. Sample codes, descriptions, locations, and collection times are presented in Table 1, and sample locations are shown in Figure 3. Six groundwater samples were collected, including five from onsite monitoring wells and one from a private well used as a background location. (For this study, monitoring wells were renumbered and thus differ from the number designations in previous studies, as indicated in Table 1.)

One waste sample was collected from an onsite fly ash pile. The six subsurface soil samples consisted of five onsite samples (including one from a fly ash area) and one offsite background sample. Three sediment samples and three surface water samples were collected; one sediment sample and one surface water sample were collected from an upstream background location in Browns Creek, and the remaining samples were collected in the wetlands of Browns Creek and in Cross Pond, along the surface water runoff pathway.

4.1.4 Field Measurements

Field measurements taken for water samples include pH, temperature, conductivity, and, for groundwater samples, depth to water. These measurements are presented in Table 2.

TABLE 1

SAMPLE CODES, DESCRIPTIONS, LOCATIONS, AND COLLECTION TIMES
 BLADEN COUNTY LANDFILL
 ELIZABETHTOWN, BLADEN COUNTY, NORTH CAROLINA

Sample Code	Description/Location	Date Collected	Time Collected
BC-PW-01	Groundwater from a private well west of U.S. Highway 70 (southwest of the landfill) at the Jessie/Esther B. Inman residence. Background sample.	3/29/89	0815
BC-MW-01*	Groundwater from a monitoring well at southeastern boundary of landfill. Same well as Aquaterra, Inc. MW-1.	3/29/89	1510
BC-MW-02*	Groundwater from a monitoring well at eastern boundary of landfill. Same as Aquaterra, Inc. MW-3.	3/29/89	1415
BC-MW-03*	Groundwater from a monitoring well at easternmost boundary of landfill. Same as Aquaterra, Inc. MW-4.	3/29/89	1330
BC-MW-04*	Groundwater from a monitoring well at northern boundary of landfill. Same as Aquaterra, Inc. MW-7.	3/29/89	1600
BC-MW-05*	Groundwater from a monitoring well at western boundary of landfill. Same as Aquaterra, Inc. MW-8.	3/29/89	1630
BC-WS-01	Waste from an uncovered fly ash pile at southern boundary of landfill.	3/28/89	1555
BC-SB-01	Subsurface soil from west of U.S. Highway 701 (southwest of the landfill) at the Jessie/Esther B. Inman residence. Background sample collected at a depth of 4 feet bls.	3/28/89	0800
BC-SB-02	Subsurface soil from a covered fly ash pile in southwestern area of landfill. Collected at a depth of 3 to 4 feet bls. (Fly Ash)	3/28/89	1516

- | | | | |
|----|--|----|-------------------|
| BC | - Bladen County Landfill | SB | - Subsurface Soil |
| PW | - Groundwater, Private Well | SD | - Sediment |
| MW | - Groundwater, Monitoring Well | SW | - Surface Water |
| WS | - Waste | | |
| * | - Monitoring wells installed by Aquaterra, Inc. were renumbered for the present study. The original Aquaterra, Inc. monitoring wells are included in the sample description/location (Refs. 16, 17). | | |

TABLE 1

SAMPLE CODES, DESCRIPTIONS, LOCATIONS, AND COLLECTION TIMES
 BLADEN COUNTY LANDFILL
 ELIZABETHTOWN, BLADEN COUNTY, NORTH CAROLINA

Sample Code	Description/Location	Date Collected	Time Collected
BC-SB-03	Subsurface soil from eastern boundary of landfill. Collected at a depth of 2.5 feet bls.	3/28/89	1516
BC-SB-04	Subsurface soil from easternmost boundary of landfill. Collected at a depth of 3.5 to 4 feet bls.	3/28/89	1430
BC-SB-05	Subsurface soil from northeastern boundary of landfill. Collected at a depth of 4 feet bls.	3/28/89	1215
BC-SB-06	Subsurface soil from northernmost boundary of landfill. Collected at a depth of 4 feet bls, in an area surrounded by standing water (4 inches deep). Water in borehole was 6 inches bls.	3/28/89	1110
BC-SD-01	Sediment from southern bank of Browns Creek, 75 feet west (upstream) of U.S. Highway 701. Upstream (background) sample. Same location as BC-SW-01.	3/29/89	0925
BC-SD-02	Sediment from point of entry of surface water runoff into wetlands of Browns Creek/Cross Pond. Same location as BC-SW-02.	3/29/89	1805
BC-SD-03	Sediment from Cross Pond, on western side of dam. Downstream sample. Same location as BC-SW-03.	3/30/89	0740
BC-SW-01	Surface water from southern bank of Browns Creek, 75 feet west (upstream) of U.S. Highway 701. Upstream (background) sample. Same location as BC-SD-01.	3/29/89	0920

- | | | | | | |
|----|---|------------------------------|----|---|-----------------|
| BC | - | Bladen County Landfill | SB | - | Subsurface Soil |
| PW | - | Groundwater, Private Well | SD | - | Sediment |
| MW | - | Groundwater, Monitoring Well | SW | - | Surface Water |
| WS | - | Waste | | | |
- * - Monitoring wells installed by Aquaterra, Inc. were renumbered for the present study. The original Aquaterra, Inc. monitoring wells are included in the sample description/location (Refs. 16, 17).

TABLE 1

**SAMPLE CODES, DESCRIPTIONS, LOCATIONS, AND COLLECTION TIMES
BLADEN COUNTY LANDFILL
ELIZABETHTOWN, BLADEN COUNTY, NORTH CAROLINA**

Sample Code	Description/Location	Date Collected	Time Collected
BC-SW-02	Surface water from point of entry of surface water runoff into wetlands of Browns Creek/Cross Pond. Same location as BC-SD-02.	3/29/89	1800
BC-SW-03	Surface water from Cross Pond, on western side of dam. Downstream sample. Same location as BC-SD-03.	3/30/89	0730

- BC - Bladen County Landfill
- PW - Groundwater, Private Well
- MW - Groundwater, Monitoring Well
- WS - Waste
- * - Monitoring wells installed by Aquaterra, Inc. were renumbered for the present study. The original Aquaterra, Inc. monitoring wells are included in the sample description/location (Refs. 16, 17).
- SB - Subsurface Soil
- SD - Sediment
- SW - Surface Water

TABLE 2
FIELD MEASUREMENTS
BLADEN COUNTY LANDFILL
ELIZABETHTOWN, BLADEN COUNTY, NORTH CAROLINA

Sample Code	pH	Temp. (°C)	Conductivity (umhos/cm)	Depth to Water (ft bis)
BC-PW-01	6.6	18	210	Unknown
BC-MW-01	8.7	20	120	13.2
BC-MW-02	7.0	20	318	8.7
BC-MW-03	7.2	21	290	33.9
BC-MW-04	7.3	18.5	375	1.1
BC-MW-05	7.3	19	127	14.2
BC-SW-01	7.5	21	74	NA
BC-SW-02	7.5	19.5	210	NA
BC-SW-03	7.6	16	88	NA

BC - Bladen County Landfill
PW - Groundwater, Private Well
MW - Groundwater, Monitoring Well
SW - Surface Water

**SAMPLE LOCATION MAP
 BLADEN COUNTY LANDFILL
 ELIZABETHTOWN, NORTH CAROLINA**

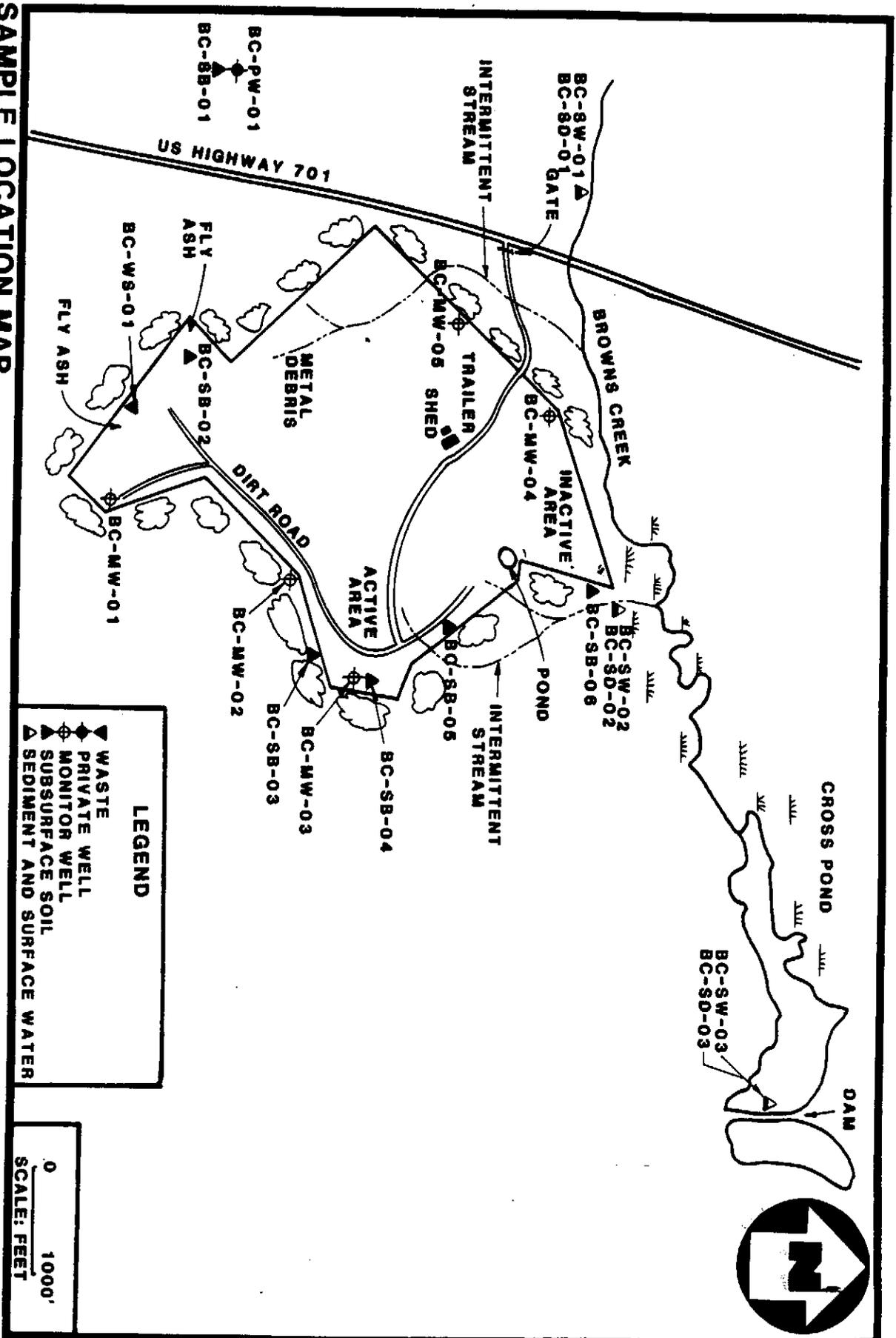


FIGURE 3

4.2 SAMPLE ANALYSIS

4.2.1 Analytical Support and Methodology

All samples collected were analyzed under the Contract Laboratory Program (CLP) and analyzed for all parameters listed in the Target Compound List (TCL). Both organic and inorganic analyses of soil and water samples were performed by the USEPA Environmental Service Division in Athens, Georgia.

All laboratory analyses and laboratory quality assurance procedures used during this investigation were in accordance with standard procedures and protocols as specified in the Analytical Support Branch Operations and Quality Assurance Manual, United States Environmental Protection Agency, Region IV, Environmental Services Division, revised June 1, 1985; or as specified by the existing United States Environmental Protection Agency standard procedures and protocols for the contract analytical laboratory program.

4.2.2 Analytical Data Quality

All analytical data were subjected to a quality assurance review as described in the EPA Environmental Services Division laboratory data guidelines. In the tables, some of the concentrations of the organic and inorganic parameters have been flagged with a "J". This indicates that the qualitative analysis was acceptable, but the quantitative value has been estimated. A few other compounds are flagged with an "N", indicating that they were detected based on the presumptive evidence of their presence. This means that the compound was tentatively identified, and its detection cannot be used as positive identification to its presence. The complete analytical data sheets are provided in Appendix B.

4.2.3 Presentation of Analytical Results

This section discusses the significant results from the analysis of environmental samples collected at the Bladen County Landfill. Results of inorganic and organic analyses of subsurface soil, sediment, and waste samples are presented in Tables 3 and 4, respectively. Results of inorganic and organic analyses of groundwater and surface water samples are presented in Tables 5 and 6, respectively.

Subsurface soil sample BC-SB-02 was collected from a covered fly ash pile. As seen in Table 3, the inorganic chemical composition and concentrations detected in BC-SB-02 were estimated and similar to those detected in fly ash waste sample BC-WS-01. Metals of concern present in these samples at

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TABLE 3

PARAMETERS (mg/kg)	Subsurface Soil						Sediment			Waste (Fly Ash)
	Background BC-SB-01	BC-SB-02	BC-SB-03	On Site BC-SB-04	BC-SB-05	BC-SB-06	Upstream BC-SD-01	Point of Runoff Entry BC-SD-02	Downstream BC-SD-03	
ALUMINIUM	11,000	8500	3100	650	8600	12,000	3400	520	9000	9300
ARSENIC	3U	34	-	-	4.4	-	3U	-	-	21
BARIUM	6.1	320	8.8	2.2	12	49	32	-	22	220
BERYLLIUM	5U	3.6	-	-	-	-	5U	-	1.0	5.6
CALCIUM	93	3800	780	53	540	2600	1200	120	1900	6500
CHROMIUM	14	27	4.3	-	21	16	3.9	1.4	19	40
COBALT	1U	11	-	-	-	2.2	1.9	-	-	14
COPPER	1U	87	-	-	2.2	-	2.4	-	3.7	130
IRON	9900	17,000	480	400	13,000	5200	3400	1000	12,000	15,000
LEAD	7.1	47	-	-	-	-	7.1	-	-	62
MAGNESIUM	140	520	82	26	580	680	230	34	900	460
MANGANESE	3.2	49	4.3	3.6	30	29	58	7.6	38	44
NICKEL	2U	24	-	-	-	-	2.3	-	6.1	27
POTASSIUM	210	1100	-	-	640	440	200U	200	760	850
SELENIUM	4U	11	-	-	-	-	4U	-	-	14
SODIUM	100U	260	-	-	-	-	100U	-	-	770

- Material analyzed for but not detected above minimum quantitation limit
 U Material analyzed for but not detected The number given is the minimum quantitation limit.

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TABLE 3

PARAMETERS (mg/kg)	Subsurface Soil						Sediment			Waste (Fly Ash)
	Background		On Site				Upstream	Point of Runoff Entry	Downstream	
	BC-SB-01	BC-SB-02	BC-SB-03	BC-SB-04	BC-SB-05	BC-SB-06	BC-SD-01	BC-SD-02	BC-SD-03	BC-WS-01
TIN	2.5U	7	-	-	-	-	2.5U	-	-	6.0
VANADIUM	33	90	4.0	1.3	25	18	4.8	-	22	130
ZINC	1.2	65	-	-	9.2	8.0	19	1.9	16	53
CYANIDE	12U	0.19	-	-	-	-	-	-	-	0.31
STRONTIUM	2.3	280	6.0	-	8.1	25	9.7	1.2	27	450
TITANIUM	22	780	57	59	69	56	56	12	80	1000
YTRIIUM	1.5	21	4.5	-	4.6	13	4.1	-	11	27
MOLYBDENUM	1U	6.9	-	-	-	-	-	-	-	7.4

Material analyzed for but not detected above minimum quantitation limit
 U Material was analyzed for but not detected. The number given is the minimum quantitation limit.

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TABLE 4

PARAMETERS (ug/kg)	Subsurface Soil						Sediment			Waste (Fly Ash)
	Background	On Site					Upstream	Point of Runoff Entry	Downstream	
	BC-SB-01	BC-SB-02	BC-SB-03	BC-SB-04	BC-SB-05	BC-SB-06	BC-SD-01	BC-SD-02	BC-SD-03	
PURGEABLE COMPOUNDS										
ACETONE	370U	-	-	-	-	-	-	330J	-	-
TOLUENE	37U	45,000	20J	-	-	-	1600J	-	-	84,000
EXTRACTABLE COMPOUNDS										
BENZOFUORANTHENE (NOT B OR K)(1)			300JN							
DIMETHYLOCTAHYDROPHENANTHRENE CARBOXYLIC ACID(1)			200JN							
METHYL(METHYLETHYL)PHENANTHRENE(1)			600JN							
UNIDENTIFIED COMPOUNDS/MO. (1)			7000J/2				5000J/2			

- Material analyzed for but not detected above minimum quantitation limit
- J Estimated value
- N Presumptive evidence of presence of material
- U Material was analyzed for but not detected. The number given is the minimum quantitation limit.
- (1) Tentatively identified compound (TIC). This compound not on CLP Target Compound List (TCL) and is reported only as detected in individual samples; MQL not determined.

concentrations at least three times greater than the background concentration or the minimum quantitation limit (MQL) were arsenic, barium, copper, lead, manganese, nickel, and zinc. Sample BC-SB-05, collected from the northeastern boundary of the landfill, contained manganese and zinc at concentrations significantly elevated above background levels. Sample BC-SB-06, collected from the northernmost boundary of the landfill, in an area surrounded by standing water, contained barium, manganese, and zinc at concentrations significantly elevated above background levels.

As seen in Table 3, no inorganic chemicals of concern were found in significant concentrations in the point of runoff entry sediment sample (BC-SD-02). However, the downstream sediment sample from Cross Pond (BC-SD-03) contained chromium and iron at concentrations significantly greater than those in the upstream sediment sample (BC-SD-01).

Table 4 shows that no organic compounds were detected above the minimum quantitation limits in the background subsurface soil sample (BC-SB-01). Toluene was found at significantly high concentrations in the fly ash samples (45,000 ug/kg in BC-SB-02, 84,000 ug/kg in BC-WS-01). However, no other organic compounds were detected above the minimum quantitation limits in the fly ash samples. Onsite subsurface soil sample BC-SB-03, from the eastern boundary of the landfill, contained presumptive evidence of three extractable compounds and two unidentified extractable compounds at an estimated concentration of 7,000 ug/kg. The remaining onsite subsurface soil samples contained no organic compounds at concentrations above the minimum quantitation limits.

As seen in Table 4, the upstream sediment sample (BC-SD-01) contained toluene at an estimated concentration of 1,600 ug/kg, presumptive evidence of a petroleum product, and two unidentified extractable compounds at an estimated concentration of 5,000 ug/kg. No organic compounds were found at significant concentrations in the runoff point of entry or downstream sediment samples.

Table 5 shows that the preservative blank for the water samples contained low concentrations of metals. None of the metals found in the private well sample (BC-PW-01) used as a background water sample exceeded North Carolina's water quality standards for groundwater (Ref. 36). The concentration of barium in sample BC-MW-01, the southernmost monitoring well, was significantly greater than the background concentration, but it was not significantly elevated in the remaining onsite groundwater samples. Significantly elevated concentrations of manganese were found in monitoring wells on the eastern (BC-MW-03) and northwestern (BC-MW-04, BC-MW-05) areas of the landfill. Concentrations of manganese in BC-MW-04 (110 ug/l) and BC-MW-05 (71 ug/l) exceeded the North Carolina groundwater standard of 50 ug/l (Ref. 36). The concentration of iron was much greater than the background concentration in all onsite groundwater samples except BC-MW-01.

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TABLE 5

PARAMETERS (ug/l)	Preservative	Groundwater							Surface Water		
	Blank	Background	On Site					Upstream	Point of Runoff Entry	Downstream	
	BC-P8-01	BC-PW-01	BC-MW-01	BC-MW-02	BC-MW-03	BC-MW-04	BC-MW-05	BC-SW-01	BC-SW-02	BC-SW-03	
ALUMINUM	45	27	720	250	480	790	420	1100	910	810	
BARIUM	37	8.8	54	13	21	18	19	32	32	28	
CADMIUM	-	1.2U	-	-	-	-	18	-	-	-	
CALCIUM	3700	4800	17,000	58,000	54,000	71,000	18,000	5200	26,000	6400	
COPPER	-	350	-	-	-	-	-	-	-	-	
IRON	-	140	160	3400	600	2100	2100	890	1700	760	
MAGNESIUM	1300	950	3400	560	500	1200	770	1800	2600	1800	
MANGANESE	-	4.1	11	-	26	110	71	50	84	44	
POTASSIUM	-	3400	-	-	-	-	-	-	4400	-	
SODIUM	280	42,000	6900	5700	3000	5600	3800	4000	7900	4300	
ZINC	-	28	19	31	23	30	38	14	-	16	
STRONTIUM	49	30	59	330	280	400	110	27	150	31	
TITANIUM	-	2.5U	-	11	21	27	48	13	14	10	

Material analyzed for but not detected above minimum quantitation limit

Iron ranged from 600 to 3,400 ug/l in these samples, exceeding the North Carolina groundwater standard of 300 ug/l for iron (Ref. 36).

Table 5 shows that no inorganic chemicals of concern were found in the point of entry runoff or downstream surface water samples at concentrations significantly greater than those in the upstream surface water sample. However, the concentration of iron in the midstream surface water sample (1,700 ug/l) exceeded North Carolina's surface water quality standard of 1,000 ug/l (Ref. 37). The high concentrations of iron in onsite groundwater and midstream surface water are consistent with previous sampling results for the landfill (Refs. 13, 14, 15, 17).

Few organic compounds were found in the groundwater and surface water samples, as revealed in Table 6. The private well sample used as a background sample contained a low estimated concentration of toluene and presumptive evidence of isopropanol. However, a low estimated concentration of toluene was also found in the trip blank, possibly reflecting contamination of the samples during handling. Toluene was the only organic compound found in onsite groundwater samples (BC-MW-03, BC-MW-04) at concentrations significantly greater than the background concentration. Toluene was also found in the upstream surface water sample but was below the minimum quantitation limit in the point of entry runoff and downstream surface water samples. The occurrence of toluene in the onsite groundwater samples might be related to the high concentration of toluene found in the fly ash samples. However, the occurrence of toluene in the upstream surface water and sediment samples also suggests a possible upstream source of toluene.

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TABLE 6

PARAMETERS (ug/l)	Trip Blank	Groundwater					Surface Water			
	BC-TB-01	Background BC-PW-01	BC-MW-01	BC-MW-02	On Site BC-MW-03	BC-MW-04	BC-MW-05	Upstream BC-SW-01	Point of Runoff Entry BC-SW-02	Downstream BC-SW-03
PURGEABLE COMPOUNDS										
ACETONE		500J			120J					
METHYL ETHYL KETONE		500J								5.2J
1000L TOLUENE	1.5J	1.1J	2.1J		6.2	8.8	0.69J	8.9		
ISOPROPANOL		100JN	5JN	10JN	9JN	100JN	60JN	20JN	5JN	5JN
EXTRACTABLE COMPOUNDS										
OCTANOIC ACID(1)			1JN							
CAPROLACTAM(1)			1JN				5JN			
OCTADECANOIC ACID(1)										
DIOXOLANEMETHANOL(1)									2JN	
UNIDENTIFIED COMPOUNDS/NO (1)			100J/2	60J/2	80J/3	30J/2	100J/3			

- Material analyzed for but not detected above minimum quantitation limit
- J Estimated value
- N Presumptive evidence of presence of material
- U Material was analyzed for but not detected. The number given is the minimum quantitation limit.
- (1) Tentatively identified compound (TIC). This compound not on CLP Target Compound List (TCL) and is reported only as detected in individual samples; MQL not determined.

5.0 SUMMARY

The Bladen County Landfill accepted a variety of industrial wastes including 5 tons of sludge from a wastewater treatment pond. Fly ash has been disposed of in the Bladen County Landfill in large quantities since 1986. The precise amount of waste accepted is unknown. There are 6,494 residents within 4 miles of this facility who depend on groundwater for their source of potable water. This includes both those persons who are connected to a public water system, and those who utilize private wells.

The results of this investigation revealed the presence of toluene and various heavy metals in the subsurface soils, sediments, and groundwater. Toluene was detected in various sample media, and particularly high concentrations were found in samples from the fly ash piles.

Because an unknown amount of waste is buried in the landfill and a large number of groundwater targets exist, FIT 4 recommends that this facility be reevaluated under the revised HRS as a candidate for a Listing Site Inspection.

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