# *STATE OF NORTH CAROLINA*

***Department of Environmental Quality***
***Division of Waste Management***
***Superfund Section***

## *SITE INSPECTION (SI)*
## *REFERENCES*

***Alcoa Badin Works Landfill***
***NCD 003 162 542***
***Badin, Stanly County, NC***

***June 2016***

***Stuart F. Parker***
***Hydrogeologist***

Alcoa Badin Works Landfill
NC 003 162 542
Site Inspection
References
January 2016


1) US EPA 40 CFR Part 300, *Hazard Ranking System, Final Rule*, Federal Register Volume 55, No. 241 Part II, December 14, 1990. http://www.epa.gov/superfund/hrs-toolbox#HRS Rule

2) Superfund Chemical Data Matrix, Revised January 30, 2014. http://www.epa.gov/superfund/superfund-chemical-data-matrix-scdm

3) NUS Corporation, Tucker, Georgia: Preliminary Re-Assessment Report, Alcoa Badin Works, Badin, Stanly County, North Carolina, EPA ID No. NCD 003 162 542. TDD No. F4-8808-02 March 28, 1989, 1985.

4) NUS Corporation, Tucker, Georgia: Final Preliminary Assessment Report, Alcoa Badin Works, Badin, Stanly County, North Carolina, EPA ID No. NCD 003 162 542, Hwy 740, Badin, NC, 28809 October 30, 1985.

5) Parker, Stuart F., North Carolina Superfund Section, Latitude and Longitude Calculation Worksheet and Site Location map, August 11, 2015.

6) (A) National Oceanic and Atmospheric Administration, National Climatic Data Center: Climate Data Normals (Albemarle, NC), https://www.ncdc.noaa.gov/cdo-web/datatools/normals

   (B) US Department of Commerce, *Climatic Atlas of the United States*, Climatic Data Center, Asheville, NC, 1979.

7) Alcoa Power Generating, Inc., Yadkin Division, Badin Works, 2015: https://www.alcoa.com/yadkin/en/info_page/about_badin.asp

8) US Environmental Protection Agency (EPA), Office of Solid Waste: "Proposed Best Demonstrated Available Technology (BDAT) Background Document for Spent Aluminum Potliners – K088", May 31, 2000. http://www3.epa.gov/epawaste/hazard/tsd/ldr/k088/k088back.pdf

9) Parker, Stuart F., Hydrogeologist II, NCDENR, Superfund Section: Field Notes for Reconnaissance at Alcoa Badin Works, April 7-9, 2015.

10) MFG Inc., Pittsburg Pennsylvania: "RCRA Facility Investigation, Volume I of II, Alcoa Badin Works, Badin, North Carolina, March 2001. [Excerpts]

11) McConney, John, NC DEHNR, Superfund Section: Screening Site Investigation Report, Alcoa Badin Landfill, NCD 986 171 320, Badin, Stanly County, NC, March 1991.

12) IT Corporation, Monroeville, Pennsylvania: "Technical Specifications and Drawings, Low Flow Seep Collection System, Alcoa Badin Landfill Ceat #2, IT Project No. 802173-001, February 17, 2000.

13) Parker, Stuart F., Hydrogeologist II, NCDENR, Superfund Section: Field Notes for Sampling at Alcoa Badin Landfill, July 21, 2015.

14) Morris, Robert, SISB, US EPA, Memorandum to File Re: Alcoa Badin Works, NC. July 18, 1989.

15) Environeering, Inc., Raleigh, NC: "Phase III – Engineering Data Collection for the Corrective Measures Study, Badin Works Facility, Badin, North Carolina", October 31, 2012. [Excerpts]

16) Matthews, Mary, Appalachian State University: "Little Mountain Creek ALCOA Leachate: Water Chemistry, Fish and Macroinvertebrate Assessment. Environmental Toxicology BIO3542-101/5542-101", in collaboration with: Will Scott, Yadkin Riverkeeper, Inc.; Dr. Shea Tuberty, Appalachian State University; Ryke Longest, Duke University Environmental Law Clinic; Brandon Tate, Appalachian State University; Macy Hinson. May 6, 2015.

17) Tuberty, Shea, PhD, Department of Biology, Appalachian State University: Electronic communication with Stuart Parker, NC DENR, with attached sample location map. May 5, 2015.

18) Longest, Ryke, Duke Environmental Law and Policy Clinic: Letter Report to Franklin Hill, Superfund Division Director, US EPA: Request for Preliminary Assessment for Areas Surrounding Alcoa Badin Works Facility in Badin, NC". October 17, 2014.

19) NC Division of Water Resources (DWR) January 2012: Sample Location Map and Results Summary, Alcoa Badin Landfill, April 24 and May 17, 2015.

20) Environeering, Inc., Houston, Texas: "Sampling Plan for the Alcoa Badin Landfill and Former Ball Field, Former Badin Works Facility, Badin, North Carolina", February 23, 2015 (Revised June 5, 2015). [Excerpts]

21) Environeering, Inc., Morrisville, NC: "Alcoa Badin Landfill and Former Ball Field, Sampling Activities, Former Badin Works Facility, Badin, North Carolina", September 15, 2015. [Excerpts]

22) Heath, Ralph, *Basic Elements of Groundwater Hydrology with Reference to Conditions in North Carolina*, Parts I-II, US Geological Survey Water Resources Investigations Open-File Report 80-44, 1980.

23) Goldsmith, Richard, Milton, Daniel J., Horton, J. Wright: "Geologic map of the Charlotte 1° and 2° Quadrangles, North and South Carolina, 1:250,000", Miscellaneous Investigations Series, US Geological Survey. 1988.

24) US Department of Agriculture, Soil Conservation Service: "Soil Survey of Stanly County, North Carolina". September, 1989.

25) NC Division of Water Resources (DWR): Local Water Supply Planning. http://www.ncwater.org/Water_Supply_Planning/Local_Water_Supply_Plan/report.php?pwsid=01-84-010&year=2014

26) Parker, Stuart F., Hydrogeologist II, NCDENR, Superfund Section, Memorandum to File: GIS-based Estimate of Groundwater-using Populations. September 18, 2015

27) US Fish and Wildlife Service, National Wetlands Inventory On-line Mapper: http://wetlandsfws.er.usgs.gov/.

28) Parker, Stuart F, NC Hydrogeologist II, NCDENR,Superfund Section, Memorandum to File: Alcoa Badin Landfill Surface Water Pathway and Wetland Definition, August 13, 2015.

29) US Geological Survey: "Drainage Areas of Selected Sites on Streams in North Carolina" Open File 83-211. 1983

30) US Geological Survey: "Map of Mean Annual Runoff for the Northeastern, Southeastern and Mid-Atlantic United States" Water Resources Investigations Report 88-4094. 1990

31) Stanly County, NC, Geographic Inquiry System (GIS): http://www.stanlygis.net

32) Morrow Mountain State Park, NC, Trail Map, March 2015: http://www.ncparks.gov/sites/default/files/ncparks/maps-and-brochures//morrow-mountain-parkmap_0.pdf

33) Kingfisher Maps, Inc. "High Rock, Tuckertown, Badin & Tillery Lakes, Map # 1200 and 1201, Copyright A270612001201. Undated.

34) NC Department of Health and Human Services (DHHS), NC Public Epidemiology, Current Fish Consumption Advisories: http://epi.publichealth.nc.gov/occ/fish/advisories.html

35) State of NC Department of Environmental Quality: Permit to Discharge Wastewater and Stormwater Under the National Pollution Discharge Elimination System. Alcoa Badin Works, Permit NC0004308 (Draft)

# REFERENCE 1

**ENVIRONMENTAL PROTECTION AGENCY**

**40 CFR Part 300**

**[FRL-3730-6]**

**RIN 2050 AB73**

## Hazard Ranking System

**AGENCY:** Environmental Protection Agency.

**ACTION:** Final rule.

**SUMMARY:** The Environmental Protection Agency (EPA) is adopting revisions to the Hazard Ranking System (HRS), the principal mechanism for placing sites on the National Priorities List (NPL). The revisions change the way EPA evaluates potential threats to human health and the environment from hazardous waste sites and make the HRS more accurate in assessing relative potential risk. These revisions comply with other statutory requirements in the Superfund Amendments and Reauthorization Act of 1986 (SARA).

**DATES:** Effective date March 14, 1991. As discussed in Section III H of this preamble, comments are invited on the addition of specific benchmarks in the air and soil exposure pathways until January 14, 1991.

**ADDRESSES:** Documents related to this rulemaking are available at and comments on the specific benchmarks in the air and soil exposure pathways may be mailed to the CERCLA Docket Office, OS-245, U.S. Environmental Protection Agency, Waterside Mall, 401 M Street, SW, Washington, DC 20460, phone 202-382-3046. Please send four copies of comments. The docket is available for viewing by appointment only from 9:00 am to 4:00 pm, Monday through Friday, excluding Federal holidays. The docket number is 105NCP-HRS.

**FOR FURTHER INFORMATION CONTACT:** Steve Caldwell or Agnes Ortiz, Hazardous Site Evaluation Division, Office of Emergency and Remedial Response, OS-230, U.S. Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460, or the Superfund Hotline at 800-424-9346 (in the Washington, DC area, 202-382-3000).

**SUPPLEMENTARY INFORMATION:**

**Table of Contents**



## I. Background

In 1980, Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. 9601 *et seq.*), commonly called the Superfund, in response to the dangers posed by uncontrolled releases of hazardous substances, contaminants, and pollutants. To implement section 105(8)(A) of CERCLA and Executive Order 12316 (46 FR 42237, August 20, 1981), the U.S. Environmental Protection Agency (EPA) revised the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR part 300, on July 16, 1982 (47 FR 31180), with later revisions on September 16, 1985 (50 FR 37624), November 20, 1985 (50 FR 47912), and March 8, 1990 (55 FR 8666). The NCP sets forth guidelines and procedures for responding to releases or potential release of hazardous substances, pollutants, or contaminants.

Section 105(8)(A) of CERCLA (now section 105(a)(8)(A)) requires EPA to establish:

> Criteria for determining priorities among releases or threatened releases [of hazardous substances] throughout the United States for the purpose of taking remedial action and, to the extent practicable taking into account the potential urgency of such action, for the purpose of taking removal action. Criteria and priorities * * * shall be based upon the relative risk or danger to public health or welfare or the environment * * * taking into account to the extent possible the population at risk, the hazard potential of the hazardous substances at such facilities, the potential for contamination of drinking water supplies, the potential for direct human contact, [and] the potential for destruction of sensitive ecosystems * * *.

To meet this requirement and help set priorities, EPA adopted the Hazard Ranking System (HRS) as appendix A to the NCP (47 FR 31180, July 16, 1982). The HRS is a scoring system used to assess the relative threat associated with actual or potential releases of hazardous substances at sites. The HRS is the primary way of determining whether a site is to be included on the National Priorities List (NPL), the Agency's list of sites that are priorities for long-term evaluation and remedial response, and is a crucial part of the Agency's program to address the identification of actual and potential releases. (Each State can nominate one site to the NPL as a State top priority regardless of its HRS score; sites may also be added in response to a health advisory from the Agency for Toxic Substances and Disease Registry (see NCP, 40 CFR 300.425(c)(3)).) Under the original HRS, a score was determined for a site by evaluating three migration pathways—ground water, surface water, and air. Direct contact and fire and explosion threats were also evaluated to determine the need for emergency actions, but did not enter into the decision on whether to place a site on the NPL.

In 1986, Congress enacted the Superfund Amendments and Reauthorization Act of 1986 (SARA) (Pub. L. 99-499), which added section 105(c)(1) to CERCLA, requiring EPA to amend the HRS to assure "to the maximum extent feasible, that the hazard ranking system accurately assesses the relative degree of risk to human health and the environment posed by sites and facilities subject to review." Congress, in its Conference Report on SARA, stated the substantive standard against which HRS revisions could be assessed:

> This standard is to be applied within the context of the purpose for the National Priorities List; i.e., identifying for the States and the public those facilities and sites which appear to warrant remedial actions. * * * This standard does not, however, require the Hazard Ranking System to be equivalent to detailed risk assessments, quantitative or qualitative, such as might be performed as part of remedial actions. The standard requires the Hazard Ranking System to rank sites as accurately as the Agency believes is feasible using information from preliminary assessments and site inspections * * * Meeting this standard does not require long-term monitoring or an accurate determination of the full nature and extent of contamination at sites or the projected levels of exposure such as might be done during remedial investigations and feasibility studies. This provision is intended to ensure that the Hazard Ranking System performs with a degree of accuracy appropriate to its role in expeditiously identifying candidates for response actions. [H.R. Rep. No. 962, 99th Cong., 2nd Sess. at 199-200 (1986)]

Section 105(c)(2) further specifies that the HRS appropriately assess the human health risks associated with actual or potential contamination of surface waters used for recreation or drinking

**REFERENCE 2**

Menu

EPA United States Environmental Protection Agency

# Superfund

## Superfund Chemical Data Matrix (SCDM)

SCDM is a source for factor values and screening concentration benchmarks that can be applied when evaluating potential National Priorities List (NPL) sites using the Hazard Ranking System (HRS). Factor values are part of the HRS equation for determining the relative threat posed by a hazardous waste site and reflect hazardous substance characteristics, such as toxicity and persistence in the environment, mobility and the potential for bioaccumulation. Screening concentration benchmarks are environment- or health-based concentration limits, including some developed by or used in other EPA regulatory programs. SCDM contains HRS factor values and screening concentration benchmarks for hazardous substances that are frequently found at sites evaluated using the HRS, as well as physical, chemical and radiological data used to calculate those values. The accompanying SCDM Methodology describes how data are selected or calculated for inclusion in SCDM.

On January 30, 2014, EPA released an updated SCDM with many revisions to the HRS factor values and benchmarks. The revisions were based on a comprehensive review and update of all the information contained in SCDM. These revisions were necessary because of updates to some of the toxicity data, as well as updates to several of the equations used to determine screening concentration benchmarks. This update also provided increased consistency across EPA programs. Following the January 2014 publication, revisions were made to SCDM on an as-needed basis to reflect changes within the cited references. A Change Control and Errata Sheet (PDF) (7pp, 118K, About PDF) is provided to document and track any changes or corrections that have been made since the January 2014 publication; these changes are reflected in the SCDM Query and reports below.

**Disclaimer**

**SCDM should be used for HRS and NPL purposes only.**

SCDM contains factor values and benchmarks used for applying the HRS [40 CFR Part 300 Appendix A, 55 FR 51583] to evaluate potential NPL sites. The physical, chemical, toxicological and radiological data used to calculate the factor values and benchmarks are obtained from references listed in the SCDM Methodology. The references and the data extracted from these references were selected to meet specific HRS requirements and conditions which may not be applicable or representative for other uses. SCDM values are updated only on an "as needed" basis. As a screening tool, the HRS and SCDM are used for quickly assessing sites at the screening stage and data used to perform this task may not be applicable for other site specific purposes.

# Superfund Chemical Data Matrix Query and Methodology

The SCDM Query allows you to access the SCDM information and generate a list of the corresponding HRS factor values, benchmarks, and data elements.

- SCDM Query (The SCDM Query Web page requires JavaScript.)
- SCDM Methodology Report (PDF) (63 pp, 610 K, About PDF)
- Appendix A - Hazardous Substance Synonyms Report (PDF) (88 pp, 1 MB, About PDF)

NOTE: Please do not assume that substances not listed in SCDM cannot be used for HRS scoring. If you have technical questions about SCDM, or if values are needed for a substance that is not listed in SCDM and are thought to be critical to the listing decision, please use the SCDM contact listed below.

**For SCDM information, contact:**
Linda Gaines, Ph.D., P.E. (gaines.linda@epa.gov)
US Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460
Phone: (703) 603-7189

Last updated on December 23, 2015

**REFERENCE 3**

North Carolina Department of Human Resources
**Division of Health Services**
**P.O. Box 2091 • Raleigh, North Carolina 27602-2091**

James G. Martin, Governor
Phillip J. Kirk, Jr., Secretary

Ronald H. Levine, M.D., M.P.H.
State Health Director

30 October 1985

Ms. Denise Bland
EPA NC CERCLA Project Officer
Air and Hazardous Material Division
345 Courtland Street, N.E.
Atlanta, GA 30365

SUBJECT: Final Preliminary Assessment Report
Alcoa Badin Works NC D003162542
Hwy. 740
Badin, NC 28009

Dear Ms. Bland:

Enclosed please find the Preliminary Assessment report for the subject site. This priority is based on review of available data and communications with those most knowledgeable about the site. We have concluded that:

Alcoa Badin Works has operated at this location since 1916 as a manufacturer of carbon anodes and cathodes, and as a smelter of aluminum. Alcoa's principal waste type is spent potlining from primary aluminum production, which they presently generate at a rate of 100 tons/month. This waste type, K088, contains cyanide; it was suspended from the RCRA list of hazardous wastes in January 1981.

Unknown quantities of K088 were landfilled on-site during the plant's earlier years in a 300' x 400' landfill. Presently this material is manifested to a hazardous waste landfill in South Carolina. According to Conrad Carter, Alcoa's environmental manager, Alcoa Badin Works has attempted to determine other K088 disposal locations used since 1916.

Another potential source of contamination at the facility is a clay-lined, aerated lagoon. This lagoon serves as part of the plant's NPDES permitted WWTP.

There are no monitoring wells at Alcoa, though Carter claims the company is planning to install some in the future. They are needed around the lagoons and landfill. An old drinking well, no longer in operation, exists 150' from the landfill; this is not monitored by Alcoa.

Local residents are served by city water; it is therefore believed that any groundwater contamination which may have occurred due to leaching from land units would not pose a health threat. Priority assigned is Low.

References used in completing this Preliminary Assessment are as follows:

1. Files at NC Solid and Hazardous Waste Management Branch, Raleigh, NC.
2. Conrad Carter, env. manager at Alcoa Badin Works, personal communication, 10-1-85.
3. David Richardson at NRCD/DEM-Mooresville, NC, personal communication, 10-1-85.

On 29 October 1985, this Preliminary Assessment was reviewed by Jerry Rhodes, Assistant Branch Head, Solid and Hazardous Waste Management Branch, NC Department of Human Resources; by CERCLA Unit personnel; and by the following representatives from the North Carolina Department of Natural Resources and Community Development, Division of Environmental Management: Fay Sweat and Doug Dixon, Groundwater Section; Glen Ross, Air Quality Section; and Howard Bryant, Water Quality Section.

If you have any questions, please call me at (919) 733-2178.

Sincerely,

D. Mark Durway

D. Mark Durway, Geologist
Solid and Hazardous Waste Management Branch
Environmental Health Section

DMD/tb/0175b

**EPA**

# POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT
## PART 1 - SITE INFORMATION AND ASSESSMENT

**I. IDENTIFICATION**

| 01 STATE | 02 SITE NUMBER |
|---|---|
| NC | D003162542 |

**II. SITE NAME AND LOCATION**

- 01 SITE NAME *(Legal, common, or descriptive name of site)*: Alcoa Badin Works
- 02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER: Hwy. 740
- 03 CITY: Badin
- 04 STATE: NC
- 05 ZIP CODE: 28009
- 06 COUNTY: Stanly
- 07 COUNTY CODE: 84
- 08 CONG DIST: 8
- 09 COORDINATES: LATITUDE 35° 24' 40" LONGITUDE 80° 07' 05"
- 10 DIRECTIONS TO SITE *(Starting from nearest public road)*: Facility located approx. 5 miles NE of Albemarle on NC Hwy. 740.

**III. RESPONSIBLE PARTIES**

- 01 OWNER *(if known)*: Aluminum Company of America
- 02 STREET *(Business, mailing, residential)*: 1501 Alcoa Bldg.
- 03 CITY: Pittsburgh
- 04 STATE: PA
- 05 ZIP CODE: 15219
- 06 TELEPHONE NUMBER: (412) 553-4545
- 07 OPERATOR *(If known and different from owner)*: Alcoa Badin Works
- 08 STREET *(Business, mailing, residential)*: P.O. Box 576
- 09 CITY: Badin
- 10 STATE: NC
- 11 ZIP CODE: 28009
- 12 TELEPHONE NUMBER: (704) 422-3621
- 13 TYPE OF OWNERSHIP *(Check one)*: ☒ A. PRIVATE ☐ B. FEDERAL: ______ *(Agency name)* ☐ C. STATE ☐ D. COUNTY ☐ E. MUNICIPAL ☐ F. OTHER: ______ *(Specify)* ☐ G. UNKNOWN
- 14 OWNER/OPERATOR NOTIFICATION ON FILE *(Check all that apply)*: ☒ A. RCRA [redacted] Part A DATE RECEIVED: 11 / 17 / 80 (MONTH DAY YEAR) ☐ B. UNCONTROLLED WASTE SITE *(CERCLA 103 c)* DATE RECEIVED: __ / __ / __ (MONTH DAY YEAR) ☐ C. NONE

**IV. CHARACTERIZATION OF POTENTIAL HAZARD**

- 01 ON SITE INSPECTION: ☐ YES ☒ NO DATE __ / __ / __ (MONTH DAY YEAR)
  - BY *(Check all that apply)*: ☐ A. EPA ☐ B. EPA CONTRACTOR ☐ C. STATE ☐ D. OTHER CONTRACTOR ☐ E. LOCAL HEALTH OFFICIAL ☐ F. OTHER: ______ *(Specify)*
  - CONTRACTOR NAME(S): ______
- 02 SITE STATUS *(Check one)*: ☒ A. ACTIVE ☐ B. INACTIVE ☐ C. UNKNOWN
- 03 YEARS OF OPERATION: 1916 (BEGINNING YEAR) ______ (ENDING YEAR) ☐ UNKNOWN
- 04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED

Facility has operated since 1916. In about 1965, plant was rebuilt; resultant rubble and waste, including spent potlining, was landfilled on plant property in an area roughly 300' x 400'. Spent potlining (K088) was suspended from RCRA as a hazardous waste in January 1981. it contains cyanide.

- 05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION

Facility also has a clay-lined aerated lagoon, used in connection with their WW treatment system (NPDES permit # NC0004308). Potential groundwater contamination due to leaching at LDFL and lagoon; facility has no monitoring wells. One on-site well 150' from landfill (no longer used); it is never monitored. In general ALCOA runs a clean operation, according to David Richardson (NRCD-Mooresville).

385' deep drilled well "clean"

**V. PRIORITY ASSESSMENT**

- 01 PRIORITY FOR INSPECTION *(Check one. If high or medium is checked, complete Part 2 - Waste Information and Part 3 - Description of Hazardous Conditions and Incidents)*: ☐ A. HIGH *(Inspection required promptly)* ☐ B. MEDIUM *(Inspection required)* ☒ C. LOW *(Inspect on time available basis)* ☐ D. NONE *(No further action needed, complete current disposition form)*

**VI. INFORMATION AVAILABLE FROM**

- 01 CONTACT: Conrad A. Carter, Jr., envir. mgr.
- 02 OF *(Agency/Organization)*: Alcoa Badin Works
- 03 TELEPHONE NUMBER: (704) 422-5631
- 04 PERSON RESPONSIBLE FOR ASSESSMENT: Durway/Crosby
- 05 AGENCY: NC DHR/DHS
- 06 ORGANIZATION: SHW Mgmt. Br.
- 07 TELEPHONE NUMBER: (919) 733-2178
- 08 DATE: 10 / 01 / 85 (MONTH DAY YEAR)

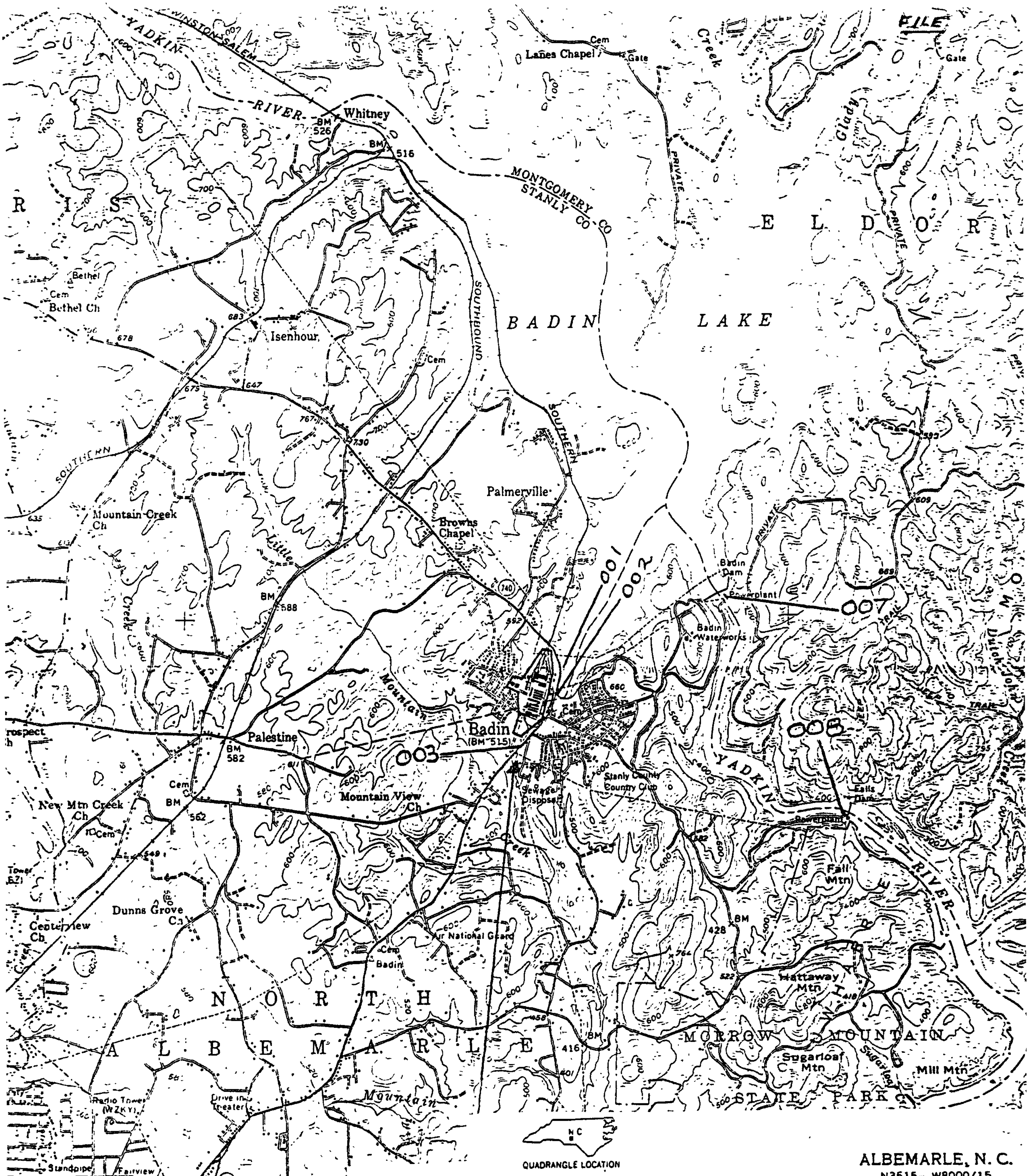
EPA FORM 2070-12 (7-81)

Local residents use city water supply. No known drinking wells near plant; no immediate health threats. Conrad Carter, envir. mgr. at ALCOA, claims that company is considering installing monitoring wells next year.

## NOTIFICATIONS

✱ 24 Hour Telephone Number

| Date | Agency | Telephone | Time | Contact |
|---|---|---|---|---|
| | Spill Response Center-DEM | (919) 733-5291 | | |
| | Water Supply-DHR | (919) 733-2321 | | |
| | Solid/Hazardous Waste-DHR | (919) 733-2178 | | |
| | Regional Office | | | |
| | Emergency Mngt.-CC&PS | (919) 733-3867 | | |
| | Pesticides-DOA | (919) 733-3556 | | |
| | Inland Fisheries-WRC | (919) 733-3633 | | |
| | Wildlife Resources Commission | (800) 662-7137 ✱ | | |
| | Marine Fisheries | (919) 726-7021 | | |
| | Radiation Protection-DHR | (919) 733-4283 | | |
| | EPA-Atlanta | (404) 881-4062 ✱ | | |
| | Coast Guard-Wilmington | (919) 343-4567 | | |
| | Coast Guard-Hampton Roads | (804) 441-3307 | | |
| | National Response Center | (800) 424-8802 ✱ | | |
| | (your supervisor) | | | |
| | (PIO) | | | |
| | (shipper) | | | |
| | (carrier) | | | |
| | | | | |
| | | | | |
| | | | | |
| | CHEMTREC (Chemical Spills Only) | (800) 424-9300 ✱ | | |
| | N.C. Poison Center | (919) 684-8111 ✱ | | |
| | Explosives problems-SBI | (919) 779-1400 ✱ | | |
| | State Warning Point-SHP (emergencies only) | (919) 733-3861 ✱ (800) 662-7956 ✱ | | |
| | EPA-PCB problems | (919) 541-4573 | | |




ALBEMARLE, N. C.
N3515—W8000/15

1957

AMS 4954 I—SERIES V742

NOTE:

Aluminum Company of America Smelting
Facility boundary outlined with solid line.
NPDES NC0004308 Outfalls 001, 002, 003, 006
007, 008 indicated by number

Incident # ________
County: ________

# POLLUT . INCIDENT REPORTING FORM

## EMERGENCY INCIDENT RESPONSIBILITIES

RESPONSIBILITY: ________ Local ________ State ________ Federal ________ Responsible party

ON-SCENE COORDINATOR: ________________________ name ________ phone number

________________________ agency/EOC location ________ EOC phone

________________________ EOC contacts

Assumed, date: ________ time: ________ Relinquished, date: ________ time: ________

On-site representatives: ________________________

________________________

TECHIICAL COORDINATOR: ________________________ name ________ phone number

________________________ agency/EOC location ________ EOC phone

________________________ EOC contacts

Assumed, date: ________ time: ________ Relinquished, date: ________ time: ________

On-site representatives: ________________________

________________________

RESOURCE TRUSTEE: ________________________ name ________ phone number

________________________ agency/EOC location ________ EOC phone

________________________ EOC contacts

Assumed, date: ________ time: ________ Relinquished, date: ________ time: ________

On-site representatives: ________________________

________________________

PIO: ________ name ________ agency ________ phone number

Assumed,date: ________ time: ________ Relinquished, date: ________ time: ________

# POLLUTION INCIDENT RE[illegible]RTING FORM

Incident # ________

County: ________

## SOIL TYPES

**COASTAL PLAIN REGION**

1. Middle Coastal Plain
2. Upper Coastal Plain/Piedmont
3. Sandhills
4. Lower Coastal/Wicomico, Talbot
5. Lower Coastal Plain/Pamlico
6. Organic Soil
7. Brackish and Freshwater Marsh
8. Outer Banks
9. Large River Valleys/Flood Plain

**PIEDMONT SOIL REGION**

10. Felsic Crystalline
11. Carolina Slate Belt
12. Triassic Basin
13. Mixed Felsic and Mafic

**MOUNTAIN SOIL REGION**

14. Low and Intermediate Mountain
15. Basins/Terraces/Flood Plain
16. High Mountain

**LANDFORM**

1. River/coastal terrace
2. Coastal (flat) plain
3. Mountain range
4. Sandhills
5. Swamp
6. Linear (valley) slope
7. Head slope (concave)
8. Nose slope (convex)
9. Foot slope
10. Barrier island
11. Barrier system
12. Beach ridge
13. Tidal marsh
14. Floodplain
15. Upland: 0-5% slope (interstream divide)

**OBSERVED AVERAGE GRADIENTS**

To nearest water supply: ________ %

Water table gradient: ________ %

To nearest stream: ________ %

Stream gradient: ________ %

**ESTIMATED DEPTHS**

To uppermost confining bed: ______ ft.

To water table: ______ ft.

To bedrock: ______ ft.

**ESTIMATE HYDRAULIC CONDUCTIVITIES**

| Soil | Unsaturated zone | Water Table | Upper confined aquifer |
|---|---|---|---|
| 1. high | 1. high | 1. high | 1. high |
| 2. medium | 2. medium | 2. medium | 2. medium |
| 3. low | 3. low | 3. low | 3. low |
| 4. unknown | 4. unknown | 4. unknown | 4. unknown |

**AQUIFER USE**

1. Little or no use
2. Moderate uses
3. Heavily used

DISTANCE TO NEAREST WATER SUPPLY: ________ ft.

DISTANCE TO NEAREST BUILDING: ________ ft.

Describe general lithology of soil and unsaturated zone

________________________________________

________________________________________

________________________________________

________________________________________

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________________________________________

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________________________________________

________________________________________

Provide map showing: 1. Pollutant source 2. Threatened water supplies 3. Direction of overland flow

| Incident # |
|---|
| County |

# POLLU..ON INCIDENT REPORTING FC..M

## LOCATION OF INCIDENT

| Street Address, Road | | City/Town | County |
|---|---|---|---|
| Hwy 740 | | Badin | Stanly |

| Date Incident Occurred | Time Incident Occurred | 7 1/2 Quad Name | Lat. : Deg: Min: Sec: |
|---|---|---|---|
| | | | Long. : Deg: Min: Sec: |

Draw Sketch of Area

ATTACH PHOTOCOPY OF MAP SHOWING: 1. Pollutant Source 2. Threatened Water Supplies 3. Direction of Overland Flow

Incident #: ______
County: ______

# PO TION INCIDENT REPORTING F M

## RESPONSIBLE PARTY

**I**

| | | | |
|---|---|---|---|
| Responsible Party/Names | | | Telephone |
| Company | | Street Address | |
| City | County | State | Zip Code |

| SOURCE IN USE | SOURCE OF SIA LIST | PERMIT TYPE | OWNERSHIP | OPERATION TYPE |
|---|---|---|---|---|
| 0. N/A | 0. N/A | 0. N/A | 0. N/A | 0. N/A |
| 1. Yes | 1. Yes #: ______ | 1. Nondischarge | 1. Municipal | 1. Public Service |
| 2. No | 2. No | 2. Oil terminal | 2. Military | 2. Agricultural |
| **SOURCE PERMITTED** | **SOURCE ON ERRIS LIST** | 3. Landfill | 3. Unknown | 3. Other Source |
| 1. Yes | 1. Yes | 4. Mining | 4. Private | 4. Educational |
| 2. No | 2. No | 5. NPDES | 5. Federal | 5. Industrial |
| | | 6. RCRA | 6. County | 6. Commercial |
| Permit Number | ERRIS Number | 7. Air | 7. State | 7. Mining |

## INITIAL SITUATION

**J**

| REASON FOR INCIDENT | |
|---|---|
| 1. Transportation accident | Describe Any Injuries |
| 2. Mechanical failure | |
| 3. Facility design | People/Agencies On-site |
| 4. Invenotry only | |
| 5. Human error | People/Agencies Enroute |
| 6. Vandalism | |
| 7. Unknown | ETA |

Detailed Explanation of Incident

Containment Cleanup/Actions Taken

| Direction Wind From | Wind Speed | Air Temperature | Precipitation | Weather/Precipitation |
|---|---|---|---|---|
| Nearest Populated Buildings--Type | | | Distance to Buildings | |

Incident # ______
County: ______

# POLLU[illegible]ON INCIDENT REPORTING F[illegible]M

## POLLUTANTS INVOLVED

**E**

| MATERIALS INVOLVED | AMOUNT STORED | AMOUNT LOST | AMOUNT RECOVERED |
|---|---|---|---|
| Spent potlining - | ? | | |
| contains cyanide | | | |
| | | | |

REPORTABLE QUANTITY: 1. Yes 2. No 3. Unknown

Amount Infiltrating Land

## IMPACT ON SURFACE WATERS

**F**

| | | |
|---|---|---|
| WATERS EFFECTED 1. Yes 2. No No 3. Potentially | Distance to Stream (ft) | Amount in Water (gal) |
| FISH KILL: 1. Yes 2. No | Name of Stream | Stream Class |

## RISK ASSESSMENT

**G**

Use these codes: High= 3 Low=1 Default=2 None=0 Unknown=?

HUMAN HEALTH: ___ Inhalation (breathing) ___ Absorption (touching) ___ Ingestion (eating)

COMMUNITY: 3 Population density 0 Drinking water ___ Property

ENVIRONMENT: ___ Sensitive areas ___ Wildlife ___ Fish

| RESOURCE THREAT | GROUNDWATER | SURFACE WATER | AIR |
|---|---|---|---|
| Probability of violations | 2 | | |
| Overall regional concern | 1 | | |
| Remedial action priority | 1 | | |
| Extent of contamination | ? | | |
| Seriousness of threat | 1 | | |
| Need to designate RS | ? | | |

Sources of Information

## POTENTIAL SOURCE OF POLLUTION

**H**

| SOURCE OF POTENTIAL POLLUTION | | TYPE OF POLLUTANT | LOCATION | SETTING |
|---|---|---|---|---|
| 1. Intentional discharge | 9. Dredge spoil | 0. Pesticide/herbicide | (1.) Facility | 1. Residential |
| 2. Pit, pond, lagoon | 10. Septic tank | 1. Radioactive waste | 2. Railroad | (2) Industrial |
| 3. Leak--underground | 11. Sewer line | 2. Gasoline/diesel | 3. Waterway | 3. Urban |
| 4. Spray irrigation | 12. Stockpile | 3. Sewage/septage | 4. Pipeline | 4. Rural |
| 5. Land application | (13) Landfill | 4. Other chemical | 5. Dumpsite | |
| 6. Nonpoint source | 14. Bypass | 5. Other organic | 6. Highway | |
| 7. Animal feedlot | 15. Spill | 6. Fertilizers | 7. Other | |
| 8. Source unknown | 16. Well | (7.) Solid waste - leachate | | |
| MULTIPLE SOURCES AT SITE: 1. Yes 2. No | | 8. Other oil | POLLUTION CONFIRMED 1. Yes 2. No | |
| | | 9. Sludge | | |

# POLLUTION INCIDENT REPORTING FORM

1. Incident # 3118 Stanly Co
2. Tabulate only ______

Division of Environmental Management
GROUNDWATER SECTION

## TYPE OF ACTION

**A**

1. Emergency response
2. Remedial action
3. Compliance investigation
4. Complaint investigation
5. (circled) Routine inventory
6. Fish kill
7. Re-evaluation : # ______
8. Other : ______

POTENTIAL HAZARDS : 1. Toxic chemicals 2. Radioactivity 3. Air emissons 4. Explosives 5. Fire

## REGIONAL OFFICE CONTACT

**B**

| Incident Name: Alcoa Badin Works | | | | TYPE INCIDENT |
|---|---|---|---|---|
| Inhouse Contact for this Incident | | | Telephone | 3. Major |
| Department | Division | Section | Region | 2. Moderate<br>1. Minor |

## PERSON REPORTING INCIDENT

**C**

| Name | Date | Telephone | Time |
|---|---|---|---|
| Company/Agency | | City | County |

Briefly Describe Incident

In 1965 rubble, waste & spent potlining was landfilled on plant property (300' x 400') One on-site well located 150' from landfill has never been monitored.

REPORTED BY: 1. Responsible party 2. Government agency 3. Private party

## RECOMMENDED ACTION

**D**

1. Investigation complete
2. Continue investigation
3. Initiate/complete cleanup
4. Long-term remedial action
5. Technical support
6. Drill crew
7. Enforcement action
8. Monitoring plan

Comments

| LAB SAMPLES: 1. Yes 2. No | Signature | Date |
|---|---|---|

:KEX88/MP 06/04/86

COMPLIANCE EVALUATION ANALYSIS REPORT PAGE 1

PERMIT--NC0004308 PIPE--003 REPORT PERIOD: 8505-8604 LOC---E
'ACILITY--ALCOA-LK BADIN #1 DESIGN FLOW-- 5.1200 CLASS--2
.OCATION--BADIN REGION/COUNTY--03 STANLY

| | | 50050 | 00310 | 00530 | 00010 | 00400 | 00556 | 00951 |
|---|---|---|---|---|---|---|---|---|
| 1ONTH | | Q/MGD | BOD | RES/TSS | TEMP | PH | OIL-GRSE | FLUORIDE |
| .IMIT | F | .1810 F | 58.00 F | 1050.0 | NOL | 9.0 6.0 F | 15.090 F | 7.690 |
| 35/05 | | .2598F | | | 30.00 | 6.5-6.5 | | |
| .IMIT | | | | | | | | |
| 35/06 | | .0870 | 10.00 | 14.5 | 28.75 | 6.9-6.4 | 3.000 | 1.000 |
| 35/07 | | .1115 | 7.00 | 13.2 | 29.75 | 7.5-6.5 | 2.000 | 1.000 |
| 35/08 | | .0886 | 7.00 | 24.6 | 28.40 | 7.2-6.9 | 3.000 | 2.000 |
| 35/09 | | .0350 | 3.00 | 14.5 | 26.50 | 7.5-7.0 | 13.000 | 2.000 |
| 35/11 | | .1347 | 5.00 | 19.7 | 19.50 | 7.6-7.4 | 6.666 | 2.000 |
| .IMIT | | | | | | | | |
| 35/12 | | .0850 | 4.00 | 11.2 | 11.00 | 7.4-7.0 | | |
| '6/01 | | .0740 | 6.00 | 12.2 | 9.20 | 7.6-6.3 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| .IMIT | | | | | | | |
| 16/02 | .0502 | 14.00 | 31.7 | 12.00 | 7.4-6.9 | 25.333 | 1.000 |
| 16/03 | .0757 | 13.00 | 33.0 | 14.75 | 7.3-7.2 | 10.666 | 2.000 |
| 16/04 | .0795 | 11.00 | 27.2 | 18.75 | 7.6-7.0 | 7.500 | 2.000 |
| ıVERAGE | .0982 | 8.00 | 20.1 | 20.78 | ________ | 8.895 | 1.625 |
| ıAXIMUM | .3360 | 14.00 | 45.0 | 32.00 | 7.600 | 34.000 | 2.000 |
| ıINIMUM | .0110 | 3.00 | 6.0 | 7.00 | 6.300 | 1.000 | 1.000 |
| INIT | MGD | MG/L | MG/L | DEG.C | SU | MG/L | MG/L |



PERMIT--NC0004308 PIPE--001 REPORT PERIOD: 8505-8604 LOC---E

'ACILITY--ALCOA-LK BADIN #1 DESIGN FLOW-- 5.1200 CLASS--2

.OCATION--BADIN REGION/COUNTY--03 STANLY

| | | 50050 | 00010 | 00400 |
|---|---|---|---|---|
| IONTH | | Q/MGD | TEMP | PH |
| .IMIT | F | .5000 | NOL | 9.0 6.0 |
| 15/05 | | .0170 | 26.00 | 7.6-7.6 |
| 15/06 | | | | |
| 16/01 | | | | |
| 16/02 | | | | |
| ıVERAGE | | .0170 | 26.00 | ________ |
| ıAXIMUM | | .0270 | 26.00 | 7.600 |
| ıINIMUM | | .0070 | 26.00 | 7.600 |
| INIT | | MGD | DEG.C | SU |

;KEX88/MP 06/04/86

COMPLIANCE EVALUATION ANALYSIS REPORT PAGE 1

PERMIT--NC0004308 PIPE--002 REPORT PERIOD: 8505-8604 LOC---E
'ACILITY--ALCOA-LK BADIN #1 DESIGN FLOW-- 5.1200 CLASS--2
.OCATION--BADIN REGION/COUNTY--03 STANLY

| | | 50050 | 00010 | 00400 |
|---|---|---|---|---|
| 1ONTH | | Q/MGD | TEMP | PH |
| .IMIT | F | .5000 | NOL | 9.0 6.0 |
| 35/05 | | .0448 | 24.20 | 6.9-6.0 |
| 35/06 | | .0682 | 34.00 | 10.1-0.1F |
| 35/07 | | .0410 | 36.00 | 7.2-7.2 |
| 35/08 | | .0954 | 35.50 | 8.3-7.2 |
| 35/09 | | .1200 | 33.00 | 7.4-7.4 |
| 35/11 | | .1245 | 30.00 | 7.5-7.5 |
| 35/12 | | .0522 | 20.00 | 7.8-7.8 |
| '6/01 | | .0246 | 21.00 | 6.6-6.6 |

| | | | |
|---|---|---|---|
| 86/02 | .0352 | 20.00 | 7.7-7.7 |
| 86/03 | .0310 | 22.00 | 7.8-7.8 |
| 86/04 | .0612 | 28.00 | 8.0-8.0 |
| AVERAGE | .0634 | 27.60 | ________ |
| MAXIMUM | .3020 | 36.00 | 10.100 |
| MINIMUM | .0040 | 20.00 | 6.000 |
| UNIT | MGD | DEG.C | SU |

GKEX88/MP 06/04/86

COMPLIANCE EVALUATION ANALYSIS REPORT PAGE 1

PERMIT--NC0004308 PIPE--004 REPORT PERIOD: 8505-8604 LOC---E
FACILITY--ALCOA-LK BADIN #1 DESIGN FLOW-- 5.1200 CLASS--2
LOCATION--BADIN REGION/COUNTY--03 STANLY

| | | 50050 | 00010 | 00400 |
|---|---|---|---|---|
| MONTH | | Q/MGD | TEMP | PH |
| LIMIT | F | .5000 | NOL | 9.0 6.0 |
| 85/05 | | .0740 | 20.00 | 6.5-6.5 |
| 85/06 | | .2417 | 35.00 | 7.6-7.6 |
| 85/07 | | .2240 | 39.00 | 7.3-7.3 |
| 85/08 | | .2620 | 37.00 | 7.4-7.4 |
| 85/09 | | .3910 | 35.00 | 7.6-7.6 |
| 85/11 | | .2707 | 27.00 | 8.4-8.4 |
| 85/12 | | .2907 | 19.00 | 7.5-7.5 |
| 86/01 | | .3634 | 16.00 | 7.4-7.4 |

| | | | |
|---|---|---|---|
| 36/02 | .3067 | 17.00 | 7.9-7.9 |
| 36/03 | .4070 | 19.00 | 7.0-7.0 |
| 36/04 | .3107 | 25.00 | 7.4-7.4 |
| AVERAGE | .2856 | 26.27 | ________ |
| MAXIMUM | .5050 | 39.00 | 8.400 |
| MINIMUM | .0530 | 16.00 | 6.500 |
| UNIT | MGD | DEG.C | SU |

GKEX88/MP 06/04/86

COMPLIANCE EVALUATION ANALYSIS REPORT PAGE 1

PERMIT--NC0004308 PIPE--005 REPORT PERIOD: 8505-8604 LOC---E
FACILITY--ALCOA-LK BADIN #1 DESIGN FLOW-- 5.1200 CLASS--2
LOCATION--BADIN REGION/COUNTY--03 STANLY

| | | 50050 | 00010 | 00400 |
|---|---|---|---|---|
| MONTH | | Q/MGD | TEMP | PH |
| LIMIT | F | .5000 | NOL | 9.0 6.0 |
| 85/05 | | .7340F | 27.00 | 7.0-7.0 |
| 85/06 | | .0977 | 28.00 | 7.2-7.2 |
| 85/07 | | .0970 | 31.00 | 7.2-7.2 |
| 85/08 | | .0952 | 31.00 | 7.4-7.4 |
| 85/09 | | .0942 | 29.00 | 7.3-7.3 |
| 85/11 | | .0855 | 22.00 | 8.0-8.0 |
| 85/12 | | .0757 | 15.00 | 7.8-7.8 |
| 86/01 | | .0326 | 14.00 | |

| | | | |
|---|---|---|---|
| 86/02 | .0372 | 13.00 | 8.0-8.0 |
| 86/03 | .1577 | 16.00 | 6.9-6.9 |
| 86/04 | .0560 | 21.00 | 7.6-7.6 |
| AVERAGE | .1420 | 22.45 | ________ |
| MAXIMUM | .7340 | 31.00 | 8.000 |
| MINIMUM | .0230 | 13.00 | 6.900 |
| UNIT | MGD | DEG.C | SU |

KEX88/MP 06/04/86

COMPLIANCE EVALUATION ANALYSIS REPORT PAGE 1

PERMIT--NC0004308 PIPE--006 REPORT PERIOD: 8505-8604 LOC---E
FACILITY--ALCOA-LK BADIN #1 DESIGN FLOW-- 5.1200 CLASS--2
LOCATION--BADIN REGION/COUNTY--03 STANLY

| | 50050 | 00010 |
|---|---|---|
| MONTH | Q/MGD | TEMP |
| LIMIT | F .5000 | NOL |
| 85/05 | 1.8000F | 25.00 |
| 85/06 | .7340F | 28.00 |
| 85/07 | .7340F | 32.00 |
| 85/08 | .7340F | 33.00 |
| 85/09 | .7340F | 31.00 |
| 85/11 | .7340F | 22.00 |
| 85/12 | .7340F | 14.00 |
| 86/01 | .7340F | 10.00 |

| | | |
|---|---|---|
| 36/02 | .7340F | 10.00 |
| 36/03 | .7340F | 13.00 |
| 36/04 | .7340F | 18.00 |
| AVERAGE | .8309 | 21.45 |
| MAXIMUM | 1.8000 | 33.00 |
| MINIMUM | .7340 | 10.00 |
| UNIT | MGD | DEG.C |



PERMIT--NC0004308 PIPE--007 REPORT PERIOD: 8505-8604 LOC---E
FACILITY--ALCOA-LK BADIN #1 DESIGN FLOW-- 5.1200 CLASS--2
LOCATION--BADIN REGION/COUNTY--03 STANLY

| | 50050 | 00010 |
|---|---|---|
| MONTH | Q/MGD | TEMP |
| LIMIT F | .5000 | NOL |
| 85/05 | .7990F | 18.00 |
| 85/06 | 1.8000F | 29.00 |
| 85/07 | 1.8000F | 32.00 |
| 85/08 | 1.8000F | 34.00 |
| 85/09 | 1.8000F | 33.00 |
| 85/11 | 1.8000F | 20.00 |
| 85/12 | 1.8000F | 14.00 |
| 86/01 | 1.8000F | 7.00 |

| | | |
|---|---|---|
| ;6/02 | 1.8000F | 7.00 |
| ;6/03 | 1.8000F | 10.00 |
| ;6/04 | 1.8000F | 17.00 |
| \VERAGE | 1.7090 | 20.09 |
| 1AXIMUM | 1.8000 | 34.00 |
| 1INIMUM | .7990 | 7.00 |
| JNIT | MGD | DEG.C |

;KEX88/MP 06/04/86

COMPLIANCE EVALUATION ANALYSIS REPORT PAGE . 1

PERMIT--NC0004308 PIPE--008 REPORT PERIOD: 8505-8604 LOC---E

'ACILITY--ALCOA-LK BADIN #1 DESIGN FLOW-- 5.1200 CLASS--2

.OCATION--BADIN REGION/COUNTY--03 STANLY

| | | 50050 | 00010 |
|---|---|---|---|
| 1ONTH | | Q/MGD | TEMP |
| .IMIT | F | .5000 | NOL |
| 15/05 | | .0772 | 23.00 |
| 15/06 | | .7990F | 22.00 |
| 15/07 | | .7990F | 24.00 |
| 15/08 | | .7990F | 27.00 |
| 15/09 | | .7990F | 23.00 |
| ;5/11 | | .7990F | 17.00 |
| ;5/12 | | .7990F | 12.00 |
| ;6/01 | | .7990F | 11.00 |

| | | |
|---|---|---|
| 36/02 | .7990F | 9.00 |
| 36/03 | .7990F | 14.00 |
| 36/04 | .7990F | 15.00 |
| VERAGE | .7333 | 17.90 |
| AXIMUM | .7990 | 27.00 |
| INIMUM | .0320 | 9.00 |
| NIT | MGD | DEG.C |

KEX88/MP 06/04/86

COMPLIANCE EVALUATION ANALYSIS REPORT PAGE 1

PERMIT--NC0004308 PIPE--009 REPORT PERIOD: 8505-8604 LOC---E
ACILITY--ALCOA-LK BADIN #1 DESIGN FLOW-- 5.1200 CLASS--2
OCATION--BADIN REGION/COUNTY--03 STANLY

| | | 50050 | 00010 | 00400 |
|---|---|---|---|---|
| ONTH | | Q/MGD | TEMP | PH |
| LIMIT | F | .5000 | NOL | 9.0 6.0 |
| 85/06 | | .1112 | 27.00 | 7.3-7.3 |
| 85/07 | | .0822 | 29.00 | 7.3-7.3 |
| 85/08 | | .0806 | 30.00 | 7.3-7.3 |
| 85/09 | | .0950 | 28.00 | 7.6-7.6 |
| 85/11 | | .0987 | 27.00 | 8.4-8.4 |
| 85/12 | | .0852 | 14.00 | 7.4-7.4 |
| 86/01 | | .0628 | 12.00 | 6.4-6.4 |
| 86/02 | | .0715 | 12.00 | 7.6-7.6 |
| 86/03 | | .0992 | 14.00 | 7.0-7.0 |
| 86/04 | | .0822 | 19.00 | 7.4-7.4 |
| VERAGE | | .0868 | 21.20 | ________ |
| AXIMUM | | .2560 | 30.00 | 8.400 |
| INIMUM | | .0230 | 12.00 | 6.400 |
| NIT | | MGD | DEG.C | SU |

**EPA**

# POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT
## PART 1 - SITE INFORMATION AND ASSESSMENT

| I. IDENTIFICATION | |
|---|---|
| 01 STATE | 02 SITE NUMBER |
| NC | D003162542 |

## II. SITE NAME AND LOCATION

| 01 SITE NAME (Legal, common, or descriptive name of site) | 02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER |
|---|---|
| Alcoa Badin Works | Hwy. 740 |

| 03 CITY | 04 STATE | 05 ZIP CODE | 06 COUNTY | 07 COUNTY CODE | 08 CONG DIST |
|---|---|---|---|---|---|
| Badin | NC | 28009 | Stanly | 84 | 8 |

| 09 COORDINATES LATITUDE | LONGITUDE |
|---|---|
| 35° 24' 40" | 80° 07' 05" |

10 DIRECTIONS TO SITE (Starting from nearest public road)

Facility located approx. 5 miles NE of Albemarle on NC Hwy. 740.

## III. RESPONSIBLE PARTIES

| 01 OWNER (if known) | 02 STREET (Business, mailing, residential) |
|---|---|
| Aluminum Company of America | 1501 Alcoa Bldg. |

| 03 CITY | 04 STATE | 05 ZIP CODE | 06 TELEPHONE NUMBER |
|---|---|---|---|
| Pittsburgh | PA | 15219 | (412) 553-4545 |

| 07 OPERATOR (if known and different from owner) | 08 STREET (Business, mailing, residential) |
|---|---|
| Alcoa Badin Works | P.O. Box 576 |

| 09 CITY | 10 STATE | 11 ZIP CODE | 12 TELEPHONE NUMBER |
|---|---|---|---|
| Badin | NC | 28009 | (704) 422-3621 |

13 TYPE OF OWNERSHIP (Check one)

☒ A. PRIVATE ☐ B. FEDERAL: ____ (Agency name) ☐ C. STATE ☐ D. COUNTY ☐ E. MUNICIPAL

☐ F. OTHER: ____ (Specify) ☐ G. UNKNOWN

14 OWNER/OPERATOR NOTIFICATION ON FILE (Check all that apply)

☒ A. RCRA [redacted] Part A DATE RECEIVED: 11/17/80 (MONTH DAY YEAR) ☐ B. UNCONTROLLED WASTE SITE (CERCLA 103 c) DATE RECEIVED: __/__/__ (MONTH DAY YEAR) ☐ C. NONE

## IV. CHARACTERIZATION OF POTENTIAL HAZARD

01 ON SITE INSPECTION

☐ YES DATE __/__/__ (MONTH DAY YEAR)
☒ NO

BY (Check all that apply) ☐ A. EPA ☐ B. EPA CONTRACTOR ☐ C. STATE ☐ D. OTHER CONTRACTOR ☐ E. LOCAL HEALTH OFFICIAL ☐ F. OTHER: ____ (Specify)

CONTRACTOR NAME(S): ____

02 SITE STATUS (Check one)

☒ A. ACTIVE ☐ B. INACTIVE ☐ C. UNKNOWN

03 YEARS OF OPERATION

1916 (BEGINNING YEAR) ____ (ENDING YEAR) ☐ UNKNOWN

04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED

Facility has operated since 1916. In about 1965, plant was rebuilt; resultant rubble and waste, including spent potlining, was landfilled on plant property in an area roughly 300' x 400'. Spent potlining (K088) was suspended from RCRA as a hazardous waste in January 1981; it contains cyanide.

05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION

Facility also has a clay-lined aerated lagoon, used in connection with their WW treatment system (NPDES permit # NC0004308). Potential groundwater contamination due to leaching at LDFL and lagoon; facility has no monitoring wells. One on-site well 150' from landfill (no longer used); it is never monitored. In general ALCOA runs a clean operation, according to David Richardson (NRCD-Mooresville).

## V. PRIORITY ASSESSMENT

01 PRIORITY FOR INSPECTION (Check one. If high or medium is checked, complete Part 2 - Waste Information and Part 3 - Description of Hazardous Conditions and Incidents)

☐ A. HIGH (Inspection required promptly) ☐ B. MEDIUM (Inspection required) ☒ C. LOW (Inspect on time available basis) ☐ D. NONE (No further action needed, complete current disposition form)

## VI. INFORMATION AVAILABLE FROM

| 01 CONTACT | 02 OF (Agency/Organization) | 03 TELEPHONE NUMBER |
|---|---|---|
| Conrad A. Carter, Jr., envir. mgr. | Alcoa Badin Works | (704) 422-5631 |

| 04 PERSON RESPONSIBLE FOR ASSESSMENT | 05 AGENCY | 06 ORGANIZATION | 07 TELEPHONE NUMBER | 08 DATE |
|---|---|---|---|---|
| Durway/Crosby | NC DHR/DHS | SHW Mgmt. Br. | (919) 733-2178 | 10/01/85 |

EPA FORM 2070-12 (7-81)

Local residents use city water supply. No known drinking wells near plant; no immediate health threats. Conrad Carter, envir. mgr. at ALCOA, claims that company is considering installing monitoring wells next year.

**EPA**

# POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT
## PART 2 - WASTE INFORMATION

**I. IDENTIFICATION**

| 01 STATE | 02 SITE NUMBER |
|---|---|
| NC | D003162542 |

## II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

**01 PHYSICAL STATES** *(Check all that apply)*

- [X] A. SOLID
- [ ] B. POWDER, FINES
- [ ] C. SLUDGE
- [ ] D. OTHER ______ *(Specify)*
- [ ] E. SLURRY
- [ ] F. LIQUID
- [ ] G. GAS

**02 WASTE QUANTITY AT SITE** *(Measures of waste quantities must be independent)*

TONS: Unknown

CUBIC YARDS: ______

NO. OF DRUMS: ______

**03 WASTE CHARACTERISTICS** *(Check all that apply)*

- [ ] A. TOXIC
- [ ] B. CORROSIVE
- [ ] C. RADIOACTIVE
- [ ] D. PERSISTENT
- [ ] E. SOLUBLE
- [ ] F. INFECTIOUS
- [ ] G. FLAMMABLE
- [ ] H. IGNITABLE
- [ ] I. HIGHLY VOLATILE
- [ ] J. EXPLOSIVE
- [ ] K. REACTIVE
- [ ] L. INCOMPATIBLE
- [ ] M. NOT APPLICABLE

Unknown

## III. WASTE TYPE

| CATEGORY | SUBSTANCE NAME | 01 GROSS AMOUNT | 02 UNIT OF MEASURE | 03 COMMENTS |
|---|---|---|---|---|
| SLU | SLUDGE | | | Generates 100 tons of K088/month |
| OLW | OILY WASTE | | | |
| SOL | SOLVENTS | | | |
| PSD | PESTICIDES | | | |
| OCC | OTHER ORGANIC CHEMICALS | | | |
| IOC | INORGANIC CHEMICALS | Unknown | | |
| ACD | ACIDS | | | |
| BAS | BASES | | | |
| MES | HEAVY METALS | Unknown | | |

## IV. HAZARDOUS SUBSTANCES *(See Appendix for most frequently cited CAS Numbers)*

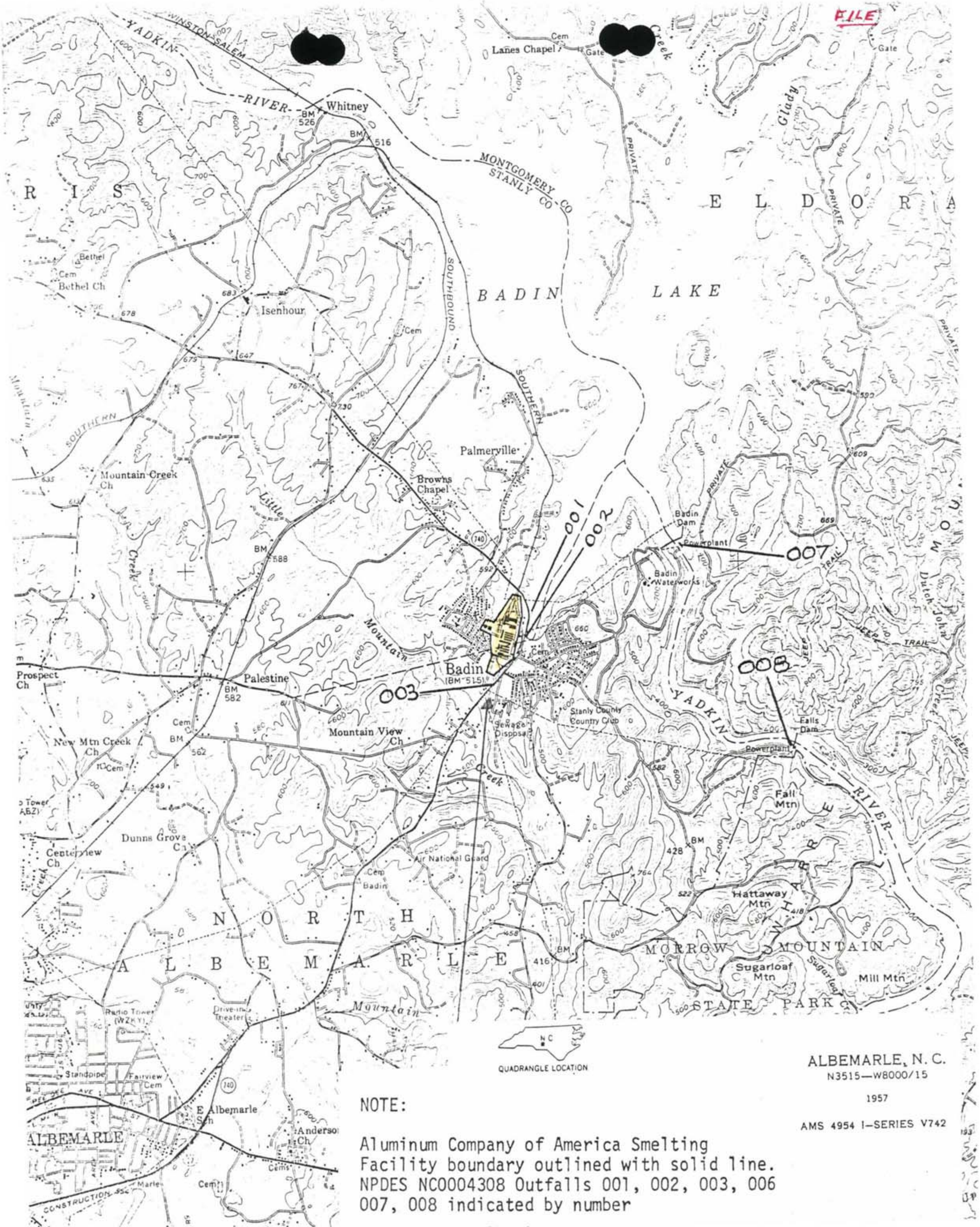
| 01 CATEGORY | 02 SUBSTANCE NAME | 03 CAS NUMBER | 04 STORAGE/DISPOSAL METHOD | 05 CONCENTRATION | 06 MEASURE OF CONCENTRATION |
|---|---|---|---|---|---|
| K088 | spent potliners (cathodes) ---- from primary aluminum production. Contains cyanide. | | disposed on-site in past (amount unknown). Although suspended from RCRA 1-81, facility manifests waste to haz. waste site in SC, in anticipation of future reg. changes. | | |

## V. FEEDSTOCKS *(See Appendix for CAS Numbers)*

| CATEGORY | 01 FEEDSTOCK NAME | 02 CAS NUMBER | CATEGORY | 01 FEEDSTOCK NAME | 02 CAS NUMBER |
|---|---|---|---|---|---|
| FDS | N/A | | FDS | | |
| FDS | | | FDS | | |
| FDS | | | FDS | | |
| FDS | | | FDS | | |

## VI. SOURCES OF INFORMATION *(Cite specific references, e.g., state files, sample analysis, reports)*

1. Files at NC Solid and Haz. Waste Mgmt. Branch, Raleigh, NC.
2. Conrad Carter, env. mgr. at ALCOA Badin Works, personal communication, 10-1-85.
3. David Richardson at NRCD/DEM-Mooresville, NC, personal communication, 10-1-85.




NOTE:

Aluminum Company of America Smelting Facility boundary outlined with solid line. NPDES NC0004308 Outfalls 001, 002, 003, 006 007, 008 indicated by number

PRELIMINARY ASSESSMENT DOCUMENTATION SHEET - SITE NAME ALCOA BADIN WORKS ID# NCD 003162542

STAFF MEMBER ASSIGNED D. Mark Durway TOTAL HOURS ON PA 11 HRS

| COMMENTS | DATE/YR | HRS./TASK |
|---|---|---|
| I. GATHERING SITE INFORMATION | | |
| locate and photocopy files | 10-1-85 | — 30 MIN |
| II. REVIEW & EVALUATE DATA review data and phone calls | 10-1 | 1 HR — |
| review data and write memos | 10-2 | 1 HR — |
| III. DRAFT PA REPORT | | |
| complete PA form | 10-2 | 1 HR 30 MIN |
| write narrative summary | 10-2 | 1 HR 30 MIN |
| IV. TYPE COPY AND FILE | 10-31 | 3 hrs |
| V. SITE REVIEW MEETING, SUPERVISOR REVIEW AND CONCURRENCE | 10-29 | 1/2 hr |
| VI. GENERAL ADMINISTRATION & DATA PROCESSING | 10-30 | 2 hr |

TELEPHONE CALLS (Hours not added to above)

| DATE | TIME | CALL TO/FROM (Company) | PERSON CONTACTED | TEL. # | SUMMARY OF CALL | MIN/CALL |
|---|---|---|---|---|---|---|
| 10-1-85 | 1400 | ALCOA BADIN-WORKS | CONRAD CARTER | 704/422-5631 | waste disposal info | — 10 MIN |
| 10-1-85 | 1455 | DEM- Mooresville | DAVID RICHARDSON | 704/663-1699 | general facility info | — 10 MIN |
| 10-2-85 | 1320 | " | MONTY PAYNE | " | " | — 5 MIN |

0182D

TO: FILE

FROM: D. Mark Durway

DATE: 10-1-85

SUBJECT: phone call to CONRAD A. CARTER, JR, environ mgr. at ALCOA BADIN WORKS / NC D003162542 BADIN, NC

Mr. Carter reported the following:

1) about 20 yrs ago, ALCOA rebuilt facility. Waste generated during renovation included K088 (spent potlining) which was landfilled in an area roughly 400' x 300'. This area is located S of the plant outside plant fence. LDFL location is shown on site map, attached to RCRA Part A. K088 was delisted (suspended) from RCRA in January 1981; it contains cyanide.

2) a well exists on plant property 150' away from LDFL, it is presumed functional, but is not used. Depth unknown. ALCOA doesn't monitor this well.

3) Alcoa operates a clay-lined aerated lagoon. Sludge accumulates on bottom; this is removed once per year. This lagoon is used in conjunction with facility's NPDES-permitted WWTP. This lagoon receives WW from ingot plant, which has high castor oil content.

→

ALCOA memo, 10-1-85, cont'd

(4) ALCOA is considering installing monitoring wells next year. (These are needed around LDFL and lagoon).

(5) Town of Badin has about 500 homes. City uses public water supply. No known drinking water wells "near" plant.

TO: FILE

FROM: D. Mark Durway

DATE: 10-1-85

SUBJECT: phone call to DAVID RICHARDSON @ NRCD-DEM Mooresville Office
re: ALCOA BADIN WORKS (NC D003162542)
BADIN, NC

David Richardson, wh is with Water Quality told me the following:

① they run clean operation; any spills they've had (knowledge of post 1980 spills only) have been addressed immediately and to satisfaction of DEM).

② knows of no groundwater monitoring performed by DEM at the facility.

ALUMINUM COMPANY OF AMERICA
P.O. BOX 576
BADIN, NORTH CAROLINA 28009

ALCOA

RECEIVED
SOLID & HAZARDOUS WASTE MANAGEMENT BRANCH
MAY 11

1984 May 07

Mr. Rick Doby
66 East Cliff Drive
Concord, North Carolina 28025

Re: Spent Potlining

Dear Mr. Doby:

On 1981 January 16, in the Federal Register, the EPA "suspended temporarily" spent potliners from primary aluminum production - K088 - from their list of Hazardous Wastes. This temporary exclusion from control under Subtitle C under 261.4 (b) of the regulations, was necessary to implement Section 7 of the Solid Waste Disposal Act Amendments of 1980. This Amendment states that "solid wastes from the extraction, beneficiation and processing of ores and minerals are excluded from regulation under Subtitle C of RCRA." The EPA continues to interpret this exclusion to include solid wastes generated during the smelting of ores and so excludes this waste stream.

In fact, Hazardous Waste No. K088 has been removed from EPA's list. As you know, we continue to dispose of this material in SCA, Inc.'s hazardous waste landfill in South Carolina, even though this is not required by current EPA regulations.

K088 contains cyanide

I can assure you that our decision to "do more than the law requires" has caused much confusion for our Local and State regulatory agencies. We are simply preparing ourselves in case spent potliners are declared hazardous waste by EPA.

I do hope this sheds some light on the subject.

Very truly yours,

Conrad A. Carter, Jr., P.E.

CONRAD A. CARTER, JR., P.E.
Manager - Environmental Protection

CACJr:bdt

cc: G. J. Crouth - Pittsburgh

South Carolina Department of Health and Environmental Control
Solid and Hazardous Waste Management Division
2600 Bull Street, Columbia, SC 29201
Phone: (803) 758-5681
Emergency & Holidays: (803) 758-5531

# NONHAZARDOUS WASTE MANIFEST

Manifest Document Number
**Nº 65251**

| A. Name | I.D. Code | Address | Phone Number (area code & number) | Date Shipped or Accepted (year / month / day) |
|---|---|---|---|---|
| (1) Generator: Alum. Co. of America | NCD-003162542 | Box 576, Badin, NC 28009 | (704) 422-3621 | 84 / 04 / 05 |
| (2) Transporter No. 1: Jack Gray Transport | IND-042534875 | 1600 E. 15th Ave. Gary, IN 46403 | (219) 938-7020 | 84 / 04 / 05 |
| Transporter No 2 | | | | / / |
| (3) TSDF: SCA Services | SCD070375985 | Rt. 1, Box 255 Pinewood, SC 29125 | (803) 452-5003 (Larry Johnson) | 84 / 4 / 6 |

B.

| (1) Generator Item Count: Number | (1) Generator Item Count: Container Type | (2) DOT Proper Shipping Name/Hazard Class/ DOT Identification Number | (3) Total Quantity | (4) Weight (pounds) | (5) Waste Code | (6) TSDF Item Check: Number | (6) TSDF Item Check: Container Type | (7) Quantity by Weight (pounds) |
|---|---|---|---|---|---|---|---|---|
| 1 | Dump Trailer | Aluminum Smelting Residue (Solid Spent ~~Potlining~~) Non EPA/DOT Regulated | (Approx.) ~~20 YD$^3$~~ | (Estimated) 44990 | 7777 ~~SC EPA 7777-001~~ | 1 | Dump | 44,840 |

C. Emergency Response Information:
In event of an emergency, phone the Generator at: ( 704 ) 422-3621
In event of a spill in South Carolina, call the Department at (803) 758 5531

D. Special Handling Instructions:
FOR LANDFILL

E. Comments:
Jack Gray SCDH/EC No. 042534875
Work Order No. 31893
SCA Code No. 1190-4101

F. This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to all applicable regulations of the U.S. DOT, U.S. EPA, the S.C. PSC and the S.C. DHEC.

Signature: M. E. Christain — Name and Title: M. E. CHRISTAIN, S/PLAN.&TRAFFIC SUPV. — Date: 84/04/05

G. I hereby certify that I am an authorized representative of the transporter and that the waste(s) and quantity described in this Manifest have been accepted by us for ultimate delivery to the TSDF identified above.

Transporter No. 1: Signature: [signature] — Name: JACK GRAY TRANSPORT — Date: 4-5-84

Transporter No. 2: Signature: ______ Name: ______ Date: ______

H. I hereby certify that I am an authorized representative of the TSDF identified above and that the waste(s) and quantity in this Manifest have been accepted by me for treatment, storage, and/or disposal.

Signature: Paul Beardsley — Name and Title: PAUL BEARDSLEY SCA LAB — Date: 4-6-84

(1/80)

Instructions for completing this Form on reverse side.

NORTH CAROLINA

DEPARTMENT OF HUMAN RESOURCES

INTER OFFICE MEMORANDUM

DATE

pertains to ALCOA BADIN WORKS

TO BADIN, NC

FROM

The K088 waste is being stored on a concrete pad and a roof is being constructed over it.

Presently going to Texas about every 2-3 mo. to have $F^-$ extracted.

Talked w/ Ellis on Aug 4, 1981

Wm Paige

DHR Form 2 (8/75)

fill—in areas are spaced for elite type, i.e., 12 characters/inch.

FORM 1 GENERAL

EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY

# GENERAL INFORMATION

*Consolidated Permits Program*

*(Read the "General Instructions" before starting.)*

I. EPA I.D. NUMBER

F NCD003162542 D

LABEL ITEMS

I. EPA I.D. NUMBER

III. FACILITY NAME

V. FACILITY MAILING ADDRESS

VI. FACILITY LOCATION

02867

PLEASE PLACE LABEL IN THIS SPACE

RECEIVED

NOV 19 11 46 AM '0

ENFORCEMENT

GENERAL INSTRUCTIONS

If a preprinted label has been provided, affix it in the designated space. Review the information carefully; if any of it is incorrect, cross through it and enter the correct data in the appropriate fill—in area below. Also, if any of the preprinted data is absent *(the area to the left of the label space lists the information that should appear)*, please provide it in the proper fill—in area(s) below. If the label is complete and correct, you need not complete Items I, III, V, and VI *(except VI-B which must be completed regardless)*. Complete all items if no label has been provided. Refer to the instructions for detailed item descriptions and for the legal authorizations under which this data is collected.

## II. POLLUTANT CHARACTERISTICS

INSTRUCTIONS: Complete A through J to determine whether you need to submit any permit application forms to the EPA. If you answer "yes" to any questions, you must submit this form and the supplemental form listed in the parenthesis following the question. Mark "X" in the box in the third column if the supplemental form is attached. If you answer "no" to each question, you need not submit any of these forms. You may answer "no" if your activity is excluded from permit requirements; see Section C of the instructions. See also, Section D of the instructions for definitions of bold—faced terms.

| SPECIFIC QUESTIONS | YES | NO | FORM ATTACHED | SPECIFIC QUESTIONS | YES | NO | FORM ATTACHED |
|---|---|---|---|---|---|---|---|
| A. Is this facility a publicly owned treatment works which results in a discharge to waters of the U.S.? (FORM 2A) | | X | | B. Does or will this facility *(either existing or proposed)* include a concentrated animal feeding operation or aquatic animal production facility which results in a discharge to waters of the U.S.? (FORM 2B) | | X | |
| C. Is this a facility which currently results in discharges to waters of the U.S. other than those described in A or B above? (FORM 2C) | X | | | D. Is this a proposed facility *(other than those described in A or B above)* which will result in a discharge to waters of the U.S.? (FORM 2D) | | X | |
| E. Does or will this facility treat, store, or dispose of hazardous wastes? (FORM 3) | X | | X | F. Do you or will you inject at this facility industrial or municipal effluent below the lowermost stratum containing, within one quarter mile of the well bore, underground sources of drinking water? (FORM 4) | | X | |
| G. Do you or will you inject at this facility any produced water or other fluids which are brought to the surface in connection with conventional oil or natural gas production, inject fluids used for enhanced recovery of oil or natural gas, or inject fluids for storage of liquid hydrocarbons? (FORM 4) | | X | | H. Do you or will you inject at this facility fluids for special processes such as mining of sulfur by the Frasch process, solution mining of minerals, in situ combustion of fossil fuel, or recovery of geothermal energy? (FORM 4) | | X | |
| I. Is this facility a proposed stationary source which is one of the 28 industrial categories listed in the instructions and which will potentially emit 100 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an attainment area? (FORM 5) | | X | | J. Is this facility a proposed stationary source which is NOT one of the 28 industrial categories listed in the instructions and which will potentially emit 250 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an attainment area? (FORM 5) | | X | |

## III. NAME OF FACILITY

1 SKIP ALCOA BADIN WORKS

## IV. FACILITY CONTACT

| A. NAME & TITLE (last, first, & title) | B. PHONE (area code & no.) |
|---|---|
| 2 HINKLE ROBERT MGR ENV PROT | 704 422 5631 |

## V. FACILITY MAILING ADDRESS

A. STREET OR P.O. BOX

3 P O BOX 576

| B. CITY OR TOWN | C. STATE | D. ZIP CODE |
|---|---|---|
| 4 BADIN | NC | 28009 |

## VI. FACILITY LOCATION

A. STREET, ROUTE NO. OR OTHER SPECIFIC IDENTIFIER

5 HWY 740

B. COUNTY NAME

STANLY

| C. CITY OR TOWN | D. STATE | E. ZIP CODE | F. COUNTY CODE (if known) |
|---|---|---|---|
| 6 BADIN | NC | 28009 | |

EPA Form 3510-1 (6-80)

CONTINUE ON REVERS

fill—in areas are spaced for elite type, i.e., 12 characters/inch

FORM 1 GENERAL

U.S. ENVIRONMENTAL PROTECTION AGENCY
# GENERAL INFORMATION
*Consolidated Permits Program*
(Read the "General Instructions" before starting.)

I. EPA I.D. NUMBER

| S | | T/A | C |
|---|---|---|---|
| F | N C D 0 0 3 1 6 2 5 4 2 | | D |

LABEL ITEMS

I. EPA I.D. NUMBER

III. FACILITY NAME

V. FACILITY MAILING ADDRESS

VI. FACILITY LOCATION

PLEASE PLACE LABEL IN THIS SPACE

02867

RECEIVED
NOV 19 11 45 AM '90
ENFORCEMENT

GENERAL INSTRUCTIONS

If a preprinted label has been provided, affix it in the designated space. Review the information carefully; if any of it is incorrect, cross through it and enter the correct data in the appropriate fill—in area below. Also, if any of the preprinted data is absent *(the area to the left of the label space lists the information that should appear)*, please provide it in the proper fill—in area(s) below. If the label is complete and correct, you need not complete Items I, III, V, and VI *(except VI-B which must be completed regardless)*. Complete all items if no label has been provided. Refer to the instructions for detailed item descriptions and for the legal authorizations under which this data is collected.

## II. POLLUTANT CHARACTERISTICS

INSTRUCTIONS: Complete A through J to determine whether you need to submit any permit application forms to the EPA. If you answer "yes" to any questions, you must submit this form and the supplemental form listed in the parenthesis following the question. Mark "X" in the box in the third column if the supplemental form is attached. If you answer "no" to each question, you need not submit any of these forms. You may answer "no" if your activity is excluded from permit requirements; see Section C of the instructions. See also, Section D of the instructions for definitions of bold—faced terms.

| SPECIFIC QUESTIONS | YES | NO | FORM ATTACHED | SPECIFIC QUESTIONS | YES | NO | FORM ATTACHED |
|---|---|---|---|---|---|---|---|
| A. Is this facility a publicly owned treatment works which results in a discharge to waters of the U.S.? (FORM 2A) | | X | | B. Does or will this facility *(either existing or proposed)* include a concentrated animal feeding operation or aquatic animal production facility which results in a discharge to waters of the U.S.? (FORM 2B) | | X | |
| C. Is this a facility which currently results in discharges to waters of the U.S. other than those described in A or B above? (FORM 2C) | X | | | D. Is this a proposed facility *(other than those described in A or B above)* which will result in a discharge to waters of the U.S.? (FORM 2D) | | X | |
| E. Does or will this facility treat, store, or dispose of hazardous wastes? (FORM 3) | X | | X | F. Do you or will you inject at this facility industrial or municipal effluent below the lowermost stratum containing, within one quarter mile of the well bore, underground sources of drinking water? (FORM 4) | | X | |
| G. Do you or will you inject at this facility any produced water or other fluids which are brought to the surface in connection with conventional oil or natural gas production, inject fluids used for enhanced recovery of oil or natural gas, or inject fluids for storage of liquid hydrocarbons? (FORM 4) | | X | | H. Do you or will you inject at this facility fluids for special processes such as mining of sulfur by the Frasch process, solution mining of minerals, in situ combustion of fossil fuel, or recovery of geothermal energy? (FORM 4) | | X | |
| I. Is this facility a proposed stationary source which is one of the 28 industrial categories listed in the instructions and which will potentially emit 100 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an attainment area? (FORM 5) | | X | | J. Is this facility a proposed stationary source which is NOT one of the 28 industrial categories listed in the instructions and which will potentially emit 250 tons per year of any air pollutant regulated under the Clean Air Act and may affect or be located in an attainment area? (FORM 5) | | X | |

## III. NAME OF FACILITY

1 SKIP ALCOA BADIN WORKS

## IV. FACILITY CONTACT

| A. NAME & TITLE (last, first, & title) | B. PHONE (area code & no.) |
|---|---|
| 2 HINKLE ROBERT MGR ENV PROT | 704 422 5631 |

## V. FACILITY MAILING ADDRESS

A. STREET OR P.O. BOX

3 P O BOX 576

| B. CITY OR TOWN | C. STATE | D. ZIP CODE |
|---|---|---|
| 4 BADIN | NC | 28009 |

## VI. FACILITY LOCATION

A. STREET, ROUTE NO. OR OTHER SPECIFIC IDENTIFIER

5 HWY 740

B. COUNTY NAME

STANLY

| C. CITY OR TOWN | D. STATE | E. ZIP CODE | F. COUNTY CODE (if known) |
|---|---|---|---|
| 6 BADIN | NC | 28009 | |

EPA Form 3510-1 (6-80)

CONTINUE ON REVERSE

## SIC CODES (4-digit, in order of priority)

| A. FIRST | | B. SECOND | |
|---|---|---|---|
| 3334 | (specify) Primary Alu[illegible]lting | 7 | (specify) |

| C. THIRD | | D. FOURTH | |
|---|---|---|---|
| | (specify) | 7 | (specify) |

## VIII. OPERATOR INFORMATION

A. NAME: ALUMINUM COMPANY OF AMERICA

B. Is the name listed in Item VIII-A also the owner? [X] YES [ ] NO

C. STATUS OF OPERATOR (Enter the appropriate letter into the answer box; if "Other", specify.)

F = FEDERAL
S = STATE
P = PRIVATE
M = PUBLIC (other than federal or state)
O = OTHER (specify)

Answer: P (specify)

D. PHONE (area code & no.): A 412 553 4545

E. STREET OR P.O. BOX: 501 ALCOA BUILDING

| F. CITY OR TOWN | G. STATE | H. ZIP CODE |
|---|---|---|
| PITTSBURGH | PA | 15219 |

## IX. INDIAN LAND

Is the facility located on Indian lands? [ ] YES [X] NO

## X. EXISTING ENVIRONMENTAL PERMITS

| A. NPDES (Discharges to Surface Water) | D. PSD (Air Emissions from Proposed Sources) |
|---|---|
| N NC0004308 | 9 P |

| B. UIC (Underground Injection of Fluids) | E. OTHER (specify) | |
|---|---|---|
| U | 9 | (specify) |

| C. RCRA (Hazardous Wastes) | E. OTHER (specify) | |
|---|---|---|
| R | 9 | (specify) |

## XI. MAP

Attach to this application a topographic map of the area extending to at least one mile beyond property bounderies. The map must show the outline of the facility, the location of each of its existing and proposed intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all springs, rivers and other surface water bodies in the map area. See instructions for precise requirements.

## XII. NATURE OF BUSINESS (provide a brief description)

MANUFACTURE OF CARBON ANODES AND CATHODES FOR ALUMINUM SMELTING CELLS.
SMELTING OF ALUMINUM FROM ALUMINA. CASTING OF ALUMINUM INGOTS.

## XIII. CERTIFICATION (see instructions)

*I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.*

| A. NAME & OFFICIAL TITLE (type or print) | B. SIGNATURE | C. DATE SIGNED |
|---|---|---|
| S. A. Jones<br>Vice President, Primary Metals | [signature] | [illegible]-11-17 |

COMMENTS FOR OFFICIAL USE ONLY

C

Please print or type in the unshaded areas only (fill-in areas are spaced for elite type, i.e., 12 characters/inch).

Form Approved OMB No. 158-S80004

FORM 3 RCRA — EPA — U.S. ENVIRONMENTAL PROTECTION AGENCY

# HAZARDOUS WASTE PERMIT APPLICATION

Consolidated Permits Program

(This information is required under Section 3005 of RCRA.)

## I. EPA I.D. NUMBER

F | N C D 0 0 3 1 6 2 5 4 2 | T/A C: 1

## FOR OFFICIAL USE ONLY

| APPLICATION APPROVED | DATE RECEIVED (yr., mo., & day) | COMMENTS |
|---|---|---|
| | | |

## II. FIRST OR REVISED APPLICATION

Place an "X" in the appropriate box in A or B below *(mark one box only)* to indicate whether this is the first application you are submitting for your facility or a revised application. If this is your first application and you already know your facility's EPA I.D. Number, or if this is a revised application, enter your facility's EPA I.D. Number in Item I above.

**A. FIRST APPLICATION** *(place an "X" below and provide the appropriate date)*

[X] 1. EXISTING FACILITY *(See instructions for definition of "existing" facility. Complete item below.)*

[ ] 2. NEW FACILITY *(Complete item below.)*

C: 8 — YR. 16 MO. 08 DAY 09 — FOR EXISTING FACILITIES, PROVIDE THE DATE *(yr., mo., & day)* OPERATION BEGAN OR THE DATE CONSTRUCTION COMMENCED *(use the boxes to the left)*

YR. ___ MO. ___ DAY ___ — FOR NEW FACILITIES, PROVIDE THE DATE *(yr., mo., & day)* OPERATION BEGAN OR IS EXPECTED TO BEGIN

**B. REVISED APPLICATION** *(place an "X" below and complete Item I above)*

[ ] 1. FACILITY HAS INTERIM STATUS

[ ] 2. FACILITY HAS A RCRA PERMIT

## III. PROCESSES – CODES AND DESIGN CAPACITIES

A. PROCESS CODE — Enter the code from the list of process codes below that best describes each process to be used at the facility. Ten lines are provided for entering codes. If more lines are needed, enter the code*(s)* in the space provided. If a process will be used that is not included in the list of codes below, then describe the process *(including its design capacity)* in the space provided on the form *(Item III-C)*.

B. PROCESS DESIGN CAPACITY — For each code entered in column A enter the capacity of the process.

1. AMOUNT — Enter the amount.
2. UNIT OF MEASURE — For each amount entered in column B(1), enter the code from the list of unit measure codes below that describes the unit of measure used. Only the units of measure that are listed below should be used.

| PROCESS | PROCESS CODE | APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY |
|---|---|---|
| **Storage:** | | |
| CONTAINER *(barrel, drum, etc.)* | S01 | GALLONS OR LITERS |
| TANK | S02 | GALLONS OR LITERS |
| WASTE PILE | S03 | CUBIC YARDS OR CUBIC METERS |
| SURFACE IMPOUNDMENT | S04 | GALLONS OR LITERS |
| **Disposal:** | | |
| INJECTION WELL | D79 | GALLONS OR LITERS |
| LANDFILL | D80 | ACRE-FEET *(the volume that would cover one acre to a depth of one foot)* OR HECTARE-METER |
| LAND APPLICATION | D81 | ACRES OR HECTARES |
| OCEAN DISPOSAL | D82 | GALLONS PER DAY OR LITERS PER DAY |
| SURFACE IMPOUNDMENT | D83 | GALLONS OR LITERS |
| **Treatment:** | | |
| TANK | T01 | GALLONS PER DAY OR LITERS PER DAY |
| SURFACE IMPOUNDMENT | T02 | GALLONS PER DAY OR LITERS PER DAY |
| INCINERATOR | T03 | TONS PER HOUR OR METRIC TONS PER HOUR; GALLONS PER HOUR OR LITERS PER HOUR |
| OTHER *(Use for physical, chemical, thermal or biological treatment processes not occurring in tanks, surface impoundments or incinerators. Describe the processes in the space provided; Item III-C.)* | T04 | GALLONS PER DAY OR LITERS PER DAY |

| UNIT OF MEASURE | UNIT OF MEASURE CODE | UNIT OF MEASURE | UNIT OF MEASURE CODE | UNIT OF MEASURE | UNIT OF MEASURE CODE |
|---|---|---|---|---|---|
| GALLONS | G | LITERS PER DAY | V | ACRE-FEET | A |
| LITERS | L | TONS PER HOUR | D | HECTARE-METER | F |
| CUBIC YARDS | Y | METRIC TONS PER HOUR | W | ACRES | B |
| CUBIC METERS | C | GALLONS PER HOUR | E | HECTARES | Q |
| GALLONS PER DAY | U | LITERS PER HOUR | H | | |

RECEIVED NOV 1 1986 EPA/REGION IV — ENVIRONMENT — AM 11 46 — 2868

EXAMPLE FOR COMPLETING ITEM III *(shown in line numbers X-1 and X-2 below)*: A facility has two storage tanks, one tank can hold 200 gallons and the other can hold 400 gallons. The facility also has an incinerator that can burn up to 20 gallons per hour.

C | DUP | T/A C: 1

| LINE NUMBER | A. PROCESS CODE (from list above) | B. PROCESS DESIGN CAPACITY 1. AMOUNT (specify) | 2. UNIT OF MEASURE (enter code) | FOR OFFICIAL USE ONLY | LINE NUMBER | A. PROCESS CODE (from list above) | B. PROCESS DESIGN CAPACITY 1. AMOUNT | 2. UNIT OF MEASURE (enter code) | FOR OFFICIAL USE ONLY |
|---|---|---|---|---|---|---|---|---|---|
| X-1 | S 0 2 | 600 | G | | 5 | | | | |
| X-2 | T 0 3 | 20 | E | | 6 | | | | |
| 1 | | | | | 7 | | | | |
| 2 | S 0 3 | 370 | Y | | 8 | | | | |
| 3 | | | | | 9 | | | | |
| 4 | | | | | 10 | | | | |

## ROCESSES (continued)

SPACE FOR ADDITIONAL PROCESS CODES OR FOR DESCRIBING OTHER PROCESSES (code "T04"). FOR EACH PROCESS ENTERED HERE NCLUDE DESIGN CAPACITY.

N.A.

## DESCRIPTION OF HAZARDOUS WASTES

EPA HAZARDOUS WASTE NUMBER — Enter the four–digit number from 40 CFR, Subpart D for each listed hazardous waste you will handle. If you handle hazardous wastes which are not listed in 40 CFR, Subpart D, enter the four–digit number(s) from 40 CFR, Subpart C that describes the characteristics and/or the toxic contaminants of those hazardous wastes.

STIMATED ANNUAL QUANTITY — For each listed waste entered in column A estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in column A estimate the total annual quantity of all the non–listed waste(s) that will be handled which possess that characteristic or contaminant.

UNIT OF MEASURE — For each quantity entered in column B enter the unit of measure code. Units of measure which must be used and the appropriate codes are:

| ENGLISH UNIT OF MEASURE | CODE | METRIC UNIT OF MEASURE | CODE |
|---|---|---|---|
| POUNDS | P | KILOGRAMS | K |
| TONS | T | METRIC TONS | M |

facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure taking into account the appropriate density or specific gravity of the waste.

PROCESSES

. PROCESS CODES:

**For listed hazardous waste:** For each listed hazardous waste entered in column A select the code(s) from the list of process codes contained in Item III to indicate how the waste will be stored, treated, and/or disposed of at the facility.

**For non–listed hazardous wastes:** For each characteristic or toxic contaminant entered in column A, select the code(s) from the list of process codes contained in Item III to indicate all the processes that will be used to store, treat, and/or dispose of all the non–listed hazardous wastes that possess that characteristic or toxic contaminant.

**Note:** Four spaces are provided for entering process codes. If more are needed: (1) Enter the first three as described above; (2) Enter "000" in the extreme right box of Item IV-D(1); and (3) Enter in the space provided on page 4, the line number and the additional code(s).

PROCESS DESCRIPTION: If a code is not listed for a process that will be used, describe the process in the space provided on the form.

E: HAZARDOUS WASTES DESCRIBED BY MORE THAN ONE EPA HAZARDOUS WASTE NUMBER — Hazardous wastes that can be described by than one EPA Hazardous Waste Number shall be described on the form as follows:

Select one of the EPA Hazardous Waste Numbers and enter it in column A. On the same line complete columns B,C, and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.

In column A of the next line enter the other EPA Hazardous Waste Number that can be used to describe the waste. In column D(2) on that line enter "included with above" and make no other entries on that line.

Repeat step 2 for each other EPA Hazardous Waste Number that can be used to describe the hazardous waste.

MPLE FOR COMPLETING ITEM IV *(shown in line numbers X-1, X-2, X-3, and X-4 below)* — A facility will treat and dispose of an estimated 900 pounds ear of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non–listed wastes. Two wastes orrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

| A. EPA HAZARD. WASTE NO (enter code) | B. ESTIMATED ANNUAL QUANTITY OF WASTE | C. UNIT OF MEASURE (enter code) | D. PROCESSES 1. PROCESS CODES (enter) | | | | D. PROCESSES 2. PROCESS DESCRIPTION (if a code is not entered in D(1)) |
|---|---|---|---|---|---|---|---|
| K054 | 900 | P | T03 | D80 | | | |
| D002 | 400 | P | T03 | D80 | | | |
| D001 | 100 | P | T03 | D80 | | | |
| D002 | | | | | | | *included with above* |

 CONTINUE ON PAGE 3

…ntinued from page 2.
…OTE: Photocopy this page before completing if … more than 26 wastes to list.

Form Approved OMB No. 158-S80004

EPA I.D. NUMBER (enter from page 1): N C D 0 0 3 1 6 2 5 4 2 | T/A: 1

FOR OFFICIAL U…: W | DUP | T/A C: 2 | DUP

## V. DESCRIPTION OF HAZARDOUS WASTES (continued)

| LINE NO. | A. EPA HAZARD. WASTE NO. (enter code) | B. ESTIMATED ANNUAL QUANTITY OF WASTE | C. UNIT OF MEASURE (enter code) | D. PROCESSES 1. PROCESS CODES (enter) | | | | D. PROCESSES 2. PROCESS DESCRIPTION (if a code is not entered in D(1)) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | |
| 2 | K088 | 4800 | T | S03 | | | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | | | | | | | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| 16 | | | | | | | | |
| 17 | | | | | | | | |
| 18 | | | | | | | | |
| 19 | | | | | | | | |
| 20 | | | | | | | | |
| 21 | | | | | | | | |
| 22 | | | | | | | | |
| 23 | | | | | | | | |
| 24 | | | | | | | | |
| 25 | | | | | | | | |
| 26 | | | | | | | | |

IV. DESCRIPTION OF HAZARDOUS WASTES (continued)

E. USE THIS SPACE TO LIST ADDITIONAL PROCESS CODES FROM ITEM D(1) ON PAGE 3.

N.A.

EPA I.D. NO. (enter from page 1)

| | | | | | | | | | | | | T/A | C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | C | D | 0 | 0 | 3 | 1 | 6 | 2 | 5 | 4 | 2 | | 6 |

## V. FACILITY DRAWING

All existing facilities must include in the space provided on page 5 a scale drawing of the facility *(see instructions for more detail).*

## VI. PHOTOGRAPHS

All existing facilities must include photographs *(aerial or ground–level)* that clearly delineate all existing structures; existing storage, treatment and disposal areas; and sites of future storage, treatment or disposal areas *(see instructions for more detail).*

## VII. FACILITY GEOGRAPHIC LOCATION

| LATITUDE (degrees, minutes, & seconds) | LONGITUDE (degrees, minutes, & seconds) |
|---|---|
| 35 24 040 | 080 07 005 |

## VIII. FACILITY OWNER

☒ A. If the facility owner is also the facility operator as listed in Section VIII on Form 1, "General Information", place an "X" in the box to the left and skip to Section IX below.

B. If the facility owner is not the facility operator as listed in Section VIII on Form 1, complete the following items:

| 1. NAME OF FACILITY'S LEGAL OWNER | 2. PHONE NO. (area code & no.) |
|---|---|
| | |

| 3. STREET OR P.O. BOX | 4. CITY OR TOWN | 5. ST. | 6. ZIP CODE |
|---|---|---|---|
| | | | |

## IX. OWNER CERTIFICATION

*I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.*

| A. NAME (print or type) | B. SIGNATURE | C. DATE SIGNED |
|---|---|---|
| . A. Jones<br>ice President - Primary Metals | S. A. Jones | 1980-11-17 |

## X. OPERATOR CERTIFICATION

*I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.*

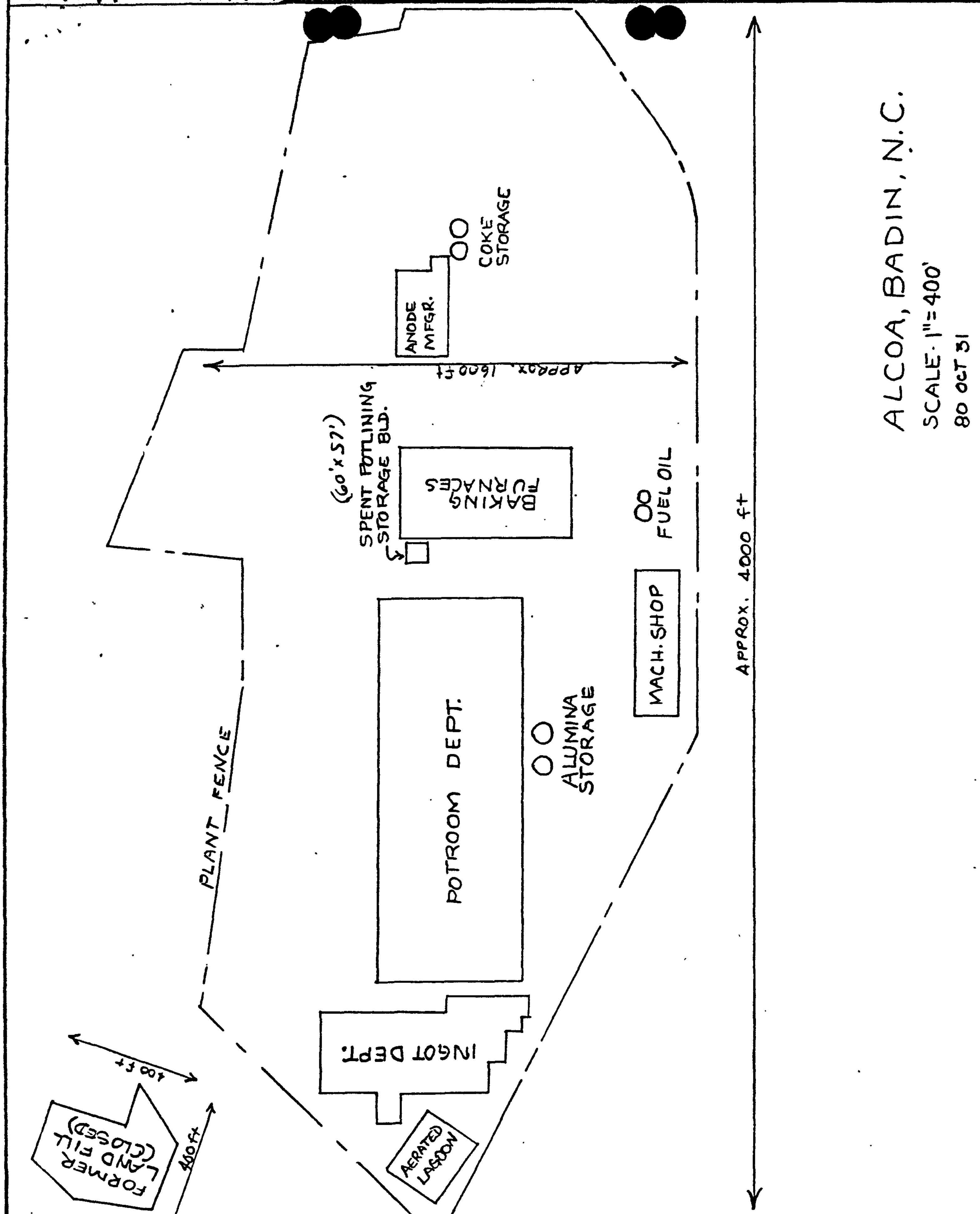
| A. NAME (print or type) | B. SIGNATURE | C. DATE SIGNED |
|---|---|---|
| | | |

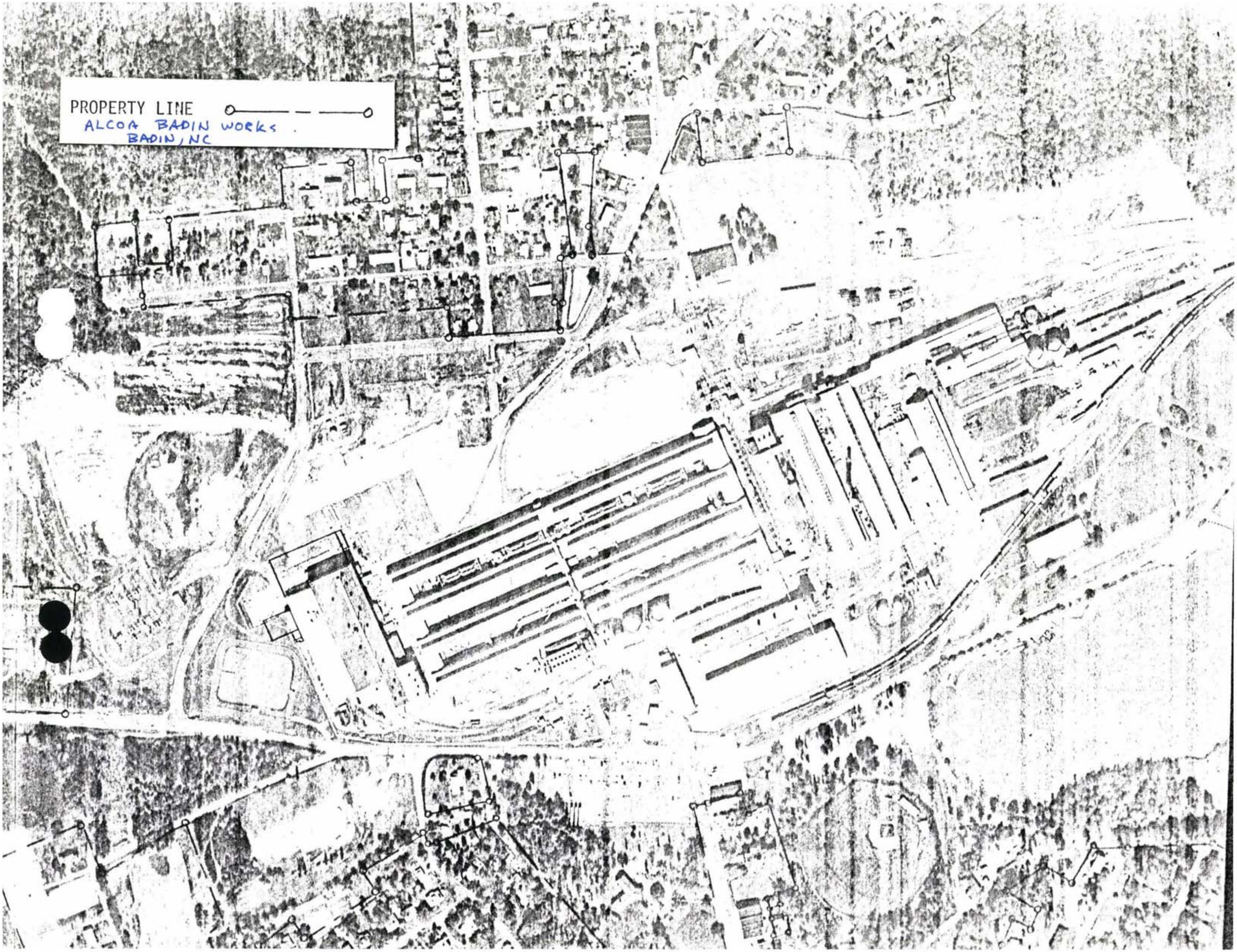
 CONTINUE ON PAGE

Continued from page 4.



## V. FACILITY DRAWING *(see page 4)*




PROPERTY LINE
ALCOA BADIN WORKS
BADIN, NC

```
ÖáSITE INITIALIZATION - VIEW ááááááááááááSITE - 05261ááááááááááááScreen 1 of 3á¢
°    FMS Id Number:*04                               EPA Site Id:*NCD986171320    °
°             Name:*ALCOA BADIN LANDFILL                                          °
°           Street:*STANLY CNTY                                                   °
°             City:*BADIN                                 State:*NC               °
°           County:*STANLY                             Zip Code:*28009-           °
° Owner. Indicator:*PR       Federal Facility Indicator:*D   RCRA Flag:*          °
°         Category:*L                        Further Action:*                     °
°NPL Status Indic.:*N                         Incident Type:*                     °
°         Latitude:*00 00 00.0                    Longitude:*000 00 00.0          °
°       Site Class:*ND                    SARA Mandate (SI): N                    °
°  Fed. Agency PRP:*      State PRP:*       Municipal PRP:*                       °
ááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááì
ÖááááááááááááááááááááááááááááááááááDISCOVERYáááááááááááááááááááááááááááááááááááá¢
°             Lead:*F                     Reported By Name:                       °
°   Discovery Date:*08/01/89                 Phone Number: (    )    -            °
°           Agency:                                                               °
ááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááì
ÖáááááááááááááááááááááááááááááááááááREFERRALáááááááááááááááááááááááááááááááááááá¢
°               To:                                       Date:                   °
áááááááááááááááááááááá [N]ext, [P]revious, or [C]ontinue: [C] áááááááááááááááááááì
                          (F)orward screen, (M)enu  ( )


ÖááSITE INITIALIZATION - VIEW áááááSITE - 05261áááááááááááááááááááScreen 2 of 3á¢
°                                                                                 °
°                                    RPM/OSC                                      °
°             Name:                           Phone Number: (    )    -           °
ááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááì

ÖááááááááááááááááááááááááááááááSITE DESCRIPTIONááááááááááááááááááááááááááááááááá¢
°                                                                                 °
°      LDFL. CONTAINS AN EST.22000 CUBIC YDS. OF POTLINING WASTE &                °
°      FURNACE BRICK. 10 - 15 ACRES                                               °
°                                                                                 °
°                                                                                 °
°ááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááá°
° Enter:*LDFL. CONTAINS AN EST.22000 CUBIC YDS. OF POTLINING WASTE &              °
ááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááì
ÖááááááááááááááááááááááááááááááSITE DIRECTIONSáááááááááááááááááááááááááááááááááá¢
°                                                                                 °
°      ADJACENT TO BADIN LAKE. .75 MI NW OF ALCOA PLANT.                          °
°                                                                                 °
°ááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááá°
° Enter: ADJACENT TO BADIN LAKE. .75 MI NW OF ALCOA PLANT.                        °
ááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááì
                   (F)orward screen, (B)ack screen, (M)enu  (F)
```

```
ÕááSITE INITIALIZATION - VIEW ááááSITE - 05261áááááááááááááááááááScreen 3 of 3á¢
°                                    COMMENTS                                   °
°      ALCOA HAS DONE SOME WORK ON THIS SITE.                                   °
°                                                                               °
°                                                                               °
°                                                                               °
°ááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááá°
° Enter:*ALCOA HAS DONE SOME WORK ON THIS SITE.                                 °
ââááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááì
ÕáááááááááááááááááááááááááááááááREGIONAL FIELDSááááááááááááááááááááááááááááááááá¢
°       REG_FIELD1:*                REG_FIELD2:*                REG_FIELD3:*    °
°       REG_FIELD4:*                REG_FIELD5:*                REG_FIELD6:*    °
°       REG_FIELD7:*                REG_FIELD8:*                                °
ââááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááì


              (G)eneric subevent, (B)ack screen, (M)enu  ( )
```

# REFERENCE 4

NUS CORPORATION
1927 LAKESIDE PARKWAY
SUITE 614
TUCKER, GEORGIA 30084
404-938-7710

C-586-3-9-243

March 28, 1989

Mr. A.R. Hanke
Site Investigation and Support Branch
Waste Management Division
Environmental Protection Agency
345 Courtland Street, N. E.
Atlanta, Georgia 30365

Subject: Preliminary Reassessment
Alcoa Badin Works
Badin, Stanly County, North Carolina
TDD No. F4-8808-02
EPA ID No. NCD003162542

Dear Mr. Hanke:

FIT 4 conducted a preliminary reassessment of Alcoa Badin Works, located on Highway 740 in Badin, Stanly County, North Carolina. The reassessment included a review of both EPA and state file material, a target survey, and an offsite reconnaissance of the facility and the surrounding area.

Alcoa Badin Works has been in operation since 1916 as a manufacturer of carbon anodes and cathodes as well as a smelter of aluminum. Spent potlining waste (K088) was being produced at a rate of 100 tons per month during 1985 as a result of these processes. Spent potlining waste at the facility contains cyanide (Ref.1).

Unknown quantities of spent potlining waste were disposed of in an onsite landfill, especially during a plant renovation starting in 1965. The abandoned landfill is located outside the facility fence approximately 500 feet south of the plant (Ref.2). The Alcoa Badin Works property also contains a clay-lined, aerated lagoon, which is used in connection with the plant's wastewater treatment facility (NPDES permit NC004308) (Ref. 3).

The EPA temporarily suspended spent potlining waste from the RCRA list of hazardous wastes in January 1981. Alcoa Badin has been transporting the potlining waste to the SCA landfill in South Carolina for a number of years.

Alcoa Badin Works lies in the Piedmont Physiographic Province in the south-central portion of North Carolina. Net annual precipitation is approximately 3 inches (Ref.4); recharge to the crystalline rock aquifer results from the infiltration of rainfall through the unsaturated zone to the saturated regolith and underlying, fractured crystalline rocks. Depth to the water table in the Piedmont typically ranges from 15 to 25 feet below land surface (Ref.5, p.50).

Geologically, Alcoa Badin Works lies within the Carolina Slate Belt, a distinct sequence of metamorphosed, sedimentary and volcanic rocks (Refs. 6,7). These fractured, crystalline rocks are overlain by a layer of residual soil and saprolite known as the regolith. The regolith and the underlying crystalline rocks are hydrologically connected and together comprise the crystalline rock aquifer.

The crystalline rock aquifer of the Piedmont Physiographic Province in North Carolina is an unconfined aquifer with saturation in the fractured, crystalline rocks rarely exceeding a depth of 300 feet below land surface (Refs.5; 8, p.330). Groundwater in the immediate area most likely flows to the east-southeast towards Badin Lake and the Peedee River (Ref. 9). Average well depths in the Piedmont generally range from 75 to 200 feet below land surface. Well production is generally a function of the thickness of the saturated regolith overlying the fractured crystalline rocks. Locally, well yields in the crystalline rock aquifer may be as high as 200 gallons per minute (gpm), but yields are more commonly in the 5-35 gpm range (Ref.8, p. 330).

Local residents in the Badin District use the water supplied by Alcoa Water Supply (Ref. 10). Alcoa Water Supply has a surface water intake at Badin Dam, located approximately 2 miles to the northeast of the Alcoa Aluminum facility (Refs. 10, 11). This intake cannot be considered on the surface water pathway. Badin Lake is located approximately 1000 feet to the northeast of the facility. Little Mountain Creek is the most likely surface water pathway from the facility, and is located approximately 1000 feet south of Alcoa Badin Works. Little Mountain Creek flows south and joins Mountain Creek approximately 3 miles south of the facility. Mountain Creek empties into the Peedee River approximately 6 miles from the Alcoa facility. Recreational fishing and camping take place along the 15-mile surface water pathway. The Uwharrie National Forest and Morrow Mountain State Park are both located within 2 miles of Alcoa Badin Works (Ref. 9).

There is no record of private wells being used within a small radius of Alcoa Badin Works (Refs.3, 10). The target population is based on a estimation of the houses on a topographic map, which are shown as not being served by the Alcoa Water Supply or the city of Albemarle. The population using private wells within a 3-mile radius of Alcoa Badin is 1,003, and the population between 3 and 4 miles is 1,159 (Ref. 9). The potential for surface and groundwater contamination exists due to the lack of containment measures in the old landfill (Ref. 3). No sampling has taken place at Alcoa Badin Works to prove or disprove such contamination. Alcoa did not have monitoring wells at the facility in 1985 but was planning to install several wells in 1986 (Ref.2). The facility is fenced and not accessible to the public (Ref.3).

Based on the file review and target survey, a high-priority screening site inspection is recommended for the Alcoa Badin Works facility. If you have any questions regarding this matter, please contact me at NUS Corporation.

Very truly yours,

McKenzie Mallary

McKenzie Mallary
Project Manager

Approved:

[signature]

MM/jec

Enclosures

cc: Robert Morris

References


1. Mark D. Durway, N.C. Division of Health Services, letter to Denise Bland, project officer, EPA NC 3012, Subject: Final Preliminary Assessment Report for Alcoa Badin Works, October 30, 1985.

2. Mark D. Durway, letter to file, Subject: Telephone conversation with Conrad Carter, Environmental Manager at Alcoa Badin, October 1, 1985.

3. Potential Hazardous Waste Site Preliminary Assessment (EPA Form 2070-12), Part 1--Site Information and Assessment for Alcoa Badin Works. Filed by Conrad Carter, environmental engineer at Alcoa, October 1, 1985.

4. U.S. Dept. of Commerce Center, <u>Climatic Atlas of the United States</u>, Asheville, North Carolina (1979).

5. Harry E. LeGrand, "Ground Water and Its Contamination in North Carolina", (July 1984), pp. 19-21, 50-51.

6. North Carolina Geological Survey Publications List, Geologic Belts and Generalized Map of North Carolina (February 1988).

7. Jasper L. Stuckey and Warren G. Steel, "Geology and Mineral Resources of North Carolina," Figure 2, (Raleigh: North Carolina Dept. of Natural Resources, 1953).

8. U.S. Geological Survey, "Hydrologic Events Selected Water-Quality Trends and Ground Water Resources. National Water Summary 1984", Water-Supply Paper 2275, (1984), pp. 329-332.

9. U.S. Geological Survey, 7.5 minute series Topographic Quadrangle Maps of North Carolina: New London 1980, Badin 1981, Morrow Mountain 1981, Albemarle 1981, scale 1:24,000.

10. NUS Corporation Field Logbook No. F4-1066 for Alcoa Badin Works, TDD # F4-8808-02. Documentation of facility reconnaissance, September 28, 1988.

11. North Carolina Department of Human Resources (NCDHR), Environmental Health Section, Water Supply Branch. Alphabetical Listings of Active Community and Noncommunity Private Well Survey for Stanly County, North Carolina, March 1988.

| ***NUS CORPORATION AND SUBSIDIARIES*** | | ***TELECON NOTE*** |
|---|---|---|
| **CONTROL NO.** | **DATE: July 14, 1989** | **TIME: 11:20am** |
| **DISTRIBUTION:**<br><br>**Alcoa Badin Works** | | |
| **BETWEEN: Jim Edwards** | **OF: NC Hazardous Waste Branch, Compliance Section** | **PHONE: (919) 733-2178** |
| **AND: Joan Dupont, NUS Corporation** Joan Dupont | | |

**DISCUSSION:**

**Mr. Edwards returned Ken Mallary's call concerning the RFA scheduled for Alcoa Badin in Stanly County, North Carolina. Alcoa Badin recently filed a RCRA Part A application for interim status, based upon the recent listing of potlining wastes as a hazardous waste. Alcoa's RCRA unit is a waste pile containing the potlining wastes. I mentioned that the October 1988 RCRA printout from North Carolina lists Alcoa Badin as a small generator. Mr. Edwards did not known the date that the company's RCRA status was changed. Currently, Alcoa Badin is listed as a generator and storer.**

**Mr. Edwards transferred me to Dan Bius in Permitting. Mr. Bius said that K088 for potlinings from aluminum smelters was reclassified as a hazardous waste within the past several months, but he did not known the exact date; the main concern is the toxicity of cyanide. I mentioned that Alcoa Badin Works was classified as a small generator on the state's RCRA facility printout of October 1988; he said that was probably for F003 and F005, for degreasers. On March 3, 1989, Alcoa Badin Works signed a RCRA Part A application; EPA submitted the application to North Carolina on March 22, 1989. The facility is currently classified as a generator and storage facility.**

**An RFA (RCRA Facility Assessment) is planned for Alcoa Badin during the first quarter of FY90. According to Mr. Bius (and based upon his conversation with Conrad Carter, Alcoa's environmental manager), the old landfill is not contiguous to the TSD facility. They would be contiguous if the landfill could be reached by going directly across the road from the TSD facility (i.e., drive straight across). However, he suggested confirming this with Conrad Carter.**

**ACTION ITEMS:**

NUS 067 REVISED 0685

| *NUS CORPORATION AND SUBSIDIARIES* | | *TELECON NOTE* |
|---|---|---|
| CONTROL NO. | DATE: July 14, 1989 | TIME: 11:20am |
| DISTRIBUTION: Alcoa Badin Works | Page two | |
| BETWEEN: Jim Edwards | OF: NC Hazardous Waste Branch, Compliance Section | PHONE: (919) 733-2178 |
| AND: Joan Dupont, NUS Corporation | | |

DISCUSSION:

Mr. Bius suggested combining the SI with the RFA, to save on time, personnel, and expense and to avoid making two trips to the facility. (RFA's generally do not include sampling). Mr. Bius has been in contact with John Dickinson (EPA RCRA Permitting) and Robert Morris; apparently a tentative agreement has been reached to include the RFA with the SI. Jim Edwards (NC RCRA Compliance) had suggested that FIT wait on the SI until after the RFA has been completed. North Carolina has not yet called for Part B of Alcoa's permit application. If we do a joint RFA-SI, Mr. Bius wants to send an observer along. I told him I would check with Robert Morris and let him know.

ACTION ITEMS:

**NUS CORPORATION AND SUBSIDIARIES** **TELECON NOTE**

| CONTROL NO. | DATE: July 17, 1989 | TIME: 9:00am |
|---|---|---|

**DISTRIBUTION:**

Alcoa Badin Works

| BETWEEN: Scott Readling - Compliance | OF: NC Regional Office, NC Haz. Waste Mgmt., Field Oper. Team | PHONE: (919) 476-0030 |
|---|---|---|

**AND:** Joan Dupont, NUS Corporation

Joan Dupont

**DISCUSSION:**

I asked Mr. Readling about the old landfill at Alcoa Badin Works in Badin, Stanly County, North Carolina. At first, Mr. Readling said that the old landfill is not contiguous to the TSD facility. However, Mr. Readling said that the old landfill that he knows of is on the other side of the lake (i.e., Badin Lake). Conrad Carter (environmental manager for Alcoa Badin Works) showed the area to Mr. Readling during a visit to the facility. Old potliners were disposed of in the landfill. Mr. Readling was not aware of a landfill located southwest of the facility (i.e., the landfill indicated on page 5 of EPA Form 3510-3). The old lagoon is no longer present at the facility.

**ACTION ITEMS:**

NUS 067 REVISED 0685

**NUS CORPORA..JN ANL _UBSIDIARIES** **TELECON NOTE**

| CONTROL NO: | DATE: 7-18-89 | TIME: 9:20 AM |
|---|---|---|

DISTRIBUTION:

| BETWEEN: CONRAD CARTER, ENVIRONMENTAL ENGINEER | OF: ALCOA BADIN, BADIN, NORTH CAROLINA | PHONE: (704) 422-3621 |
|---|---|---|

AND: McKENZIE MALLARY Ken Mallary 7-18-89

DISCUSSION:

1) MR. CARTER STATED THAT THERE ARE 2 LANDFILLS WHICH WERE USED BY ALCOA IN THE PAST. THE LANDFILL ON THE SOUTHSIDE OF THE PLANT WAS USED FROM EARLY 1900's TO 1970's FOR DISPOSAL OF MUNICIPAL WASTE. THIS IS THE LANDFILL REFERRED TO IN THE FILE MATERIAL. THE SECOND LANDFILL IS LOCATED

AND WAS USED FOR THE DISPOSAL OF POTLINING WASTE AND BAKING FURNACE BRICK.

2) MR. CARTER DOES WANT TO SPLIT SAMPLES, AND HE WAS INFORMED THAT THEY WILL BE RESPONSIBLE FOR PROVIDING CONTAINERS AND LAB SERVICES.

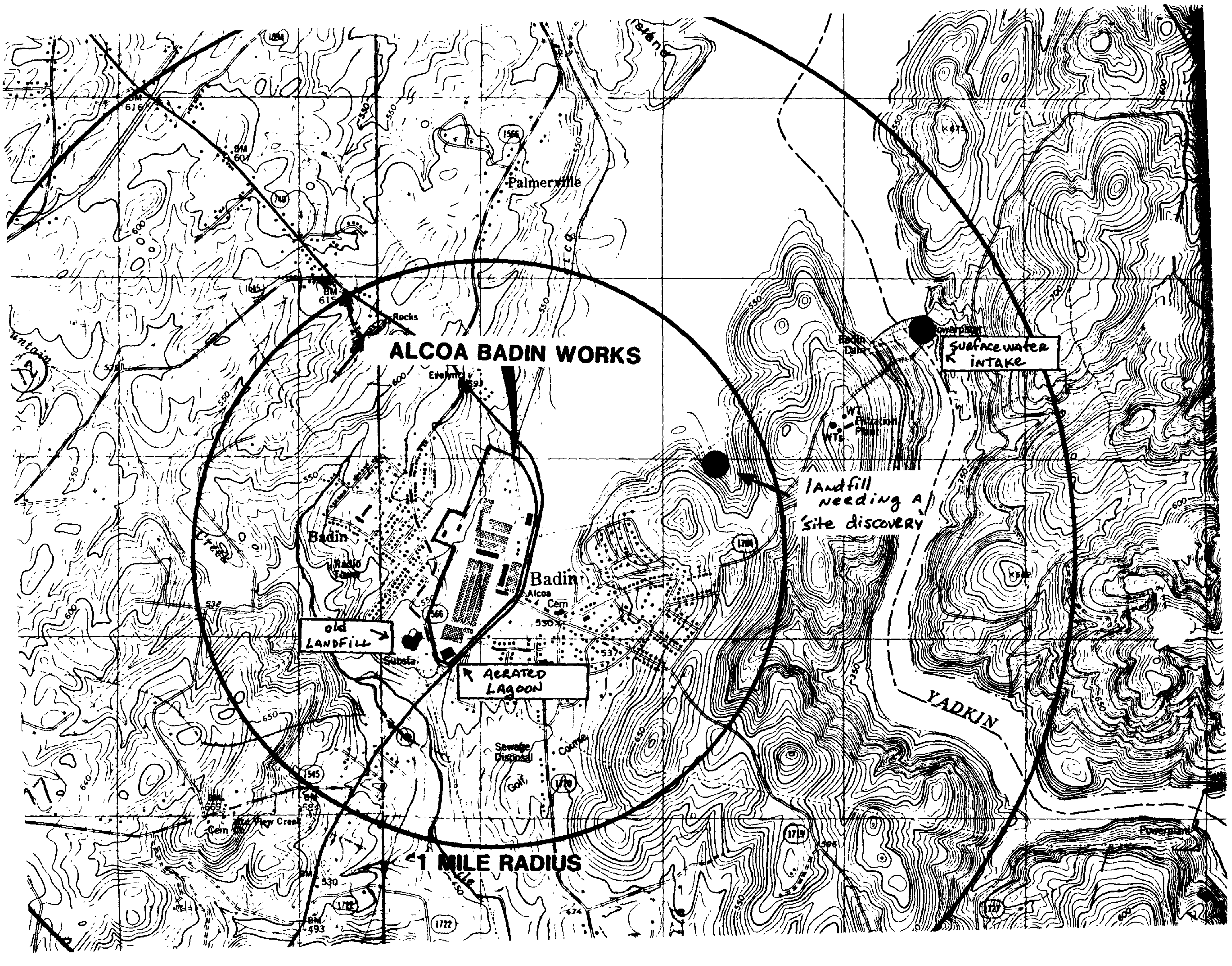
ACTION ITEMS:

PHONE NUMBERS AT ALCOA:

CONRAD CARTER – ENVIRONMENTAL ENGINEER
(704) 422-5631

– SAFETY
(704) 422-5606

NUS 067 REVISED 0685


ALCOA BADIN WORKS
1 MILE RADIUS
old LANDFILL
AERATED LAGOON
landfill needing a site discovery
Surface water intake
Badin
Badin
Palmerville
Badin Dam
WT Filtration Plant
Sewage Disposal
Golf Course
Alcoa Cem
Rocks
Substa
Powerplant
YADKIN

# REFERENCE 5

LATITUDE AND LONGITUDE CALCULATION WORKSHEET #2

LI USING ENGINEER'S SCALE (1/60)

SITE NAME: Alcoa Badin Works Landfill CERCLIS #: NA

AKA: SSID:

ADDRESS: NC Hwy 740 and Wood St

CITY: Badin STATE: NC ZIP CODE: 28009

SITE REFERENCE POINT: Entrance

USGS QUAD MAP NAME: Statesville East TOWNSHIP: - N/S RANGE: - E/W

SCALE: 1 : 24,000 MAP DATE: 1981 SECTION: - 1/4 - 1/4 - 1/4

MAP DATUM 1927 1985 (CIRCLE ONE) MERIDIAN: -

COORDINATES FROM LOWER RIGHT (SOUTHEAST) CORNER OF 7.5' MAP (attach photocopy)

LONGITUDE: 80 ° 0 ' 0.00 " LATITUDE: 35 ° 22 ' 30.00 "

COORDINATES FROM LOWER RIGHT (SOUTHEAST) CORNER OF 2.5' GRID CELL:

LONGITUDE: 80 ° 5 ' 0.00 " LATITUDE: 35 ° 22 ' 30.00 "

CALCULATIONS: LATITUDE (7.5' QUADRANGLE MAP)

A) NUMBER OF RULER GRADUATIONS FROM LATITUDE GRID LINE TO SITE REF POINT: 318

B) MULTIPLY (A) BY 0.3304 TO CONVERT TO SECONDS:

A X 0.3304 = 105.07 "

C) EXPRESS IN MINUTES AND SECONDS (1' = 60") : 1 ' 45.07 "

D) ADD TO STARTING LATITUDE: 35 ° 22 ' 30.00 " + 1 ' 45.07 "

SITE LATITUDE: 35 ° 24 ' 15.07 "

CALCULATIONS: LONGITUDE (7.5' QUADRANGLE MAP)

A) NUMBER OF RULER GRADUATIONS FROM RIGHT LONGITUDE LINE TO SITE REF POINT: 431

B) MULTIPLY (A) BY 0.3304 TO CONVERT TO SECONDS:

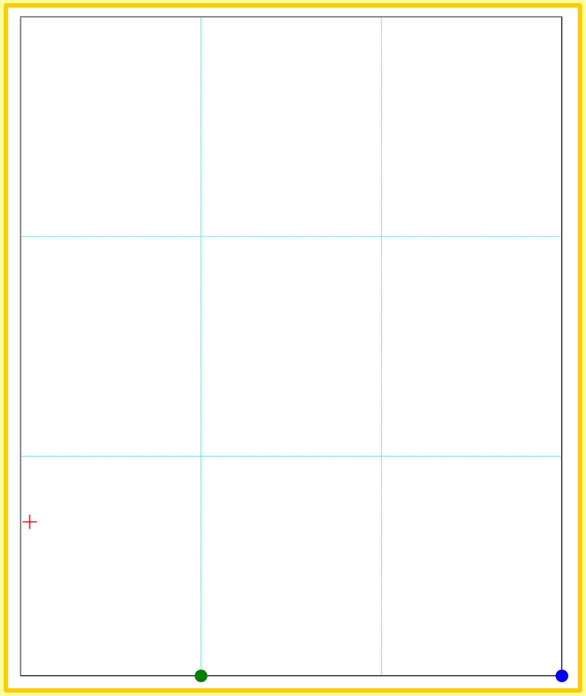
A X 0.3304 = 142.40 "

C) EXPRESS IN MINUTES AND SECONDS (1' = 60") : 2 ' 22.40 "

D) ADD TO STARTING LATITUDE: 80 ° 5 ' 0.00 " + 2 ' 22.40 "

SITE LONGITUDE: 80 ° 7 ' 22.40 "

INVESTIGATOR: Stuart F. Parker DATE: 8/11/2015



**Site Name:** **Alcoa Badin Works Landfill**

**USGS 7.5" Quadrangle:** **Statesville East**

| | Longitude | Latitude |
|---|---|---|
| **COORDINATES FROM LOWER RIGHT (SOUTHEAST) CORNER OF 7.5' MAP** | 80 ° 0 ' 0.00 " | 35 ° 22 ' 30.00 " |
| | 80.0000 ° | 35.3750 ° |
| **COORDINATES FROM LOWER RIGHT (SOUTHEAST) CORNER OF 2.5' GRID CELL** | 80 ° 5 ' 0.00 " | 35 ° 22 ' 30.00 " |
| | 80.0833 ° | 35.3750 ° |
| **SITE COORDINATES** | 80 ° 7 ' 22.40 " | 35 ° 24 ' 15.07 " |
| | 80.1229 ° | 35.4042 ° |

**REFERENCE 6**

# Data Tools: 1981-2010 Normals

The 1981-2010 Climate Normals are NCDC's latest three-decade averages of climatological variables, including temperature and precipitation. This new product replaces the 1971-2000 Climate Normals (http://hurricane.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl?directive=prod_select&subrnum=) product, which remains available as historical data.

The tool below provides temperature and precipitation Climate Normals for over 9,800 stations across the United States. Begin by selecting the desired dataset tab to view monthly, daily, annual/seasonal, or hourly Normals. Then select the desired location and a corresponding station.

Monthly Normals Daily Normals Annual/Seasonal Normals Hourly Normals

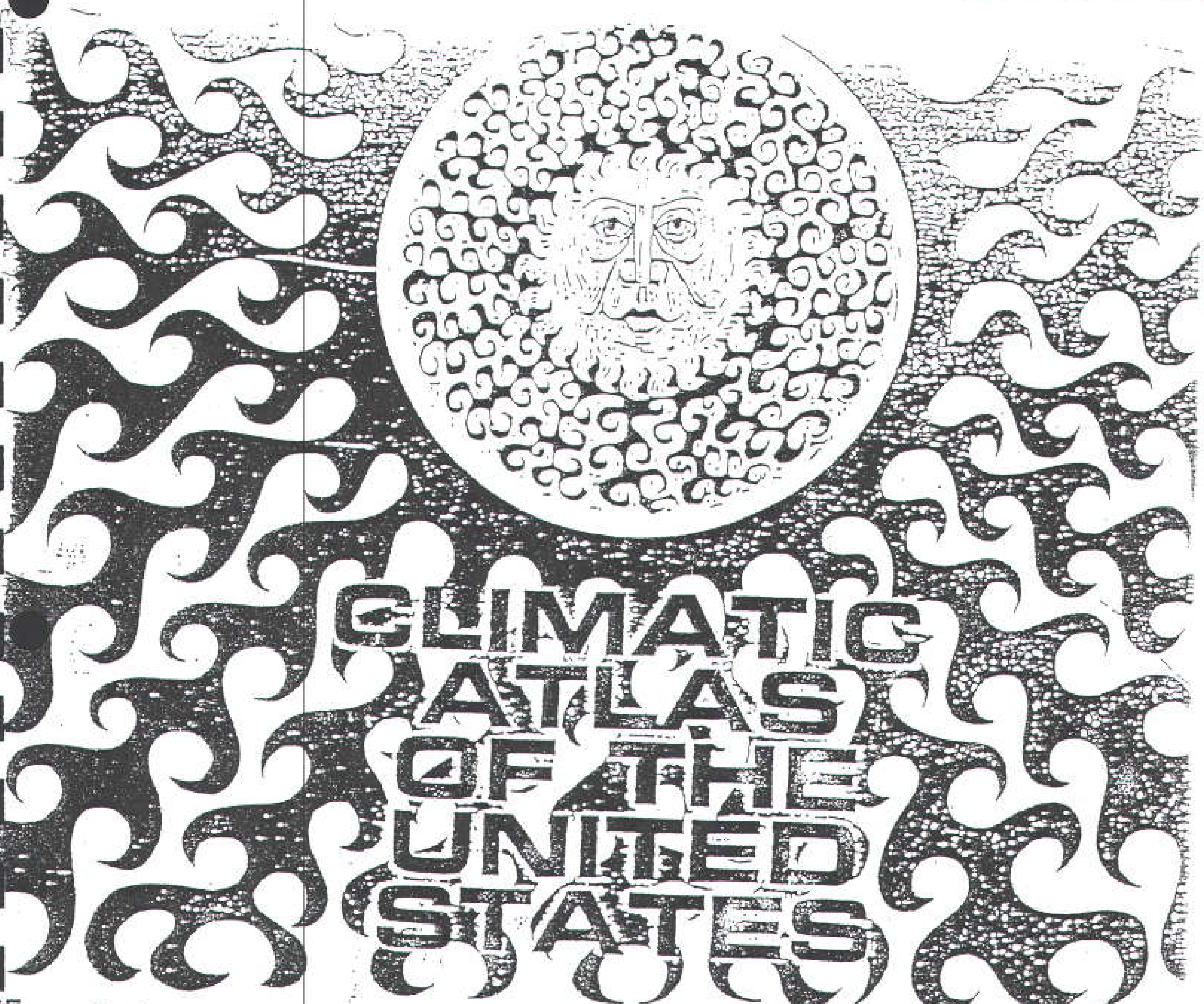
Use the form below to select the geographic region in the first pane, then select the station name in the next pane as the name list is populated.

| | |
|---|---|
| MONTANA | ALBEMARLE, NC US |
| NEBRASKA | APEX, NC US |
| NEVADA | ARCOLA, NC US |
| NEW HAMPSHIRE | ASHEBORO 2 W, NC US |
| NEW JERSEY | ASHEVILLE 13 S, NC US |
| NEW MEXICO | ASHEVILLE 8 SSW, NC US |
| NEW YORK | ASHEVILLE REGIONAL AIRPORT, NC US |
| NORTH CAROLINA | ASHEVILLE, NC US |

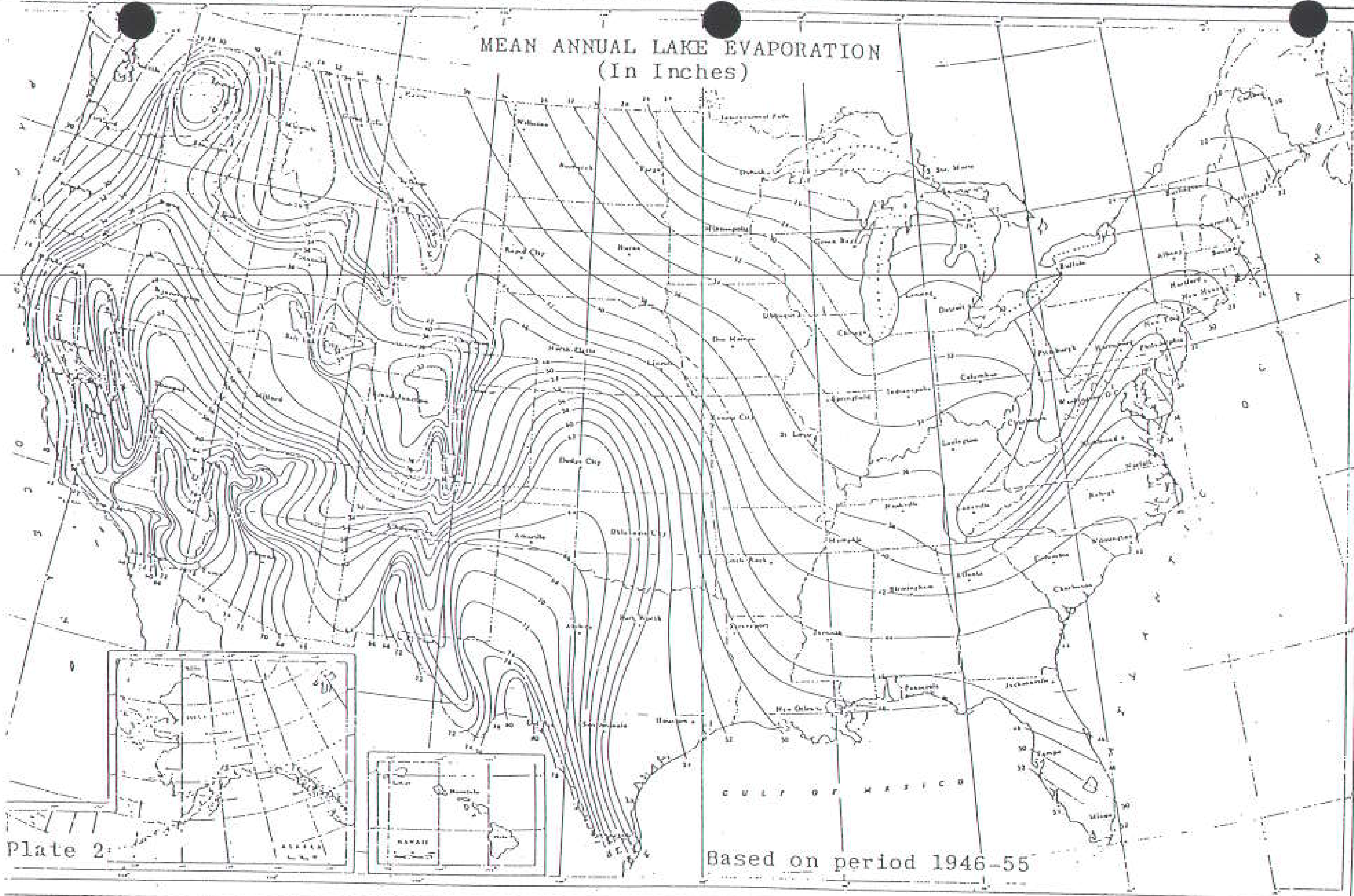
## ALBEMARLE, NC US

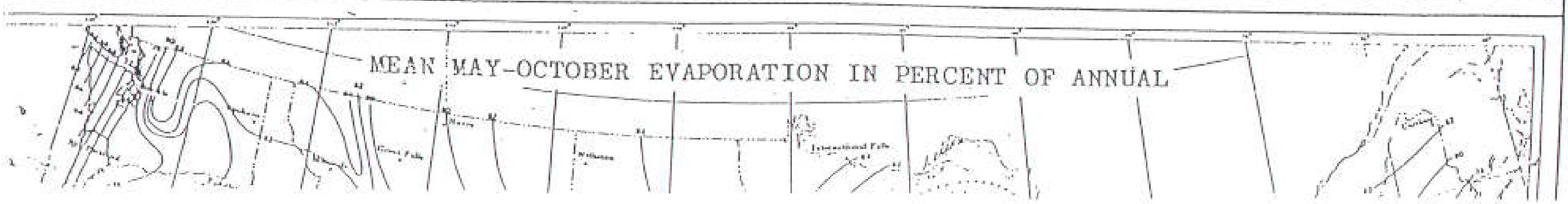
View Station Details (https://www.ncdc.noaa.gov/cdo-web/datasets/normal_ann/stations/GHCND:USC00310090/detail) View Station Report

| SEASON | PRECIP (IN) | MIN TMP (°F) | AVG TMP (°F) | MAX TMP (°F) |
|---|---|---|---|---|
| Annual | 48.76 | 48.9 | 59.9 | 70.8 |
| Winter | 10.98 | 31.3 | 42.0 | 52.7 |
| Summer | 14.88 | 67.5 | 77.3 | 87.2 |
| Spring | 11.45 | 47.2 | 58.9 | 70.7 |
| Autumn | 11.45 | 49.6 | 60.8 | 72.1 |




CE · Environmental Science Services Administration · Environmental Data Service


MEAN ANNUAL LAKE EVAPORATION
(In Inches)
GULF OF MEXICO
Plate 2:
Based on period 1946-55


MEAN MAY-OCTOBER EVAPORATION IN PERCENT OF ANNUAL

**REFERENCE 7**

ALCOA

Alcoa began producing aluminum at its Badin Works, a primary aluminum smelter, in August 1917. Electricity generated at the Yadkin Project was used to support the electric power needs of Badin Works.

Aluminum production at Badin was curtailed by Alcoa in August 2002, as part of a series of business decisions made by Alcoa to continue its long-term, low cost production strategy within the context of a weak economy. The plant continued to manufacture anodes and high-purity aluminum until 2007. The plant was permanently closed in 2010.

# REFERENCE 8

**PROPOSED**

# BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR SPENT ALUMINUM POTLINERS – K088

Fred Chanania
Chief, Waste Treatment Branch

Elaine Eby
Work Assignment Manager

U.S. Environmental Protection Agency
Office of Solid Waste
Aerial Rios Building (5101)
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Washington, D.C. 20460

May 31, 2000

## DISCLAIMER STATEMENT

## Table of Contents

**APPENDICES**

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## EXECUTIVE SUMMARY

This background document provides the U.S. Environmental Protection Agency's (EPA's) rationale and technical support for developing revised Land Disposal Restriction (LDR) treatment standards for K088. EPA defines K088 as spent potliners from primary aluminum reduction.

EPA prohibited the land disposal of both nonwastewater and wastewater forms of Hazardous Waste K088 in the Phase III Land Disposal Restrictions Rule (61 FR 15566, April 8, 1996). In that rule, the Agency established concentration-based limits for 25 constituents in nonwastewater and wastewater forms of K088. Subsequent to the publication of the final rule, petitions for judicial review of the Phase III rule were filed with the U.S. Court of Appeals for the District of Columbia. In an April 3, 1998 decision, the Court ruled that EPA's use of the Toxicity Characteristic Leaching Procedure (TCLP) as a basis for setting treatment standards was arbitrary and capricious for those constituents for which the TCLP demonstratively and significantly underpredicted the amount of the constituent that would leach.[1] While this language applied only to fluoride and arsenic, the Court vacated all of the treatment standards established for K088 in the Phase III rule. Issuance of the Court's decision was to be delayed, until September 24, 1998, in response to an Agency motion. On September 24, 1998, EPA published the land disposal prohibition and treatment standards for wastewater and nonwastewater forms of K088 (63 FR 51254), including a revised, interim treatment standard for arsenic in nonwastewater forms of K088 and deferral of revised fluoride standards. In that interim final rule, the Agency announced its long-term goal of promulgating a revised set of treatment standards for K088 based on the performance of a treatment technology that results in the immobilization of arsenic and fluoride, as well as the other toxic metals in the waste.

This background document supports EPA's current task, as outlined in the September 24, 1998 final rule, of proposing revised waste-specific LDR treatment standards for nonwastewater forms of K088, specifically, fluoride and two forms of cyanide. Compliance with these standards will be based on the concentrations of total cyanide, amenable cyanide, and the leachable

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[1]EPA's interpretation of the Court's opinion. See 139 F.3d 914.

concentration of fluoride in the waste as measured by a version of the TCLP that uses deionized water as the leaching fluid (ASTM Method D3987–85 (1999)). The Agency is deferring further action of a revised arsenic standard to replace the interim standard at this time pending completion of additional research. Treatment standards for arsenic and the remaining 22 constituents in wastewater and nonwastewater forms of K088 wastes remain in effect, as promulgated in the September 24, 1998 rule, and must be complied with before land disposal. These standards, along with the proposed treatment standards for amenable cyanide, total cyanide, and fluoride, are also highlighted in Table ES–1.

In developing the LDR treatment standards presented in this document, EPA initially focused only on three constituents in K088 wastes–arsenic, fluoride and cyanide. Additional constituents, including PAHs and other metals, are regulated constituents in K088 and were not subject to the Agency's re-evaluation. EPA subsequently is proposing treatment standards for fluoride and cyanide. However, because the proposed treatment standards are developed from a technology different than the one used in developing the current treatment standards, EPA evaluated whether this treatment technology would generate residuals that would also meet these existing treatment standards.

The treatment standards for fluoride and cyanide are based on performance data for a full-scale combustion melting system process in operation at Ormet Corporation, Hannibal, Ohio[2], and were developed consistent with existing EPA procedures detailed in *Final Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance, Quality Control Procedures, and Methodologies,* October, 1991 (1).

For the convenience of the reader, Table ES–1 presents a full listing of the constituents of concern and their corresponding treatment standards. The proposed revisions for fluoride and cyanide appear at the beginning of Table ES–1.

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[2]After analyzing and evaluating technical performance data of full-scale treatment facilities, the Agency determined Ormet's process to be BDAT for the treatment of fluoride and cyanide. The BDAT process at Ormet also can produce a treatment residual with concentrations of the remaining 23 hazardous constituents, including arsenic, that meet treatment standards of nonwastewater forms of K088.

**Table ES–1. Summary of Existing Treatment Standards and Proposed Numerical Treatment Standards for Selected Constituents in Spent Aluminum Potliner — K088**

| Constituent of Concern | Proposed Numerical Standard[a] (40 CFR §268) | |
|---|---|---|
| | WW (mg/L) | NWW |
| Fluoride | — | 2.7 mg/L[b] |
| Cyanide | — | 1.4 mg/kg[c] |
| Cyanide (amenable) | — | 1.4 mg/kg[c] |
| | Existing Numerical Standard (40 CFR §268) | |
| | WW (mg/L) | NWW (mg/kg) or noted as mg/L TCLP[d] |
| Acenaphthene | 0.059 | 3.4 |
| Anthracene | 0.059 | 3.4 |
| Benz(a)anthracene | 0.059 | 3.4 |
| Benzo(a)pyrene | 0.061 | 3.4 |
| Benzo(b)fluoranthene | 0.11 | 6.8 |
| Benzo(k)fluoranthene | 0.11 | 6.8 |
| Benzo(g,h,i)perylene | 0.0055 | 1.8 |
| Chrysene | 0.059 | 3.4 |
| Dibenz(a,h) anthracene | 0.055 | 8.2 |
| Fluoranthene | 0.068 | 3.4 |
| Indeno(1,2,3-cd)pyrene | 0.0055 | 3.4 |
| Phenanthrene | 0.059 | 5.6 |
| Pyrene | 0.067 | 8.2 |
| Antimony[e] | 1.9 | 1.15 mg/L TCLP |
| Arsenic | 1.4 | 26.1 |
| Barium[e] | 1.2 | 21.0 mg/L TCLP |
| Beryllium[e] | 0.82 | 1.22 mg/L TCLP |
| Cadmium[e] | 0.69 | 0.11 mg/L TCLP |
| Chromium (total) | 2.77 | 0.60 mg/L TCLP |
| Cyanide (total) | 1.2 | 590[a] |
| Cyanide (amenable) | 0.86 | 30[a] |
| Fluoride | 35 | — |
| Lead[e] | 0.69 | 0.75 mg/L TCLP |
| Mercury[e] | 0.15 | 0.025 mg/L TCLP |
| Nickel[e] | 3.98 | 11.0 mg/L TCLP |
| Selenium[e] | 0.82 | 5.7 mg/L TCLP |
| Silver[e] | 0.43 | 0.14 mg/L TCLP |

[a] The numerical treatment standards for nonwastewater forms of total cyanide and amenable cyanide found in K088 wastes are currently published in 40 CFR §268 as: total cyanide - 590 mg/kg, and amenable cyanide - 30 mg/kg.
[b] The previous treatment standard for fluoride was 48 mg/L TCLP. The proposed fluoride treatment standard presented is based on a total fluoride analysis of the TCLP leaching procedure using distilled water as the leaching fluid (ASTM Method D3987–85 (1999)). Fluoride analysis may be performed according to SW–846 Method 9056. No preparation of the sample extract should be necessary.
[c] The proposed cyanide treatment standards presented are based on total and amenable analyses. These analyses may be performed according to SW–846 Method 9010 or 9012. The methods must be followed, as written, for liquid samples. For solid samples, an additional note is presented in 40 CFR 268.40, footnote 7 of the Treatment Standard Table.
[d] TCLP refers to the Toxicity Characteristic Leaching Procedure, SW–846 Method 1311.
[e] The nonwastewater numerical standards included here were revised in May 1998 by EPA as Universal Treatment Standards (UTS). The listed UTS apply to nonwastewater forms of any listed or characteristic hazardous waste required for land disposal. (63 FR 28556, May 26, 1998.)

## 1.0 INTRODUCTION

This background document presents calculations for revised treatment standards for nonwastewater forms of spent potliners from primary aluminum reduction (K088 waste). Specifically, the U.S. Environmental Protection Agency (EPA) is proposing revised, concentration-based treatment standards for amenable cyanide, total cyanide, and fluoride under its Land Disposal Restrictions (LDR) program. The Agency is proposing these treatment standards as part of its long-term goal of promulgating a revised set of treatment standards for K088.

Section 3004(m) of the Resource Conservation and Recovery Act (RCRA) of 1976 enacted by the Hazardous and Solid Waste Amendments (HSWA) of November 8, 1984 specifies that treatment standards must minimize long- and short-term threats to human health and the environment arising from land disposal of hazardous wastes. EPA's treatment standards for individual wastes are presented at Title 40 *Code of Federal Regulations* Section 268.40 (40 CFR 268.40). For a given waste, a treatment standard specifies (1) the concentration of each constituent in total or Toxicity Characteristic Leaching Procedure (TCLP) analysis or (2) a technology which must be used for treating the waste. EPA establishes treatment standards for wastewaters and nonwastewaters, as well as any subgroups which may be appropriate. Compliance with treatment standards is a prerequisite for land disposal, as defined in 40 CFR Part 268. In 40 CFR 268.44 and 268.6, respectively, EPA supplies provisions, that, if met, may justify granting a variance or waste- and site-specific waivers from the applicable treatment standards in 268.40.

EPA's general approach for complying with the requirements, as outlined in HSWA, was promulgated as part of the November 7, 1986 Solvents and Dioxins rule. EPA has, however, established the treatment standards presented in this document according to its guidance in the *Final Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance, Quality Control Procedures, and Methodologies*, October 1991 (1).

### 1.1 Regulatory Background

EPA finalized the land disposal of both nonwastewater and wastewater forms of K088 in the Phase III Land Disposal Restriction rule (61 FR 15566, April 8, 1996). The Phase III LDR prohibited the land disposal of spent potliner unless the waste satisfied the section 3004(m) treatment standard established in the same rulemaking. The Phase III rule also established concentration-based treatment standards for various constituents in both wastewater and nonwastewater forms of K088. These 25 constituents, included arsenic, cyanide, fluoride, toxic metals, and a group of organic compounds called polycyclic aromatic hydrocarbons (PAHs).

With one exception, the treatment standard limits established for K088 were equivalent to the universal treatment standards in 40 CFR 268.48. The fluoride standard, however, was based generally on data submitted in a delisting petition from the Reynolds Metal Company. During a nine-month national capacity variance pursuant to Section 3004(h)(20), where the Agency allowed facilities generating K088 adequate time to work out logistics (61 FR 15589, April 8, 1996), unexpected performance problems in the Reynolds treatment process resulted in the generation of leachate exhibiting characteristics of hazardous waste.[3] The company was also disposing of the treatment residues in non-subtitle C units. EPA therefore felt that further time was needed to evaluate whether adequate protective treatment capacity was available and, as part of this determination, whether Reynolds' practices in fact satisfied the mandate of Section 3004(m) that threats posed by land disposal of the hazardous waste be minimized through treatment. Until these questions were answered, and a finding of sufficient protective treatment capacity was made, there was insufficient treatment capacity for the waste because Reynolds, at the time, was the only existing commercial treatment facility for spent potliners. Consequently, on January 14, 1997 (62 FR 1992), the Agency extended the national capacity variance and postponed implementing the land disposal prohibition for an additional six months to be able to study the efficacy of the Reynolds treatment process and the resulting leachate.

---

[3]It was discovered that the Reynolds treatment process produced residues having actual leachate that contained higher concentrations of arsenic and fluoride than the concentrations predicted by the Toxicity Characteristic Leaching Procedure (TCLP). Also, arsenic and fluoride were significantly more soluble in highly alkaline conditions (the disposal environment of the landfill used by Reynolds) than acidic conditions (the modeled environment predicted by the TCLP)(62 FR 1992, January 14, 1997).

In July 1997 (62 FR 37696), EPA announced that, "Reynolds' treatment (albeit imperfect) does reduce the overall toxicity associated with the waste," that disposal of treatment residues would occur only in units meeting Subtitle C standards, and consequently, treatment was an improvement over the disposal of untreated spent potliner and provided adequate protective treatment capacity. On October 8, 1997, the national capacity extension ended, and the prohibition on land disposal of untreated spent potliner took effect.

Subsequent to the publication of the Phase III rule, the January 1997 extension, and the July 1997 rule, petitions for judicial review were filed with the U.S. Court of Appeals for the District of Columbia. The petitioners, namely Columbia Falls Aluminum Company and other aluminum producers from the Pacific Northwest, argued (among other things) that use of the Toxicity Characteristic Leaching Procedure (TCLP) did not accurately predict the leaching of waste constituents, particularly arsenic and fluoride, to the environment and that it was, therefore, arbitrary to measure compliance with the treatment standard using this test. The U.S. Court of Appeals for the District of Columbia decided on April 3, 1998 that EPA's use of the TCLP as a basis for measuring concentrations for treatment standard calculations of K088 waste was arbitrary and capricious for those constituents for which the TCLP demonstratively and significantly underpredicted the amount of the constituent that would leach (138 F.3d 914). With this language only applied to arsenic and fluoride in nonwastewater forms of K088, only 2 of 54 treatment standards were implicated; however, the Court vacated all of the treatment standards established for K088 in the Phase III rule and the prohibition on land disposal.

In response to the April 3, 1998 Court decision, EPA filed a motion with the Court on May 18, 1998 to delay issuance of its mandate for four months while the Agency promulgated a replacement prohibition and accompanying treatment standards. The Court granted this motion, indicating that its mandate would not issue before September 24, 1998.

Shortly thereafter, on September 24, 1998, the Agency published a final rule prohibiting the land disposal of K088 and promulgated interim replacement standards for K088, pending the completion of a review of all information on treatment processes that could serve as a basis for permanent, revised standards. (63 FR 51254, September 24, 1998.) The Agency reinstated the previously vacated standards for the 52 wastewater and nonwastewater treatment standards for which compliance was not measured through the use of the TCLP. For arsenic in nonwastewater forms of K088, the Agency promulgated a concentration-based numerical standard of 26.1 mg/kg, based on total arsenic concentrations. The concentration-based, numerical standard was determined from data sets submitted to the Agency identified in a Notice of Data Availability (NODA).[4] (63 FR 41536, August 4, 1998). For fluoride, the Agency elected not to develop an interim standard in nonwastewater K088, but to defer action until additional research and analysis could be completed. Refer to Appendix A for more information regarding the regulatory history affecting K088 treatment standard development, and Appendices B and C for additional information regarding the August 4, 1998 NODA and the September 24, 1998 final rule, respectively.

## 1.2 Summary

This background document presents calculations for revised treatment standards for fluoride, total cyanide, and amenable cyanide in K088 waste. A revised treatment standard for fluoride is calculated to be 2.7 mg/L, based on concentrations measured by a version of the TCLP that uses deionized water as the leaching fluid (ASTM Method D3987–85 (1999)). The proposed treatment standards for total cyanide and amenable cyanide, 1.4 mg/kg and 1.4 mg/kg, respectively, were based on analysis performed according to SW–846 Method 9010. Although treatment standards were promulgated for total and amenable cyanide in the September 24, 1998 rule, EPA found that the cyanide present in K088 waste can be treated to levels far below the current treatment standard and has maintained its objective of controlling the release of high

---

[4]The August 4, 1998 NODA (63 FR 41536) issued by the Agency identified four data sets as possible data sets from which a total arsenic standard could be developed. Two of the data sets represented full-scale data from the treatment of K088 at the Reynolds Metal Company treatment facility. The other two data sets represented pilot-scale data from a combustion melting system process at the Ormet Corporation treatment facility. The arsenic treatment standard was calculated using one of the Reynolds data sets.

concentrations of cyanide by developing these revised, concentration-based treatment standards.

After comparing full-scale treatment technologies within the aluminum industry, namely, treatment processes at Reynolds Metal Company in Gum Springs, Arkansas, Chemical Waste Management of the Northwest (CWMNW) in Gilliam County, Oregon,[5] and Ormet Corporation in Hannibal, Ohio, the Agency determined Ormet's combustion melting system process as BDAT and calculated the treatment standards presented within this document based on concentrations of treated, spent potliner samples taken from this process. The Ormet process is a direct-fired vitrification system that provides highly effective treatment of cyanide, along with organic compounds contained in the K088 waste and effectively recovers the fluoride in the form of dust for reuse material. Specifically, a baghouse dust is produced from the treatment process and is fluoride-rich material which can be recycled back into the aluminum process or can be used by other industrial sectors. Also, Ormet's process effectively immobilizes the residual fluoride in the treated potliner in a glass-like matrix or "frit" and meets all treatment standards for regulated constituents in K088 nonwastewaters. Samples of the untreated spent potliner, treated glass residue, and baghouse dust were collected on June 15, 1999 and analyzed using methodologies outlined in Appendix I.

[5]Although the Agency reviewed treatment processes at CWMNW, performance data submitted by the facility was labeled as Confidential Business Information (CBI) and, therefore, was not presented in this Background Document.

## 2.0 DESCRIPTION OF SPENT ALUMINUM POTLINERS

This section describes the industry generating Hazardous Waste Number K088, the facilities generating these wastes, the processes generating the waste, the physical and chemical characteristics of this waste, and waste management practices handling these wastes.

### 2.1 Description of the Aluminum Production Industry

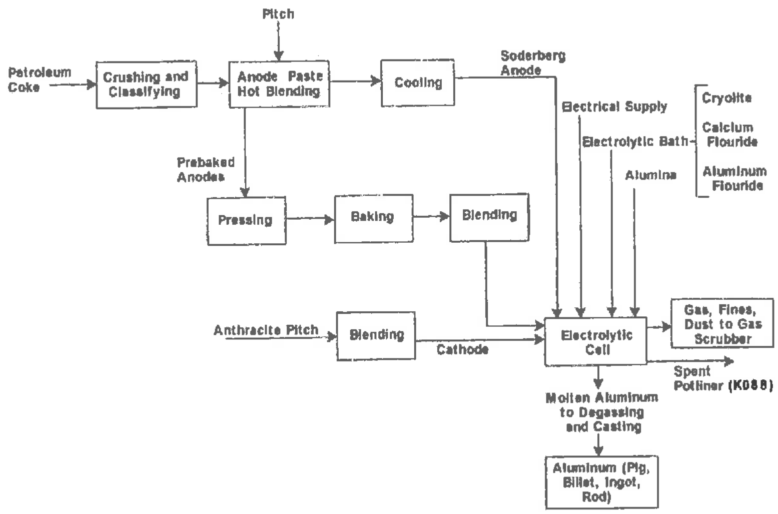
#### 2.1.1 Description of Aluminum Reduction Process

Aluminum reduction facilities are classified by the U.S. Office of Management and Budget under Standard Industrial Classification (SIC) code 3334, which is under major heading 33, primary metal industries (4).

The production of aluminum occurs in four distinct steps: (1) the mining of bauxite ores, (2) the refining of bauxite to produce alumina ($Al_2O_3$), (3) the reduction of alumina to aluminum metal, and (4) casting of the molten aluminum. Spent potliner (K088) is generated from Step (3), so only that portion of the process will be described. Figure 2–1 provides a simplified process flow diagram of the aluminum reduction process. The diagram shows the location of the generation of the spent potliner in the process.

All primary aluminum produced in the United States is manufactured by the Hall-Heroult process using alumina as a raw material. Aluminum is refined by dissolving alumina (aluminum oxide) in a molten cryolite ($Na_3AlF_6$) bath. An electric current is then introduced reducing the alumina to aluminum. The reduction process requires high purity aluminum oxide, carbon, and electrical power and takes place in carbon-lined, steel electrolytic Hall cells, or "pots."

**Figure 2–1. Schematic of the Aluminum Process**




Reference: U.S. EPA, Office of Water, Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Primary Aluminum Smelting Subcategory of Aluminum Segment of the Nonferrous Metals Manufacturing Point Source Category, 1974 (5).

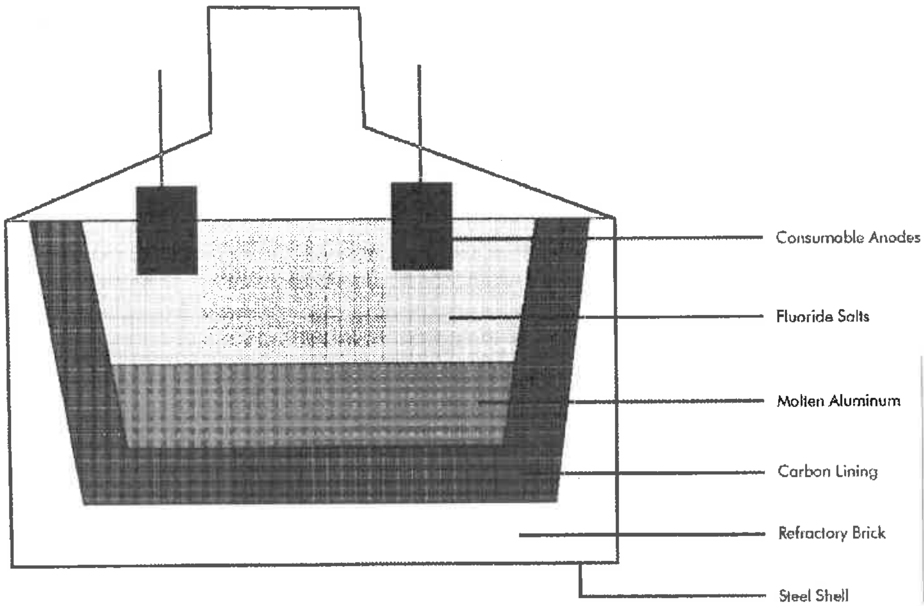
Pots consist of a steel container lined with refractory brick with an inner lining of carbon. The size of a pot ranges from 6x18 to 14x42 feet (5). Figure 2–2 shows a general sketch of a typical pot. These pots are electrically connected in series to form a potliner, which may contain from 100 to 300 reduction cells. Incoming, alternating current is transformed directly to direct current (DC) at high voltages and is fed to the line of pots. In this way, the operation is essentially at constant current, but the individual voltages can be varied on each pot. The DC supplied is on the order of several hundred volts and 60,000 to 100,000 amps. The carbon liner is usually up to 15 inches thick and serves as the cathode in the electrolytic circuit transforming aluminum ions from the molten bath to molten aluminum. The electrolysis takes place is in a molten bath generally composed of the following materials:

| | |
|---|---|
| Cryolite ($Na_3AlF_6$) | 80 to 85% |
| Calcium fluoride ($CaF_2$) | 5 to 7% |
| Aluminum fluoride ($AlF_3$) | 5 to 7% |
| Alumina ($Al_2O_3$) | 2 to 8% |

The function of the electrolyte is to enable physical separation between the cathodically produced aluminum and the anodically evolved oxides of carbon while also enabling electrolytic decomposition of the alumina. The essential ingredient of the electrolyte is cryolite, or sodium aluminum fluoride ($Na_3AlF_6$). The pure white or colorless mineral is used principally because it is the best flux for alumina. Various additions to the cryolite modify its physical and chemical properties and, thus, improve cell performance. Aluminum fluoride and calcium fluoride are used to lower the melting point of the electrolyte.

The composition of the bath varies as electrolysis proceeds. Electrolyte is absorbed by the lining, which becomes saturated in the first 80 to 85 days of operation. The electrolytic bath normally operates at approximately 950 EC . The aluminum reduction reaction results in reducing trivalent aluminum ($Al^{+3}$) to liquid metal at the cathode. Oxygen appears at the anode and reacts with the anode to form a mixture of 75 percent carbon dioxide and 25 percent carbon monoxide, consuming the carbon anode (6). The main electrochemical reaction occurring is represented by the following equation, with the aluminum being deposited at the bottom of the cell: $2Al_2O_3$ (dissolved) + 3C(s) X 4Al(l) + $3CO_2$(g).

**Figure 2–2. Simplified Diagram of a Typical Pot**




Reference: U.S. EPA, Office of Water, Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Primary Aluminum Smelting Subcategory of Aluminum Segment of the Nonferrous Metals Manufacturing Point Source Category (5).

There are basically two types of cells that are used for the production of aluminum. These are referred to as pre-baked anode (intermittent replacement) and the Soderberg anode (continuous replacement). The primary difference between the cells is the manner in which the anode is baked and consumed. For either system, the anode preparation begins in the anode paste plant, where petroleum coke and pitch are hot blended. For prebaked anodes, the anode paste is pressed in molds, and the anodes are baked in an anode bake plant. The baked anodes are used to replace consumed anodes. In the Soderberg anode system, the anode paste is not baked initially, but is fed continuously in the form of briquettes through the shell of the pot. As the anode is consumed in the pot, it must be continually lowered to maintain a constant depth of anode immersed within the electrolyte. Additional paste is added to the top of the anode to replace the consumed anode. As the paste approaches the hot bath, the paste is baked in place to form the anode. Soderberg anodes are supported in the pot by one of two methods: vertical stud Soderberg (VSS) or by horizontal stud Soderberg (HSS) (5). While all electrolytic pots operate on the same principles, the pots produced by each aluminum company may vary in design. The same facility conducting aluminum reduction may also produce (and bake) anodes.

At predetermined intervals the overlaying crust is broken into the bath. Alumina is added to the bath intermittently to maintain the concentration of dissolved alumina within a desired range. The molten aluminum is collected from each pot by siphoning a measured aliquot from the cell into a transportable vessel. The aluminum is then taken directly to the casting process to be cast into ingots or pigs as the final product in a separate casthouse facility or it is taken to a holding furnace.

It is essential for purity of the product aluminum and the structural integrity of the cell that the molten aluminum be isolated from the steel shell. Over the life of the cathode, the carbon materials become impregnated with the cryolite electrolytic solution. As the cryolite is absorbed into the cathode, the integrity of the lining can be reduced and cracks or heaving of the lining can occur. A pot "fails" when iron is detected in the molten aluminum, when cell voltage increases, or when the shell leaks molten metal or electrolyte. The iron contamination can be caused by the development of cracks or by erosion in the carbon lining, which allow electrolyte to come in contact with the steel collector bars or steel shell. Upon failure of a liner, the cell is emptied and cooled. The pot is then removed from the cellroom to a working area or dismantled in place. By mechanical drilling and/or soaking in water, the steel shell is stripped of the carbon lining. There are two portions of spent potliner. These are designated as first cut and second cut potliner. First cut potliner consists of the upper portions of the carbon from the bottom block and side walls. Second cut material is the thermal insulation composed of carbon insulating brick or alumina. The first cut carbon lining is the subject of the K088 listing. The second cut, which includes the steel collector bars, steel shell, insulating brick, and possibly molten aluminum, is segregated or co-disposed. Aluminum may be present in the second potliner if the carbon lining cracks or erodes and allows electrolyte to come in contact with the shell or collector bars. Following removal from the cell, the spent potliner is generally stored in rail cars, dumpsters, or piles prior to treatment and disposal.

The service life of a pot is variable. At one facility, a service life of four years is typical (Appendix H; 1999 site visit report). Older information from 1980 report that four to seven years for a potliner is common, with a service life of up to ten years in some cases (7). Some of the factors that may impact the potlife include strength of the pot shell, cell preheat procedures, quality of cathode blocks and sidewall blocks, and type of ramming paste. While a longer service life reduces the generation rate of hazardous waste (and the costs for management), longer use of a potliner may detrimentally affect the quality of the aluminum produced.

### 2.1.2 Size and Geographical Distribution of Facilities

Currently, there are 23 aluminum reduction facilities (each generating spent potliners) operated in the United States. These facilities produced an estimated 3,700,000 metric tons of aluminum in 1998, which were produced in the following states (8; 9):

| | |
|---|---|
| Indiana | Ohio |
| Kentucky | Oregon |
| Maryland | South Carolina |
| Missouri | Tennessee |
| Montana | Texas |
| New York | Washington |
| North Carolina | West Virginia |

Table 2–1 provides a list of these facilities. This list includes the name and location of the facility, aluminum reduction capacity, and quantity of spent potliner generated in 1997. Figure 2–3 shows a map with the approximate location of each facility.

**Table 2–1. Aluminum Reduction Facilities Generating Spent Potliner**

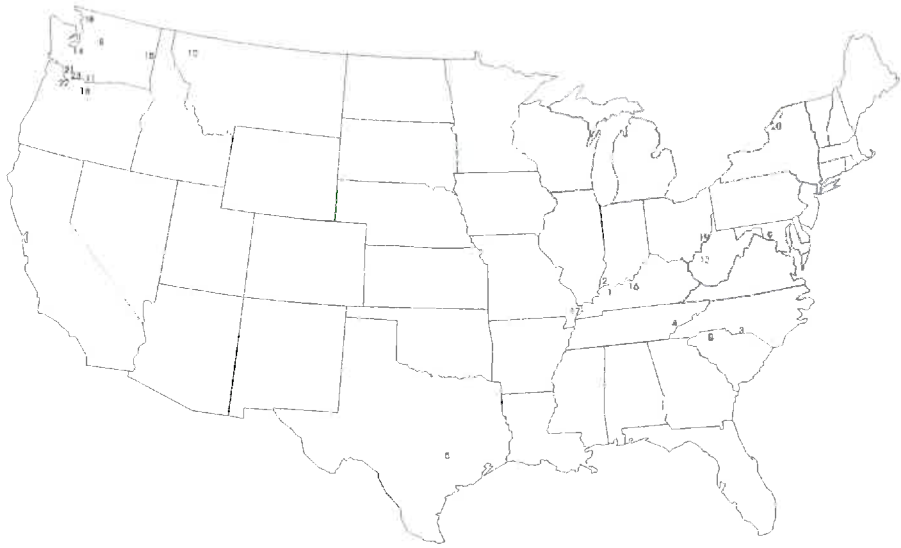
| Company | Location | 1997 Year-End Reduction Capacity (Thousand Metric Tons)[a] | 1997 Spent Potliner Generation Rate (Tons) |
|---|---|---|---|
| Alcan | Sebree, KY | 186 | 3,658 |
| Alcoa | Evansville, IN | 300 | 6,069 |
| Alcoa | Badin, NC | 115 | 1,169 |
| Alcoa | Alcoa, TN | 210 | 1,069 |
| Alcoa | Rockdale, TX | 315 | 7,119 |

**Table 2–1. Aluminum Reduction Facilities Generating Spent Potliner**

| Company | Location | 1997 Year-End Reduction Capacity (Thousand Metric Tons)[a] | 1997 Spent Potliner Generation Rate (Tons) |
|---|---|---|---|
| Alcoa | Wenatchee, WA | 220 | 2,469 |
| Alcoa | Massena, NY | 125 | 2,043 |
| Alumax | Mt. Holly, SC | 205 | 2,449 |
| Alumax/Eastalco | Frederick, MD | 174 | 2,469 |
| Alumax/Intalco | Ferndale, WA | 272 | 8,681 |
| Goldendale Aluminum Corp. | Goldendale, WA | 160 | 6,527 |
| Columbia Falls Aluminum Co. | Columbia Falls, MT | 168 | 4,558 |
| Kaiser Aluminum | Tacoma, WA | 73 | 2,253 |
| Kaiser Aluminum | Spokane, WA | 200 | NA |
| NSA | Hawesville, KY | 186 | 3,096 |
| Noranda Aluminum | New Madrid, MO | 215 | 5,643 |
| Northwest Aluminum | The Dalles, OR | 82 | 1,212 |
| Ormet Corporation | Hannibal, OH | 256 | 5,170[b] |
| Century Aluminum Corp. | Ravenswood, WV | 168 | 6,546 |
| Reynolds Metals Co. | Massena, NY | 123 | 3,981 |
| Reynolds Metals Co. | Longview, WA | 204 | 4,987 |
| Reynolds Metals Co. | Troutdale, OR | 121 | NA |
| Vanalco | Vancouver, WA | 116 | 2,634 |
| Total | | 4,190 | 83,802 |

[a]The 1997 Year End Reduction Capacity was determined based on the facilities' available *capacity* to produce the reported amounts of aluminum. These numbers do not represent actual production of aluminum in 1997; actual year- end production information was unavailable.
[b]Note that this amount of potliner generated at Ormet Corporation does not represent the amounts of baghouse dust and treated residue generated as a result of treatment since the current full-scale process was not operated at that time.
NA: Data not available in 1997 BRS for this facility.
References:
U.S. Geological Survey, Minerals Information 1997, Aluminum (8).
1997 Biennial Reporting System, public release version April 1999 (14).

**Figure 2–3. Locations of Aluminum Reduction Facilities Generating Spent Potliner**



1. Alcan—Sebree, KY
2. ALCOA—Evansville, IN
3. ALCOA—Badin, NC
4. ALCOA—Alcoa, TN
5. ALCOA—Rockdale, TX
6. ALCOA—Wenatchee, WA
7. ALCOA—Massena, NY
8. Alumax—Mt. Holly, SC
9. Alumax/Eastalco—Frederick, MD
10. Alumax/Intalco—Ferndale, WA
11. Goldendale Al. Corp.—Goldendale, WA
12. Columbia Falls Al. Co.—Columbia Falls, MT
13. Century Aluminum—Ravenswood, WV
14. Kaiser Aluminum—Tacoma, WA
15. Kaiser Aluminum—Spokane, WA
16. National Southwire—Hawesville, KY
17. Noranda Aluminum—New Madrid, MO
18. Northwest Aluminum—The Dalles, OR
19. Ormet Corp—Hannibal, OH
20. Reynolds Metals—Massena, NY
21. Reynolds Metals—Longview, WA
22. Reynolds Metals—Troutdale, OR
23. Vanalco—Vancouver, WA

Reference: U.S. Geological Survey, 1997 Minerals Information: Aluminum (8).

Table 2–1 also includes the K088 generation rate from the 1997 Biennial Reporting System (BRS) database. A total of 21 reduction facilities generating K088 reported data to the 1997 BRS.[6,7] As shown in Table 2–1, approximately 84,000 tons of K088 were generated in

[6] A total of 23 facilities currently use processes that generate K088, but two facilities did not report any K088 generation data for 1997. This may be because some facilities may have been idle, may not have generated K088 in the reporting year, or they may have labeled their 1997 National Biennial Reports as Confidential Business Information (CBI).

[7] In support of K088 treatment standard development, the Agency has collected data on K088 generation from 1991 to 1998 BRS reports. However, within this Background Document EPA has analyzed and included the most recent data collected from the 1997 BRS and the 1998 BRS.

1997. Table 2–1 also shows that Alcoa, Alumax, Reynolds Metal, Century Aluminum, and Goldendale Aluminum Corporation, with 19,938, 13,599, 8,968, 6,546, and 6,527 tons, respectively, were top generators of spent potliner in 1997.

Domestic primary aluminum production has been rising since 1994. In 1994, 3.3 million metric tons of primary aluminum were produced compared with 3.7 million metric tons in 1998. Additional production capacity remains, with approximately 430,000 metric tons remaining idle as of October 1998. The estimated aluminum reduction capacity in 1998 was 4.2 million metric tons per year (9).

### 2.1.3 Aluminum Products and Their Uses

Aluminum and its alloys have properties that make it one of the most widely used metals in the world. The best known property of aluminum is its light weight. Its specific gravity is 2.7 and is approximately one–third as dense as iron, copper or zinc. Despite its light weight, it can be made strong enough to replace heavier and more costly metals in many applications. Aluminum and its alloys are highly resistant to corrosion making them very useful in coating applications. Its high electrical conductivity and comparative low density make aluminum ideal for many electrical transmission and distribution uses. Because aluminum is an excellent conductor of heat, it is widely used in heat exchange applications such as radiators and cooling coils. In addition, aluminum is an excellent reflector of all forms of radiant energy, which results in wide use in roofing materials and building insulation. Because aluminum is effective at keeping heat in or out it is also widely used as food wraps.

## 2.2 Waste Stream Characteristics

### 2.2.1 Waste Stream Status Under Other Regulations

Under the Clean Water Act, the discharge of pollutants into surface waters and Publicly-Owned Treatment Works (POTWs) from primary aluminum smelting facilities is regulated under the Aluminum Segment of the Non-ferrous Metals Manufacturing Point Source Category (40

CFR Part 421 Subpart B). This subpart includes effluent limitations and standards for cyanide, fluoride, antimony, nickel, aluminum, benzo(a)pyrene, oil and grease, total suspended solids (TSS), and pH for wastewaters discharged from the aluminum reduction process, including wastewaters from the anode and cathode paste plants, anode bake plant, cathode reprocessing, potliner and potroom air pollution control, aluminum degassing, pot repair and soaking, and aluminum casting.

Of the two constituents for which EPA is proposing revised standards, cyanide compounds (as a class) are regulated under the Emergency Planning and Community Right-to-Know Act (EPCRA) Section 313. Under Section 313, facilities that manufacture, process, or otherwise use these chemicals, and that meet certain other criteria, must report the releases and transfers or these chemicals.

Air emissions from aluminum production have been regulated by EPA under the Clean Air Act since the 1970s. A principal constituent of concern is fluoride, present as hydrogen fluoride (HF) in vapor form as well as in particulates entrained in offgas. A common treatment technique is the use of dry scrubbers, which collect particulates and sorb HF on alumina which is reused in the cells. When introduced to the cell, the alumina/hydrogen fluoride is converted to molten $AlF_3$ (27). Dry scrubbers are used at most U.S. aluminum reduction facilities and represent the most efficient technique for fluoride removal (61 Federal Register 50558, September 26, 1996).

Rules for air emissions (National Emission Standards for Hazardous Air Pollutants, or NESHAPs) from primary aluminum production were most recently revised on October 7, 1997 (62 FR 52383). This final rule affects three separate plant areas: the potliner (i.e., the electrolytic reduction of alumina that generates K088), the paste production plant (i.e., mixing of petroleum coke and coal tar pitch to make green anodes), and the anode bake furnace (i.e., the baking of green anodes in a furnace for use in the potliner). The final rule limits emissions of polycyclic organic matter (including polynuclear aromatic hydrocarbons) for all three areas and total fluoride for the potliner and anode bake furnace areas. Limits for total fluoride emissions from the potliner area range from 1.6 to 3.0 pounds fluoride per ton of aluminum produced, and polycyclic organic matter emissions from the potliner area range from 2.4 to 4.7 pounds per ton of aluminum produced (depending on the potliner technology used at each particular plant). EPA had previously set Standards of Performance for New Stationary Sources (under the Clean Air Act) that required any facility that commenced construction or modification after October 23, 1974 to meet emissions standards for fluoride and opacity; such standards were amended with the new NESHAP rules.

In calculating limits from potliner emissions for this NESHAP rule, EPA identified a control option consisting of a dry alumina scrubber (with a baghouse to collect the alumina and other particulate matter) at those plants that do not have them. Additional reduction techniques that were identified included work practice improvements, equipment modifications, operating practices, housekeeping measures, and in-process recycling.

### 2.2.2 Waste Stream Descriptions

Waste characterization data for nonwastewater forms of K088 were obtained during EPA-conducted sampling in 1990, additional waste characterization data was submitted to the Agency with delisting petitions (6 and 11) and in conjunction with revised treatment standard development since 1997. Although the Agency urges submitters to include valid quality assurance/quality control information with their K088 waste sampling data, most facilities provided characterization data on spent potliners that was limited to a few constituents (e.g., cyanide) and generally lacked the rigorous QA/QC requirements of the Land Disposal Program.[8] EPA has included these characterization data of spent potliner samples from eight aluminum reduction facilities in Table 2–2. Constituents found in this waste included polynuclear aromatic hydrocarbons and metals, including arsenic, fluoride, and cyanide. Generally, concentrations of these constituents in spent potliners are as follows: <0.005mg/kg to 200 mg/kg polynuclear

[8]Generally, the Agency requests that submitters provide detailed quality assurance/quality control data along with facility data measured from samples. Quality assurance/quality control data should include, but is not limited to, documentation of basis for selecting sample point, documentation that SW–846 sample preservation procedures were followed, and documentation that chain-of-custody procedures were followed. Sample analysis data should include documentation of instrument calibration procedures, clearly-labeled results of blanks for field analysis, laboratory , and trips, matrix spike duplicates, detection limits, and documentation of quantitative results of all method-specific QC procedures for each sample reported. For more information on this guidance, see the Final Best Demonstrated Available Technology (BDAT) Background Document for Quality Assurance, Quality Control Procedures, and Methodologies, October 1991 (1).

aromatics, <1.1 to <40 mg/kg arsenic, 18.25 mg/kg to 9,190 mg/kg total cyanide, 2.6 mg/kg to 4,800 mg/kg amenable cyanide, 230 mg/kg to 135,000 mg/kg fluoride, and various concentrations of other hazardous metals.

As shown in Table 2–2, concentrations of total cyanide ranged from 18.25 mg/kg to 9,190 mg/kg, varying greatly among the eight facilities. Four of the eight facilities had analyzed for samples of amenable cyanide, and those concentrations ranged from 2.6 mg/kg to 4,800 mg/kg. Average concentrations of total cyanide were 2,646 mg/kg, while average concentrations of amenable cyanide were 1,676 mg/kg. Possible variation among facilities may be the result of varying qualities of aluminum oxide used within the aluminum reduction process. The life of the steel pot may also affect the quality of aluminum produced and concentration levels of the waste constituents. Levels of cyanides vary from pot to pot and within a pot. Within a pot, levels can vary between the bottom of the pot liners and its side or end walls. Cyanide is also found in higher concentrations at the side wall where the bottom block carbon is exposed to air. Total cyanide may vary by two orders of magnitude within a single pot.

Fluoride, mostly in the form of sodium fluoride, was also detected at high concentrations in these wastes, ranging from 230 mg/kg to 135,000 mg/kg. In contrast to cyanide, fluoride is generally found in the bottom block carbon since it is in direct contact with the molten fluoride salt. Again, possible variations among facilities may be due to different qualities of aluminum oxide longer usage of the steel pot, which may affect the quality of aluminum produced and concentration levels of the waste constituents.

Table 2–2. Waste Characterization Data for K088 Spent Potliner[a]

| | Facility Number | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Alcoa, Massena, NY | Alumax/Eastalco, Frederick, MD | Noranda Aluminum, New Madrid, MO | Reynolds Metals, Longview, MA | Reynolds Metals, Massena, NY | Reynolds Metals, Baie Comeau, Quebec | Reynolds Metals, Troutdale, OR | Ormet Corporation, Hannibal, OH[b] |
| **Constituent** | **Total Composition Concentration (mg/kg)** | | | | | | | |
| aluminum | 47,900 | 46,400 | 53,400 | NA | NA | NA | NA | NA |
| antimony | 3.6 | <6.5 | <1.4 | 9.9–12.0 | 5.4–14.0 | 7.0–9.8 | <0.34–<3.3 | <10 |
| arsenic | <2.2 | <25.7 | <1.1 | <20 | <20 | <20 | <40 | 3.1–7 |
| barium | 145 | 153 | 149 | 100–110 | 130–150 | 97–130 | 150–180 | 180–210 |
| beryllium | 8.4 | 2.6 | 23.3 | 15–20 | 30–32 | 9.6–13 | 16–19 | 36,906 |
| cadmium | <0.42 | <0.28 | 0.7 | 0.63–1.10 | 0.37–0.48 | 0.44–0.96 | <0.39–0.44 | <0.5 |
| calcium | 15,000 | 24,500 | 11,600 | NA | NA | NA | NA | NA |
| chromium | 35.9 | 18.4 | 41.1 | 14–53 | 36,841 | 16–22 | 15–26 | 28–59 |
| cobalt | 9.9 | 5.0 | 11.9 | 2.5–4.3 | 2.4–3.0 | 5.8–11.0 | 4.1–5.2 | NA |
| copper | 8.8 | 3.9 | 16.9 | 40–76 | 28–67 | 32–56 | 34–56 | NA |
| iron | 3,280 | 1,850 | 4,360 | NA | NA | NA | NA | NA |
| lead | 8.7 | 11.7 | 16.7 | 9.7–13 | 8.9–11 | 7.6–19 | 4.8–26 | 20–26 |
| lithium | 23.4 | 167 | 6,880 | NA | NA | NA | NA | NA |
| magnesium | 555 | 626 | 518 | NA | NA | NA | NA | NA |
| manganese | 116 | 22.5 | 26.4 | NA | NA | NA | NA | NA |
| mercury | <0.085 | <0.097 | <0.093 | <0.10 | <0.10 | <0.10 | <0.1 | <0.25 |
| molybdenum | <0.59 | <7.0 | 1.9 | NA | NA | NA | NA | NA |
| nickel | 13.7 | 6.0 | 52.3 | 18–36 | 32–64 | 38–60 | 24–51 | 20–23 |
| potassium | 597.0 | 376.0 | 774.0 | NA | NA | NA | NA | NA |
| selenium | <3.4 | <2.2 | 10.8 | <4.0 | <4.0 | <4.0 | <2.0 | <0.2–2 |
| silver | <0.25 | <0.37 | <0.39 | <0.63–0.67 | <0.69 | <0.69 | <0.66–0.99 | <2 |

**Table 2–2. Waste Characterization Data for K088 Spent Potliner[a]**

| | Facility Number | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Alcoa, Massena, NY** | **Alumax/Eastalco, Frederick, MD** | **Noranda Aluminum, New Madrid, MO** | **Reynolds Metals, Longview, MA** | **Reynolds Metals, Massena, NY** | **Reynolds Metals, Baie Comeau, Quebec** | **Reynolds Metals, Troutdale, OR** | **Ormet Corporation, Hannibal, OH[b]** |
| **Constituent** | **Total Composition Concentration (mg/kg)** | | | | | | | |
| sodium | 121,000 | 177,000 | 179,000 | NA | NA | NA | NA | NA |
| strontium | 48.1 | 153 | 147 | NA | NA | NA | NA | NA |
| thallium | 11.9 | <5.4 | 20.4 | <0.50 | <0.50 | <0.50 | <0.5 | <0.25–<0.5 |
| tin | <210 | <234 | <247 | 150–180 | 130–170 | 100–130 | 85–110 | <0.5–1.1 |
| vanadium | 20.5 | 6.6 | 60.4 | 22–23 | 33–38 | 42–52 | 28–34 | <50 |
| zinc | 7.0 | 10.4 | 22.6 | 32–44 | 24–63 | 40–62 | 23–27 | 0.8–6.1 |
| cyanide (total) | 810 | 1,010 | 9,190 | 415–1,110 | 45.5–773 | 18.5–80.1 | 1,300–5,800 | 840–2,400 |
| cyanide (amenable) | NA | NA | NA | 415–1,110 | 39–772 | 2.6–25.3 | 200–4,800 | NA |
| fluoride | 17,700 | 18,000 | 20,200 | 6,910–31,400 | 39,200–64,700 | 230–135,000 | 61,000–113,000 | 73,000–110,000 |
| sulfide | 304 | 104 | 112 | NA | NA | NA | NA | NA |
| phosphorous | 135 | 83.1 | 189 | NA | NA | NA | NA | NA |
| acetone | <0.05 | 0.41 | 0.35 | <0.063 | <0.063 | <0.063 | <1.0 | <10–<20 |
| acetonitrile | <0.025 | 0.2 | <0.100 | <0.050 | <0.050 | <0.050 | <1.0 | NA |
| acrolein | <0.025 | 1.2 | <0.050 | <2.5 | <2.5 | <2.5 | <0.75 | NA |
| benzene | <0.025 | 0.008 | <0.005 | <0.050 | <0.050 | <0.050 | <0.050 | <0.5–<1.0 |
| carbon disulfide | 0.043 | <0.005 | <0.005 | <0.050 | <0.050 | <0.050 | <0.050 | <0.5–<1.0 |
| chloroform | <0.025 | <0.005 | <0.005 | <0.050–0.089 | <0.050 | <0.050–0.081 | <0.050 | <1 |
| dichlorodifluoromethane | <0.025 | <0.005 | <0.005 | <0.63–1.0 | <0.63 | <0.63 | <0.050 | <0.5 |
| ethyl cyanide | <0.025 | 0.021 | <0.005 | NA | NA | NA | NA | NA |
| methyl ethyl ketone | <0.05 | 0.014 | 0.011 | <0.25–0.31 | <0.25–0.58 | <0.25 | <1.0 | <20 |
| methylene chloride | <0.025 | <0.005 | 0.009 | <0.25–0.30 | <0.25 | <0.25 | <0.050 | <1 |

**Table 2–2. Waste Characterization Data for K088 Spent Potliner[a]**

| | Facility Number | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Alcoa, Massena, NY | Alumax/Eastalco, Frederick, MD | Noranda Aluminum, New Madrid, MO | Reynolds Metals, Longview, MA | Reynolds Metals, Massena, NY | Reynolds Metals, Baie Comeau, Quebec | Reynolds Metals, Troutdale, OR | Ormet Corporation, Hannibal, OH[b] |
| Constituent | Total Composition Concentration (mg/kg) | | | | | | | |
| pyridine | <0.025 | 1.6 | <0.250 | <1.0 | <1.0 | <1.0 | <1.0 | NA |
| toluene | 0.23 | 0.009 | <0.005 | <0.050 | <0.050 | <0.050 | <1.0 | <0.5–<1.0 |
| trichloromonofluoromethan | <0.050 | <0.010 | 0.02 | <0.25 | <0.25 | <0.25 | <1.0 | NA |
| bis(2-ethylhexyl)phthalate | 0.31 | <0.680 | <0.990 | <1.0 | 2.8 | <1.0 | <1.0 | <0.160 |
| anthracene | <0.660 | <0.680 | <0.990 | <10 | <10 | 18–31 | <1.0 | <0.160–0.32 |
| benz(a)anthracene | <0.660 | <0.680 | <0.990 | <10–15 | 15–44 | 87–160 | <1.0 | <0.160–0.61 |
| benzo(a)pyrene | <0.660 | <0.680 | <0.990 | <10–12 | 22–59 | 92–180 | <1.0 | <0.160 |
| benzo(b)fluoranthene | <0.660 | <0.680 | <0.990 | 25–52 | 67–180 | 190–310 | <1.0 | <0.160–0.170 |
| benzo(k)fluoranthene | <0.660 | <0.680 | <0.990 | 25–52 | 67–180 | 190–310 | <1.0 | <0.160 |
| benzo(g,h,i)perylene | <0.660 | <0.680 | <0.990 | <10 | 14–47 | 71–140 | <1.0 | <0.160 |
| chrysene | <0.660 | <0.680 | <0.990 | 17–45 | 39–88 | 140–200 | <1.0 | <0.160–1.2 |
| dibenz(a,h) anthracene | <0.660 | <0.680 | <0.990 | <10 | <10–14 | 24–48 | <1.0 | <0.160 |
| di-n-octyl phthalate | <0.660 | <0.680 | <0.990 | <10 | <10 | <10 | <1.0 | 0.38–12 |
| fluoranthene | <0.660 | <0.680 | <0.990 | <10–12 | 34–78 | 170–240 | <1.0 | 0.26–5.7 |
| indeno(1,2,3-cd)pyrene | <0.660 | <0.680 | <0.990 | <10 | 12–37 | 64–120 | <1.0 | <0.160 |
| phenanthrene | <0.660 | <0.680 | <0.990 | <10 | <10–28 | 91–140 | <1.0 | <0.160–2.3 |
| pyrene | <0.660 | <0.680 | <0.990 | <10–13 | 18–65 | 130–200 | <1.0 | 0.2-8 |
| butyl benzyl phthalate | 0.25 | <0.680 | <0.990 | NA | NA | NA | NA | NA |
| hexachlorodibenzofurans | 0.38 | NA | NA | NA | NA | NA | NA | NA |

[a] The waste characterization data for the K088 constituents listed within this table were gathered from EPA sampling activities and data provided in delisting petitions (6, 10, and 11).
[b] Data presented in this table are from spent potliner samples at Ormet Corporation's Hannibal, Ohio facility which does not include the newer 1999 data. Ormet's operation generates waste constituents having far lower concentrations, and may be due to the fact that the facility uses steel pots in their aluminum reduction process for only three years compared to some potliners being serviced for up to seven years. To compare current data collected from Ormet Corporation's full-scale facility, refer to section 3.3.
NA: Not Analyzed

# REFERENCE 9

ALCOA BADIN RECONAISSANCE 4/7/15

P(1)

AMY AXON
CAROLYN CALLIHAN EPA REGION 4 SUPERFUND
CYNTHIA PEURIFOY EPA ~~[illegible]~~ JUSTICE
SIOBAHN TARVER EPA ENV JUSTICE
NEEMA ATASHI EPA COMM INVOLVEMENT
MERCEDES HERNANDEZ PELLETIER NC DHHS (W/SANDS WORK)

DISCUSSED AMY'S FINDINGS AND INTERVIEWS W/ CAROLYN + OTHER EPA, THEN VISITED SITES 1,5 AND SPOKE W/ CLYDE WAY

1030 MET W/ BUD MCCARTY + ROB MCDANIEL ALSO TERESA RODRIGUEZ, KEN PICKLE (STORMWATER PERMITTING) YANG SONG. THEN PROCEEDED TO ALCOA OFFICE ACROSS 740 TO MEET ROBERT ~~[illegible]~~ PRESBITDOWSKI MGR [illegible] + RANDALL KISER, ALSO MARK GROSS (BANC ALCOA), 1110 SIGNED IN & ISSUED SAFETY EQUIPMENT.

MIKE ~~GROSS~~ ENGINEERING, CONSULTANT FOR ALCOA
ROUND TABLE INTRODUCTIONS WES BELL FROM REGIONAL DWR NPDES.
MIKE WORDEN CONSULTANT/GUIDE ON LF RECON.

PSA TO DOC TARGETS → PA DOES WORST CASE SCENARIO — PUSH SF INTO POST-DEADLINE

ALCOA BADIN RECONAISSANCE (AND BALLFIELD) 4/7/15

P(2)

MIKE — EARLIEST PLAN DRAWING: 1917 PLANNED BALL FIELD. 1919 TOPO MAP DIFFERENCE BETW 1919 + PRESENT (IN WORK PLAN)

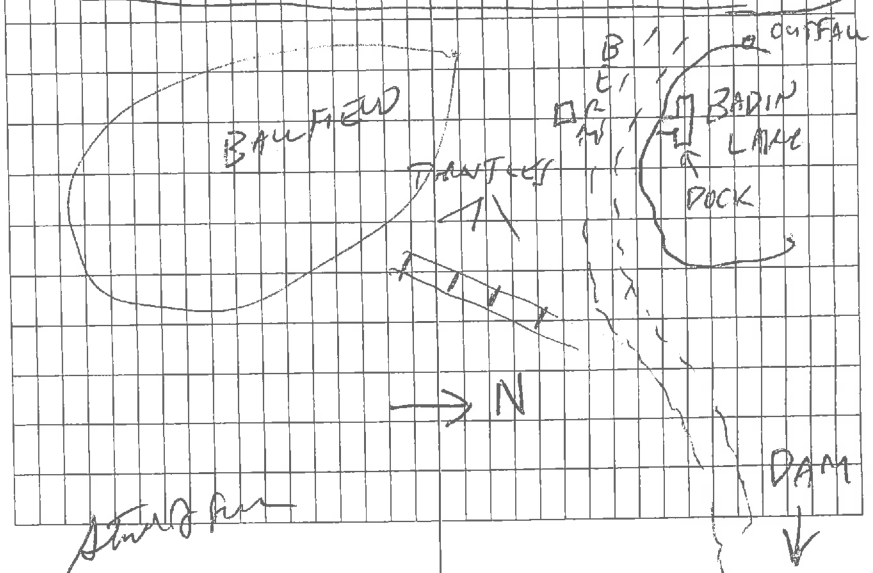
Q/A ANY ACTIVITY/STORAGE? NOT TO HIS KNOWLEDGE

— NO INFO ON FILL ACTIVITY — RR INSTALLATION PROBABLY GRADED 1919 – 1949 (WHEN 1949 BALL FIELD WAS CONSTRUCTED)

BOAT DOCK + RAMP. (AERIALS NOT SHOWING) THE BERM AT THE DOCK IS PART OF A FORMER CURVED SIDING (RAIL, TOWARD DAM

PLANT

740




[signature]

ALCOA BADIN LANDFILL RECON 4/7/15 P(3)

~~MIKE GATES PLANT MGR~~
LANDFILL DESCRIPTION + HISTORY
MIXED USE

1/2000 COLLECTION SYSTEM FOR SEEPS OUTFALL #21
2005 IMPLEMENTED CONNECTION OF SEEPS TO LIFT STATION TO POTW. (NOW CLOSED)
RANDALL HYZER:
OUTFALL 21 IS STILL MONITORED
CYANIDE LEVELS VV LOW

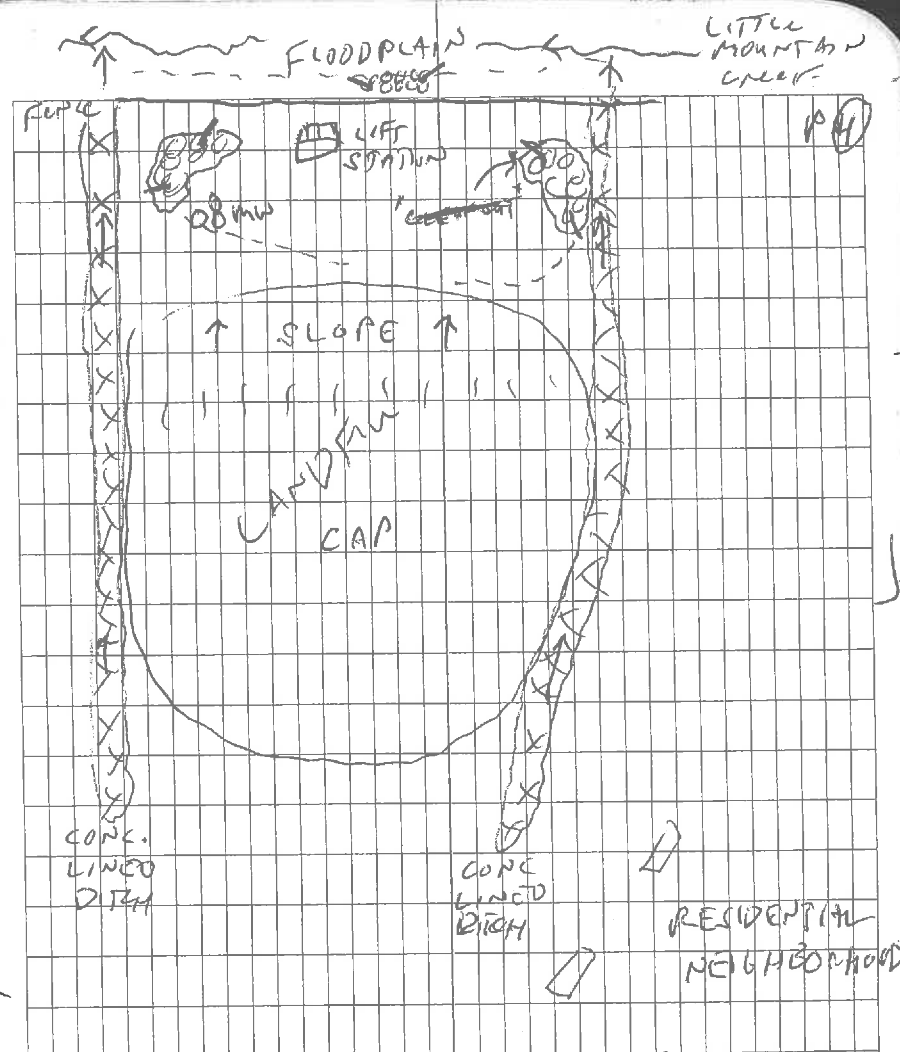
OUTFALL #18 COLLECTS RUNOFF THAT IS DIVERTED FROM TOP OF L.F., NOT SEEPS

FLUORIDE #S IN PPM; CN IN ppb

1200 WALKED OVER TOP OF LANDFILL TO CREEK
MIKE ~~MARK GATES~~ REPORTED THAT CONSTRUCTION OF LIFT STATION INCLUDED WETLAND ASSESSMT IN 1999
BLUE SEEP COLLECTION PIPES FORMERLY WENT TO JUNCTION BOX WHICH DISQ'd TO LITTLE MTN CREEK. NOW RE-ROUTED TO POTW

[signature]

P(4)




BELOW LF FENCE, IN FLOODPLAIN, NOTED STICKUPS ARE "CLEANOUTS" W/ "BROKEN PIPE" BELOW (GREEN W/ PARTIAL OUTER PVC SLEEVE)
CC: INCLUDE SAMPLE POINT BELOW THE CRACKED SECTION OF PIPE (3") EXAMINED BOX VAULT W/ V NOTCH WEIR, FORMERLY USED TO GAGE OUTFLOW TO CREEK AS OUTFALL 21
DITCH ENTERS CREEK JUST BELOW AS OF.18.

ALCOA BADIN LANDFILL RECON 4/7/15 (RS)

HEADED UPSTREAM ALONG SEEP CORRIDOR TO MIDDLE SEEP COLLECTION PIPE

MIKE GAUS: STREAM MONITORING HAS SHOWN LIMITED EXCEEDENCES. FLUORIDE WAS THE PRIMARY DETECTED CONSTITUENT (>2L) (FORMERLY SAMPLED FOR VOCs, SVOC, CYANIDE)

STANDING $H_2O$ POOL AT EDGE OF FLOODPLAIN WHERE PETITIONER SAMPLED AND REPORTED ~20 ppm Fluoride.

PROCEEDED TO WESTERN SEEP COLLECTION AREA. DURING FLOOD EVENTS, A DISTURB CHANNEL PASSES ADJACENT TO RIPRAP. REDDISH DISCOLORATION (IRON) WHICH WE'D BEEN NOTED WAS SIGNATURE OF EMERGENT GROUND WATER, BUT MARK GAUS REPORTED NO HISTORY OF CONSTITUENTS EXCEEDING @ THIS LOCATION.

[CC: NEED TO SAMPLE HERE BEC OF EMERGING GROUND WATER, IN ADDITION TO SPLITTING W/ALCOA, BEC OF APPARENT GW/SW INTERACTION]

NOTE: THE "BROKEN PIPE" RUNS TO THE EMPTY WEIR BOX, NO LONGER USED.

ALCOA BADIN BALL FIELD RECON 4/7/15 (RO)
AND CITIZEN INTERVIEWS 4/8/15

130-230 Amy A.

LUNCH, THEN BACK TO BALL FIELD. LEFT IN BANK OF BADIN LAKE, NEAR DOCK (RR GRADE) OBSERVED VARIOUS TYPES OF BRICK SLAG. SOME OF THE BRICK LOOKED MULTI-HUED/BURNT. BRICKS DEPOSITED OUT ACROSS BOTTOM NEAR SHORE.

NOTE: REQUEST FOR PA: ~~p 13 PHOTO~~, (SEA) "~~LEAKING PIPE NEAR LITTLE MOUNTAIN CREEK~~"
p14: LMC sampling location showing outfall 018

INTERVIEW (1): MS. HARRISON 8:20 4/8/15

- REPORTED LONG-TERM FIRES @ THE LANDFILL
- BAD POLLUTION FROM PLANT STACKS 1960s-1980s
- FATHER WORKED @ ALCOA IN POT ROOM, CLEANING OUT POTLINER
- LANDFILL (TRASH) WAS UNRESTRICTED ACCESS - PLAYED.
- LIVED @ 403 GRANT ST. GMOTHER ON LEE ST ALCOA EXPANDED, RELOCATED (WOOD) HOMES
- CONCERNED (MANY PEOPLE) ABOUT RESPIRATORY HEALTH PROBLEMS (BRONCHITIS). GENERALLY CONCERNED ABOUT LANDFILL AND WASTE
- HEARD "NOT TO GO TO OLD WATER TREATMENT PLANT BECAUSE OF DUMPING THERE."
- CLASS ACTION LAWSUIT BY FORMER EMPLOYEES ABOUT HEALTH PROBS (INCL CANCER)
- PEOPLE RAISED HOGS, GARDENED NEAR BALLFIELD

ALCOA BADIN CITIZEN INTERVIEWS 4/8/15 (7)

- PLAYED / SWAM @ LAKE (SEGREGATION), BUT NOT SO MUCH @ CURRENT BOAT RAMP
- SUBSISTENCE / REC FISHING @ CURRENT RAMP / BALLFIELD
- PEOPLE FISH (STILL) FOR SUBSISTENCE ON BADIN LAKE ~~(ESPECIAN~~ SUBSEQUENT TO 2008/2010 FISHING ADVISORY (STATE: MERCURY; LOCAL PCB)
- CHURCHES / CIVIC ORGANIZATIONS A GOOD WAY TO COMMUNICATE

INTERVIEW (2): RICKY ~~TEAL~~ 6?? STEWART ST
- WORKED 33 YRS @ ALCOA, RETIRED 10 YEARS
- WASTE DUMPED IN BLACK NEIGHBORHOODS (GENERALLY COVERED / BURIED)
- CONCERNS ABOUT HIGH MORTALITY OF ALCOA EMPLOYEES.
- FURNACE OPERATOR. USED TO WEAR WORK CLOTHES HOME, UNTIL ~~EARLY~~ ~2000. SOOTY MATERIAL ON CLOTHING. ~~NO~~ MEDICAL MONITORING ~~UNTIL~~ INCLUDED SPIROMETRY TEST, THROUGHOUT
- SPRAY ON ASBESTOS USED TO PATCH HOLES
- ALUMINUM ORE + CARBON IN CRUCIBLE, HEATED W/ IRON ROD / GRAPHITE ANODE/CATHODE. GRAPHITE CUT TO LENGTH IN SAWMILL: DIRTIEST JOB IN THE PLANT.
- MANY EMPLOYEES LIVED ONLY A COUPLE YEARS AFTER RETIRING IN AGE ~ EARLY 60s ~~RESPIRATORY~~ ILLNESS / CANCER
- WORE FILTER MASKS NOT CARTRIDGE RESPIRATORS, IN CARBON PLANT / BAG ROOMS.

ALCOA BADIN INTERVIEWS 4/8/15 P(8)

- FATHER WORKED ALCOA, DIED CARDIAC IN 50s
- CLASS ACTION SUIT STILL IN COURT, STILL BEING CHARGED FOR INSURANCE, WHICH WAS SUPPOSED TO BE PROVIDED IN RETIREMENT
- SCRUBBERS DID NOT COMPLETELY ALLEVIATE THE 500 FT STACKS. FALLOUT VISIBLE IN COMMUNITY, ON CARS, ETC.
- ~ 750 PEOPLE WORKED @ PLANT. LABOR WAS MOSTLY BLACK, MANAGEMENT WHITE. AUTOMATION LATER REPLACED MUCH OF THE LABOR
- MARY STARTED WEST BADIN CONCERNED CITIZENS. MEET MONTHLY @ VARIOUS CHURCHES
- BRICK USED IN ANODE-BAKING REUSED IN HOME UNDERPINNINGS + FIREPLACES →
- POTLINER WAS JACKHAMMERED OUT. BLACK RESIDUE. MONTHLY REMOVAL

[2 TYPES OF BRICK: FURNACE BRICK (BAKE ANODES) / POT BRICK (BLACK)]

STAGED ~~DUMPED~~ INSIDE FENCE NEAR BROWN LAKE, THEN TRUCKED AWAY. SOME ALLEGEDLY DISPOSED @ END OF STEWART ST INSIDE PERIMETER FENCE OF ALCOA PLANT.

- BOAT RAMP: > ~~~~ 43 YEARS. CEMENT POURED IN 1990s NO SPECIFIC KNOWLEDGE OF DISPOSAL @ BALLFIELD
- MULTIPLE MYELOMA DIAGNOSES ARE COMMON IN THE COMMUNITY

[RANDALL KIZER 7045626138 1030 AM THU BALLFIELD]

ALCOA BADIN CITIZEN INTERVIEWS 4/8/15 p(9)

INTERVIEW (3) JOHNNY WESTBROOK @ COMMUNITY CENTER
4/8/15 1430

- HE'S CURIOUS "WHY NOW", AFTER PLANT CLOSED
- CAROLYN EXPLAINED SITE ASSESSMENT PROCESS
- HE HAD CONCERNS ABOUT PLANT BUILDING MATERIALS, ESP ASBESTOS
- DISCUSSION OF AREAS OF INTEREST, AND RCRA, SWMUS, SITE PROSPECTIVE DISPOSITION
- JW — HARD TO FIND PEOPLE WHO KNOW EXACTLY WHERE DISPOSAL OF POTLINER/WASTE TOOK PLACE — SAVE FOR THE ACTUAL HAULERS, WHO MIGHT NOT HAVE KNOWN WHAT WAS BEING HAULED.
- JW SHOWED VIDEO STILLS (PHOTO SLIDES) OF ~~[illegible]~~ BADIN IN LATE 1960S AFTER PLANT HAD BEEN RE-BUILT. SHOWED WHERE HOMES USED TO STAND ON LEE ST ALSO, ORIGINAL PLANT (W/ BLDGS ⊥ TO NOW) ARE 1960 AND 1923
- WWTP built by AR contractor 1914
- NARROWS DAM CONSTRUCTED 1912-1914
- NUMEROUS AERIALS (OBLIQUE) OF TOWN, PLANT, INCL. BASEBALL FIELD + ACTIVE LANDFILL.

[signature]

ALCOA BADIN CITIZEN INTERVIEWS 4/8-9/15 p(10)

INTERVIEW (4): ZAVIER + ALICIA
- WEST OF LANDFILL AND OLD WWTP ON LINCOLN ST (AMY AXON REPORT STOP 4). BLACK WASTE MATERIAL TRUCKED IN AND DUMPED. A 'S FATHER WORKED @ ALCOA. PASSED AWAY ~2008, AGE 70. C.O.D. = HEART ATTACK. WORKED IN POTROOM/LINER
- ASKED ABOUT FISH CONSUMPTION ADVISORY. MERCEDES EXPLAINED HER ROLE AND INQUIRED AS TO CATCHING/EATING HABITS OF PUBLIC.
- ZAVIER USED TO CATCH/EAT FISH REGULARLY UNTIL HIS DAUGHTER WAS BORN AND SPACE IN REFRIGERATOR BECAME LIMITED.
- REFERENCE TO RCRA PCB CAP.
- C CALLIHAN EXPLAINED SUPERFUND PROCESS.
- E PONIFOY GAVE PACKET

---

4/9/15 AM MET W/ TOMMY GIBSON (RET. ALCOA H&S) AND RANDALL [illegible].
PIPE TO LEFT OF BOAT LAUNCH IS OF #2
PCB CLEANUP WAS VOLUNTARY. PCBS BORDERLINE
CAPPED W/ SAND/CLAY + FABRIC RIPRAP @
5 LOCATIONS (LOWERED LAKE 15') FROM
SWIMMING BEACH TO COVE @ OUTFALL.
NOTCHED BRICK NOT PART OF COVER.
RR SPUR PROBABLY BUILT DURING PLANT
DEMOLITION/RECONSTRUCTION IN LATE 1950S - 60S

11:00 TOM GIBSON + RANDAL KISER EXAMINED THE BLACK OBJECT ON THE BANK



CATCH BASIN ONE OF 3 @ BALL FIELD. ACCORDING TO ALCOA PERSONNEL → DIAGRAM UNDERGROUND PIPE FLOWS FROM BASINS SOUTH (NOT TO BADIN LAKE) TO LITTLE MOUNTAIN CREEK ~1.5 MILES, PER ALCOA FOLLOWS NANTAHALA ST, PARTIALLY OPEN CHANNEL

PER RANDAL KIZER: K088 HAS TO HAVE CYANIDE. DENIED MATCH OF CATCH BASIN WATER W/ K088 CONSTITUENTS:

SILICON OXIDE NOT FOUND IN ELECTRODES, CARBON CATHODE LINER OF POT IS WHERE K088 IS. CATHODE IS GRAPHITE + ANTHRACITE AND IS WHERE PAH COMES FROM

TOMMY GIBSON CITED 2012 STUDY BY ALCOA:

MATERIAL ON BANK: FLOOR & FURNACE BRICK. BLACK STUFF WAS TESTED: BASED ON SILICON OXIDE CONTENT, IT IS CASTING (FOUNDRY) SAND. SOME SLAG, ALSO.

DID NOT USE SODERBURG (PASTE) ANODES, ONLY BAKED GRAPHITE

BAKING WAS IN FLUID COKE (ANOXIC) IN FLUE

FLUID COKE CAN CLING TO BRICK → DISCOLORATION

FURNACE BRICKS CONTAIN FLUORIDE, but are not haz waste

LOOK UP RCRA REF | PEOPLE THINK SPENT POTLINER, BUT CARBON FROM WHERE

ALCOA BADIN RECONNAISSANCE AND INTERVIEWS 4/9/15 p. 17

NO SAMPLES OF SPENT POTLINER AVAILABLE
BUT SHOWED US (AND I PHOTOGRAPHED
"COAL TAR PITCH (L) ANTHRACITE (A)" IN JARS
"BUTT" (BLACK NUGGET): SPENT ANODE

BATH / CRYOLITE ALUMINA BAUXITE

IRON SLAG FOUNDRY SAND

RANDALL: CAPITAL WOOD PRODUCTS MILLED/
SAWED BLOCKS OF GRAPHITE WHICH
HAD BEEN "BAKED" BUT NOT YET USED
IN THE SMELTING POTS ("GREEN")

WWTP EROSION APPROVAL Tamara Eplin 2015 007

[illegible signature]

**REFERENCE 10**

**Alcoa Inc.**

ALCOA

April 06, 2001

UPS Next Day Air
1Z 214 688 22 1003 767 7

Ms. Jill Burton, Acting Chief
Hazardous Waste Section
North Carolina Department of Environment and Natural Resources
401 Oberlin Road, Suite 150
Raleigh, NC 27605

APR 2001
Received
Hazardous Waste
Section

RE. **RCRA Facility Investigation Report**
**Alcoa Inc. – Badin Works**
**Badin, North Carolina**
**EPA I.D. Number NCD 003 162 542**

Dear Ms. Burton:

Enclosed, please find three copies of the RCRA Facility Investigation (RFI) Report for Alcoa Inc.'s Badin Works facility in Badin North Carolina. The RFI Report presents the findings of activities conducted under the RFI Workplan and the RFI Phase II Workplan, which were previously approved by the Hazardous Waste Section on February 10, 1999 and June 27, 2000, respectively.

As required under Condition VII.L.2 of Alcoa's RCRA Part B Permit and in accordance with 40 CFR 270.11(d), I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Base on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If you have any questions or comments regarding this RFI Report, please contact Mr. Henk van der Meyden at (704) 422-5624.

Sincerely,

Bruce A. Cox
Works Manager

Enclosures

| | | |
|---|---|---|
| Cc. | Z. T. Gibson - Badin | (Letter only) |
| | H. J. van der Meyden - Badin | (Letter and Attachments) |
| | W. L. McCaskill - Badin | (Letter only) |
| | K. J. Gribben – ATC-C | (Letter and Attachments) |
| | J. L. Millett – Tennessee | (Letter only) |
| | R. S. Bear – Pittsburgh | (Letter only) |
| | M. Portman – MFG, Inc. | (Letter only) |

# RCRA FACILITY INVESTIGATION REPORT

## VOLUME I OF II

## ALCOA BADIN WORKS
## BADIN, NORTH CAROLINA

## MARCH 2001

*Prepared for:*

**ALCOA, INC.**
Highway 740
Badin, NC 28009

*Prepared by:*

**MFG, INC.**
800 Vinial Street
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(412) 321-2278
Fax: (412) 321-2283

MFG Project No. 120006.1E

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# 1.0 INTRODUCTION

This report presents the findings of work conducted at the Alcoa Inc. (Alcoa) Badin, North Carolina Works in accordance with the requirements set forth in the facility's Part-B Resource Conservation and Recovery Act (RCRA) Permit (No. NCD003162542). Specifically, this report fulfills the requirements for conducting a RCRA Facility Investigation (RFI) of the Alcoa Badin Works as required in Part VII.F of the Part-B Permit.

In addition to providing the findings of the RFI, environmental investigation findings and voluntary interim measures work conducted at the Badin Works prior to the RFI are incorporated to provide a comprehensive report of site conditions. This report also provides conclusions and recommendations regarding the need for a Corrective Measures Study (CMS) based on the site conditions.

## 1.1 Facility Overview

### 1.1.1 Site Location and Description

Alcoa's Badin Works is located on Highway 740 in Badin, Stanly County, North Carolina (Figure 1-1). The Badin Works occupies 123 acres of land and the fenced, active part of the site is about 90 acres (Figure 1-2). In addition to the main plant area, Alcoa owns two inactive, capped, and closed off-site landfills, the Alcoa/Badin Landfill and the Old Brick Landfill (Figure 1-2). The Alcoa/Badin Landfill is approximately 14 acres in size and is located 500 feet southwest of the fenced part of the plant. The Old Brick Landfill occupies approximately 3 acres and is approximately 0.75 miles to the northeast of the Badin Works main plant site, near Badin Lake.

Alcoa began operations at the site in 1915 as a primary aluminum smelter. Principal products manufactured at the plant site include carbon cathodes and anodes, and continuous cast sheets and specialty metals. In the smelting process, alumina, an aluminum oxide is reduced to aluminum metal in carbon-lined, steel electrolytic cells known as "pots". A conducting, electrolytic bath solution used in the process contains sodium fluoride and aluminum fluoride. After continued use, the carbon potlining ("potliner") fails and must be removed and replaced. The resulting spent potlining (SPL) is regulated as waste (K088) by the United States Environmental Protection Agency (USEPA) under 40 Code of Federal

Regulations (CFR) 261.32. The hazardous constituent of concern in SPL is cyanide (40 CFR 261, App. VII). Fluoride, which is also associated with SPL, is not a RCRA listed hazardous waste or a hazardous constituent. At full operation, Alcoa generates and disposes off-site approximately 2,700 tons per year of SPL from the production of aluminum.

### 1.1.2 Environmental Setting

#### 1.1.2.1 Regional Geology

The Badin Works is located in the Carolina Slate Belt of the Piedmont Physiographic Province of North Carolina. The Piedmont typically is subdivided into a series of northeast-trending belts on the basis of lithologic, structural, or metamorphic characteristics. The Carolina Slate Belt is characteristically composed of Cambrian Age metamorphic volcanic and sedimentary rocks, often identified as "argillite" (NC Geologic Survey, 1985). The metavolcanic and metasedimentary rocks of the slate belt have been locally intruded by igneous rocks. The series of rocks comprising the Carolina Slate Belt constitute a stratigraphic succession, which is probably over 30,000 feet thick and extends east below the sediments of the coastal plain (Conley, 1962). The belt varies in width from 25 to 70 miles and extends through the central portion of the state. The belt originates in South Carolina and extends into New England. The Carolina Slate Belt is flanked to the northwest by medium to high-grade metamorphic rocks of the Charlotte Belt. To the southeast, the slate belt is overlain by unconsolidated Cretaceous and Tertiary-age sediments of the Atlantic Coastal Plain.

Weathering of the Carolina Slate Belt rocks often results in a veneer of residual soil overlying bedrock. Residual soils that retain the relic structure of the parent bedrock are referred to as "saprolite". The boundary between soil and rock is often not sharply defined; a transition zone termed "partially weathered bedrock" is normally found. Weathering is facilitated by fractures, joints, and the presence of less resistant rock types. Consequently, the profile of partially weathered bedrock and hard rock is quite irregular and erratic, even over short horizontal distances. Lenses and boulders of hard rock and zones of partially weathered rock often are found within the soil mantle, well above the general bedrock level.

Alluvial soils, eroded by surface water from hillsides, often blanket the residual soils and weathered rock in valleys and floodplains. Colluvial soils, sloughed from the hillsides, often collect on the lower hillsides and at the base of slopes.

### 1.1.2.2 Regional Hydrogeology

Groundwater occurs in intergranular pore spaces of the residual soils and saprolite, and in fractures present in the bedrock. Residual soils and saprolite, which normally contain clay and silt, are capable of storing fairly large volumes of water because of their high porosity. The ability of residual soils and saprolite to transmit water is fairly low, however, because of the small size of the pores and the complexity of their interconnections.

Unweathered bedrock essentially has no primary (intergranular) porosity. Stresses through geologic time have fractured the rocks, however, and groundwater is transmitted through these fractures. In general, storage capacity of bedrock is lower than that of an equal volume of residual soils or saprolite, but its hydraulic conductivity (ability to transmit water) locally may be greater due to the presence of fractures. Fractures in the rock become smaller and less numerous with depth, and are normally insignificant for water supply at depths greater than about 300 feet (Law Environmental, August 6, 1992).

### 1.1.2.3 Surface Water

The Alcoa Badin Works is situated near Badin Lake (Figure 1-2). The lake is one of four reservoirs managed by the Yadkin Division of Alcoa Power Generating Inc., a wholly-owned subsidiary of Alcoa, for hydroelectric power generation. SWMU No. 3 (Old Brick Landfill) is situated above and near a cove of the lake (Figure 1-2).

As shown on Figure 1-2, Little Mountain Creek bounds the Alcoa property, immediately south of SWMU No. 2 (Alcoa/Badin Landfill). Alcoa's property line approximates midstream of the creek. The creek has no known significant public use. The creek flows southeastward from the site and eventually enters Mountain Creek (a flow distance of approximately one and one-half miles from the toe of the Alcoa/Badin Landfill). From its juncture with Little Mountain Creek, Mountain Creek flows approximately one and one-half miles to Lake Tillery. Lake Tillery is a reservoir managed by Carolina Power and Light for hydroelectric power generation.

## 1.2 Regulatory Framework

Figure 1-3 provides a regulatory summary of the Badin Works RCRA compliance process, beginning with Alcoa's submittal of a Part-B Permit application to USEPA and ending with a list of Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) subject to the RFI requirement. Table 1-1 provides a description and Figure 1-4 the location of the plant area SWMUs and AOCs included in the RFI. Figure 1-2 shows the location of the two off-plant SWMUs; the Alcoa/Badin Landfill (SWMU No. 2); and the Old Brick Landfill (SWMU No. 3) relative to the plant.

In March 1990, Alcoa filed a RCRA Part B permit application with USEPA to store SPL waste (K088) on-site in an enclosed storage building for greater than 90 days. In response to the permit application, USEPA Region IV contracted A.T. Kearney Inc. and DPRA, Inc. to perform a RCRA Facility Assessment (RFA) of the Alcoa Badin Works and associated off-site locations. The RFA conducted by the USEPA contractors included a "Preliminary Review" and "Visual Site Inspection", but did not include a "Sampling Visit".

The contractors submitted to USEPA the March 1990 document entitled Interim *RCRA Facility Assessment Report; Alcoa Badin Works; Badin North Carolina; USEPA I.D. No. NCD003162542*. The RFA report included recommendations from the contractors that several of the SWMUs/AOCs be subjected to an RFI (SWMU Nos. 1, 2, 3, and 7), Confirmatory (RFA Phase II) Sampling (SWMU Nos. 4, 7[a], [b] 11, 22, and AOCs-A and -B), or Further Assessment (SWMU Nos. 25, and 33).

In response to the RFA and ensuing additional information provided by Alcoa, the North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR) Division of Solid Waste Management (now the NCDENR Division of Waste Management [Department]), in cooperation with USEPA Region IV, issued the final RCRA Part-B Permit to Alcoa on March 30, 1992. The permit (No. NCD003162542) became effective on May 4, 1992 and authorizes Alcoa to operate an on-site, hazardous waste storage facility.

In addition to authorizing the storage of hazardous waste, the permit requires Alcoa to conduct the following investigation of the facility SWMUs and AOCs:

---

[a] The RFA recommended Confirmatory Sampling of the air compressor portion of SWMU No. 7, the Aerated Lagoon.

- Part VII.E requires Confirmatory Sampling of eight SWMUs (Nos. 4, 7, 11, 20, 22, 36, 38, and 39) and AOC-A; and

- Part VII.F requires a RCRA Facility Investigation of six SWMUs (Nos. 1, 2, 3, 25, 33, and 35) and AOC-B.

On June 18, 1992, Alcoa submitted the Confirmatory Sampling Work Plan as required by Part II.E of the permit. The Confirmatory Sampling Work Plan provided for sampling to evaluate potential releases of hazardous wastes or constituents from the eight SWMUs and one AOC listed in Part VII.E of the Permit. USEPA sent comments on the Work Plan to Alcoa on January 26, 1993. Alcoa incorporated USEPA's comments and on March 12, 1993 submitted a revised Confirmatory Sampling Work Plan. USEPA approved the Work Plan in a letter to Alcoa dated April 29, 1993.

Alcoa initiated Confirmatory Sampling activities in accordance with the approved Work Plan to address potential releases from the SWMUs and AOCs subjected to this requirement except for SWMU No. 7, the Aerated Lagoon. In approving the final Confirmatory Sampling Work Plan, USEPA agreed to permit Alcoa to defer Confirmatory Sampling at this SWMU pending drainage of the lagoon to enable soil sampling beneath the lagoon.

Alcoa submitted to USEPA the Confirmatory Sampling Report (Law Environmental, June 28, 1993), and an addendum to the report (Law Environmental, November 1, 1993) regarding Confirmatory Sampling of SWMU No. 7, the Aerated Lagoon. USEPA reviewed these reports, and in a letter dated January 11, 1994 directed Alcoa to include, in addition to the SWMUs and AOC listed in Part VII.F of the Part-B Permit, RFI activities for SWMU Nos. 4, 11, 22, 38, AOC-A, and two newly identified SWMUs (Nos. 42 and 43). SWMU Nos. 42 and 43 were added based on information provided by Alcoa to USEPA in a letter dated October 7, 1993. SWMU Nos. 7, 20, and 39 were eliminated from the RFI based on the Confirmatory Sampling findings.

Alcoa submitted the RFI Work Plan to the USEPA in April 1994. After the Work Plan submittal, the Department assumed responsibility from USEPA as the authorizing agency for the Badin Works RFI. The Work Plan subsequently was revised to address Department comments (Revision 1 October 1995; Revision 2 November 1998; and Revision 3 February 1999). The Department approved the RFI Work Plan in a letter to Alcoa dated February 10, 1999. Alcoa implemented the approved Work Plan in September through October 1999 and January 2000.

In addition to the SWMUs in the approved RFI Work Plan, Alcoa identified two new SWMUs (Nos. 44 and 46) and subjected them to RFI activities. SWMU No. 44 was added by Alcoa in a letter to the Department dated October 10, 1996 following voluntary investigation of this area by a geophysical survey and test borings. SWMU No. 46 was identified as an area of suspected SPL based on an aerial photo review by Alcoa and was investigated during RFI activities in September 1999. Following verification of SPL by laboratory analysis of subsurface soil samples, Alcoa reported SWMU No. 46 to the Department in a letter dated November 22, 1999.

In April 2000, Alcoa submitted a Phase II RFI Work Plan to NCDENR. The purpose of Phase II was to fill data gaps identified after evaluating the data from the initial RFI work. The Department approved the Phase II Work Plan in a letter to Alcoa dated June 27, 2000. Alcoa implemented the Phase II Work Plan in August and September 2000.

As indicated on Figure 1-3 and Table 1-1, Alcoa implemented the RFI activities for several SWMUs prior to final approval of the RFI Work Plan by the Department. The investigation work at these SWMUs was done to enable Alcoa to implement voluntary Interim Measures (IMs). The accelerated investigation work and IMs are further discussed in Section 2.11 and throughout Section 4 of this report.

## 1.3 RFI Objectives

The objectives of the RFI are as follows:

- Assess whether there have been releases of site constituents of interest (COIs) from the facility SWMUs and AOCs at concentrations posing potential risks to human health and the environment.
- Define nature, extent, and rate of migration of any release of COIs from SWMUs or AOCs at concentrations posing potential risk to human health and the environment.
- Characterize the site physical conditions (e.g., geology and hydrogeology) to understand potential COI transport mechanisms.
- Characterize the potential risks to human health and the environment posed by exposure to media containing COIs.

The basis of these objectives is Appendix B.II of the Badin Works Part-B Permit and USEPA's *RCRA Facility Investigation (RFI) Guidance* (1989a).

This RFI Report focuses on evaluating potential risks to human health related to the SWMUs and AOCs. This is appropriate because the Alcoa Badin Works land use is industrial and the site is occupied by active plant operations and/or areas that undergo routine operation and maintenance activities (e.g., mowing of capped landfill areas).

## 1.4 Land Use and Risk Assessment Considerations

In recent years, USEPA has published proposed rulemaking and guidance that emphasizes the importance of considering current and reasonably anticipated future land use and reasonable risk exposure assumptions throughout the RCRA Corrective Action process. The *Advanced Notice of Proposed Rulemaking (ANPR)* for Corrective Action (Federal Register, Volume 61, Number 85, 19432-19464, May 1, 1996) is considered to reflect USEPA's most recent thinking on land use considerations in the RCRA Corrective Action program. Furthermore, USEPA has emphasized its expectation that the ANPR will be used as guidance for the RCRA Corrective Action process [Memorandum from Elliot Laws and Steven Herman, USEPA Headquarters to RCRA/CERCLA Senior Policy Managers entitled *Use of the Corrective Action Advance Notice of Proposed Rulemaking as Guidance* (January 17, 1997)].

The ANPR discusses how site investigation, site remediation, land use, and risk assessment are all linked together. As discussed in the ANPR, the objective of site investigation and remediation activities is to ultimately achieve conditions such that the site may be used for its "reasonably anticipated future land use." This means that all site investigation activities, including the risk assessment, as well as all evaluations of potential corrective measures, should focus on the development of "practicable and cost-effective remedies" that are consistent with "reasonable anticipated future land use." As a result, site investigation activities, risk assessment exposure evaluations, and remediation activities for an industrial site (assuming reasonably anticipated future land use is industrial) may differ from a site where future residential land use is likely.

In addition to USEPA rules and guidance, North Carolina Senate Bill 1159 Law 1999-198 recognizes the importance of allowing the NCDENR to consider current and future land use in site remedial action programs. Bill 1159 allows restrictions to be placed on current and future land use to control public exposure to site media (e.g., soil, fill material and groundwater). If a risk-based approach is used for a site, the land owner can deed-record the land use restrictions.

The Badin Works property has been used for industrial purposes since 1915, and it is Alcoa's position that the reasonably anticipated future land use for the property is industrial. As a result, the RFI for the Badin Works was completed on the basis of current and future industrial land use. However, to be conservative in protecting human health now and in the future, the risk assessment portion of this RFI also evaluates on-site media concentrations against highly conservative residential values. The comparison to residential screening values ensures the protection of current off-site residential areas and also documents for Alcoa and the Department where future work may be required in the unlikely event land use would change from industrial to residential.

### 1.5 Primary Constituent of Interest (COI)

The primary COI in the Badin Works soil and groundwater is cyanide associated with SPL that was disposed on site and in the two off-site landfills. Most of the cyanide in fresh SPL is in the form of free cyanide. However, once released to the environment, such as that found in the subsurface at the Badin Works, this free cyanide will quickly convert to iron-cyanide complexes (hexacyanoferrate compounds or ferro-ferric-cyanides – $Fe(CN)_6$).

Free cyanide ($CN^-$) and hydrogen cyanide (HCN) are considered the more toxic forms, whereas the iron cyanides and other complexed cyanides are considerably less bioavailable and therefore less toxic (ATSDR, 1997). The North Carolina 2L Groundwater Protection Standard (NC 2L Standard) for cyanide is based on the toxicity assessment of the USEPA reference dose (RfD) for free cyanide. In the critical study upon which the RfD is based, hydrogen cyanide (HCN) was the chemical form administered in the 2-year rat feeding study (USEPA, 2000a). In the gastric environment, HCN is readily dissociates to free cyanide, and the exposure dose reflects free cyanide (USEPA, 2000a). However, the NCDENR conservatively applies the NC 2L Standard for (free) cyanide to measurements of total cyanide. The complexed cyanide found in groundwater at this site is expected to be less bioavailable than free cyanide.

USEPA recognizes that the toxicity of cyanide is highly dependent on the species present (USEPA, 1992b) and references free cyanide as the applicable form to which the Maximum Contaminant Level (MCL) applies (40CFR, Chapter 1, §141.62). As a result, it is Alcoa's position that for cyanide, the decision to further investigate or remediate a SWMU or AOC should be based on free cyanide, not total cyanide concentrations. However, to ensure conservatism in the risk assessment, total cyanide concentrations in site media are screened against values that are based on the toxicity of free cyanide.

The screening values include the Region III Risk Based Concentrations (RBCs), USEPA default Soil Screening Levels (SSLs), NC SSLs, Federal MCLs, and NC 2L Standard for cyanide, which are all based on the toxicity of free cyanide. This step ensures total cyanide is not prematurely dropped as a COI in the risk assessment.

## 1.6 SWMU-Area Concept

RFI SWMUs/AOCs in the plant area include SWMU Nos. 1, 4, 11, 22, 25, 33, 35, 38, 42, 44 and 46 and AOCs –A and –B (Figure 1-4, Table 1-1). SWMUs in the north end of the plant (North End) include SWMU Nos. 1, 4, 22, 25, 33, 35, and 44. In accordance with NCDENR's letter to Alcoa dated September 9, 1999 and the approved RFI Work Plan, SWMUs in the North End are addressed in the RFI using the "SWMU-Area Concept", whereby SWMUs are grouped together based on commonalities.

Groundwater for all the SWMUs in the North End (SWMU Nos. 1, 4, 22, 25, 33, 35, and 44) is addressed using the SWMU-Area concept because the SWMUs are all located within a contiguous infilled valley, have the same COIs, and the COIs in groundwater are not traceable to any individual SWMU. Groundwater beneath the SWMUs and AOCs in the central and southern portion of the plant (SWMU Nos. 11, 38, 42, and 46, and AOCs-A and -B), and off-site landfills (SWMU Nos. 2 and 3) is addressed on an individual SWMU and AOC basis.

SWMU Nos. 1, 4, and 33 are grouped into "SWMU Group 1" for the purposes of evaluating soils based on the results of the RFI and interim measures work. These SWMUs are grouped together based on similar COIs, proximity to one another, and common interim measure (capped). The soil evaluation is performed individually for each of the remaining SWMUs/AOCs.

## 1.7 Report Organization

Section 2 of this report provides the RFI scope of work and details of the RFI implementation. Section 3 presents the approach followed in conducting the screening level and quantitative human health risk assessment. Section 4 presents the RFI findings and risk assessment results. Section 5 presents the RFI summary, conclusions, and recommendations. Section 6 provides a list of the references cited within this report.

## 2.0 RFI SCOPE OF WORK

This section describes the activities performed for the Badin Works RFI. Included in this section are the scope of work for the RFI soil, groundwater, surface water, and sediment investigation; fracture trace analysis; and residential well survey. In addition, this section describes the RFI data validation activities and provides an overview of the human health risk assessment. These activities were completed in accordance with the approved RFI Work Plan (Alcoa, April 11, 1994; Revision 1-October 26, 1995; Revision 2-November 2, 1998; and Revision 3-February 5, 1999) and Phase II Work Plan (Alcoa, April 11, 2000).

MFG Inc. (MFG) was responsible for overall management of the RFI, which was comprised of two phases. The initial phase of RFI field data collection (Phase I) was performed by IT Corporation (IT) in September and October 1999, and January 2000. IT subcontracted the drilling and test pit work to Parratt-Wolff Inc. of Hillsborough, NC and surveying work to T.W. Harris of Albemarle, NC. Phase I laboratory analytical work was performed by Quanterra, Inc. (now Severn Trent Laboratories [STL]) under contract to IT. Quanterra's NC-certified Tampa, Florida and Austin, Texas Laboratories were responsible for receipt of RFI samples and coordination of sample analysis.

Phase II RFI field data collection was performed by MFG in August and September 2000. MFG subcontracted the drilling and test pit work to Parratt-Wolff and surveying to T.W. Harris. Phase II laboratory analytical work was performed by STL. STL's NC-certified Canton, Ohio laboratory was responsible for receipt of the Phase II samples and coordination of sample analysis.

In addition to the activities described above, this section discusses the integration of pre-existing site environmental information into this RFI report. Pre-existing information includes RFI data collected on an accelerated schedule by Alcoa prior to implementation of voluntary interim measures, as well as previous environmental site investigations. Section 2.11 provides a summary of the pre-existing environmental information that is incorporated into the RFI report.

### 2.1 Soil Investigation

A summary of the RFI soil sampling and analysis program implemented during Phase I is provided in Table 2-1 and Phase II in Table 2-2. Table 2-3 provides the analytical methods used to analyze the RFI samples. More than 100 soil samples were collected during the investigation. Some of the Phase I samples were recollected due to missed holding times. The recollected samples are distinguished on Table 2-1 by the "R" at the end of the sample designation. The RFI soil sample locations are shown on Figures 2-1, 2-2, and 2-3. Section 2.11 and Section 4 provide details on the utilization of soil data that pre-dates the 1999 RFI work. Following is a description of the RFI soil investigation, which followed the protocol in the approved RFI Work Plan.

### 2.1.1 Soil Sample Collection Procedures

Equipment used to collect RFI soil samples included a hollow stem auger (HSA) drill rig and split-spoon samplers, a backhoe, and hand bucket augers. Tables 2-1 and 2-2 identify the sampling method used to collect each RFI soil sample.

The HSA drill rig and split-spoon samplers were generally used to retrieve soil at test boring locations where samples deeper than 2 feet were planned. The HSA test borings were advanced using 3 ¼-inch inside diameter (ID) HSAs, and a 1 ½ ID and 2-inch outside diameter (OD), 2-foot long split-spoon sampler. Split-spoon soil samples were collected ahead of the lead auger by pushing the sampler into undisturbed soil with a hydraulic hammer. Upon completion, the borings were backfilled and sealed with a cement/bentonite grout.

The backhoe was used to excavate test pits to allow for visual investigation of suspected SPL. Samples were retrieved from the test pits at selected locations using the backhoe bucket. The soil samples for laboratory analysis were taken from the center of the backhoe bucket. Upon completion, excavated soil was placed back into the test pit.

Stainless steel hand-operated bucket augers were used to retrieve soil at locations where surface samples (0-to 6-inches) were collected and where test borings of approximately 2 feet or less were advanced. The small volume of excess soil generated by boring activities was placed back into the bore hole.

Immediately upon retrieval by the sampling equipment, each sample designated for laboratory analysis was properly prepared and placed into the appropriate sample containers. If a sample was designated for VOC analysis, a discrete VOC sample was collected first using an EnCore™ sampler and containers.

Following collection of soil for VOC analysis, the remainder of the sample was placed into a stainless steel bowl and thoroughly homogenized with a stainless steel spoon prior to filling sample bottles for the remaining parameters (e.g., SVOCs, PCBs/pesticides, and inorganics). At SWMU No. 46 (West SPL Area), it was necessary in a few cases to screen the homogenized soil through a No. 10 sieve to remove coarse particles or rock fragments in order to obtain a sample that could be analyzed by the laboratory. In one case at SWMU No. 46 (waste sample WA-TP-01-3.5-4.5), the sample was too coarse to be placed in the sample jars. An attempt to break the sample into smaller pieces with a hammer was not successful. As a result, the sample was placed in a plastic bag and sent to the laboratory with instructions to crush the sample and analyze.

Phase II soil samples from SWMU No. 35 were screened in the field for PCBs using a Strategic Diagnostics Ensys™ PCB test kit. The kit is a system that performs relatively rapid, semi-quantitative testing for PCBs in soil at a specific action level. MFG personnel utilized a kit that was standardized for 2 parts per million (ppm) using Aroclor 1248, and 1260, which were the only two PCBs detected in Phase I soil samples from this SWMU.

The test kit operation is based on an enzyme-linked immunosorbant assay to determine the concentration of PCBs. The kit uses an enzyme that has been chemically linked to a PCB molecule to create a PCB reagent (conjugate). The test procedure entails collecting a 5 gram soil sample and extracting PCBs from it using methanol. To initiate the PCB test, a PCB-enzyme conjugate is added to antibody-coated test tubes. The soil extract is then added to the test tube. The PCBs from the soil extract (if present) and the PCB-enzyme conjugate compete for a limited number of antibody sites in the test tube. After an incubation period, the test tube is rinsed and a color developing solution is added. A photometer is used to measure the absorbance of each test tube and compared to a standard. Color development is inversely related to the PCB concentration (darker color indicates less PCB than calibrated standard material). Selected soil screening results were confirmed by laboratory analysis.

After filling, the soil sample containers designated for shipment to the laboratory were sealed, labeled, and placed in ice-filled shipping containers. If held overnight before shipping, samples were placed inside a sample refrigerator within a secure room in plant Building No. 134. Samples were logged onto a chain of custody (COC) form and shipped by overnight courier (Federal Express, Airborne or United Parcel Service) to the laboratory. COC forms are included in Appendix A-1.

Geologic descriptions of the soil samples were recorded in the field book. Test boring logs and test pit logs are included in Appendix B.

### 2.1.2 Decontamination Procedure

All soil samples were collected with clean soil sampling equipment. Soil sampling equipment was decontaminated after use in accordance with the following procedure, as included in the approved RFI Work plan:

- If heavily soiled, wash with tap water and use a brush to remove soil particles;
- Wash with tap water/non-phosphate soap;
- Rinse with tap water;
- Rinse with 10 % nitric acid/90% tap water solution;
- Rinse with organic free/analyte free water;
- Rinse with solvent (pesticide grade isopropanol);
- Rinse with organic free/analyte free water;
- Air dry; and
- Cover with plastic.

## 2.2 Groundwater Investigation

The Phase I RFI groundwater investigation included installation and development of two monitoring wells, measurement of groundwater elevations in 44 monitoring wells/piezometers, and collection of groundwater samples from 43 wells and a free product sample from one well. A summary of the Phase I RFI groundwater sampling and analysis program is provided in Table 2-4. Several of the wells were resampled in January 2000 due to the missed holding times for cyanide analysis. The recollected samples are distinguished on Table 2-4 by the "R" at the end of the sample designation. The Phase II investigation included the installation and development of three monitoring wells and collection and analysis of groundwater samples from eight wells. A summary of the Phase II groundwater investigation is provided on Table 2-5. The RFI groundwater sample locations are shown on Figures 2-2, 2-3, and 2-4.

Section 2.11 and Section 4 provide discuss utilization of groundwater data that pre-date the RFI work. The following is a description of the RFI groundwater investigation, which followed protocols presented in the approved RFI Work Plan.

### 2.2.1 Monitoring Well Installation and Development

Two monitoring wells (B016-MW-3 and MW-27) were installed during Phase I RFI activities and three (OBL-MW-6, MW-28 and MW-29) during Phase II using a HSA drilling rig. Initially, test borings were advanced into the subsurface using 3 ¼ –inch ID HSAs. Split-spoon sampling was conducted ahead of the lead auger to identify soil types and the top of the saturated zone. This information was used to select the appropriate interval for well screen placement.

At locations OBL-MW-6, MW-27, MW-28, and MW-29, 3 ¼ -inch ID HSAs and split-spoon samples were used to obtain subsurface lithology and identify the saturated zone for well screen placement. The borings were subsequently overdrilled using 6 ¼-inch ID and 10-inch OD HSAs prior to constructing each well. Boring S42-TB-02 was used to determine well screen placement at B016-MW-3. S42-TB-02 was abandoned by grouting after reaching the total depth. The borehole for B016-MW-3 was drilled using 6 ¼ -inch ID/10-inch OD HSAs within a few feet of boring S42-TB-02.

At MW-27, MW-28, MW-29 and OBL-MW-6, a 2-inch Schedule 40 PVC monitoring well, consisting of a 10-foot length of 0.010-inch well screen with riser pipe extending a few feet above the land surface was placed inside the HSA's in the borehole. Placement of remaining well materials inside the HSAs proceeded in a manner that allowed the well construction material to fill the annular space between the casing and borehole as the augers were slowly withdrawn. A sand filter pack was installed around the well screen and riser pipe to a minimum height of two feet above the well screen. A minimum of one-foot of bentonite pellets were placed above the sand filter pack and hydrated with potable water. A cement/bentonite grout mixture was placed above the bentonite seal to the land surface. MW-27, MW-28, MW-29 and OBL-MW-6 were completed at surface by installing a 4-inch diameter outer steel protective casing. A two-foot round or square concrete pad was installed at the surface at each well. The concrete pad was sloped to promote drainage of precipitation runoff away from the well. B016-MW-3 was constructed in a similar manner, except construction was done inside an open borehole. The soils (partially weathered rock) encountered in B016-MW-3 allowed the borehole to remain open during construction. B016-MW-3 was completed at surface with a steel flush mount well cover and a two-foot diameter, round, sloped concrete pad. Monitoring well construction diagrams are included in Appendix B. The monitoring wells were developed no sooner than 24 hours after installation. Wells were developed by surging and pumping with a 1 ½ -inch centrifugal purge pump.

### 2.2.2 Groundwater Sample Collection Procedure

Table 2-4 and 2-5 identify the sampling method used to collect each RFI groundwater sample. All except two of the monitoring wells used for the RFI were purged and sampled using Teflon-lined stainless steel bladder pumps with Teflon-lined discharge tubing. Groundwater in MW-FO-2 was purged and sampled using a disposable Teflon bailer. In addition, a disposable Teflon bailer was used to collect free-floating product (lubricating oil) from B016-MW-2.

Prior to initiating well purging for groundwater sample collection, groundwater levels were measured in each well and the volume of standing water in the well casing calculated. A minimum of three well volumes were removed from the well and periodic field measurements of pH, specific conductivity, turbidity, and temperature were recorded. Groundwater samples were collected from the well when pH was ± 0.1 standard units (SU), temperature was stable, specific conductivity was ± 10% for three consecutive volumes, and turbidity was less than or equal to 10 NTU. At the discretion of the field manager, wells that did not stabilize were sampled after removing five well volumes. Table 2-6 provides a summary of the final readings of pH, specific conductivity, turbidity, and temperature taken after the well was purged and prior to sample collection.

When the bladder pump was used for well purging, samples were collected from the Teflon-lined discharge hose directly into the appropriate sample containers. The samples for dissolved metals analysis were collected into the sample containers through a 0.45 micron in-line filter attached to the Teflon-lined discharge hose.

When a Teflon bailer was used for purging and sampling MW-FO-2, it was gently lowered into and removed from the water column to minimize turbulence. When purging was complete, the sample was poured from the bailer directly into the appropriate sample containers. The free-product sample was collected from B016-MW-2 without purging to allow for collection of sufficient sample volume.

The vials for VOC samples were the only pre-preserved sample containers used for groundwater sampling. Preservatives were added in the field to the remaining samples as required by method protocol. Although chlorine is not a chemical associated with the aluminum smelting process, groundwater samples from three North End monitoring wells (MW-6, MW-7, and MW-16) were field screened during Phase II for residual chlorine prior to preservation (with NaOH) and analysis for cyanide, as indicated by the state of North Carolina [15A NCAC 2H.0805(a)]. The chlorine test consisted of moistening a small piece of potassium iodide-starch test paper with an acetate buffer solution and adding a few drops of the groundwater sample. If the test paper changes color to blue, chlorine is present, and a reductant should be added before preservation and analysis. None of the groundwater samples tested from the North End monitoring wells had an indication of residual chlorine and therefore it was not necessary to add the reductant.

Each sample container was sealed, labeled, and placed in ice-filled shipping containers. If held overnight before shipping, samples were placed inside a sample refrigerator within a secured room in plant Building No. 134. Samples were logged onto a COC form and shipped by overnight courier to the laboratory.

### 2.2.3 Decontamination Procedure

Bladder pumps were field decontaminated after use in a well. Teflon tubing used with the bladder pumps was dedicated to each well and as a result was not subjected to field decontamination. Teflon bailers were disposed after use and therefore did not require decontamination.

Field decontamination of bladder pumps was in accordance with the following procedure, as specified in the approved RFI Work Plan.

- Wash with tap water/non-phosphate detergent;
- Rinse with Tap water;
- Rinse with 10% nitric acid/90% tap water solution;

- Rinse with organic free/analyte free water;
- Rinse with pesticide grade isopropanol;
- Rinse with organic free/analyte free water;
- Air dry; and
- Cover with plastic.

The pumps were decontaminated by fully submerging them inside 4-inch PVC tubes filled with each of the decontamination solutions listed above. The pumps were then flushed with a minimum of 7 cycles of each solution. The outsides of the pumps were washed concurrently with the inside of the pumps.

## 2.3 Surface Water and Sediment Investigation

A summary of the Phases I and II RFI surface water/sediment sampling and analysis program is provided in Table 2-7. RFI surface water and sediment samples were collected from Little Mountain Creek at the two locations shown on Figure 2-2. A surface water sample (NE-SW) was collected from Badin Lake at the location illustrated on Figure 2-4.

The following is a description of the RFI surface water and sediment investigation, which followed the protocols in the approved RFI Work Plan.

### 2.3.1 Sample Collection Procedures

During Phase I, surface water and sediment samples were collected from Little Mountain Creek. Sampling personnel were positioned downstream of the sample location to avoid having the samples affected by disturbed bottom sediments. With the exception of VOC samples, surface water samples were collected directly into the appropriate sample containers by dipping the mouth of the container into the stream and filling. The surface water sample for VOC analysis was first collected from the stream into a 500 ml amber glass sample container and then poured into the pre-preserved VOC vials. This was done so the preservative would not be flushed from the vial during sampling and to prevent air bubbles in the VOC sample container. When collecting the surface water sample from the stream, the mouth of the containers were positioned upstream.

An attempt was made to directly collect sediment sample for VOC analysis directly from the stream bed using the EnCore™ sampler. However, the presence of rocks on the stream bed prevented direct collection. A sediment sample was collected from the stream bed using a stainless steel spoon and was screened through a No. 10 sieve into a stainless steel bowl to remove coarse rocks. The Encore sampler was then used to collect the VOC sample from the stainless steel bowl. The remaining sediment was thoroughly homogenized and the other parameters (e.g., SVOCs, PCBs and inorganics) were collected into the appropriate sample containers.

The Phase II surface water sample for trichloroethene (NE-SW) was collected along the west shore of Badin Lake, east of monitoring well MW-16. The sample was collected by dipping the mouth of a clean 8-ounce sample jar into the lake water, then carefully transferring the sample into the pre-preserved 40-ml VOC vials. This procedure was used to keep the preservative from being flushed from the VOC vials and to remain consistent with procedures used in surface water sample collection during Phase I.

After filling, the surface water and sediment sample containers were sealed, labeled, and placed in ice-filled shipping containers. Samples were logged onto a COC form and shipped by overnight courier to the laboratory.

### 2.3.2 Decontamination Procedures

Decontamination procedures for the sediment sampling equipment followed that described for soils in Section 2.1.2. There was no equipment decontamination associated with surface water sampling because of direct collection into the sample bottle. For the VOCs, which were transferred from an amber glass container to the 40 ml vials, a clean, dedicated amber container supplied by the analytical laboratory was used each time to collect a surface water sample.

## 2.4 Field QA/QC Samples

Field quality assurance/quality control (QA/QC) samples collected during the RFI include duplicate samples, trip blanks, and equipment/field blanks. In addition to the field QA/QC samples described below, the field team collected a triple sample volume for every 20 samples of similar matrix to accommodate laboratory matrix spike/matrix spike duplicate analysis. Following is a description of the field QA/QC samples and frequency of collection.

Duplicate Samples: Duplicate samples are useful in documenting the precision of sampling. Duplicate samples are independent samples collected from the same source and as close as possible in time during a sampling event. One duplicate sample was collected per analytical parameter for each group of samples of similar matrix (i.e., solid or aqueous) at a minimum frequency of one duplicate for every 20 samples collected.

Trip Blanks: Trip blanks are used to assess the potential for cross-contamination by VOCs during field sampling, handling, and shipping of samples. Trip blanks are sealed samples prepared by the laboratory that accompany the sample jars from the lab to the field and the samples from field back to the laboratory. The trip blanks were prepared by the RFI analytical laboratory and were comprised of analyte-free water in VOC vials. One trip blank was submitted per shipment of VOCs.

Equipment/Field Blanks: Equipment blanks are used to assess the adequacy of the equipment decontamination in the field and field blanks are used to assess potential for sample cross-contamination by air-borne contaminants from sources not associated with the sample. Equipment blanks are prepared by pouring analyte-free water over or through cleaned sample equipment and into the appropriate sample containers. Field blanks are prepared by pouring analyte-free water directly into the sample containers.

Because the collection of both equipment and field blanks is somewhat redundant (i.e., an equipment blank would account for contaminants of both air-borne contaminants and equipment decontamination), Alcoa requested that the Department allow collection of equipment blanks where non-dedicated sampling equipment is used and field blanks where dedicated sampling equipment is used. The Department approved this modification in a letter to Alcoa dated September 9, 1999.

A minimum of one equipment blank was collected per parameter for each group of 20 samples submitted to the laboratory. Equipment blanks for soil and sediment were collected by pouring analyte free water over cleaned equipment (e.g., stainless steel bowls, split-spoons, or hand augers). Equipment blanks for groundwater samples were collected through cleaned pumps and Teflon tubing. For dissolved metals equipment blanks, a new in-line 0.45 micron filter was added to the Teflon-lined discharge hose prior to collecting the sample. An equipment blank was collected for trichloroethene for the Phase II surface water sample from Badin Lake, by first decontaminating an 8-ounce sampling jar, then adding analyte free water to the 8-ounce jar. The analyte-free water was then transferred to the 40-ml VOC vials as outlined above to be used as the blank.

Field blanks were not collected as dedicated equipment (Teflon bailers) were used on only two wells and two Little Mountain Creek surface water samples (amber bottle for VOCs), and the 1 per 20 QA/QC requirement was accounted for by the equipment blanks.

## 2.5 Waste Handling and Disposal

All monitoring well development and purge waters, decontamination fluids, and drill cuttings were properly managed and disposed. Purged groundwater from the plant area and Alcoa/Badin Landfill monitoring wells was collected into 5-gallon polyethylene containers with sealing screw-top lids. With the exception of the purged water from SWMU No. 42 (Building 016) and AOC-A (Fuel Oil Release Tank), the purge water in the polyethylene containers was transferred to a 120-gallon polyethylene tank, transported to Alcoa's 90-day hazardous waste storage area, and transferred to 55-gallon drums. The purged water from SWMU No. 42 and AOC-A was transferred directly from the 5-gallon polyethylene containers to 55-gallon drums. All the drums were securely sealed and labeled.

Purged groundwater at SWMU No. 3 (Old Brick Landfill) was collected into the 5-gallon polyethylene containers and transferred to a 55-gallon drum staged inside the secured, fenced area. The drum in the Old Brick Landfill was not transported to Alcoa's 90-day hazardous waste storage because this would have required transport over public roadways. Instead, Alcoa shipped the drum directly to a permitted disposal facility using a licensed hazardous waste transporter.

Purged groundwater and development water from Building 016 wells (B016-MW-1 and B016-MW-3) were disposed of as non-hazardous following receipt and review of the analytical results. There was no water generated from B016-MW-2. Purged groundwater from all other sampled wells, development water from newly installed monitoring wells MW-27, MW-28, MW-29 and OBL-MW-6, and all decontamination fluids were disposed of by Alcoa as hazardous waste.

Soil cuttings from SWMU No. 42 (Building 016) and SWMU No. 3 (Old Brick Landfill) were managed as non-hazardous. Soil cuttings from SWMU No. 35 ("Old" Waste Oil Storage Area) and SWMU No. 46 (West SPL Area) were managed as hazardous waste by Alcoa.

### 2.6 Sample Location Survey

T.W. Harris and Associates, Inc., a North Carolina Registered Land Surveyor, surveyed all RFI soil and sediment sample locations to an accuracy of 0.1 foot horizontally and vertically. Monitoring wells installed during the RFI were surveyed to an accuracy of 0.01 foot vertically and 0.1 foot horizontally. Existing monitoring wells were surveyed previously by T.W. Harris and Associates. Horizontal coordinates were surveyed to both the state plane and plant coordinate systems.

### 2.7 Fracture Orientation Evaluation

Fracture orientation was evaluated to assess the potential for preferential groundwater flow paths within bedrock and saprolite. This evaluation consisted of two tasks: 1) lineament analysis of topographic maps of the site area, and 2) measurement of fracture orientation on outcrops within a two-mile radius of the site using a Brunton® compass.

#### 2.7.1 Topographic Lineament (Fracture Trace) Analysis

Lineament analysis of topographic maps is a remote sensing technique used to identify potential bedrock fracture orientation based on differential weathering of bedrock. Due to the increased surface area, weathering along fractures typically occurs more rapidly than surrounding unfractured rock. Straight line segments of streams and/or valleys, termed lineaments, can be used to identify potential fracture orientations remotely. This method can provide regional information regarding fracture orientation that can be used to assess the potential for preferential flow of groundwater within bedrock and saprolite. Lineament analysis, when used in combination with field measurements and local geologic information provides reliable regional information regarding fracture orientation. Section 4.1.1 provides the results of the lineament analysis.

### 2.7.2 Outcrop Fracture Measurements

Fracture orientation was measured to assess the direction of potential preferential groundwater flow paths within bedrock and saprolite in the vicinity of the Badin Works. Due to the expected low primary porosity (such as interstices between grains of sand) in the bedrock and saprolite, secondary porosity resulting from fractures is expected to control groundwater flow. Therefore, understanding the orientation of the fractures as well as the hydraulic gradient is important in understanding groundwater flow and contaminant transport.

Fracture orientation was measured using a Brunton® compass from 15 separate rock outcrops within a two-mile radius of the Alcoa Badin facility. A total of 131 fractures were measured at these outcrops. Section 4.1.2 provides the results of the outcrop fracture orientation evaluation.

## 2.8 Residential Well Survey

A residential well survey was performed to identify areas within a two-mile radius of the Alcoa Badin facility that rely on groundwater as their potable water source. This survey was performed by first obtaining a listing of residences served by the Stanly County Utility Department and by reviewing the water supply area identified in the Stanly County, North Carolina geographic information system. The location of these residences were confirmed during a drive-by survey. Areas served by public water were confirmed by the presence of fire hydrants and water supply meters, both of which were generally visible from the road. Section 4.2 provides the results of the residential well survey.

## 2.9 Data Validation

As agreed with the Department in a conference call held on November 19, 1999 and documented in a follow-up letter by MFG to the Department dated November 23, 1999, a minimum of 10 percent validation of the Alcoa Badin RFI analytical data was performed. The organic data were reviewed according to USEPA's National Functional Guidelines for Organic Data Review (USEPA, 1994a). The inorganic data were reviewed according to USEPA's National Functional Guidelines for Inorganic Data Review (USEPA, 1994b) and with respect to method requirements.

The organic analytical data were evaluated by the following quality assurance/quality control (QA/QC) parameters where applicable: technical holding times and preservation, GC/MS instrument performance checks, initial and continuing calibrations, system monitoring compound/surrogate spike recoveries, method and field blanks, laboratory control samples (LCSs), matrix spike/matrix spike duplicates (MS/MSDs), field duplicates, internal standard areas and retention times, analytical sequence, compound identification and quantitation, and transcription. The inorganic analytical data were evaluated by the following quality assurance/quality control (QA/QC) parameters where applicable: technical holding times and preservation, initial and continuing calibrations, method and field blanks, LCSs, MS/MSDs, laboratory and field duplicates, inductively coupled plasma (ICP) serial dilution, ICP interference check samples, analytical sequence, and transcription. All results, with the exceptions of those that were rejected and flagged with an "R" are deemed acceptable and valid for the intended use. Areas of concern with respect to data quality and usability are discussed in the respective data validation reports. Validation reports are provided in Appendix A-2. The entire laboratory data packages are provided in portable document format (PDF) on a compact disk in Appendix A-3.

As described above, a minimum of ten percent of the analytical data underwent formal validation. Only the analyses for asbestos were not subjected to the validation process as the method utilized (polarized light microscopy) relies strictly on visual counts of the fibers and, as such, does not lend itself to meaningful review. The numbers of samples validated relative to the total number of samples collected are presented in the Tables 2-8 (soil/sediment samples) and 2-9 (groundwater/surface water samples).

Note that samples MW-6-2639, MW-6-2639D, and ABL-MW-5-2699 were analyzed for Appendix IX metals, while the other aqueous samples were only analyzed for arsenic, barium, cadmium, chromium, lead, and selenium (and, in certain instances, mercury). As all metals (except mercury) were analyzed by the same method (i.e., by trace ICP), it was considered, for validation purposes, that the review of samples analyzed for the six constituents would also be representative of those analyzed for the additional Appendix IX metals.

## 2.10 Background Concentration Evaluation

In order to determine if soil concentrations were within background levels, a statistical evaluation of the background soil concentrations for selected compounds was performed. Background samples were collected from representative site areas that are unaffected by potential releases from the RFI

SWMUs/AOCs. The analytes that were evaluated included the following organic and inorganic compounds: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, arsenic, cadmium, chromium, total and weak acid dissociable cyanide, and fluoride. These were selected following a preliminary screening of site RFI data against risk-based screening values. The statistical evaluation results are presented in Section 4.3.

Few COIs were detected in upgradient monitoring wells and as a result, a statistical determination of background groundwater concentrations was not performed.

### 2.11 Integration of Pre-Existing Data

Numerous environmental investigations and voluntary interim measures of the Plant Area, Alcoa/Badin Landfill, and Old Brick Landfill were conducted prior to 1999/2000 RFI work. The scopes of these past environmental investigations encompass soil borings and soil sampling, monitoring well installation and sampling, aquifer characterization testing, and surface water and sediment sampling. Voluntary interim measures have included soil removal, regrading, capping and run-on control. The interim measures at the On-Site Landfill and Alcoa/Badin Landfill were voluntary and done in accordance with Interim Measures Work Plans that were approved by NCDENR. The channel and landslide repair work at the Old Brick Landfill, while not interim measures, were also done with NCDENR approval of the specifications for that work.

The site knowledge gained from the past investigations, voluntary measures, and interim measures work are incorporated into this RFI report to arrive at a comprehensive understanding of site conditions. Section 4 (RFI Findings) provides an overview of the past work and incorporates the past findings in making conclusions and recommendations regarding the course of action for SWMUs and AOCs. Table 2-10 lists the past investigation, voluntary, and interim measures reports previously submitted to the Department that were completed for the plant area SWMUs/AOCs, SWMU No. 2 (Alcoa/Badin Landfill), and SWMU No. 3 (Old Brick Landfill). The reader is referred to the individual reports if additional details are desired.

In addition to the reports previously submitted to the Department, Alcoa has conducted extensive voluntary groundwater sampling at the Badin Works. Since May 1990, Alcoa has performed periodic voluntary groundwater monitoring for the plant area wells. Since June 1991, Alcoa has performed periodic groundwater monitoring of SWMU No. 2 (Alcoa/ Badin Landfill) and SWMU No. 3 (Old Brick Landfill). The primary constituents analyzed include total cyanide, free cyanide (by various methods), and fluoride. Groundwater samples from selected areas of the plant (i.e., SWMU No. 42 and AOC-B) have been analyzed for VOCs and SVOCs. Since 1992, periodic sampling of the Alcoa/Badin Landfill has included total and dissolved chromium, nickel, and lead in addition to the free and total cyanide and fluoride. The historic groundwater elevation data and groundwater quality results are provided in Appendix D.

In order to accommodate voluntary Interim Measures work completed by Alcoa, some of the RFI soil sampling was implemented on an accelerated schedule prior to the Department's final approval of the RFI Work Plan. The soil analytical data from many of these accelerated investigations were collected and analyzed following the RFI protocols and, as a result, are deemed to be suitable for inclusion in the risk assessment. Table 2-11 provides a summary of the soil samples collected prior to 1999/2000 RFI activities that are included in the risk assessment. Figure 2-1 shows the location of these soil samples.

In addition to the soil samples, surface water and sediment data (Woodward Clyde, 1997) collected from Badin Lake are incorporated into the risk assessment. Table 2-12 provides a summary of the Woodward Clyde surface water samples and Table 2-13 the sediment samples. The surface water and sediment sample locations are shown on Figure 2-5. The sediment and surface water data were previously provided to representatives of NCDENR during a meeting in Raleigh, North Carolina on May 15, 1997.

## 2.12 Human Health Risk Assessment Overview

The RFI incorporated a risk assessment to evaluate potential risks to human health associated with releases of hazardous constituents from SWMUs or AOCs. The objective of the risk assessment was to determine whether releases pose unacceptable risks that warrant further evaluation in the corrective measures study (CMS).

The role of a SSRA has been clearly defined by USEPA for the RCRA corrective action program in the *Advanced Notice for Proposed Rulemaking (ANPR)* for RCRA Corrective Action (Federal Register, Volume 61, Number 85, 19432-19464, May 1, 1996). Within the ANPR, USEPA emphasizes that site-specific risk assessments should be based on the extensive guidance developed under CERCLA [(e.g., *Risk Assessment Guidance for Superfund* (USEPA, 1989b)]. Risk-based concentrations or screening values were used to evaluate the RFI data, identify additional data needs, and identify COIs to include in site-specific risk assessments for individual SWMUs/AOCs. Section 3 provides the details of the Risk Assessment approach followed for the RFI.

## 3.0 HUMAN HEALTH RISK ASSESSMENT

This section presents the methodology used to conduct the human health screening risk assessments and gives a general overview of site-specific risk assessments for SWMUs/AOCs that exceed screening risk levels. This risk assessment was conducted as part of the Badin Works RFI to evaluate the potential for adverse human health effects associated with the release of chemical constituents from SWMUs/AOCs to environmental media at the site. The risk assessment is a baseline evaluation. The purpose of the risk assessment is to determine whether unacceptable risks associated with constituent release(s) from SWMUs/AOCs may exist, and to provide a tool for managing risks in the future, if needed.

### 3.1 General Approach

The risk assessment portions of the RFI are presented on a SWMU/AOC by SWMU/AOC basis, with two exceptions. North End groundwater is presented using the SWMU-Area concept because the commingling of plumes in the contiguous infilled valley makes COIs untraceable to any individual SWMU. The SWMUs included in the North End groundwater SWMU-Area concept are SWMU Nos. 1, 4, 22, 25, 33, 35, and 44.

Also, soils at SWMU No. 1 (On-Site Landfill), SWMU No. 4 (Former K088 Storage Pad), and SWMU No. 33 (Wet-Weather Run-on Diversion) are addressed together using the SWMU-Area concept as SWMU Group 1 due to their proximity to one another, common COIs, and common interim measure (capped).

The risk assessment follows the general approach to conducting risk assessments as specified in USEPA's *Risk Assessment Guidance for Superfund* [RAGS (USEPA, 1989b)] and consists of the following parts:

- Data evaluation;
- Identification of COIs;
- Exposure assessment;
- Toxicity assessment; and

- Risk characterization and uncertainty analysis.

The steps of data evaluation, identification of COIs, and a preliminary exposure analysis make up a screening-level risk assessment. Each SWMU/AOC is subjected, at a minimum, to a screening-level risk assessment. If concentrations of constituents in SWMU/AOC media are lower than screening-level risk-based concentrations, then risks are shown to be acceptable without further quantitative risk assessment. Conversely, if screening-level risk-based concentrations are exceeded in SWMU/AOC media, then a quantitative risk assessment is carried out to determine whether site-specific risks are acceptable. In a quantitative risk assessment, the COIs are carried through the steps of exposure assessment, toxicity assessment, and risk characterization.

The following sections discuss in detail the Screening-Level Risk Assessment methods (i.e., data evaluation, identification of COIs, and the preliminary exposure analysis) and briefly discuss the remaining steps of quantitative risk assessment. More details of the site-specific risk assessment methods are found in Appendix E-1 and are referenced in the SWMU/AOC-specific discussion in Section 4 for those areas requiring a quantitative risk assessment.

## 3.2 Data Evaluation

Data evaluation was performed to determine if the data are appropriate and of sufficient quality for use in performing the risk assessment. The evaluation consisted of a review of the quality and quantity of the analytical data. Specifically, data collected during the RFI were evaluated according to six data usability criteria, as specified in *Guidance for Data Usability in Risk Assessment (Part A)* (USEPA, 1992a). These six criteria include:

- Evaluation of data sources;
- Review of documentation;
- Assessment of analytical methods and detection limits;
- Evaluation of data quality indicators (completeness, comparability, representativeness, precision, and accuracy);
- Data review; and
- Data reports and assessment.

The analytical data used in the RFI risk assessment were generated in accordance with the analytical methods specified in the approved RFI Work Plan (Alcoa, 1999) and Phase II Work Plan (Alcoa, 2000). The detection limits were assessed and found to be in agreement with those routinely and reliably achieved by the approved analytical methods. The remainder of the data quality evaluation was performed on the data set as a whole through validation of a representative portion of the data (minimum of 10 % of the entire dataset). The data validation information was presented in Section 2.9.

The validation results indicate that the data are of sufficient quality for use in this risk assessment. The data validation process necessarily qualifies some of the analytical data. A small amount of data were qualified with an "R," rejected as unreliable, and therefore not used in this risk assessment. These include non-detect sample values for soil samples from SWMU No. 44 for specific compounds that are unrelated to site activities: acrolein; acetonitrile; propionitrile; isobutyl alcohol; 1,4-dioxane; 2,4-dinitrophenol; 4,6-dinitro-2-methylphenol; 1,3,5-trinitrobenzene; and 4-nitroquinoline-1-oxide. Likewise, sample concentrations that were found to be less than five times (ten times in the instances of common laboratory contaminants) the levels detected in associated field or laboratory blanks were not used in the risk assessment as these values may not be representative of actual site conditions. Constituents qualified "U" were not detected; and the value presented is the analytical detection limit. Non-detected constituent concentrations were incorporated into exposure point concentrations, where calculated, at one-half of the reported detection limit. All other qualified data as well as unqualified data were used in the risk assessment at the reported concentrations.

The data quantity evaluation was performed separately for each SWMU/AOC (or SWMU-Area) and included the evaluation of observed laboratory concentrations relative to screening values, spatial distribution of detections, and whether or not the sample locations adequately bounded apparent releases. Where it was determined that sufficient data had been collected, the risk assessment evaluation proceeded. In areas where the data evaluation indicated that more data collection was necessary, additional samples were proposed and collected during Phase II. Following Phase II, sufficient data were available to complete all risk evaluations.

## 3.3 Identification of COIs

A screening level risk assessment of site analytical data was performed for each SWMU/AOC to identify the COIs in site media that warrant evaluation in the quantitative risk assessment. The identification of COIs was conducted by comparing the maximum concentrations of detected constituents to conservative screening values. The screening procedure for soils included comparison with background concentrations, the USEPA Region III Risk Based Concentrations (RBCs) for both industrial and residential exposures, a calculated default soil screening level (SSL) based on the North Carolina (NC) groundwater protection (2L) standards, and the default USEPA SSL for groundwater protection. For the purpose of illustrating the general screening rationale, the screening process for evaluation of the soil data are presented graphically in Figure 3-1. The screening process considers the soil direct contact pathway and the soil to groundwater pathway separately because the exposure endpoints are different. The screening procedure for groundwater included screening against NC 2L Standards and Federal Maximum Contaminant Levels (MCLs). The following sections describe the screening process and the screening values used.

### 3.3.1 Background Screening for Soil

Representative background values were calculated for a number of analytes that may be attributable to natural or anthropogenic background. Samples collected for background determination were analyzed for total metals and PAHs. Background statistical evaluations were focused on specific inorganic compounds and PAHs that tend to be relatively more toxic. These are cyanide, fluoride, arsenic, cadmium, and chromium for inorganics and benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene for organic constituents. Section 4.3 describes the methodology used to calculate representative background values for these constituents. For each SWMU/AOC or SWMU Group, the maximum concentration of each of these constituents was compared to the respective calculated background concentration. If the concentration of a particular constituent was less than the background concentration, the constituent was identified as being within background levels and eliminated as a COI.

### 3.3.2 Soil Direct Contact Screening

The soil direct contact screening was conducted by comparing the maximum constituent concentration to the respective screening value. The screening values used for direct contact exposure pathways included the USEPA Region III RBCs (USEPA, 2000b) for both residential and industrial exposure scenarios.

Maximum detected concentrations were first compared to the USEPA Region III residential RBC. If the maximum detected concentration was less than the residential RBC, the constituent was eliminated from further evaluation in the direct contact risk assessment both on- and off-site because the residential screening values are lower than the respective industrial values. If the constituent maximum concentration exceeded the residential RBC in surface soil, the constituent was retained as a COI in an evaluation of potential off-site residential risks. It is assumed that constituents in subsurface soil (i.e., greater than 0.5 ft-bgs) do not have the potential to migrate via wind erosion to off-site areas. Therefore, constituents that exceeded residential RBCs in subsurface soil only were not included as COIs for the off-site residential scenario.

Constituents exceeding the residential RBC were further evaluated with respect to on-site exposures by comparing the maximum concentration to the USEPA Region III industrial RBC. If the maximum detected concentration was less than the industrial RBC, the constituent was eliminated from further evaluation in the direct contact risk assessment for on-site exposures. If the constituent maximum concentration exceeded the industrial RBC, it was retained as a COI in the site-specific risk assessment.

### 3.3.3 Soil to Groundwater Screening

The detected constituents in soil samples were evaluated with respect to the potential for leaching to groundwater. The purpose of this evaluation was to determine if constituents detected in soil can migrate to groundwater in concentrations exceeding the NC 2L Standards or Federal MCLs. It should be noted however, that exceeding the soil to groundwater screening value does not necessarily indicate that leaching will occur, rather it indicates that constituent concentrations warrant further evaluation with respect to the potential for leaching. The following paragraphs describe the process used for evaluating the potential for migration from soil to groundwater.

The soil to groundwater leaching evaluation used the methodologies presented in the USEPA Soil Screening Guidance (USEPA, 1996a) to calculate SSLs. This guidance uses a linear equilibrium soil/water partitioning equation to estimate constituent migration in soil leachate. These equations back-calculate an acceptable target soil concentration based on an acceptable target groundwater concentration. The default assumptions in the model result in conservative soil target concentrations that tend to overestimate the degree of leaching to groundwater. The SSLs were calculated using the default input values and a dilution attenuation factor (DAF) of 20. The Department has adopted this approach with the substitution of NC 2L groundwater standard as the target groundwater concentration. In cases where a NC 2L Standard did not exist, the default USEPA SSL was used in place of an SSL derived from the NC 2L Standards. The equation for the calculation of the SSLs and the default input values are as follows:

$$C_{soil} = C_{gw}\left[k_s + \frac{(\theta_w + \theta_a H')}{P_b}\right]df$$

Where:

$C_{soil}$ = Calculated concentration in soil
$C_{gw}$ = Target concentration in groundwater; constituent specific
df = Dilution factor; 20
$k_s$ = Soil-water partitioning coefficient; constituent specific
for organic constituents $k_s = k_{oc} * f_{oc}$
for inorganic constituents $k_s = k_d$
$k_{oc}$ = Soil organic carbon-water partitioning coefficient; constituent specific
$f_{oc}$ = Fraction of organic carbon; 0.001 kg/kg
$k_d$ = Soil-water partitioning coefficient for metals; constituent specific
$\theta_w$ = Water filled soil porosity; 0.3 l/l
$\theta_a$ = Air filled soil porosity; 0.13 l/l
$P_b$ = Dry bulk density; 1.5 kg/l
H' = Dimensionless Henry's Law Constant; constituent specific.

The constituent specific values for the input variables are presented in Table 3-1.

The maximum concentrations of detected constituents were compared to the calculated default SSLs. Constituents with maximum concentrations less than the SSLs were eliminated from further consideration in the leaching portion of the risk assessment. Constituents found to exceed the calculated SSL were evaluated and where appropriate carried forward into the site-specific risk assessment for groundwater.

### 3.3.4 Groundwater

A SWMU-Area approach was applied to groundwater in the North End because SWMUs in this area have the same COIs and are located within the same contiguous infilled valley. As a result, the COIs in North End groundwater have commingled, making releases not traceable to any individual SWMU. Therefore, data from the wells in this area were combined in the screening-level risk assessment. SWMUs included in the North End SWMU-Area approach are SWMU Nos. 1, 4, 22, 25, 33, 35, and 44.

Groundwater evaluations for all other SWMUs/AOCs were conducted on an individual SWMU/AOC basis.

Detected constituents in groundwater samples were compared with the NC 2L Standards (15A NCAC, Subchapter 2L.0202(g), Groundwater Quality Standards, amended November 1994), Interim Standards (see Appendix E Table 1E) and Federal MCLs (USEPA, 1996c). If the maximum detected concentration of a constituent was greater than the screening value, then the constituent was identified as a COI for groundwater. There are no complete exposure pathways with groundwater as the plant does not use groundwater for production or drinking purposes. In addition, potential residential wells are either hydraulically isolated or upgradient of the Badin Works on-site and off-site SWMUs/AOCs. The results of the residential well survey are further discussed in Section 4.2. Because there is no complete exposure pathway, a quantitative risk assessment of exposure to COIs was not conducted for groundwater. However, COIs in groundwater may migrate to surface water in three areas: from the plant area to Badin Lake in the Alcoa embayment, from SWMU No. 2 (Alcoa/Badin Landfill) to Little Mountain Creek, and from SWMU No. 3 (Old Brick Landfill) to Badin Lake. Therefore, COIs in groundwater were the focus of risk screening of surface water and sediments.

### 3.3.5 Surface Water

Surface water samples collected during the RFI from Little Mountain Creek and Badin Lake and prior to the RFI from Badin Lake (Woodward Clyde, 1997) were evaluated to determine if site-related constituents were present at concentrations that warrant evaluation in the quantitative risk assessment. The Woodward Clyde (1997) data include 17 surface water samples collected in the embayment to the east of the plant and one surface water sample collected near the Old Brick Landfill.

In the screening process for surface water, the maximum concentration of detected constituents was compared to the North Carolina 2B (2B) surface water standards (NC 2B Standards) for the protection of human health [Class WS-IV Waters, 15A NCAC02B.0216(3)(g)(i,ii)] and to the USEPA Water Quality Criteria (WQC) (USEPA, 1999b). If the maximum concentration of the detected constituent was less than the published value, it was eliminated as a COI in the quantitative risk assessment. If the concentration of a constituent exceeded the screening value, it was carried forward for evaluation in the quantitative risk assessment. Constituents for which there is no 2B Standard or WQC were not identified as COIs.

### 3.3.6 Sediment

The concentrations of detected constituents in sediments in Little Mountain Creek (RFI data) and Badin Lake (Woodward Clyde, 1997) were evaluated to determine if quantitative evaluation in the risk assessment was warranted for this medium. Sediment data were collected in the Little Mountain Creek area to evaluate whether, prior to capping SWMU No. 2, constituents may have been released to Little Mountain Creek via runoff of surface soils, discharge of seeps, or discharge of groundwater containing landfill COIs. Badin Lake sediment data were collected from the embayment east of the plant and from the cove near SWMU No. 3 to evaluate the presence of COIs in sediment at these locations. The maximum concentrations of detected constituents were compared to USEPA Region III RBCs for industrial soil because there are no standardized human health risk-based screening criteria for sediments. However, the use of industrial soil RBCs for screening sediment concentrations for human health is conservative because potential contact with sediments would be significantly lower than the frequency of contact assumed for industrial soil (e.g., 250 days per year).

If the maximum detected concentration of a constituent exceeded the human health screening values, the constituent was retained as a COI in the site-specific (quantitative) risk assessment. If the maximum detected concentration of the detected constituent was less than the screening value, the constituent was eliminated from further evaluation in the site-specific risk assessment. If there were no constituents with concentrations exceeding the screening criteria, then risks were regarded to be acceptable and a site-specific risk assessment was not required.

## 3.4 Exposure Assessment

Exposure assessment is the process of qualitatively characterizing the exposure setting and potential receptors as well as quantitatively measuring or estimating the intensity, frequency and duration of human exposure to an agent in the environment. The exposure assessment generally follows the recommendations for conducting an exposure assessment provided by USEPA in RAGS (USEPA, 1989b), and the more recent guidance in USEPA's Guidance for Exposure Assessment (USEPA, 1992c, 1997b). This exposure assessment considered current and reasonably expected future land use at the site. This is consistent with the *Advanced Notice of Proposed Rulemaking (ANPR)* for Corrective Action (Federal Register, Volume 61, Number 85, 19432-19464, May 1, 1996), which references the criteria from USEPA's *Land Use in the CERCLA Remedy Selection Process* (USEPA, 1995). Current land use associated with SWMUs and AOCs is industrial and has been since 1915. Surrounding land uses are commercial, residential and recreational. For the landfill areas, development for alternative future land uses is restricted since the objective is to manage the landfill cover to assure its integrity against future releases.

A qualitative exposure assessment (preliminary exposure analysis) was performed in the screening-level risk evaluation for each SWMU, and is described below in Section 3.4.1. Section 3.4.2 gives a brief summary of quantitative exposure assessment methods used in the site-specific risk assessments that were needed to evaluate some of the SWMUs/AOCs.

### 3.4.1 Preliminary Exposure Analysis

This section discusses the environmental setting of the SWMUs/AOCs and the potential receptors for site-specific conditions. The salient features of the site and the surrounding area that might influence human exposure are described and potentially exposed populations identified. The specific exposure pathways by which receptors may potentially come in contact with COIs in environmental media are presented in Section 4 for those SWMUs/AOCs that require a site-specific risk assessment. Methods for quantifying these exposures are presented in Appendix E-1 and referenced in the respective SWMU/AOC sections of Section 4.

Table 3-2 presents a preliminary exposure analysis of the SWMUs/AOCs of the Alcoa Badin RFI. The exposure analysis includes potentially affected environmental media, the environmental setting, and potential receptors for each SWMU/AOC. Currently with the exception of SWMU No. 44 (Pine Tree Grove Area), the plant is fenced and contains the buildings, equipment and infrastructure to support the plant operations. As a result of limited access to the site, the potential on-site receptors include industrial workers who, depending on the location or conditions of a specific SWMU/AOC, may have varying potential for exposure to COIs in soil. Most SWMUs/AOCs are located in areas where plant workers are not routinely present. Contact with the SWMUs/AOCs is infrequent and would primarily be related to some non-routine activity such as digging for repair or construction. Although it is possible that someone could trespass on the Badin Works property, this is unlikely to occur on the main plant area because it is fenced and monitored by security personnel. A trespasser scenario is potentially relevant for SWMU No. 44 (Pine Tree Grove) because this area lies outside of the plant fence. SWMU Nos. 2 and 3 are fenced, but differ somewhat from many of the plant area SWMUs/AOCs because they are more isolated (especially SWMU No. 3) and have no structures on them. SWMU Nos. 2 and 3 are likely to have less frequent contact by industrial workers but may be more vulnerable to a trespassing scenario.

Potential off-site receptors were identified and evaluated in the risk assessment where a release from a SWMU or AOC may result in the potential for transport of on-site COIs to an off-site receptor. The areas adjacent to the plant boundary include residential, recreational and commercial areas. The ground cover on the site is predominantly grass, gravel or pavement, and the cover likely reduces the potential for windborne particle migration to off-site areas. Air pathways to off-site areas are not likely to be significant given the surface cover of the site areas. However, to maintain conservatism in the risk assessment, it was assumed possible that COIs in soil may be released to air and migrate off-site.

In order to evaluate the receptors in the off-site residential, recreational, and commercial areas, the on-site surface soil data were first screened against the residential RBCs. If the SWMU/AOC constituent concentrations were less than the residential values, an off-site evaluation was not conducted. If the concentrations in surface soil exceeded the residential criteria, the off-site receptors were evaluated in the site-specific risk assessment.

As explained previously, there are no current nor likely future complete exposure pathways by direct contact with COIs in groundwater. Alcoa owns the property adjacent to the surface water body and as a result residential wells cannot be installed. Furthermore, a residential well survey confirms that all residences in the vicinity of the site are supplied by the Stanly County Utilities Department. The nearest drinking water well is approximately 0.3 miles hydrogeologically upgradient of the plant. However, groundwater migrates to surface water and sediment in Little Mountain Creek downgradient of SWMU No. 2 (Alcoa/Badin Landfill) and to surface water and sediment in Badin Lake downgradient of the plant and SWMU No. 3 (Old Brick Landfill). If the risk screening indicates that there are site-related COIs in surface water and/or sediment, then further evaluation of potential receptors is warranted. The most relevant current and future receptors for Little Mountain Creek are an industrial worker that is very infrequently present and a trespassing youth receptor. East of the plant, a different set of potential receptors is relevant for Badin Lake because it is used by the public for recreational purposes. Therefore, potential receptors in the lake include an adult swimmer, a child swimmer, and persons who put boats into the lake from the boat launch area.

The site has been industrial since 1915 and is reasonably anticipated to remain industrial in the future. Therefore, potential future on-site exposure scenarios are expected to be industrial only. Some SWMU/AOC areas that are currently undeveloped on the site (e.g., SWMU No. 11), could be developed as active process areas in the future. Therefore, while under current conditions an infrequent industrial worker may be relevant, a full-time industrial worker may be more appropriate to consider under future conditions. With potential redevelopment, construction may occur in non-landfill SWMU/AOC areas in the future. Construction activities are assumed to be one time exposure events for the workers involved and provide an opportunity for exposure to subsurface soil COIs.

### 3.4.2 Methods for Quantitative Exposure Assessment (Applied in Site-Specific Risk Assessments of SWMUs/AOCs)

This section gives a general overview of methods followed to quantitatively estimate exposure in a risk assessment. These steps include identifying complete exposure pathways for receptors, and calculating exposure dose through estimates of exposure point concentrations and exposure parameters based on assumptions of potential contact with site environmental media. SWMU/AOC-specific exposure assessment information is presented in Section 4 and in Appendix E-1 for those SWMU/AOCs that require site-specific risk evaluation.

#### 3.4.2.1 Identification of Exposure Pathways

This section describes the potential pathways by which the receptors could be exposed to constituents located at or released from the SWMUs/AOCs. An exposure pathway is a description of the mechanism by which an individual may come into contact with constituents in the environment. In accordance with USEPA Risk Assessment Guidance (1989b), the significant potential exposure pathways applicable to the site have been identified and incorporated into the risk assessment.

An exposure pathway is defined by four elements (USEPA, 1989b):

- A source and mechanism of constituent release to the environment (e.g., historic landfill with migrating leachate);
- An environmental receiving or transport medium (e.g., soil, groundwater) for the released constituent;
- A point of potential contact with the medium of interest (e.g., exposed surface soil or air); and
- An exposure route (e.g., ingestion, dermal contact, or inhalation) at the contact point.

An exposure pathway is considered "complete" if all elements are present. The characterization of the potential exposure pathways at the site, and whether each pathway is complete, is presented in the risk assessment sections of the SWMU/AOC discussions in Section 4 and in Appendix E.

#### 3.4.2.2 Quantification of Exposures

Potential exposure to constituents in the environment is directly proportional to concentrations of the constituents in environmental media (e.g., soil and air) and characteristics of exposure (e.g., frequency and duration). The site-specific risk assessments present the reasonable maximum exposure (RME) exposure estimate, as recommended in USEPA guidance RAGS (USEPA, 1989b). The RME is the "maximum exposure that is reasonably expected to occur at a site," and USEPA has indicated that factors included in estimating exposure are a combination of both average and 95th percentile values (USEPA, 1989b).

An exposure dose is an estimated amount of exposure that is calculated from COI exposure point concentrations and assumptions of the degree of contact a receptor has with site environmental media. Doses are presented in this risk assessment as a dose rate per unit body weight (mg/kg/day). The "Average Daily Dose" (ADD) or "Lifetime Average Daily Dose" (LADD) is the general parameter used to quantify exposure doses in site risk assessments. The ADD is used as a standard measure for characterizing long-term non-carcinogenic effects. The LADD addresses exposures that may occur over varying durations, which are averaged over a 70-year human lifetime; these are used in estimating potential carcinogenic risks. Algorithms for calculating ADD and LADD for complete exposure pathways that are evaluated in the SWMU/AOC site-specific risk assessments of Section 4 are provided in Appendix E-1.

**Exposure Point Concentrations (EPCs)**

The levels of constituents at exposure points are generally referred to as EPCs, and the analytical results for samples from a given area are combined to derive a single EPC for each constituent. An EPC represents the level of an individual COI to which potential receptors may be exposed. In the RFI risk assessment with the exception of ambient air concentrations, EPCs were statistically calculated from sampling data.

The concentrations of constituents at specific exposure points will vary over space and time. However, a single estimate of an EPC is needed for deterministic risk assessment calculations according to agency guidance (USEPA, 1989b, 1992b). This single value is used to represent the average concentration to which a person would be exposed over the area and duration of the chronic exposure that is assumed in the risk assessment. Depending on a number of factors, including the distribution of the data (normal versus lognormal), the proportion of the samples reported as non-detect (ND), and the total number of samples, there are several statistical parameters that may be used to estimate EPCs.

The most appropriate estimate of the representative concentration to which a receptor will be exposed over an extended period of time is the mean concentration (USEPA, 1992b). Because the true mean concentration of a constituent can never be known, an estimate of the mean based on the collection of samples is made using the 95% upper confidence limit (95% UCL). If the 95% UCL exceeds the maximum detected concentration, then the maximum detected concentration was applied as the RME EPC.

The following describes the statistical approaches used to calculate the mean and 95% UCL of the mean for COIs in specific environmental media. The data for each COI in a specific exposure medium were tested for fit to a normal distribution with the Shapiro-Wilk test (Gilbert, 1987). If the data fit a normal distribution, the 95% UCL of the arithmetic mean of the normal distribution (USEPA, 1992b) was then calculated as the representative concentration for exposure of receptors. If the data do not fit a normal distribution, the data were transformed using the natural logarithm and tested for fit to a lognormal distribution with the Shapiro-Wilk test. If the data fit a lognormal distribution or were nonparametric, then USEPA (1999a) guidance was followed to calculate the 95% UCL using a nonparametric means (i.e., a bootstrap or Jackknife method). Air concentrations of constituents released from soil are calculated with simple emissions and dispersion models provided in USEPA Soil Screening Guidance (1996a). Specific methods are presented in Appendix E-1.3.

**Exposure Parameters**

The quantitative estimation of constituent intake involves the incorporation of numerical assumptions for a variety of exposure parameters. Exposure parameters were based on factors outlined in the "Exposure Factors Handbook" (USEPA, 1997b), the primary scientific literature, and on best professional judgment of the site-specific characteristics. Exposure parameters used in the site-specific risk assessments are presented in Appendix E-1 following reference in Section 4.

elevations are provided in Appendix D. Free-floating product (lubricating oil) has been observed in B016-MW-2. However, VOCs and SVOCs have never been detected in groundwater samples collected at this SWMU. In October 1998, 0.2 feet of free product was noted in B016-MW-2. A sample of the lubricating oil was collected following RFI sampling protocols and submitted for a petroleum fingerprint analysis by Centre Analytical in State College, Pennsylvania. At the same time, a sample of the used compressor lubricating oil from the air compressors was submitted for fingerprinting to determine if the oil in the well was the same lubricating oil used in the air compressor.

The oil samples collected from monitoring well B016-MW-2 and the Building 016 compressor were determined by Centre Analytical to be similar in composition. The primary compounds, chemical class and molecular formula for the largest peaks on the sample chromatographs for the B016-MW-2 and compressor oil samples are provided on Tables 4-40 and 4-41. The kind of lubricating oil released at SWMU No. 42 is essentially a dewaxed paraffin.

#### 4.4.12.2 Summary of Voluntary Work

Accessible, contaminated soils associated with the SWMU were removed in 1991 and 1994 in conjunction with air compressor upgrades. Buried plastic air compressor blowdown lines were replaced with iron piping in February 1999.

#### 4.4.12.3 Phase I RFI Data Summary

Two soil borings (S42-TB-01 and S42-TB-02) were installed during the Phase I RFI activities at the locations illustrated on Figure 4-25 to assess for visual evidence of lubricating oil. No visual evidence of oil was found in the soil borings. B016-MW-3 was installed within a few feet of S42-TB-02. B016-MW-3 was installed to assess whether groundwater was impacted with dissolved phase constituents.

An oil/water interface probe was used to determine if free-floating oil was present in B016-MW-1, B016-MW-2, and B016-MW-3. In the absence of free-floating oil, groundwater samples were collected from B016-MW-1 and B016-MW-3 during the RFI and analyzed for VOCs and SVOCs. Groundwater was not sampled at B016-MW-2 due to the presence of free-floating product (lubricating oil) in the well. However, a sample of the lubricating oil was collected from the well and analyzed for VOCs and SVOCs. Table 4-42 provides the analytical results.

#### 4.4.12.4 Surface and Subsurface Conditions

The ground surface within Building 016 is a concrete floor. The surface immediately outside and hydraulically downgradient (east) of Building 016 is vegetated with grass. At S42-TB-01 and S42-TB-02 (B016-MW-3), a dark-brown sandy silt (topsoil) with weathered slate fragments is present beneath the grass. Reddish-brown to yellowish-brown clayey-silt fill with fragments of weathered rock is generally present from 0.5 to 6 ft-bgs (Figure 26). Olive-colored weathered slate (residuum) is present from approximately 6 ft-bgs to the total depth of deepest boring (16 ft-bgs). The weathered slate is described as hard at 14 ft-bgs. S42-TB-01 and S42-TB-02 did not encounter any evidence of free product during drilling.

At B016-MW-1, red-brown silty clay is present beneath the topsoil to a depth of 17 ft-bgs where bedrock was encountered. At B016-MW-2, the red-brown silty clay is present from beneath the topsoil to total depth of the boring (17.5 ft-bgs). Bedrock was not encountered in B016-MW-2.

A free product thickness of 0.09 feet was measured on September 29, 1999 above the water table in B016-MW-2. Free product was not present in B016-MW-1 and B016-MW-3.

B016-MW-2 is believed to be within a backfilled area possibly associated with the Building 016 foundation. As illustrated on Figure 4-26, residual soils/partially weathered bedrock are relatively shallow at B016-MW-3 (about 6 ft-bgs) and at B016-MW-2 residual soils/partially weathered bedrock were not encountered at the total depth of the boring (17.5 ft-bgs). The residual soils/partially weathered bedrock were excavated from the B016-MW-2 area during construction of the foundation for Building 016 and the air compressors located in this building. The backfill materials, although of low permeability (e.g., silt and clay), are more permeable than the surrounding natural residual soils (e.g., the weathered bedrock/residual soils found at 6 ft-bgs in B016-MW-3), resulting in a local "bathtub" effect in the foundation area. The oil observed in B016-MW-2 is believed to be trapped inside of the foundation fill materials and localized very near to the Building 016 foundation area (Figure 4-26).

#### 4.4.12.5 Screening Level Risk Assessment for Groundwater

Figure 4-25 provides the well locations and selected analytical results for the free-product sample. There were no VOCs and SVOCs detected in the groundwater samples from B016-MW-1 and B016-MW-3. Appendix IX organic constituents detected in the oil sample are methylene chloride (0.7 mg/l), bis(2-ethylhexyl)phthalate (600 mg/l), and Di-N-Octyl Phthalate (360 mg/l). However, the laboratory report for the free-product sample states that methylene chloride was introduced by the laboratory.

#### 4.4.12.6 Conclusions and Recommendations

A thin layer (0.09 foot) of lubricating oil was found on top of groundwater in B016-MW-2. However, the oil is believed to be trapped within fill materials in the immediate vicinity of the Building 016 foundation and unable to migrate to surrounding, less permeable natural soils. Monitoring results for wells B016-MW-1 and B016-MW-3 support this finding. The oil/water interface probe did not detect free product in these wells nor were VOCs and SVOCs detected in the groundwater samples. Based on the past voluntary work and RFI findings, no further action other than a periodic check for free product in B016-MW-2 and free-product removal from this well, if present, is recommended for this SWMU.

### 4.4.13 SWMU No. 43: Overhead Crane Rebuild Structure

The Overhead Crane Rebuild Structure is located in the west-central part of the plant facility, north of Building 061. It was an open structure consisting of a non-reinforced concrete slab (approximately 65 feet x 30 feet x 5 inches) and a sloping metal roof supported by steel columns (Figure 4-27). The structure contained several girders for placing and positioning overhead cranes. The structure was built in April 1992 as a temporary facility and used until early 1994 for rebuilding, sandblasting and painting overhead cranes. In July 1993, Alcoa collected surface soil samples adjacent to the structure to determine if constituents potentially associated with the sandblasting activities were present. Laboratory analysis indicated the presence of cadmium, chromium, and lead. Alcoa reported the Overhead Crane Rebuild Structure as a new SWMU in October 1993. The structure was dismantled in February 1994 and only the concrete slab remains. The SWMU No. 43 area is currently used for scrap wood management.

#### 4.4.13.1 Phase I RFI Data Summary

Soil samples were collected from eight borings (S43-HA-01 through S43-HA-08) at the locations illustrated on Figure 4-27 during Phase I. Except for S43-HA-05, four samples were collected from each boring at surface (0 to 0.5 ft-bgs), 0.5 to 1.0 ft-bgs, 1.0 to 1.5 ft-bgs, and 1.5 to 2.0 ft-bgs. At location S43-HA-05, only the top three intervals (0 to 0.5 ft-bgs, 0.5 to 1.0 ft-bgs, 1.0 to 1.5 ft-bgs) were sampled due to hand auger refusal when trying to retrieve a sample from 1.5 to 2.0 ft-bgs. The sample depths were based on the logic that sandblasted particles may accumulate in surface or near-surface soils. These samples were analyzed for cadmium, chromium, lead, and arsenic. Table 4-43 provides the soil analytical results.

#### 4.4.13.2 Surface and Subsurface Conditions

A concrete pad is present where the SWMU No. 43 structure once stood. The surface soils surrounding the pad are comprised of variegated fill materials that are sparsely vegetated in some areas. Crushed stone is present at the surface over portions of the area surrounding the SWMU. The maximum thickness of the stone based on the borings is about 0.5 ft. Soils comprised of gravelly fine to coarse sand, are also found at surface. Beneath grassy areas, the surface soil is comprised of sandy silt. Fill materials comprised of dense reddish-brown clayey-silt material are generally found at a depth of about 0.5 ft-bgs and extend to at least 2 ft-bgs (the total depth of the borings). SPL, associated with SWMU No. 46 (West SPL Area), is present beneath a portion of this SWMU (see Section 4.4.14).

#### 4.4.13.3 Screening Level Risk Assessment for Soil

Table 4-44 provides a summary of all detected constituents in soil samples, the frequency of detection, minimum and maximum detections, and a comparison to the risk screening values. Figure 4-27 provides a plan view of the soil sample locations and depths.

As indicated on Table 4-44, arsenic is the only constituent detected in soil that exceeds Region III industrial and residential RBCs. The maximum detected concentration of arsenic at this SWMU is 16.3 mg/kg, which is well below the statistically derived background concentration of 33 mg/kg.

The maximum detected concentration of chromium (44.1 mg/kg) exceeds the USEPA SSL and NC SSL of 38 mg/kg, but it exceeded the SSL in only a single sample collected at a depth of 0.5 to 1.0 ft-bgs from boring S43-HA-04-0.5-1.0. Two samples collected from the same boring at depths of 1.0 to 1.5 ft-bgs and 1.5 to 2 ft-bgs do not exceed the SSL values and show diminishing concentrations with depth. The sample collected at 1.0 to 1.5 ft-bgs concentration is 31.7 mg/kg and the sample at 1.5 to 2.0 ft-bgs drops is 23.1 mg/kg. Also, the maximum detected concentration of chromium is far less than the statistically derived background value of 81 mg/kg and the depth to groundwater beneath this SWMU is relatively deep (approximately 25 ft-bgs) based on water levels measured in MW-28 and MW-29.

#### 4.4.13.4 Conclusions and Recommendations

Historical activities at this SWMU (e.g., sand blasting) may have resulted in the potential for surface soil contamination. There were no constituents, other than arsenic, detected at concentrations in surface or subsurface soil exceeding the industrial and residential RBC. The arsenic concentrations are less than naturally occurring background concentrations. As a result, this SWMU does not present more of a direct contact risk than background and no further evaluation of this pathway is warranted.

Chromium exceeds the NC SSL value in a single surface soil sample, but samples at depth show chromium concentrations diminish to values less than the SSL more than 20 feet above the water table. Also, the maximum concentration of chromium is less than the statistically derived background values. As a result, this constituent does not present a concern for the soil to groundwater leaching pathway. Based on the screening level risk assessment results, no further action is recommended for this SWMU.

### 4.4.14 SWMU No. 46: West SPL Area

Alcoa identified this area as potentially receiving SPL through a review of historical photographs in 1998. Based on the photographs, filling activities are believed to have started after March 1964 and ended before April 1977. A February 1968 photograph shows evidence of activity in the area. Although not included in the RFI Work Plan, Alcoa decided to subject this area to RFI activities to assess the potential for SPL and determine whether it warranted inclusion as a SWMU. The West SPL Area was added as a SWMU in September 1999 with Alcoa's notification to the Department.

#### 4.4.14.1 Phase I RFI Soil Data Summary

Thirteen test pits (WA-TP-01, WA-TP01E, WA-TP-02 through WA-TP-05, WA-TP-06N, WA-TP-06S, and WA-TP07 through WA-TP-011) were advanced at the locations illustrated on Figure 4-28 to visually inspect for SPL. The test pit boring logs are provided in Appendix B-2.

Soil samples were collected for laboratory analysis to confirm the presence of SPL and to delineate the lateral extent of SPL. Six soil samples were collected and submitted for laboratory analysis. Sample WA-TP01-3.5-4.0 was collected as suspected SPL material and was analyzed for VOCs, SVOCs, metals (arsenic, barium, cadmium, chromium, lead, and selenium), total cyanide, weak acid dissociable cyanide, fluoride, and asbestos. Table 4-45 provides the soil analytical results from Phase I.

Soil samples WA-TP02-9.0-10.0 and WA-TP-01-8.5-9.5 were collected about a foot beneath the suspected SPL to assess vertical migration of potential COIs. WA-TP03-8.0-10.0, WA-TP01E-6.0-8.0, and WA-TP06-5.0-6.0 were collected outside the perimeter of suspected SPL to verify the lateral limits. The samples collected beneath the base and around the perimeter of the suspected SPL were analyzed for VOCs, SVOCs, metals (arsenic, barium, cadmium, chromium, lead, selenium), total cyanide, weak acid dissociable cyanide, and fluoride (Table 4-45).

#### 4.4.14.2 Phase II RFI Data Summary

In August 2000, three surface soil samples (S46-SS-01, S46-SS-02, and S46-SS-03) were collected and three test pits (S46-TP-12, S46-TP-13, and S46-TP-14) were excavated at the locations illustrated on Figure 4-28. All surface soil samples were collected from the 0 to 0.5 ft-bgs interval to provide data needed to evaluate direct contact with the surface of the SWMU. Test pit samples were collected from the 7.0 to 8.0 ft-bgs interval at the WA-TP-12 and WA-TP-14 locations while the sample collected at the WA-TP-13 location was from the 9.0 to 10.0 ft-bgs interval. The subsurface samples were collected outside the limit of the suspected SPL to delineate the landfill boundary. Test pit logs are provided in Appendix B-2. All the samples were analyzed for Appendix IX PAHs, total and weak acid dissociable cyanide, and fluoride. Table 4-46 presents the analytical results from soil samples collected during Phase II from the area of SWMU No. 46.

During Phase II, an upgradient and a downgradient monitoring well (MW-28 and MW-29, respectively) were installed for the purposes of characterizing groundwater flow in this area and evaluating groundwater quality downgradient of SWMU No. 46. Table 4-7 provides information on the monitoring well construction, and Table 4-47 presents analytical results from these wells. Figure 4-29 shows the locations of these wells, and Figure 4-7 shows groundwater contours based on groundwater level measurements.

#### 4.4.14.3 Surface and Subsurface Conditions

The surface soils in the SWMU are comprised primarily of crushed stone that ranges from about 0.5 to 1 foot thick. Beneath the crushed stone, reddish-brown clayey-silt fill material is present to the base of the excavations outside of the SWMU boundary. Test pits inside the SWMU boundary show fill material comprised of carbonaceous material (including some SPL) and red brick present beneath the reddish-brown clayey-silt. In WA-TP-01, carbonaceous material and red brick was observed in the 3 to 7 ft-bgs interval. At WA-TP-02, carbonaceous material is present at 4.5 ft-bgs, and then again in the 7 to 9 ft-bgs interval. At WA-TP-03, carbonaceous material was observed from 3.5 ft-bgs to total depth of the test pit (10 ft-bgs). In WA-TP-11, a thin layer of carbonaceous material was found in the 8.5 to 9 ft-bgs interval. The reddish brown clayey-silt is present beneath the carbonaceous material. Depth to groundwater beneath this SWMU is approximately 25 ft-bgs based on water levels measured in MW-28 and MW-29.

#### 4.4.14.4 Screening Level Risk Assessment for Soil

Table 4-48 provides a summary of all constituents detected in soil samples, the frequency of detection, minimum and maximum detection, and a comparison to risk screening values for soil samples collected from all depths from SWMU No. 46. Figure 4-28 shows the soil sample locations, depths, and analytical results for constituents whose concentrations exceed the risk-based screening values.

Benzo(a)pyrene and arsenic are the only constituents detected at concentrations greater than the industrial and residential RBCs. Arsenic is present at a maximum detected concentration of 19.4 mg/kg; however, this concentration is below the background concentration of 33 mg/kg. In addition to benzo(a)pyrene, four other PAHs were detected at concentrations in surface soil that exceed the USEPA Region III residential RBCs. These are benzo(a)anthracene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. Along with benzo(a)pyrene, these four PAHs are further assessed in a site-specific risk assessment for the SWMU soils in Section 4.4.14.6.

Concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and p-cresol in soil exceed the NC SSL. There are no organic constituents detected at concentrations exceeding the USEPA SSLs. The maximum concentration of total cyanide exceeds the NC and USEPA SSLs.

#### 4.4.14.5 Screening Level Risk Assessment for Groundwater

There were no detected cyanide species or fluoride in the sample from MW-28, the upgradient well for SWMU No. 46. In downgradient well MW-29, total cyanide, weak acid dissociable cyanide, and fluoride were detected in groundwater samples at concentrations that exceed the NC 2L Standards for groundwater and the USEPA MCLs.

Groundwater flow in this area of the plant is generally to the east toward Badin Lake. While concentrations of cyanide and fluoride in MW-29 groundwater samples are above drinking water standards, there are no receptors drinking this groundwater, nor directly contacting it in any other means. The closest point of potential exposure is Badin Lake, and analytical results from well MW-10 located further downgradient (see Section 4.4.10) indicate that the cyanide and fluoride attenuate on-site to levels below the drinking water standards and below surface water human health criteria before groundwater reaches the lake. Therefore, cyanide and fluoride from this SWMU can be eliminated as COIs and a site-specific risk assessment for groundwater is not necessary for SWMU No. 46.

#### 4.4.14.6 Site-Specific Risk Assessment for Soils

Following the risk assessment screening of Phase I and Phase II site data, benzo(a)pyrene was identified as a COI in soil for on-site (i.e., industrial) scenarios. Benzo(a)anthracene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene also exceed residential RBCs in surface soil; therefore, these additional PAHs were included as COIs for off-site residential receptors with potential exposure to airborne particulates generated from the SWMU.

SWMU No. 46 is located in the west-central end of the main Plant area. It is an open area where no active plant processes are performed. Scrap wood is staged near the SWMU. Under current conditions plant workers are not present at SWMU No. 46 on a regular basis. However, workers may infrequently pass through this area. In addition, under current conditions, there are no complete exposure pathways with COIs in subsurface soil as there are no intrusive activities occurring in this area. Future conditions in the SWMU are expected to remain industrial. However, to maintain conservatism in the risk assessment, it was assumed this area could be developed as a process area in the future. It was assumed future construction may occur in the SWMU No. 46 area, resulting in the potential for construction workers to contact subsurface soil and that there may be a process area with the opportunity for regular contact by plant workers. This risk assessment evaluates the following potential receptors and complete exposure pathways.

- **Current Infrequent and Future Full-time Industrial Worker**– Incidental ingestion of COIs in surface soil, dermal contact with COIs in surface soil, inhalation of airborne particles generated by wind erosion. (No evaluation of inhalation of volatiles is necessary because the COIs are not considered to be volatile);
- **Current Off-Site Adult and Child Resident** - Inhalation of airborne particles generated by wind erosion on-site and carried by wind toward off-site residential areas; and
- **Future Construction Worker** - Incidental ingestion of COIs in all soil (i.e.,, surface and subsurface soil down to 10 ft-bgs), dermal contact with COIs in all soil; and inhalation of airborne particulates released during digging activities.

Appendix E-1 presents the major assumptions and exposure factors used in evaluating potential risks for each receptor. Exposure point concentrations for COIs in surface and subsurface soil are presented in Table 4-49. Toxicity criteria are provided in Table E-3 of Appendix E.

Table 4-50 presents the theoretical excess lifetime cancer risks for the current and possible future receptors for SWMU No. 46. All of the risks for current receptors are well below the range of $10^{-6}$ to $10^{-4}$, and the possible future industrial worker's theoretical excess lifetime cancer risk is at the lower end of the range. Therefore risks for all potential current and future receptors are acceptable.

### 4.4.14.7 Conclusions and Recommendations

The site-specific risk assessment for SWMU No. 46 shows estimated risks are below USEPA's acceptable range for both on-site and off-site potential receptors. As a result, there is no concern with this direct contact pathways at this SWMU.

PAHs were detected at concentrations exceeding the conservative NC SSLs, however, PAHs are eliminated as COIs for the soil to groundwater leaching pathway because they were not detected in groundwater downgradient of this SWMU or in any other site groundwater samples.

The concentration of total cyanide exceeds the NC and USEPA SSLs. Cyanide and fluoride were detected at concentrations exceeding the Federal MCLs and NC 2L Standards downgradient of this SWMU in MW-29. However, the concentration of these constituents diminish to less than the MCL, NC 2L Standard, and applicable surface water criteria within Alcoa's property boundary at downgradient monitoring well MW-10. There are no receptors drinking or contacting the groundwater. As a result, no further action, except for inclusion of MW-28 and MW-29 in a groundwater monitoring program for the site, is recommended for this SWMU.

#### 4.4.15 AOC-A: Fuel Oil Tank Release

Figure 4-30 provides a plan view map of AOC-A. AOC-A refers to a release of approximately 3,500 gallons of No. 2 fuel oil from an underground pipeline located near Building 134 that occurred in 1985.

##### 4.4.15.1 Summary of Previous Interim Measures Work

Alcoa discovered the release in June of 1985, and excavated 1,300 cubic feet of soil contaminated by the release. Alcoa installed two groundwater monitoring wells. One of the wells (MW-FO-2) remains; the other well is paved over. The wells were located downgradient from the location of the pipeline, as determined from topography and the location of Little Mountain Creek (interpreted to be in the direction of groundwater movement). These wells were sampled and tested five times between June 1987 and June 1989. Sample parameters included phenol, total alkanes, benzene, toluene and xylene. The results were provided to the Groundwater Section of the former Division of Environmental Management. These data are presented in the approved Confirmatory Sampling Work Plan.

#### 4.4.15.2 Summary of Previous Investigation Work

As part of Confirmatory Sampling, one groundwater sample was collected from MW-FO-2 and one soil sample from beneath the pipeline backfill. The groundwater sample was analyzed for VOCs and SVOCs. Low levels of benzene (0.008 mg/l), naphthalene (0.015 mg/l) and bis(2-ethylhexyl)phthalate (0.025 mg/l) were detected in groundwater. Analytes were not detected in soil.

Periodic groundwater sampling has been conducted by Alcoa on a voluntary basis. Samples have been analyzed for VOCs and SVOCs. The sampling results are provided in Appendix D.

#### 4.4.15.3 Phase I RFI Data Summary

An oil/water interface probe was used to determine whether free product is present in MW-FO-2. No free product was detected. Groundwater from MW-FO-2 was sampled and analyzed for VOCs and SVOCs. Table 4-51 provides the analytical results.

#### 4.4.15.4 Surface and Subsurface Conditions

The surface of this area is paved. Depth to groundwater at this location is approximately 13 ft-bgs. The oil/water interface probe did not detect free product (e.g., fuel oil) in MW-FO-2.

#### 4.4.15.5 Screening Level Risk Assessment for Groundwater

There were no VOCs and SVOCs detected in the RFI groundwater samples.

#### 4.4.15.6 Conclusions and Recommendations

The RFI sample results show no VOCs and SVOCs in MW-FO-2. Based on the previous soil removal action and RFI results, no further action is recommended for AOC-A.

### 4.4.16 AOC B: Compressor Oil Leakage Area

The Compressor Oil Leakage Area is located immediately north of SWMU No. 7, the Aerated

Lagoon (Figure 4-31). The dimensions of the area are approximately 70 feet x 75 feet (largest dimensions). Alcoa located portable air compressors here for approximately two years from 1987 to 1989, situated on plastic sheeting, to complement the permanent compressed air system. Lubricating and crankcase oils used in the compressors during this time were Unocal products UNAX RX 68 and Guardol Motor Oil 15W-40, respectively. Stained soils were noted at the area upon removal of the air compressors in 1989. The RFA report also noted staining of soil in several locations in the AOC during the visual site inspection in 1990.

#### 4.4.16.1 Summary of Interim Measures

In 1996, Alcoa completed the removal and proper disposal of visibly contaminated surface and near surface soil at AOC-B in conjunction with the closure of the Aerated Lagoon. In advance of the soil removal activity, Alcoa collected surface (0 to 1 ft-bgs) and near surface (1 to 2 ft-bgs) soil samples from 16 surveyed locations (32 soil samples total) to delineate the extent of oil and grease in AOC-B soils (Geraghty & Miller, October 1996). In addition to oil and grease (USEPA 9071A), soil samples were analyzed for PCBs (USEPA 8081) and none were detected. The sampling was done in accordance with the draft RFI Work Plan, dated April 11, 1994 and revised October 26, 1995. Because these samples were collected and analyzed following the protocol established in the draft RFI Work plan, the five sample locations that were not excavated as part of the interim measure are included in the RFI data set (e.g., included in the RFI risk assessment).

#### 4.4.16.2 Phase I RFI Data Summary

The location of the excavation was re-established and soil samples were collected in October 1999 during Phase I at three locations (AB-HA-01 through AB-HA-03) at the bottom of the former excavation. In addition, three surface soil samples were collected outside the limits of the former excavation (AB-SS-01 through AB-SS-03). All six samples were analyzed for VOCs and SVOCs. Table 4-52 provides a summary of the AOC-B analytical data.

#### 4.4.16.3 Surface and Subsurface Conditions

The boring logs (Appendix B-1) show crushed stone is present from surface to depths ranging from 0.2 to 0.5 ft-bgs. At location AB-HA-01, reddish-brown clayey-silt is present to total depth of the boring (1.6 ft-bgs). Auger refusal prevented further advancement of this boring. At AB-HA-02, reddish-brown slate was present beneath the crushed stone to 2.7 ft-bgs, the depth where auger refusal occurred. Yellowish-to reddish-brown clayey-silt was present in AB-HA-03 beneath the crushed stone to 1.5 ft-bgs. Reddish-brown clayey-silt is present at AB-HA-03 from 1.5 to 5 ft-bgs.

#### 4.4.16.4 Screening Level Risk Assessment for Soil

Table 4-53 provides a summary of the constituents detected in soil, frequency of detection, minimum and maximum detected concentration, and a comparison to the risk screening values. Figure 4-31 provides sample location and depths, and selected analytical results.

There are no constituents detected at concentrations that exceed the industrial RBC for soil. Benzo(a)pyrene (0.04 mg/kg) is the only constituent detected in soil at a concentration that exceeds the residential RBC. The single detection of benzo(a)pyrene (out of six samples) was in the sample at location AB-HA-02 collected at a depth of 0.7 to 2 ft-bgs.

There are no constituents at concentrations exceeding the USEPA SSL values for the soil to groundwater leaching pathway. The benzo(a)pyrene detection in AB-HA-02 is also the only constituent detected in soil that exceeds the NC SSL. This is the same sample found to contain benzo(a)pyrene at a concentration greater than the residential RBC (soil sample from AB-HA-02 at a depth of 0.7 to 2 ft-bgs).

#### 4.4.16.5 Conclusions and Recommendations

The RFI found benzo(a)pyrene in one soil sample from this AOC at concentrations greater than the residential RBC and NC SSL. However, this was detected at concentrations exceeding the screening values in only one of six samples and was not detected in any surface samples. As a result, this constituent does not present any direct contact issues with respect to on-site industrial workers because it is less than the industrial RBC. In addition, since the only detection of benzo(a)pyrene is in the subsurface, there is no potential for off-site transport to residential areas.

From a leaching perspective, the concentration of benzo(a)pyrene is 20 times less than the conservative USEPA SSL for this constituent. PAHs such as benzo(a)pyrene are not highly mobile in the subsurface because they tend to adsorb to soil particles. Also, even though PAHs have been detected elsewhere in site soils at higher concentrations, they have not been detected in any of the site monitoring wells. The single detection of benzo(a)pyrene at a concentration greater than the NC SSL is not believed to present a concern to the leaching from soil to groundwater pathway. As a result of these findings, no further action is recommended for AOC-B.

### 4.4.17 Badin Lake Surface Water and Sediment – Plant Area

As indicated previously in Section 4.4.9, North End groundwater COIs may migrate to Badin Lake, which is a potential point of contact for human receptors. This section provides a data summary and risk assessment of surface water and sediment of Badin Lake in the embayment east of the plant.

#### 4.4.17.1 Summary of Pre-RFI Investigations

Badin Lake surface water and sediment sampling was conducted by Woodward Clyde in 1996 and 1997 (Woodward Clyde, 1997). Figure 4-32 shows the sample locations adjacent to the plant area. The surface water and sediment samples were analyzed for a broad list of constituents, including most of the plant area groundwater COIs (arsenic, total and free cyanide, and fluoride) as well as PCBs and PAHs. These data are deemed to be of RFI quality, and therefore are included in the RFI groundwater to surface water evaluation. The analytical data from surface water and sediment samples collected in the Alcoa Embayment of Badin Lake are summarized in Tables 4-54 and 4-55, respectively.

#### 4.4.17.2 Phase II RFI Data Summary

A surface water sample was collected from Badin Lake at the location shown on Figure 4-33. The sample was analyzed for trichloroethene to assess whether the detections of this constituent in groundwater at MW-4, MW-9, and MW-16 have affected Badin Lake surface water quality. Table 4-56 provides the Phase II RFI surface water data.

#### 4.4.17.3 Screening Level Risk Assessment for Badin Lake Surface Water – Plant Area

Table 4-57 summarizes the detected constituents in Badin Lake embayment surface water and compares the maximum detected concentrations to available NC 2B Standards (15A NCAC 02B.0216 (3)(g)(i,ii)) and USEPA Water Quality Criteria (USEPA, 1999b) for the protection of human health.

Figures 4-32 and 4-33 provide sample locations. PAHs, PCBs, trichloroethene, and fluoride were not detected in surface water samples collected from the embayment east of the plant Few inorganic constituents were detected, and none at levels that exceed the human health surface water screening values. Cyanide was detected in only one of 18 samples. Because concentrations of constituents in surface water samples are lower than these screening values, no COIs were identified in surface water in the embayment. Based on the results of the screening level risk assessment, potential risks associated with contact with embayment surface water are acceptable.

#### 4.4.17.4 Screening Level Risk Assessment for Badin Lake Sediment – Plant Area

Table 4-58 presents a summary of all the sediment data collected in the embayment area of Badin Lake (Woodward Clyde, 1997), and compares maximum detected concentrations with screening values for human health. Industrial soil RBCs were applied as screening values for sediment as there are no standard human health-based criteria for sediment. The industrial soil RBCs are conservative values to apply to sediment, a medium for which only the most incidental contact is likely. Use of soil screening values for human health exposure to sediment is a common practice in human health risk assessment. A number of PAHs, Aroclors 1242 and 1260, and arsenic were detected at concentrations that exceed the screening values. The maximum detection of arsenic in sediment (11 mg/kg) is less than the background soil concentration of 33 mg/kg, and therefore arsenic is not included as a COI for sediment.

Most of the sediment samples were collected from surface water depths of 10 feet or greater, and therefore would not be accessible to human receptors in the lake. The initial screening-level risk assessment includes all of the sediment samples, but is followed by subsequent screenings of data from areas where human receptors may contact sediments (i.e., depth less than 10 feet). These are (1) the swimming cove to the east of the northernmost area of the plant and defined by a buoy line and (2) the boat launch area at the southern end of the Alcoa embayment of Badin Lake (Figure 4-32). In the swimming cove, ten samples were collected from sediments within the swimming cove buoy line and the shore (two samples collected in fall of 1996 and eight samples collected in December 1996/January 1997). Sample NEP-4 was collected from the swimming cove area in fall 1996, and the analytical results of this sample are in question because of laboratory QA/QC issues. Additional sampling was performed in the swimming cove in the winter of 1996/1997 to resolve the QA/QC issues associated with sample NEP-4. Therefore, NEP-4 was eliminated from the quantitative risk assessment of the swimming cove. Three of the subsequently collected samples (NEP-6, -9, and -10) were from depths greater than 10 feet and, therefore, were excluded for the screening of COIs for human receptors because they would not be accessible to these receptors. The other samples (NEP-1, -2, -3, -5, and -11, including two duplicate samples) were used to identify COIs and included in the quantitative risk assessment of sediments. However, it should be noted that sediments are discontinuous in this area, and there are many locations where a swimmer would encounter a rock subsurface rather than sediment when swimming in the cove.

Table 4-59 presents the screening of sediment data including the frequency of detection, minimum and maximum detected concentrations, and the USEPA Region III industrial soil RBCs for the swimming cove area sediments. Benzo(a)pyrene is the only constituent detected at higher concentrations in sediment than the screening values for human health, and it is identified as a COI for the site-specific risk assessment for the swimming cove area.

In the boat launch area, there were three samples (NEP-22, -23, and -24) collected for chemical analysis. The depths below the water surface of NEP-22 and NEP-24 are 7 to 9 meters (i.e., approximately 20 to 30 feet); only NEP-23 was collected at a depth that has potential for contact by a human receptor. Table 4-60 compares the concentrations of detected constituents with the human health screening values. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were detected at concentrations greater than the screening values, and are therefore identified as COIs for the boat launch area.

#### 4.4.17.5 Site-specific Risk Assessment for Sediment

There were two exposure scenarios identified for sediment related to different areas of the Alcoa embayment. These are incidental contact with sediment while swimming in the swimming cove area and incidental contact with sediment in the boat launch area. Separate risk screenings were conducted for these areas. Benzo(a)pyrene was identified as a COI for the swimming cove; benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene were identified as COIs in the boat launch area.

There are limited opportunities for human receptors to contact sediments in the Alcoa embayment of Badin Lake in large part because the lake bottom drops to a significant depth in a relatively short distance from shore in this area of the lake. The swimming cove and boat launch areas are two areas that have been identified as locations where human contact with sediments may occur. An adult and child swimmer is evaluated for contacting sediments in the swimming cove area and an adult boater is a potential receptor in the boat launch area. However, this latter receptor is evaluated only qualitatively because it is highly unlikely that anyone would contact sediments when launching a boat from a concrete shoreline ramp.

Incidental dermal contact with sediment while swimming is evaluated quantitatively in the risk assessment. Dose algorithms and exposure assumptions for this exposure pathway are provided in Appendix E-1. Toxicity criteria are provided in Table E-3 of Appendix E. The EPC for benzo(a)pyrene, the only identified COI in the swimming cove, is 1.4 mg/kg, the 95% UCL of the mean. The data for benzo(a)pyrene are normally distributed, with a maximum concentration of 1.9 mg/kg (the average of duplicates of 2.4 and 1.4 mg/kg).

Table 4-61 presents the summed theoretical excess lifetime cancer risk for the current and possible future adult and child swimmer receptors in the swimming cove.. The estimated risk for the adult swimmer is $8 \times 10^{-8}$and child swimmer is $1 \times 10^{-7}$, which is below the range of $10^{-6}$ to $10^{-4}$, and therefore acceptable.

For sediments in the boat launch area, it is unlikely that anyone would contact sediments when launching a boat from a concrete shoreline ramp. If a person were to step into the sediments on a very rare occasion, the sediments are likely to wash off as the person's foot would pass through the water upon removal from the water. Although sediment PAH concentrations are between one and two orders of magnitude higher than those concentrations in the swimming cove, such incidental and rare contact in the boat launch area, if it occurred at all, would be expected to yield acceptable risks.

#### 4.4.17.6 Conclusions and Recommendation

The screening level risk assessment for surface water and site-specific risk assessment for sediment show acceptable risks for these media. These estimated risks are likely greater than actual risks given the generally conservative nature of risk assessment methods. As a result, no further action is necessary for Badin Lake surface water and sediment for protection of human health.

## 4.5 SWMU NO. 2: Alcoa/Badin Landfill

Alcoa operated the Alcoa/Badin Landfill (ABL) for approximately 70 years as an unlined municipal/industrial solid-waste landfill. The landfill is located approximately 500 ft south of the fenced plant area and occupies approximately 14 acres (Figures 1-2 and 4-34). In addition to municipal refuse generated by the town of Badin, undetermined amounts of solid refuse and various process wastes including carbon dust, small amounts of SPL and possibly asbestos were deposited in the landfill. Alcoa ceased operations at the landfill in the mid-1970's. The landfill was graded, covered with native soils, and seeded with grass. The landfill is partly surrounded by a chain-link fence with locking gates. The fence extends around the upland sides of the landfill, but does not extend along the landfill's southern boundary at Little Mountain Creek.

### 4.5.1 Summary of Pre-RFI Investigation Work

Periodic groundwater sampling has been conducted by Alcoa on a voluntary basis since 1991. Samples have been routinely analyzed for total and free cyanide, and fluoride and selected total and dissolved metals. Groundwater elevation data have been collected in conjunction with the sampling. The sampling results and groundwater elevation data are provided in Appendix D. The groundwater quality data are also discussed in Section 4.5.6.4.

In 1989, Alcoa initiated assessment of landfill gas emissions that focused on potential subsurface gas migration from the landfill to the homes along Grant Street, located west of the landfill. This assessment included installation and sampling of six gas probes (P-1 through P-6). The findings of sampling and assessment activities conducted over the period 1989 through 1994 were included in the RFI Work Plan previously submitted to the Department. Based on the results of the monitoring, Alcoa suspected that one or both of two underground North Carolina Natural Gas (NCNG) natural gas pipelines present beneath the landfill may have been leaking. The two pipelines, one 3-inch diameter and one 4-inch diameter supplied the Badin Works with natural gas. Based on review of historical aerial photographs, the 3-inch line was installed between 1959 and 1961, and the 4-inch line around 1980.

### 4.5.2 Summary of Accelerated RFI Activities

As part of the described RFI Work Plan activities, Alcoa proposed to conduct "additional evaluation of potential air emissions". Alcoa completed this work on an accelerated schedule through monitoring conducted in 1995 and 1996. Following reports of gas odors in the landfill area, RFI activities were initiated in June 1995. The objective of the assessment was to characterize the nature (i.e., what gas(ses) are present) and extent (i.e., where is the gas) of the gas emissions at the Alcoa/Badin Landfill. To achieve this objective, 57 monitoring probes were installed on an approximately 100 feet grid on the landfill surface. The probes were constructed by hand augering approximately 2 to 3 feet into the landfill and placing a 2-inch diameter PVC pipe in the hole. Each pipe was capped and the space around the pipe backfilled with cuttings. In addition, four additional monitoring probes were constructed by hollow stem auger drilling along the west side of Grant Street to monitor for gas migration. The new and existing probes were screened for the presence of gas constituents using field instruments. Based on the field measurements, gas samples were collected from selected probes and laboratory analyzed for a broad suite of parameters.

The work conducted in 1995 and 1996 identified leaking natural gas line(s) as the major source of the air emissions from the landfill. The analytical results indicated that the gas samples composition were more indicative of natural gas than of landfill gas, suggesting possible leakage from one or both of the natural gas lines running through the landfill. First, the reported high concentrations of ethane, propane and butane are unlikely to be the result of biological degradation but are known to be present in natural gas. Second, the samples were characterized by low or absent carbon dioxide, a typical product of biological degradation. In contrast, carbon dioxide is typically absent from natural gas because its combination with moisture produces a corrosive condition that is damaging to pipe lines.

### 4.5.3 Summary of Interim Measures Work

Following discussion of the landfill gas monitoring results with representatives of NCNG, the 3-inch pipeline was tested in September 1995 and found to be leaking. The 3-inch line was cut and abandoned in place in September 1995. The 4-inch pipeline could not be tested without interrupting service to Alcoa. Construction of a new 6-inch pipeline around the Alcoa/Badin Landfill was started and completed in 1996 May. The 4-inch pipeline was cut and abandoned in place following the switch to the new 6-inch pipeline.

In addition, interim measures consisting of landfill regrading and cover improvements were completed at the Alcoa/Badin Landfill in 1997 in accordance with an Interim Measures Work Plan (Alcoa, 1997) that was approved by the Department in a letter to Alcoa dated May 29, 1997. The objectives of the interim measures were to prevent surface run-on, promote surface run-off, and reduce infiltration. An Interim Measures Report was submitted to Department on June 8, 1998. As part of the studies in support of Interim Measures, a triple piezometer nest was installed between the toe of the Alcoa/Badin Landfill and Little Mountain Creek to determine if groundwater is captured by Little Mountain Creek.

### 4.5.4 Alcoa/Badin Landfill Topography

Elevations at the Alcoa/Badin Landfill (SWMU No. 2) range from about 540 ft-msl at the north and central location of the landfill to about 460 ft-msl at Little Mountain Creek (Figure 4-35).

### 4.5.5 Alcoa/Badin Landfill Geology

Past investigations by Aquaterra, Inc. (September, 1991a) and Geraghty & Miller (April, 1997) describe the geology at the SWMU No. 2 (Alcoa/Badin Landfill). The ABL overlies a natural ravine, which extends from the Badin Works south to Little Mountain Creek. Native fill material, municipal refuse, and various process wastes produced from the Badin Works plant operations were deposited in the former ravine. Based on the available boring logs (Geraghty & Miller, Inc. 1997 and Orbital Engineering, Inc., 1997) these disposal activities resulted in raising the topographic elevations of the valley by approximately 13 to 42 feet. This is illustrated in the cross-section presented on Figure 4-35, which is oriented along the axis of the ravine. Note that this cross-section reflects conditions prior to the regrading and cover improvements done in 1997. However, the new topography resulting from the cover improvements is also shown on the cross-section.

The bedrock beneath the site consists of volcanic argillite (green slate). Weathering has altered the uppermost portion of the slate into a silty clay saprolite. Based on drilling logs (Geraghty & Miller, Inc. 1997 and Orbital Engineering, Inc. 1997), this silty clay zone is approximately 4 to 14 feet thick. A mixture of native fill materials and plant waste overlies this silty clay and where present ranges in thickness to over 35 feet (Figure 4-35). It appears the waste material was deposited mainly along the axis of the ancestral ravine. As a result of past disposal activities, a portion of the ravine was filled, and a cover fill typically 10 feet thick was emplaced over the waste material. The cover and waste material were regraded in 1997 and covered with two feet of low permeability clay. The clay was covered with six inches of topsoil and a vegetative cover established. The topography of the landfill was reshaped to promote runoff, prevent run-on, and allow for maintenance of the face.

### 4.5.6 Alcoa/Badin Landfill Hydrogeology

Table 4-62 provides a summary of SWMU No. 2 (Alcoa/Badin Landfill) monitoring wells and selected piezometers construction details, and lithology of the screened intervals. Groundwater at the Alcoa/Badin Landfill is present in the landfill materials, residual soils (saprolite), alluvium, and bedrock. As illustrated on Figure 4-35, the water table resides within alluvium, fill materials, and residual soils (saprolite). Saturated bedrock lies beneath the residual soils.

#### 4.5.6.1 Water Table Units (Alluvium, Fill Materials, and Residual Soils)

Groundwater elevations measured during the RFI range from approximately 523 ft-msl at ABL-PZ-1S to approximately 464 ft-msl at ABL-MW-5 and ABL-PZ-3S. Figure 4-36 provides an elevation contour map of the water table. The groundwater flow direction is southward toward Little Mountain Creek, and the average hydraulic gradient is approximately 0.05 ft/ft. Saturated thickness of the water table units is approximately 10 feet.

North of the landfill waste material, the water table surface resides within "native" fill material and residual soils (saprolite) (Figure 4-35). Beneath the northern and central portion of the landfill area, the water table resides within saprolite. Further south, the water table crosses into landfill waste material and then back into the "native fill material". South of the toe of the landfill, the water table resides within alluvium associated with the Little Mountain Creek flood plain. Groundwater in the alluvium discharges to Little Mountain Creek. Note that Figure 4-35 shows a typical water table elevation prior to installation of the clay cap. The saturated waste material at the base of the landfill may become dewatered as the cap inhibits precipitation infiltration.

Slug tests were performed on the triple piezometer nests installed by Geraghty & Miller in October and November 1996 and five of the piezometers installed by Orbital Engineering, Inc. (Table 4-63). The results of 12 slug tests conducted in the fill material, alluvium, saprolite, and/or the partially weathered bedrock zone, indicate that the hydraulic conductivity of these units range from $3.4 \times 10^{-6}$ to $6.7 \times 10^{-3}$ cm/sec (0.01 to 19 ft/day), with an average of $8.3 \times 10^{-4}$ cm/sec (1.1 ft/day).

Based on the gradient of 0.05, an estimated effective porosity of 25 percent, and an average hydraulic conductivity of 1.1 ft/day, the average groundwater flow velocity of the water table units is 0.22 ft/day. The range of velocities based on the minimum and maximum hydraulic conductivities is 0.002 to 3.8 ft/day.

#### 4.5.6.2 Bedrock Groundwater Zone

Groundwater potentiometric heads of bedrock wells indicate flow in this zone is from north to south beneath SWMU No. 2. The average horizontal gradient in the bedrock groundwater zone is approximately 0.035 ft/ft.

Slug tests performed by Geraghty and Miller (April, 1997) on eight bedrock wells are summarized on Table 4-63. The results of eight slug tests conducted in the bedrock indicate the hydraulic conductivity of this unit locally ranges from $2.1 \times 10^{-5}$ to $2.1 \times 10^{-4}$ cm/sec (0.06 to 0.6 ft/day), with an average of $8.23 \times 10^{-5}$ cm/sec (0.23 ft/day). The average hydraulic conductivity of the bedrock units is an order of magnitude less than those determined for the water table units.

Using the gradient of 0.035 ft/ft and the average hydraulic conductivity calculated by the slug tests, and assuming 25% effective porosity the velocity in the bedrock is $1.15 \times 10^{-5}$ cm/sec (0.03 ft/day). Based on the minimum and maximum hydraulic conductivity values, the range of velocities in bedrock is from $4.2 \times 10^{-6}$ cm/sec to $4.2 \times 10^{-5}$ cm/sec (0.008 to 0.08 ft/day). Actual velocities may vary due to heterogeneities and conduits that facilitate secondary flow (i.e., fractures and bedding planes).

#### 4.5.6.3 Vertical Gradients

Vertical gradients are provided by three triple piezometer nests at the landfill (ABL-PZ-1S, 1I, and 1D, ABL-PZ-2S, 2I, and 2D, and ABL-PZ-3S, 3I, and 3D). The piezometer nests are located in a general north to south orientation across the Alcoa/Badin Landfill (Figure 4-36). ABL-PZ-1S, 1I, and 1D, located at a topographic high, have the greatest downward gradients between water table and bedrock piezometers. Downward gradients decrease at piezometer nest ABL-PZ-2S, 2I, and 2D, which are located within the Alcoa/Badin Landfill, with ABL-PZ-2S and -2I almost equal. At piezometer nest ABL-PZ-3S, 3I, and 3D, which is located near Little Mountain Creek, there is an upward gradient. The ABL-PZ-3 piezometer nest suggests the floodplain along Little Mountain Creek represents an area of discharge (i.e., the ancestral ravine and Little Mountain Creek). The vertical gradient observed in the floodplain suggests that both the water table units and bedrock groundwater discharges to Little Mountain Creek. In addition to the water elevation data, the observation of air bubbles in Little Mountain Creek during installation of ABL-PZ-3D with an air rotary rig supports a strong hydraulic connection between the creek and flood plain. As a result, there is no groundwater underflow beneath Little Mountain Creek at the depths investigated.

#### 4.5.6.4 Groundwater Quality

Appendix D contains tables of historic groundwater elevations and fluoride, cyanide, and free cyanide (amenable, weak acid dissociable, and microdiffusion) analytical data. The historic data are consistent with the current RFI data set. Like the RFI data, total cyanide has been detected in the past in ABL-MW-5 at concentrations slightly exceeding the NC 2L Standard. However, it should be noted that the NC 2L Standard for total cyanide is based on the RfD for free cyanide, which is a more toxic form (see Section 1.5). Free cyanide and fluoride have never been detected in any of the monitoring wells at concentrations exceeding the NC 2L Standards.

#### 4.5.6.5 Seeps

Three seeps (western, middle, and eastern) are present at the base of the landfill at the locations illustrated on Figure 4-37. Historic chemical data suggest the seeps emanate water that passes through the landfill materials. Table D.2-5 in Appendix D contains the seep data. A portion of the seep water is believed to originate upslope of the landfill due to precipitation infiltration and a portion from recharge from bedrock through the base of the landfill. The interim measures discussed in Section 4.5.3 are believed to be effectively minimizing precipitation infiltration. The seeps discharge into a seep collection system that discharges to Little Mountain Creek. Alcoa has submitted an NPDES permit application to the North Carolina Division of Water Quality to address the seep discharge to Little Mountain Creek.

### 4.5.7 Phase I RFI Data Summary

Soil samples were collected from borings S2-HA-01 through S2-HA-06 around the perimeter of the landfill at the locations illustrated on Figure 4-34. Table 4-64 provides the soil analytical results. Soil samples were collected from each boring at surface (0-0.5 ft-bgs) and 0.5 to 2.0 ft-bgs. Samples S2-HA-01 and S2-HA-02 were collected to assess for potential releases near the toe of the landfill. Samples from S2-HA-01 and S2-HA-02 were analyzed for the potential landfill COIs, which include VOCs, SVOCs, total metals (arsenic, barium, cadmium, chromium, lead, and selenium), total cyanide, weak acid dissociable cyanide, and fluoride.

Samples S2-HA-05 and S2-HA-06 were collected upslope of the landfill to provide background data. These samples were analyzed for background parameters and the potential landfill COIs, except for VOCs (VOCs would not be expected in background samples). The samples were analyzed for PAHs, total metals (arsenic, barium, cadmium, chromium, lead, selenium, and mercury), total cyanide, weak acid dissociable cyanide, and fluoride.

Samples S2-HA-03 and S2-HA-04 were collected to assess the potential for releases along each side of the landfill. These data were considered potentially useful for determining background in addition to delineation, and as a result were analyzed for both potential landfill COIs and background parameters [VOCs, SVOCs (which includes the PAHs), total metals (arsenic, barium, cadmium, chromium, lead, selenium, and mercury), total cyanide, weak acid dissociable cyanide, and fluoride]. The sample depths (0 to 6-inches and 0.5 to 2 ft-bgs) were selected to assess if landfill materials may have been released via transport over the edges of the landfill near their perimeters. Based on the similarity in constituent concentrations to upslope samples and their locations, these samples were included in the background data set. S2-HA-03 is on the other side of a drainage ditch from the landfill and S2-HA-04 on a natural topographic high.

Groundwater samples were collected during Phase I from six monitoring wells in the Alcoa/Badin Landfill (ABL-MW-1 through ABL-MW-6) (Figure 4-37). In accordance with the RFI Work Plan, the "most contaminated well" in the Alcoa/Badin Landfill was to be sampled for Appendix IX parameters. ABL-MW-5 was selected as the "most contaminated well" due to past observed concentrations of cyanide and fluoride and was subjected to Appendix IX analysis plus filtered metals, weak acid dissociable cyanide, free cyanide, fluoride, and TSS. Groundwater samples from the remaining wells were analyzed for VOCs, SVOCs, total cyanide, weak acid dissociable cyanide, free cyanide, total fluoride, total metals (arsenic, barium, cadmium, chromium, lead, and selenium), filtered metals (arsenic, barium, cadmium, chromium, lead, and selenium), and TSS. Table 4-65 provides the groundwater analytical results.

To assess the potential impact of the Alcoa/Badin Landfill on Little Mountain Creek, two surface water samples and two sediment samples were collected during Phase I of the RFI from the creek at the locations shown on Figure 4-34 and 4-37. The sediment samples were analyzed for VOCs, SVOCs, total metals (arsenic, barium, cadmium, chromium, lead, and selenium), total cyanide, weak acid dissociable cyanide, total fluoride, and PCBs. In addition to the parameters analyzed for sediments, the surface water samples were analyzed for filtered metals (arsenic, barium, cadmium, chromium, lead, and selenium). Tables 4-66 and 4-67 provide the Little Mountain Creek sediment and surface water sample results.

### 4.5.8 Surface and Subsurface Conditions

The surface of the landfill is vegetated with grass and is regularly mown as part of an on-going O&M plan to inspect and maintain the landfill cap. Beneath the grass is a 6-inch top-soil layer and then two feet of low permeability clay. Refer to sections 4.5.5 (Geology) and 4.5.6 (Hydrogeology) for further descriptions of the surface and subsurface conditions at SWMU No. 2.

### 4.5.9 Screening Level Risk Assessment for Soil

Table 4-68 provides a summary of the constituents detected in soil, frequency of detection, minimum and maximum detected concentration, and a comparison to the risk screening values. Figure 4-34 provide the soil sample locations and depths sampled.

Arsenic is the only constituent detected at concentrations exceeding the Region III RBCs for residential and industrial soil. The maximum detected concentration of arsenic is 15.8 mg/kg at location S2-HA-01 (0.5 to 1 ft-bgs). However, the maximum detected concentration of arsenic is well below the calculated background concentration of 33 mg/kg.

There were no constituents detected in soil at concentrations exceeding the USEPA and NC SSL values.

### 4.5.10 Screening Level Risk Assessment for Groundwater

Table 4-69 provides a summary of the constituents detected in downgradient groundwater, minimum and maximum detected concentrations, and a comparison to the risk screening values.

Dissolved arsenic is found at concentrations exceeding the NC 2L Standard and the Federal MCL. However, this constituent is detected in only one of the six samples collected at this SWMU and the detection is in upgradient well ABL-MW-6 (Figure 4-37). Arsenic is reported to occur naturally in groundwater in parts of the Carolina Slate Belt including Stanly County. As a result, arsenic is eliminated as a COI.

Total cyanide was found at concentrations slightly exceeding the NC 2L Standard for cyanide in a single well. However, as discussed in section 1.5 of this report, the actual basis for the numerical calculation of the MCL and NC 2L standard is free cyanide and therefore it is the free cyanide concentration (e.g., weak acid dissociable and microdiffusion), which should be the basis for assessing risk. Because of this and the fact that only one well only slightly exceeded the 2L Standard as total cyanide, total cyanide is eliminated as a COI.

### 4.5.11 Screening Level Risk Assessment for Surface Water and Sediment

Table 4-70 and 4-71 provide a summary of the constituents detected in sediment and surface water, frequency of detection, minimum and maximum detected concentration, and a comparison to the risk screening values.

Only cyanide and fluoride were detected in Little Mountain Creek surface water samples. The only detection of cyanide by the microdiffusion method was well below the human health surface water screening values. There is no human health NC 2B Class WS-IV Standard (15 NCAC 02B.0216(3)(g)(i,ii) or Federal AWQC (USEPA, 1999) for fluoride. However, the detections were well below the NC 2L Standard and Federal MCL, which are very conservative values for surface water as they are based on exposure in drinking water.

Of the detected constituents in Little Mountain Creek sediments, only arsenic was above the conservative human health screening criteria for sediments. However, an upgradient sediment sample had a higher concentration of arsenic than the downgradient one. Therefore, arsenic is not identified as a site-specific COI in sediment.

### 4.5.12 Conclusions and Recommendations

There are no constituents detected in soil around the perimeter of the Alcoa/Badin Landfill at concentrations exceeding both risk-based screening values and background (arsenic exceeds risk-based screening values but not background concentrations). The surface of the SWMU has been capped with clean soil comprised of two feet of low permeability clay, six-inches of top-soil, and covered with vegetation. As a result, there is no concern regarding direct contact with soils on top of or adjacent to this SWMU.

Constituents were not detected in the soil samples collected outside the perimeter of the SWMU at concentrations exceeding the NC or USEPA SSLs. In the landfill area, surface drainage improvements and the low permeability clay cap are expected to reduce the amount of precipitation infiltration reaching the waste materials. However, groundwater also enters the landfill materials through discharge from the bedrock interface beneath the landfill into waste materials. As a result, the seep flow may diminish but may not dry up completely. To address the seeps, Alcoa has constructed a seep collection system and applied for an NPDES permit for the seeps from the NC DWQ. There were no COIs detected at concentrations greater than both the risk-based screening values and background concentrations in surface water and sediment samples.

Based on the RFI findings, the interim measures work, and the permitting of the seeps with the NC DWQ, no further action is recommended for this SWMU.

## 4.6 SWMU No. 3: Old Brick Landfill

Alcoa used the Old Brick Landfill from 1915 to 1960 as a disposal site for SPL and furnace brick originating from aluminum smelting operations. The landfill occupies approximately 3 acres and is located on Alcoa property, approximately 0.75 miles northeast of the main plant site, near Badin Lake. Alcoa estimates that approximately 22,000 cubic yards of waste were disposed in the landfill. The fill area slopes downward toward Badin Lake. In 1987, the fill area was covered with 12 inches of compacted clay, and a ditch was constructed on the upslope side to divert stormwater. A chain-link fence with locking gates surrounds the landfill (Figure 4-38).

### 4.6.1 Summary of Pre-RFI Investigations

Periodic groundwater sampling has been conducted by Alcoa on a voluntary basis since 1991. Samples have been routinely analyzed for total and free cyanide, and fluoride. Groundwater elevation data have been collected in conjunction with the sampling. The sampling results and groundwater elevation data are provided in Appendix D. The groundwater quality data are also discussed in Section 4.6.5.2.

### 4.6.2 Summary of Voluntary Measures

Since 1995, Alcoa has conducted additional voluntary activities to minimize infiltration of surface waters into the landfill. These activities included the 1996 improvements to a diversion channel to route surface water run-on around the landfill and the 1997 landslide and cover repairs. Notification of the 1996 diversion channel work was provided by Alcoa to the Department in a letter dated May 10, 1996. Notification for the Old Brick Landfill repair was provided by Alcoa to the Department in a letter dated August 25, 1997. The Department provided Alcoa with approval to implement the landslide and cover repairs in a letter dated September 8, 1997. These activities address the general recommendations that were contained in Law Environmental's 1994 Landfill Cap Inspection Report (Appendix F.3.3.4 of the RFI Work Plan).

### 4.6.3 Old Brick Landfill Topography

Topography at the Old Brick Landfill (SWMU No. 3) rises steeply from an elevation of about 600 ft-msl at the upper part of the fill area to 675 feet at the hilltop to the southwest. From the toe of SWMU No. 3 at about 560 ft-msl, again the slope is steep down to Badin Lake (approximately 510 ft-msl) to the northeast.

### 4.6.4 Old Brick Landfill Geology

Past investigations by Aquaterra (September 1991b) describe the geology at the Old Brick Landfill. The site has been mapped and reported as being underlain by basaltic tuff (a volcanic rock). The rock is described as well jointed, fine-grained rock that does not exhibit cleavage (Conley, 1962). The base of the basaltic tuffs are characterized by conglomerate comprised of mafic lithic fragments and round argillite pebbles in a matrix of fine-grained mafic tuff. Above its base the basaltic tuff consists of faintly-bedded lithic crystal tuffs. The basaltic tuffs consist of predominantly chlorite, feldspar, horneblende, and pyroxene minerals (Aquaterra, September 1991b).

Five soil borings installed by Aquaterra indicate the geology encountered during drilling operations and exhibited in the outcrops at the site are consistent with the reported descriptions. Spheroid ally weathered basaltic tuff boulders were abundant. Mineralized quartz veins were also located throughout the site. The soils encountered were silty clays composed of red, brown, and yellow color mixtures and appeared to be the result of weathering of the mafic bedrock.

A past investigation by Law Engineering (November 1987) initially defined the limits of the waste area using soil borings. Soil borings also determined the fill to be approximately 29 ft deep inside the landfill.

### 4.6.5 Old Brick Landfill Hydrogeology

The following sections discuss the hydrogeology of the Old Brick Landfill including groundwater occurrence and flow and groundwater quality.

#### 4.6.5.1 Groundwater Occurrence and Flow

Monitoring well construction for the SWMU No. 3 (Old Brick Landfill) is summarized on Table 4-72. Groundwater at the Old Brick Landfill occurs in bedrock and saprolite/partially weathered bedrock. Based on observation of water levels made during well installation, semi-confined conditions are suspected at OBL-MW-2, OBL-MW-3, and OBL-MW-5. The landfilled materials are situated well above the water table. The base of the landfill is reported by Law Engineering (November 1987) at an elevation of about 570 ft-msl, whereas the highest groundwater elevation on the up-slope side of the landfill is approximately 545 ft-msl (or 25 feet below the base of the landfilled materials). The groundwater elevation at the downslope side of the landfill is about 520 ft-msl (or 50 feet below the base of the landfill materials).

A groundwater elevation contour map for the Old Brick Landfill (Figure 4-39) shows groundwater flow is to the northeast toward Badin Lake. Elevations measured during the RFI range approximately from 586 ft-msl at OBL-MW-1 to 505 ft-msl at OBL-MW-3. The horizontal gradient averages 0.12 ft/ft.

Hydraulic conductivity of the units at the Old Brick Landfill have been defined based on past hydrogeologic investigations (Aquaterra, September 1991b). Table 4-73 summarizes hydraulic conductivity values calculated from slug tests performed on four monitoring wells. The hydraulic conductivities measured by slug testing ranged from $1.3 \times 10^{-5}$ cm/sec (0.004 ft/day) to $1.19 \times 10^{-2}$ cm/sec (34 ft/day). The average hydraulic conductivity is $3.3 \times 10^{-3}$ cm/sec (8.8 ft/day).

In addition, a recovery test was conducted in OBL-MW-2 by bailing the well dry and measuring the change in water levels over time. The hydraulic conductivity values calculated from this method is $5.11 \times 10^{-7}$ cm/sec (0.001 ft/day).

Using the gradient of 0.12 ft/ft and the average hydraulic conductivity determined by the slug tests, the velocity, assuming 25% effective porosity (Fetter, 1980, Freeze and Cherry, 1979) is $1.5 \times 10^{-3}$ cm/sec (4.2 ft/day). Actual velocities may vary due to heterogeneities and conduits that facilitate secondary flow (i.e., fractures and bedding planes).

#### 4.6.5.2 Groundwater Quality

Appendix D contains tables of historic groundwater elevations and fluoride, cyanide, and free cyanide (amenable, weak acid dissociable, and microdiffusion) analytical data. The historic data are consistent with the current RFI data. Like the RFI data, total cyanide has been detected in the past in OBL-MW-2 and OBL-MW-4 at concentrations slightly exceeding the NC 2L Standard. However, the NC 2L Standard for total cyanide is conservatively based on the RfD for free cyanide (see Section 1.5). Free cyanide has been detected at concentrations slightly exceeding the NC 2L Standard in less than half the sampling rounds. Fluoride has never been detected in any of the monitoring wells at concentrations exceeding the NC 2L Standards.

### 4.6.6 Phase I RFI Data Summary

Soil samples were collected from borings S3-HA-01 through S3-HA-06 around the perimeter of the landfill at the locations illustrated on Figure 4-38. Table 4-74 provides the soil analytical results. Soil samples were collected from each boring at surface (0 to 0.5 ft-bgs) and 0.5 to 2.0 ft-bgs. Samples S3-HA-04 and S3-HA-05 were collected to assess for potential releases near the toe of the landfill. Samples from S3-HA-04 and S3-HA-05 were analyzed for the potential landfill COIs, which include VOCs, SVOCs, total metals (arsenic, barium, cadmium, chromium, lead, and selenium), total cyanide, weak acid dissociable cyanide, and fluoride.

Samples S3-HA-01 and S3-HA-02 were collected upslope of the landfill to provide background data. The sample depths (0 to 6-inches and 0.5 to 2 ft-bgs) were selected to assess whether landfill materials may have been released via transport over the edges of the landfill near the perimeter. These samples were analyzed for background parameters and the landfill COIs, except for VOCs (VOCs would not be expected in background samples). The samples were analyzed for PAHs, total metals (arsenic, barium, cadmium, chromium, lead, selenium, and mercury), total cyanide, weak acid dissociable cyanide, and fluoride.

Samples S3-HA-03 and S3-HA-06 were collected to assess if releases had occurred along each side of the landfill. These data were considered to be potentially useful for background purposes in addition to delineation and as a result were analyzed for both landfill COIs and background parameters VOCs, SVOCs (including PAHs), total metals (arsenic, barium, cadmium, chromium, lead, selenium, and mercury), total cyanide, weak acid dissociable cyanide, and fluoride. Based on the similarities in constituent concentrations and the location in the field, the sample results for S3-HA-03 and S3-HA-06 were incorporated into the background data set.

Groundwater samples were collected from five monitoring wells in the Old Brick Landfill (OBL-MW-1 through OBL-MW-5) during Phase I. Groundwater samples were analyzed for VOCs, SVOCs, total cyanide, weak acid dissociable cyanide, microdiffusion cyanide, total fluoride, total metals (arsenic, barium, cadmium, chromium, lead, and selenium), filtered metals (arsenic, barium, cadmium, chromium, lead, and selenium), and TSS. Analytical results are on Table 4-75.

### 4.6.7 Phase II RFI Data Summary

One monitoring well (OBL-MW-6) was installed at the location shown on Figure 4-40 to further delineate the Phase I detection of cyanide in OBL-MW-4. Groundwater from OBL-MW-6 was sampled and laboratory analyzed for total cyanide, weak acid dissociable cyanide, and microdiffusion cyanide (Table 4-76).

### 4.6.8 Surface and Subsurface Conditions

The surface of the landfill is vegetated with grass that is regularly mown as part of routine landfill cover O&M activities. Beneath the vegetative cover is a 6-inch layer of top soil and a 12-inch layer of compacted clay. Refer to Section 4.6.4 (Geology) and 4.6.5 (Hydrogeology) for further descriptions of subsurface conditions at SWMU No. 3.

### 4.6.9 Screening Level Risk Assessment for Soil

Table 4-77 provides a summary of the constituents detected in soil, frequency of detection, minimum and maximum detected concentration, and a comparison to the risk screening values. Figure 4-38 provides a summary of constituents detected in soil at concentrations exceeding the risk-based screening values.

Arsenic is the only constituent detected in soil at concentrations that exceed the Region III RBCs for industrial and residential soil. However, the maximum concentration of this constituent (36.3 mg/kg) is less than the statistically-derived concentrations in background samples for this area (86 mg/kg).

Chromium is the only inorganic constituent detected at concentrations that exceed the USEPA and NC SSL values for the soil to groundwater migration pathway. However, the chromium concentrations downslope of the SWMU in S3-HA-04 and S3-HA-05 are less than the statistically derived background value of 62 mg/kg.

Acetone (3.8 mg/kg) is present in one sample (S3-HA-04) at a concentration greater than the SSL value calculated using the North Carolina leaching equation. The detection of acetone is believed to be an artifact of the laboratory and not believed to be present in SWMU No. 3 soils. Owing to its volatility, this constituent would not be expected in surface soils. Also, it was detected in S3-HA-03, which is also considered a background sample because it was collected north of drainage ditch that runs along the north side of the SWMU. As a result, acetone is dropped as a COI and no further evaluation of this constituent is warranted.

### 4.6.10 Screening Level Risk Assessment for Groundwater

Table 4-78 provides a summary of the constituents detected in groundwater, minimum and maximum detected concentration, and a comparison to the risk screening values.

Total cyanide was detected in groundwater at concentrations greater than the NC 2L Standards in three monitoring wells (OBL-MW-2, OBL-MW-3 and OBL-MW-4). However, as noted in Section 1.5, free rather than total cyanide should be the applicable form for comparing with groundwater standards because NC 2L Standard is based on the RfD for free cyanide. The Federal MCL for cyanide references free cyanide only. Weak acid dissociable cyanide was detected at concentrations exceeding the screening value in OBL-MW-2. Microdiffusion cyanide was detected at concentrations exceeding the screening value in OBL-MW-2 and OBL-MW-4. As a result of the constituents detected at concentrations exceeding the screening values, this SWMU is subjected to a site-specific risk assessment for groundwater. There was no cyanide (microdiffusion, weak acid dissociable, or total) detected in the groundwater sample collected from OBL-MW-6 during Phase II of the RFI.

### 4.6.11 Site-Specific Risk Assessment for Groundwater

Groundwater beneath SWMU No. 3 is not used for any purpose and is at depths that do not present a direct contact risk to site workers. Alco, Alcoa owns the property in the vicinity of this SWMU and therefore controls the drilling or installation of wells in this area. The residential wells survey determined that the vast majority of local residences use water supplied by Stanly County. The residential wells survey also determined that those residences believed to utilize home wells are either hydraulically isolated or upgradient from Alcoa's on-site and off-site SWMUs and AOCs. The nearest residential well to SWMU No. 3 is on the opposite side of Badin Lake. As a result, the groundwater at

SWMU No. 3 does not present a risk to on-site receptors and residential well users because there are no complete exposure pathways.

Groundwater beneath SWMU No. 3 flows toward and discharges to Badin Lake surface water. The only potential complete exposure to groundwater at SWMU No. 3 is for receptors in Badin Lake.

### 4.6.12 Badin Lake Surface Water and Sediment – Old Brick Landfill Area

#### 4.6.12.1 Summary of Pre-RFI Investigations

Badin Lake surface water and sediment sampling was conducted by Woodward Clyde in 1996 and 1997 (Woodward Clyde, 1997). Figure 4-41 shows the location of the surface water and sediment samples collected downgradient of SWMU No. 3 in Badin Lake. The surface water and sediment samples were analyzed for a broad list of constituents. These data are deemed to be of RFI quality, and therefore are included in the RFI groundwater to surface water evaluation. The surface water data are summarized on Table 4-54 (see sample results for WA-OBL-092296-001) and the sediment data on Table 4-55 (see sample SX-OBL-092296-002).

#### 4.6.12.2 Screening Level Risk Assessment for Badin Lake Surface Water – Old Brick Landfill

Table 4-79 summarizes the constituents detected in Badin Lake adjacent to the Old Brick Landfill. This table also compares the maximum concentration of detected constituents to the NC 2B Standards (15A NCAC 02B.0216(3)(g)(i,ii)) and USEPA Water Quality Criteria (USEPA, 1999b) for the protection of human health. None of the detected constituents are present at concentrations exceeding these surface water screening values.

#### 4.6.12.3 Screening Level Risk Assessment for Badin Lake Sediment – Old Brick Landfill

Table 4-80 presents a summary of all constituents detected in the sediment sample collected from Badin Lake adjacent to SWMU No. 3. It also compares the maximum detected concentration of constituents to the industrial soil RBCs. Industrial soil RBCs were applied as screening values for sediments as there are no standard human health-based criteria for sediment. The industrial soil RBCs are conservative values to apply to sediment, a medium for which only the most incidental contact is likely.

Use of soil screening values for human health exposure to sediment is a common practice in human health risk assessment. As indicated on Table 4-80, arsenic is the only constituent detected at concentrations exceeding the industrial RBCs. However, the concentration of arsenic in sediment (37 mg/kg) is less than the calculated background value for soil (86 mg/kg).

#### 4.6.12.4 Conclusions and Recommendations

The screening level risk assessment for soil shows no constituents present in soil adjacent to the landfill at concentrations exceeding the risk screening values. As a result, there are no direct contact concerns related to soil surrounding the SWMU. The SWMU itself has a cap that is maintained by Alcoa, which prevents direct contact with underlying materials. There were no detections of constituents in soil at concentrations that exceed the conservative SSLs and background values, and the landfill cap is believed to be effectively inhibiting leaching of landfill materials. As a result, no further action is necessary to address the soil to groundwater leaching pathways.

Cyanide (total, weak acid dissociable, and free) were detected at concentrations exceeding the NC 2L Standard and USEPA MCL for cyanide. However, groundwater beneath this SWMU is not used for any purpose and is hydraulically isolated from residential wells. The only potential, complete exposure pathway to groundwater is after it flows into Badin Lake.

Evaluation of Badin Lake surface water and sediment data show no constituents present at concentrations exceeding the screening values and background levels. Based on these findings, no further action other than periodic monitoring of groundwater for cyanide is recommended for SWMU No. 3.

# 5.0 RFI SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

## 5.1 Summary

The RFI evaluated environmental conditions at 14 on-site and two off-site SWMUs/AOCs. The RFI provided the data needed to effectively characterize the nature and extent of COIs detected in the media of interest at each of the SWMUs and AOCs. Media investigated during the RFI included soil, groundwater, surface water, sediment, and landfill gas. The site physical conditions (e.g., geology and hydrogeology) were characterized to understand the potential COI transport mechanisms.

A conservative risk-based screening approach was used to evaluate analytical data and focus the RFI on COIs found at concentrations potentially posing risk to human health. As appropriate, the risk assessment of the SWMUs and AOCs focused on potential human exposure scenarios because the Badin Works is an active industrial facility occupied by plant operations and/or areas that undergo routine operation and maintenance activities (e.g., mowing of landfill areas). In addition to the media on the plant property (i.e., soil and groundwater), the risk assessment included an evaluation of human health for off-property surface water and sediment in Badin Lake and Little Mountain Creek.

A site-specific risk assessment was conducted for those SWMUs/AOCs where COIs exceeded the screening values. The site-specific risk assessment assumed current and future land use at the facility is industrial, but also included an evaluation of off-site residential areas and Badin Lake.

Following is a summary of the major findings for the plant area, SWMU No. 2 (Alcoa/Badin Landfill), and SWMU No. 3 (Old Brick Landfill).

### 5.1.1 Plant Area

RFI SWMUs/AOCs in the plant area include SWMU Nos. 1, 4, 11 22, 25, 33, 35, 38, 42, 44 and 46 and AOCs –A and –B (Figure 1-4, Table 1-1). SWMUs in the north end of the plant (North End) include SWMU Nos. 1, 4, 22, 25, 33, 35, and 44. In accordance with NCDENR's letter to Alcoa dated September 9, 1999 and the approved RFI Work Plan, SWMUs in the North End are addressed using the "SWMU-Area Concept", whereby SWMUs are grouped together based on commonalities.

Groundwater for all the SWMUs in the North End (SWMU Nos. 1, 4, 22, 25, 33, 35, and 44) is addressed using the SWMU-Area concept because the SWMUs are all located within a contiguous infilled valley, have the same COIs, and the COIs in groundwater are not traceable to any individual SWMU. Groundwater beneath the SWMUs and AOCs in the central and southern portion of the plant (SWMU Nos. 11, 38, 42, and 46, and AOCs-A and –B), and off-site landfills (SWMU Nos. 2 and 3) is addressed on an individual SWMU and AOC basis.

SWMU Nos. 1, 4, and 33 are grouped into "SWMU Group 1" for the purpose of evaluating soils based on the results of the RFI and Interim Measures (IMs) Work. These SWMUs were grouped together based on similar COIs and proximity to one another. The soil evaluation for each of the remaining SWMUs is evaluated individually.

The major findings of the RFI in the plant area are:

- The primary COIs identified in soil by the screening level risk assessment are total and free (weak acid dissociable) cyanide, fluoride, PAHs and PCBs. Based on the interim measures work previously performed and the risk assessment, these COIs do not present a direct contact risk to potential receptors under current and reasonably anticipated future land use.

  The emplacement of a low permeability cap as an interim measure at SWMU Group 1 (SWMU Nos. 1, 4, and 33) has eliminated the potential for contact by workers with the constituents detected in SWMU Group 1 soil. Also, the cap eliminates any potential concerns for off-site contact with SWMU Group 1 soil because the cap eliminates the potential for soil to be eroded and transported off-site by wind or water. As a result, soils at this SWMU Group do not present a concern with respect to direct contact by workers or residents. Alcoa has a program in place to inspect and maintain the cap on a semi-annual basis.

  The RFI verified the effectiveness of soil removal activities previously conducted by Alcoa at SWMU No. 22, AOC-A, and AOC-B. RFI analytical data show no constituents in SWMU No. 22 soil detected at concentrations exceeding the direct contact risk-based screening values or background concentrations, verifying the effectiveness of the 1994 soil removal activities at this SWMU. RFI samples collected at AOC-B show no constituents detected at concentrations greater than the applicable direct contact screening values (residential and industrial RBCs for surface soils and industrial RBCs for subsurface soil). These results verify the effectiveness of the soil removal action conducted at AOC-B in 1996. The effectiveness of AOC-A soil removal performed in 1985 was verified through historic monitoring and RFI groundwater samples at AOC-A that show no constituents detected.

  The screening level risk assessment for SWMU No. 43 shows no constituents detected at concentrations exceeding the risk screening levels. SWMU Nos. 11, 35, 44, and 46 each had constituents detected at concentrations exceeding the conservative risk screening values and therefore were subjected to site-specific risk assessments. The site-specific risk assessments for each SWMU found direct contact risks at these SWMUs to be within or below USEPA's acceptable range.

As a result of the interim measures work and soil removal activities, and based on the RFI risk assessment, no further action is required to address direct contact pathways for soils at the SWMUs and AOCs in the plant area.

- The screening level risk assessment indicated that SWMU Group 1 (SWMU Nos. 1, 4, and 33), SWMU Nos. 11, 35, 44, and 46 and AOC-B contain constituents at concentrations exceeding the conservative screening values used to evaluate the soil to groundwater leaching pathway. The cap placed as an interim measure at SWMU Group 1 addresses the leaching from soil to groundwater at SWMU Nos. 1, 4, and 33. Many of the constituents identified (e.g., PAHs) are eliminated as COIs for the soil to groundwater leaching pathway because they were not detected in site groundwater.

- COIs identified in plant groundwater by the screening level risk assessment are total and free (weak acid dissociable and microdiffusion) cyanide, fluoride, arsenic, trichloroethene, and trichloromethane (chloroform). LNAPL was found in a single monitoring at SWMU No. 42 trapped within the immediate area of the Building 016 foundation; however, there were no dissolved phase LNAPL constituents found in groundwater immediately downgradient of SWMU No 42, confirming the limited extent of the LNAPL. Groundwater beneath the plant area is not used for any purpose and there is no direct exposure potential with groundwater to the plant workers or local residents. Alcoa owns the land from the plant to Badin Lake to the east. Therefore, Alcoa can ensure that no drinking water wells will be installed between the SWMUs/AOCs and Badin Lake. A residential well survey determined that nearly all residences are connected to the Stanly County potable supply. While there are few residences with home wells, these homes are hydraulically upgradient of the plant area. Based on the RFI findings, there is no risk to current or potential groundwater users from COIs in groundwater.

- Groundwater beneath the plant area flows toward and discharges to Badin Lake. As a result, Badin Lake represents the only potential complete exposure pathway to the COIs in groundwater. The groundwater velocity is relatively slow beneath the plant area (average of 1 ft/day). Therefore, the groundwater discharge rate from the plant area to the Lake is low and plant area groundwater provides only a minor contribution to this large volume lake. The risk-based screening of surface water samples in Badin Lake shows plant area groundwater COIs are not present in the Lake at levels exceeding human health surface water screening values. A human health screening level risk assessment of Badin Lake sediments identified PCBs and PAHs as potential COIs and as a result a site-specific human health risk assessment was performed. The site-specific risk assessment for Badin Lake sediments concluded that areas where sediments can be contacted by human receptors are limited (e.g., the swimming cove or boat launch area), and that potential risks to COIs in this area are within acceptable limits.

### 5.1.2 SWMU No. 2 (Alcoa/Badin Landfill)

- This SWMU was subjected to an interim measure (regrading and capping) to minimize the amount of precipitation infiltration and leaching of Landfill COIs. The cap also eliminates the potential for direct contact with the landfill materials.

- The screening level risk assessment for soil shows there are no COIs present in soil adjacent to the landfill at concentrations exceeding the conservative risk-based screening values. As a result, soils surrounding SWMU No. 2 do not pose unacceptable risk to potential current or reasonably anticipated future receptors.

- The screening level risk assessment for groundwater shows only total cyanide exceeding the screening values, in a single well downgradient of the landfill. Groundwater beneath the landfill is not used for any purpose. There is a residential groundwater well on the opposite side of Little Mountain Creek, at an approximate distance of 0.3 miles to the south. However, groundwater elevation data from triple piezometers at this SWMU show Little Mountain Creek acts as a hydraulic barrier and as a result, groundwater containing COIs does not flow under the creek. The groundwater velocity beneath the Alcoa Badin Landfill is relatively slow (average of about 0.2 ft/day) and as a result the rate of groundwater discharge to Little Mountain Creek is minor. Also, the concentration of free cyanide (i.e., weak acid dissociable and microdiffusion) in SWMU No. 2 monitoring wells does not exceed the screening value. The MCL and NC 2L Standard for cyanide are based on the RfD for free cyanide. As a result, the total cyanide detection in the single well at concentrations slightly above the screening value does not warrant further evaluation.

- Seeps containing low levels of cyanide and fluoride manifest at the base of the landfill. Alcoa has constructed a seep collection system and applied for an NPDES permit for seep discharge to Little Mountain Creek. As a result, there is no further action necessary to address seep discharge.

- The screening level risk assessment for Little Mountain Creek shows no COIs present at concentrations exceeding applicable human health screening values.

## 5.2 SWMU No. 3 (Old Brick Landfill)

- This SWMU was subjected to an interim measure (regrading and capping) to minimize the amount of precipitation infiltration and leaching of landfill COIs. The cap also eliminates the potential for direct contact with the landfill materials.

- The screening level risk assessment for soil shows there are no COIs present adjacent to the landfill at concentrations exceeding the conservative risk-based screening values. As a result, soils do not present a risk to potential current or reasonably anticipated future receptors.

- The screening level risk assessment for groundwater shows only total and free cyanide exceeding the screening values. Groundwater beneath the landfill is not used for any purpose. Residential wells identified in the survey are on the other side of Badin Lake and hydraulically isolated from SWMU No. 3.

- Groundwater beneath this SWMU flows toward and discharges to Badin Lake. As a result, Badin Lake surface water and sediment represents the only potential complete exposure pathway to the COIs in groundwater. The groundwater velocity is relatively slow beneath the landfill area (average of about 4 ft/day). As a result of this low velocity, groundwater discharge to the Lake is minor. The risk-based screening of surface water and sediment samples in Badin Lake shows Old Brick Landfill COIs are not present in the lake at levels exceeding the risk screening values.

## 5.3 Conclusions and Recommendations

The next step in the RCRA Corrective Action process for sites where remediation is warranted would be to evaluate potential remedial alternatives in a Corrective Measures Study (CMS). The purpose of the remediation would be based on the need to satisfy one or more remedial goals. The corrective action goals for the Alcoa Badin Works would be to perform remediation on media with contaminants at concentrations posing unacceptable risk to human health and/or the environment, where appropriate.

The RFI has established that no unacceptable risks currently exist due to constituents at the Badin Works SWMUs and AOCs under current and reasonably anticipated future land use. Therefore no remediation is warranted, and accordingly a CMS is not necessary at this time to address the media at the SWMUs. Alcoa is recommending that a groundwater monitoring plan be developed to monitor the natural attenuation of those constituents found at concentrations greater than MCLs or NC 2L Standards.

## 6.0 REFERENCES


Agency for Toxic Substances and Disease Registry (ATSDR), 1993. *Toxicological Profile for Polychlorinate Biphenyls (PCBs).* Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA.

Agency for Toxic Substances and Disease Registry (ATSDR), 1997. *Toxilogical Profile for Cyanide.* U.S. Department of Health and Human Services. September.

Alcoa, 1991. *SOC Compliance Letter to the Department.* December 6.

Alcoa Technical Center, Analytical Chemistry Division, 1993. *Badin Groundwater Characterization.* September 9.

Alcoa, 1994. *RCRA Facilities Investigation Work Plan.* April 11. (Revision 1 by Law Engineering and Environmental Services October 1995; Revision 2 by ICF Kaiser November 2, 1998; Revision 3 by Alcoa February 5, 1999).

Alcoa, 1996a. *Interim Measures Workplan, On-Site Landfill (SWMU #1) and Wet-Weather Run-On Diversion (SWMU #33).* January.

Alcoa, 1996b. *Specifications for Old Brick Landfill (SWMU #3) Channel Improvements.* May.

Alcoa, 1996c. *Interim Measures Report, On-Site Landfill and Wet Weather Run-on Diversion.* December.

Alcoa, 1997a. *Interim Measures Workplan, Alcoa-Badin Landfill (SWMU #2) Regrading and Cover System Installation.* April.

Alcoa, 1997b. *Specifications for the Landslide Repair at the Old Brick Landfill (SWMU #3).* August

Alcoa, 1998. *Interim Measures Report, Alcoa-Badin Landfill (SWMU #2) Regrading and Cover System Installation.* May.

Alcoa, 2000. *Phase II RFI Work Plan.* April 11.

Aquaterra, Inc., 1991a. *Preliminary Soil and Ground-Water Assessment, Alcoa/Badin Municipal Landfill.* September 3.

Aquaterra, 1991b. *Preliminary Soil and Ground Water Assessment Alcoa Brick Landfill.* September 3.

Aquaterra, Inc., 1992a. *Soil and Ground Water Assessment Aluminum Company of America.* July 31.

Aquaterra, Inc., 1992b. *Building 016 Groundwater Assessment Alcoa-Badin.* October 5.

Aquaterra, Inc.: 1993. *Additional Ground Water Sampling Report Building 016 Aluminum Company of America.* June 29.

Aquaterra, Inc., 1994. *November 1993 Ground Water Sampling Event.* February 7.

Conley, James F., 1962. *Geology of the Albemarle Quadrangle, North Carolina.* North Carolina Geologic Survey. Bulletin 75.

Fetter, C.W. 1980. *Applied Hydrogeology.* Merril Publishing Company, Columbus, Ohio. 592 p.

Freeze, R.A., and Cherry, J.A., 1979. *Groundwater.* Prentice-Hall Inc.,Englewood Cliffs, N.J., 604 p.

Four Seasons Environmental Inc., 1994a. *Proposal of Sampling and Delineation of PCBs at Former Scrap Yard.* February 23.

Four Seasons, Environmental, Inc., 1994b. *Final Report PCB Delineation Operations Solid Waste Management Unit-22.* June 10.

Four Seasons Environmental, Inc., 1994c. *Final Report; Soil and Debris Removal Project: Solid Waste Management Unit 22.* November 3.

Geraghty and Miller, Inc., 1995a. *On-Site SPL Landfill Boring Data, Alcoa Badin Works.* December.

Geraghty and Miller, Inc. 1995b. *Hydrogeologic Investigation at SWMU N o. 1 the On-site Landfill.* October.

Geraghty and Miller, Inc., 1996a. *Findings of Soil Assessment Activities at Area of Concern B (AOC-B).* October.

Geraghty and Miller, Inc., 1996b. *Pine Tree Area Investigation.* November.

Geraghty and Miller, Inc., 1996c. *Constituent Flux Determination, North End Setting Badin Works Facility.* November.

Geraghty and Miller, Inc., 1997a. *Constituent Flux Determination Aluminum Company of America North End Setting Badin Works Facility.* April 1.

Geraghty and Miller, 1997b. *Groundwater Flux Determination Aluminum Company of America Badin Landfill.* April.

Geraghty and Miller, Inc., 1997c. *Findings of Soil Assessment Activities at the Spent Potlining Landfill (SWMU #1) and Wet Weather Run-On Diversion (SWMU #33).* February.

Geophex, Ltd., 1996, *Geophysical Survey Report.* April.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring.* Van Nostrand Reinhold Co., New York, New York. pp. 320.

Klaassen, C.D., 1996. *Casarett and Doull's Toxicology: The Basic Science of Poisons.* McGraw-Hill Publishing, U.S.

Law Engineering, 1987. *Report of Subsurface Exploration , Off-Site Waste Pile.* November.

Law Engineering, 1989. *Report of Environmental Services, North End Subsurface Exploration; Alcoa-Badin Works.* (Appendix F.3.1.1 of RFI Work Plan). October 20, Law Engineering, Inc., 1994a. *Report of Air Emissions Monitoring (February, 1994).* May 9.

Law Engineering, Inc., 1994b. *Report of Air Emissions Monitoring (August, 1994).* October 19.

Law Engineering and Environmental Services, Inc., 1996a. *Geotechnical Exploration – Old Brick Landfill Cap.* October 9.

Law Engineering and Environmental Services, Inc., 1996b. *CQA Report, On-Site Landfill Surface Water Control Improvements.* October 31.

Law Environmental, Inc., 1990a. *Preliminary Assessment of Gas Emissions, Badin Landfill.* January 22.

Law Environmental, Inc., 1990b. *Phase I Ground-Water Assessment Northwest Valley; Alcoa-Badin Works.* (Appendix F.3.1.2 of RFI Work Plan). June 1.

Law Environmental, Inc. 1990c. *Phase II Ground-Water Assessment Northwest Valley; Alcoa-Badin Works.* (Appendix F.3.1.3 of RFI Work Plan). November 12.

Law Environmental, Inc.: 1991a. *Report of Methane Gas Probe Installation and Monitoring, Badin Landfill.* March 15.

Law Environmental, Inc.: 1991b. *Report of Methane Monitoring, Homesites Near Old Badin Landfill.* March 28.

Law Environmental, Inc., 1991c. *Installation of Ground-Water Monitoring Well (MW-16) Northwest Valley Ground-Water Contamination Assessment; Alcoa-Badin Works.* (Appendix F-3.1.4 of RFI Work Plan). April 3.

Law Environmental, Inc., 1992. *Report of Ground-Water Assessment and Preliminary Ground-Water Recovery Study, Alcoa-Badin Works* (Appendix F-3.1.5 of RFI Work Plan). August 6.

Law Environmental, Inc., 1993a. *Report of Consulting Services and Methane Monitoring.* April 8.

Law Environmental, Inc., 1993b. *Confirmatory Sampling Report Aluminum Company of America Badin Works.* June 28.

Law Environmental, Inc. 1993c. *Addendum to the Confirmatory Sampling Report Aluminum Company of America Badin Works.* November 1.

Law Environmental, Inc, 1993d. *Quarterly Monitoring and Analysis Ground-Water MonitoringWells Northwest Valley and Bake Furnace Area; Alcoa-Badin Works.* (Appendix F-3.1.6 of RFI Work Plan) December 6,

Law Environmental, Inc., 1994a. *Results of Fill Delineation, Northwest Valley.* (Appendix F.3.7.1 of work Plan). March 2.

Law Environmental, Inc., 1994b. "Landfill Cap Inspection Report, Old Brick Landfill". March 4.

Law Environmental National Laboratories, 1994. *Chemical Analysis of Samples Received on 2/24/99.* March 14.

NCDEHNR, 1991. *Screening Site Investigation Report.* March 21.

Trigon Engineering Consultants, Inc., 1996a. *Soil Vapor Monitoring Report.* April 4.

Trigon Engineering Consultants, Inc., 1996b. *Soil Vapor Monitoring Report.* August 16.

Trigon Engineering Consultants, Inc., 1996c. *Soil Vapor Monitoring Report.* September 16,

Trigon Engineering Consultants, Inc., 1996d. *Soil Vapor Monitoring Report.* November 22.

Trigon Engineering Consultants, Inc., 1997, *Soil Vapor Monitoring Report.* January 22.

United States Environmental Protection Agency (USEPA), 1986. *Guidelines for Carcinogenic Risk Assessment.* Federal Register. 51:33992.

United States Environmental Protection Agency (USEPA), 1988. *Laboratory Data Validation Functional Guidelines for Organic and Inorganic Analyses.*

United States Environmental Protection Agency (USEPA), 1989a. *RCRA Facility Investigation Guidance.* Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9502.00.6D. May.

United States Environmental Protection Agency (USEPA), 1989b. *Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Volume I, Part A. Interim Final.* Office of Emergency and Remedial Response, Washington, DC. EPA 540/1-89/002. December 1989.

United States Environmental Protection Agency (USEPA), 1991a. *Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Part B: Development of Risk-based Preliminary Remediation Goals.* Office of Solid Waste and Emergency Response, Washington, DC. OSWER Directive 9285.7-01B. December 13.

United States Environmental Protection Agency (USEPA), 1991b. *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions.* Office of Solid Waste and Emergency and Remedial Response, Washington, DC. OSWER 9355.0-30, April 22.

United States Environmental Protection Agency (USEPA), 1992a. *Guidance for Data Usability in Risk Assessment (Part A) Final.* Office of Emergency and Remedial Response, Washington, DC. 9285.7-09A. April 1992.

United States Environmental Protection Agency (USEPA), 1992b. *Supplemental Guidance to RAGS: Calculating the Concentration Term.* Office of Solid Waste and Emergency Response. OSWER Directive 9285.7-081. May.

United States Environmental Protection Agency (USEPA), 1992c. *Dermal Exposure Assessment: Principles and Applications.* Office of Research and Development, Washington, DC. EPA 600/8-91/011B.

United States Environmental Protection Agency (USEPA), 1994a. *National Functional Guidelines for Organic Data Review.* February.

United States Environmental Protection Agency (USEPA), 1994b. *National Functional Guidelines for Inorganic Data Review.* February.

U.S. Environmental Protection Agency (USEPA), 1995. *Land Use in the CERCLA Remedy Selection Process.* Directive Number 9355.7-04. Federal Register Volume 60 Number 107. June.

United States Environmental Protection Agency (USEPA), 1996a. *Soil Screening Guidance Technical Background Document.* Office of Solid Waste and Emergency Response. EPA/540/R95/128. May.

United States Environmental Protection Agency (USEPA), 1996b. *Soil Screening Guidance: Users Guide* Office of Solid Waste and Emergency Response. Publication 9355.4-23. July.

United States Environmental Protection Agency (USEPA), 1996c. *Drinking Water Regulations and Health Advisories.* Office of Water, Washington DC.

United States Environmental Protection Agency (USEPA), 1996d. *Proposed Guidelines for Carcinogenic Risk Assessment.* Office of Research and Development. EPA/600/P-92/003C. April.

United States Environmental Protection Agency (USEPA), 1996e. *Advanced Notice of Proposed Rulemaking (ANPR).* Federal Register, Volume 61, Number 85, 19432-19464. May 1.

United States Environmental Protection Agency (USEPA), 1997a. *Use of the Corrective Action Advance Notice of Proposed Rulemaking as Guidance.* Memorandum from Elliot Laws and Steven Herman USEPA Headquarters to RCRA/CERCLA Policy Managers. January 17.

United States Environmental Protection Agency (USEPA), 1997b. *Exposure Factors Handbook. Office of Research and Development.* EPA/600/P-95/002F. August.

United States Environmental Protection Agency (USEPA), 1997c. *The Lognormal Distribution in Environmental Applications.* Office of Research and Development. Office of Solid Waste and Emergency Response. EPA/600/R-97/006. December.

United States Environmental Protection Agency (USEPA), 1997d. *Health Effects Assessment Summary Tables (HEAST). FY 1997 Update.* EPA-540-R-97-036, July.

United States Environmental Protection Agency (USEPA), 1999a. *Some Practical Aspects of Sample Size and Power Computations for Estimating the Mean of Positively Skewed Distributions in Environmental Applications.* Authors: Ashok K. Singh, Anita Singh, and Max Engelhardt. EPA Technology Support Center Issue. Office of Research and Development, Office of Solid Waster and Emergency Response. EPA/600/s-99/006. November.

United States Environmental Protection Agency (USEPA), 1999b. *Ambient Water Quality Criteria. Federal Register.*

United States Environmental Protection Agency (USEPA), (2000a*). Integrated Risk Information System (IRIS). On-line database.*

United States Environmental Protection Agency (USEPA), (2000b). *Region III Risk-Based Concentration (RBCs) Table.*

Woodward Clyde, 1997. *Preliminary Sediment and Surface Water Sampling Results from Alcoa's Badin, North Carolina Works.* May.

TABLES

## Table 1-1

### Summary of Alcoa Badin Works SWMUs and AOCs Included in RFI
### Alcoa Badin, NC Works RFI

| Designation | Description | Source of Inclusion In RFI | | |
|---|---|---|---|---|
| | | Part-B Permit VII.F (RFI)[a] | Part-B Permit VII.E (CS)[b] | Added By Alcoa |
| SWMU No. 1[c] | On-Site Landfill | X[d] | | |
| SWMU No. 2[c] | Alcoa/Badin Landfill | X | | |
| SWMU No. 3 | Old Brick Landfill | X | | |
| SWMU No. 4[c] | Old K088 Storage Pad | | X | |
| SWMU No. 11 | Waste Oil Accumulation Area/Miscellaneous Storage Area/Pot Pad Burning Area[2]/Old Bake Furnace Site | | X | |
| SWMU No. 22[c] | Scrap Yard | | X | |
| SWMU No. 25[c] | Underground Conveyance Line to NPDES Outfall 009 | X | | |
| SWMU No. 33[c] | Wet Weather Run-on Diversion | X | | |
| SWMU No. 35 | "Old" Waste Oil Storage Area | X | | |
| SWMU No. 38 | Old Rotary Station | | X | |
| SWMU No. 42 | Building 016 | | | X |
| SWMU No. 43 | Overhead Crane Rebuild Structure | | | X |
| SWMU No. 44[c] | Pine Tree Grove Area | | | X |
| SWMU No. 46 | West SPL Area | | | X |
| AOC-A | Fuel Oil Tank Release | | X | |
| AOC-B | Compressor Oil Leakage Area | X | | |

Notes:

[a] RFI = RCRA Facility Investigation.
[b] CS = Confirmatory Sampling.
[c] SWMUs included in the North End of Plant SWMU Area.
[d] X = Indicates Source of Inclusion in RFI.

SWMUs eliminated from the RFI by USEPA based on Confirmatory Sampling findings include SWMU No. 7: Aerated Lagoon, SWMU No. 20: Vehicle Wash Station, and SWMU No. 39: PCB Storage Building.

# Table 2-3
## Summary of Analytical Methods
## Alcoa Badin, NC Works RFI

| Parameter Group | Reference | |
|---|---|---|
| | Soil/Sediment | Groundwater/Surface Water |
| Appendix IX Volatile Organic Compounds | SW846 5035/8260B | SW846 8260B |
| Appendix IX Semi-volatile Organic Compounds | SW846 8270C | SW846 8270C |
| Appendix IX PCBs | SW846 8082 | SW846 8082 |
| Appendix IX Pesticides | -- | SW846 8081A |
| Appendix IX Herbicides | -- | SW846-8151A |
| Total Cyanide | SW846 9012A | SW846 9012A |
| Weak Acid Dissociable Cyanide | SM18-4500-I | SM18-4500-I |
| Free Cyanide (by Microdiffusion) | -- | ASTM D4282-83 |
| Fluoride | EPA 340.2M | EPA 340.2M |
| Sulfide | -- | EPA 376.1 |
| Appendix IX Metals (except Mercury) | SW846 6010B | SW846 6010B |
| Six Metals [b] | SW846 6010B | SW846 6010B |
| Mercury | SW846 7471A | SW846 7471A |
| Total Suspended Solids | -- | EPA 160.2 |

Note:

[a] Media not analyzed for indicated parameter group.

[b] Six metals include Asenic, Barium, Cadmium, Chromium, Lead, and Selenium

Table 2

Phase I RFI Groundwater Ir

Alcoa Badin, NC

| Groundwater Investigation Location | Sample Location | Analytical Sample Designation | Sample Date | Sample Collection Method | Total CN[(a)] | WAD CN[(b)] | MD CN[(c)] | F |
|---|---|---|---|---|---|---|---|---|
| | MW-24 | MW-24-2599 | 9/16/99 | Bladder Pump | X | X | X | X |
| | MW-25 | MW-25-2659 | 9/22/99 | Bladder Pump | X | X | X | X |
| | | MW-25-0050R | 1/5/00 | Bladder Pump | X | X | X | -- |
| | MW-25A | MW-25A-2659 | 9/22/99 | Bladder Pump | X | X | X | X |
| | | MW-25A-0050R | 1/5/00 | Bladder Pump | X | X | X | -- |
| | MW-26 | MW-26-2659 | 9/22/99 | Bladder Pump | X | X | X | X |
| | | MW-26-2659D | 9/22/99 | Bladder Pump | X | X | X | X |
| | | MW-26-0050R | 1/5/00 | Bladder Pump | X | X | X | -- |
| | MW-27 | MW-27-2779 | 10/04/99 | Bladder Pump | X | X | X | X |
| SWMU 2: Alcoa/Badin Landfill | ABL-MW-1 | ABL-MW-1-2679 | 9/24/99 | Bladder Pump | X | X | X | X |
| | | ABL-MW-1-0050R | 1/5/00 | Bladder Pump | X | X | X | -- |
| | ABL-MW-2 | ABL-MW-2-2679 | 9/24/99 | Bladder Pump | X | X | X | X |
| | | ABL-MW-2-0060R | 1/6/00 | Bladder Pump | X | X | X | -- |
| | ABL-MW-3 | ABL-MW-3 | 9/23/99 | Bladder Pump | X | X | X | X |
| | ABL-MW-4 | ABL-MW-4-2679 | 9/24/99 | Bladder Pump | X | X | X | X |
| | | ABL-MW-4-0060R | 1/6/00 | Bladder Pump | X | X | X | -- |
| | ABL-MW-5 | ABL-MW-5-2699 | 9/23/99 | Bladder Pump | X | X | X | X |
| | | ABL-MW-5-2699D | 9/23/99 | Bladder Pump | X | X | X | X |
| | ABL-MW-6 | ABL-MW-6-2679 | 9/24/99 | Bladder Pump | X | X | X | X |
| | | ABL-MW-6-0080R | 1/8/00 | Bladder Pump | X | X | X | -- |
| SWMU 3: Old Brick Landfill | OBL-MW-1 | OBL-MW-1-2689 | 9/25/99 | Bladder Pump | X | X | X | X |
| | | OBL-MW-1-0070R | 1/7/00 | Bladder Pump | X | X | X | -- |
| | OBL-MW-2 | OBL-MW-2-2689 | 9/25/99 | Bladder Pump | X | X | X | X |
| | | OBL-MW-2-0070R | 1/7/00 | Bladder Pump | X | X | X | -- |
| | OBL-MW-3 | OBL-MW-3-2689 | 9/25/99 | Bladder Pump | X | X | X | X |
| | | OBL-MW-3-2689D | 9/25/99 | Bladder Pump | X | X | X | X |
| | | OBL-MW-3-0070R | 1/7/00 | Bladder Pump | X | X | X | -- |

4

vestigation Summary

Works RFI

| [d] | TSS[e] | Total Metals (6)[f] | Diss. Metals (6)[g] | Total Hg[h] | Diss Hg[i] | Total Metals APP IX[j] | Diss. Metals APP IX[k] | APP IX VOCs[l] | APP IX SVOCs[m] | [n]APP IX PCBs/ Pest/ Herb |
|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | X | -- | -- | -- | -- | X | X | X | X | X |
| | X | -- | -- | -- | -- | X | X | X | X | X |
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | X | X | X | -- | -- | -- | -- | X | X | -- |
| | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

## Table 2-7

## Phases I and II RFI Surface Water and Sediment Investigation Summary

## Alcoa Badin, NC Works RFI

| Surface Water/ Sediment Investigation Location | Sample Location | Analytical Sample Designation | Sample Date (and RFI Phase) | Sample Depth ft-bgs[a] | Sample Collection Method | Total CN[b] | WAD CN[c] | MD CN[d] | FL[e] | TSS[f] | Total Metals (6)[g] | Diss. Metals (6)[h] | APP IX VOCs[i] | Trichloroethene | APP IX SVOCs[j] | PCBs[k] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Little Mountain Creek Surface Water | LMC-SW-01 | LMC-SW01-2799 | 10/16/99 (Phase I) | -- | Direct into Container[l] | X[m] | X | --[n] | X | X | X | X | X | -- | X | X |
| | | LMC-SW-01 | 9/25/99 (Phase I) | -- | Direct into Container | -- | -- | X | -- | -- | -- | -- | -- | -- | -- | -- |
| | LMC-SW-02 | LMC-SW02-2799 | 10/06/99 (Phase I) | --- | Direct into Container | X | X | -- | X | X | X | X | X | -- | X | X |
| | | LMC-SW-02 | 9/25/99 (Phase I) | -- | Direct into Container | -- | -- | X | -- | -- | -- | -- | -- | -- | -- | -- |
| Little Mountain Creek Sediment | LMC-SD-01 | LMC-S001-0.0-0.3 | 9/25/99 (Phase I) | 0.0-0.3 | Stainless Steel Spoon | X | X | -- | X | -- | X | X | X | -- | X | X |
| | LMC-SD-02 | LMC-S002-0.0-0.4 | 9/25/99 (Phase I) | 0.0-0.4 | Stainless Steel Spoon | X | X | -- | X | -- | X | X | X | -- | X | X |
| Badin Lake Surface Water | NE-SW | NE-SW-2520 | 9/7/00 (Phase II) | -- | Direct into Container | -- | -- | -- | -- | -- | -- | -- | -- | X | -- | -- |

Note:

(a) ft-bgs = feet below ground surface.
(b) Total CN = total cyanide.
(c) WAD CN = weak acid dissociable cyanide.
(d) MD CN = microdiffusion cyanide.
(e) Fl = fluoride.
(f) TSS = total suspended solids.
(g) Total Metals include arsenic, barium, cadmium, chromium, lead and selenium.
(h) Dissolved Metals include arsenic, barium, cadmium, chromium, lead and selenium.
(i) App IX VOCs = Appendix IX volatile organic compounds.
(j) App IX SVOCs = Appendix IV semi-volatile organic compounds.
(k) PCBs = polychlorinated bi-phenyls.
(l) Collected directly into sample container except for VOCs. VOC vials were pre-preserved; therefore samples were collected into a dedicated amber glass container and poured into the VOC containers.
(m) X = sample analyzed for indicated parameter.
(n) -- = sample not analyzed for indicated parameter.

## Table 2-8

## Data Validation Summary For Soil/Sediment Samples

## Alcoa Badin, NC Works RFI

| Parameter | Total Number of Samples | Validated Number of Samples | Percent Validated (%) |
|---|---|---|---|
| Total Cyanide | 85 | 30 | 35 |
| Weak Acid Dissociable Cyanide | 85 | 30 | 35 |
| Fluoride | 85 | 30 | 35 |
| Total metals (Arsenic, Cadmium, Chromium, Lead) | 104 | 18 | 17 |
| Total metals (Barium, Selenium) | 73 | 18 | 25 |
| Total Metals (Mercury) | 39 | 5 | 13 |
| VOCs[a] | 64 | 22 | 34 |
| SVOCs (includes PAH analyses)[b] | 90 | 19 | 21 |
| PCBs[c] | 21 | 9 | 43 |
| Asbestos | 2 | 0 | See Text |

Notes:

[a] VOCs = Volatile Organic Compounds
[b] SVOCs = Semi-Volatile Organic Compounds, PAHs = Polynuclear Aromatic Hydrocarbons
[c] PCBs = Polychlorinated Biphenyls

## Table 2-9

## Data Validation Summary For Groundwater/Surface Water Samples

## Alcoa Badin, NC Works RFI

| Parameter | Total Number of Samples | Number of Validated Samples | Percent Validated (%) |
|---|---|---|---|
| Total Cyanide | 76 | 76 | 100 |
| Weak Acid Dissociable Cyanide | 76 | 76 | 100 |
| Microdiffusion Cyanide | 76 | 76 | 100 |
| Fluoride | 51 | 11 | 22 |
| Total metals (As, Ba Cd, Cr, Pb, Se or Appendix IX Metals)[a] | 43<br>45[e]<br>6[f] | 6<br>8[e]<br>6[f] | 14<br>18[e]<br>100[f] |
| Dissolved metals (As, Ba Cd, Cr, Pb, Se or Appendix IX Metals) | 43<br>47[e]<br>6[f] | 6<br>10[e]<br>6[f] | 14<br>21[e]<br>100[f] |
| Total Metals (Mercury) | 2 | 1 | 50 |
| Dissolved Metals (Mercury) | 2 | 1 | 50 |
| Total Suspended Solids | 48 | 8 | 17 |
| VOCs[b] | 51 | 6 | 11 |
| SVOCs[c] | 51 | 6 | 11 |
| Pesticides | 3 | 1 | 33 |
| PCBs[d] | 5 | 1 | 20 |
| Herbicides | 3 | 1 | 33 |
| Sulfide | 3 | 1 | 33 |
| Trichloromethane | 4 | 4 | 100 |
| Trichloroethene | 4 | 4 | 100 |
| Appendix IX PAHs[g] | 3 | 3 | 100 |

Notes:

[a] As = Arsenic, Ba = Barium, Cd = Cadmium, Cr = Chromium, Pb = Lead, Se = Selenium
[b] VOCs = Volatile Organic Compounds
[c] SVOCs = Semi-Volatile Organic Compounds
[d] PCBs = Polychlorinated Biphenyls
[e] Barium only
[f] Thallium and Antimony only
[g] PAHs = polynuclear aromatic hydrocarbons

## Table 2-10

## Investigations and Interim Measures Reports Previously Submitted to the Department

## Alcoa Badin, NC Works RFI

| Plant Area Reports | SWMU No. 2 (Alcoa/Badin Landfill) Reports | SWMU No. 3 (Old Brick Landfill) Reports |
|---|---|---|
| Law Engineering: October 20, 1989, "Report of Environmental Services -- North End Subsurface Exploration" | Law Environmental, Inc.: January 22, 1990, "Preliminary Assessment of Gas Emissions, Badin Landfill | Law Engineering: November 25, 1987, "Report of Subsurface Exploration, Off-Site Waste Pile" |
| Law Environmental, Inc.: June 1, 1990, "Phase I Groundwater Assessment Northwest Valley" | Law Environmental, Inc.: March 15, 1991, "Report of Methane Gas Probe Installation and Monitoring, Badin Landfill" | Aquaterra, Inc.: September 3, 1991 "Preliminary Soil and Groundwater Assessment" |
| Law Environmental, Inc.: November 12, 1990, "Phase II Groundwater Assessment Northwest Valley" | Law Environmental, Inc.: March 28, 1991, "Report of Methane Monitoring, Homesites Near Old Badin Landfill" | PACE, Inc.: March 18, 1992, "Report of Laboratory Analysis" |
| Law Environmental, Inc.: April 3, 1991, "Installation of Ground-Water Monitoring Well (MW-16), Northwest Valley Ground-Water Contamination Assessment" | Aquaterra, Inc.: September 3, 1991, "Preliminary Soil and Ground-Water Assessment" | Aquaterra, Inc.: October 28, 1992, "Ground Water Assessment Report" |
| Alcoa: December 6, 1991 SOC Compliance Letter to the Department | Aquaterra, Inc.: December 6, 1991, "Groundwater Sampling" | Aquaterra, Inc.: February 7, 1994, "November 1993 Ground Water Sampling Event" |
| Aquaterra, Inc.: July 31, 1992 "Soil and Ground Water Assessment Aluminum Company of America" | PACE, Inc.: March 18, 1992, "Report of Laboratory Analysis" | Law Environmental, Inc.: March 4, 1994, "Landfill Cap Inspection Report, Old Brick Landfill" |
| Law Environmental, Inc.: August 6, 1992, "Report of Ground-Water Assessment and Preliminary Ground-Water Recovery Study" | Aquaterra, Inc.: October 28, 1992, "Ground Water Assessment Report" | Alcoa: May 1996, "Specifications for Old Brick Landfill (SWMU #3) Channel Improvements" |
| Aquaterra, Inc.: October 5, 1992 "Building 016 Groundwater Assessment Alcoa-Badin" | Law Environmental, Inc.: April 8, 1993 "Report of Consulting Services and Methane Monitoring" | Law Engineering and Environmental Services, Inc.: October 9, 1996, "Geotechnical Exploration – Old Brick Landfill Cap" |
| Law Environmental, Inc. June 28, 1993 "Confirmatory Sampling Report Alcoa Badin Works" | Alcoa Technical Center, Analytical Chemistry Division: September 9, 1993, "Badin Groundwater Characterization" | Alcoa: August 1997, "Specification for the Landslide Repair at the Old Brick Landfill (SWMU #3)" |

## Table 2-10

## Past Investigations and Interim Measures Reports Previously Submitted to the Department

## Alcoa Badin, NC Works RFI

| Plant Area Reports | SWMU No. 2 (Alcoa/Badin Landfill) Reports | SWMU No. 3 (Old Brick Landfill) Reports |
|---|---|---|
| Aquaterra, Inc.: June 29, 1993 "Additional Ground Water Sampling Report Building 016 Aluminum Company of America" | Aquaterra, Inc.: February 7, 1994, "November 1993 Ground Water Sampling Event" | --- |
| Pace, Inc.: August 12, 1993 "Report of Laboratory Analysis" | Performance Analytical, Inc.: March 2, 1994 and March 15, 1994, "Laboratory Reports" | --- |
| Aquaterra, Inc.: "Building 016 Monthly Groundwater Sampling October 18, 1993 and January 6, 1994" | Trigon Engineering Consultants, Inc.: April 4, 1996, "Soil Vapor Monitoring Report" | --- |
| Four Seasons Environmental Inc.: February 23, 1994, "Proposal of Sampling and Delineation of PCBs at Former Scrap Yard" | Law Engineering, Inc.: May 9, 1994, "Report of Air Emissions Monitoring (February, 1994)" | --- |
| Law Environmental National Laboratories: March 14, 1994 "Chemical Analysis of Samples Received on 2/24/94" | Law Engineering, Inc.: October 19, 1994 "Report of Air Emissions Monitoring (August, 1994)" | --- |
| Law Environmental National Laboratories: April, 1994 "Report of Groundwater Monitoring " | Trigon Engineering Consultants, Inc.: August 16, 1996, "Soil Vapor Monitoring Report" | --- |
| Four Seasons, Environmental, Inc.: June 10, 1994, "Final Report PCB Delineation Operations Solid Waste Management Unit-22" | Trigon Engineering Consultants, Inc.: September 16, 1996, "Soil Vapor Monitoring Report" | --- |
| Four Seasons Environmental, Inc.: November 3, 1994 "Final Report; Soil and Debris Removal Project: Solid Waste Management Unit 22" | Trigon Engineering Consultants, Inc.: November 22, 1996, "Soil Vapor Monitoring Report" | --- |
| Geraghty and Miller, Inc.: December 1995,"Onsite SPL Landfill Boring Data, Alcoa Badin Works" | Trigon Engineering Consultants, Inc.: January 22, 1997, "Soil Vapor Monitoring Report" | --- |
| Alcoa: January 1996, "Interim Measures Workplan, On-Site Landfill (SWMU #1) and Wet-Weather Run-On Diversion (SWMU #33)" | Geraghty and Miller, Inc.: April 1, 1997, "Constituent Flux Determination Aluminum Company of America North End Setting Badin Works Facility" | --- |

## Table 2-10

### Past Investigations and Interim Measures Reports Previously Submitted to the Department

### Alcoa Badin, NC Works RFI

| Plant Area Reports | SWMU No. 2 (Alcoa/Badin Landfill) Reports | SWMU No. 3 (Old Brick Landfill) Reports |
|---|---|---|
| Geophex, Ltd.: April 1996, "Geophysical Survey Report" | Alcoa: April 1997, "Interim Measures Workplan, Alcoa-Badin Landfill (SWMU #2) Regrading and Cover System Installation" | --- |
| Geraghty and Miller, Inc.: October 1996, "Findings of Soil Assessment Activities at Area of Concern B (AOC-B)" | Alcoa: May 1998, "Interim Measures Report, Alcoa-Badin Landfill (SWMU #2) Regrading and Cover System Installation" | --- |
| Law Engineering and Environmental Services, Inc.: October 31, 1996 "CQA Report, On-Site Landfill Surface Water Control Improvements" | --- | --- |
| Geraghty and Miller, Inc.: November 1996, "Pine Tree Area Investigation" | --- | --- |
| Geraghty and Miller, Inc.: November 1996, "Constituent Flux Determination, North End Setting Badin Works Facility" | --- | --- |
| Alcoa: December 1996, "Interim Measures Report, On-Site Landfill and Wet Weather Run-on Diversion" | --- | --- |
| Geraghty and Miller, Inc.: February 1997, "Findings of Soil Assessment Activities at the Spent Potlining Landfill (SWMU #1) and Wet Weather Run-On Diversion (SWMU #33)" | --- | --- |

## Table

## Pre-Phase I RFI Surface

## Alcoa Badin, N

| Sample Location | Analytical Sample Designation | Sample Date | Sample Depth | TOC [a] | TSS [b] | Alkalinity | Hardness | Amenable CN [c] | Free CN [d] | Total CN |
|---|---|---|---|---|---|---|---|---|---|---|
| DAM1 | WA-DAM-092396-001 | 9/23/96 | Top Water | X [r] | X | X | X | | | |
| | WB-DAM-092396-002 | 9/23/96 | Bottom Water | X [s] | X | X | X | --- | --- | --- |
| | WA-DAM-101296-002 | 10/12/96 | Top Water | --- | --- | --- | --- | --- | --- | --- |
| | WB-DAM-101296-003 | 10/12/96 | Bottom Water | --- | --- | --- | --- | X | X | X |
| LMC1 | WA-LMC-092496-001 | 9/24/96 | Top Water | X | X | X | X | X | X | X |
| | WA-LMC-101496-005 | 10/14/96 | Top Water | | | | | --- | --- | --- |
| LMC2 | WA-LMC-092496-003 | 9/24/96 | Top Water | X | X | X | X | X | X | X |
| | WA-LMC-101496-003 | 10/14/96 | Top Water | --- | --- | --- | --- | --- | | |
| LMC3 | WA-LMC-092496-005 | 9/24/96 | Top Water | X | X | X | X | X | X | X |
| | WA-LMC-101496-001 | 10/14/96 | Top Water | --- | --- | --- | --- | --- | --- | --- |
| LMC5 | WA-LMC-092496-008 | 9/24/96 | Top Water | X | X | X | X | X | X | X |
| NEP14 | WA-NEP-092296-004 | 9/22/96 | Top Water | X | X | X | X | X | X | X |
| | WB-NEP-092296-005 | 9/22/96 | Bottom Water | X | X | X | X | X | X | X |
| | WA-NEP-101296-003 | 10/12/96 | Top Water | --- | --- | --- | --- | X | X | X |
| | WA-NEP-012297-004 | 1/22/97 | Top Water | --- | X | --- | --- | X | X | X |
| | WA-NEP-012297-006F | 1/22/97 | Top Water | --- | --- | --- | --- | X | X | X |
| NEP14 (dup) | WA-NEP-012297-005 | 1/22/97 | Top Water | --- | --- | --- | --- | --- | --- | --- |
| NEP15 | WA-NEP-012297-016 | 1/22/97 | Top Water | --- | --- | --- | --- | --- | --- | --- |
| NEP16 | WA-NEP-092296-006 | 9/22/96 | Top Water | X | X | X | X | --- | --- | --- |
| | WB-NEP-092296-008 | 9/22/96 | Bottom Water | X | X | X | X | X | X | X |
| NEP16 (dup) | WA-NEP-092296-007 | 9/22/96 | Top Water | X | X | X | X | --- | --- | --- |
| NEP18 | WA-NEP-012297-007 | 1/22/97 | Top Water | --- | --- | --- | --- | X | X | X |
| | WB-NEP-012297-008 | 1/22/97 | Bottom Water | --- | --- | --- | --- | X | X | X |
| NEP19 | WA-NEP-012297-010 | 1/22/97 | Top Water | --- | --- | --- | --- | X | X | X |
| | WB-NEP-012297-009 | 1/22/97 | Bottom Water | --- | --- | --- | --- | X | X | X |
| NEP20 | WA-NEP-012297-013 | 1/22/97 | Top Water | --- | --- | --- | --- | X | X | X |
| | WB-NEP-012297-015 | 1/22/97 | Bottom Water | --- | --- | --- | --- | X | X | X |
| NEP20 (dup) | WA-NEP-012297-014 | 1/22/97 | Top Water | --- | --- | --- | --- | X | X | X |
| NEP4 | WA-NEP-092296-001 | 9/22/96 | Top Water | X | X | X | X | X | X | X |
| | WB-NEP-092296-002 | 9/22/96 | Bottom Water | X | X | X | X | X | X | X |
| | WA-NEP-012297-002 | 1/22/97 | Top Water | --- | X | --- | --- | X | X | X |
| | WA-NEP-012297-003F | 1/22/97 | Top Water | --- | --- | --- | --- | --- | --- | --- |
| | WB-NEP-012297-001 | 1/22/97 | Bottom Water | --- | --- | --- | --- | --- | --- | --- |
| NEP7 | WA-NEP-012297-017 | 1/22/97 | Top Water | --- | --- | --- | --- | --- | --- | --- |
| NEP8 | WA-NEP-012297-011 | 1/22/97 | Top Water | --- | --- | --- | --- | X | X | X |
| | WB-NEP-012297-012 | 1/22/97 | Bottom Water | --- | --- | --- | --- | X | X | X |
| OBL1 | WA-OBL-092296-001 | 9/22/96 | Top Water | X | X | X | X | X | X | X |
| | WA-OBL-101296-001 | 10/12/96 | Top Water | --- | --- | --- | --- | --- | --- | --- |
| REF1 | WA-REF-101296-001 | 10/12/96 | Top Water | X | X | X | X | X | X | X |
| | WB-REF-101296-002 | 10/12/96 | Bottom Water | X | X | X | X | X | X | X |
| | | | | | | | | X | X | X |

Notes:

(a) TOC = total organic carbon
(b) TSS = total suspended solids
(c) Amenable CN = amenable cyanide
(d) Free CN = free cyanide
(e) Total CN = total cyanide
(f) WAD CN = weak acid dissociable cyanide
(g) Fl = fluoride
(h) As = arsenic
(i) Ba = barium
(j) Cd = cadmium
(k) Cr = chromium
(l) Iron CN = iron cyanide
(m) Na = sodium
(n) Pb = lead
(o) Se = selenium
(p) SVOCs = semi-volatile organic compounds
(q) PCBs = polychlorinated biphenyls include Aroclors 1248 and 1260.
(r) x = analyzed for indicated parameter
(s) -- = not analyzed for indicated parameter

## Water Data Summary

## C Works RFI

| WAD CN [f] | Fl [g] | Ammonia | As [h] | Ba [i] | Cd [j] | Cr [k] | Iron CN [l] | Na [m] | Pb [n] | Nitrate/Nitrite | Nitrite | Se [o] | PCBs [p] | SVOCs [q] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| --- | X | X | X | X | X | X | --- | X | X | X | --- | X | X | X |
| --- | X | X | X | X | X | X | --- | X | X | X | --- | X | X | X |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| --- | X | X | X | X | X | X | | X | X | X | --- | X | X | X |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| | X | X | X | X | X | X | | X | X | X | --- | X | X | X |
| X | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| --- | X | X | X | X | X | X | | X | X | X | --- | X | X | X |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| X | X | X | X | X | X | X | X | X | X | X | --- | X | X | X |
| X | X | X | X | X | X | X | X | X | X | X | --- | X | X | X |
| X | X | X | X | X | X | X | X | X | X | X | --- | X | X | X |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| --- | X | X | X | X | X | X | --- | X | X | X | --- | X | X | X |
| X | X | X | X | X | X | X | X | X | X | X | --- | X | X | X |
| X | X | X | X | X | X | X | X | X | X | X | --- | X | X | X |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| X | X | X | X | X | X | X | X | X | X | X | --- | X | X | X |
| X | X | X | X | X | X | X | X | X | X | X | --- | X | X | X |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | X | --- | --- | --- |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| --- | X | X | X | X | X | X | --- | X | X | X | --- | X | X | X |
| X | --- | --- | --- | --- | --- | --- | X | --- | --- | --- | --- | --- | --- | --- |
| X | X | X | X | X | X | X | X | X | X | X | --- | X | X | X |
| X | X | X | X | X | X | X | X | X | X | X | --- | X | X | X |

## Table

## Pre-Phase I RFI Sedin

## Alcoa Badin, N

| Sample Location | Analytical Sample Designation | Sample Date | Sample Depth (ft-bgs) | % Moisture | TOC [a] | AMENABLE CN [b] | FREE CN | Total CN [c] | WAD CN |
|---|---|---|---|---|---|---|---|---|---|
| DAM1 | SX-DAM-101296-001 | 10/12/96 | Surface Sed | --[n] | X[o] | X | X | X | X |
| LMC1 | SX-LMC-092496-002 | 9/24/96 | Surface Sed | -- | X | -- | -- | -- | -- |
| | SX-LMC-101496-006 | 10/14/96 | Surface Sed | -- | -- | X | X | X | X |
| LMC2 | SX-LMC-092496-004 | 9/24/96 | Surface Sed | -- | X | -- | -- | -- | -- |
| | SX-LMC-101496-004 | 10/14/96 | Surface Sed | -- | -- | X | X | X | X |
| LMC3 | SX-LMC-092496-006 | 9/24/96 | Surface Sed | -- | X | -- | -- | -- | -- |
| | SX-LMC-101496-002 | 10/14/96 | Surface Sed | -- | -- | X | X | X | X |
| LMC4 | SX-LMC-092496-007 | 9/24/96 | Surface Sed | -- | X | X | X | X | X |
| LMC5 | SX-LMC-092496-009 | 9/24/96 | Surface Sed | -- | X | X | X | X | X |
| NEP1 | SA-SWC-012097-018 | 1/20/97 | Surface Sed | X | X | -- | -- | -- | -- |
| NEP2 | SA-SWC-012097-001 | 1/20/97 | Surface Sed | X | X | -- | -- | -- | -- |
| NEP3 | SA-SWC-012097-008 | 1/20/97 | Surface Sed | X | X | -- | -- | -- | -- |
| | SB-SWC-012097-009 | 1/20/97 | Bottom Sed | X | X | -- | -- | -- | -- |
| NEP4 | SA-NEP-012197-001 | 1/21/97 | Surface Sed | X | -- | -- | -- | -- | -- |
| | SX-NEP-092296-003 | 9/22/96 | Surface Sed | -- | X | -- | | | |
| | SX-NEP-101296-004 | 10/12/96 | Surface Sed | -- | -- | X | X | X | X |
| NEP5 | SA-SWC-012097-010 | 1/20/97 | Surface Sed | X | X | -- | -- | -- | -- |
| | SB-SWC-012097-011 | 1/20/97 | Bottom Sed | X | X | -- | -- | -- | -- |
| NEP6 | SA-SWC-012097-002 | 1/20/97 | Surface Sed | X | X | -- | -- | -- | -- |
| NEP8 | SA-NEP-012197-003 | 1/21/97 | Surface Sed | -- | -- | X | X | X | X |
| NEP8(dup) | SA-NEP-012197-004 | 1/21/97 | Surface Sed | -- | -- | X | X | X | X |
| NEP9 | SA-SWC-012097-017 | 1/20/97 | Surface Sed | X | X | -- | -- | -- | -- |
| NEP10 | SA-SWC-012097-015 | 1/20/97 | Surface Sed | X | X | -- | -- | -- | -- |
| | SB-SWC-012097-016 | 1/20/97 | Bottom Sed | X | X | -- | -- | -- | -- |
| NEP11 | SA-SWC-012097-003 | 1/20/97 | Surface Sed | X | X | -- | -- | -- | -- |
| NEP12 | SA-SWC-012097-004 | 1/20/97 | Surface Sed | X | X | -- | -- | -- | -- |
| | SA-SWC-012097-005 | 1/20/97 | Surface Sed | X | X | -- | -- | -- | -- |
| NEP13 | SA-SWC-012097-006 | 1/20/97 | Surface Sed | X | X | -- | -- | -- | -- |
| NEP16 | SA-NEP-012197-002 | 1/21/97 | Surface Sed | X | -- | -- | -- | -- | -- |
| | SX-NEP-092396-009 | 9/23/96 | Surface Sed | -- | X | -- | -- | -- | -- |
| | SX-NEP-101296-001 | 10/12/96 | Surface Sed | -- | | X | X | X | X |
| NEP16(dup) | SX-NEP-092396-010 | 9/23/96 | Surface Sed | -- | X | -- | -- | -- | -- |
| | SX-NEP-101296-002 | 10/12/96 | Surface Sed | -- | | X | X | X | X |
| NEP17 | SA-SWC-012097-012 | 1/20/97 | Surface Sed | X | X | -- | -- | -- | -- |
| | SB-SWC-012097-013 | 1/20/97 | Bottom Sed | X | X | -- | -- | -- | -- |
| NEP17 (dup) | SB-SWC-012097-014 | 1/20/97 | Bottom Sed | X | X | -- | -- | -- | -- |
| NEP20 | SA-NEP-012197-005 | 1/21/97 | Surface Sed | -- | -- | X | X | X | X |
| NEP21 | SA-SWC-012097-007 | 1/20/97 | Surface Sed | X | X | -- | -- | -- | -- |
| NEP22 | SA-002-012197-003 | 1/21/97 | Surface Sed | X | X | -- | -- | -- | -- |
| NEP23 | SA-002-012197-002 | 1/21/97 | Surface Sed | X | X | -- | -- | -- | -- |
| NEP24 | SA-002-012197-001 | 1/21/97 | Surface Sed | X | X | -- | -- | -- | -- |
| OBL1 | SX-OBL-092296-002 | 9/22/96 | Surface Sed | -- | X | -- | -- | -- | -- |
| | SX-OBL-101296-002 | 10/12/96 | Surface Sed | -- | -- | X | X | X | X |
| REF1 | SX-REF-101296-003 | 10/12/96 | Surface Sed | -- | X | X | X | X | X |

Notes:

(a) TOC = total organic carbon
(b) Amenable CN = amenable cyanide
(c) Total CN = total cyanide
(d) WAD CN = weak acid dissociable cyanide
(e) Fl = fluoride
(f) As = arsenic
(g) Ba = barium
(h) Cd = cadmium
(i) Cr = chromium
(j) Iron CN = iron cyanide
(k) Pb = lead
(l) Se = selenium
(m) SVOCs = semi-volatile organic compounds

(n) -- = not analyzed for indicated parameter
(o) X = analysed for indicated parameter

2-13

## ient Data Summary

## C Works RFI

| [d] | Fl [e] | As [f] | Ba [g] | Cd [h] | Cr [i] | Iron CN [j] | Pb [k] | Se [l] | Aroclor 1242 | Aroclor 1248 | Aroclor 1254 | Aroclor 1260 | SVOCs [m] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X | X | X | X | X | X | X | X | -- | X | -- | X | X |
| | X | X | X | X | X | -- | X | X | -- | X | -- | X | X |
| | -- | -- | -- | -- | -- | X | -- | -- | -- | -- | -- | -- | -- |
| | X | X | X | X | X | -- | X | X | -- | X | -- | X | X |
| | -- | -- | -- | -- | -- | X | -- | -- | -- | -- | -- | | |
| | X | X | X | X | X | -- | X | X | -- | X | -- | X | X |
| | -- | -- | -- | -- | -- | X | | | -- | -- | -- | -- | -- |
| | X | X | X | X | X | X | X | X | -- | X | -- | X | X |
| | X | X | X | X | X | X | X | X | -- | X | -- | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | X | -- | -- | X | -- | -- | -- | -- | -- | -- |
| | X | X | X | X | X | -- | X | X | -- | X | -- | X | X |
| | -- | -- | -- | -- | -- | X | -- | -- | -- | -- | -- | -- | -- |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | X | -- | -- | | -- | -- | -- | -- |
| | -- | -- | -- | -- | -- | X | -- | -- | | -- | -- | -- | -- |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | X | -- | -- | X | -- | -- | -- | -- | -- | -- |
| | X | X | X | X | X | -- | X | X | -- | X | -- | X | X |
| | -- | -- | -- | | | X | -- | -- | -- | -- | -- | | |
| | X | X | X | X | X | | X | X | -- | X | -- | X | X |
| | -- | -- | -- | -- | -- | X | -- | -- | -- | -- | -- | -- | -- |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | X | -- | -- | -- | -- | -- | -- | -- |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | -- | -- | -- | -- | -- | -- | -- | -- | X | X | X | X | X |
| | X | X | X | X | X | -- | X | X | -- | X | -- | X | X |
| | -- | -- | -- | -- | -- | X | -- | -- | -- | -- | -- | -- | -- |
| | X | X | X | X | X | X | X | X | -- | X | X | X | X |

# Table 3-1

## Constituent Specific Parameters Used to Develop Default SSLs

## Alcoa Badin, NC Works RFI

| Constituent | Cw[a] (mg/L) | Cw[a] Source | Koc[b] (L/kg) | Kd[c] (Default) (L/kg) | Kd (Site-Specific) | H[d] (atm-m³/mol) | H'[d] (dimensionless) |
|---|---|---|---|---|---|---|---|
| **Inorganics** | | | | | | | |
| Arsenic | 0.05 | NC 2L | NA(e) | 29 | NA | NA | NA |
| Barium | 2 | NC 2L | NA | 41 | NA | NA | NA |
| Cadmium | 0.005 | NC 2L | NA | 75 | NA | NA | NA |
| Chromium | 0.05 | NC 2L | NA | 1800000 | NA | NA | NA |
| Copper | 1 | NC 2L | NA | 360 | NA | NA | NA |
| Cyanide | 0.154 | NC 2L | NA | 9.9 | NA | NA | NA |
| Lead | 0.015 | NC 2L | NA | 890 | NA | NA | NA |
| Mercury | 0.0011 | NC 2L | NA | 52 | NA | NA | NA |
| Nickel | 0.1 | NC 2L | NA | 65 | NA | NA | NA |
| Selenium | 0.05 | NC 2L | NA | 5 | NA | NA | NA |
| Silver | 0.018 | NC 2L | NA | 8.3 | NA | NA | NA |
| Thallium | 0.0005 | NC 2L | NA | 71 | NA | NA | NA |
| Vanadium | 0.26 | NC 2L | NA | 1000 | NA | NA | NA |
| Zinc | 2.1 | NC 2L | NA | 62 | NA | NA | NA |
| **Organics** | | | | | | | |
| 1,1-Dichloroethene | 0.007 | NC 2L | 58.9 | 0.0589 | 0.30039 | 2.61E-02 | 1.07E+00 |
| 1,1,1-Trichloroethane | 0.2 | NC 2L | 110 | 0.11 | 0.561 | 1.72E-02 | 7.05E-01 |
| 2-Butanone (MEK) | 0.17 | NC 2L | 32 | 0.032 | 0.1632 | 5.14E-05 | 2.11E-03 |
| 2-Hexanone | 0.28 | NC 2L | 14.8 | 0.0148 | 0.07548 | 3.78E-05 | 1.55E-03 |
| 2-Methylnaphthalene | 0.028 | NC 2L | 7940 | 7.94 | 40.494 | 3.31E-04 | 1.36E-02 |
| 4-Methylphenol | 0.0035 | NC 2L | 17 | 0.017 | 0.0867 | 2.37E-07 | 9.72E-06 |
| Acenaphthene | 0.08 | NC 2L | 7080 | 7.08 | 36.108 | 1.55E-04 | 6.36E-03 |
| Acetone | 0.7 | NC 2L | 0.575 | 0.000575 | 0.0029325 | 3.88E-05 | 1.59E-03 |
| Anthracene | 2.1 | NC 2L | 29500 | 29.5 | 150.45 | 6.51E-05 | 2.67E-03 |
| Benzene | 0.001 | NC 2L | 58.9 | 0.0589 | 0.30039 | 5.56E-03 | 2.28E-01 |
| Benzo(a)anthracene | 0.00005 | NC 2L | 398000 | 398 | 2029.8 | 3.34E-06 | 1.37E-04 |
| Benzo(a)pyrene | 0.0000047 | NC 2L | 1020000 | 1020 | 5202 | 1.13E-06 | 4.63E-05 |
| Benzo(b)fluoranthene | 0.000047 | NC 2L | 1230000 | 1230 | 6273 | 1.11E-04 | 4.55E-03 |
| Benzo(k)fluoranthene | 0.00047 | NC 2L | 1230000 | 1230 | 6273 | 8.29E-07 | 3.40E-05 |
| Benzo(g,h,i)perylene | 0.21 | NC 2L | 1600000 | 1600 | 8160 | 1.25E-07 | 5.13E-06 |
| bis(2-Chloroethyl)ether | 0.000031 | NC 2L | 16 | 0.0155 | 0.07905 | 1.80E-05 | 7.38E-04 |
| bis(2-Ethylhexyl) phthalate | 0.003 | NC 2L | 15100000 | 15100 | 77010 | 1.02E-07 | 4.18E-06 |
| Carbon Disulfide | 0.7 | NC 2L | 46 | 0.0457 | 0.23307 | 3.02E-02 | 1.24E+00 |
| Carbon Tetrachloride | 0.0003 | NC 2L | 174 | 0.174 | 0.8874 | 3.05E-02 | 1.25E+00 |
| Chlorobenzene | 0.05 | NC 2L | 219 | 0.219 | 1.1169 | 3.73E-03 | 1.52E-01 |
| Chloromethane | 0.0026 | NC 2L | 5.5 | 0.0055 | 0.02805 | 9.90E-03 | 4.06E-01 |
| Chrysene | 0.005 | NC 2L | 398000 | 398 | 2029.8 | 9.46E-05 | 3.88E-03 |
| cis-1,2-Dichloroethene | 0.07 | NC 2L | 35.5 | 0.0355 | 0.18105 | 4.07E-03 | 1.67E-01 |
| Dibenzofuran | 0.028 | NC 2L | 9120 | 9.12 | 46.512 | 7.45E-07 | 3.05E-05 |
| Dibenz(a,h)anthracene | 0.0000047 | NC 2L | 3800000 | 3800 | 19380 | 1.47E-08 | 6.03E-07 |
| di-n-Butyl phthalate | 0.7 | NC 2L | 33900 | 33.9 | 172.89 | 9.39E-10 | 3.85E-08 |
| Ethylbenzene | 0.029 | NC 2L | 363 | 0.363 | 1.8513 | 7.88E-03 | 3.23E-01 |
| Fluoranthene | 0.28 | NC 2L | 107000 | 107 | 545.7 | 1.61E-05 | 6.60E-04 |
| Fluorene | 0.28 | NC 2L | 13800 | 13.8 | 70.38 | 6.37E-05 | 2.61E-03 |
| Indeno(1,2,3-cd)pyrene | 0.000047 | NC 2L | 3470000 | 3470 | 17697 | 1.60E-06 | 6.56E-05 |
| Methylene Chloride | 0.005 | NC 2L | 11.7 | 0.0117 | 0.05967 | 2.19E-03 | 8.98E-02 |
| Naphthalene | 0.021 | NC 2L | 2000 | 2 | 10.2 | 4.83E-04 | 1.98E-02 |
| Phenanthrene | 0.21 | NC 2L | 14000 | 14 | 71.4 | 3.90E-05 | 1.60E-03 |
| Phenol | 0.3 | NC 2L | 28.8 | 0.0288 | 0.14688 | 3.98E-07 | 1.63E-05 |
| Pyrene | 0.21 | NC 2L | 105000 | 105 | 535.5 | 1.10E-05 | 4.51E-04 |
| Styrene | 0.1 | NC 2L | 776 | 0.776 | 3.9576 | 2.76E-03 | 1.13E-01 |
| Tetrachloroethene | 0.0007 | NC 2L | 155 | 0.155 | 0.7905 | 1.84E-02 | 7.54E-01 |
| Toluene | 1 | NC 2L | 182 | 0.182 | 0.9282 | 6.63E-03 | 2.72E-01 |
| Trichloroethene | 0.0028 | NC 2L | 166 | 0.166 | 0.8466 | 1.03E-02 | 4.22E-01 |
| Trichloromethane | 0.00019 | NC 2L | 39.8 | 0.0398 | 0.20298 | 3.66E-03 | 1.50E-01 |
| Trichlorofluoromethane (Freon 11) | 2.1 | NC 2L | 159 | 0.159 | 0.8109 | 5.83E-02 | 2.39E+00 |
| m+p-Xylene | 0.53 | NC 2L | 407 | 0.407 | 2.0757 | 7.34E-03 | 3.01E-01 |
| o-Xylene | 0.53 | NC 2L | 363 | 0.363 | 1.8513 | 5.20E-03 | 2.13E-01 |

Notes:

[a]Cw = target groundwater concentration (milligrams/liter)

[b]Koc = soil-organic carbon partition coefficient (liters/kilogram)

[c]Kd = soil-water partition coefficient (liters/kilograms)

[d]H, H' = Henry's Law constant (atmosphere - cubic meters/moles)

[e]NA = not applicable

## Table 3-2

### Preliminary Exposure Analysis of SWMUs/AOCs

### Alcoa Badin, NC Works RFI

| SWMU/AOC | Potentially Affected Media | Exposure Setting | Potential Receptors |
|---|---|---|---|
| AOC-B | Surface Soil | Within Plant fence; not an active production area | Current Infrequent Worker, Future Full-time Industrial Worker |
| | Air | Wind-generation of COIs in surface soil particulates, volatile COIs released from soil | On-site Worker Receptors, Off-site Residential Receptors (Adult and Child) |
| | Subsurface Soil | Contact only through digging | Future Construction Worker |
| | Groundwater | No complete exposure pathways | None |
| Badin Lake - Plant area | Surface Water | Recreational swimming | Swimmer, Adult and Child |
| | Sediment | Recreational swimming | Swimmer, Adult and Child |
| SWMU No. 2 | Subsurface Soil | Fenced, capped landfill, no complete exposure pathways | None |
| | Perimeter Surface Soil (potential pre-cap migration) | Within SWMU fence | Infrequent Worker, Trespasser |
| Little Mountain Creek | Surface Water | Hiking, playing | Hiker, Adult and Adolescent child |
| | Sediment | Hiking, playing | Hiker, Adult and Adolescent child |
| SWMU No. 3 | Subsurface Soil | Fenced, capped landfill, no complete exposure pathways | None |
| | Perimeter Surface Soil (potential pre-cap migration) | Outside of SWMU fence on Alcoa property; SWMU 3 is located away from the Plant. | Hiker/Trespasser, Adult and Adolescent Child |
| Badin Lake - OBL area | Surface Water | Hiking, incidental contact | Hiker, Adult and Adolescent Child |
| | Sediment | Hiking, incidental contact | Hiker, Adult and Adolescent Child |

(a) SWMUs No. 1, 4, and 33

(b) Groundwater in North End of Plant evaluated as a single unit.

# Table 4-1

## Topographic Map Fracture Trace Summary

## Alcoa-Badin, NC Works RFI

| Range (Degrees) | Number of Occurances | Percentage |
|---|---|---|
| N0-9E | 14 | 6.3 |
| N10-19E | 8 | 3.6 |
| N20-29E | 29 | 12.9 |
| N30-39E | 22 | 9.8 |
| N40-49E | 26 | 11.6 |
| N50-59E | 16 | 7.1 |
| N60-69E | 11 | 4.9 |
| N70-79E | 10 | 4.5 |
| N80-90E | 7 | 3.1 |
| | | |
| N0-9W | 9 | 4.0 |
| N10-19W | 14 | 6.3 |
| N20-29W | 9 | 4.0 |
| N30-39W | 9 | 4.0 |
| N40-49W | 8 | 3.6 |
| N50-59W | 11 | 4.9 |
| N60-69W | 4 | 1.8 |
| N70-79W | 10 | 4.5 |
| N80-90W | 7 | 3.1 |
| **Total** | 224 | 100 |

# Table 4-2

## Field Fracture Measurement Summary

## Alcoa Badin, NC Works RFI

| Range (Degrees) | Number of Occurances | Percentage |
|---|---|---|
| | | |
| N0-9E | 4 | 3.0 |
| N10-19E | 3 | 2.2 |
| N20-29E | 5 | 3.7 |
| N30-39E | 8 | 6.0 |
| N40-49E | 25 | 18.7 |
| N50-59E | 11 | 8.2 |
| N60-69E | 12 | 9.0 |
| N70-79E | 4 | 3.0 |
| N80-90E | 9 | 6.7 |
| | | |
| N0-9W | 5 | 3.7 |
| N10-19W | 7 | 5.2 |
| N20-29W | 9 | 6.7 |
| N30-39W | 3 | 2.2 |
| N40-49W | 5 | 3.7 |
| N50-59W | 12 | 9.0 |
| N60-69W | 3 | 2.2 |
| N70-79W | 7 | 5.2 |
| N80-90W | 2 | 1.5 |
| **Total** | 134 | 100 |

## RFI Background Soil Sample Analytical Results

### Alcoa Badin, NC Works RFI

| Sample ID<br>Sample Depth (ft-bgs)[a]<br>Parameter | NE-HA01-0.0-0.5<br>0.0-0.5 | NE-HA01-0.5-2.0<br>0.5-2.0 | NE-HA02-0.0-0.5<br>0.0-0.5 | NE-HA02-0.5-0.9<br>0.5-0.9 | NE-HA03-0.0-0.5<br>0.0-0.5 | NE-HA03-0.0-0.5D<br>Duplicate | NE-HA03-0.5-2.0<br>0.5-2.0 | NE-HA04-0.0-0.5<br>0.0-0.5 | NE-HA04-0.5-2.0<br>0.5-2.0 |
|---|---|---|---|---|---|---|---|---|---|
| Inorganics (mg/kg)[b] | | | | | | | | | |
| Fluoride | 7.10 | 7.30 | 5.00 | 3.00 | 3.20 | 3.1 | 2.00 | 2.90 | < 0.63 |
| Cyanide, Free (Weak Acid Dissociable) | < 3.2[c] | < 3.1 | < 3.5 | < 3.1 | < 3.1 | <3.1 | < 3.1 | < 3.1 | < 3.2 |
| Cyanide, Total | 3.40 | < 3.1 | < 3.5 | < 3.1 | < 3.1 | <3.1 | < 3.1 | < 3.1 | < 3.2 |
| Arsenic | 9.90 | 13.80 | 7.20 | 12.10 | 14.40 | 9.4 | 14.60 | 18.50 | 20.80 |
| Barium | 116.00 | 41.60 | 111.00 | 59.20 | 75.40 | 84.6 | 49.70 | 68.00 | < 101 |
| Cadmium | < 0.25 | < 0.24 | < 0.28 | < 0.25 | < 0.25 | <0.25 | < 0.25 | < 0.25 | < 1 |
| Chromium | 22.30 | 43.10 | 13.30 | 14.20 | 45.80 | 28.5 | 30.40 | 23.30 | 40.60 |
| Lead | 63.90 | 21.60 | 35.60 | 24.60 | 17.10 | 17.2 | 12.60 | 34.70 | 19.60 |
| Selenium | 0.80 | 1.50 | < 0.71 | < 0.62 | 1.40 | 1.3 | 1.30 | < 0.62 | < 2.5 |
| Mercury | < 0.13 | < 0.12 | < 0.14 | < 0.12 | < 0.12 | <0.12 | < 0.12 | < 0.12 | < 0.13 |
| VOCs[d] (mg/kg) | | | | | | | | | |
| 1,1,1,2-Tetrachloroethane | NA[e] | NA | NA | NA | NA | N/A | NA | NA | NA |
| 1,1,1-Trichloroethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| 1,1,2,2-Tetrachloroethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| 1,1,2-Trichloroethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| 1,1-Dichloroethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| 1,1-Dichloroethene | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| 1,2,3-Trichloropropane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| 1,2-Dibromo-3-Chloropropane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| 1,2-Dibromoethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| 1,2-Dichloroethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| 1,2-Dichloropropane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| 1,4-Dioxane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| 2-Butanone | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| 2-Hexanone | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| 4-Methyl-2-Pentanone | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Acetone | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Acetonitrile | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Acrolein | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Acrylonitrile | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Allyl Chloride | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Benzene | NA | | NA | NA | NA | N/A | NA | NA | NA |
| Bromodichloromethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Bromoform | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Bromomethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Carbon Disulfide | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Carbon Tetrachloride | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Chlorobenzene | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Chloroethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Chloroform | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Chloromethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Chloroprene | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Cis-1,3-Dichloropropene | NA | NA | NA | NA | NA | N/A | NA | NA | NA |

## Table 4-3

## RFI Background Soil Sample Analytical Results

## Alcoa Badin, NC Works RFI

| Sample ID / Sample Depth (ft-bgs)[a] | NE-HA01-0.0-0.5 | NE-HA01-0.5-2.0 | NE-HA02-0.0-0.5 | NE-HA02-0.5-0.9 | NE-HA03-0.0-0.5 | NE-HA03-0.0-0.5D | NE-HA03-0.5-2.0 | NE-HA04-0.0-0.5 | NE-HA04-0.5-2.0 |
|---|---|---|---|---|---|---|---|---|---|
| | 0.0-0.5 | 0.5-2.0 | 0.0-0.5 | 0.5-0.9 | 0.0-0.5 | Duplicate | 0.5-2.0 | 0.0-0.5 | 0.5-2.0 |
| **Parameter** | | | | | | | | | |
| Dibromochloromethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Dibromomethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Dichlorodifluoromethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Dichloromethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Ethyl Methacrylate | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Ethylbenzene | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Iodomethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Isobutyl Alcohol | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Methacrylonitrile | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Methyl Methacrylate | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Propionitrile | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Styrene | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Tetrachloroethene | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Toluene | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Trans-1,2-Dichloroethene | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Trans-1,3-Dichloropropene | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Trans-1,4-Dichloro-2-Butene | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Trichloroethylene | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Trichlorofluoromethane | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Vinyl Acetate | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Vinyl Chloride | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| Xylene (Total) | NA | NA | NA | NA | NA | N/A | NA | NA | NA |
| SVOCs[b] (mg/kg) | | | | | | | | | |
| 1,2,4,5-Tetrachlorobenzene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 1,2,4-Trichlorobenzene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 1,2-Dichlorobenzene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 1,3-Dichlorobenzene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 1,4-Dichlorobenzene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 1,3,5-Trinitrobenzene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 1,3-Dinitrobenzene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 1,4-Naphthoquinone | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 1-Naphthylamine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2,3,4,6-Tetrachlorophenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2,4,5-Trichlorophenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2,4,6-Trichlorophenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2,4-Dichlorophenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2,4-Dimethylphenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2,4-Dinitrophenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2,4-Dinitrotoluene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2,6-Dichlorophenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2,6-Dinitrotoluene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2-Acetylaminofluorene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2-Chloronaphthalene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2-Chlorophenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |

Table 4-3

RFI Background Soil Sample Analytical Results

Alcoa Badin, NC Works RFI

| Sample ID<br>Sample Depth (ft-bgs)[a]<br>Parameter | NE-HA01-0.0-0.5<br>0.0-0.5 | NE-HA01-0.5-2.0<br>0.5-2.0 | NE-HA02-0.0-0.5<br>0.0-0.5 | NE-HA02-0.5-0.9<br>0.5-0.9 | NE-HA03-0.0-0.5<br>0.0-0.5 | NE-HA03-0.0-0.5D<br>Duplicate | NE-HA03-0.5-2.0<br>0.5-2.0 | NE-HA04-0.0-0.5<br>0.0-0.5 | NE-HA04-0.5-2.0<br>0.5-2.0 |
|---|---|---|---|---|---|---|---|---|---|
| 2-Methyl-4,6-Dinitrophenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2-Methylnaphthalene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2-Methylphenol (O-Cresol) | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2-Naphthylamine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2-Nitroaniline | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2-Nitrophenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 2-Picoline | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 3,3'-Dichlorobenzidine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 3,3'-Dimethylbenzidine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 3,5,5-Trimethyl-2-Cyclohexen-1-One | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 3-Methylcholanthrene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 3-Nitroaniline | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 4-Aminobiphenyl | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 4-Bromophenyl Phenyl Ether | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 4-Chloro-3-Methylphenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 4-Chloroaniline | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 4-Chlorophenyl Phenyl Ether | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 4-Methylphenol (P-Cresol) | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 4-Nitrophenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 4-Nitroquinoline-1-Oxide | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 5-Nitro-O-Toluidine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 7,12-Dimethylbenz(A)Anthracene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| A,A-Dimethylphenethylamine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Acenaphthene | 0.47 | < 0.4 | < 0.47 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Acenaphthylene | 0.45 | < 0.4 | < 0.47 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Acetophenone | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Aniline | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Anthracene | 1.5 | 0.68 | < 0.47 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Aramite | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Benz(B)Fluoranthene | 4.8 | 1.3 | 0.94 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Benzo(A)Anthracene | 5.4 | 1.8 | < 0.47 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Benzo(A)Pyrene | 4.8 | 1.5 | < 0.47 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Benzo(G,H,I)Perylene | 2.6 | 0.67 | < 0.47 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Benzo(K)Fluoranthene | 4.5 | 1.5 | 0.7 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Benzyl Alcohol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Benzyl Butyl Phthalate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Bis(2-Chloroethoxy)Methane | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Bis(2-Chloroethyl)Ether | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Bis(2-Chloroisopropyl)Ether | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Bis(2-Ethylhexyl)Phthalate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Chlorobenzilate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Chrysene | 5.2 | 1.7 | 0.68 | < 0.41 | < 0.41 | < 0.41 | < 0.41 | < 0.41 | < 0.42 |
| Diallate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Dibenzo(A,H)Anthracene | 1.1 | < 0.4 | < 0.47 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Dibenzofuran | NA | NA | NA | NA | NA | NA | NA | NA | NA |

Table 4-3

## RFI Background Soil Sample Analytical Results

### Alcoa Badin, NC Works RFI

| Sample ID<br>Sample Depth (ft-bgs)[a]<br>Parameter | NE-HA01-0.0-0.5<br>0.0-0.5 | NE-HA01-0.5-2.0<br>0.5-2.0 | NE-HA02-0.0-0.5<br>0.0-0.5 | NE-HA02-0.5-0.9<br>0.5-0.9 | NE-HA03-0.0-0.5<br>0.0-0.5 | NE-HA03-0.0-0.5D<br>Duplicate | NE-HA03-0.5-2.0<br>0.5-2.0 | NE-HA04-0.0-0.5<br>0.0-0.5 | NE-HA04-0.5-2.0<br>0.5-2.0 |
|---|---|---|---|---|---|---|---|---|---|
| Diethyl Phthalate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Dimethoate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Dimethyl Phthalate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Di-N-Butyl Phthalate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Di-N-Octylphthalate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Dinoseb | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Disulfoton | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Ethyl Methanesulfonate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Famphur | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Fluoranthene | 8.6 | 3.2 | 0.52 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Fluorene | 0.62 | < 0.4 | < 0.47 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Hexachlorobenzene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Hexachlorobutadiene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Hexachlorocyclopentadiene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Hexachloroethane | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Hexachlorophene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Hexachloropropene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Indeno(1,2,3-Cd)Pyrene | 2.6 | 0.76 | < 0.47 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Isodrin | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Isosafrole | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Kepone | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Methapyrilene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Methyl Methanesulfonate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Methyl Parathion | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Naphthalene | < 0.42 | < 0.4 | < 0.47 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Nitrobenzene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| N-Nitrosodiethylamine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| N-Nitrosodimethylamine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| N-Nitrosodi-N-Butylamine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| N-Nitroso-Di-N-Propylamine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| N-Nitrosodiphenylamine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| N-Nitrosodiphenylamine/Diphenylamine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| N-Nitrosomethylethylamine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| N-Nitrosomorpholine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| N-Nitrosopiperidine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| N-Nitrosopyrrolidine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| O,O,O-Triethyl Phosphorothioate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| O-Toluidine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Parathion | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| P-Dimethylaminoazobenzene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Pentachlorobenzene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Pentachloroethane | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Pentachloronitrobenzene | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Pentachlorophenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Phenacetin | NA | NA | NA | NA | NA | NA | NA | NA | NA |

Table 4-3

RFI Background Soil Sample Analytical Results

Alcoa Badin, NC Works RFI

| Sample ID / Sample Depth (ft-bgs)[a] | NE-HA01-0.0-0.5 | NE-HA01-0.5-2.0 | NE-HA02-0.0-0.5 | NE-HA02-0.5-0.9 | NE-HA03-0.0-0.5 | NE-HA03-0.0-0.5D | NE-HA03-0.5-2.0 | NE-HA04-0.0-0.5 | NE-HA04-0.5-2.0 |
|---|---|---|---|---|---|---|---|---|---|
| | 0.0-0.5 | 0.5-2.0 | 0.0-0.5 | 0.5-0.9 | 0.0-0.5 | Duplicate | 0.5-2.0 | 0.0-0.5 | 0.5-2.0 |
| Parameter | | | | | | | | | |
| Phenanthrene | 4.9 | 2.1 | < 0.47 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Phenol | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Phorate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| P-Nitroaniline | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| P-Phenylene Diamine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Pronamide | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Pyrene | 6.3 | 2 | < 0.47 | < 0.41 | < 0.41 | <0.41 | < 0.41 | < 0.41 | < 0.42 |
| Pyridine | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Safrole | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Tetraethyldithiopyrophosphate | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Thionazin | NA | NA | NA | NA | NA | NA | NA | NA | NA |

Notes:

[a] ft-bgs = feet below ground surface.

[b] mg/kg = milligram per kilogram.

[c] < = not detected at indicated detection limit.

[d] VOCs = Volatile Organic Compounds.

[e] NA = Not Analyzed.

[f] SVOCs - Semi-Volatile Organic Compounds.

## Table 4-3

### RFI Background Soil Sample Analytical Results

### Alcoa Badin, NC Works RFI

| Sample ID / Sample Depth (ft-bgs)[a] | NE-HA05-0.0-0.5 / 0.0-0.5 | S2-HA03-0.0-0.5 / 0.0-0.5 | S2-HA03-0.0-0.5D / 0.0-0.5 | S2-HA03-0.0-0.5R / 0.0-0.5 | S2-HA03-0.5-2.0 / 0.5-2.0 | S2-HA03-0.5-2.0R / 0.5-2.0 | S2-HA04-0.0-0.5 / 0.0-0.5 | S2-HA04-0.5-2.0 / 0.5-2.0 | S2-HA05-0.0-0.5 / 0.0-0.5 |
|---|---|---|---|---|---|---|---|---|---|
| Parameter | | | | | | | | | |
| Inorganics (mg/kg)[b] | | | | | | | | | |
| Fluoride | 2.50 | < 0.61 | < 0.6 | NA | < 0.63 | NA | < 0.6 | < 0.6 | 1.20 |
| Cyanide, Free (Weak Acid Dissociable) | < 3 | < 3.1 | < 3 | NA | < 3.1 | NA | < 3 | < 3 | < 3.2 |
| Cyanide, Total | < 3 | < 3.1 | < 3 | NA | < 3.1 | NA | < 3 | < 3 | < 3.2 |
| Arsenic | 8.20 | 12.20 | 12.2 | NA | 15.70 | NA | 7.80 | 2.30 | 19.10 |
| Barium | 88.10 | 50.40 | 51.6 | NA | 29.90 | NA | < 23.9 | < 24.1 | 76.90 |
| Cadmium | < 0.24 | < 0.24 | < 0.24 | NA | < 0.25 | NA | < 0.24 | < 0.24 | < 0.51 |
| Chromium | 17.60 | 22.60 | 25.3 | NA | 24.00 | NA | 19.80 | 14.50 | 45.90 |
| Lead | 25.10 | 11.70 | 12.3 | NA | 13.40 | NA | 24.40 | 17.30 | 31.80 |
| Selenium | 1.20 | 1.00 | 1.2 | NA | 1.10 | NA | 1.10 | < 0.6 | < 1.3 |
| Mercury | < 0.12 | < 0.12 | < 0.12 | NA | < 0.13 | NA | < 0.12 | < 0.12 | < 0.13 |
| VOCs[d] (mg/kg) | | | | | | | | | |
| 1,1,1,2-Tetrachloroethane | NA | < 0.0062 | < 0.0062 | < 0.0061 | <0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| 1,1,1-Trichloroethane | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| 1,1,2,2-Tetrachloroethane | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| 1,1,2-Trichloroethane | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| 1,1-Dichloroethane | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| 1,1-Dichloroethene | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | 0.0069 | < 0.006 | NA |
| 1,2,3-Trichloropropane | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| 1,2-Dibromo-3-Chloropropane | NA | < 0.012 | < 0.012 | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.012 | NA |
| 1,2-Dibromoethane | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| 1,2-Dichloroethane | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| 1,2-Dichloropropane | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| 1,4-Dioxane | NA | < 0.62 | < 0.62 | < 0.61 | < 0.63 | < 0.63 | < 0.6 | < 0.6 | NA |
| 2-Butanone | NA | < 0.025 | < 0.025 | < 0.024 | < 0.025 | < 0.025 | < 0.024 | < 0.024 | NA |
| 2-Hexanone | NA | < 0.025 | < 0.025 | < 0.024 | < 0.025 | < 0.025 | < 0.024 | < 0.024 | NA |
| 4-Methyl-2-Pentanone | NA | < 0.025 | < 0.025 | < 0.024 | < 0.025 | < 0.025 | < 0.024 | < 0.024 | NA |
| Acetone | NA | 0.038 | 0.071 | 0.032 | < 0.025 | < 0.025 | 0.062 | < 0.024 | NA |
| Acetonitrile | NA | < 0.12 | < 0.12 | < 0.12 | < 0.13 | < 0.13 | < 0.12 | < 0.12 | NA |
| Acrolein | NA | < 0.12 | < 0.12 | < 0.12 | < 0.13 | < 0.13 | < 0.12 | < 0.12 | NA |
| Acrylonitrile | NA | < 0.12 | < 0.12 | < 0.12 | < 0.13 | < 0.13 | < 0.12 | < 0.12 | NA |
| Allyl Chloride | NA | < 0.012 | < 0.012 | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.012 | NA |
| Benzene | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Bromodichloromethane | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Bromoform | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Bromomethane | NA | < 0.012 | < 0.012 | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.012 | NA |
| Carbon Disulfide | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Carbon Tetrachloride | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Chlorobenzene | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Chloroethane | NA | < 0.012 | < 0.012 | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.012 | NA |
| Chloroform | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Chloromethane | NA | < 0.012 | < 0.012 | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.012 | NA |
| Chloroprene | NA | < 0.012 | < 0.012 | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.012 | NA |
| Cis-1,3-Dichloropropene | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |

Table 4-3

## RFI Background Soil Sample Analytical Results

### Alcoa Badin, NC Works RFI

| Sample ID | NE-HA05-0.0-0.5 | S2-HA03-0.0-0.5 | S2-HA03-0.0-0.5D | S2-HA03-0.0-0.5R | S2-HA03-0.5-2.0 | S2-HA03-0.5-2.0R | S2-HA04-0.0-0.5 | S2-HA04-0.5-2.0 | S2-HA05-0.0-0.5 |
|---|---|---|---|---|---|---|---|---|---|
| Sample Depth (ft-bgs)[a] | 0.0-0.5 | 0.0-0.5 | 0.0-0.5 | 0.0-0.5 | 0.5-2.0 | 0.5-2.0 | 0.0-0.5 | 0.5-2.0 | 0.0-0.5 |
| Parameter | | | | | | | | | |
| Dibromochloromethane | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Dibromomethane | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Dichlorodifluoromethane | NA | < 0.012 | < 0.012 | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.012 | NA |
| Dichloromethane | NA | 0.011 | 0.0092 | < 0.0061 | 0.0075 | < 0.0063 | 0.0076 | < 0.006 | NA |
| Ethyl Methacrylate | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Ethylbenzene | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Iodomethane | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | 0.0064 | < 0.006 | NA |
| Isobutyl Alcohol | NA | < 0.25 | < 0.25 | < 0.24 | < 0.25 | < 0.25 | < 0.24 | < 0.24 | NA |
| Methacrylonitrile | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Methyl Methacrylate | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Propionitrile | NA | < 0.025 | < 0.025 | < 0.024 | < 0.025 | < 0.025 | < 0.024 | < 0.024 | NA |
| Styrene | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Tetrachloroethene | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Toluene | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Trans-1,2-Dichloroethene | NA | < 0.0031 | < 0.0031 | < 0.003 | < 0.0032 | < 0.0031 | < 0.003 | < 0.003 | NA |
| Trans-1,3-Dichloropropene | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Trans-1,4-Dichloro-2-Butene | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Trichloroethylene | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Trichlorofluoromethane | NA | < 0.012 | < 0.012 | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.012 | NA |
| Vinyl Acetate | NA | < 0.012 | < 0.012 | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.012 | NA |
| Vinyl Chloride | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| Xylene (Total) | NA | < 0.0062 | < 0.0062 | < 0.0061 | < 0.0063 | < 0.0063 | < 0.006 | < 0.006 | NA |
| SVOCs[f] (mg/kg) | | | | | | | | | |
| 1,2,4,5-Tetrachlorobenzene | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 1,2,4-Trichlorobenzene | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 1,2-Dichlorobenzene | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 1,3-Dichlorobenzene | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 1,4-Dichlorobenzene | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 1,3,5-Trinitrobenzene | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| 1,3-Dinitrobenzene | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 1,4-Naphthoquinone | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| 1-Naphthylamine | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 2,3,4,6-Tetrachlorophenol | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| 2,4,5-Trichlorophenol | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.39 | NA |
| 2,4,6-Trichlorophenol | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 2,4-Dichlorophenol | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 2,4-Dimethylphenol | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.39 | NA |
| 2,4-Dinitrophenol | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| 2,4-Dinitrotoluene | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 2,6-Dichlorophenol | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 2,6-Dinitrotoluene | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 2-Acetylaminofluorene | NA | < 4 | < 3.9 | NA | < 4.2 | NA | < 3.9 | < 4 | NA |
| 2-Chloronaphthalene | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 2-Chlorophenol | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |

Table 4-3

## RFI Background Soil Sample Analytical Results

### Alcoa Badin, NC Works RFI

| Sample ID / Sample Depth (ft-bgs)[a] | NE-HA05-0.0-0.5 | S2-HA03-0.0-0.5 | S2-HA03-0.0-0.5D | S2-HA03-0.0-0.5R | S2-HA03-0.5-2.0 | S2-HA03-0.5-2.0R | S2-HA04-0.0-0.5 | S2-HA04-0.5-2.0 | S2-HA05-0.0-0.5 |
|---|---|---|---|---|---|---|---|---|---|
| | 0.0-0.5 | 0.0-0.5 | 0.0-0.5 | 0.0-0.5 | 0.5-2.0 | 0.5-2.0 | 0.0-0.5 | 0.5-2.0 | 0.0-0.5 |
| Parameter | | | | | | | | | |
| 2-Methyl-4,6-Dinitrophenol | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| 2-Methylnaphthalene | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 2-Methylphenol (O-Cresol) | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 2-Naphthylamine | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 2-Nitroaniline | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| 2-Nitrophenol | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 2-Picoline | NA | < 0.81 | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 | NA |
| 3,3'-Dichlorobenzidine | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| 3,3'-Dimethylbenzidine | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| 3,5,5-Trimethyl-2-Cyclohexen-1-One | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 3-Methylcholanthrene | NA | < 0.81 | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 | NA |
| 3-Nitroaniline | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| 4-Aminobiphenyl | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| 4-Bromophenyl Phenyl Ether | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 4-Chloro-3-Methylphenol | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 4-Chloroaniline | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 4-Chlorophenyl Phenyl Ether | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 4-Methylphenol (P-Cresol) | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| 4-Nitrophenol | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| 4-Nitroquinoline-1-Oxide | NA | < 4 | < 3.9 | NA | < 4.2 | NA | < 3.9 | < 4 | NA |
| 5-Nitro-O-Toluidine | NA | < 0.81 | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 | NA |
| 7,12-Dimethylbenz(A)Anthracene | NA | < 0.81 | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 | NA |
| A,A-Dimethylphenethylamine | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| Acenaphthene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Acenaphthylene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Acetophenone | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Aniline | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Anthracene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Aramite | NA | < 0.81 | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 | NA |
| Benz(B)Fluoranthene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Benzo(A)Anthracene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Benzo(A)Pyrene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Benzo(G,H,I)Perylene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Benzo(K)Fluoranthene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Benzyl Alcohol | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Benzyl Butyl Phthalate | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Bis(2-Chloroethoxy)Methane | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Bis(2-Chloroethyl)Ether | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Bis(2-Chloroisopropyl)Ether | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Bis(2-Ethylhexyl)Phthalate | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Chlorobenzilate | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Chrysene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Diallate | NA | < 0.81 | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 | NA |
| Dibenzo(A,H)Anthracene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Dibenzofuran | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |

Table 4-3

RFI Background Soil Sample Analytical Results

Alcoa Badin, NC Works RFI

| Sample ID<br>Sample Depth (ft-bgs)[a]<br>Parameter | NE-HA05-0.0-0.5<br>0.0-0.5 | S2-HA03-0.0-0.5<br>0.0-0.5 | S2-HA03-0.0-0.5D<br>0.0-0.5 | S2-HA03-0.0-0.5R<br>0.0-0.5 | S2-HA03-0.5-2.0<br>0.5-2.0 | S2-HA03-0.5-2.0R<br>0.5-2.0 | S2-HA04-0.0-0.5<br>0.0-0.5 | S2-HA04-0.5-2.0<br>0.5-2.0 | S2-HA05-0.0-0.5<br>0.0-0.5 |
|---|---|---|---|---|---|---|---|---|---|
| Diethyl Phthalate | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Dimethoate | NA | < 0.81 | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 | NA |
| Dimethyl Phthalate | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Di-N-Butyl Phthalate | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Di-N-Octylphthalate | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Dinoseb | NA | < 0.00033 | < 0.79 | NA | < 0.00033 | NA | < 0.00033 | < 0.8 | NA |
| Disulfoton | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| Ethyl Methanesulfonate | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Famphur | NA | < 4 | < 3.9 | NA | < 4.2 | NA | < 3.9 | < 4 | NA |
| Fluoranthene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Fluorene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Hexachlorobenzene | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Hexachlorobutadiene | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Hexachlorocyclopentadiene | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| Hexachloroethane | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Hexachlorophene | NA | < | < | NA | < | NA | < | < | NA |
| Hexachloropropene | NA | < 4 | < 3.9 | NA | < 4.2 | NA | < 3.9 | < 4 | NA |
| Indeno(1,2,3-Cd)Pyrene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Isodrin | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Isosafrole | NA | < 0.81 | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 | NA |
| Kepone | NA | < 4 | < 3.9 | NA | < 4.2 | NA | < 3.9 | < 4 | NA |
| Methapyrilene | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| Methyl Methanesulfonate | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Methyl Parathion | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| Naphthalene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Nitrobenzene | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| N-Nitrosodiethylamine | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| N-Nitrosodimethylamine | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| N-Nitrosodi-N-Butylamine | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| N-Nitroso-Di-N-Propylamine | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| N-Nitrosodiphenylamine | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| N-Nitrosodiphenylamine/Diphenylamine | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| N-Nitrosomethylethylamine | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| N-Nitrosomorpholine | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| N-Nitrosopiperidine | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| N-Nitrosopyrrolidine | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| O,O,O-Triethyl Phosphorothioate | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| O-Toluidine | NA | < 0.81 | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 | NA |
| Parathion | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| P-Dimethylaminoazobenzene | NA | < 0.81 | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 | NA |
| Pentachlorobenzene | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Pentachloroethane | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| Pentachloronitrobenzene | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| Pentachlorophenol | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| Phenacetin | NA | < 0.81 | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 | NA |

Table 4-3

RFI Background Soil Sample Analytical Results

Alcoa Badin, NC Works RFI

| Sample ID<br>Sample Depth (ft-bgs)[a]<br>Parameter | NE-HA05-0.0-0.5<br>0.0-0.5 | S2-HA03-0.0-0.5<br>0.0-0.5 | S2-HA03-0.0-0.5D<br>0.0-0.5 | S2-HA03-0.0-0.5R<br>0.0-0.5 | S2-HA03-0.5-2.0<br>0.5-2.0 | S2-HA03-0.5-2.0R<br>0.5-2.0 | S2-HA04-0.0-0.5<br>0.0-0.5 | S2-HA04-0.5-2.0<br>0.5-2.0 | S2-HA05-0.0-0.5<br>0.0-0.5 |
|---|---|---|---|---|---|---|---|---|---|
| Phenanthrene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Phenol | NA | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | NA |
| Phorate | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| P-Nitroaniline | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| P-Phenylene Diamine | NA | < 4 | < 3.9 | NA | < 4.2 | NA | < 3.9 | < 4 | NA |
| Pronamide | NA | < 0.81 | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 | NA |
| Pyrene | < 0.39 | < 0.4 | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 | < 0.42 |
| Pyridine | NA | < 0.81 | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 | NA |
| Safrole | NA | < 0.81 | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 | NA |
| Tetraethyldithiopyrophosphate | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |
| Thionazin | NA | < 2 | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 | NA |

Notes:

[a] ft-bgs = feet below ground surface.

[b] mg/kg = milligram per kilogram.

[c] < = not detected at indicated detection limit.

[d] VOCs = Volatile Organic Compounds.

[e] NA = Not Analyzed.

[f] SVOCs - Semi-Volatile Organic Compounds.

Table 4-3

RFI Background Soil Sample Analytical Results

Alcoa Badin, NC Works RFI

| Sample ID / Sample Depth (ft-bgs)[a] / Parameter | S2-HA05-0.5-2.0 0.5-2.0 | S2-HA06-0.0-0.5 0.0-0.5 | S2-HA06-0.5-2.0 0.5-2.0 | S3-HA01-0.0-0.5 0.0-0.5 | S3-HA01-0.5-2.0 0.5-2.0 | S3-HA02-0.0-0.5 0.0-0.5 |
|---|---|---|---|---|---|---|
| **Inorganics (mg/kg)[b]** | | | | | | |
| Fluoride | < 0.6 | 1.20 | 7.20 | 2.1 | < 0.66 | 1.9 |
| Cyanide, Free (Weak Acid Dissociable) | < 3 | < 3.1 | < 3.1 | < 3.4 | < 3.3 | < 3.3 |
| Cyanide, Total | < 3 | < 3.1 | < 3.1 | < 3.4 | < 3.3 | 5.30 |
| Arsenic | 33.60 | 18.80 | 18.00 | 47.10 | 64.00 | 51.60 |
| Barium | 81.40 | 167.00 | 262.00 | 34.60 | < 26.4 | 68.50 |
| Cadmium | < 0.24 | < 0.99 | < 1 | < 0.27 | < 0.26 | < 0.26 |
| Chromium | 26.20 | 33.90 | 35.60 | 50.60 | 46.90 | 32.50 |
| Lead | 27.60 | 179.00 | 239.00 | 9.70 | 6.00 | 5.50 |
| Selenium | < 0.6 | < 2.5 | < 2.5 | 0.89 | 1.20 | < 0.66 |
| Mercury | < 0.12 | < 0.12 | < 0.13 | < 0.13 | < 0.13 | < 0.13 |
| **VOCs[d] (mg/kg)** | | | | | | |
| 1,1,1,2-Tetrachloroethane | NA | NA | NA | NA | NA | NA |
| 1,1,1-Trichloroethane | NA | NA | NA | NA | NA | NA |
| 1,1,2,2-Tetrachloroethane | NA | NA | NA | NA | NA | NA |
| 1,1,2-Trichloroethane | NA | NA | NA | NA | NA | NA |
| 1,1-Dichloroethane | NA | NA | NA | NA | NA | NA |
| 1,1-Dichloroethene | NA | NA | NA | NA | NA | NA |
| 1,2,3-Trichloropropane | NA | NA | NA | NA | NA | NA |
| 1,2-Dibromo-3-Chloropropane | NA | NA | NA | NA | NA | NA |
| 1,2-Dibromoethane | NA | NA | NA | NA | NA | NA |
| 1,2-Dichloroethane | NA | NA | NA | NA | NA | NA |
| 1,2-Dichloropropane | NA | NA | NA | NA | NA | NA |
| 1,4-Dioxane | NA | NA | NA | NA | NA | NA |
| 2-Butanone | NA | NA | NA | NA | NA | NA |
| 2-Hexanone | NA | NA | NA | NA | NA | NA |
| 4-Methyl-2-Pentanone | NA | NA | NA | NA | NA | NA |
| Acetone | NA | NA | NA | NA | NA | NA |
| Acetonitrile | NA | NA | NA | NA | NA | NA |
| Acrolein | NA | NA | NA | NA | NA | NA |
| Acrylonitrile | NA | NA | NA | NA | NA | NA |
| Allyl Chloride | NA | NA | NA | NA | NA | NA |
| Benzene | NA | NA | NA | NA | NA | NA |
| Bromodichloromethane | NA | NA | NA | NA | NA | NA |
| Bromoform | NA | NA | NA | NA | NA | NA |
| Bromomethane | NA | NA | NA | NA | NA | NA |
| Carbon Disulfide | NA | NA | NA | NA | NA | NA |
| Carbon Tetrachloride | NA | NA | NA | NA | NA | NA |
| Chlorobenzene | NA | NA | NA | NA | NA | NA |
| Chloroethane | NA | NA | NA | NA | NA | NA |
| Chloroform | NA | NA | NA | NA | NA | NA |
| Chloromethane | NA | NA | NA | NA | NA | NA |
| Chloroprene | NA | NA | NA | NA | NA | NA |
| Cis-1,3-Dichloropropene | NA | NA | NA | NA | NA | NA |

Table 4-3

RFI Background Soil Sample Analytical Results

Alcoa Badin, NC Works RFI

| Sample ID / Sample Depth (ft-bgs)[a] / Parameter | S2-HA05-0.5-2.0 | S2-HA06-0.0-0.5 | S2-HA06-0.5-2.0 | S3-HA01-0.0-0.5 | S3-HA01-0.5-2.0 | S3-HA02-0.0-0.5 |
|---|---|---|---|---|---|---|
| | 0.5-2.0 | 0.0-0.5 | 0.5-2.0 | 0.0-0.5 | 0.5-2.0 | 0.0-0.5 |
| Dibromochloromethane | NA | NA | NA | NA | NA | NA |
| Dibromomethane | NA | NA | NA | NA | NA | NA |
| Dichlorodifluoromethane | NA | NA | NA | NA | NA | NA |
| Dichloromethane | NA | NA | NA | NA | NA | NA |
| Ethyl Methacrylate | NA | NA | NA | NA | NA | NA |
| Ethylbenzene | NA | NA | NA | NA | NA | NA |
| Iodomethane | NA | NA | NA | NA | NA | NA |
| Isobutyl Alcohol | NA | NA | NA | NA | NA | NA |
| Methacrylonitrile | NA | NA | NA | NA | NA | NA |
| Methyl Methacrylate | NA | NA | NA | NA | NA | NA |
| Propionitrile | NA | NA | NA | NA | NA | NA |
| Styrene | NA | NA | NA | NA | NA | NA |
| Tetrachloroethene | NA | NA | NA | NA | NA | NA |
| Toluene | NA | NA | NA | NA | NA | NA |
| Trans-1,2-Dichloroethene | NA | NA | NA | NA | NA | NA |
| Trans-1,3-Dichloropropene | NA | NA | NA | NA | NA | NA |
| Trans-1,4-Dichloro-2-Butene | NA | NA | NA | NA | NA | NA |
| Trichloroethylene | NA | NA | NA | NA | NA | NA |
| Trichlorofluoromethane | NA | NA | NA | NA | NA | NA |
| Vinyl Acetate | NA | NA | NA | NA | NA | NA |
| Vinyl Chloride | NA | NA | NA | NA | NA | NA |
| Xylene (Total) | NA | NA | NA | NA | NA | NA |
| SVOCs[f] (mg/kg) | | | | | | |
| 1,2,4,5-Tetrachlorobenzene | NA | NA | NA | NA | NA | NA |
| 1,2,4-Trichlorobenzene | NA | NA | NA | NA | NA | NA |
| 1,2-Dichlorobenzene | NA | NA | NA | NA | NA | NA |
| 1,3-Dichlorobenzene | NA | NA | NA | NA | NA | NA |
| 1,4-Dichlorobenzene | NA | NA | NA | NA | NA | NA |
| 1,3,5-Trinitrobenzene | NA | NA | NA | NA | NA | NA |
| 1,3-Dinitrobenzene | NA | NA | NA | NA | NA | NA |
| 1,4-Naphthoquinone | NA | NA | NA | NA | NA | NA |
| 1-Naphthylamine | NA | NA | NA | NA | NA | NA |
| 2,3,4,6-Tetrachlorophenol | NA | NA | NA | NA | NA | NA |
| 2,4,5-Trichlorophenol | NA | NA | NA | NA | NA | NA |
| 2,4,6-Trichlorophenol | NA | NA | NA | NA | NA | NA |
| 2,4-Dichlorophenol | NA | NA | NA | NA | NA | NA |
| 2,4-Dimethylphenol | NA | NA | NA | NA | NA | NA |
| 2,4-Dinitrophenol | NA | NA | NA | NA | NA | NA |
| 2,4-Dinitrotoluene | NA | NA | NA | NA | NA | NA |
| 2,6-Dichlorophenol | NA | NA | NA | NA | NA | NA |
| 2,6-Dinitrotoluene | NA | NA | NA | NA | NA | NA |
| 2-Acetylaminofluorene | NA | NA | NA | NA | NA | NA |
| 2-Chloronaphthalene | NA | NA | NA | NA | NA | NA |
| 2-Chlorophenol | NA | NA | NA | NA | NA | NA |

Table 4-3

RFI Background Soil Sample Analytical Results

Alcoa Badin, NC Works RFI

| Sample ID<br>Sample Depth (ft-bgs)[a]<br>Parameter | S2-HA05-0.5-2.0<br>0.5-2.0 | S2-HA06-0.0-0.5<br>0.0-0.5 | S2-HA06-0.5-2.0<br>0.5-2.0 | S3-HA01-0.0-0.5<br>0.0-0.5 | S3-HA01-0.5-2.0<br>0.5-2.0 | S3-HA02-0.0-0.5<br>0.0-0.5 |
|---|---|---|---|---|---|---|
| 2-Methyl-4,6-Dinitrophenol | NA | NA | NA | NA | NA | NA |
| 2-Methylnaphthalene | NA | NA | NA | NA | NA | NA |
| 2-Methylphenol (O-Cresol) | NA | NA | NA | NA | NA | NA |
| 2-Naphthylamine | NA | NA | NA | NA | NA | NA |
| 2-Nitroaniline | NA | NA | NA | NA | NA | NA |
| 2-Nitrophenol | NA | NA | NA | NA | NA | NA |
| 2-Picoline | NA | NA | NA | NA | NA | NA |
| 3,3'-Dichlorobenzidine | NA | NA | NA | NA | NA | NA |
| 3,3'-Dimethylbenzidine | NA | NA | NA | NA | NA | NA |
| 3,5,5-Trimethyl-2-Cyclohexen-1-One | NA | NA | NA | NA | NA | NA |
| 3-Methylcholanthrene | NA | NA | NA | NA | NA | NA |
| 3-Nitroaniline | NA | NA | NA | NA | NA | NA |
| 4-Aminobiphenyl | NA | NA | NA | NA | NA | NA |
| 4-Bromophenyl Phenyl Ether | NA | NA | NA | NA | NA | NA |
| 4-Chloro-3-Methylphenol | NA | NA | NA | NA | NA | NA |
| 4-Chloroaniline | NA | NA | NA | NA | NA | NA |
| 4-Chlorophenyl Phenyl Ether | NA | NA | NA | NA | NA | NA |
| 4-Methylphenol (P-Cresol) | NA | NA | NA | NA | NA | NA |
| 4-Nitrophenol | NA | NA | NA | NA | NA | NA |
| 4-Nitroquinoline-1-Oxide | NA | NA | NA | NA | NA | NA |
| 5-Nitro-O-Toluidine | NA | NA | NA | NA | NA | NA |
| 7,12-Dimethylbenz(A)Anthracene | NA | NA | NA | NA | NA | NA |
| A,A-Dimethylphenethylamine | NA | NA | NA | NA | NA | NA |
| Acenaphthene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Acenaphthylene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Acetophenone | NA | NA | NA | NA | NA | NA |
| Aniline | NA | NA | NA | NA | NA | NA |
| Anthracene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Aramite | NA | NA | NA | NA | NA | NA |
| Benz(B)Fluoranthene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Benzo(A)Anthracene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Benzo(A)Pyrene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Benzo(G,H,I)Perylene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Benzo(K)Fluoranthene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Benzyl Alcohol | NA | NA | NA | NA | NA | NA |
| Benzyl Butyl Phthalate | NA | NA | NA | NA | NA | NA |
| Bis(2-Chloroethoxy)Methane | NA | NA | NA | NA | NA | NA |
| Bis(2-Chloroethyl)Ether | NA | NA | NA | NA | NA | NA |
| Bis(2-Chloroisopropyl)Ether | NA | NA | NA | NA | NA | NA |
| Bis(2-Ethylhexyl)Phthalate | NA | NA | NA | NA | NA | NA |
| Chlorobenzilate | NA | NA | NA | NA | NA | NA |
| Chrysene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Diallate | NA | NA | NA | NA | NA | NA |
| Dibenzo(A,H)Anthracene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Dibenzofuran | NA | NA | NA | NA | NA | NA |

Table 4-3

RFI Background Soil Sample Analytical Results

Alcoa Badin, NC Works RFI

| Sample ID / Sample Depth (ft-bgs)[a] / Parameter | S2-HA05-0.5-2.0 0.5-2.0 | S2-HA06-0.0-0.5 0.0-0.5 | S2-HA06-0.5-2.0 0.5-2.0 | S3-HA01-0.0-0.5 0.0-0.5 | S3-HA01-0.5-2.0 0.5-2.0 | S3-HA02-0.0-0.5 0.0-0.5 |
|---|---|---|---|---|---|---|
| Diethyl Phthalate | NA | NA | NA | NA | NA | NA |
| Dimethoate | NA | NA | NA | NA | NA | NA |
| Dimethyl Phthalate | NA | NA | NA | NA | NA | NA |
| Di-N-Butyl Phthalate | NA | NA | NA | NA | NA | NA |
| Di-N-Octylphthalate | NA | NA | NA | NA | NA | NA |
| Dinoseb | NA | NA | NA | NA | NA | NA |
| Disulfoton | NA | NA | NA | NA | NA | NA |
| Ethyl Methanesulfonate | NA | NA | NA | NA | NA | NA |
| Famphur | NA | NA | NA | NA | NA | NA |
| Fluoranthene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Fluorene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Hexachlorobenzene | NA | NA | NA | NA | NA | NA |
| Hexachlorobutadiene | NA | NA | NA | NA | NA | NA |
| Hexachlorocyclopentadiene | NA | NA | NA | NA | NA | NA |
| Hexachloroethane | NA | NA | NA | NA | NA | NA |
| Hexachlorophene | NA | NA | NA | NA | NA | NA |
| Hexachloropropene | NA | NA | NA | NA | NA | NA |
| Indeno(1,2,3-Cd)Pyrene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Isodrin | NA | NA | NA | NA | NA | NA |
| Isosafrole | NA | NA | NA | NA | NA | NA |
| Kepone | NA | NA | NA | NA | NA | NA |
| Methapyrilene | NA | NA | NA | NA | NA | NA |
| Methyl Methanesulfonate | NA | NA | NA | NA | NA | NA |
| Methyl Parathion | NA | NA | NA | NA | NA | NA |
| Naphthalene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Nitrobenzene | NA | NA | NA | NA | NA | NA |
| N-Nitrosodiethylamine | NA | NA | NA | NA | NA | NA |
| N-Nitrosodimethylamine | NA | NA | NA | NA | NA | NA |
| N-Nitrosodi-N-Butylamine | NA | NA | NA | NA | NA | NA |
| N-Nitroso-Di-N-Propylamine | NA | NA | NA | NA | NA | NA |
| N-Nitrosodiphenylamine | NA | NA | NA | NA | NA | NA |
| N-Nitrosodiphenylamine/Diphenylamine | NA | NA | NA | NA | NA | NA |
| N-Nitrosomethylethylamine | NA | NA | NA | NA | NA | NA |
| N-Nitrosomorpholine | NA | NA | NA | NA | NA | NA |
| N-Nitrosopiperidine | NA | NA | NA | NA | NA | NA |
| N-Nitrosopyrrolidine | NA | NA | NA | NA | NA | NA |
| O,O,O-Triethyl Phosphorothioate | NA | NA | NA | NA | NA | NA |
| O-Toluidine | NA | NA | NA | NA | NA | NA |
| Parathion | NA | NA | NA | NA | NA | NA |
| P-Dimethylaminoazobenzene | NA | NA | NA | NA | NA | NA |
| Pentachlorobenzene | NA | NA | NA | NA | NA | NA |
| Pentachloroethane | NA | NA | NA | NA | NA | NA |
| Pentachloronitrobenzene | NA | NA | NA | NA | NA | NA |
| Pentachlorophenol | NA | NA | NA | NA | NA | NA |
| Phenacetin | NA | NA | NA | NA | NA | NA |

Table 4-3

RFI Background Soil Sample Analytical Results

Alcoa Badin, NC Works RFI

| Sample ID / Sample Depth (ft-bgs)[a] / Parameter | S2-HA05-0.5-2.0 0.5-2.0 | S2-HA06-0.0-0.5 0.0-0.5 | S2-HA06-0.5-2.0 0.5-2.0 | S3-HA01-0.0-0.5 0.0-0.5 | S3-HA01-0.5-2.0 0.5-2.0 | S3-HA02-0.0-0.5 0.0-0.5 |
|---|---|---|---|---|---|---|
| Phenanthrene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Phenol | NA | NA | NA | NA | NA | NA |
| Phorate | NA | NA | NA | NA | NA | NA |
| P-Nitroaniline | NA | NA | NA | NA | NA | NA |
| P-Phenylene Diamine | NA | NA | NA | NA | NA | NA |
| Pronamide | NA | NA | NA | NA | NA | NA |
| Pyrene | < 0.4 | < 0.41 | < 0.41 | < 0.44 | < 0.44 | < 0.44 |
| Pyridine | NA | NA | NA | NA | NA | NA |
| Safrole | NA | NA | NA | NA | NA | NA |
| Tetraethyldithiopyrophosphate | NA | NA | NA | NA | NA | NA |
| Thionazin | NA | NA | NA | NA | NA | NA |

Notes:

[a] ft-bgs = feet below ground surface.

[b] mg/kg = milligram per kilogram.

[c] < = not detected at indicated detection limit.

[d] VOCs = Volatile Organic Compounds.

[e] NA = Not Analyzed.

[f] SVOCs - Semi-Volatile Organic Compounds.

Table 4-3

RFI Background Soil Sample Analytical Results

Alcoa Badin, NC Works RFI

| Sample ID / Sample Depth (ft-bgs)[a] / Parameter | S3-HA02-0.5-1.7 0.5-1.7 | S3-HA03-0.0-0.5 0.0-0.5 | S3-HA03-0.0-0.5R 0.0-0.5 | S3-HA03-0.5-2.0 0.5-2.0 | S3-HA03-0.5-2.0R 0.5-2.0 | S3-HA06-0.0-0.5 0.0-0.5 | S3-HA06-0.0-0.5D 0.0-0.5 | S3-HA06-0.0-0.5R 0.0-0.5 | S3-HA06-0.5-2.0 0.5-2.0 |
|---|---|---|---|---|---|---|---|---|---|
| **Inorganics (mg/kg)[b]** | | | | | | | | | |
| Fluoride | < 0.64 | 1.5 | NA | < 0.63 | NA | 1.2 | < 0.66 | NA | < 0.67 |
| Cyanide, Free (Weak Acid Dissociable) | < 3.2 | < 3 | NA | < 3.1 | NA | < 3.4 | < 3.3 | NA | < 3.4 |
| Cyanide, Total | < 3.2 | < 3 | NA | < 3.1 | NA | < 3.4 | < 3.3 | NA | < 3.4 |
| Arsenic | 59.20 | 57.8 | NA | 72.7 | NA | 28.50 | 24.20 | NA | 36.30 |
| Barium | 43.30 | 81.2 | NA | 55.2 | NA | 75.80 | 102.00 | NA | 37.50 |
| Cadmium | < 0.26 | < 0.24 | NA | < 0.25 | NA | < 0.27 | < 0.26 | NA | < 0.27 |
| Chromium | 31.80 | 30.9 | NA | 40.3 | NA | 63.20 | 58.90 | NA | 96.40 |
| Lead | 4.80 | 11.9 | NA | 8 | NA | 12.00 | 14.70 | NA | 12.30 |
| Selenium | 0.97 | < 0.61 | NA | 1.8 | NA | 1.90 | < 0.66 | NA | < 0.67 |
| Mercury | < 0.13 | < 0.12 | NA | < 0.13 | NA | < 0.14 | < 0.13 | NA | < 0.13 |
| **VOCs[d] (mg/kg)** | | | | | | | | | |
| 1,1,1,2-Tetrachloroethane | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| 1,1,1-Trichloroethane | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| 1,1,2,2-Tetrachloroethane | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| 1,1,2-Trichloroethane | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| 1,1-Dichloroethane | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| 1,1-Dichloroethene | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| 1,2,3-Trichloropropane | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| 1,2-Dibromo-3-Chloropropane | NA | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.014 | < 0.013 | < 0.014 | < 0.013 |
| 1,2-Dibromoethane | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| 1,2-Dichloroethane | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| 1,2-Dichloropropane | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| 1,4-Dioxane | NA | < 0.61 | < 0.63 | < 0.63 | < 0.62 | < 0.68 | < 0.66 | < 0.68 | < 0.67 |
| 2-Butanone | NA | 0.052 | < 0.025 | < 0.025 | < 0.025 | < 0.027 | 0.028 | < 0.027 | < 0.027 |
| 2-Hexanone | NA | < 0.024 | < 0.025 | < 0.025 | < 0.025 | < 0.027 | < 0.026 | < 0.027 | < 0.027 |
| 4-Methyl-2-Pentanone | NA | < 0.024 | < 0.025 | < 0.025 | < 0.025 | < 0.027 | < 0.026 | < 0.027 | < 0.027 |
| Acetone | NA | < 1.2 | 0.21 | 0.16 | 0.00021 | 0.13 | < 1.3 | 0.12 | 0.075 |
| Acetonitrile | NA | < 0.12 | < 0.13 | < 0.13 | < 0.12 | < 0.14 | < 0.13 | < 0.14 | < 0.13 |
| Acrolein | NA | < 0.12 | < 0.13 | < 0.13 | < 0.12 | < 0.14 | < 0.13 | < 0.14 | < 0.13 |
| Acrylonitrile | NA | < 0.12 | < 0.13 | < 0.13 | < 0.12 | < 0.14 | < 0.13 | < 0.14 | < 0.13 |
| Allyl Chloride | NA | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.014 | < 0.013 | < 0.014 | < 0.013 |
| Benzene | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Bromodichloromethane | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Bromoform | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Bromomethane | NA | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.014 | < 0.013 | < 0.014 | < 0.013 |
| Carbon Disulfide | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Carbon Tetrachloride | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Chlorobenzene | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Chloroethane | NA | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.014 | < 0.013 | < 0.0068 | < 0.0067 |
| Chloroform | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.014 | < 0.013 |
| Chloromethane | NA | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.014 | < 0.013 | < 0.0068 | < 0.0067 |
| Chloroprene | NA | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.014 | < 0.013 | < 0.014 | < 0.013 |
| Cis-1,3-Dichloropropene | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.014 | < 0.013 |
| | | | | | | | | < 0.0068 | < 0.0067 |

Table 4-3

RFI Background Soil Sample Analytical Results

Alcoa Badin, NC Works RFI

| Sample ID<br>Sample Depth (ft-bgs)[a] | S3-HA02-0.5-1.7<br>0.5-1.7 | S3-HA03-0.0-0.5<br>0.0-0.5 | S3-HA03-0.0-0.5R<br>0.0-0.5 | S3-HA03-0.5-2.0<br>0.5-2.0 | S3-HA03-0.5-2.0R<br>0.5-2.0 | S3-HA06-0.0-0.5<br>0.0-0.5 | S3-HA06-0.0-0.5D<br>0.0-0.5 | S3-HA06-0.0-0.5R<br>0.0-0.5 | S3-HA06-0.5-2.0<br>0.5-2.0 |
|---|---|---|---|---|---|---|---|---|---|
| Parameter | | | | | | | | | |
| Dibromochloromethane | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Dibromomethane | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Dichlorodifluoromethane | NA | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.014 | < 0.013 | < 0.014 | < 0.013 |
| Dichloromethane | NA | 0.01 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Ethyl Methacrylate | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Ethylbenzene | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Iodomethane | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Isobutyl Alcohol | NA | < 0.24 | < 0.25 | < 0.25 | < 0.25 | < 0.27 | < 0.26 | < 0.27 | < 0.27 |
| Methacrylonitrile | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Methyl Methacrylate | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Propionitrile | NA | < 0.024 | < 0.025 | < 0.025 | < 0.025 | < 0.027 | < 0.026 | < 0.027 | < 0.027 |
| Styrene | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Tetrachloroethene | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Toluene | NA | 0.045 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Trans-1,2-Dichloroethene | NA | < 0.003 | < 0.0032 | < 0.0031 | < 0.0031 | < 0.0034 | < 0.0033 | < 0.0034 | < 0.0034 |
| Trans-1,3-Dichloropropene | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Trans-1,4-Dichloro-2-Butene | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Trichloroethylene | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Trichlorofluoromethane | NA | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.014 | < 0.013 | < 0.014 | < 0.013 |
| Vinyl Acetate | NA | < 0.012 | < 0.013 | < 0.013 | < 0.012 | < 0.014 | < 0.013 | < 0.014 | < 0.013 |
| Vinyl Chloride | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| Xylene (Total) | NA | < 0.0061 | < 0.0063 | < 0.0063 | < 0.0062 | < 0.0068 | < 0.0066 | < 0.0068 | < 0.0067 |
| SVOCs[b] (mg/kg) | | | | | | | | | |
| 1,2,4,5-Tetrachlorobenzene | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 1,2,4-Trichlorobenzene | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 1,2-Dichlorobenzene | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 1,3-Dichlorobenzene | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 1,4-Dichlorobenzene | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 1,3,5-Trinitrobenzene | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| 1,3-Dinitrobenzene | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 1,4-Naphthoquinone | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| 1-Naphthylamine | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 2,3,4,6-Tetrachlorophenol | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| 2,4,5-Trichlorophenol | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 2,4,6-Trichlorophenol | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 2,4-Dichlorophenol | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 2,4-Dimethylphenol | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 2,4-Dinitrophenol | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| 2,4-Dinitrotoluene | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 2,6-Dichlorophenol | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 2,6-Dinitrotoluene | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 2-Acetylaminofluorene | NA | < 4 | NA | < 4.1 | NA | < 4.5 | < 4.4 | NA | < 4.4 |
| 2-Chloronaphthalene | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 2-Chlorophenol | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |

Table 4-3

RFI Background Soil Sample Analytical Results

Alcoa Badin, NC Works RFI

| Sample ID / Sample Depth (ft-bgs)[a] / Parameter | S3-HA02-0.5-1.7 0.5-1.7 | S3-HA03-0.0-0.5 0.0-0.5 | S3-HA03-0.0-0.5R 0.0-0.5 | S3-HA03-0.5-2.0 0.5-2.0 | S3-HA03-0.5-2.0R 0.5-2.0 | S3-HA06-0.0-0.5 0.0-0.5 | S3-HA06-0.0-0.5D 0.0-0.5 | S3-HA06-0.0-0.5R 0.0-0.5 | S3-HA06-0.5-2.0 0.5-2.0 |
|---|---|---|---|---|---|---|---|---|---|
| 2-Methyl-4,6-Dinitrophenol | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| 2-Methylnaphthalene | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 2-Methylphenol (O-Cresol) | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 2-Naphthylamine | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 2-Nitroaniline | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| 2-Nitrophenol | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 2-Picoline | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |
| 3,3'-Dichlorobenzidine | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| 3,3'-Dimethylbenzidine | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| 3,5,5-Trimethyl-2-Cyclohexen-1-One | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 3-Methylcholanthrene | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |
| 3-Nitroaniline | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| 4-Aminobiphenyl | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| 4-Bromophenyl Phenyl Ether | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 4-Chloro-3-Methylphenol | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 4-Chloroaniline | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 4-Chlorophenyl Phenyl Ether | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 4-Methylphenol (P-Cresol) | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| 4-Nitrophenol | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| 4-Nitroquinoline-1-Oxide | NA | < 4 | NA | < 4.1 | NA | < 4.5 | < 4.4 | NA | < 4.4 |
| 5-Nitro-O-Toluidine | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |
| 7,12-Dimethylbenz(A)Anthracene | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |
| A,A-Dimethylphenethylamine | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| Acenaphthene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Acenaphthylene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Acetophenone | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Aniline | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Anthracene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Aramite | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |
| Benz(B)Fluoranthene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Benzo(A)Anthracene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Benzo(A)Pyrene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Benzo(G,H,I)Perylene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Benzo(K)Fluoranthene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Benzyl Alcohol | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Benzyl Butyl Phthalate | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Bis(2-Chloroethoxy)Methane | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Bis(2-Chloroethyl)Ether | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Bis(2-Chloroisopropyl)Ether | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Bis(2-Ethylhexyl)Phthalate | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Chlorobenzilate | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Chrysene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Diallate | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |
| Dibenzo(A,H)Anthracene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Dibenzofuran | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |

Table 4-3

## RFI Background Soil Sample Analytical Results

### Alcoa Badin, NC Works RFI

| Sample ID | S3-HA02-0.5-1.7 | S3-HA03-0.0-0.5 | S3-HA03-0.0-0.5R | S3-HA03-0.5-2.0 | S3-HA03-0.5-2.0R | S3-HA06-0.0-0.5 | S3-HA06-0.0-0.5D | S3-HA06-0.0-0.5R | S3-HA06-0.5-2.0 |
|---|---|---|---|---|---|---|---|---|---|
| Sample Depth (ft-bgs)[a] | 0.5-1.7 | 0.0-0.5 | 0.0-0.5 | 0.5-2.0 | 0.5-2.0 | 0.0-0.5 | 0.0-0.5 | 0.0-0.5 | 0.5-2.0 |
| Parameter | | | | | | | | | |
| Diethyl Phthalate | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Dimethoate | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |
| Dimethyl Phthalate | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Di-N-Butyl Phthalate | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Di-N-Octylphthalate | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Dinoseb | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |
| Disulfoton | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| Ethyl Methanesulfonate | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Famphur | NA | < 4 | NA | < 4.1 | NA | < 4.5 | < 4.4 | NA | < 4.4 |
| Fluoranthene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Fluorene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Hexachlorobenzene | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Hexachlorobutadiene | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Hexachlorocyclopentadiene | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| Hexachloroethane | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Hexachlorophene | NA | < 1.9 | NA | < | NA | < 2.2 | < | NA | < |
| Hexachloropropene | NA | < 4 | NA | < 4.1 | NA | < 4.5 | < 4.4 | NA | < 4.4 |
| Indeno(1,2,3-Cd)Pyrene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Isodrin | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Isosafrole | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |
| Kepone | NA | < 4 | NA | < 4.1 | NA | < 4.5 | < 4.4 | NA | < 4.4 |
| Methapyrilene | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| Methyl Methanesulfonate | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Methyl Parathion | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| Naphthalene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Nitrobenzene | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| N-Nitrosodiethylamine | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| N-Nitrosodimethylamine | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| N-Nitrosodi-N-Butylamine | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| N-Nitroso-Di-N-Propylamine | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| N-Nitrosodiphenylamine | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| N-Nitrosodiphenylamine/Diphenylamine | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| N-Nitrosomethylethylamine | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| N-Nitrosomorpholine | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| N-Nitrosopiperidine | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| N-Nitrosopyrrolidine | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| O,O,O-Triethyl Phosphorothioate | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| O-Toluidine | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |
| Parathion | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| P-Dimethylaminoazobenzene | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |
| Pentachlorobenzene | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Pentachloroethane | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| Pentachloronitrobenzene | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| Pentachlorophenol | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| Phenacetin | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |

Table 4-3

RFI Background Soil Sample Analytical Results

Alcoa Badin, NC Works RFI

| Sample ID / Sample Depth (ft-bgs)[a] / Parameter | S3-HA02-0.5-1.7 0.5-1.7 | S3-HA03-0.0-0.5 0.0-0.5 | S3-HA03-0.0-0.5R 0.0-0.5 | S3-HA03-0.5-2.0 0.5-2.0 | S3-HA03-0.5-2.0R 0.5-2.0 | S3-HA06-0.0-0.5 0.0-0.5 | S3-HA06-0.0-0.5D 0.0-0.5 | S3-HA06-0.0-0.5R 0.0-0.5 | S3-HA06-0.5-2.0 0.5-2.0 |
|---|---|---|---|---|---|---|---|---|---|
| Phenanthrene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Phenol | NA | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Phorate | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| P-Nitroaniline | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| P-Phenylene Diamine | NA | < 4 | NA | < 4.1 | NA | < 4.5 | < 4.4 | NA | < 4.4 |
| Pronamide | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |
| Pyrene | < 0.43 | < 0.4 | NA | < 0.41 | NA | < 0.45 | < 0.44 | NA | < 0.44 |
| Pyridine | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |
| Safrole | NA | < 0.8 | NA | < 0.83 | NA | < 0.9 | < 0.87 | NA | < 0.89 |
| Tetraethyldithiopyrophosphate | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |
| Thionazin | NA | < 1.9 | NA | < 2 | NA | < 2.2 | < 2.1 | NA | < 2.1 |

Notes:

[a] ft-bgs = feet below ground surface.

[b] mg/kg = milligram per kilogram.

[c] < = not detected at indicated detection limit.

[d] VOCs = Volatile Organic Compounds.

[e] NA = Not Analyzed.

[f] SVOCs - Semi-Volatile Organic Compounds.

# Table 4-4

## Background Concentrations for Selected Parameters

## Alcoa Badin, NC Works RFI

| Sample Designation | Benzo(a)anthracene mg/kg[a] | Benzo(a)pyrene mg/kg | Benzo(b)fluoranthene mg/kg | Dibenzo(a,h)anthracene mg/kg | Indeno(1,2,3-cd)pyrene mg/kg | Fluoride mg/kg | Total Cyanide mg/kg | Weak Acid Dissociable Cyanide mg/kg | Arsenic mg/kg | Cadmium mg/kg | Chromium mg/kg |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Northeast End of Plant and SWMU No. 2** | | | | | | | | | | | |
| NE-HA01-0.0-0.5 | 5.40 | 4.80 | 4.80 | 1.10 | 2.60 | 7.1 | 3.4 | 3.2 U[b] | 9.9 | 0.25 U | 22.3 |
| NE-HA01-0.5-2.0 | 1.80 | 1.50 | 1.30 | 0.40 U | 0.76 | 7.3 | 3.1 U | 3.1 U | 13.8 | 0.24 U | 43.1 |
| NE-HA02-0.0-0.5 | 0.47 U | 0.47 U | 0.94 | 0.47 U | 0.47 U | 5 | 3.5 U | 3.5 U | 7.2 | 0.28 U | 13.3 |
| NE-HA02-0.5-0.9 | 0.41 U | 0.41 U | 0.41 U | 0.41 U | 0.41 U | 3 | 3.1 U | 3.1 U | 12.1 | 0.25 U | 14.2 |
| NE-HA03-0.0-0.5 | 0.41 U | 0.41 U | 0.41 U | 0.41 U | 0.41 U | 3.2 | 3.1 U | 3.1 U | 14.4 | 0.25 U | 45.8 |
| NE-HA03-0.5-2.0 | 0.41 U | 0.41 U | 0.41 U | 0.41 U | 0.41 U | 2 | 3.1 U | 3.1 U | 14.6 | 0.25 U | 30.4 |
| NE-HA04-0.0-0.5 | 0.41 U | 0.41 U | 0.41 U | 0.41 U | 0.41 U | 2.9 | 3.1 U | 3.1 U | 18.5 | 0.25 U | 23.3 |
| NE-HA04-0.5-2.0 | 0.42 U | 0.42 U | 0.42 U | 0.42 U | 0.42 U | 0.63 U | 3.2 U | 3.2 U | 20.8 | 1 U | 40.6 |
| NE-HA05-0.0-0.5 | 0.39 U | 0.39 U | 0.39 U | 0.39 U | 0.39 U | 2.5 | 3 U | 3 U | 8.2 | 0.24 U | 17.6 |
| S2-HA03-0.0-0.5 | 0.40 U | 0.40 U | 0.40 U | 0.40 U | 0.40 U | 0.61 U | 3.1 U | 3.1 U | 12.2 | 0.24 U | 22.6 |
| S2-HA03-0.0-0.5D | 0.39 U | 0.39 U | 0.39 U | 0.39 U | 0.39 U | 0.6 U | 3 U | 3 U | 12.2 | 0.24 | 25.3 |
| S2-HA03-0.5-2.0 | 0.42 U | 0.42 U | 0.42 U | 0.42 U | 0.42 U | 0.63 U | 3.1 U | 3.1 U | 15.7 | 0.25 U | 24 |
| S2-HA04-0.0-0.5 | 0.39 U | 0.39 U | 0.39 U | 0.39 U | 0.39 U | 0.6 U | 3 U | 3 U | 33.6 | 0.24 U | 26.2 |
| S2-HA04-0.5-2.0 | 0.40 U | 0.40 U | 0.40 U | 0.40 U | 0.40 U | 0.6 U | 3 U | 3 U | 2.3 | 0.24 U | 14.5 |
| S2-HA05-0.0-0.5 | 0.42 U | 0.42 U | 0.42 U | 0.42 U | 0.42 U | 1.2 | 3.2 U | 3.2 U | 7.8 | 0.24 U | 19.8 |
| S2-HA05-0.5-2.0 | 1.40 U | 0.40 U | 0.40 U | 0.40 U | 0.40 U | 0.6 U | 3 U | 3 U | 19.1 | 0.51 U | 45.9 |
| S2-HA06-0.0-0.5 | 0.41 U | 0.41 U | 0.41 U | 0.41 U | 0.41 U | 1.2 | 3.1 U | 3.1 U | 24.2 | 0.26 U | 58.9 |
| S2-HA06-0.5-2.0 | 0.41 U | 0.41 U | 0.41 U | 0.41 U | 0.41 U | 7.2 | 3.1 U | 3.1 U | 36.3 | 0.27 U | 96.4 |
| **SWMU No. 3** | | | | | | | | | | | |
| S3-HA01-0.0-0.5 | 0.44 U | 0.44 U | 0.44 U | 0.44 U | 0.44 U | 2.1 | 3.4 U | 3.4 U | 72.7 | 0.25 U | 40.3 |
| S3-HA01-0.5-2.0 | 0.44 U | 0.44 U | 0.44 U | 0.44 U | 0.44 U | 0.66 U | 3.3 U | 3.3 U | 18 | 1 U | 35.6 |
| S3-HA02-0.0-0.5 | 0.44 U | 0.44 U | 0.44 U | 0.44 U | 0.44 U | 1.9 | 5.3 | 3.3 U | 28.5 | 0.27 U | 63.2 |
| S3-HA02-0.5-1.7 | 0.43 U | 0.43 U | 0.43 U | 0.43 U | 0.43 U | 0.64 U | 3.2 U | 3.2 U | 59.2 | 0.26 U | 31.8 |
| S3-HA03-0.0-0.5 | 0.4 U | 0.40 U | 0.40 U | 0.40 U | 0.40 U | 1.5 | 3 U | 3 U | 18.8 | 0.99 U | 33.9 |
| S3-HA03-0.5-2.0 | 0.41 U | 0.41 U | 0.41 U | 0.41 U | 0.41 U | 0.63 U | 3.1 U | 3.1 U | 51.6 | 0.26 U | 32.5 |
| S3-HA06-0.0-0.5 | 0.45 U | 0.45 U | 0.45 U | 0.45 U | 0.45 U | 1.2 | 3.4 U | 3.4 U | 64 | 0.26 U | 46.9 |
| S3-HA06-0.0-0.5D | 0.44 U | 0.44 U | 0.44 U | 0.44 U | 0.44 U | 0.66 U | 3.3 U | 3.3 U | 47.1 | 0.27 U | 50.6 |
| S3-HA06-0.5-2.0 | 0.44 U | 0.44 U | 0.44 U | 0.44 U | 0.44 U | 0.67 U | 3.4 U | 3.4 U | 57.8 | 0.24 U | 30.9 |

Notes:

(a) mg/kg = milligrams per kilogram
(b)"U" - Not detected.

## Table 4-5

### Summary of Selected Soil Background Concentrations - Organics

### Alcoa Badin, NC Works RFI

| | Benzo(a)anthracene mg/kg[a] | Benzo(a)pyrene mg/kg | Benzo(b)fluoranthene mg/kg | Dibenzo(a,h)anthracene mg/kg | Indeno(1,2,3-cd)pyrene mg/kg |
|---|---|---|---|---|---|
| **All Background Areas - Excluding SWMU No. 3** | | | | | |
| Normality Test Used | Wilks-Shapiro | Wilks-Shapiro | Wilks-Shapiro | Wilks-Shapiro | Wilks-Shapiro |
| Data Distribution | Non-parametric | Non-parametric | Non-parametric | Non-parametric | Non-parametric |
| Method Utilized to Determine 95% UCL | Jackknife | Jackknife | Jackknife | Jackknife | Jackknife |
| 95% UCL or maximum non-detect value | 1.10 | 0.99 | 1.01 | 0.34 | 0.60 |
| **Background Area SWMU No. 3** | | | | | |
| Normality Test Used | NA[b] | NA | NA | NA | NA |
| Data Distribution | NA | NA | NA | NA | NA |
| Method Utilized to Determine 95% UCL | NA | NA | NA | NA | NA |
| 95% UCL or maximum non-detect value | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 |

Notes:

(a) mg/kg = milligrams per kilograms
(b) NA - Not Applicable

## Table 4-6

## Summary of Selected Soil Background Concentrations - Inorganics

## Alcoa Badin, NC Works RFI

| | Fluoride mg/kg[a] | Total Cyanide mg/kg | Weak Acid Dissociable Cyanide mg/kg | Arsenic mg/kg | Cadmium mg/kg | Chromium mg/kg |
|---|---|---|---|---|---|---|
| **All Background Areas - Excluding SWMU No. 3** | | | | | | |
| Normality Test Used | Wilks-Shapiro | Wilks-Shapiro | NA[b] | Wilks-Shapiro | NA | Wilks-Shapiro |
| Data Distribution | Non-parametric | Non-parametric | NA | Normal | NA | Log-Normal |
| Method Utilized to Determine 95% UCL | Jackknife | Jackknife | NA | NA | NA | NA |
| Mean + 2 standard deviations[c] | NA | NA | NA | 33.3 | NA | 81.3 |
| 95% UCL or maximum non-detect value | 3.53E+00 | 1.84E+00 | 3.50E+00 | NA | 1.00E+00 | NA |
| **Background Area SWMU No. 3** | | | | | | |
| Normality Test Used | Wilks-Shapiro | Wilks-Shapiro | NA | Wilks-Shapiro | NA | Wilks-Shapiro |
| Data Distribution | Non-parametric | Non-parametric | NA | Normal | NA | Normal |
| Method Utilized to Determine 95% UCL | Jackknife | Jackknife | NA | NA | NA | NA |
| Mean + 2 standard deviations* | NA | NA | NA | 86.5 | NA | 62.5 |
| 95% UCL or maximum non-detect value | 1.39E+00 | 2.80E+00 | 3.40E+00 | NA | 1.00E+00 | NA |

Notes:

(a) mg/kg = milligrams per kilogram.
(b) NA = not applicable.
(c) for normal distributions = mean + 2x standard deviation of normal data, for lognormal distributions = e^(mean of log transformed data + 2*standard deviation of log transformed data)

# Woodward Clyde (1997) Badin Lake Surface Water Analytical Results - Plant and Old Brick Landfill Areas

## Alcoa Badin, NC Works RFI

| Sample Designation / Sample Location / Sample Date / Sample Depth | WA-OBL-092296-001<br>OBL1<br>9/22/96<br>Top Water | WA-OBL-101296-001<br>OBL1<br>10/12/96<br>Top Water | WA-NEP-092296-001<br>NEP4<br>9/22/96<br>Top Water | WA-NEP-092296-004<br>NEP14<br>9/22/96<br>Top Water | WA-NEP-092296-006<br>NEP16<br>9/22/96<br>Top Water | WA-NEP-092296-007<br>NEP16 (dup)<br>9/22/96<br>Top Water | WB-NEP-092296-002<br>NEP4<br>9/22/96<br>Bottom Water |
|---|---|---|---|---|---|---|---|
| Parameter | | | | | | | |
| Miscellaneous (mg/l) [a] | | | | | | | |
| TOC | 6.2 | NA [b] | 6.2 | 9 | 5.3 | 4.2 | 21 |
| TSS | 7.3 | NA | 7.7 | 6.3 | < 5 [c] | 5.3 | 8.7 |
| Alkalinity | 22 | NA | 23 | 23 | 23 | 22 | 24 |
| Hardness | 19 | NA | 19 | 18 | 19 | 18 | 19 |
| PCBs [d] (mg/l) | | | | | | | |
| Aroclor 1248 | < 0.001 J [e] | NA | < 0.001 J | < 0.001 | < 0.001 J | < 0.001 J | < 0.001 J |
| Aroclor 1260 | < 0.001 J | NA | < 0.001 J | < 0.001 | < 0.001 J | < 0.001 J | < 0.001 J |
| Inorganics (mg/l) | | | | | | | |
| Cyanide, Amenable | NA | < 0.005 | < 0.005 | < 0.005 | NA | < 0.005 | < 0.005 |
| Cyanide, Free | NA | < 0.005 | < 0.005 | < 0.005 | NA | < 0.005 | < 0.005 |
| Cyanide, Total | NA | < 0.005 | < 0.005 | < 0.005 | NA | < 0.005 | < 0.005 |
| Cyanide, Weak Acid Dissociable | NA | < 0.005 | < 0.005 | < 0.005 | NA | < 0.005 | < 0.005 |
| Fluoride | < 0.2 | NA | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| Ammonia | < 0.03 | NA | 0.036 | 0.054 | 0.049 | 0.19 | 0.08 |
| Arsenic | < 0.01 | NA | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 |
| Barium | 0.017 | NA | 0.018 | 0.017 | 0.018 | 0.016 | 0.018 |
| Cadmium | 0.000071 | NA | 0.00016 | < 0.00005 | < 0.00005 | < 0.00005 | < 0.00005 |
| Chromium | < 0.01 | NA | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 |
| Iron CN | NA | < 0.004 | < 0.004 | < 0.004 | NA | < 0.004 | < 0.004 |
| Lead | < 0.0005 | NA | 0.00094 | 0.0005 | 0.0005 | < 0.0005 | < 0.0005 |
| Nitrate/Nitrite | 0.35 | NA | 0.35 | 0.34 | 0.4 | 0.43 | 1.1 |
| Nitrite | NA | NA | NA | NA | NA | NA | NA |
| Selenium | < 0.01 | NA | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 |
| Sodium | 8.6 | NA | 8.6 | 8.4 | 8.8 | 8.2 | 8.3 |
| SVOCs [f] (mg/l) | | | | | | | |
| 1-Methylnaphthalene | < 0.001 | NA | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| 2-Methylnaphthalene | < 0.001 | NA | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthene | < 0.001 | NA | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Acenaphthylene | < 0.001 | NA | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Anthracene | < 0.0002 | NA | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Benzo(a)anthracene | < 0.0002 | NA | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Benzo(a)pyrene | < 0.0002 | NA | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Benzo(b)fluoranthene | < 0.0002 | NA | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Benzo(g,h,i)perylene | < 0.0005 | NA | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 |
| Benzo(k)fluoranthene | < 0.0005 | NA | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 |
| Chrysene | < 0.0002 | NA | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Dibenzo(a,h)anthracene | < 0.001 | NA | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Fluoranthene | < 0.0005 | NA | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 |
| Fluorene | < 0.0005 | NA | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 |
| Indeno(1,2,3-cd)pyrene | < 0.0005 | NA | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 |
| Naphthalene | < 0.001 | NA | < 0.001 | < 0.001 | < 0.001 | < 0.001 | < 0.001 |
| Phenanthrene | < 0.0002 | NA | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 | < 0.0002 |
| Pyrene | < 0.0005 | NA | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 | < 0.0005 |

## Woodward Clyde (1997) Badin Lake Surface Water Analytical Results - Plant and Old Brick Landfill Areas

### Alcoa Badin, NC Works RFI

| Sample Designation / Sample Location / Sample Date / Sample Depth / Parameter | WB-NEP-092296-005<br>NEP14<br>9/22/96<br>Bottom Water | WB-NEP-092296-008<br>NEP16<br>9/22/96<br>Bottom Water | WA-NEP-101296-003<br>NEP14<br>10/12/96<br>Top Water | WA-NEP-012297-002<br>NEP4<br>1/22/97<br>Top Water | WA-NEP-012297-003F<br>NEP4<br>1/22/97<br>Top Water | WA-NEP-012297-004<br>NEP14<br>1/22/97<br>Top Water | WA-NEP-012297-005<br>NEP14 (dup)<br>1/22/97<br>Top Water |
|---|---|---|---|---|---|---|---|
| **Miscellaneous (mg/l)[e]** | | | | | | | |
| TOC | 4.6 | 4.4 | NA | NA | NA | NA | NA |
| TSS | 8 | 6.3 | NA | < 3.4 | NA | < 3.4 | NA |
| Alkalinity | 25 | 23 | NA | NA | NA | NA | NA |
| Hardness | 18 | 18 | NA | NA | NA | NA | NA |
| **PCBs[d] (mg/l)** | | | | | | | |
| Aroclor 1248 | < 0.001 | < 0.0013 | NA | NA | NA | NA | NA |
| Aroclor 1260 | < 0.001 | < 0.0013 | NA | NA | NA | NA | NA |
| **Inorganics (mg/l)** | | | | | | | |
| Cyanide, Amenable | < 0.005 | < 0.005 | < 0.005 | NA | NA | NA | NA |
| Cyanide, Free | < 0.005 | < 0.005 | < 0.005 | NA | NA | NA | NA |
| Cyanide, Total | < 0.005 | < 0.005 | < 0.005 | NA | NA | NA | NA |
| Cyanide, Weak Acid Dissocisble | < 0.005 | < 0.005 | < 0.005 | NA | NA | NA | NA |
| Fluoride | < 0.2 | < 0.2 | NA | NA | NA | NA | NA |
| Ammonia | 0.092 | 0.053 | NA | NA | NA | NA | NA |
| Arsenic | < 0.01 | < 0.01 | NA | NA | NA | NA | NA |
| Barium | 0.018 | 0.018 | NA | NA | NA | NA | NA |
| Cadmium | < 0.00005 | < 0.00005 | NA | NA | NA | NA | NA |
| Chromium | < 0.01 | < 0.01 | NA | NA | NA | NA | NA |
| Iron CN | < 0.004 | < 0.004 | < 0.004 | NA | NA | NA | NA |
| Lead | < 0.0005 | < 0.0005 | NA | < 0.0012 | < 0.0012 | < 0.0012 | < 0.0012 |
| Nitrate/Nitrite | 0.36 | 0.36 | NA | NA | NA | NA | NA |
| Nitrite | NA | NA | NA | NA | NA | NA | NA |
| Selenium | < 0.01 | < 0.01 | NA | NA | NA | NA | NA |
| Sodium | 8.3 | 8.8 | NA | NA | NA | NA | NA |
| **SVOCs[f] (mg/l)** | | | | | | | |
| 1-Methylnaphthalene | < 0.001 | < 0.001 | NA | NA | NA | NA | NA |
| 2-Methylnaphthalene | < 0.001 | < 0.001 | NA | NA | NA | NA | NA |
| Acenaphthene | < 0.001 | < 0.001 | NA | NA | NA | NA | NA |
| Acenaphthylene | < 0.001 | < 0.001 | NA | NA | NA | NA | NA |
| Anthracene | < 0.0002 | < 0.0002 | NA | NA | NA | NA | NA |
| Benzo(a)anthracene | < 0.0002 | < 0.0002 | NA | NA | NA | NA | NA |
| Benzo(a)pyrene | < 0.0002 | < 0.0002 | NA | NA | NA | NA | NA |
| Benzo(b)fluoranthene | < 0.0002 | < 0.0002 | NA | NA | NA | NA | NA |
| Benzo(g,h,i)perylene | < 0.0005 | < 0.0005 | NA | NA | NA | NA | NA |
| Benzo(k)fluoranthene | < 0.0005 | < 0.0005 | NA | NA | NA | NA | NA |
| Chrysene | < 0.0002 | < 0.0002 | NA | NA | NA | NA | NA |
| Dibenzo(a,h)anthracene | < 0.001 | < 0.001 | NA | NA | NA | NA | NA |
| Fluoranthene | < 0.0005 | < 0.0005 | NA | NA | NA | NA | NA |
| Fluorene | < 0.0005 | < 0.0005 | NA | NA | NA | NA | NA |
| Indeno(1,2,3-cd)pyrene | < 0.0005 | < 0.0005 | NA | NA | NA | NA | NA |
| Naphthalene | < 0.001 | < 0.001 | NA | NA | NA | NA | NA |
| Phenanthrene | < 0.0002 | < 0.0002 | NA | NA | NA | NA | NA |
| Pyrene | < 0.0005 | < 0.0005 | NA | NA | NA | NA | NA |

Table 4-54

## Woodward Clyde (1997) Badin Lake Surface Water Analytical Results - Plant and Old Brick Landfill Areas

Alcoa Badin, NC Works RFI

| Sample Designation<br>Sample Location<br>Sample Date<br>Sample Depth | WA-NEP-012297-006F<br>NEP14<br>1/22/97<br>Top Water | WA-NEP-012297-007<br>NEP18<br>1/22/97<br>Top Water | WA-NEP-012297-010<br>NEP19<br>1/22/97<br>Top Water | WA-NEP-012297-011<br>NEP8<br>1/22/97<br>Top Water | WA-NEP-012297-013<br>NEP20<br>1/22/97<br>Top Water | WA-NEP-012297-014<br>NEP20 (dup)<br>1/22/97<br>Top Water | WA-NEP-012297-016<br>NEP15<br>1/22/97<br>Top Water |
|---|---|---|---|---|---|---|---|
| Parameter | | | | | | | |
| Miscellaneous (mg/l) [a] | | | | | | | |
| TOC | NA | NA | NA | NA | NA | NA | NA |
| TSS | NA | NA | NA | NA | NA | NA | NA |
| Alkalinity | NA | NA | NA | NA | NA | NA | NA |
| Hardness | NA | NA | NA | NA | NA | NA | NA |
| PCBs [d] (mg/l) | | | | | | | |
| Aroclor 1248 | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1260 | NA | NA | NA | NA | NA | NA | NA |
| Inorganics (mg/l) | | | | | | | |
| Cyanide, Amenable | NA | < 0.005 | < 0.005 | < 0.003 | < 0.005 | < 0.005 | < 0.005 |
| Cyanide, Free | NA | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 |
| Cyanide, Total | NA | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 |
| Cyanide, Weak Acid Dissociable | NA | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 | < 0.005 |
| Fluoride | NA | NA | NA | NA | NA | NA | NA |
| Ammonia | NA | NA | NA | NA | NA | NA | NA |
| Arsenic | NA | NA | NA | NA | NA | NA | NA |
| Barium | NA | NA | NA | NA | NA | NA | NA |
| Cadmium | NA | NA | NA | NA | NA | NA | NA |
| Chromium | NA | NA | NA | NA | NA | NA | NA |
| Iron CN | NA | < 0.004 | < 0.004 | < 0.004 | < 0.004 | < 0.004 | < 0.004 |
| Lead | < 0.0012 | NA | NA | NA | NA | NA | NA |
| Nitrate/Nitrite | NA | NA | NA | NA | NA | NA | NA |
| Nitrite | NA | NA | NA | NA | NA | NA | NA |
| Selenium | NA | NA | NA | NA | NA | NA | NA |
| Sodium | NA | NA | NA | NA | NA | NA | NA |
| SVOCs [f] (mg/l) | | | | | | | |
| 1-Methylnaphthalene | NA | NA | NA | NA | NA | NA | NA |
| 2-Methylnaphthalene | NA | NA | NA | NA | NA | NA | NA |
| Acenaphthene | NA | NA | NA | NA | NA | NA | NA |
| Acenaphthylene | NA | NA | NA | NA | NA | NA | NA |
| Anthracene | NA | NA | NA | NA | NA | NA | NA |
| Benzo(a)anthracene | NA | NA | NA | NA | NA | NA | NA |
| Benzo(a)pyrene | NA | NA | NA | NA | NA | NA | NA |
| Benzo(b)fluoranthene | NA | NA | NA | NA | NA | NA | NA |
| Benzo(g,h,i)perylene | NA | NA | NA | NA | NA | NA | NA |
| Benzo(k)fluoranthene | NA | NA | NA | NA | NA | NA | NA |
| Chrysene | NA | NA | NA | NA | NA | NA | NA |
| Dibenzo(a,h)anthracene | NA | NA | NA | NA | NA | NA | NA |
| Fluoranthene | NA | NA | NA | NA | NA | NA | NA |
| Fluorene | NA | NA | NA | NA | NA | NA | NA |
| Indeno(1,2,3-cd)pyrene | NA | NA | NA | NA | NA | NA | NA |
| Naphthalene | NA | NA | NA | NA | NA | NA | NA |
| Phenanthrene | NA | NA | NA | NA | NA | NA | NA |
| Pyrene | NA | NA | NA | NA | NA | NA | NA |

Table 4-54

**Woodward Clyde (1997) Badin Lake Surface Water Analytical Results - Plant and Old Brick Landfill Areas**

**Alcoa Badin, NC Works RFI**

| Sample Designation<br>Sample Location<br>Sample Date<br>Sample Depth<br>Parameter | WA-NEP-012297-017<br>NEP7<br>1/22/97<br>Top Water | WB-NEP-012297-001<br>NEP4<br>1/22/97<br>Bottom Water | WB-NEP-012297-008<br>NEP18<br>1/22/97<br>Bottom Water | WB-NEP-012297-009<br>NEP19<br>1/22/97<br>Bottom Water | WB-NEP-012297-012<br>NEP8<br>1/22/97<br>Bottom Water | WB-NEP-012297-015<br>NEP20<br>1/22/97<br>Bottom Water |
|---|---|---|---|---|---|---|
| Miscellaneous (mg/l) [a] | | | | | | |
| TOC | NA | NA | NA | NA | NA | NA |
| TSS | NA | NA | NA | NA | NA | NA |
| Alkalinity | NA | NA | NA | NA | NA | NA |
| Hardness | NA | NA | NA | NA | NA | NA |
| PCBs[d] (mg/l) | | | | | | |
| Aroclor 1248 | NA | NA | NA | NA | NA | NA |
| Aroclor 1260 | NA | NA | NA | NA | NA | NA |
| Inorganics (mg/l) | | | | | | |
| Cyanide, Amenable | 0.024 | NA | < 0.005 | < 0.005 | < 0.005 | < 0.005 |
| Cyanide, Free | < 0.005 | NA | < 0.005 | < 0.005 | < 0.005 | < 0.005 |
| Cyanide, Total | 0.031 | NA | < 0.005 | < 0.005 | < 0.005 | < 0.005 |
| Cyanide, Weak Acid Dissociable | 0.011 | NA | < 0.005 | < 0.005 | < 0.005 | < 0.005 |
| Fluoride | NA | NA | NA | NA | NA | NA |
| Ammonia | NA | NA | NA | NA | NA | NA |
| Arsenic | NA | NA | NA | NA | NA | NA |
| Barium | NA | NA | NA | NA | NA | NA |
| Cadmium | NA | NA | NA | NA | NA | NA |
| Chromium | NA | NA | NA | NA | NA | NA |
| Iron CN | 0.000015 | NA | < 0.004 | < 0.004 | < 0.004 | < 0.004 |
| Lead | NA | NA | NA | NA | NA | NA |
| Nitrate/Nitrite | NA | NA | NA | NA | NA | NA |
| Nitrite | NA | < 0.5 | NA | NA | NA | NA |
| Selenium | NA | NA | NA | NA | NA | NA |
| Sodium | NA | NA | NA | NA | NA | NA |
| SVOCs[f] (mg/l) | | | | | | |
| 1-Methylnaphthalene | NA | NA | NA | NA | NA | NA |
| 2-Methylnaphthalene | NA | NA | NA | NA | NA | NA |
| Acenaphthene | NA | NA | NA | NA | NA | NA |
| Acenaphthylene | NA | NA | NA | NA | NA | NA |
| Anthracene | NA | NA | NA | NA | NA | NA |
| Benzo(a)anthracene | NA | NA | NA | NA | NA | NA |
| Benzo(a)pyrene | NA | NA | NA | NA | NA | NA |
| Benzo(b)fluoranthene | NA | NA | NA | NA | NA | NA |
| Benzo(g,h,i)perylene | NA | NA | NA | NA | NA | NA |
| Benzo(k)fluoranthene | NA | NA | NA | NA | NA | NA |
| Chrysene | NA | NA | NA | NA | NA | NA |
| Dibenzo(a,h)anthracene | NA | NA | NA | NA | NA | NA |
| Fluoranthene | NA | NA | NA | NA | NA | NA |
| Fluorene | NA | NA | NA | NA | NA | NA |
| Indeno(1,2,3-cd)pyrene | NA | NA | NA | NA | NA | NA |
| Naphthalene | NA | NA | NA | NA | NA | NA |
| Phenanthrene | NA | NA | NA | NA | NA | NA |
| Pyrene | NA | NA | NA | NA | NA | NA |

NOTES:

[a] mg/l = milligrams/liter

[b] NA = not analyzed

[c] < = not detected at indicated detection limit

[d] PCBs = Polychlorinated Biphenyls

[e] J = estimated value

[f] SVOCs = semi-volatile organic compounds

Table 4-55

Woodward Clyde (1997) Badin Lake Sediment Analytical Results - Plant and Old Brick Landfill Areas

Alcoa Badin, NC Works RFI

| Sample Designation<br>Sample Location<br>Sample Date | SX-NEP-092296-003<br>NEP4<br>9/22/96 | SX-OBL-092296-002<br>OBL1<br>9/22/96 | SX-NEP-092396-009<br>NEP16<br>9/23/96 | SX-NEP-092396-010<br>NEP16(dup)<br>9/23/96 | SX-NEP-101296-001<br>NEP16<br>10/12/96 | SX-NEP-101296-002<br>NEP16(dup)<br>10/12/96 | SX-NEP-101296-004<br>NEP4<br>10/12/96 |
|---|---|---|---|---|---|---|---|
| Sample Depth<br>Parameter | Surface Sed | Surface Sed | Surface Sed | Surface Sed | Surface Sed | Surface Sed | Surface Sed |
| Miscellaneous | | | | | | | |
| % Moisture | NA[a] | NA | NA | NA | NA | NA | NA |
| AVS SEM | NA | NA | NA | NA | NA | NA | NA |
| TOC | 120000 | 8000 | 380000 | 410000 | NA | NA | NA |
| PCBs[b] [mg/kg][c] | | | | | | | |
| Aroclor 1242 | NA[d][e] | NA | NA | NA | NA | NA | NA |
| Aroclor 1248 | < 2.6 J | < 0.87 J | < 2.2 | < 2.9 | NA | NA | NA |
| Aroclor 1254 | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1260 | < 2.6 J | < 0.87 J | 4.3 | 6.5 | NA | NA | NA |
| Inorganics [mg/kg] | | | | | | | |
| CYANIDE, AMENABLE | NA | NA | NA | NA | < 0.5 | < 0.5 | 2.1 |
| CYANIDE, FREE | NA | NA | NA | NA | < 0.5 | < 0.5 | < 0.5 |
| Cyanide, Total | NA | NA | NA | NA | 7.1 | 6.2 | 5.2 |
| Cyanide, Weak Acid Dissociable | NA | NA | NA | NA | < 0.5 | 1.5 | 3.4 |
| Fluoride | 50 | < 5.8 | < 8.5 | < 8.6 | NA | NA | NA |
| Arsenic | 11 | 37 | 4.5 | 7.8 | NA | NA | NA |
| Barium | 64 | 68 | 120 | 110 | NA | NA | NA |
| Cadmium | 1.1 | 2.7 | 1.6 | 1.6 | NA | NA | NA |
| Chromium | 23 | 25 | 36 | 38 | NA | NA | NA |
| Iron CN | NA | NA | NA | NA | 5.2 | 5.8 | 3.5 |
| Lead | 29 | 7.4 | 46 | 50 | NA | NA | NA |
| Selenium | < 1 | < 1 | < 1 | 1.8 | NA | NA | NA |
| SVOCs[f] [mg/kg] | | | | | | | |
| 1-Methylnaphthalene | < 7.9 | < 0.032 | < 11 | < 11 | NA | NA | NA |
| 2-Methylnaphthalene | < 7.9 | < 0.032 | < 11 | < 11 | NA | NA | NA |
| Acenaphthene | < 7.9 | < 0.032 | < 11 | < 11 | NA | NA | NA |
| Acenaphthylene | < 7.9 J | < 0.032 | < 11 | < 11 | NA | NA | NA |
| Anthracene | 3.1 J | < 0.0063 | 12 | 10 | NA | NA | NA |
| Benzo(a)anthracene | 11 J | 0.021J | 53 | 51 | NA | NA | NA |
| Benzo(a)pyrene | 13 J | 0.03 J | 51 | 48 | NA | NA | NA |
| Benzo(b)fluoranthene | 16 J | 0.079J | 62 | 60 | NA | NA | NA |
| Benzo(g,h,i)perylene | 11 J | 0.041J | 34 | 33 | NA | NA | NA |
| Benzo(k)fluoranthene | 6.4 J | 0.021 J | 27 | 26 | NA | NA | NA |
| Chrysene | 11 J | 0.027 J | 54 | 52 | NA | NA | NA |
| Dibenzo(a,h)anthracene | < 7.9 | 0.03 J | 29 | 25 | NA | NA | NA |
| Fluoranthene | 23 J | 0.033 J | 100 | 100 | NA | NA | NA |
| Fluorene | < 4 | < 0.016 | < 5.6 | < 5.4 | NA | NA | NA |
| Indeno(1,2,3-cd)pyrene | 10 J | 0.035 J | 35 | 30 | NA | NA | NA |
| Naphthalene | < 7.9 | < 0.032 | < 11 | < 11 | NA | NA | NA |
| Phenanthrene | 14 J | 0.013 J | 40 | 39 | NA | NA | NA |
| Pyrene | 16 J | 0.023 J | 78 | 69 | NA | NA | NA |

Table 4-55

## Woodward Clyde (1997) Badin Lake Sediment Analytical Results - Plant and Old Brick Landfill Areas

Alcoa Badin, NC Works RFI

| Sample Designation / Sample Location / Sample Date / Sample Depth | SX-OBL-101296-002<br>OBL1<br>10/12/96<br>Surface Sed | SA-SWC-012097-001<br>NEP2<br>1/20/97<br>Surface Sed | SA-SWC-012097-002<br>NEP6<br>1/20/97<br>Surface Sed | SA-SWC-012097-003<br>NEP11<br>1/20/97<br>Surface Sed | SA-SWC-012097-004<br>NEP12<br>1/20/97<br>Surface Sed | SA-SWC-012097-005<br>NEP12<br>1/20/97<br>Surface Sed | SA-SWC-012097-006<br>NEP13<br>1/20/97<br>Surface Sed |
|---|---|---|---|---|---|---|---|
| **Parameter** | | | | | | | |
| **Miscellaneous** | | | | | | | |
| % Moisture | NA | 55.6 | 47.9 | 16.4 | 60.4 | 60.8 | 46.9 |
| AVS SEM | NA | NA | NA | NA | NA | NA | NA |
| TOC | NA | 17400 | 8400 | 1570 | 9600 | 14100 | 8300 |
| PCBs[b] [mg/kg][c] | | | | | | | |
| Aroclor 1242 | NA | < 0.0023 | < 0.002 | < 0.0012 | < 0.0026 | < 0.0027 | < 0.002 |
| Aroclor 1248 | NA | 0.0221 J | 0.251 | 0.051 | 0.097 | 0.175 | 0.166 |
| Aroclor 1254 | NA | 0.0197 J | 0.151 | 0.0182 J | 0.257 | 0.545 | 0.394 |
| Aroclor 1260 | NA | 0.012 J | 0.183 | 0.0118 J | 0.044 | 0.114 | 0.062 |
| **Inorganics [mg/kg]** | | | | | | | |
| CYANIDE, AMENABLE | 14 | NA | NA | NA | NA | NA | NA |
| CYANIDE, FREE | < 0.5 | NA | NA | NA | NA | NA | NA |
| Cyanide, Total | 40 | NA | NA | NA | NA | NA | NA |
| Cyanide, Weak Acid Dissociable | 1.2 | NA | NA | NA | NA | NA | NA |
| Fluoride | NA | NA | NA | NA | NA | NA | NA |
| Arsenic | NA | NA | NA | NA | NA | NA | NA |
| Barium | NA | NA | NA | NA | NA | NA | NA |
| Cadmium | NA | NA | NA | NA | NA | NA | NA |
| Chromium | NA | NA | NA | NA | NA | NA | NA |
| Iron CN | 37 | NA | NA | NA | NA | NA | NA |
| Lead | NA | NA | NA | NA | NA | NA | NA |
| Selenium | NA | NA | NA | NA | NA | NA | NA |
| **SVOCs[f] [mg/kg]** | | | | | | | |
| 1-Methylnaphthalene | NA | NA | NA | NA | NA | NA | NA |
| 2-Methylnaphthalene | NA | NA | NA | NA | NA | NA | NA |
| Acenaphthene | NA | < 0.075 | < 0.064 | 0.13 | 0.43 J | 0.52 J | 0.34 J |
| Acenaphthylene | NA | < 0.075 | < 0.064 | < 0.04 | < 0.084 | < 0.085 | < 0.063 |
| Anthracene | NA | < 0.075 | 0.12 J | 0.22 J | 1 | 1.2 | 0.86 |
| Benzo(a)anthracene | NA | 0.75 J | 0.81 | 0.98 | 6 | 7.8 | 4.8 |
| Benzo(a)pyrene | NA | 0.83 | 0.85 | 1.2 | 7.2 | 9.1 | 5.9 |
| Benzo(b)fluoranthene | NA | 2.4 | 1.7 | 1.7 | 11 | 11 | 9.5 |
| Benzo(g,h,i)perylene | NA | 0.77 | 0.78 | 0.86 | 5.1 | 7 | 4.6 |
| Benzo(k)fluoranthene | NA | 0.59 J | 0.5 J | 0.55 | 3.7 | 4.7 | 3.1 |
| Chrysene | NA | 1.3 | 1 | 1.1 | 7.2 | 9.2 | 5.7 |
| Dibenzo(a,h)anthracene | NA | < 0.15 | < 0.13 | < 0.08 | 1.5 | 2 | 1.2 |
| Fluoranthene | NA | 1 | 1.3 | 1.7 | 8.3 | 9.8 | 6.2 |
| Fluorene | NA | < 0.075 | < 0.064 | < 0.04 | 0.33 J | 0.41 J | 0.31 J |
| Indeno(1,2,3-cd)pyrene | NA | < 0.15 | 0.72 | 0.91 | 5.4 | 7.6 | 4.6 |
| Naphthalene | NA | < 0.075 | < 0.064 | 0.047 J | < 0.084 | < 0.085 | 0.11 J |
| Phenanthrene | NA | 0.34 J | 0.59 J | 0.8 | 3.4 | 4.2 | 3 |
| Pyrene | NA | 1 | 1.3 | 1.5 | 8.2 | 9.5 | 6.2 |

Table 4-55

## Woodward Clyde (1997) Badin Lake Sediment Analytical Results - Plant and Old Brick Landfill Areas

### Alcoa Badin, NC Works RFI

| Sample Designation<br>Sample Location<br>Sample Date<br>Sample Depth | SA-SWC-012097-007<br>NEP21<br>1/20/97<br>Surface Sed | SA-SWC-012097-008<br>NEP3<br>1/20/97<br>Surface Sed | SA-SWC-012097-010<br>NEP5<br>1/20/97<br>Surface Sed | SA-SWC-012097-012<br>NEP17<br>1/20/97<br>Surface Sed | SA-SWC-012097-015<br>NEP10<br>1/20/97<br>Surface Sed | SA-SWC-012097-017<br>NEP9<br>1/20/97<br>Surface Sed | SA-SWC-012097-018<br>NEP1<br>1/20/97<br>Surface Sed |
|---|---|---|---|---|---|---|---|
| **Parameter** | | | | | | | |
| **Miscellaneous** | | | | | | | |
| % Moisture | 61.7 | 26.9 | 48.8 | 63.4 | 55.4 | 54.6 | 27.5 |
| AVS SEM | NA | NA | NA | NA | NA | NA | NA |
| TOC | 11900 | 3600 | 7900 | 9900 | 9100 | 13200 | 5710 |
| **PCBs[b] [mg/kg][c]** | | | | | | | |
| Aroclor 1242 | < 0.0027 | < 0.0014 | < 0.002 | < 0.0028 | < 0.0023 | < 0.0023 | < 0.0014 |
| Aroclor 1248 | 0.202 | < 0.0038 | 0.093 | 1.07 | 0.213 | 0.053 | < 0.0039 |
| Aroclor 1254 | 0.261 | < 0.0031 | < 0.0044 | 1.5 | 0.211 | 0.078 | 0.0046 J |
| Aroclor 1260 | 0.094 | < 0.0035 | 0.157 | 0.419 | 0.327 | 0.073 | 0.0058 J |
| **Inorganics [mg/kg]** | | | | | | | |
| CYANIDE, AMENABLE | NA | NA | NA | NA | NA | NA | NA |
| CYANIDE, FREE | NA | NA | NA | NA | NA | NA | NA |
| Cyanide, Total | NA | NA | NA | NA | NA | NA | NA |
| Cyanide, Weak Acid Dissociable | NA | NA | NA | NA | NA | NA | NA |
| Fluoride | NA | NA | NA | NA | NA | NA | NA |
| Arsenic | NA | NA | NA | NA | NA | NA | NA |
| Barium | NA | NA | NA | NA | NA | NA | NA |
| Cadmium | NA | NA | NA | NA | NA | NA | NA |
| Chromium | NA | NA | NA | NA | NA | NA | NA |
| Iron CN | NA | NA | NA | NA | NA | NA | NA |
| Lead | NA | NA | NA | NA | NA | NA | NA |
| Selenium | NA | NA | NA | NA | NA | NA | NA |
| **SVOCs[f] [mg/kg]** | | | | | | | |
| 1-Methylnaphthalene | NA | NA | NA | NA | NA | NA | NA |
| 2-Methylnaphthalene | NA | NA | NA | NA | NA | NA | NA |
| Acenaphthene | 0.42 J | < 0.046 | 0.14 J | 0.48 J | < 0.075 | < 0.073 | < 0.046 |
| Acenaphthylene | < 0.087 | < 0.046 | < 0.065 | < 0.091 | < 0.075 | < 0.073 | < 0.046 |
| Anthracene | 0.54 J | < 0.046 | 0.36 J | 1.3 | 0.094 J | 0.16 J | < 0.046 |
| Benzo(a)anthracene | 2.9 | < 0.046 | 2.1 | 9.3 | 0.71 J | 1 | 0.15 J |
| Benzo(a)pyrene | 3.4 | < 0.091 | 2.4 | 10 | 0.69 J | 1.1 | 0.18 J |
| Benzo(b)fluoranthene | 5 | < 0.091 | 4.5 | 13 | 1.2 | 1.9 | 0.27 J |
| Benzo(g,h,i)perylene | 2.2 | < 0.091 | 2 | 8.6 | 0.73 J | 0.89 | 0.15 |
| Benzo(k)fluoranthene | 1.7 | < 0.18 | 1.2 | 5.3 | 0.4 J | 0.53 J | < 0.18 |
| Chrysene | 3.6 | < 0.046 | 2.8 | 11 | 0.88 | 1.4 | 0.2 J |
| Dibenzo(a,h)anthracene | 0.68 J | < 0.091 | < 0.13 | 2.5 | 0.23 J | 0.28 J | < 0.092 |
| Fluoranthene | 4.3 | 0.063 J | 2.8 | 14 | 1.3 | 1.9 | 0.25 J |
| Fluorene | 0.5 J | < 0.046 | 0.12 J | 0.35 J | < 0.075 | < 0.073 | < 0.046 |
| Indeno(1,2,3-cd)pyrene | 2.5 | < 0.091 | 2.1 | 9.2 | 0.83 | 1 | 0.22J |
| Naphthalene | 0.26 J | < 0.046 | 0.096 J | < 0.091 | < 0.075 | < 0.073 | < 0.046 |
| Phenanthrene | 1.3 | < 0.046 | 1.3 | 4.4 | 0.46 J | 0.61 J | 0.086 J |
| Pyrene | 4.3 | < 0.091 | 2.8 | 11 | 0.87 | 1.2 | 0.16 J |

Table 4-55

Woodward Clyde (1997) Badin Lake Sediment Analytical Results - Plant and Old Brick Landfill Areas

Alcoa Badin, NC Works RFI

| Sample Designation<br>Sample Location<br>Sample Date<br>Sample Depth | SB-SWC-012097-009<br>NEP3<br>1/20/97<br>Bottom Sed | SB-SWC-012097-011<br>NEP5<br>1/20/97<br>Bottom Sed | SB-SWC-012097-013<br>NEP17<br>1/20/97<br>Bottom Sed | SB-SWC-012097-014<br>NEP17 (dup)<br>1/20/97<br>Bottom Sed | SB-SWC-012097-016<br>NEP10<br>1/20/97<br>Bottom Sed | SA-002-012197-001<br>NEP24<br>1/21/97<br>Surface Sed | SA-002-012197-002<br>NEP23<br>1/21/97<br>Surface Sed |
|---|---|---|---|---|---|---|---|
| Parameter | | | | | | | |
| Miscellaneous | | | | | | | |
| % Moisture | 29.7 | 42.6 | 52 | 57.8 | 45.1 | 38.3 | 23.2 |
| AVS SEM | NA | NA | NA | NA | NA | NA | NA |
| TOC | 5500 | 7500 | 7900 | 8600 | 7400 | 3740 | 2220 |
| PCBs[e] [mg/kg][c] | | | | | | | |
| Aroclor 1242 | < 0.0015 | < 0.0018 | < 0.0022 | < 0.0025 | < 0.0019 | 3.35 | < 0.0014 J |
| Aroclor 1248 | < 0.004 | 0.328 | 0.106 | 0.138 | 0.034 | < 0.023 | 0.323 J |
| Aroclor 1254 | < 0.0032 | < 0.0039 | 0.191 | 0.269 | 0.045 | 0.75 | 0.204 J |
| Aroclor 1260 | < 0.0036 | 0.495 | 0.044 | 0.073 | 0.06 | 0.22 | 0.064 J |
| Inorganics [mg/kg] | | | | | | | |
| CYANIDE, AMENABLE | NA | NA | NA | NA | NA | NA | NA |
| CYANIDE, FREE | NA | NA | NA | NA | NA | NA | NA |
| Cyanide, Total | NA | NA | NA | NA | NA | NA | NA |
| Cyanide, Weak Acid Dissociable | NA | NA | NA | NA | NA | NA | NA |
| Fluoride | NA | NA | NA | NA | NA | NA | NA |
| Arsenic | NA | NA | NA | NA | NA | NA | NA |
| Barium | NA | NA | NA | NA | NA | NA | NA |
| Cadmium | NA | NA | NA | NA | NA | NA | NA |
| Chromium | NA | NA | NA | NA | NA | NA | NA |
| Iron CN | NA | NA | NA | NA | NA | NA | NA |
| Lead | NA | NA | NA | NA | NA | NA | NA |
| Selenium | NA | NA | NA | NA | NA | NA | NA |
| SVOCs[f] [mg/kg] | | | | | | | |
| 1-Methylnaphthalene | NA | NA | NA | NA | NA | NA | NA |
| 2-Methylnaphthalene | NA | NA | NA | NA | NA | NA | NA |
| Acenaphthene | < 0.047 | 0.089 J | 0.47 J | 0.44 J | < 0.061 | 8.4 J | 3.5 J |
| Acenaphthylene | < 0.047 | < 0.058 | < 0.069 | < 0.079 | < 0.061 | 0.16 J | < 0.22 J |
| Anthracene | < 0.047 | 0.21 J | 1.7 | 1.4 | < 0.061 | 28 J | 16 J |
| Benzo(a)anthracene | 0.069 J | 1.2 | 11 | 9.4 | 0.33 J | 190 J | 77 J |
| Benzo(a)pyrene | < 0.095 | 1.4 | 9.4 | 8.3 | 0.34 J | 180 J | 75 J |
| Benzo(b)fluoranthene | 0.31 J | 2.1 | 19 | 16 | 0.64 | 250 J | 98 J |
| Benzo(g,h,i)perylene | < 0.095 | 1.3 | 7 | 6.7 | 0.41 J | 130 J | 48 J |
| Benzo(k)fluoranthene | < 0.19 | 0.74 | 5 | 4.7 | < 0.24 | 94 J | 30 J |
| Chrysene | 0.36 J | 1.6 | 18 | 15 | 0.47 J | 210 J | 85 J |
| Dibenzo(a,h)anthracene | < 0.095 | 0.41 J | 2.1 | 2 | < 0.12 | 42 J | 16 J |
| Fluoranthene | 0.065 J | 2.5 | 30 | 24 | 0.67 | 360 J | 150 J |
| Fluorene | < 0.047 | 0.084 J | 0.52 J | 0.48 J | < 0.061 | 7.3 J | 3 J |
| Indeno(1,2,3-cd)pyrene | < 0.095 | 1.3 | 6.5 | 6.2 | 0.47 J | 140 J | 54 J |
| Naphthalene | < 0.047 | 0.063 J | 0.1 J | 0.09 J | < 0.061 | 1.3 J | 0.92 J |
| Phenanthrene | < 0.047 | 1 | 6.6 | 5.6 | 0.3 J | 100 J | 40 J |
| Pyrene | < 0.095 | 1.6 | 20 | 16 | 0.45 J | 230 J | 96 J |

Table 4-55

Woodward Clyde (1997) Badin Lake Sediment Analytical Results - Plant and Old Brick Landfill Areas

Alcoa Badin, NC Works RFI

| Sample Designation<br>Sample Location<br>Sample Date | SA-002-012197-003<br>NEP22<br>1/21/97 | SA-NEP-012197-001<br>NEP4<br>1/21/97 | SA-NEP-012197-002<br>NEP16<br>1/21/97 | SA-NEP-012197-003<br>NEP8<br>1/21/97 | SA-NEP-012197-004<br>NEP8(dup)<br>1/21/97 | SA-NEP-012197-005<br>NEP20<br>1/21/97 |
|---|---|---|---|---|---|---|
| Sample Depth | Surface Sed | Surface Sed | Surface Sed | Surface Sed | Surface Sed | Surface Sed |
| Parameter | | | | | | |
| Miscellaneous | | | | | | |
| % Moisture | 37.4 | 32.2 | 62.1 | NA | NA | NA |
| AVS SEM | NA | 0.0118 J | 0.0475 | NA | NA | NA |
| TOC | 5620 | NA | NA | NA | NA | NA |
| PCBs[b] [mg/kg][c] | | | | | | |
| Aroclor 1242 | < 0.0017 | NA | NA | NA | NA | NA |
| Aroclor 1248 | 0.127 | NA | NA | NA | NA | NA |
| Aroclor 1254 | 0.117 | NA | NA | NA | NA | NA |
| Aroclor 1260 | 0.05 | NA | NA | NA | NA | NA |
| Inorganics [mg/kg] | | | | | | |
| CYANIDE, AMENABLE | NA | NA | NA | 1 | < 0.5 | 1.9 |
| CYANIDE, FREE | NA | NA | NA | < 0.5 | < 0.5 | < 0.5 |
| Cyanide, Total | NA | NA | NA | 1 | 0.5 | 3.7 |
| Cyanide, Weak Acid Dissociable | NA | NA | NA | 0.7 | 0.5 | 0.8 |
| Fluoride | NA | NA | NA | NA | NA | NA |
| Arsenic | NA | NA | NA | NA | NA | NA |
| Barium | NA | NA | NA | NA | NA | NA |
| Cadmium | NA | 0.76 J | 3 J | NA | NA | NA |
| Chromium | NA | NA | NA | NA | NA | NA |
| Iron CN | NA | NA | NA | 0.8 | 0.5 | 1.4 |
| Lead | NA | 15.4 | 36 | NA | NA | NA |
| Selenium | NA | NA | NA | NA | NA | NA |
| SVOCs[f] [mg/kg] | | | | | | |
| 1-Methylnaphthalene | NA | NA | NA | NA | NA | NA |
| 2-Methylnaphthalene | NA | NA | NA | NA | NA | NA |
| Acenaphthene | 0.86 J | NA | NA | NA | NA | NA |
| Acenaphthylene | < 0.053 J | NA | NA | NA | NA | NA |
| Anthracene | 4.6 J | NA | NA | NA | NA | NA |
| Benzo(a)anthracene | 33 J | NA | NA | NA | NA | NA |
| Benzo(a)pyrene | 35 J | NA | NA | NA | NA | NA |
| Benzo(b)fluoranthene | 48 J | NA | NA | NA | NA | NA |
| Benzo(g,h,i)perylene | 23 J | NA | NA | NA | NA | NA |
| Benzo(k)fluoranthene | 18 J | NA | NA | NA | NA | NA |
| Chrysene | 38 J | NA | NA | NA | NA | NA |
| Dibenzo(a,h)anthracene | 7.1 J | NA | NA | NA | NA | NA |
| Fluoranthene | 54 J | NA | NA | NA | NA | NA |
| Fluorene | 0.61 J | NA | NA | NA | NA | NA |
| Indeno(1,2,3-cd)pyrene | 25 J | NA | NA | NA | NA | NA |
| Naphthalene | 0.24 J | NA | NA | NA | NA | NA |
| Phenanthrene | 16 J | NA | NA | NA | NA | NA |
| Pyrene | 36 J | NA | NA | NA | NA | NA |

[a] NA = not analyzed
[b] PCBs = Polychlorinated Biphenyls
[c] mg/kg = milligrams per kilogram
[d] < = not detected at indicated detection limit
[e] J = estimated value
[f] SVOCs = semi-volatile organic compounds

## Table 4-56

## Badin Lake
## Phase II RFI Surface-Water Analytical Results

### Alcoa Badin, NC Works RFI

| Sample Designation<br>Sample Date<br>Parameter | NE-SW-2520<br>9/7/00 | NE-SW-2520D<br>9/7/00 |
|---|---|---|
| **VOCs (mg/l)[a]** | | |
| Trichloroethene | < 0.001 | < 0.001 |

[a] mg/l = milligrams per liter

Table 4-57

## Surface Water Screening Table
## Badin Lake - Plant Area

### Alcoa Badin, NC Works RFI

| Constituent | Number Detected | Number Analyzed | Units | Minimum Detection | Maximum Detection | North Carolina[a] Human Health 2B Standards | USEPA[b] WQC | NC 2B Standard | USEPA WQC |
|---|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | | |
| Barium | 7 | 7 | mg/l[c] | 0.016 | 0.018 | 1 | 1 | | |
| Cadmium | 1 | 7 | mg/l | 0.00016 | 0.00016 | NA | NA | | |
| Iron CN | 1 | 18 | mg/l | 0.000015 | 0.000015 | NA | NA | | |
| Lead | 3 | 12 | mg/l | 0.0005 | 0.00094 | NA | NA | | |
| Sodium | 7 | 7 | mg/l | 8.2 | 8.8 | NA | NA | | |
| **Other** | | | | | | | | | |
| Ammonia | 7 | 7 | mg/l | 0.036 | 0.19 | NA | NA | | |
| Cyanide, Amenable | 1 | 18 | mg/l | 0.024 | 0.024 | NA | 0.7 | | |
| Cyanide, Free | 0 | 18 | mg/l | NA | NA | NA | 0.7 | | |
| Cyanide, Total | 1 | 18 | mg/l | 0.031 | 0.031 | NA | 0.7 | | |
| Cyanide, Weak Acid Dissociable | 1 | 18 | mg/l | 0.011 | 0.011 | NA | 0.7 | | |
| Nitrate/Nitrite | 7 | 7 | mg/l | 0.34 | 1.1 | 10 | 10 | | |
| **VOCs[d]** None Detected | | | | | | | | | |
| **PCBs[e]** None Detected | | | | | | | | | |
| **PAHs[f]** None Detected | | | | | | | | | |

Notes:

[a] NC 2B Standards for the protection of human health (Class W-IV Waters 15 A NCAC 02B.0216 (3)(g)(i, ii) (NCDENR, 2000)

[b] USEPA Recommended Water Quality Criteria (WQC) for the protection of human health (for consumption of water and organisms) (USEPA, 1999)

[c] mg/l = milligrams per liter

[d] VOCs = Volatile Organic Compounds

[e] PCBs = Polychlorinated Biphenyls

[f] PAHs = Polyaromatic Hydrocarbons

## Table 4-58

### Sediment Screening Table (All Samples)
### Badin Lake - Plant Area

### Alcoa Badin, NC Works RFI

| Constituent | Number Detected | Number Analyzed | Units | Minimum Detection | | Maximum Detection | | USEPA Region III Industrial Soil RBC [a] | Ind RBC |
|---|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | | |
| Arsenic | 3 | 3 | mg/kg[b] | 4.5 | | 11 | | 3.8 | ✓ |
| Barium | 3 | 3 | mg/kg | 64 | | 120 | | 140000 | |
| Cadmium | 5 | 5 | mg/kg | 0.76 | | 3 | | 2000 | |
| Chromium | 3 | 3 | mg/kg | 23 | | 38 | | 6100 | |
| Iron CN | 7 | 7 | mg/kg | 0.5 | | 5.8 | | NA | |
| Lead | 5 | 5 | mg/kg | 15.4 | | 50 | | 1000 | |
| Selenium | 1 | 3 | mg/kg | 1.8 | | 1.8 | | 10000 | |
| **Other** | | | | | | | | | |
| Cyanide, Amenable | 3 | 7 | mg/kg | 1 | | 2.1 | | NA | |
| Cyanide, Free | 0 | 7 | mg/kg | NA | | NA | | NA | |
| Cyanide, Total | 7 | 7 | mg/kg | 0.5 | | 7.1 | | 41000 | |
| Cyanide, Weak Acid Dissociable | 6 | 7 | mg/kg | 0.5 | | 3.4 | | 41000 | |
| Fluoride | 1 | 3 | mg/kg | 50 | | 50 | | 120000 | |
| **PCBs** | | | | | | | | | |
| Aroclor 1242 | 1 | 20 | mg/kg | 3.35 | | 3.35 | | 2.9 | ✓ |
| Aroclor 1248 | 16 | 23 | mg/kg | 0.0221 | | 1.07 | | 2.9 | |
| Aroclor 1254 | 16 | 20 | mg/kg | 0.0046 | | 1.5 | | 2.9 | |
| Aroclor 1260 | 20 | 23 | mg/kg | 0.0058 | | 6.5 | | 2.9 | ✓ |
| **SVOCs** | | | | | | | | | |
| Acenaphthene | 12 | 23 | mg/kg | 0.089 | J | 8.4 | J | 120000 | |
| Acenaphthylene | 1 | 23 | mg/kg | 0.16 | J | 0.16 | J | 120000 | |
| Anthracene | 18 | 23 | mg/kg | 0.094 | | 28 | | 610000 | |
| Benzo(a)anthracene | 22 | 23 | mg/kg | 0.069 | | 190 | | 7.8 | ✓ |
| Benzo(a)pyrene | 21 | 23 | mg/kg | 0.18 | | 180 | | 0.78 | ✓ |
| Benzo(b)fluoranthene | 22 | 23 | mg/kg | 0.27 | | 250 | | 7.8 | ✓ |
| Benzo(g,h,i)perylene[c] | 21 | 23 | mg/kg | 0.15 | | 130 | | 61000 | |
| Benzo(k)fluoranthene | 19 | 23 | mg/kg | 0.4 | | 94 | | 78 | ✓ |
| Chrysene | 22 | 23 | mg/kg | 0.2 | | 210 | | 780 | |
| Dibenzo(a,h)anthracene | 14 | 23 | mg/kg | 0.23 | | 42 | | 0.78 | ✓ |
| Fluoranthene | 23 | 23 | mg/kg | 0.063 | | 360 | | 82000 | |
| Fluorene | 11 | 23 | mg/kg | 0.084 | J | 7.3 | J | 82000 | |
| Indeno(1,2,3-cd)pyrene | 20 | 23 | mg/kg | 0.22 | | 140 | | 7.8 | ✓ |
| Naphthalene | 10 | 23 | mg/kg | 0.047 | J | 1.3 | J | 41000 | |
| Phenanthrene[d] | 21 | 23 | mg/kg | 0.086 | | 100 | | 61000 | |
| Pyrene | 21 | 23 | mg/kg | 0.16 | | 230 | | 61000 | |

Notes:

[a] Risk-Based Concentration (USEPA, 2000b) for industrial soil;
screening criteria are conservative for less frequently contacted medium of sediment.

[b] mg/kg = milligrams per kilogram.

[c] RBC for Pyrene used as a Surrogate.

Detected concentration of arsenic in sediment is below Plant-area background soil arsenic level of 33 mg/kg.

Table 4-59

## Sediment Screening Table (Samples from Swimming Cove and <10 feet deep)
## Badin Lake - Plant Area

### Alcoa Badin, NC Works RFI

| Constituent | Number Detected | Number Analyzed | Units | Minimum Detection | | Maximum Detection | | USEPA Region III Industrial Soil RBC[(a)] | Ind RBC |
|---|---|---|---|---|---|---|---|---|---|
| **PCBs[(b)]** | | | | | | | | | |
| Aroclor 1248 | 4 | 7 | mg/kg[(c)] | 0.0221 | | 0.328 | | 2.9 | |
| Aroclor 1254 | 3 | 7 | mg/kg | 0.0046 | J | 0.0197 | J | 2.9 | |
| Aroclor 1260 | 5 | 7 | mg/kg | 0.0058 | | 0.495 | | 2.9 | |
| **SVOCs[(d)]** | | | | | | | | | |
| Acenaphthene | 3 | 7 | mg/kg | 0.089 | J | 0.14 | J | 120000 | |
| Anthracene | 3 | 7 | mg/kg | 0.21 | J | 0.36 | J | 610000 | |
| Benzo(a)anthracene | 6 | 7 | mg/kg | 0.069 | | 2.1 | | 7.8 | |
| Benzo(a)pyrene | 5 | 7 | mg/kg | 0.18 | | 2.4 | | 0.78 | ✓ |
| Benzo(b)fluoranthene | 6 | 7 | mg/kg | 0.27 | | 4.5 | | 7.8 | |
| Benzo(g,h,i)perylene[(e)] | 5 | 7 | mg/kg | 0.15 | | 2 | | 61000 | |
| Benzo(k)fluoranthene | 4 | 7 | mg/kg | 0.55 | | 1.2 | | 78 | |
| Chrysene | 6 | 7 | mg/kg | 0.2 | | 2.8 | | 780 | |
| Dibenzo(a,h)anthracene | 1 | 7 | mg/kg | 0.41 | J | 0.41 | J | 0.78 | |
| Fluoranthene | 7 | 7 | mg/kg | 0.063 | | 2.8 | | 82000 | |
| Fluorene | 2 | 7 | mg/kg | 0.084 | J | 0.12 | J | 82000 | |
| Indeno(1,2,3-cd)pyrene | 4 | 7 | mg/kg | 0.22 | | 2.1 | | 7.8 | |
| Naphthalene | 3 | 7 | mg/kg | 0.047 | J | 0.096 | J | 41000 | |
| Phenanthrene[(c)] | 5 | 7 | mg/kg | 0.086 | | 1.3 | | 61000 | |
| Pyrene | 5 | 7 | mg/kg | 0.16 | | 2.8 | | 61000 | |

Notes:

[(a)] Risk-Based Concentration (USEPA, 2000b) for industrial soil;

screening criteria are conservative for less frequently contacted medium (sediment).

[(b)]PCBs = Polychlorinated Biphenyls

[(c)]mg/kg = milligram per kilogram

[(d)]SVOCs = Semi-Volatile Organic Compounds

[(e)]RBC for Pyrene as a Surrogate

Table 4-60

## Sediment Screening Table (Sample NEP 23 from Boat Launch Area)
## Badin Lake - Plant Area

### Alcoa Badin, NC Works RFI

| Constituent | Units | Detection | | USEPA Region III Industrial Soil RBC [a] | Ind RBC |
|---|---|---|---|---|---|
| **SVOCs** | | | | | |
| Acenaphthene | mg/kg[b] | 3.5 | J | 120000 | |
| Anthracene | mg/kg | 16 | J | 610000 | |
| Benzo(a)anthracene | mg/kg | 77 | J | 7.8 | ✓ |
| Benzo(a)pyrene | mg/kg | 75 | J | 0.78 | ✓ |
| Benzo(b)fluoranthene | mg/kg | 98 | J | 7.8 | ✓ |
| Benzo(g,h,i)perylene[c] | mg/kg | 48 | J | 61000 | |
| Benzo(k)fluoranthene | mg/kg | 30 | J | 78 | |
| Chrysene | mg/kg | 85 | J | 780 | |
| Dibenzo(a,h)anthracene | mg/kg | 16 | J | 0.78 | ✓ |
| Fluoranthene | mg/kg | 150 | J | 82000 | |
| Fluorene | mg/kg | 3 | J | 82000 | |
| Indeno(1,2,3-cd)pyrene | mg/kg | 54 | J | 7.8 | ✓ |
| Naphthalene | mg/kg | 0.92 | J | 41000 | |
| Phenanthrene[c] | mg/kg | 40 | J | 61000 | |
| Pyrene | mg/kg | 96 | J | 61000 | |
| **PCBs** | | | | | |
| Aroclor 1248 | mg/kg | 0.323 | | 2.9 | |
| Aroclor 1254 | mg/kg | 0.204 | | 2.9 | |
| Aroclor 1260 | mg/kg | 0.064 | | 2.9 | |

[a] Risk-Based Concentration (USEPA, 2000b) for industrial soil;
screening criteria are conservative for less frequently contacted medium (sediment).
[b] mg/kg = milligram per kilogram.
[c] RBC for Pyrene as a Surrogate.

## Table 4-61

## Badin Lake - Plant Area Swimming Cove - Risk Characterization [a]

## Alcoa Badin, NC Works RFI

**ADULT SWIMMER**
**SEDIMENT - SWIMMING COVE AREA**

| Constituent | Dermal Contact with Sediment | TOTAL |
|---|---|---|
| | | |
| Benzo(a)pyrene | 1.4E-08 | 1E-08 |

**CHILD SWIMMER**
**SEDIMENT - SWIMMING COVE AREA**

| Constituent | Dermal Contact with Sediment | TOTAL |
|---|---|---|
| | | |
| Benzo(a)pyrene | 7.0E-09 | 7E-09 |

[a] No Hazard Indices were calculated because carcinogenic PAHs do not have EPA-derived RfDs.

Table 4-62

## Well Construction Summary for SWMU No. 2
## Alcoa/Badin Landfill

## Alcoa Badin, NC Works RFI

| Well Number | Top of Casing Elevation (ft-msl)[a] | Ground Surface | Top of Screen (ft-toc)[b] | Bottom of Screen (ft-toc) | Top of Screen Elevation (ft-msl) | Bottom of Screen Elevation (ft-msl) | Screened Interval Lithology |
|---|---|---|---|---|---|---|---|
| ABL-MW-1 | 541.46 | 538.92 | 35 | 45 | 506.46 | 493.92 | Bedrock |
| ABL-MW-2 | 541.04 | 538.01 | 37 | 47 | 504.04 | 491.01 | Residual Soil[c] |
| ABL-MW-3 | 478.46 | 476.14 | 4 | 14 | 474.46 | 462.14 | Alluvium/Residual Soil/Partially Weathered Bedrock |
| ABL-MW-4 | 472.11 | 469.87 | 4 | 14 | 468.11 | 455.87 | Alluvium/Residual Soil/Partially Weathered Bedrock |
| ABL-MW-5 | 468.75 | 466.53 | 4 | 14 | 464.75 | 452.53 | Alluvium/Residual Soil/Partially Weathered Bedrock |
| ABL-MW-6 | 538.03 | 536.17 | 25 | 35 | 513.03 | 501.17 | Bedrock |
| ABL-PZ-1S | 539.10 | 537 | 8 | 18 | 531.10 | 519 | Native Fill Material/Residual Soil |
| ABL-PZ-1I | 538.98 | 537 | 30 | 40 | 508.98 | 497 | Bedrock |
| ABL-PZ-1D | 539.03 | 537 | 46 | 56 | 493.03 | 481 | Bedrock |
| ABL-PZ-2S | 534.68 | 532 | 24 | 34 | 510.68 | 498 | Mixed Waste/Fill Material |
| ABL-PZ-2I | 534.81 | 532 | 43 | 53 | 491.81 | 479 | Bedrock |
| ABL-PZ-2D | 534.93 | 532 | 60 | 70 | 474.93 | 462 | Bedrock |
| ABL-PZ-3S | 470.37 | 468 | 3 | 8 | 467.37 | 460 | Residual Soil/Alluvium |
| ABL-PZ-3I | 469.81 | 467 | 15 | 25 | 454.81 | 442 | Bedrock |
| ABL-PZ-3D | 469.82 | 467 | 40 | 50 | 429.82 | 417 | Bedrock |

Notes:

(a) ft-msl = feet above mean sea level.

(b) ft-toc = feet below top of casing.

(c) residual soils are interpreted to be saprolite

## Table 4-63

## Hydraulic Conductivity Data for SWMU NO 2: (Alcoa/Badin Landfill)

## Alcoa Badin, NC Works RFI

| Well No. | Lithologic Unit Screened | Test Type | Hydraulic Conductivity cm/sec[a] | Hydraulic Conductivity ft/day[b] |
|---|---|---|---|---|
| ABL-MW-1 | Bedrock | Slug Out | 9.20E-05 | 0.26 |
| ABL-MW-2 | Saprolite | Slug Out | 8.80E-05 | 0.25 |
| ABL-MW-3 | Alluvium/Saprolite/Partially Weathered Bedrock | Slug Out | 3.80E-04 | 1.08 |
| ABL-MW-4 | Alluvium/Saprolite/Partially Weathered Bedrock | Slug Out | 8.00E-05 | 0.23 |
| ABL-MW-5 | Alluvium/Saprolite/Partially Weathered Bedrock | Slug Out | 1.40E-03 | 3.97 |
| ABL-MW-6 | Alluvium/Saprolite/Partially Weathered Bedrock | Slug Out | 2.10E-05 | 0.06 |
| ABL-PZ-1S | Native Fill Material/Saprolite | Slug Out | 6.70E-06 | 0.02 |
| ABL-PZ-1I | Bedrock | Slug In | 5.75E-05 | 0.16 |
| ABL-PZ-1D | Bedrock | Slug In | 3.50E-05 | 0.10 |
| ABL-PZ-2S | Mixed Waste/Fill Material | Slug Out | 2.30E-04 | 0.65 |
| ABL-PZ-2I | Bedrock | Slug In | 4.30E-05 | 0.12 |
| ABL-PZ-2D | Bedrock | Slug In | 6.00E-05 | 0.17 |
| ABL-PZ-3S | Saprolite/Alluvium | Slug Out | 4.90E-06 | 0.01 |
| ABL-PZ-3I | Bedrock | Slug In | 1.40E-04 | 0.40 |
| ABL-PZ-3D | Bedrock | Slug In | 2.10E-04 | 0.60 |
| ABL-PZ-4 | Saprolite/Alluvium/Fill Material | Slug Out | 9.10E-04 | 2.58 |
| ABL-PZ-5 | Saprolite | Slug Out | 3.40E-06 | 0.01 |
| ABL-PZ-6 | Saprolite | Slug Out | 6.70E-03 | 18.99 |
| ABL-PZ-10 | Saprolite | Slug Out | 6.60E-05 | 0.19 |
| ABL-PZ-11 | Saprolite | Slug Out | 1.30E-04 | 0.37 |
| Average Saprolite/Fill/Alluvium/Partially Weathered Bedrock | | | 8.33E-04 | 1.10E+00 |
| Average Bedrock | | | 8.23E-05 | 2.33E-01 |

Notes:

(a) cm/sec = centimeters per second

(b) ft/day = feet per day

Reference: Geraghty and Miller, April 1997

## Table 4-64

## SWMU No. 2 (Alcoa/Badin Landfill)
## Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Parameter / Sample ID / Sample Depth (ft-bgs)[a] | S2-HA01-0.0-0.5<br>0-0.5 | S2-HA01-0.5-1.0<br>0.5-1.0 | S2-HA02-0.0-0.5<br>0-0.5 | S2-HA02-0.5-2.0<br>0.5-2.0 | S2-HA03-0.0-0.5<br>0-0.5 | S2-HA03-0.0-0.5R<br>0-0.5 |
|---|---|---|---|---|---|---|
| Inorganics (mg/kg)[b] | | | | | | |
| Fluoride | 10.7 | 8.4 | 3.9 | 2.9 | < 0.61[c] | NA |
| Cyanide, Weak Acid Dissociable | < 3.3 | < 3.2 | < 3.1 | < 3.1 | < 3.1 | NA |
| Cyanide, Total | < 3.3 | < 3.2 | < 3.1 | 10.3 | < 3.1 | NA |
| Arsenic | 12.4 J | 15.8 J | 5.4 J | 7.3 J | 12.2 J | NA |
| Barium | 108 J | 95.9 J | 75.4 J | 107 J | 50.4 J | NA |
| Cadmium | < 0.26 | < 0.25 | < 0.25 | < 0.24 | < 0.24 | NA |
| Chromium | 28 | 31.6 | 19.7 | 21.1 | 22.6 | NA |
| Lead | 20.7 J | 21.1 J | 22.1 J | 17.2 J | 11.7 J | NA |
| Selenium | < 0.66 J | < 0.64 J | < 0.62 J | 0.78 J | 1 J | NA |
| Mercury | NA | < 0.13 | NA | NA | < 0.12 | NA |
| VOCs[d] | | | | | | |
| 1,1,1,2-Tetrachloroethane | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| 1,1,1-Trichloroethane | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| 1,1,2,2-Tetrachloroethane | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| 1,1,2-Trichloroethane | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| 1,1-Dichloroethane | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| 1,1-Dichloroethene | < 0.0063 | 0.0088 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| 1,2,3-Trichloropropane | < 0.0063 | < 0.0066 | < 0.0062 | NA | < 0.0062 J | < 0.0061 |
| 1,2-Dibromo-3-Chloropropane | < 0.013 J | < 0.013 J | < 0.012 J | < 0.0061 | < 0.0062 J | < 0.0061 |
| 1,2-Dibromoethane | < 0.0063 | < 0.0066 | < 0.0062 | < 0.012 J | < 0.012 J | < 0.012 |
| 1,2-Dichloroethane | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| 1,2-Dichloropropane | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| 1,4-Dioxane | < 0.63 R | < 0.66 R | < 0.62 R | < 0.0061 | < 0.0062 J | < 0.0061 |
| 2-Butanone | < 0.025 | < 0.026 | < 0.025 | < 0.61 R | < 0.62 R | < 0.61 |
| 2-Hexanone | < 0.025 | < 0.026 | < 0.025 | < 0.024 | < 0.025 J | < 0.024 |
| 4-Methyl-2-Pentanone | < 0.025 | < 0.026 | < 0.025 | < 0.024 | < 0.025 J | < 0.024 |
| Acetone | 0.16 J | 0.18 J | 0.15 J | < 0.024 | < 0.025 J | < 0.024 |
| Acetonitrile | < 0.13 R | < 0.13 R | < 0.12 R | 0.04 J | 0.038 J | 0.048 |
| Acrolein | < 0.13 J | < 0.13 J | < 0.12 J | < 0.12 R | < 0.12 R | < 0.12 |
| Acrylonitrile | < 0.13 | < 0.13 | < 0.12 | < 0.12 J | < 0.12 J | < 0.12 |
| Allyl Chloride | < 0.013 | < 0.013 | < 0.012 | < 0.12 | < 0.12 J | < 0.12 |
| Benzene | < 0.0063 | < 0.0066 | < 0.0062 | < 0.012 | < 0.012 J | < 0.012 |
| Bromodichloromethane | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Bromoform | < 0.0063 J | < 0.0066 J | < 0.0062 J | < 0.0061 | < 0.0062 J | < 0.0061 |
| | | | | < 0.0061 J | < 0.0062 J | < 0.0061 |

Table 4-64

SWMU No. 2 (Alcoa/Badin Landfill)
Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Sample ID / Sample Depth (ft-bgs)[a] / Parameter | S2-HA01-0.0-0.5 0-0.5 | S2-HA01-0.5-1.0 0.5-1.0 | S2-HA02-0.0-0.5 0-0.5 | S2-HA02-0.5-2.0 0.5-2.0 | S2-HA03-0.0-0.5 0-0.5 | S2-HA03-0.0-0.5R 0-0.5 |
|---|---|---|---|---|---|---|
| Bromomethane | < 0.013 | < 0.013 | < 0.012 | < 0.012 | < 0.012 J | < 0.012 |
| Carbon Disulfide | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Carbon Tetrachloride | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Chlorobenzene | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Chloroethane | < 0.013 | < 0.013 | < 0.012 | < 0.012 | < 0.012 J | < 0.012 |
| Chloroform | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Chloromethane | < 0.013 | < 0.013 | < 0.012 | < 0.012 | < 0.012 J | < 0.012 |
| Chloroprene | < 0.013 | < 0.013 | < 0.012 | < 0.012 | < 0.012 J | < 0.012 |
| Cis-1,3-Dichloropropene | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Dibromochloromethane | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Dibromomethane | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Dichlorodifluoromethane | < 0.013 | < 0.013 | < 0.012 | < 0.012 | < 0.012 J | < 0.012 |
| Dichloromethane (Methylene Chloride) | 0.007 J | 0.01 J | 0.0077 J | 0.0083 J | 0.011 J | < 0.0061 |
| Ethyl Methacrylate | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Ethylbenzene | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Iodomethane | < 0.0063 | 0.0092 J | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.24 |
| Isobutyl Alcohol | < 0.25 R | < 0.26 R | < 0.25 R | < 0.24 R | < 0.25 R | < 0.0061 |
| Methacrylonitrile | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Methyl Methacrylate | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Propionitrile | < 0.025 R | < 0.026 R | < 0.025 R | < 0.024 R | < 0.025 R | < 0.024 |
| Styrene | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Tetrachloroethene | < 0.0063 J | < 0.0066 J | < 0.0062 J | < 0.0061 J | < 0.0062 J | < 0.0061 |
| Toluene | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Trans-1,2-Dichloroethene | < 0.0032 | < 0.0033 | < 0.0031 | < 0.003 | < 0.0031 J | < 0.003 |
| Trans-1,3-Dichloropropene | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Trans-1,4-Dichloro-2-Butene | < 0.0063 J | < 0.0066 J | < 0.0062 J | < 0.0061 J | < 0.0062 J | < 0.0061 |
| Trichloroethylene | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Trichlorofluoromethane | < 0.013 | < 0.013 | < 0.012 | < 0.012 | < 0.012 J | < 0.012 |
| Vinyl Acetate | < 0.013 J | < 0.013 J | < 0.012 J | < 0.012 J | < 0.012 J | < 0.012 |
| Vinyl Chloride | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| Xylene (Total) | < 0.0063 | < 0.0066 | < 0.0062 | < 0.0061 | < 0.0062 J | < 0.0061 |
| SVOCs[e] | | | | | | |
| 1,2,4,5-Tetrachlorobenzene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 1,2,4-Trichlorobenzene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 1,2-Dichlorobenzene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |

Table 4-64

SWMU No. 2 (Alcoa/Badin Landfill)
Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Sample ID<br>Sample Depth (ft-bgs)[a]<br>Parameter | S2-HA01-0.0-0.5<br>0-0.5 | S2-HA01-0.5-1.0<br>0.5-1.0 | S2-HA02-0.0-0.5<br>0-0.5 | S2-HA02-0.5-2.0<br>0.5-2.0 | S2-HA03-0.0-0.5<br>0-0.5 | S2-HA03-0.0-0.5R<br>0-0.5 |
|---|---|---|---|---|---|---|
| 1,3,5-Trinitrobenzene | < 2.1 | < 2 | < 2 | < 2 | < 2 | NA |
| 1,3-Dinitrobenzene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 1,4-Dichlorobenzene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 1,4-Naphthoquinone | < 2.1 | < 2 | < 2 | < 0.4 | < 2 | NA |
| 1-Naphthylamine | < 0.44 | < 0.42 | < 0.41 | < 2 | < 0.4 | NA |
| 2,3,4,6-Tetrachlorophenol | < 2.1 | < 2 | < 2 | < 0.4 | < 2 | NA |
| 2,4,5-Trichlorophenol | < 0.44 | < 0.42 | < 0.41 | < 2 | < 0.4 | NA |
| 2,4,6-Trichlorophenol | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 2,4-Dichlorophenol | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 2,4-Dimethylphenol | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 2,4-Dinitrophenol | < 2.1 J | < 2 J | < 2 J | < 0.4 J | < 2 J | NA |
| 2,4-Dinitrotoluene | < 0.44 | < 0.42 | < 0.41 | < 2 | < 0.4 | NA |
| 2,6-Dichlorophenol | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 2,6-Dinitrotoluene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 2-Acetylaminofluorene | < 4.4 | < 4.2 | < 4.1 | < 0.4 | < 4 | NA |
| 2-Chloronaphthalene | < 0.44 | < 0.42 | < 0.41 | < 4 | < 0.4 | NA |
| 2-Chlorophenol | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 2-Methyl-4,6-Dinitrophenol | < 2.1 | < 2 | < 2 | < 0.4 | < 2 | NA |
| 2-Methylnaphthalene | < 0.44 | < 0.42 | < 0.41 | < 2 | < 0.4 | NA |
| 2-Methylphenol (O-Cresol) | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 2-Naphthylamine | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 2-Nitroaniline | < 2.1 | < 2 | < 2 | < 0.4 | < 2 | NA |
| 2-Nitrophenol | < 0.44 | < 0.42 | < 0.41 | < 2 | < 0.4 | NA |
| 2-Picoline | < 0.87 | < 0.84 | < 0.82 | < 0.4 | < 0.81 | NA |
| 3,3'-Dichlorobenzidine | < 2.1 | < 2 | < 2 | < 0.81 | < 2 | NA |
| 3,3'-Dimethylbenzidine | < 2.1 | < 2 | < 2 | < 2 | < 2 | NA |
| 3,5,5-Trimethyl-2-Cyclohexen-1-One | < 0.44 | < 0.42 | < 0.41 | < 2 | < 0.4 | NA |
| 3-Methylcholanthrene | < 0.87 | < 0.84 | < 0.82 | < 0.4 | < 0.81 | NA |
| 3-Nitroaniline | < 2.1 | < 2 | < 2 | < 0.81 | < 2 | NA |
| 4-Aminobiphenyl | < 2.1 | < 2 | < 2 | < 2 | < 2 | NA |
| 4-Bromophenyl Phenyl Ether | < 0.44 | < 0.42 | < 0.41 | < 2 | < 0.4 | NA |
| 4-Chloro-3-Methylphenol | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 4-Chloroaniline | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 4-Chlorophenyl Phenyl Ether | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| 4-Methylphenol (P-Cresol) | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |

Table 4-64

SWMU No. 2 (Alcoa/Badin Landfill)
Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Sample ID / Sample Depth (ft-bgs)[a] / Parameter | S2-HA01-0.0-0.5 0-0.5 | S2-HA01-0.5-1.0 0.5-1.0 | S2-HA02-0.0-0.5 0-0.5 | S2-HA02-0.5-2.0 0.5-2.0 | S2-HA03-0.0-0.5 0-0.5 | S2-HA03-0.0-0.5R 0-0.5 |
|---|---|---|---|---|---|---|
| 4-Nitrophenol | < 2.1 J | < 2 J | < 2 J | < 0.4 J | < 2 J | |
| 4-Nitroquinoline-1-Oxide | < 4.4 J | < 4.2 J | < 4.1 J | < 2 J | < 4 J | NA |
| 5-Nitro-O-Toluidine | < 0.87 | < 0.84 | < 0.82 | < 4 | < 0.81 | NA |
| 7,12-Dimethylbenz(a)Anthracene | < 0.87 J | < 0.84 J | < 0.82 J | < 0.81 J | < 0.81 J | NA |
| A,A-Dimethylphenethylamine | < 2.1 | < 2 | < 2 | < 0.81 | < 2 | NA |
| Acenaphthene | < 0.44 | < 0.42 | < 0.41 | < 2 | < 0.4 | NA |
| Acenaphthylene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Acetophenone | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Aniline | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Anthracene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Aramite | < 0.87 R | < 0.84 R | < 0.82 R | < 0.4 R | < 0.81 R | NA |
| Benz(B)Fluoranthene | < 0.44 | < 0.42 | < 0.41 | < 0.81 | < 0.4 | NA |
| Benzo(A)Anthracene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Benzo(A)Pyrene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Benzo(G,H,I)Perylene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Benzo(K)Fluoranthene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Benzyl Alcohol | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Benzyl Butyl Phthalate | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Bis(2-Chloroethoxy)Methane | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Bis(2-Chloroethyl)Ether | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Bis(2-Chloroisopropyl)Ether | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Bis(2-Ethylhexyl)Phthalate | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Chlorobenzilate | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Chrysene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Diallate | < 0.87 | < 0.84 | < 0.41 | < 0.4 | < 0.4 | NA |
| Dibenzo(A,H)Anthracene | < 0.44 | < 0.42 | < 0.82 | < 0.4 | < 0.81 | NA |
| Dibenzofuran | < 0.44 | < 0.42 | < 0.41 | < 0.81 | < 0.4 | NA |
| Diethyl Phthalate | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Dimethoate | < 0.87 J | < 0.84 J | < 0.82 J | < 0.4 J | < 0.81 J | NA |
| Dimethyl Phthalate | < 0.44 | < 0.42 | < 0.41 | < 0.81 | < 0.4 | NA |
| Di-N-Butyl Phthalate | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Di-N-Octylphthalate | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Dinoseb | < 0.87 | < 0.84 | < 0.82 | < 0.4 | < 0.81 | NA |
| Disulfoton | < 2.1 | < 2 | < 2 | < 0.81 | < 2 | NA |
| Ethyl Methanesulfonate | < 0.44 | < 0.42 | < 0.41 | < 2 | < 0.4 | NA |

Table 4-64

SWMU No. 2 (Alcoa/Badin Landfill)
Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Sample ID / Sample Depth (ft-bgs)[a] / Parameter | S2-HA01-0.0-0.5 0-0.5 | S2-HA01-0.5-1.0 0.5-1.0 | S2-HA02-0.0-0.5 0-0.5 | S2-HA02-0.5-2.0 0.5-2.0 | S2-HA03-0.0-0.5 0-0.5 | S2-HA03-0.0-0.5R 0-0.5 |
|---|---|---|---|---|---|---|
| Famphur | < 4.4 R | < 4.2 R | < 4.1 R | < 0.4 R | < 4 R | NA |
| Fluoranthene | < 0.44 | < 0.42 | < 0.41 | < 4 | < 0.4 | NA |
| Fluorene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Hexachlorobenzene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Hexachlorobutadiene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Hexachlorocyclopentadiene | < 2.1 | < 2 | < 2 | < 0.4 | < 2 | NA |
| Hexachloroethane | < 0.44 | < 0.42 | < 0.41 | < 2 | < 0.4 | NA |
| Hexachlorophene | < | < | < | < 0.4 | < | NA |
| Hexachloropropene | < 4.4 | < 4.2 | < 4.1 | < | < 4 | NA |
| Indeno(1,2,3-Cd)Pyrene | < 0.44 | < 0.42 | < 0.41 | < 4 | < 0.4 | NA |
| Isodrin | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Isosafrole | < 0.87 | < 0.84 | < 0.82 | < 0.4 | < 0.81 | NA |
| Kepone | < 4.4 R | < 4.2 R | < 4.1 R | < 0.81 R | < 4 R | NA |
| M-Dichlorobenzene | < 0.44 | < 0.42 | < 0.41 | < 4 | < 0.4 | NA |
| Methapyrilene | < 2.1 | < 2 | < 2 | < 2 | < 2 | NA |
| Methyl Methanesulfonate | < 0.44 J | < 0.42 J | < 0.41 J | < 0.4 J | < 0.4 J | NA |
| Methyl Parathion | < 2.1 J | < 2 J | < 2 J | < 2 J | < 2 J | NA |
| Naphthalene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Nitrobenzene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| N-Nitrosodiethylamine | < 0.44 J | < 0.42 J | < 0.41 J | < 0.4 J | < 0.4 J | NA |
| N-Nitrosodimethylamine | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| N-Nitrosodi-N-Butylamine | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| N-Nitroso-Di-N-Propylamine | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| N-Nitrosodiphenylamine | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| N-Nitrosodiphenylamine/Diphenylamine | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| N-Nitrosomethylethylamine | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| N-Nitrosomorpholine | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| N-Nitrosopiperidine | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| N-Nitrosopyrrolidine | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| O,O,O-Triethyl Phosphorothioate | < 2.1 | < 2 | < 2 | < 2 | < 2 | NA |
| O-Toluidine | < 0.87 | < 0.84 | < 0.82 | < 0.81 | < 0.81 | NA |
| Parathion | < 2.1 | < 2 | < 2 | < 2 | < 2 | NA |
| P-Dimethylaminoazobenzene | < 0.87 | < 0.84 | < 0.82 | < 0.81 | < 0.81 | NA |
| Pentachlorobenzene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Pentachloroethane | < 2.1 | < 2 | < 2 | < 2 | < 2 | NA |

Table 4-64

**SWMU No. 2 (Alcoa/Badin Landfill)**
**Phase I RFI Soil Analytical Results**

Alcoa Badin, NC RFI

| Sample ID<br>Sample Depth (ft-bgs)[a]<br>Parameter | S2-HA01-0.0-0.5<br>0-0.5 | S2-HA01-0.5-1.0<br>0.5-1.0 | S2-HA02-0.0-0.5<br>0-0.5 | S2-HA02-0.5-2.0<br>0.5-2.0 | S2-HA03-0.0-0.5<br>0-0.5 | S2-HA03-0.0-0.5R<br>0-0.5 |
|---|---|---|---|---|---|---|
| Pentachloronitrobenzene | < 2.1 | < 2 | < 2 | < 2 | < 2 | NA |
| Pentachlorophenol | < 2.1 | < 2 | < 2 | < 2 | < 2 | NA |
| Phenacetin | < 0.87 | < 0.84 | < 0.82 | < 0.81 | < 0.81 | NA |
| Phenanthrene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Phenol | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Phorate | < 2.1 | < 2 | < 2 | < 2 | < 2 | NA |
| P-Nitroaniline | < 2.1 | < 2 | < 2 | < 2 | < 2 | NA |
| P-Phenylene Diamine | < 4.4 | < 4.2 | < 4.1 | < 4 | < 4 | NA |
| Pronamide | < 0.87 J | < 0.84 J | < 0.82 J | < 0.81 J | < 0.81 J | NA |
| Pyrene | < 0.44 | < 0.42 | < 0.41 | < 0.4 | < 0.4 | NA |
| Pyridine | < 0.87 | < 0.84 | < 0.82 | < 0.81 | < 0.81 | NA |
| Safrole | < 0.87 | < 0.84 | < 0.82 | < 0.81 | < 0.81 | NA |
| Tetraethyldithiopyrophosphate | < 2.1 | < 2 | < 2 | < 2 | < 2 | NA |
| Thionazin | < 2.1 | < 2 | < 2 | < 2 | < 2 | NA |

(a) ft-bgs = feet below ground surface.

(b) mg/kg = milligrams per kilogram.

(c) < = not detected at indicated detection limit.

(d) VOCs = volatile organic compounds.

(e) SVOCs = semivolatile organic compounds.

(f) NA - Not analyzed

Table 4-64

## SWMU No. 2 (Alcoa/Badin Landfill)
## Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Sample ID / Sample Depth (ft-bgs)[a] | S2-HA03-0.0-0.5D 0-0.5 | S2-HA03-0.0-0.5DR 0-0.5 | S2-HA03-0.5-2.0 0.5-2.0 | S2-HA03-0.5-2.0R 0.5-2.0 | S2-HA04-0/0-0.5 0-0.5 | S2-HA04-0.5-2.0 0.5-2.0 |
|---|---|---|---|---|---|---|
| **Parameter** | | | | | | |
| **Inorganics (mg/kg)[b]** | | | | | | |
| Fluoride | < 0.6 | NA | < 0.63 | NA | < 0.6 | < 0.6 |
| Cyanide, Weak Acid Dissociable | < 3 | NA | < 3.1 | NA | < 3 | < 3 |
| Cyanide, Total | < 3 | NA | < 3.1 | NA | < 3 | < 3 |
| Arsenic | 12.2 J | NA | 15.7 J | NA | 7.8 J | 2.3 J |
| Barium | 51.6 | NA | 29.9 J | NA | < 23.9 J | < 24.1 J |
| Cadmium | < 0.24 J | NA | < 0.25 | NA | < 0.24 | < 0.24 |
| Chromium | 25.3 | NA | 24 | NA | 19.8 | 14.5 |
| Lead | 12.3 J | NA | 13.4 J | NA | 24.4 J | 17.3 J |
| Selenium | 1.2 J | NA | 1.1 J | NA | 1.1 J | < 0.6 J |
| Mercury | < 0.12 | NA | < 0.13 | NA | < 0.12 | < 0.12 |
| **VOCs[d]** | | | | | | |
| 1,1,1,2-Tetrachloroethane | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| 1,1,1-Trichloroethane | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| 1,1,2,2-Tetrachloroethane | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| 1,1,2-Trichloroethane | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| 1,1-Dichloroethane | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| 1,1-Dichloroethene | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | 0.0069 | < 0.006 |
| 1,2,3-Trichloropropane | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| 1,2-Dibromo-3-Chloropropane | < 0.012 J | < 0.012 | < 0.013 J | < 0.013 | < 0.012 J | < 0.012 J |
| 1,2-Dibromoethane | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| 1,2-Dichloroethane | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| 1,2-Dichloropropane | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| 1,4-Dioxane | < 0.62 R | < 0.62 | < 0.63 R | < 0.63 | < 0.6 R | < 0.6 R |
| 2-Butanone | < 0.025 J | < 0.025 | < 0.025 J | < 0.025 | < 0.024 | < 0.024 |
| 2-Hexanone | < 0.025 J | < 0.025 | < 0.025 J | < 0.025 | < 0.024 | < 0.024 |
| 4-Methyl-2-Pentanone | < 0.025 J | < 0.025 | < 0.025 J | < 0.025 | < 0.024 | < 0.024 |
| Acetone | 0.071 J | 0.032 | < 0.025 J | < 0.025 | 0.062 J | < 0.024 |
| Acetonitrile | < 0.12 R | < 0.12 | < 0.13 R | < 0.13 | < 0.12 R | < 0.12 R |
| Acrolein | < 0.12 J | < 0.12 | < 0.13 J | < 0.13 | < 0.12 J | < 0.12 J |
| Acrylonitrile | < 0.12 J | < 0.12 | < 0.13 J | < 0.13 | < 0.12 | < 0.12 |
| Allyl Chloride | < 0.012 J | < 0.012 | < 0.013 J | < 0.013 | < 0.012 | < 0.012 |
| Benzene | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Bromodichloromethane | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Bromoform | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 J | < 0.006 J |

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Table 4-64

SWMU No. 2 (Alcoa/Badin Landfill)
Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Sample ID / Sample Depth (ft-bgs)[a] / Parameter | S2-HA03-0.0-0.5D 0-0.5 | S2-HA03-0.0-0.5DR 0-0.5 | S2-HA03-0.5-2.0 0.5-2.0 | S2-HA03-0.5-2.0R 0.5-2.0 | S2-HA04-0/0-0.5 0-0.5 | S2-HA04-0.5-2.0 0.5-2.0 |
|---|---|---|---|---|---|---|
| Bromomethane | < 0.012 J | < 0.012 | < 0.013 J | < 0.013 | < 0.012 | < 0.012 |
| Carbon Disulfide | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Carbon Tetrachloride | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Chlorobenzene | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Chloroethane | < 0.012 J | < 0.012 | < 0.013 J | < 0.013 | < 0.012 | < 0.012 |
| Chloroform | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Chloromethane | < 0.012 J | < 0.012 | < 0.013 J | < 0.013 | < 0.012 | < 0.012 |
| Chloroprene | < 0.012 J | < 0.012 | < 0.013 J | < 0.013 | < 0.012 | < 0.012 |
| Cis-1,3-Dichloropropene | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Dibromochloromethane | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Dibromomethane | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Dichlorodifluoromethane | < 0.012 J | < 0.012 | < 0.013 J | < 0.013 | < 0.012 | < 0.012 |
| Dichloromethane (Methylene Chloride) | 0.011 J | < 0.0062 | 0.0075 J | < 0.0063 | 0.0076 J | 0.0084 J |
| Ethyl Methacrylate | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Ethylbenzene | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Iodomethane | < 0.0062 J | < 0.25 | < 0.0063 J | < 0.25 | 0.0064 J | < 0.006 J |
| Isobutyl Alcohol | < 0.25 R | < 0.0062 | < 0.25 J R | < 0.0063 | < 0.24 R | < 0.24 R |
| Methacrylonitrile | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Methyl Methacrylate | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Propionitrile | < 0.025 R | < 0.025 | < 0.025 J R | < 0.025 | < 0.024 R | < 0.024 R |
| Styrene | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 J | < 0.006 J |
| Tetrachloroethene | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Toluene | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Trans-1,2-Dichloroethene | < 0.0031 J | < 0.0031 | < 0.0032 J | < 0.0031 | < 0.003 | < 0.003 |
| Trans-1,3-Dichloropropene | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Trans-1,4-Dichloro-2-Butene | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Trichloroethylene | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Trichlorofluoromethane | < 0.012 J | < 0.012 | < 0.013 J | < 0.013 | < 0.012 J | < 0.012 J |
| Vinyl Acetate | < 0.012 J | < 0.012 | < 0.013 J | < 0.013 | < 0.012 | < 0.012 |
| Vinyl Chloride | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| Xylene (Total) | < 0.0062 J | < 0.0062 | < 0.0063 J | < 0.0063 | < 0.006 | < 0.006 |
| SVOCs[c] | | | | | | |
| 1,2,4,5-Tetrachlorobenzene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 1,2,4-Trichlorobenzene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 1,2-Dichlorobenzene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |

## Table 4-64

### SWMU No. 2 (Alcoa/Badin Landfill)
### Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Sample ID / Sample Depth (ft-bgs)[a] / Parameter | S2-HA03-0.0-0.5D 0-0.5 | S2-HA03-0.0-0.5DR 0-0.5 | S2-HA03-0.5-2.0 0.5-2.0 | S2-HA03-0.5-2.0R 0.5-2.0 | S2-HA04-0/0-0.5 0-0.5 | S2-HA04-0.5-2.0 0.5-2.0 |
|---|---|---|---|---|---|---|
| 1,3,5-Trinitrobenzene | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| 1,3-Dinitrobenzene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 1,4-Dichlorobenzene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 1,4-Naphthoquinone | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| 1-Naphthylamine | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 2,3,4,6-Tetrachlorophenol | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| 2,4,5-Trichlorophenol | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 2,4,6-Trichlorophenol | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 2,4-Dichlorophenol | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 2,4-Dimethylphenol | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 2,4-Dinitrophenol | < 1.9 J | NA | < 2 J | NA | < 1.9 J | < 1.9 J |
| 2,4-Dinitrotoluene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 2,6-Dichlorophenol | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 2,6-Dinitrotoluene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 2-Acetylaminofluorene | < 3.9 | NA | < 4.2 | NA | < 3.9 | < 4 |
| 2-Chloronaphthalene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 2-Chlorophenol | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 2-Methyl-4,6-Dinitrophenol | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| 2-Methylnaphthalene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 2-Methylphenol (O-Cresol) | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 2-Naphthylamine | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 2-Nitroaniline | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| 2-Nitrophenol | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 2-Picoline | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 |
| 3,3'-Dichlorobenzidine | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| 3,3'-Dimethylbenzidine | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| 3,5,5-Trimethyl-2-Cyclohexen-1-One | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 3-Methylcholanthrene | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 |
| 3-Nitroaniline | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| 4-Aminobiphenyl | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| 4-Bromophenyl Phenyl Ether | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 4-Chloro-3-Methylphenol | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 4-Chloroaniline | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 4-Chlorophenyl Phenyl Ether | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| 4-Methylphenol (P-Cresol) | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |

## SWMU No. 2 (Alcoa/Badin Landfill)
## Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Sample ID / Sample Depth (ft-bgs)[a] / Parameter | S2-HA03-0.0-0.5D | S2-HA03-0.0-0.5DR | S2-HA03-0.5-2.0 | S2-HA03-0.5-2.0R | S2-HA04-0/0-0.5 | S2-HA04-0.5-2.0 |
|---|---|---|---|---|---|---|
| Sample Depth (ft-bgs)[a] | 0-0.5 | 0-0.5 | 0.5-2.0 | 0.5-2.0 | 0-0.5 | 0.5-2.0 |
| 4-Nitrophenol | < 1.9 | NA | < 2 J | NA | < 1.9 J | < 1.9 J |
| 4-Nitroquinoline-1-Oxide | < 3.9 J | NA | < 4.2 J | NA | < 3.9 J | < 4 J |
| 5-Nitro-O-Toluidine | < 0.79 | NA | < 0.83 J | NA | < 0.79 J | < 0.8 J |
| 7,12-Dimethylbenz(a)Anthracene | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 |
| A,A-Dimethylphenethylamine | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| Acenaphthene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Acenaphthylene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Acetophenone | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Aniline | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Anthracene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Aramite | < 0.79 R | NA | < 0.83 R | NA | < 0.79 R | < 0.8 R |
| Benz(B)Fluoranthene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Benzo(A)Anthracene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Benzo(A)Pyrene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Benzo(G,H,I)Perylene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Benzo(K)Fluoranthene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Benzyl Alcohol | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Benzyl Butyl Phthalate | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Bis(2-Chloroethoxy)Methane | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Bis(2-Chloroethyl)Ether | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Bis(2-Chloroisopropyl)Ether | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Bis(2-Ethylhexyl)Phthalate | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Chlorobenzilate | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Chrysene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Diallate | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 |
| Dibenzo(A,H)Anthracene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Dibenzofuran | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Diethyl Phthalate | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Dimethoate | < 0.79 J | NA | < 0.83 J | NA | < 0.79 J | < 0.8 J |
| Dimethyl Phthalate | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Di-N-Butyl Phthalate | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Di-N-Octylphthalate | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Dinoseb | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 |
| Disulfoton | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| Ethyl Methanesulfonate | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |

Table 4-64

## SWMU No. 2 (Alcoa/Badin Landfill)
## Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Parameter / Sample ID / Sample Depth (ft-bgs)[a] | S2-HA03-0.0-0.5D<br>0-0.5 | S2-HA03-0.0-0.5DR<br>0-0.5 | S2-HA03-0.5-2.0<br>0.5-2.0 | S2-HA03-0.5-2.0R<br>0.5-2.0 | S2-HA04-0/0-0.5<br>0-0.5 | S2-HA04-0.5-2.0<br>0.5-2.0 |
|---|---|---|---|---|---|---|
| Famphur | < 3.9 R | NA | < 4.2 R | NA | < 3.9 R | < 4 R |
| Fluoranthene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Fluorene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Hexachlorobenzene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Hexachlorobutadiene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Hexachlorocyclopentadiene | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| Hexachloroethane | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Hexachlorophene | < | NA | < | NA | < | < |
| Hexachloropropene | < 3.9 | NA | < 4.2 | NA | < 3.9 | < 4 |
| Indeno(1,2,3-Cd)Pyrene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Isodrin | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Isosafrole | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 |
| Kepone | < 3.9 R | NA | < 4.2 R | NA | < 3.9 R | < 4 R |
| M-Dichlorobenzene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Methapyrilene | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| Methyl Methanesulfonate | < 0.39 J | NA | < 0.42 J | NA | < 0.39 J | < 0.4 J |
| Methyl Parathion | < 1.9 J | NA | < 2 J | NA | < 1.9 J | < 1.9 J |
| Naphthalene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Nitrobenzene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| N-Nitrosodiethylamine | < 0.39 J | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| N-Nitrosodimethylamine | < 0.39 | NA | < 0.42 J | NA | < 0.39 J | < 0.4 J |
| N-Nitrosodi-N-Butylamine | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| N-Nitroso-Di-N-Propylamine | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| N-Nitrosodiphenylamine | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| N-Nitrosodiphenylamine/Diphenylamine | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| N-Nitrosomethylethylamine | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| N-Nitrosomorpholine | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| N-Nitrosopiperidine | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| N-Nitrosopyrrolidine | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| O,O,O-Triethyl Phosphorothioate | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| O-Toluidine | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| Parathion | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 |
| P-Dimethylaminoazobenzene | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| Pentachlorobenzene | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 |
| Pentachloroethane | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |

Table 4-64

SWMU No. 2 (Alcoa/Badin Landfill)
Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Sample ID: Sample Depth (ft-bgs)[a] Parameter | S2-HA03-0.0-0.5D 0-0.5 | S2-HA03-0.0-0.5DR 0-0.5 | S2-HA03-0.5-2.0 0.5-2.0 | S2-HA03-0.5-2.0R 0.5-2.0 | S2-HA04-0/0-0.5 0-0.5 | S2-HA04-0.5-2.0 0.5-2.0 |
|---|---|---|---|---|---|---|
| Pentachloronitrobenzene | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| Pentachlorophenol | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| Phenacetin | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 |
| Phenanthrene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Phenol | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Phorate | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| P-Nitroaniline | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| P-Phenylene Diamine | < 3.9 | NA | < 4.2 J | NA | < 3.9 J | < 4 J |
| Pronamide | < 0.79 J | NA | < 0.83 | NA | < 0.79 | < 0.8 |
| Pyrene | < 0.39 | NA | < 0.42 | NA | < 0.39 | < 0.4 |
| Pyridine | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 |
| Safrole | < 0.79 | NA | < 0.83 | NA | < 0.79 | < 0.8 |
| Tetraethyldithiopyrophosphate | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |
| Thionazin | < 1.9 | NA | < 2 | NA | < 1.9 | < 1.9 |

[a] ft-bgs = feet below ground surface.

[b] mg/kg = milligrams per kilogram.

[c] < = not detected at indicated detection limit.

[d] VOCs = volatile organic compounds.

[e] SVOCs = semivolatile organic compounds.

[f] NA - Not analyzed

Table 4-64

**SWMU No. 2 (Alcoa/Badin Landfill)**
**Phase I RFI Soil Analytical Results**

Alcoa Badin, NC RFI

| Parameter / Sample ID / Sample Depth (ft-bgs)[a] | S2-HA05-0.0-0.5<br>0-0.5 | S2-HA05-0.5-2.0<br>0.5-2.0 | S2-HA06-0.0-0.5<br>0-0.5 | S2-HA06-0.5-2.0<br>0.5-2.0 |
|---|---|---|---|---|
| **Inorganics (mg/kg)[b]** | | | | |
| Fluoride | 1.2 | < 0.6 | 1.2 | 7.2 |
| Cyanide, Weak Acid Dissociable | < 3.2 | < 3 | < 3.1 | < 3.1 |
| Cyanide, Total | < 3.2 | < 3 | < 3.1 | < 3.1 |
| Arsenic | 19.1 | 33.6 | 18.8 | 18 |
| Barium | 76.9 | 81.4 | 167 | 262 |
| Cadmium | < 0.51 | < 0.24 | < 0.99 | < 1 |
| Chromium | 45.9 | 26.2 | 33.9 | 35.6 |
| Lead | 31.8 | 27.6 | 179 | 239 |
| Selenium | < 1.3 | < 0.6 | < 2.5 | < 2.5 |
| Mercury | < 0.13 | < 0.12 | < 0.12 | < 0.13 |
| **VOCs[d]** | | | | |
| 1,1,1,2-Tetrachloroethane | NA[f] | NA | NA | NA |
| 1,1,1-Trichloroethane | NA | NA | NA | NA |
| 1,1,2,2-Tetrachloroethane | NA | NA | NA | NA |
| 1,1,2-Trichloroethane | NA | NA | NA | NA |
| 1,1-Dichloroethane | NA | NA | NA | NA |
| 1,1-Dichloroethene | NA | NA | NA | NA |
| 1,2,3-Trichloropropane | NA | NA | NA | NA |
| 1,2-Dibromo-3-Chloropropane | NA | NA | NA | NA |
| 1,2-Dibromoethane | NA | NA | NA | NA |
| 1,2-Dichloroethane | NA | NA | NA | NA |
| 1,2-Dichloropropane | NA | NA | NA | NA |
| 1,4-Dioxane | NA | NA | NA | NA |
| 2-Butanone | NA | NA | NA | NA |
| 2-Hexanone | NA | NA | NA | NA |
| 4-Methyl-2-Pentanone | NA | NA | NA | NA |
| Acetone | NA | NA | NA | NA |
| Acetonitrile | NA | NA | NA | NA |
| Acrolein | NA | NA | NA | NA |
| Acrylonitrile | NA | NA | NA | NA |
| Allyl Chloride | NA | NA | NA | NA |
| Benzene | NA | NA | NA | NA |
| Bromodichloromethane | NA | NA | NA | NA |
| Bromoform | NA | NA | NA | NA |

Table 4-64

SWMU No. 2 (Alcoa/Badin Landfill)
Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Sample ID / Sample Depth (ft-bgs)[a] / Parameter | S2-HA05-0.0-0.5 0-0.5 | S2-HA05-0.5-2.0 0.5-2.0 | S2-HA06-0.0-0.5 0-0.5 | S2-HA06-0.5-2.0 0.5-2.0 |
|---|---|---|---|---|
| Bromomethane | NA | NA | NA | NA |
| Carbon Disulfide | NA | NA | NA | NA |
| Carbon Tetrachloride | NA | NA | NA | NA |
| Chlorobenzene | NA | NA | NA | NA |
| Chloroethane | NA | NA | NA | NA |
| Chloroform | NA | NA | NA | NA |
| Chloromethane | NA | NA | NA | NA |
| Chloroprene | NA | NA | NA | NA |
| Cis-1,3-Dichloropropene | NA | NA | NA | NA |
| Dibromochloromethane | NA | NA | NA | NA |
| Dibromomethane | NA | NA | NA | NA |
| Dichlorodifluoromethane | NA | NA | NA | NA |
| Dichloromethane (Methylene Chloride) | NA | NA | NA | NA |
| Ethyl Methacrylate | NA | NA | NA | NA |
| Ethylbenzene | NA | NA | NA | NA |
| Iodomethane | NA | NA | NA | NA |
| Isobutyl Alcohol | NA | NA | NA | NA |
| Methacrylonitrile | NA | NA | NA | NA |
| Methyl Methacrylate | NA | NA | NA | NA |
| Propionitrile | NA | NA | NA | NA |
| Styrene | NA | NA | NA | NA |
| Tetrachloroethene | NA | NA | NA | NA |
| Toluene | NA | NA | NA | NA |
| Trans-1,2-Dichloroethene | NA | NA | NA | NA |
| Trans-1,3-Dichloropropene | NA | NA | NA | NA |
| Trans-1,4-Dichloro-2-Butene | NA | NA | NA | NA |
| Trichloroethylene | NA | NA | NA | NA |
| Trichlorofluoromethane | NA | NA | NA | NA |
| Vinyl Acetate | NA | NA | NA | NA |
| Vinyl Chloride | NA | NA | NA | NA |
| Xylene (Total) | NA | NA | NA | NA |
| **SVOCs[e]** | | | | |
| 1,2,4,5-Tetrachlorobenzene | NA | NA | NA | NA |
| 1,2,4-Trichlorobenzene | NA | NA | NA | NA |
| 1,2-Dichlorobenzene | NA | NA | NA | NA |

Table 4-64

SWMU No. 2 (Alcoa/Badin Landfill)
Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Parameter / Sample ID / Sample Depth (ft-bgs)[a] | S2-HA05-0.0-0.5<br>0-0.5 | S2-HA05-0.5-2.0<br>0.5-2.0 | S2-HA06-0.0-0.5<br>0-0.5 | S2-HA06-0.5-2.0<br>0.5-2.0 |
|---|---|---|---|---|
| 1,3,5-Trinitrobenzene | NA | NA | NA | NA |
| 1,3-Dinitrobenzene | NA | NA | NA | NA |
| 1,4-Dichlorobenzene | NA | NA | NA | NA |
| 1,4-Naphthoquinone | NA | NA | NA | NA |
| 1-Naphthylamine | NA | NA | NA | NA |
| 2,3,4,6-Tetrachlorophenol | NA | NA | NA | NA |
| 2,4,5-Trichlorophenol | NA | NA | NA | NA |
| 2,4,6-Trichlorophenol | NA | NA | NA | NA |
| 2,4-Dichlorophenol | NA | NA | NA | NA |
| 2,4-Dimethylphenol | NA | NA | NA | NA |
| 2,4-Dinitrophenol | NA | NA | NA | NA |
| 2,4-Dinitrotoluene | NA | NA | NA | NA |
| 2,6-Dichlorophenol | NA | NA | NA | NA |
| 2,6-Dinitrotoluene | NA | NA | NA | NA |
| 2-Acetylaminofluorene | NA | NA | NA | NA |
| 2-Chloronaphthalene | NA | NA | NA | NA |
| 2-Chlorophenol | NA | NA | NA | NA |
| 2-Methyl-4,6-Dinitrophenol | NA | NA | NA | NA |
| 2-Methylnaphthalene | NA | NA | NA | NA |
| 2-Methylphenol (O-Cresol) | NA | NA | NA | NA |
| 2-Naphthylamine | NA | NA | NA | NA |
| 2-Nitroaniline | NA | NA | NA | NA |
| 2-Nitrophenol | NA | NA | NA | NA |
| 2-Picoline | NA | NA | NA | NA |
| 3,3'-Dichlorobenzidine | NA | NA | NA | NA |
| 3,3'-Dimethylbenzidine | NA | NA | NA | NA |
| 3,5,5-Trimethyl-2-Cyclohexen-1-One | NA | NA | NA | NA |
| 3-Methylcholanthrene | NA | NA | NA | NA |
| 3-Nitroaniline | NA | NA | NA | NA |
| 4-Aminobiphenyl | NA | NA | NA | NA |
| 4-Bromophenyl Phenyl Ether | NA | NA | NA | NA |
| 4-Chloro-3-Methylphenol | NA | NA | NA | NA |
| 4-Chloroaniline | NA | NA | NA | NA |
| 4-Chlorophenyl Phenyl Ether | NA | NA | NA | NA |
| 4-Methylphenol (P-Cresol) | NA | NA | NA | NA |

Table 4-64

SWMU No. 2 (Alcoa/Badin Landfill)
Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Sample ID<br>Sample Depth (ft-bgs)[a]<br>Parameter | S2-HA05-0.0-0.5<br>0-0.5 | S2-HA05-0.5-2.0<br>0.5-2.0 | S2-HA06-0.0-0.5<br>0-0.5 | S2-HA06-0.5-2.0<br>0.5-2.0 |
|---|---|---|---|---|
| 4-Nitrophenol | NA | NA | NA | NA |
| 4-Nitroquinoline-1-Oxide | NA | NA | NA | NA |
| 5-Nitro-O-Toluidine | NA | NA | NA | NA |
| 7,12-Dimethylbenz(a)Anthracene | NA | NA | NA | NA |
| A,A-Dimethylphenethylamine | NA | NA | NA | NA |
| Acenaphthene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Acenaphthylene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Acetophenone | NA | NA | NA | NA |
| Aniline | NA | NA | NA | NA |
| Anthracene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Aramite | NA | NA | NA | NA |
| Benz(B)Fluoranthene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Benzo(A)Anthracene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Benzo(A)Pyrene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Benzo(G,H,I)Perylene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Benzo(K)Fluoranthene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Benzyl Alcohol | NA | NA | NA | NA |
| Benzyl Butyl Phthalate | NA | NA | NA | NA |
| Bis(2-Chloroethoxy)Methane | NA | NA | NA | NA |
| Bis(2-Chloroethyl)Ether | NA | NA | NA | NA |
| Bis(2-Chloroisopropyl)Ether | NA | NA | NA | NA |
| Bis(2-Ethylhexyl)Phthalate | NA | NA | NA | NA |
| Chlorobenzilate | NA | NA | NA | NA |
| Chrysene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Diallate | NA | NA | NA | NA |
| Dibenzo(A,H)Anthracene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Dibenzofuran | NA | NA | NA | NA |
| Diethyl Phthalate | NA | NA | NA | NA |
| Dimethoate | NA | NA | NA | NA |
| Dimethyl Phthalate | NA | NA | NA | NA |
| Di-N-Butyl Phthalate | NA | NA | NA | NA |
| Di-N-Octylphthalate | NA | NA | NA | NA |
| Dinoseb | NA | NA | NA | NA |
| Disulfoton | NA | NA | NA | NA |
| Ethyl Methanesulfonate | NA | NA | NA | NA |

Table 4-64

SWMU No. 2 (Alcoa/Badin Landfill)
Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Sample ID<br>Sample Depth (ft-bgs)[a]<br>Parameter | S2-HA05-0.0-0.5<br>0-0.5 | S2-HA05-0.5-2.0<br>0.5-2.0 | S2-HA06-0.0-0.5<br>0-0.5 | S2-HA06-0.5-2.0<br>0.5-2.0 |
|---|---|---|---|---|
| Famphur | NA | NA | NA | NA |
| Fluoranthene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Fluorene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Hexachlorobenzene | NA | NA | NA | NA |
| Hexachlorobutadiene | NA | NA | NA | NA |
| Hexachlorocyclopentadiene | NA | NA | NA | NA |
| Hexachloroethane | NA | NA | NA | NA |
| Hexachlorophene | NA | NA | NA | NA |
| Hexachloropropene | NA | NA | NA | NA |
| Indeno(1,2,3-Cd)Pyrene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Isodrin | NA | NA | NA | NA |
| Isosafrole | NA | NA | NA | NA |
| Kepone | NA | NA | NA | NA |
| M-Dichlorobenzene | NA | NA | NA | NA |
| Methapyrilene | NA | NA | NA | NA |
| Methyl Methanesulfonate | NA | NA | NA | NA |
| Methyl Parathion | NA | NA | NA | NA |
| Naphthalene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Nitrobenzene | NA | NA | NA | NA |
| N-Nitrosodiethylamine | NA | NA | NA | NA |
| N-Nitrosodimethylamine | NA | NA | NA | NA |
| N-Nitrosodi-N-Butylamine | NA | NA | NA | NA |
| N-Nitroso-Di-N-Propylamine | NA | NA | NA | NA |
| N-Nitrosodiphenylamine | NA | NA | NA | NA |
| N-Nitrosodiphenylamine/Diphenylamine | NA | NA | NA | NA |
| N-Nitrosomethylethylamine | NA | NA | NA | NA |
| N-Nitrosomorpholine | NA | NA | NA | NA |
| N-Nitrosopiperidine | NA | NA | NA | NA |
| N-Nitrosopyrrolidine | NA | NA | NA | NA |
| O,O,O-Triethyl Phosphorothioate | NA | NA | NA | NA |
| O-Toluidine | NA | NA | NA | NA |
| Parathion | NA | NA | NA | NA |
| P-Dimethylaminoazobenzene | NA | NA | NA | NA |
| Pentachlorobenzene | NA | NA | NA | NA |
| Pentachloroethane | NA | NA | NA | NA |

Table 4-64

SWMU No. 2 (Alcoa/Badin Landfill)
Phase I RFI Soil Analytical Results

Alcoa Badin, NC RFI

| Sample ID<br>Sample Depth (ft-bgs)[a]<br>Parameter | S2-HA05-0.0-0.5<br>0-0.5 | S2-HA05-0.5-2.0<br>0.5-2.0 | S2-HA06-0.0-0.5<br>0-0.5 | S2-HA06-0.5-2.0<br>0.5-2.0 |
|---|---|---|---|---|
| Pentachloronitrobenzene | NA | NA | NA | NA |
| Pentachlorophenol | NA | NA | NA | NA |
| Phenacetin | NA | NA | NA | NA |
| Phenanthrene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Phenol | NA | NA | NA | NA |
| Phorate | NA | NA | NA | NA |
| P-Nitroaniline | NA | NA | NA | NA |
| P-Phenylene Diamine | NA | NA | NA | NA |
| Pronamide | NA | NA | NA | NA |
| Pyrene | < 0.42 | < 0.4 | < 0.41 | < 0.41 |
| Pyridine | NA | NA | NA | NA |
| Safrole | NA | NA | NA | NA |
| Tetraethyldithiopyrophosphate | NA | NA | NA | NA |
| Thionazin | NA | NA | NA | NA |

(a) ft-bgs = feet below ground surface.

(b) mg/kg = milligrams per kilogram.

(c) < = not detected at indicated detection limit.

(d) VOCs = volatile organic compounds.

(e) SVOCs = semivolatile organic compounds.

(f) NA - Not analyzed

Table 4-65

**SWMU No. 2: Alcoa / Badin Landfill**
**Phase I RFI Groundwater Analytical Results**
**Alcoa Badin, NC Works RFI**

| Sample Designation / Parameter | ABL-MW-1-2679 | ABL-MW-1-0050R | ABL-MW-2-2679 | ABL-MW-2-0060R | ABL-MW-3 | ABL-MW-3-0060R | ABL-MW-4-2679 |
|---|---|---|---|---|---|---|---|
| **Inorganics (mg/l)[a]** | | | | | | | |
| Cyanide, Total | < 0.01[b] | < 0.01 | < 0.01 | < 0.01 | 0.011 J[c] | < 0.01 | 0.036 |
| Cyanide, Microdiffusion | < 0.005 J | < 0.005 | < 0.005 J | < 0.005 | < 0.005 J | < 0.005 | < 0.005 J |
| Cyanide, Weak Acid Dissociable | < 0.01 | < 0.01 | < 0.01 | < 0.01 | < 0.01 R[d] | < 0.01 | 0.013 |
| Tss | < 4 | NA[e] | < 4 | NA | < 4 | NA | < 4 |
| Fluoride | < 0.1 | NA | < 0.1 | NA | < 0.1 | NA | 0.98 |
| Total Sulfide | NA | NA | NA | NA | NA | NA | NA |
| Antimony, Dissolved | NA | NA | NA | NA | NA | NA | NA |
| Antimony, Total | NA | NA | NA | NA | NA | NA | NA |
| Arsenic, Dissolved | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Arsenic, Total | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Barium, Dissolved | 0.43 | NA | 0.29 | NA | 0.49 | NA | < 0.2 |
| Barium, Total | < 0.2 | NA | < 0.2 | NA | < 0.2 | NA | < 0.2 |
| Beryllium, Dissolved | NA | NA | NA | NA | NA | NA | NA |
| Beryllium, Total | NA | NA | NA | NA | NA | NA | NA |
| Cadmium, Dissolved | < 0.002 | NA | < 0.002 | NA | < 0.002 | NA | < 0.002 |
| Cadmium, Total | < 0.002 | NA | < 0.002 | NA | < 0.002 | NA | < 0.002 |
| Chromium, Dissolved | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Chromium, Total | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Cobalt, Dissolved | NA | NA | NA | NA | NA | NA | NA |
| Cobalt, Total | NA | NA | NA | NA | NA | NA | NA |
| Copper, Dissolved | NA | NA | NA | NA | NA | NA | NA |
| Copper, Total | NA | NA | NA | NA | NA | NA | NA |
| Lead, Dissolved | < 0.003 | NA | < 0.003 | NA | < 0.003 | NA | < 0.003 |
| Lead, Total | < 0.003 | NA | < 0.003 | NA | < 0.003 | NA | < 0.003 |
| Mercury, Dissolved | NA | NA | NA | NA | < 0.0002 | NA | NA |
| Mercury, Total | NA | NA | NA | NA | < 0.0002 | NA | NA |
| Nickel, Dissolved | NA | NA | NA | NA | NA | NA | NA |
| Nickel, Total | NA | NA | NA | NA | NA | NA | NA |
| Selenium, Dissolved | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Selenium, Total | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Silver, Dissolved | NA | NA | NA | NA | NA | NA | NA |
| Silver, Total | NA | NA | NA | NA | NA | NA | NA |
| Thallium, Dissolved | NA | NA | NA | NA | NA | NA | NA |
| Thallium, Total | NA | NA | NA | NA | NA | NA | NA |
| Tin, Dissolved | NA | NA | NA | NA | NA | NA | NA |
| Tin, Total | NA | NA | NA | NA | NA | NA | NA |
| Vanadium, Dissolved | NA | NA | NA | NA | NA | NA | NA |
| Vanadium, Total | NA | NA | NA | NA | NA | NA | NA |
| Zinc, Dissolved | NA | NA | NA | NA | NA | NA | NA |
| Zinc, Total | NA | NA | NA | NA | NA | NA | NA |

Table 4-65

SWMU No. 2: Alcoa / Badin Landfill
Phase I RFI Groundwater Analytical Results
Alcoa Badin, NC Works RFI

| Parameter / Sample Designation | ABL-MW-1-2679 | ABL-MW-1-0050R | ABL-MW-2-2679 | ABL-MW-2-0060R | ABL-MW-3 | ABL-MW-3-0060R | ABL-MW-4-2679 |
|---|---|---|---|---|---|---|---|
| PCBs[8]/Pesticides (mg/l) | | | | | | | |
| 4,4'-DDD | NA | NA | NA | NA | NA | NA | NA |
| 4,4'-DDE | NA | NA | NA | NA | NA | NA | NA |
| 4,4'-DDT | NA | NA | NA | NA | NA | NA | NA |
| Aldrin | NA | NA | NA | NA | NA | NA | NA |
| Alpha-BHC | NA | NA | NA | NA | NA | NA | NA |
| Beta-BHC | NA | NA | NA | NA | NA | NA | NA |
| Chlordane | NA | NA | NA | NA | NA | NA | NA |
| Chlorobenzilate | NA | NA | NA | NA | NA | NA | NA |
| Decachlorobiphenyl | NA | NA | NA | NA | NA | NA | NA |
| Delta-BHC | NA | NA | NA | NA | NA | NA | NA |
| Diallate | NA | NA | NA | NA | NA | NA | NA |
| Dieldrin | NA | NA | NA | NA | NA | NA | NA |
| Endosulfan I | NA | NA | NA | NA | NA | NA | NA |
| Endosulfan II | NA | NA | NA | NA | NA | NA | NA |
| Endosulfan Sulfate | NA | NA | NA | NA | NA | NA | NA |
| Endrin | NA | NA | NA | NA | NA | NA | NA |
| Endrin Aldehyde | NA | NA | NA | NA | NA | NA | NA |
| Gamma-BHC | NA | NA | NA | NA | NA | NA | NA |
| Heptachlor | NA | NA | NA | NA | NA | NA | NA |
| Heptachlor Epoxide | NA | NA | NA | NA | NA | NA | NA |
| Isodrin | NA | NA | NA | NA | NA | NA | NA |
| Kepone | NA | NA | NA | NA | NA | NA | NA |
| Methoxychlor | NA | NA | NA | NA | NA | NA | NA |
| Tetrachloro-M-Xylene | NA | NA | NA | NA | NA | NA | NA |
| Toxaphene | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1016 | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1221 | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1232 | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1242 | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1248 | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1254 | NA | NA | NA | NA | NA | NA | NA |
| Aroclor 1260 | NA | NA | NA | NA | NA | NA | NA |
| Dimethoate | NA | NA | NA | NA | NA | NA | NA |
| Disulfoton | NA | NA | NA | NA | NA | NA | NA |
| Famphur | NA | NA | NA | NA | NA | NA | NA |
| Methyl Parathion | NA | NA | NA | NA | NA | NA | NA |
| O,O,O-Triethyl Phosphorothioate | NA | NA | NA | NA | NA | NA | NA |
| Parathion | NA | NA | NA | NA | NA | NA | NA |
| Phorate | NA | NA | NA | NA | NA | NA | NA |
| Tetraethyldithiopyrophosphate | NA | NA | NA | NA | NA | NA | NA |
| Thionazin | NA | NA | NA | NA | NA | NA | NA |

Table 4-65

SWMU No. 2: Alcoa / Badin Landfill
Phase I RFI Groundwater Analytical Results
Alcoa Badin, NC Works RFI

| Parameter / Sample Designation | ABL-MW-1-2679 | ABL-MW-1-0050R | ABL-MW-2-2679 | ABL-MW-2-0060R | ABL-MW-3 | ABL-MW-3-0060R | ABL-MW-4-2679 |
|---|---|---|---|---|---|---|---|
| Triphenyl Phosphate | NA | NA | NA | NA | NA | NA | NA |
| 2,4,5-T | NA | NA | NA | NA | NA | NA | NA |
| 2,4,5-Tp (Silvex) | NA | NA | NA | NA | NA | NA | NA |
| 2,4-D | NA | NA | NA | NA | NA | NA | NA |
| 2,4-Dichlorophenylacetic Acid | NA | NA | NA | NA | NA | NA | NA |
| VOCs[a] (mg/l) | | | | | | | |
| 1,1,1,2-Tetrachloroethane | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| 1,1,1-Trichloroethane | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| 1,1,2,2-Tetrachloroethane | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| 1,1,2-Trichloroethane | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| 1,1-Dichloroethane | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| 1,1-Dichloroethene | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| 1,2,3-Trichloropropane | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| 1,2-Dibromo-3-Chloropropane | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 1,2-Dibromoethane | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| 1,2-Dichloroethane | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| 1,2-Dichloropropane | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| 1,4-Dioxane | < 0.5 | NA | < 0.5 | NA | < 0.5 | NA | < 0.5 |
| 2-Butanone | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| 2-Hexanone | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| 4-Methyl-2-Pentanone | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| Acetone | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| Acetonitrile | < 0.1 | NA | < 0.1 | NA | < 0.1 | NA | < 0.1 |
| Acrolein | < 0.1 | NA | < 0.1 | NA | < 0.1 | NA | < 0.1 |
| Acrylonitrile | < 0.1 | NA | < 0.1 | NA | < 0.1 | NA | < 0.1 |
| Allyl Chloride | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Benzene | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Bromodichloromethane | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Bromoform | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Bromomethane | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Carbon Disulfide | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Carbon Tetrachloride | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Chlorobenzene | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Chloroethane | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Chloroform | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Chloromethane | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Chloroprene | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Cis-1,2-Dichloroethene | < 0.0025 | NA | < 0.0025 | NA | < 0.0025 | NA | < 0.0025 |
| Cis-1,3-Dichloropropene | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Dibromochloromethane | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Dibromomethane | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Dichlorodifluoromethane | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |

Table 4-65

SWMU No. 2: Alcoa / Badin Landfill
Phase I RFI Groundwater Analytical Results
Alcoa Badin, NC Works RFI

| Parameter / Sample Designation | ABL-MW-1-2679 | ABL-MW-1-0050R | ABL-MW-2-2679 | ABL-MW-2-0060R | ABL-MW-3 | ABL-MW-3-0060R | ABL-MW-4-2679 |
|---|---|---|---|---|---|---|---|
| Dichloromethane | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Ethyl Methacrylate | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Ethylbenzene | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Iodomethane | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Isobutyl Alcohol | < 0.2 | NA | < 0.2 | NA | < 0.2 | NA | < 0.2 |
| Methacrylonitrile | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Methyl Methacrylate | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Propionitrile | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| Styrene | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Tetrachloroethene | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Toluene | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Trans-1,2-Dichloroethene | < 0.0025 | NA | < 0.0025 | NA | < 0.0025 | NA | < 0.0025 |
| Trans-1,3-Dichloropropene | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Trans-1,4-Dichloro-2-Butene | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Trichloroethylene | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| Trichlorofluoromethane | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Vinyl Acetate | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Vinyl Chloride | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Xylene (Total) | < 0.005 | NA | < 0.005 | NA | < 0.005 | NA | < 0.005 |
| SVOCs[(b)] | | | | | | | |
| 1,2,4,5-Tetrachlorobenzene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 1,2,4-Trichlorobenzene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 1,2-Dichlorobenzene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 1,3,5-Trinitrobenzene | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| 1,3-Dinitrobenzene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 1,4-Dichlorobenzene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 1,4-Naphthoquinone | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| 1-Naphthylamine | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 2,3,4,6-Tetrachlorophenol | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| 2,4,5-Trichlorophenol | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 2,4,6-Trichlorophenol | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 2,4-Dichlorophenol | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 2,4-Dimethylphenol | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 2,4-Dinitrophenol | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| 2,4-Dinitrotoluene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 2,6-Dichlorophenol | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 2,6-Dinitrotoluene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 2-Acetylaminofluorene | < 0.1 | NA | < 0.1 | NA | < 0.1 | NA | < 0.1 |
| 2-Chloronaphthalene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 2-Chlorophenol | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 2-Methyl-4,6-Dinitrophenol | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| 2-Methylnaphthalene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |

## Table 4-65

**SWMU No. 2: Alcoa / Badin Landfill**
**Phase I RFI Groundwater Analytical Results**
**Alcoa Badin, NC Works RFI**

| Parameter / Sample Designation | ABL-MW-1-2679 | ABL-MW-1-0050R | ABL-MW-2-2679 | ABL-MW-2-0060R | ABL-MW-3 | ABL-MW-3-0060R | ABL-MW-4-2679 |
|---|---|---|---|---|---|---|---|
| 2-Methylphenol (O-Cresol) | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 2-Naphthylamine | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 2-Nitroaniline | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| 2-Nitrophenol | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 2-Picoline | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| 3,3'-Dichlorobenzidine | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| 3,3'-Dimethylbenzidine | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| 3,5,5-Trimethyl-2-Cyclohexen-1-One | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 3-Methylcholanthrene | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| 3-Methylphenol & 4-Methylphenol | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| 3-Methylphenol/4-Methylphenol | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 3-Nitroaniline | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| 4-Aminobiphenyl | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| 4-Bromophenyl Phenyl Ether | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 4-Chloro-3-Methylphenol | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 4-Chloroaniline | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 4-Chlorophenyl Phenyl Ether | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| 4-Nitrophenol | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| 4-Nitroquinoline-1-Oxide | < 0.1 | NA | < 0.1 | NA | < 0.1 | NA | < 0.1 |
| 5-Nitro-O-Toluidine | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| 7,12-Dimethylbenz(A)Anthracene | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| A,A-Dimethylphenethylamine | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| Acenaphthene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Acenaphthylene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Acetophenone | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Aniline | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Anthracene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Aramite | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| Benz(B)Fluoranthene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Benzo(A)Anthracene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Benzo(A)Pyrene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Benzo(G,H,I)Perylene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Benzo(K)Fluoranthene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Benzyl Alcohol | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Benzyl Butyl Phthalate | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Bis(2-Chloroethoxy)Methane | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Bis(2-Chloroethyl)Ether | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Bis(2-Chloroisopropyl)Ether | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Bis(2-Ethylhexyl)Phthalate | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Chrysene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Dibenzo(A,H)Anthracene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Dibenzofuran | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |

Table 4-65

**SWMU No. 2: Alcoa / Badin Landfill**
**Phase I RFI Groundwater Analytical Results**
**Alcoa Badin, NC Works RFI**

| Parameter / Sample Designation | ABL-MW-1-2679 | ABL-MW-1-0050R | ABL-MW-2-2679 | ABL-MW-2-0060R | ABL-MW-3 | ABL-MW-3-0060R | ABL-MW-4-2679 |
|---|---|---|---|---|---|---|---|
| Diethyl Phthalate | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Dimethoate | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| Dimethyl Phthalate | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Di-N-Butyl Phthalate | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Di-N-Octylphthalate | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Dinoseb | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| Disulfoton | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| Ethyl Methanesulfonate | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Famphur | < 0.1 | NA | < 0.1 | NA | < 0.1 | NA | < 0.1 |
| Fluoranthene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Fluorene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Hexachlorobenzene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Hexachlorobutadiene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Hexachlorocyclopentadiene | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| Hexachloroethane | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Hexachlorophene | < | NA | < | NA | < | NA | < |
| Hexachloropropene | < 0.1 | NA | < 0.1 | NA | < 0.1 | NA | < 0.1 |
| Indeno(1,2,3-Cd)Pyrene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Isosafrole | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| M-Dichlorobenzene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Methapyrilene | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| Methyl Methanesulfonate | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Methyl Parathion | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| Naphthalene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Nitrobenzene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosodiethylamine | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosodimethylamine | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosodi-N-Butylamine | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| N-Nitroso-Di-N-Propylamine | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosodiphenylamine | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosodiphenylamine/Diphenylamine | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosomethylethylamine | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosomorpholine | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosopiperidine | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosopyrrolidine | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| O,O,O-Triethyl Phosphorothioate | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| O-Toluidine | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| Parathion | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| P-Dimethylaminoazobenzene | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| Pentachlorobenzene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Pentachloroethane | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| Pentachloronitrobenzene | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |

## Table 4-65

### SWMU No. 2: Alcoa / Badin Landfill
### Phase I RFI Groundwater Analytical Results
### Alcoa Badin, NC Works RFI

| Parameter / Sample Designation | ABL-MW-1-2679 | ABL-MW-1-0050R | ABL-MW-2-2679 | ABL-MW-2-0060R | ABL-MW-3 | ABL-MW-3-0060R | ABL-MW-4-2679 |
|---|---|---|---|---|---|---|---|
| Pentachlorophenol | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| Phenacetin | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| Phenanthrene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Phenol | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Phorate | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| P-Nitroaniline | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| P-Phenylene Diamine | < 0.1 | NA | < 0.1 | NA | < 0.1 | NA | < 0.1 |
| Pronamide | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| Pyrene | < 0.01 | NA | < 0.01 | NA | < 0.01 | NA | < 0.01 |
| Pyridine | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| Safrole | < 0.02 | NA | < 0.02 | NA | < 0.02 | NA | < 0.02 |
| Tetraethyldithiopyrophosphate | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |
| Thionazin | < 0.05 | NA | < 0.05 | NA | < 0.05 | NA | < 0.05 |

Notes:
(a) mg/l = milligrams per liter
(b) < = not detected at indicated detection limit
(c) J = Estimated Value
(d) R = Rejected Value
(e) NA = Not analyzed
(f) PCBs = Polychlorinated Biphenyls
(g) VOCs = Volatile Organic Compounds
(h) SVOCs - Semi-Volatile Organic Compounds

Table 4-65

SWMU No. 2: Alcoa / Badin Landfill
Phase I RFI Groundwater Analytical Results
Alcoa Badin, NC Works RFI

| Parameter / Sample Designation | ABL-MW-4-0060R | ABL-MW-5-2669 | ABL-MW-5-0060R | ABL-MW-6-2679 | ABL-MW-6-0080R |
|---|---|---|---|---|---|
| Inorganics (mg/l)[a] | | | | | |
| Cyanide, Total | 0.016 | 0.042 | 0.25 | < 0.01 | < 0.01 |
| Cyanide, Microdiffusion | < 0.005 | 0.0059 J | 0.0579 | < 0.005 J | < 0.005 |
| Cyanide, Weak Acid Dissociable | < 0.01 | 0.1 J | 0.099 | < 0.01 | < 0.01 |
| Tss | NA | < 4 | NA | < 4 | NA |
| Fluoride | NA | 0.15 | NA | < 0.1 | NA |
| Total Sulfide | NA | < 1 | NA | NA | NA |
| Antimony, Dissolved | NA | < 0.01 | NA | NA | NA |
| Antimony, Total | NA | < 0.01 | NA | NA | NA |
| Arsenic, Dissolved | NA | < 0.01 | NA | 0.0066 | NA |
| Arsenic, Total | NA | < 0.01 | NA | < 0.01 | NA |
| Barium, Dissolved | NA | 0.26 | NA | 0.27 | NA |
| Barium, Total | NA | < 0.2 | NA | < 0.2 | NA |
| Beryllium, Dissolved | NA | < 0.005 | NA | NA | NA |
| Beryllium, Total | NA | < 0.005 | NA | NA | NA |
| Cadmium, Dissolved | NA | < 0.002 | NA | < 0.002 | NA |
| Cadmium, Total | NA | < 0.002 | NA | < 0.002 | NA |
| Chromium, Dissolved | NA | < 0.005 | NA | < 0.005 | NA |
| Chromium, Total | NA | < 0.005 | NA | < 0.005 | NA |
| Cobalt, Dissolved | NA | 0.13 | NA | NA | NA |
| Cobalt, Total | NA | 0.13 | NA | NA | NA |
| Copper, Dissolved | NA | < 0.025 | NA | NA | NA |
| Copper, Total | NA | < 0.025 | NA | NA | NA |
| Lead, Dissolved | NA | < 0.003 | NA | < 0.003 | NA |
| Lead, Total | NA | < 0.003 | NA | < 0.003 | NA |
| Mercury, Dissolved | NA | < 0.0002 | NA | NA | NA |
| Mercury, Total | NA | < 0.0002 | NA | NA | NA |
| Nickel, Dissolved | NA | < 0.04 | NA | NA | NA |
| Nickel, Total | NA | < 0.04 | NA | NA | NA |
| Selenium, Dissolved | NA | 0.0069 | NA | < 0.005 | NA |
| Selenium, Total | NA | 0.006 | NA | < 0.005 | NA |
| Silver, Dissolved | NA | < 0.01 | NA | NA | NA |
| Silver, Total | NA | < 0.01 | NA | NA | NA |
| Thallium, Dissolved | NA | < 0.01 | NA | NA | NA |
| Thallium, Total | NA | < 0.01 | NA | NA | NA |
| Tin, Dissolved | NA | < 0.1 | NA | NA | NA |
| Tin, Total | NA | < 0.1 | NA | NA | NA |
| Vanadium, Dissolved | NA | < 0.05 | NA | NA | NA |
| Vanadium, Total | NA | < 0.05 | NA | NA | NA |
| Zinc, Dissolved | NA | 0.026 | NA | NA | NA |
| Zinc, Total | NA | < 0.02 | NA | NA | NA |

Table 4-65

**SWMU No. 2: Alcoa / Badin Landfill**
**Phase I RFI Groundwater Analytical Results**
**Alcoa Badin, NC Works RFI**

| Parameter / Sample Designation | ABL-MW-4-0060R | ABL-MW-5-2669 | ABL-MW-5-0060R | ABL-MW-6-2679 | ABL-MW-6-0080R |
|---|---|---|---|---|---|
| **PCBs[f]/Pesticides (mg/l)** | | | | | |
| 4,4'-DDD | NA | < 0.00005 | NA | NA | NA |
| 4,4'-DDE | NA | < 0.00005 | NA | NA | NA |
| 4,4'-DDT | NA | < 0.0001 | NA | NA | NA |
| Aldrin | NA | < 0.00005 | NA | NA | NA |
| Alpha-BHC | NA | < 0.00005 | NA | NA | NA |
| Beta-BHC | NA | < 0.00005 | NA | NA | NA |
| Chlordane | NA | < 0.0005 | NA | NA | NA |
| Chlorobenzilate | NA | < 0.0001 | NA | NA | NA |
| Decachlorobiphenyl | NA | 0.00022 | NA | NA | NA |
| Delta-BHC | NA | < 0.00005 | NA | NA | NA |
| Diallate | NA | < 0.001 | NA | NA | NA |
| Dieldrin | NA | < 0.00005 | NA | NA | NA |
| Endosulfan I | NA | < 0.00005 | NA | NA | NA |
| Endosulfan II | NA | < 0.00005 | NA | NA | NA |
| Endosulfan Sulfate | NA | < 0.00005 | NA | NA | NA |
| Endrin | NA | < 0.00005 | NA | NA | NA |
| Endrin Aldehyde | NA | < 0.00005 | NA | NA | NA |
| Gamma-BHC | NA | < 0.00005 | NA | NA | NA |
| Heptachlor | NA | < 0.00005 | NA | NA | NA |
| Heptachlor Epoxide | NA | < 0.00005 | NA | NA | NA |
| Isodrin | NA | < 0.0001 | NA | NA | NA |
| Kepone | NA | < 0.001 | NA | NA | NA |
| Methoxychlor | NA | < 0.0001 | NA | NA | NA |
| Tetrachloro-M-Xylene | NA | 0.00017 | NA | NA | NA |
| Toxaphene | NA | < 0.002 | NA | NA | NA |
| Aroclor 1016 | NA | < 0.001 | NA | NA | NA |
| Aroclor 1221 | NA | < 0.001 | NA | NA | NA |
| Aroclor 1232 | NA | < 0.001 | NA | NA | NA |
| Aroclor 1242 | NA | < 0.001 | NA | NA | NA |
| Aroclor 1248 | NA | < 0.001 | NA | NA | NA |
| Aroclor 1254 | NA | < 0.001 | NA | NA | NA |
| Aroclor 1260 | NA | < 0.001 | NA | NA | NA |
| Dimethoate | NA | < 0.001 | NA | NA | NA |
| Disulfoton | NA | < 0.001 | NA | NA | NA |
| Famphur | NA | < 0.001 | NA | NA | NA |
| Methyl Parathion | NA | < 0.001 | NA | NA | NA |
| O,O,O-Triethyl Phosphorothioate | NA | < 0.001 | NA | NA | NA |
| Parathion | NA | < 0.001 | NA | NA | NA |
| Phorate | NA | < 0.001 | NA | NA | NA |
| Tetraethyldithiopyrophosphate | NA | < 0.001 | NA | NA | NA |
| Thionazin | NA | < 0.001 | NA | NA | NA |

# Table 4-65

## SWMU No. 2: Alcoa / Badin Landfill
## Phase I RFI Groundwater Analytical Results
## Alcoa Badin, NC Works RFI

| Sample Designation / Parameter | ABL-MW-4-0060R | ABL-MW-5-2669 | ABL-MW-5-0060R | ABL-MW-6-2679 | ABL-MW-6-0080R |
|---|---|---|---|---|---|
| Triphenyl Phosphate | NA | 0.019 | NA | NA | NA |
| 2,4,5-T | NA | < 0.001 | NA | NA | NA |
| 2,4,5-Tp (Silvex) | NA | < 0.001 | NA | NA | NA |
| 2,4-D | NA | < 0.004 | NA | NA | NA |
| 2,4-Dichlorophenylacetic Acid | NA | 0.0017 | NA | NA | NA |
| VOCs[e] (mg/l) | | | | | |
| 1,1,1,2-Tetrachloroethane | NA | < 0.005 | NA | < 0.005 | NA |
| 1,1,1-Trichloroethane | NA | < 0.005 | NA | < 0.005 | NA |
| 1,1,2,2-Tetrachloroethane | NA | < 0.005 | NA | < 0.005 | NA |
| 1,1,2-Trichloroethane | NA | < 0.005 | NA | < 0.005 | NA |
| 1,1-Dichloroethane | NA | < 0.005 | NA | < 0.005 | NA |
| 1,1-Dichloroethene | NA | < 0.005 | NA | < 0.005 | NA |
| 1,2,3-Trichloropropane | NA | < 0.005 | NA | < 0.005 | NA |
| 1,2-Dibromo-3-Chloropropane | NA | < 0.01 | NA | < 0.01 | NA |
| 1,2-Dibromoethane | NA | < 0.005 | NA | < 0.005 | NA |
| 1,2-Dichloroethane | NA | < 0.005 | NA | < 0.005 | NA |
| 1,2-Dichloropropane | NA | < 0.005 | NA | < 0.005 | NA |
| 1,4-Dioxane | NA | < 0.5 | NA | < 0.5 | NA |
| 2-Butanone | NA | < 0.02 | NA | < 0.02 | NA |
| 2-Hexanone | NA | < 0.02 | NA | < 0.02 | NA |
| 4-Methyl-2-Pentanone | NA | < 0.02 | NA | < 0.02 | NA |
| Acetone | NA | < 0.02 | NA | < 0.02 | NA |
| Acetonitrile | NA | < 0.1 | NA | < 0.1 | NA |
| Acrolein | NA | < 0.1 | NA | < 0.1 | NA |
| Acrylonitrile | NA | < 0.1 | NA | < 0.1 | NA |
| Allyl Chloride | NA | < 0.01 | NA | < 0.01 | NA |
| Benzene | NA | < 0.005 | NA | < 0.005 | NA |
| Bromodichloromethane | NA | < 0.005 | NA | < 0.005 | NA |
| Bromoform | NA | < 0.005 | NA | < 0.005 | NA |
| Bromomethane | NA | < 0.01 | NA | < 0.01 | NA |
| Carbon Disulfide | NA | < 0.005 | NA | < 0.005 | NA |
| Carbon Tetrachloride | NA | < 0.005 | NA | < 0.005 | NA |
| Chlorobenzene | NA | < 0.005 | NA | < 0.005 | NA |
| Chloroethane | NA | < 0.01 | NA | < 0.01 | NA |
| Chloroform | NA | < 0.005 | NA | < 0.005 | NA |
| Chloromethane | NA | < 0.01 | NA | < 0.01 | NA |
| Chloroprene | NA | < 0.005 | NA | < 0.005 | NA |
| Cis-1,2-Dichloroethene | NA | < 0.0025 | NA | < 0.0025 | NA |
| Cis-1,3-Dichloropropene | NA | < 0.005 | NA | < 0.005 | NA |
| Dibromochloromethane | NA | < 0.005 | NA | < 0.005 | NA |
| Dibromomethane | NA | < 0.005 | NA | < 0.005 | NA |
| Dichlorodifluoromethane | NA | < 0.01 | NA | < 0.01 | NA |

Table 4-65

SWMU No. 2: Alcoa / Badin Landfill
Phase I RFI Groundwater Analytical Results
Alcoa Badin, NC Works RFI

| Sample Designation | ABL-MW-4-0060R | ABL-MW-5-2669 | ABL-MW-5-0060R | ABL-MW-6-2679 | ABL-MW-6-0080R |
|---|---|---|---|---|---|
| **Parameter** | | | | | |
| Dichloromethane | NA | < 0.005 | NA | < 0.005 | NA |
| Ethyl Methacrylate | NA | < 0.005 | NA | < 0.005 | NA |
| Ethylbenzene | NA | < 0.005 | NA | < 0.005 | NA |
| Iodomethane | NA | < 0.005 | NA | < 0.005 | NA |
| Isobutyl Alcohol | NA | < 0.2 | NA | < 0.2 | NA |
| Methacrylonitrile | NA | < 0.005 | NA | < 0.005 | NA |
| Methyl Methacrylate | NA | < 0.005 | NA | < 0.005 | NA |
| Propionitrile | NA | < 0.02 | NA | < 0.02 | NA |
| Styrene | NA | < 0.005 | NA | < 0.005 | NA |
| Tetrachloroethene | NA | < 0.005 | NA | < 0.005 | NA |
| Toluene | NA | < 0.005 | NA | < 0.005 | NA |
| Trans-1,2-Dichloroethene | NA | < 0.0025 | NA | < 0.0025 | NA |
| Trans-1,3-Dichloropropene | NA | < 0.005 | NA | < 0.005 | NA |
| Trans-1,4-Dichloro-2-Butene | NA | < 0.005 | NA | < 0.005 | NA |
| Trichloroethylene | NA | < 0.005 | NA | < 0.005 | NA |
| Trichlorofluoromethane | NA | < 0.01 | NA | < 0.01 | NA |
| Vinyl Acetate | NA | < 0.01 | NA | < 0.01 | NA |
| Vinyl Chloride | NA | < 0.01 | NA | < 0.01 | NA |
| Xylene (Total) | NA | < 0.005 | NA | < 0.005 | NA |
| SVOCs[(b)] | | | | | |
| 1,2,4,5-Tetrachlorobenzene | NA | < 0.01 | NA | < 0.01 | NA |
| 1,2,4-Trichlorobenzene | NA | < 0.01 | NA | < 0.01 | NA |
| 1,2-Dichlorobenzene | NA | < 0.01 | NA | < 0.01 | NA |
| 1,3,5-Trinitrobenzene | NA | < 0.05 | NA | < 0.05 | NA |
| 1,3-Dinitrobenzene | NA | < 0.01 | NA | < 0.01 | NA |
| 1,4-Dichlorobenzene | NA | < 0.01 | NA | < 0.01 | NA |
| 1,4-Naphthoquinone | NA | < 0.05 | NA | < 0.05 | NA |
| 1-Naphthylamine | NA | < 0.01 | NA | < 0.01 | NA |
| 2,3,4,6-Tetrachlorophenol | NA | < 0.05 | NA | < 0.05 | NA |
| 2,4,5-Trichlorophenol | NA | < 0.01 | NA | < 0.01 | NA |
| 2,4,6-Trichlorophenol | NA | < 0.01 | NA | < 0.01 | NA |
| 2,4-Dichlorophenol | NA | < 0.01 | NA | < 0.01 | NA |
| 2,4-Dimethylphenol | NA | < 0.01 | NA | < 0.01 | NA |
| 2,4-Dinitrophenol | NA | < 0.05 | NA | < 0.05 | NA |
| 2,4-Dinitrotoluene | NA | < 0.01 | NA | < 0.01 | NA |
| 2,6-Dichlorophenol | NA | < 0.01 | NA | < 0.01 | NA |
| 2,6-Dinitrotoluene | NA | < 0.01 | NA | < 0.01 | NA |
| 2-Acetylaminofluorene | NA | < 0.1 | NA | < 0.1 | NA |
| 2-Chloronaphthalene | NA | < 0.01 | NA | < 0.01 | NA |
| 2-Chlorophenol | NA | < 0.01 | NA | < 0.01 | NA |
| 2-Methyl-4,6-Dinitrophenol | NA | < 0.05 | NA | < 0.05 | NA |
| 2-Methylnaphthalene | NA | < 0.01 | NA | < 0.01 | NA |

Table 4-65

**SWMU No. 2: Alcoa / Badin Landfill**
**Phase I RFI Groundwater Analytical Results**
**Alcoa Badin, NC Works RFI**

| Parameter / Sample Designation | ABL-MW-4-0060R | ABL-MW-5-2669 | ABL-MW-5-0060R | ABL-MW-6-2679 | ABL-MW-6-0080R |
|---|---|---|---|---|---|
| 2-Methylphenol (O-Cresol) | NA | < 0.01 | NA | < 0.01 | NA |
| 2-Naphthylamine | NA | < 0.01 | NA | < 0.01 | NA |
| 2-Nitroaniline | NA | < 0.05 | NA | < 0.05 | NA |
| 2-Nitrophenol | NA | < 0.01 | NA | < 0.01 | NA |
| 2-Picoline | NA | < 0.02 | NA | < 0.02 | NA |
| 3,3'-Dichlorobenzidine | NA | < 0.05 | NA | < 0.05 | NA |
| 3,3'-Dimethylbenzidine | NA | < 0.05 | NA | < 0.05 | NA |
| 3,5,5-Trimethyl-2-Cyclohexen-1-One | NA | < 0.01 | NA | < 0.01 | NA |
| 3-Methylcholanthrene | NA | < 0.02 | NA | < 0.02 | NA |
| 3-Methylphenol & 4-Methylphenol | NA | < 0.02 | NA | < 0.02 | NA |
| 3-Methylphenol/4-Methylphenol | NA | < 0.01 | NA | < 0.01 | NA |
| 3-Nitroaniline | NA | < 0.05 | NA | < 0.05 | NA |
| 4-Aminobiphenyl | NA | < 0.05 | NA | < 0.05 | NA |
| 4-Bromophenyl Phenyl Ether | NA | < 0.01 | NA | < 0.01 | NA |
| 4-Chloro-3-Methylphenol | NA | < 0.01 | NA | < 0.01 | NA |
| 4-Chloroaniline | NA | < 0.01 | NA | < 0.01 | NA |
| 4-Chlorophenyl Phenyl Ether | NA | < 0.01 | NA | < 0.01 | NA |
| 4-Nitrophenol | NA | < 0.05 | NA | < 0.05 | NA |
| 4-Nitroquinoline-1-Oxide | NA | < 0.1 | NA | < 0.1 | NA |
| 5-Nitro-O-Toluidine | NA | < 0.02 | NA | < 0.02 | NA |
| 7,12-Dimethylbenz(A)Anthracene | NA | < 0.02 | NA | < 0.02 | NA |
| A,A-Dimethylphenethylamine | NA | < 0.05 | NA | < 0.05 | NA |
| Acenaphthene | NA | < 0.01 | NA | < 0.01 | NA |
| Acenaphthylene | NA | < 0.01 | NA | < 0.01 | NA |
| Acetophenone | NA | < 0.01 | NA | < 0.01 | NA |
| Aniline | NA | < 0.01 | NA | < 0.01 | NA |
| Anthracene | NA | < 0.01 | NA | < 0.01 | NA |
| Aramite | NA | < 0.02 | NA | < 0.02 | NA |
| Benz(B)Fluoranthene | NA | < 0.01 | NA | < 0.01 | NA |
| Benzo(A)Anthracene | NA | < 0.01 | NA | < 0.01 | NA |
| Benzo(A)Pyrene | NA | < 0.01 | NA | < 0.01 | NA |
| Benzo(G,H,I)Perylene | NA | < 0.01 | NA | < 0.01 | NA |
| Benzo(K)Fluoranthene | NA | < 0.01 | NA | < 0.01 | NA |
| Benzyl Alcohol | NA | < 0.01 | NA | < 0.01 | NA |
| Benzyl Butyl Phthalate | NA | < 0.01 | NA | < 0.01 | NA |
| Bis(2-Chloroethoxy)Methane | NA | < 0.01 | NA | < 0.01 | NA |
| Bis(2-Chloroethyl)Ether | NA | < 0.01 | NA | < 0.01 | NA |
| Bis(2-Chloroisopropyl)Ether | NA | < 0.01 | NA | < 0.01 | NA |
| Bis(2-Ethylhexyl)Phthalate | NA | < 0.01 | NA | < 0.01 | NA |
| Chrysene | NA | < 0.01 | NA | < 0.01 | NA |
| Dibenzo(A,H)Anthracene | NA | < 0.01 | NA | < 0.01 | NA |
| Dibenzofuran | NA | < 0.01 | NA | < 0.01 | NA |

Table 4-65

**SWMU No. 2: Alcoa / Badin Landfill**
**Phase I RFI Groundwater Analytical Results**
**Alcoa Badin, NC Works RFI**

| Parameter / Sample Designation | ABL-MW-4-0060R | ABL-MW-5-2669 | ABL-MW-5-0060R | ABL-MW-6-2679 | ABL-MW-6-0080R |
|---|---|---|---|---|---|
| Diethyl Phthalate | NA | < 0.01 | NA | < 0.01 | NA |
| Dimethoate | NA | < 0.02 | NA | < 0.02 | NA |
| Dimethyl Phthalate | NA | < 0.01 | NA | < 0.01 | NA |
| Di-N-Butyl Phthalate | NA | < 0.01 | NA | < 0.01 | NA |
| Di-N-Octylphthalate | NA | < 0.01 | NA | < 0.01 | NA |
| Dinoseb | NA | < 0.02 | NA | < 0.02 | NA |
| Disulfoton | NA | < 0.05 | NA | < 0.05 | NA |
| Ethyl Methanesulfonate | NA | < 0.01 | NA | < 0.01 | NA |
| Famphur | NA | < 0.1 | NA | < 0.1 | NA |
| Fluoranthene | NA | < 0.01 | NA | < 0.01 | NA |
| Fluorene | NA | < 0.01 | NA | < 0.01 | NA |
| Hexachlorobenzene | NA | < 0.01 | NA | < 0.01 | NA |
| Hexachlorobutadiene | NA | < 0.01 | NA | < 0.01 | NA |
| Hexachlorocyclopentadiene | NA | < 0.05 | NA | < 0.05 | NA |
| Hexachloroethane | NA | < 0.01 | NA | < 0.01 | NA |
| Hexachlorophene | NA | < | NA | < | NA |
| Hexachloropropene | NA | < 0.1 | NA | < 0.1 | NA |
| Indeno(1,2,3-Cd)Pyrene | NA | < 0.01 | NA | < 0.01 | NA |
| Isosafrole | NA | < 0.02 | NA | < 0.02 | NA |
| M-Dichlorobenzene | NA | < 0.01 | NA | < 0.01 | NA |
| Methapyrilene | NA | < 0.05 | NA | < 0.05 | NA |
| Methyl Methanesulfonate | NA | < 0.01 | NA | < 0.01 | NA |
| Methyl Parathion | NA | < 0.05 | NA | < 0.05 | NA |
| Naphthalene | NA | < 0.01 | NA | < 0.01 | NA |
| Nitrobenzene | NA | < 0.01 | NA | < 0.01 | NA |
| N-Nitrosodiethylamine | NA | < 0.01 | NA | < 0.01 | NA |
| N-Nitrosodimethylamine | NA | < 0.01 | NA | < 0.01 | NA |
| N-Nitrosodi-N-Butylamine | NA | < 0.01 | NA | < 0.01 | NA |
| N-Nitroso-Di-N-Propylamine | NA | < 0.01 | NA | < 0.01 | NA |
| N-Nitrosodiphenylamine | NA | < 0.01 | NA | < 0.01 | NA |
| N-Nitrosodiphenylamine/Diphenylamine | NA | < 0.01 | NA | < 0.01 | NA |
| N-Nitrosomethylethylamine | NA | < 0.01 | NA | < 0.01 | NA |
| N-Nitrosomorpholine | NA | < 0.01 | NA | < 0.01 | NA |
| N-Nitrosopiperidine | NA | < 0.01 | NA | < 0.01 | NA |
| N-Nitrosopyrrolidine | NA | < 0.01 | NA | < 0.01 | NA |
| O,O,O-Triethyl Phosphorothioate | NA | < 0.05 | NA | < 0.05 | NA |
| O-Toluidine | NA | < 0.02 | NA | < 0.02 | NA |
| Parathion | NA | < 0.05 | NA | < 0.05 | NA |
| P-Dimethylaminoazobenzene | NA | < 0.02 | NA | < 0.02 | NA |
| Pentachlorobenzene | NA | < 0.01 | NA | < 0.01 | NA |
| Pentachloroethane | NA | < 0.05 | NA | < 0.05 | NA |
| Pentachloronitrobenzene | NA | < 0.05 | NA | < 0.05 | NA |

Table 4-65

**SWMU No. 2: Alcoa / Badin Landfill**
**Phase I RFI Groundwater Analytical Results**
**Alcoa Badin, NC Works RFI**

| Parameter / Sample Designation | ABL-MW-4-0060R | ABL-MW-5-2669 | ABL-MW-5-0060R | ABL-MW-6-2679 | ABL-MW-6-0080R |
|---|---|---|---|---|---|
| Pentachlorophenol | NA | < 0.05 | NA | < 0.05 | NA |
| Phenacetin | NA | < 0.02 | NA | < 0.02 | NA |
| Phenanthrene | NA | < 0.01 | NA | < 0.01 | NA |
| Phenol | NA | < 0.01 | NA | < 0.01 | NA |
| Phorate | NA | < 0.05 | NA | < 0.05 | NA |
| P-Nitroaniline | NA | < 0.05 | NA | < 0.05 | NA |
| P-Phenylene Diamine | NA | < 0.1 | NA | < 0.1 | NA |
| Pronamide | NA | < 0.02 | NA | < 0.02 | NA |
| Pyrene | NA | < 0.01 | NA | < 0.01 | NA |
| Pyridine | NA | < 0.02 | NA | < 0.02 | NA |
| Safrole | NA | < 0.02 | NA | < 0.02 | NA |
| Tetraethyldithiopyrophosphate | NA | < 0.05 | NA | < 0.05 | NA |
| Thionazin | NA | < 0.05 | NA | < 0.05 | NA |

Notes:
(a) mg/l = milligrams per liter.
(b) < = not detected at indicated detection limit
(c) J = Estimated Value
(d) R = Rejected Value
(e) NA = Not analyzed
(f) PCBs = Polychlorinated Biphenyls
(g) VOCs = Volatile Organic Compounds
(h) SVOCs - Semi-Volatile Organic Compounds

## Table 4-66

### Little Mountain Creek
### Phase I RFI Sediment Analytical Results

### Alcoa Badin, NC Works RFI

| Samples Designation<br>Sample Depth (ft-bgs)[a]<br>Parameter | LMC-S001-0.0-0.3<br>0-0.3 | LMC-S002-0.0-0.4<br>0-0.4 |
|---|---|---|
| **Inorganics (mg/kg)[b]** | | |
| Fluoride | < 0.65[c] | < 0.64 |
| Cyanide (Weak Acid Dissociable) | < 3.3 | < 3.2 |
| Cyanide, Total | < 3.3 | < 3.2 |
| Arsenic | 48.8 J | 25.8 J |
| Barium | 69.2 J | 61.3 J |
| Cadmium | < 0.26 | < 0.26 |
| Chromium | 101 | 87.7 J |
| Lead | 26 J | 22.4 |
| Selenium | < 0.65 J | < 0.64 J |
| **PCBs[d]** | | |
| Aroclor 1016 | < 0.043 J | < 0.042 J |
| Aroclor 1221 | < 0.043 | < 0.042 |
| Aroclor 1232 | < 0.043 | < 0.042 |
| Aroclor 1242 | < 0.043 | < 0.042 |
| Aroclor 1248 | < 0.043 | < 0.042 |
| Aroclor 1254 | < 0.043 | < 0.042 |
| Aroclor 1260 | < 0.043 | < 0.042 |
| **VOCs[e]** | | |
| 1,1,1,2-Tetrachloroethane | < 0.0064 | < 0.0065 |
| 1,1,1-Trichloroethane | < 0.0064 | < 0.0065 |
| 1,1,2,2-Tetrachloroethane | < 0.0064 | < 0.0065 |
| 1,1,2-Trichloroethane | < 0.0064 | < 0.0065 |
| 1,1-Dichloroethane | < 0.0064 | < 0.0065 |
| 1,1-Dichloroethene | < 0.0064 | < 0.0065 |
| 1,2,3-Trichloropropane | < 0.0064 | < 0.0065 |
| 1,2-Dibromo-3-chloropropane | < 0.013 J | < 0.013 J |
| 1,2-Dibromoethane (EDB) | < 0.0064 | < 0.0065 |
| 1,2-Dichloroethane | < 0.0064 | < 0.0065 |
| 1,2-Dichloropropane | < 0.0064 | < 0.0065 |
| 1,4-Dioxane | < 0.64 R | < 0.65 R |
| 2-Butanone (MEK) | < 0.026 | < 0.026 |

# Table 4-66

## Little Mountain Creek
## Phase I RFI Sediment Analytical Results

### Alcoa Badin, NC Works RFI

| Samples Designation<br>Sample Depth (ft-bgs)[a]<br>Parameter | LMC-S001-0.0-0.3<br>0-0.3 | LMC-S002-0.0-0.4<br>0-0.4 |
|---|---|---|
| 2-Hexanone | < 0.026 | < 0.026 |
| 4-Bromofluorobenzene | 0.055 | 0.062 |
| 4-Methyl-2-pentanone (MIBK) | < 0.026 | < 0.026 |
| Acetone | 0.082 J | 0.035 J |
| Acetonitrile | < 0.13 R | < 0.13 R |
| Acrolein | < 0.13 J | < 0.13 J |
| Acrylonitrile | < 0.13 | < 0.13 |
| Allyl chloride | < 0.013 | < 0.013 |
| Benzene | < 0.0064 | < 0.0065 |
| Bromodichloromethane | < 0.0064 | < 0.0065 |
| Bromoform | < 0.0064 J | < 0.0065 J |
| Bromomethane | < 0.013 | < 0.013 |
| Carbon disulfide | < 0.0064 | < 0.0065 |
| Carbon tetrachloride | < 0.0064 | < 0.0065 |
| Chlorobenzene | < 0.0064 | < 0.0065 |
| Chloroethane | < 0.013 | < 0.013 |
| Chloroform | < 0.0064 | < 0.0065 |
| Chloromethane | < 0.013 | < 0.013 |
| Chloroprene | < 0.013 | < 0.013 |
| cis-1,3-Dichloropropene | < 0.0064 | < 0.0065 |
| Dibromochloromethane | < 0.0064 | < 0.0065 |
| Dibromomethane | < 0.0064 | < 0.0065 |
| Dichlorodifluoromethane | < 0.013 | < 0.013 |
| Ethyl methacrylate | < 0.0064 | < 0.0065 |
| Ethylbenzene | < 0.0064 | < 0.0065 |
| Iodomethane | < 0.0064 | < 0.0065 |
| Isobutyl alcohol | < 0.26 R | < 0.26 R |
| Methacrylonitrile | < 0.0064 | < 0.0065 |
| Methyl methacrylate | < 0.0064 J | < 0.0065 J |
| Methylene chloride | 0.0074 J | 0.0093 J |
| Propionitrile | < 0.026 R | < 0.026 R |
| Styrene | < 0.0064 | < 0.0065 |

Table 4-66

Little Mountain Creek
Phase I RFI Sediment Analytical Results

Alcoa Badin, NC Works RFI

| Parameter / Samples Designation / Sample Depth (ft-bgs)[a] | LMC-S001-0.0-0.3<br>0-0.3 | LMC-S002-0.0-0.4<br>0-0.4 |
|---|---|---|
| Tetrachloroethene | < 0.0064 J | < 0.0065 J |
| Toluene | < 0.0064 | < 0.0065 |
| trans-1,2-Dichloroethene | < 0.0032 | < 0.0033 |
| trans-1,3-Dichloropropene | < 0.0064 | < 0.0065 |
| trans-1,4-Dichloro-2-butene | < 0.0064 J | < 0.0065 J |
| Trichloroethene | < 0.0064 | < 0.0065 |
| Trichlorofluoromethane | < 0.013 | < 0.013 |
| Vinyl acetate | < 0.013 | < 0.013 |
| Vinyl chloride | < 0.0064 | < 0.0065 |
| Xylenes (total) | < 0.0064 | < 0.0065 |
| SVOCs[f] | | |
| 1,2,4,5-Tetrachlorobenzene | < 0.43 | < 0.42 |
| 1,2,4-Trichlorobenzene | < 0.43 | < 0.42 |
| 1,2-Dichlorobenzene | < 0.43 | < 0.42 |
| 1,3,5-Trinitrobenzene | < 2.1 | < 2.1 |
| 1,3-Dichlorobenzene | < 0.43 | < 0.42 |
| 1,3-Dinitrobenzene | < 0.43 | < 0.42 |
| 1,4-Dichlorobenzene | < 0.43 | < 0.42 |
| 1,4-Naphthoquinone | < 2.1 | < 2.1 |
| 1-Naphthylamine | < 0.43 | < 0.42 |
| 2,3,4,6-Tetrachlorophenol | < 2.1 | < 2.1 |
| 2,4,5-Trichlorophenol | < 0.43 | < 0.42 |
| 2,4,6-Tribromophenol | 4.1 | 4.3 |
| 2,4,6-Trichlorophenol | < 0.43 | < 0.42 |
| 2,4-Dichlorophenol | < 0.43 | < 0.42 |
| 2,4-Dimethylphenol | < 0.43 | < 0.42 |
| 2,4-Dinitrophenol | < 2.1 J | < 2.1 J |
| 2,4-Dinitrotoluene | < 0.43 | < 0.42 |
| 2,6-Dichlorophenol | < 0.43 | < 0.42 |
| 2,6-Dinitrotoluene | < 0.43 | < 0.42 |
| 2-Acetylaminofluorene | < 4.3 | < 4.2 |
| 2-Chloronaphthalene | < 0.43 | < 0.42 |

Table 4-66

Little Mountain Creek
Phase I RFI Sediment Analytical Results

Alcoa Badin, NC Works RFI

| Samples Designation<br>Sample Depth (ft-bgs)[a]<br>Parameter | LMC-S001-0.0-0.3<br>0-0.3 | LMC-S002-0.0-0.4<br>0-0.4 |
|---|---|---|
| 2-Chlorophenol | < 0.43 | < 0.42 |
| 2-Methylnaphthalene | < 0.43 | < 0.42 |
| 2-Methylphenol | < 0.43 | < 0.42 |
| 2-Naphthylamine | < 0.43 | < 0.42 |
| 2-Nitroaniline | < 2.1 | < 2.1 |
| 2-Nitrophenol | < 0.43 | < 0.42 |
| 2-Picoline | < 0.86 | < 0.85 |
| 2-sec-Butyl-4,6-dinitrophenol | < 0.86 | < 0.85 |
| 3,3'-Dichlorobenzidine | < 2.1 | < 2.1 |
| 3,3'-Dimethylbenzidine | < 2.1 | < 2.1 |
| 3-Methylcholanthrene | < 0.86 | < 0.85 |
| 3-Nitroaniline | < 2.1 | < 2.1 |
| 4,6-Dinitro-2-methylphenol | < 2.1 | < 2.1 |
| 4-Aminobiphenyl | < 2.1 | < 2.1 |
| 4-Bromophenyl phenyl ether | < 0.43 | < 0.42 |
| 4-Chloro-3-methylphenol | < 0.43 | < 0.42 |
| 4-Chloroaniline | < 0.43 | < 0.42 |
| 4-Chlorophenyl phenyl ether | < 0.43 | < 0.42 |
| 4-Methylphenol | < 0.43 | < 0.42 |
| 4-Nitroaniline | < 2.1 | < 2.1 |
| 4-Nitrophenol | < 2.1 | < 2.1 |
| 4-Nitroquinoline-1-oxide | < 4.3 J | < 4.2 J |
| 5-Nitro-o-toluidine | < 0.86 | < 0.85 |
| 7,12-Dimethylbenz(a)anthracene | < 0.86 | < 0.85 |
| a,a-Dimethylphenethylamine | < 2.1 | < 2.1 |
| Acenaphthene | < 0.43 | < 0.42 |
| Acenaphthylene | < 0.43 | < 0.42 |
| Acetophenone | < 0.43 | < 0.42 |
| Aniline | < 0.43 | < 0.42 |
| Anthracene | < 0.43 | < 0.42 |
| Aramite | < 0.86 R | < 0.85 R |
| Benzo(a)anthracene | < 0.43 | < 0.42 |

Table 4-66

Little Mountain Creek
Phase I RFI Sediment Analytical Results

Alcoa Badin, NC Works RFI

| Samples Designation / Sample Depth (ft-bgs)[a] / Parameter | LMC-S001-0.0-0.3 0-0.3 | LMC-S002-0.0-0.4 0-0.4 |
|---|---|---|
| Benzo(a)pyrene | < 0.43 | < 0.42 |
| Benzo(b)fluoranthene | < 0.43 | < 0.42 |
| Benzo(ghi)perylene | < 0.43 | < 0.42 |
| Benzo(k)fluoranthene | < 0.43 | < 0.42 |
| Benzyl alcohol | < 0.43 | < 0.42 |
| bis(2-Chloro-1-methylethyl) ether | < 0.43 | < 0.42 |
| bis(2-Chloroethoxy)methane | < 0.43 | < 0.42 |
| bis(2-Chloroethyl) ether | < 0.43 | < 0.42 |
| bis(2-Ethylhexyl) phthalate | < 0.43 | < 0.42 |
| Butyl benzyl phthalate | < 0.43 | < 0.42 |
| Chlorobenzilate | < 0.43 | < 0.42 |
| Chrysene | < 0.43 | < 0.42 |
| Diallate | < 0.86 | < 0.85 |
| Dibenz(a,h)anthracene | < 0.43 | < 0.42 |
| Dibenzofuran | < 0.43 | < 0.42 |
| Diethyl phthalate | < 0.43 | < 0.42 |
| Dimethoate | < 0.86 J | < 0.85 J |
| Dimethyl phthalate | < 0.43 | < 0.42 |
| Di-n-butyl phthalate | < 0.43 | < 0.42 |
| Di-n-octyl phthalate | < 0.43 | < 0.42 |
| Diphenylamine | < 0.43 | < 0.42 |
| Disulfoton | < 2.1 | < 2.1 |
| Ethyl methanesulfonate | < 0.43 | < 0.42 |
| Famphur | < 4.3 R | < 4.2 R |
| Fluoranthene | < 0.43 | < 0.42 |
| Fluorene | < 0.43 | < 0.42 |
| Hexachlorobenzene | < 0.43 | < 0.42 |
| Hexachlorobutadiene | < 0.43 | < 0.42 |
| Hexachlorocyclopentadiene | < 2.1 | < 2.1 |
| Hexachloroethane | < 0.43 | < 0.42 |
| Hexachlorophene | < | < 2.1 |
| Hexachloropropene | < 4.3 | < 4.2 |

Table 4-66

Little Mountain Creek
Phase I RFI Sediment Analytical Results

Alcoa Badin, NC Works RFI

| Parameter | Samples Designation / Sample Depth (ft-bgs)[a] | LMC-S001-0.0-0.3 0-0.3 | LMC-S002-0.0-0.4 0-0.4 |
|---|---|---|---|
| Indeno(1,2,3-cd)pyrene | | < 0.43 | < 0.42 |
| Isodrin | | < 0.43 | < 0.42 |
| Isophorone | | < 0.43 | < 0.42 |
| Isosafrole | | < 0.86 | < 0.85 |
| Kepone | | < 4.3 | < 4.2 |
| Methapyrilene | | < 2.1 | < 2.1 |
| Methyl methanesulfonate | | < 0.43 | < 0.42 |
| Methyl parathion | | < 2.1 | < 2.1 |
| Naphthalene | | < 0.43 | < 0.42 |
| Nitrobenzene | | < 0.43 | < 0.42 |
| N-Nitrosodiethylamine | | < 0.43 | < 0.42 |
| N-Nitrosodimethylamine | | < 0.43 | < 0.42 |
| N-Nitrosodi-n-butylamine | | < 0.43 | < 0.42 |
| N-Nitrosodi-n-propylamine | | < 0.43 | < 0.42 |
| N-Nitrosodiphenylamine | | < 0.43 | < 0.42 |
| N-Nitrosomethylethylamine | | < 0.43 | < 0.42 |
| N-Nitrosomorpholine | | < 0.43 | < 0.42 |
| N-Nitrosopiperidine | | < 0.43 | < 0.42 |
| N-Nitrosopyrrolidine | | < 0.43 | < 0.42 |
| O,O,O-Triethyl phosphorothioate | | < 2.1 | < 2.1 |
| o-Toluidine | | < 0.86 | < 0.85 |
| Parathion | | < 2.1 | < 2.1 |
| p-Dimethylaminoazobenzene | | < 0.86 | < 0.85 |
| Pentachlorobenzene | | < 0.43 | < 0.42 |
| Pentachloroethane | | < 2.1 | < 2.1 |
| Pentachloronitrobenzene | | < 2.1 | < 2.1 |
| Pentachlorophenol | | < 2.1 | < 2.1 |
| Phenacetin | | < 0.86 | < 0.85 |
| Phenanthrene | | < 0.43 | < 0.42 |
| Phenol | | < 0.43 | < 0.42 |
| Phorate | | < 2.1 | < 2.1 |
| p-Phenylene diamine | | < 4.3 | < 4.2 |

Table 4-66

## Little Mountain Creek
## Phase I RFI Sediment Analytical Results

### Alcoa Badin, NC Works RFI

| Samples Designation<br>Sample Depth (ft-bgs)[a]<br>Parameter | LMC-S001-0.0-0.3<br>0-0.3 | LMC-S002-0.0-0.4<br>0-0.4 |
|---|---|---|
| Pronamide | < 0.86 | < 0.85 |
| Pyrene | < 0.43 | < 0.42 |
| Pyridine | < 0.86 | < 0.85 |
| Safrole | < 0.86 | < 0.85 |
| Tetraethyldithiopyrophosphate | < 2.1 | < 2.1 |
| Thionazin | < 2.1 | < 2.1 |

Notes:

[a] ft-bgs = feet below ground surface

[b] mg/kg = milligrams per kilogram.

[c] < = not detected at indicated detection limit.

[d] PCBs = polychlorinated biphenyls

[e] VOCs = volatile organic compounds.

[f] SVOCs = semivolatile organic compounds.

## Table 4-67

### Little Mountain Creek
### Phase I RFI Surface Water Analytical Results

### Alcoa Badin, NC Works RFI

| Parameter / Sample Designation | LMC-SW-01 | LMC-SW01-2799 | LMC-SW-02 | LMC-SW02-2799 |
|---|---|---|---|---|
| **Miscellaneous** | | | | |
| TSS (mg/l)[a] | NA[b] | 4 | NA | 7 |
| **Inorganics** | | | | |
| Fluoride | NA | 0.17 | NA | 0.2 |
| Cyanide, (Weak Acid Dissociable) | NA | < 0.01[c] J[d] | NA | < 0.01 J |
| Cyanide, Total | NA | < 0.01 | NA | < 0.01 |
| Cyanide, Microdiffusion | 0.0052 | < 0.005 | < 0.005 | < 0.005 |
| Arsenic | NA | < 0.01 | NA | < 0.01 |
| Arsenic, Dissolved | NA | < 0.005 | NA | < 0.005 |
| Barium | NA | < 0.2 | NA | < 0.2 |
| Barium, Dissolved | NA | < 0.2 | NA | < 0.2 |
| Cadmium | NA | < 0.002 | NA | < 0.002 |
| Cadmium, Dissolved | NA | < 0.002 | NA | < 0.002 |
| Chromium | NA | < 0.005 | NA | < 0.005 |
| Chromium, Dissolved | NA | < 0.005 | NA | < 0.005 |
| Lead | NA | < 0.003 | NA | < 0.003 |
| Lead, Dissolved | NA | < 0.003 | NA | < 0.003 |
| Selenium | NA | < 0.005 | NA | < 0.005 |
| Selenium, Dissolved | NA | < 0.005 | NA | < 0.005 |
| **PCBs (mg/l)[e]** | | | | |
| Aroclor 1016 | NA | < 0.001 | NA | < 0.001 |
| Aroclor 1221 | NA | < 0.001 | NA | < 0.001 |
| Aroclor 1232 | NA | < 0.001 | NA | < 0.001 |
| Aroclor 1242 | NA | < 0.001 | NA | < 0.001 |
| Aroclor 1248 | NA | < 0.001 | NA | < 0.001 |
| Aroclor 1254 | NA | < 0.001 | NA | < 0.001 |
| Aroclor1260 | NA | < 0.001 | NA | < 0.001 |
| **VOCs (mg/l)[f]** | | | | |
| 1,1,1,2-Tetrachloroethane | NA | < 0.005 | NA | < 0.005 |
| 1,1,1-Trichloroethane | NA | < 0.005 | NA | < 0.005 |
| 1,1,2,2-Tetrachloroethane | NA | < 0.005 | NA | < 0.005 |
| 1,1,2-Trichloroethane | NA | < 0.005 | NA | < 0.005 |
| 1,1-Dichloroethane | NA | < 0.005 | NA | < 0.005 |
| 1,1-Dichloroethene | NA | < 0.005 | NA | < 0.005 |
| 1,2,3-Trichloropropane | NA | < 0.005 | NA | < 0.005 |
| 1,2-Dibromo-3-chloropropane | NA | < 0.01 | NA | < 0.01 |
| 1,2-Dibromoethane | NA | < 0.005 | NA | < 0.005 |
| 1,2-Dichloroethane | NA | < 0.005 | NA | < 0.005 |
| 1,2-Dichloropropane | NA | < 0.005 | NA | < 0.005 |
| 1,4-Dioxane | NA | < 0.5 | NA | < 0.5 |

Table 4-67

Little Mountain Creek
Phase I RFI Surface Water Analytical Results

Alcoa Badin, NC Works RFI

| Sample Designation / Parameter | LMC-SW-01 | LMC-SW01-2799 | LMC-SW-02 | LMC-SW02-2799 |
|---|---|---|---|---|
| 2-Butanone | NA | < 0.02 | NA | < 0.02 |
| 2-Hexanone | NA | < 0.02 | NA | < 0.02 |
| 4-Methyl-2-pentanone | NA | < 0.02 | NA | < 0.02 |
| Acetone | NA | < 0.02 | NA | < 0.02 |
| Acetonitrile | NA | < 0.1 | NA | < 0.1 |
| Acrolein | NA | < 0.1 | NA | < 0.1 |
| Acrylonitrile | NA | < 0.1 | NA | < 0.1 |
| Allyl chloride | NA | < 0.01 | NA | < 0.01 |
| Benzene | NA | < 0.005 | NA | < 0.005 |
| Bromodichloromethane | NA | < 0.005 | NA | < 0.005 |
| Bromoform | NA | < 0.005 | NA | < 0.005 |
| Bromomethane | NA | < 0.01 | NA | < 0.01 |
| Carbon Disulfide | NA | < 0.005 | NA | < 0.005 |
| Carbon Tetrachloride | NA | < 0.005 | NA | < 0.005 |
| Chlorobenzene | NA | < 0.005 | NA | < 0.005 |
| Chloroethane | NA | < 0.01 | NA | < 0.01 |
| Chloroform | NA | < 0.005 | NA | < 0.005 |
| Chloromethane | NA | < 0.01 | NA | < 0.01 |
| Chloroprene | NA | < 0.005 | NA | < 0.005 |
| cis-1,2-Dichloroethene | NA | < 0.0025 | NA | < 0.0025 |
| Cis-1,3-Dichloropropane | NA | < 0.005 | NA | < 0.005 |
| Dibromochloromethane | NA | < 0.005 | NA | < 0.005 |
| Dibromomethane | NA | < 0.005 | NA | < 0.005 |
| Dichlorodifluoromethane | NA | < 0.01 | NA | < 0.01 |
| Dichloromethane | NA | < 0.005 | NA | < 0.005 |
| Ethyl methacrylate | NA | < 0.005 | NA | < 0.005 |
| Ethylbenzene | NA | < 0.005 | NA | < 0.005 |
| Iodomethane | NA | < 0.005 | NA | < 0.005 |
| Isobutyl alcohol | NA | < 0.2 | NA | < 0.2 |
| Methacrylonitrile | NA | < 0.005 | NA | < 0.005 |
| Methyl methacrylate | NA | < 0.005 | NA | < 0.005 |
| Propionitrile | NA | < 0.02 | NA | < 0.02 |
| Styrene | NA | < 0.005 | NA | < 0.005 |
| Tetrachlorethene | NA | < 0.005 | NA | < 0.005 |
| Toluene | NA | < 0.005 | NA | < 0.005 |
| Trans-1,2-Dichloroethene | NA | < 0.0025 | NA | < 0.0025 |
| Trans-1,3-Dichloropropene | NA | < 0.005 | NA | < 0.005 |
| trans-1,4-Dichloro-2-butene | NA | < 0.005 | NA | < 0.005 |
| Trichloroethylene | NA | < 0.005 | NA | < 0.005 |
| Trichlorofluoromethane | NA | < 0.01 | NA | < 0.01 |
| Vinyl Acetate | NA | < 0.01 | NA | < 0.01 |
| Vinyl Chloride | NA | < 0.01 | NA | < 0.01 |

## Table 4-67

### Little Mountain Creek
### Phase I RFI Surface Water Analytical Results

### Alcoa Badin, NC Works RFI

| Sample Designation / Parameter | LMC-SW-01 | LMC-SW01-2799 | LMC-SW-02 | LMC-SW02-2799 |
|---|---|---|---|---|
| Xylene (Total) | NA | < 0.005 | NA | < 0.005 |
| SVOCs [e] | | | | |
| 1,2,4,5-Tetrachlorobenzene | NA | < 0.01 | NA | < 0.01 |
| 1,2,4-Trichlorobenzene | NA | < 0.01 | NA | < 0.01 |
| 1,2-Dichlorobenzene | NA | < 0.01 | NA | < 0.01 |
| 1,3,5-Trinitrobenzene | NA | < 0.05 | NA | < 0.05 |
| 1,3-Dichlorobenzene | NA | < 0.01 | NA | < 0.01 |
| 1,3-Dinitrobenzene | NA | < 0.01 | NA | < 0.01 |
| 1,4-Dichlorobenzene | NA | < 0.01 | NA | < 0.01 |
| 1,4-Naphthoquinone | NA | < 0.05 | NA | < 0.05 |
| 1-Naphthylamine | NA | < 0.01 | NA | < 0.01 |
| 2,3,4,6-Tetrachlorophenol | NA | < 0.05 | NA | < 0.05 |
| 2,4,5-Trichlorophenol | NA | < 0.01 | NA | < 0.01 |
| 2,4,6-Trichlorophenol | NA | < 0.01 | NA | < 0.01 |
| 2,4-Dichlorophenol | NA | < 0.01 | NA | < 0.01 |
| 2,4-Dimethylphenol | NA | < 0.01 | NA | < 0.01 |
| 2,4-Dinitrophenol | NA | < 0.05 | NA | < 0.05 |
| 2,4-Dinitrotoluene | NA | < 0.01 | NA | < 0.01 |
| 2,6-Dichlorophenol | NA | < 0.01 | NA | < 0.01 |
| 2,6-Dinitrotoluene | NA | < 0.01 | NA | < 0.01 |
| 2-Acetylaminofluorene | NA | < 0.1 | NA | < 0.1 |
| 2-Chloronaphthalene | NA | < 0.01 | NA | < 0.01 |
| 2-Chlorophenol | NA | < 0.01 | NA | < 0.01 |
| 2-Methyl-4,6-Dinitrophenol | NA | < 0.05 | NA | < 0.05 |
| 2-Methylnaphthalene | NA | < 0.01 | NA | < 0.01 |
| 2-Methylphenol (O-Cresol) | NA | < 0.01 | NA | NA |
| 2-Naphthylamine | NA | < 0.01 | NA | < 0.01 |
| 2-Nitroaniline | NA | < 0.05 | NA | < 0.05 |
| 2-Nitrophenol | NA | < 0.01 | NA | < 0.01 |
| 2-Picoline | NA | < 0.02 | NA | < 0.02 |
| 3,3'-Dichlorobenzidine | NA | < 0.05 | NA | < 0.05 |
| 3,3'-Dimethylbenzidine | NA | < 0.05 | NA | < 0.05 |
| 3,5,5-Trimethyl-2-cyclohexen-1-one | NA | < 0.01 | NA | < 0.01 |
| 3-Methylcholanthrene | NA | < 0.02 | NA | < 0.02 |
| 3-Methylphenol & 4-Methylphenol | NA | < 0.02 | NA | < 0.02 |
| 3-Methylphenol/4-Methylphenol | NA | < 0.01 | NA | < 0.01 |
| 3-Nitroaniline | NA | < 0.05 | NA | < 0.05 |
| 4-Aminobiphenyl | NA | < 0.05 | NA | < 0.05 |
| 4-Bromophenyl Phenyl Ether | NA | < 0.01 | NA | < 0.01 |
| 4-Chloro-3-Methylphenol | NA | < 0.01 | NA | < 0.01 |
| 4-Chloroaniline | NA | < 0.01 | NA | < 0.01 |
| 4-Chlorophenyl Phenyl Ether | NA | < 0.01 | NA | < 0.01 |

Table 4-67

## Little Mountain Creek
## Phase I RFI Surface Water Analytical Results

### Alcoa Badin, NC Works RFI

| Parameter / Sample Designation | LMC-SW-01 | LMC-SW01-2799 | LMC-SW-02 | LMC-SW02-2799 |
|---|---|---|---|---|
| 4-Nitrophenol | NA | < 0.05 | NA | < 0.05 |
| 4-Nitroquinoline-1-oxide | NA | < 0.1 | NA | < 0.1 |
| 5-Nitro-o-toluidine | NA | < 0.02 | NA | < 0.02 |
| 7,12-Dimethylbenz(a)anthracene | NA | < 0.02 | NA | < 0.02 |
| a,a-Dimethylphenethylamine | NA | < 0.05 | NA | < 0.05 |
| Acenaphthene | NA | < 0.01 | NA | < 0.01 |
| Acenaphthylene | NA | < 0.01 | NA | < 0.01 |
| Acetophenone | NA | < 0.01 | NA | < 0.01 |
| Aniline | NA | < 0.01 | NA | < 0.01 |
| Anthracene | NA | < 0.01 | NA | < 0.01 |
| Aramite | NA | < 0.02 | NA | < 0.02 |
| Benz(b)Fluoranthene | NA | < 0.01 | NA | < 0.01 |
| Benzo(a)Anthracene | NA | < 0.01 | NA | < 0.01 |
| Benzo(a)Pyrene | NA | < 0.01 | NA | < 0.01 |
| Benzo(g,h,I)Perylene | NA | < 0.01 | NA | < 0.01 |
| Benzo(k)Fluoranthene | NA | < 0.01 | NA | < 0.01 |
| Benzyl Alcohol | NA | < 0.01 | NA | < 0.01 |
| Benzyl Butyl Phthalate | NA | < 0.01 | NA | < 0.01 |
| Bis(2-Chloroethoxy)Methane | NA | < 0.01 | NA | < 0.01 |
| Bis(2-Chloroethyl)Ether | NA | < 0.01 | NA | < 0.01 |
| Bis(2-Chloroisopropyl)Ether | NA | < 0.01 | NA | < 0.01 |
| Bis(2-Ethylhexyl)Phthalate | NA | < 0.01 | NA | < 0.01 |
| Chrysene | NA | < 0.01 | NA | < 0.01 |
| Dibenzo(a,h)Anthracene | NA | < 0.01 | NA | < 0.01 |
| Dibenzofuran | NA | < 0.01 | NA | < 0.01 |
| Diethyl Phthalate | NA | < 0.01 | NA | < 0.01 |
| Dimethoate | NA | < 0.02 | NA | < 0.02 |
| Dimethyl Phthalate | NA | < 0.01 | NA | < 0.01 |
| Di-n-Butyl Phthalate | NA | < 0.01 | NA | < 0.01 |
| Di-n-Octyl Phthalate | NA | NA | NA | < 0.01 |
| Dinoseb | NA | < 0.02 | NA | < 0.02 |
| Disulfoton | NA | < 0.05 | NA | < 0.05 |
| Ethyl methanesulfonate | NA | < 0.01 | NA | < 0.01 |
| Famphur | NA | < 0.1 | NA | < 0.1 |
| Fluoranthene | NA | < 0.01 | NA | < 0.01 |
| Fluorene- | NA | < 0.01 | NA | < 0.01 |
| Hexachlorobenzene | NA | < 0.01 | NA | < 0.01 |
| Hexachlorobutadiene | NA | < 0.01 | NA | < 0.01 |
| Hexachlorocyclopentadiene | NA | < 0.05 | NA | < 0.05 |
| Hexachloroethane | NA | < 0.01 | NA | < 0.01 |
| Hexachlorophene | NA | < 0.01 | NA | < |
| Hexachloropropene | NA | < 0.1 | NA | < 0.1 |

Table 4-67

Little Mountain Creek
Phase I RFI Surface Water Analytical Results

Alcoa Badin, NC Works RFI

| Parameter / Sample Designation | LMC-SW-01 | LMC-SW01-2799 | LMC-SW-02 | LMC-SW02-2799 |
|---|---|---|---|---|
| Indeno(1,2,3-cd)Pyrene | NA | < 0.01 | NA | NA |
| Isosafrole | NA | < 0.02 | NA | < 0.02 |
| Methapyrilene | NA | < 0.05 | NA | < 0.05 |
| Methyl methanesulfonate | NA | < 0.01 | NA | < 0.01 |
| Methyl parathion | NA | < 0.05 | NA | < 0.05 |
| Naphthalene | NA | < 0.01 | NA | < 0.01 |
| Nitrobenzene | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosodiethylamine | NA | < 0.01 | NA | < 0.01 |
| N-NitrosodimeThylamine | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosodi-n-butylamine | NA | < 0.01 | NA | < 0.01 |
| N-Nitroso-Di-n-Propylamine | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosodiphenylamine | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosodiphenylamine/Diphenylamine | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosomethylethylamine | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosomorpholine | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosopiperidine | NA | < 0.01 | NA | < 0.01 |
| N-Nitrosopyrolidine | NA | < 0.01 | NA | < 0.01 |
| O,O,O-Triethyl phosphorothioate | NA | < 0.05 | NA | < 0.05 |
| o-Toluidine | NA | < 0.02 | NA | < 0.02 |
| Parathion | NA | < 0.05 | NA | < 0.05 |
| p-Dimethylaminoazobenzene | NA | < 0.02 | NA | < 0.02 |
| Pentachlorobenzene | NA | < 0.01 | NA | < 0.01 |
| Pentachloroethane | NA | < 0.05 | NA | < 0.05 |
| Pentachloronitrobenzene | NA | < 0.05 | NA | < 0.05 |
| Pentachlorophenol | NA | < 0.05 | NA | < 0.05 |
| Phenacetin | NA | < 0.02 | NA | < 0.02 |
| Phenanthrene | NA | < 0.01 | NA | < 0.01 |
| Phenol | NA | < 0.01 | NA | < 0.01 |
| Phorate | NA | < 0.05 | NA | < 0.05 |
| P-Nitroaniline | NA | < 0.05 | NA | < 0.05 |
| p-Phenylene diamine | NA | < 0.1 | NA | < 0.1 |
| Pronamide | NA | < 0.02 | NA | < 0.02 |
| Pyrene | NA | < 0.01 | NA | < 0.01 |
| Pyridine | NA | < 0.02 | NA | < 0.02 |
| Safrole | NA | < 0.02 | NA | < 0.02 |
| Tetraethyldithiopyrophosphate | NA | < 0.05 | NA | < 0.05 |
| Thionazin | NA | < 0.05 | NA | < 0.05 |

Notes:
[a] mg/l = milligrams per liter.
[b] NA = Not Analyzed
[c] < = not detected at indicated detection limit
[d] PCBs = Polychlorinated Biphenyls
[e] VOCs = Volatile Organic Compounds
[f] SVOCs - Semi-Volatile Organic Compounds

Table 4-68

Soil Screening Table
SWMU No. 2 (Alcoa/Badin Landfill)

Alcoa Badin, NC Works RFI

| Parameter | Units | Number of Detects | Number Analyzed | Minimum Detection | | Maximum Detection | | USEPA Region III Industrial RBC[a] | USEPA Region III Residential RBC | USEPA SSL[b] DAF[c] = 20 | North Carolina SSL DAF = 20 | Ind. RBC | Res. RBC | USEPA SSL DAF = 20 | NC SSL DAF = 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | | | | | | | | |
| Arsenic | mg/kg [d] | 4 | 4 | 5.4 | | 15.8 | | 3.8 | 0.43 | 29 | 29.2 | ✓ | ✓ | | |
| Barium | mg/kg | 4 | 4 | 75.4 | | 108 | | 140000 | 5500 | 1600 | 1648 | | | | |
| Chromium | mg/kg | 4 | 4 | 19.7 | | 31.6 | | 6100 | 230 | 38 | 38.4 | | | | |
| Lead | mg/kg | 4 | 4 | 17.2 | | 22.1 | | 1000 | 400 | NA | 267 | | | | |
| Selenium | mg/kg | 1 | 4 | 0.78 | | 0.78 | | 10000 | 390 | 5 | 5.2 | | | | |
| **Other** | | | | | | | | | | | | | | | |
| Cyanide (total) | mg/kg | 1 | 4 | 10.3 | | 10.3 | | 41000 | 1600 | 40 | 31.1 | | | | |
| Fluoride | mg/kg | 4 | 4 | 2.9 | | 10.7 | | 120000 | 4700 | NA | NA | | | | |
| **Pesticides/Herbicides** | | | | | | | | | | | | | | | |
| None Detected | | | | | | | | | | | | | | | |
| **SVOCs [e]** | | | | | | | | | | | | | | | |
| None Detected | | | | | | | | | | | | | | | |
| **VOCs [f]** | | | | | | | | | | | | | | | |
| | mg/kg | 1 | 4 | 0.0092 | | 0.0092 | | 2900 | 110 | 0.2 | NA | | | | |
| 1,1-Dichloroethene | mg/kg | 1 | 4 | 0.0088 | | 0.0088 | | 9.5 | 1.1 | 0.06 | 0.492 | | | | |
| Acetone | mg/kg | 4 | 4 | 0.04 | | 0.18 | | 200000 | 7800 | 16 | 1250 | | | | |
| Methylene chloride | mg/kg | 4 | 4 | 0.007 | B | 0.01 | B | 760 | 85 | 0.02 | 0.022 | | | | |

Notes:

[a] RBC = Risk-Based Concentration

[b] SSL = Soil Screening Level

[c] DAF = Dilution Attenuation Factor

[d] mg/kg = milligrams per kilogram

[e] SVOCs = Semi-Volatile Organic Compounds

[f] VOCs = Volatile Organic Compounds

✓ = Maximum concentration of constituent exceeds screening value

All arsenic concentrations are less than background concentrations.

## Table 4-69
## Groundwater Screening Table
## SWMU No. 2 (Alcoa/Badin Landfill)
## Alcoa-Badin Works

| Constituent | Number Detected | Number Analyzed | Units | Minimum Detection | Maximum Detection | North Carolina 2L Standard | USEPA MCL | NC Standard | USEPA MCL |
|---|---|---|---|---|---|---|---|---|---|
| **Metals** | | | | | | | | | |
| Arsenic, Dissolved | 1 | 6 | mg/l[(a)] | 0.0066 | 0.0066 | 0.05 | 0.05 | | |
| Barium, Dissolved | 5 | 6 | mg/l | 0.26 | 0.49 | 2 | 2 | | |
| Cobalt, Total | 1 | 1 | mg/l | 0.13 | 0.13 | NA | NA | | |
| Cobalt, Dissolved | 1 | 1 | mg/l | 0.13 | 0.13 | NA | NA | | |
| Cyanide, Microdiffusion | 2 | 12 | mg/l | 0.0059 | 0.0579 | 0.154 | 0.2 | | |
| Cyanide, Total | 5 | 12 | mg/l | 0.011 | 0.25 | 0.154 | 0.2 | ✓ | ✓ |
| Cyanide, Weak Acid Dissociable | 3 | 12 | mg/l | 0.011 | 0.1 | 0.154 | 0.2 | | |
| Selenium, Total | 1 | 6 | mg/l | 0.006 | 0.006 | 0.05 | 0.05 | | |
| Selenium, Dissolved | 1 | 6 | mg/l | 0.0069 | 0.0069 | NA | NA | | |
| Zinc, Dissolved | 1 | 1 | mg/l | 0.026 | 0.026 | 2.1 | NA | | |
| **Other Parameters** | | | | | | | | | |
| Fluoride | 2 | 6 | mg/l | 0.15 | 0.98 | 2 | 4 | | |
| **SVOCs[(b)]** | | | | | | | | | |
| None Detected | | | | | | | | | |
| **VOCs[(c)]** | | | | | | | | | |
| None Detected | | | | | | | | | |

Notes:

[(a)] mg/l = milligrams per liter

[(b)] SVOCs = Semi-Volatile Organic Compounds

[(c)] VOCs = Volatile Organic Compounds

✓ = Maximum concentration of constituent exceeds screening value

The only detection of Arsenic is in upgradient monitoring well ABL-MW-6

## Table 4-70
## Sediment Screening Table
## Little Mountain Creek
## Alcoa Badin, NC Works RFI

| Parameter | Units | Number Detected | Number Analyzed | Minimum Detection | | Maximum Detection | | USEPA Region III Industrial RBC[a] | Ind. RBC |
|---|---|---|---|---|---|---|---|---|---|
| **VOCs[b]** | | | | | | | | | |
| Acetone | mg/kg[c] | 2 | 2 | 0.035 | | 0.082 | | 200000 | |
| Methylene chloride | mg/kg | 2 | 2 | 0.0074 | B[d] | 0.0093 | B | 760 | |
| **Inorganics** | | | | | | | | | |
| Arsenic | mg/kg | 2 | 2 | 25.8 | | 48.8 | | 3.8 | ✓ |
| Barium | mg/kg | 2 | 2 | 61.3 | | 69.2 | | 140000 | |
| Chromium | mg/kg | 2 | 2 | 87.7 | | 101 | | 6100 | |
| Lead | mg/kg | 2 | 2 | 22.4 | | 26 | | 1000 | |

Notes:

[a] RBC = Risk-Based Concentration

[b] VOCs = Volatile Organic Compounds

[c] mg/kg = milligrams per kilogram

[d] B = Blank contamination.

✓ = Maximum concentration of constituent exceeds screening value

Arsenic concentration in sample upgradient of site is higher than downgradient

## Table 4-71

## Surface Water Screening Table
## Little Mountain Creek

## Alcoa Badin, NC Works RFI

| Parameter | Number Detected | Number Analyzed | Frequency of Detection | Units | Minimum Detection | Maximum Detection | North Carolina[a] Human Health 2B Standard | AWQC (HH)[b] | NC Std | AWQC |
|---|---|---|---|---|---|---|---|---|---|---|
| Cyanide (Microdiffusion) | 1 | 2 | 0.5 | mg/l[c] | < 0.005 | 0.0052 | NA | 0.2 | | |
| Fluoride | 2 | 2 | 100 | mg/l | 0.17 | 0.2 | NA | NA | | |

Notes:

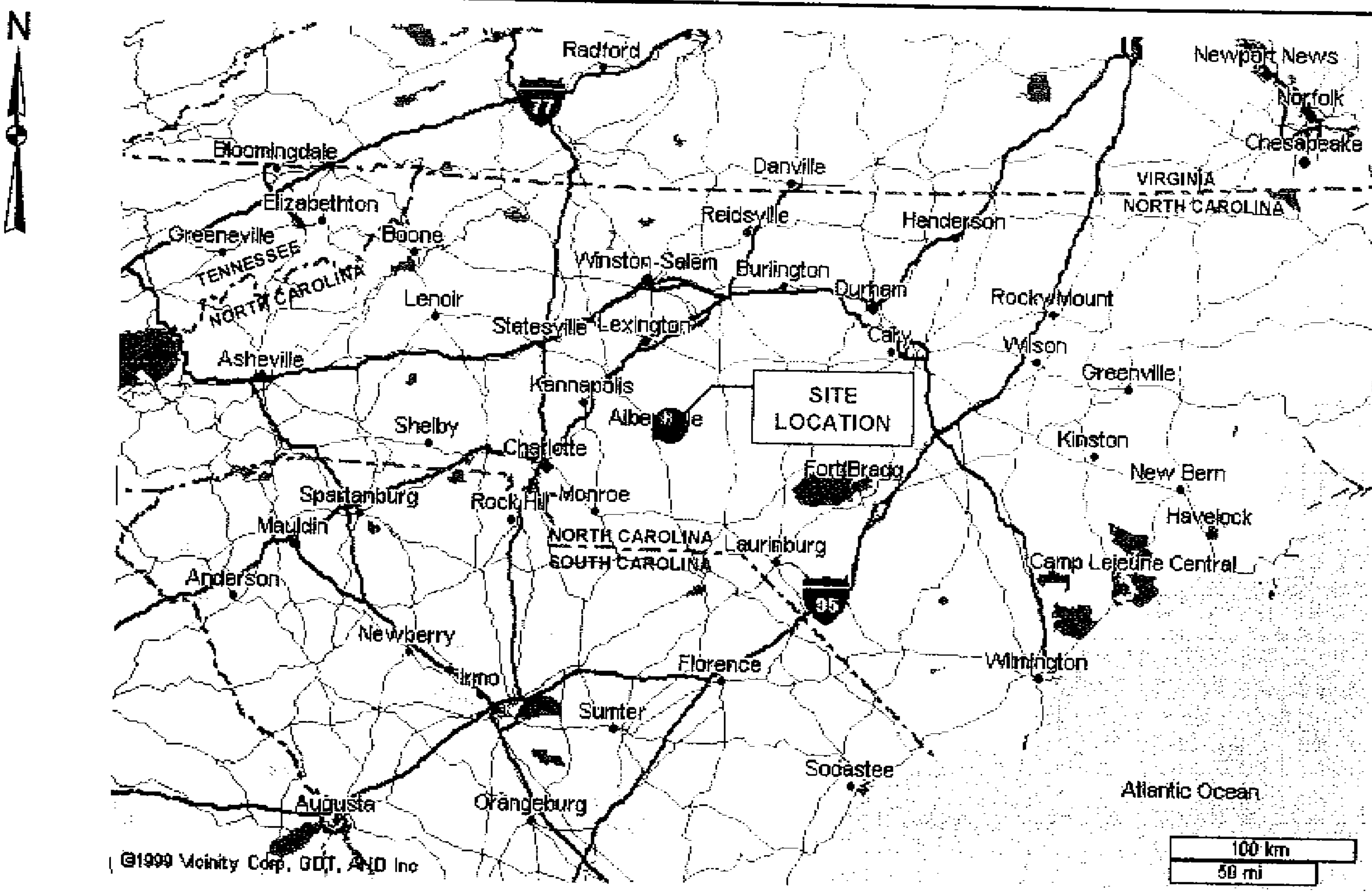
[a] NC 2B Standard for the Protection of Human Health (Class W-IV Waters-15A NCAC 02B.0216(3)(g)(i, ii)

[b] USEPA Recommended Water Quality Criteria (WQC) for the Protection of Human Health (for Consumption of Water and Organisms) (EPA, 1999)

[c] mg/l = milligrams per liter

# FIGURES

J:\PROJECTS\ALCOA\BADIN\120006\REPORTS 2001\FIGURES_FINALRFIRPRT\FIG1-1.PPT




# Site Vicinity Map

Alcoa-Badin Works
Badin, North Carolina

| | | |
|---|---|---|
| PROJECT: 120006 | BY: MAW | Figure 1-1 |
| DATE: March 2001 | CHECKED: MEP | |

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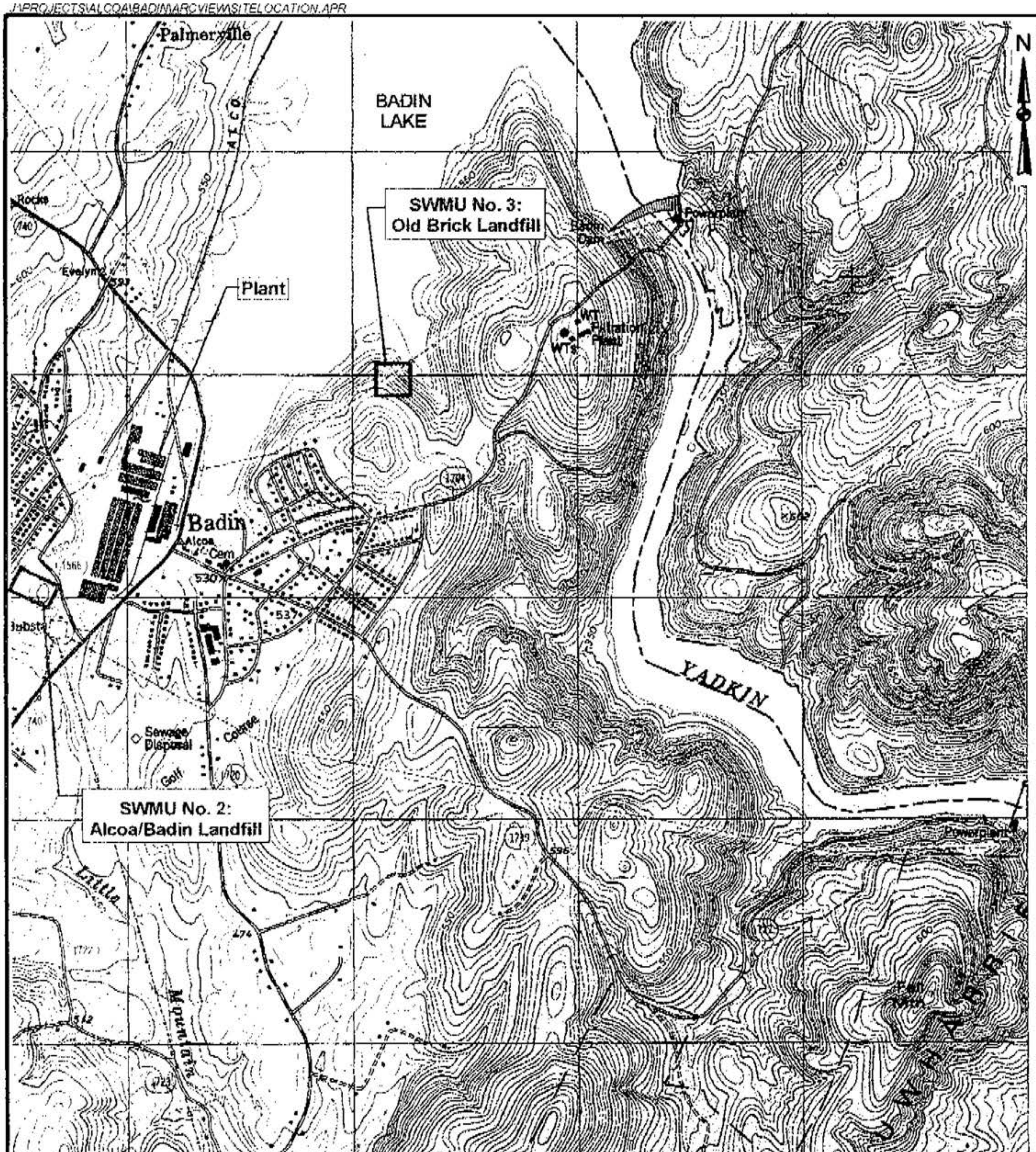
J:\PROJECTS\ALCOA\BADIN\ARCVIEW\SITELOCATION.APR




BADIN, N. C.
NE/4 ALBEMARLE 15' QUADRANGLE
N3522.5—W8000/7.5

1981
PHOTOINSPECTED 1983
DMA 4954 I NE—SERIES V842

2000 0 2000 Feet

N. C.
QUADRANGLE LOCATION

**Site Location**

Alcoa-Badin Works
Badin, North Carolina

| PROJECT: 120006 | BY: MAW | Figure 1-2 |
|---|---|---|
| DATE: March 2001 | CHECKED: MEP | |

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# Figure 1-3
# Regulatory History Summary

**March 1990**
Alcoa Submits RCRA Part-B Application to USEPA for > 90 Day On-site Storage of SPL

**March 1990**
USEPA Contractors (A.T. Kearney and DPRA) Conduct RFA
RFA Recommends:
- RFI for SWMU Nos. 1, 2, 3, 7
- Confirmatory Sampling for SWMU Nos. 4, 7[(a)], 11, 22 AOC-A, AOC-B
- Further Assessment for SWMU Nos. 25, 33

**March 1992**
USEPA and NCDENR Approve Alcoa's Permit Application Authorizing On-site > 90 Day Hazardous Storage

Permit Condition Part VII.E
Confirmatory Sampling Required for SWMU Nos. 4, 7, 11, 20, 22, 36, 38, 39 AOC-A

Permit Condition Part VII.F
RFI Required for SWMU Nos. 1, 2, 3, 25, 33, 35, AOC-B

**June 1992 – November 1993**
**Confirmatory Sampling Activities**
- June 1992 – Alcoa Submits CS Work Plan
- April 1993 – USEPA Approves Work Plan
- June 1993 – Alcoa Submits Confirmatory Sampling Report
- November 1993 – Alcoa Submits Confirmatory Sampling Report Addendum (SWMU 7)

October 1993 Alcoa adds to RFI SWMU Nos. 42[(b)], 43[(b)]

**January 1994**
USEPA Approve Confirmatory Sampling Report and Addendum. EPA adds to RFI SWMU Nos. 4, 11, 22, 38, 42, 43 AOC-A

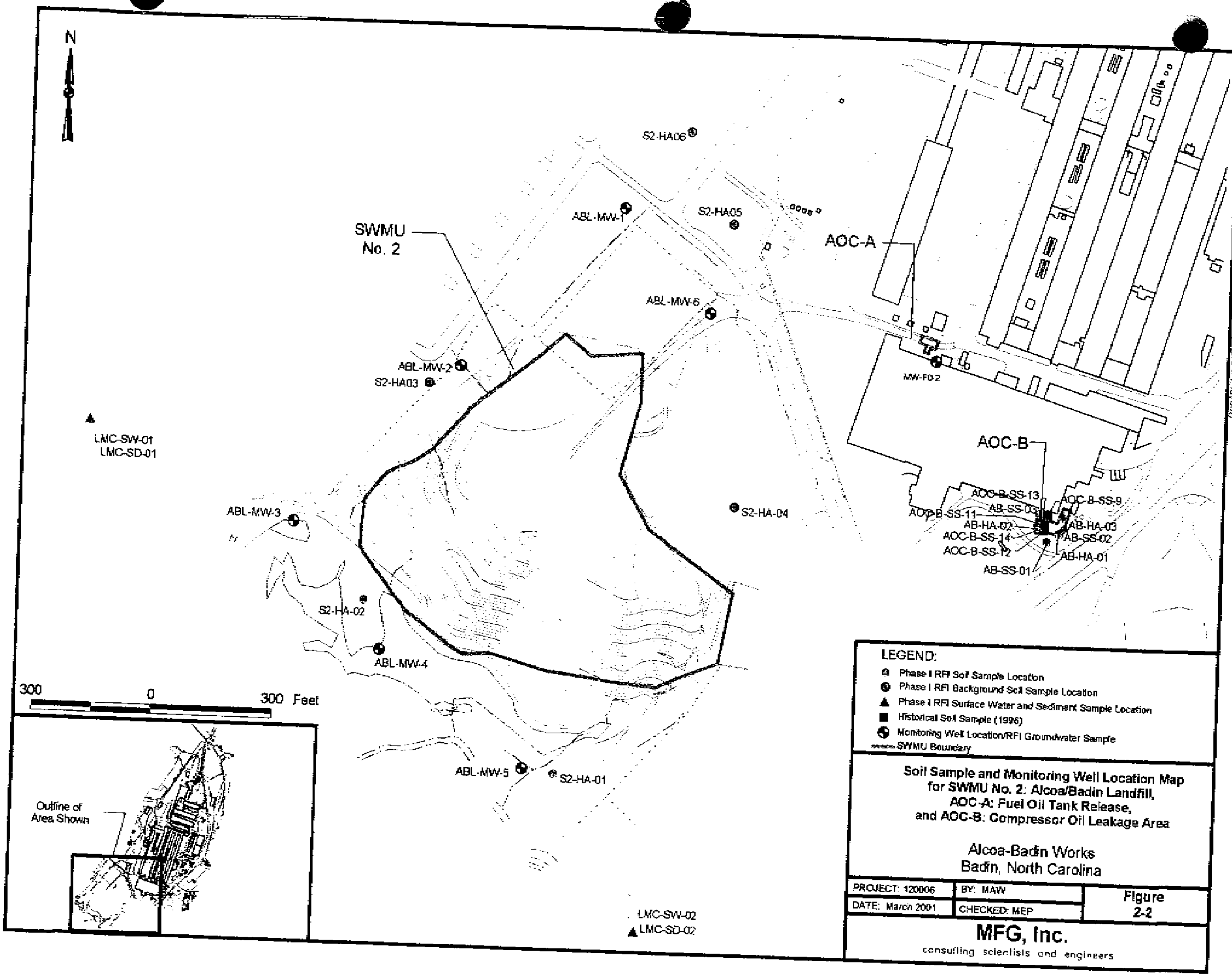
**October 1996**
Alcoa Adds to RFI SWMU No. 44[(c)]

**November 1999**
Alcoa Adds to RFI SWMU No. 46[(d)]

**April 1994 – September 2000**
- April 1994 – Alcoa submits RFI Work Plan
  - SWMU Nos. 1, 2, 3, 4, 11, 22, 25, 33, 35, 38
  - AOC–A, AOC-B
- February 1999 – NCDENR approves Work Plan
- September and October 1999 and January 2000 – Alcoa implements RFI Work Plan
- April 2000 – Alcoa submits Phase II RFI Work Plan
- June 2000 – NCDENR approves Phase II RFI Work Plan
- August and September 2000 – Alcoa implements Phase II RFI Work Plan

**SWMUs/AOCs Included In RFI Report**
SWMU Nos. 1[(e)], 2[(e)], 3[(e)], 4[(e)], 11, 22[(f)], 25[(f)], 33[(f)], 35, 38, 42, 43, 44, 46, AOC-A, AOC-B

Notes:
(a) The RFA recommended sampling of the air compressor portion of SWMU No. 7 Aerated Lagoon.
(b) SWMUs 42 and 43 were added to the RFI by EPA based on information provided by Alcoa in a letter dated October 7, 1993.
(c) SWMU No. 44 was identified by Alcoa and reported to NCDENR in a letter dated October 10, 1996.
(d) SWMU No. 46 was identified by Alcoa and reported to NCDENR in a letter dated November 22, 1999.
(e) All or portions of RFI work done by Alcoa prior to implementing voluntary Interim Measures.
(f) SWMU subjected to voluntary or interim measures prior to RFI implementation.

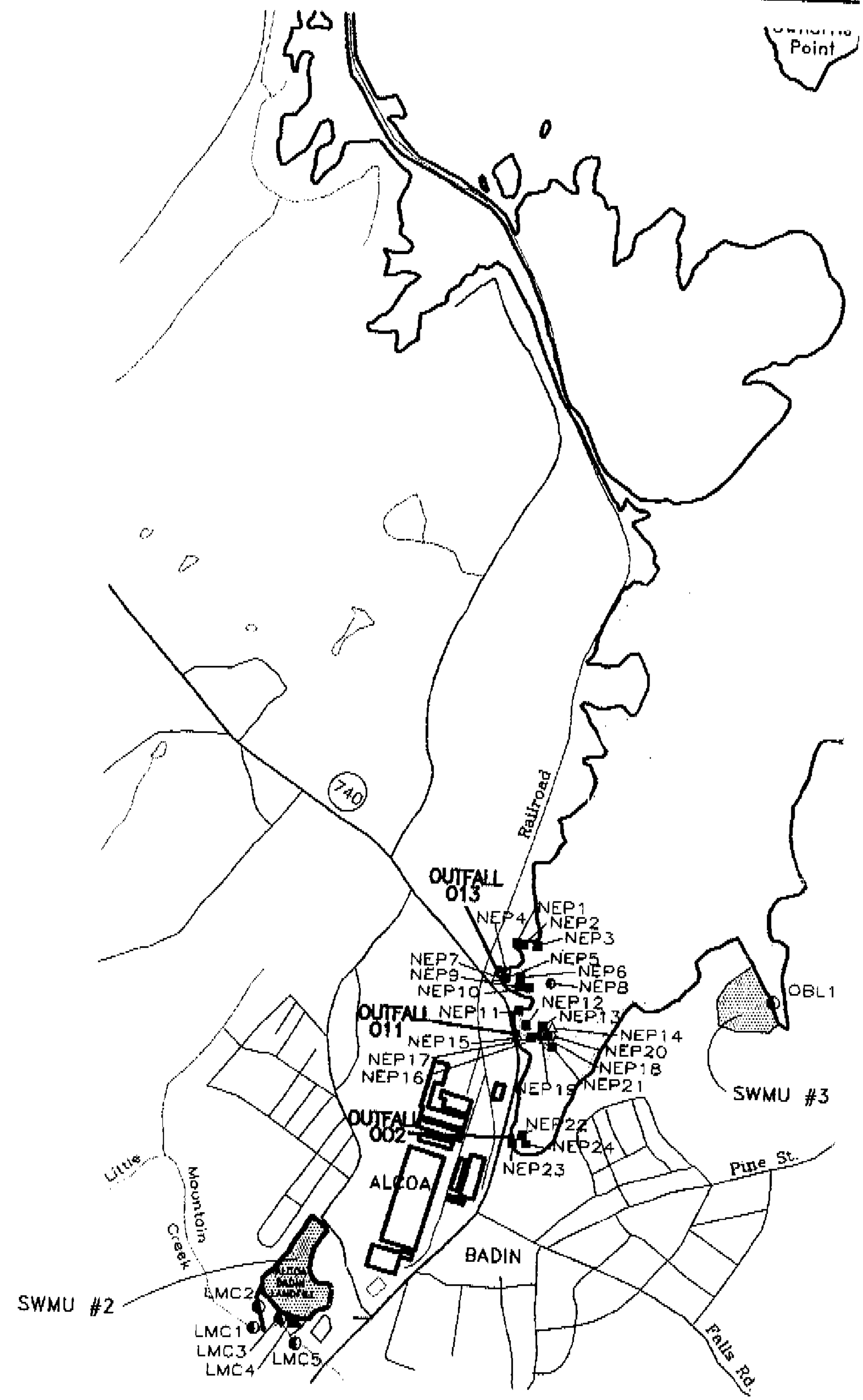



**Soil Sample and Monitoring Well Location Map for SWMU No. 2: Alcoa/Badin Landfill, AOC-A: Fuel Oil Tank Release, and AOC-B: Compressor Oil Leakage Area**

Alcoa-Badin Works
Badin, North Carolina

Figure 2-2

11/03/00 J:\AUTOCAD\0006\0006-39.DWG BY:MAW



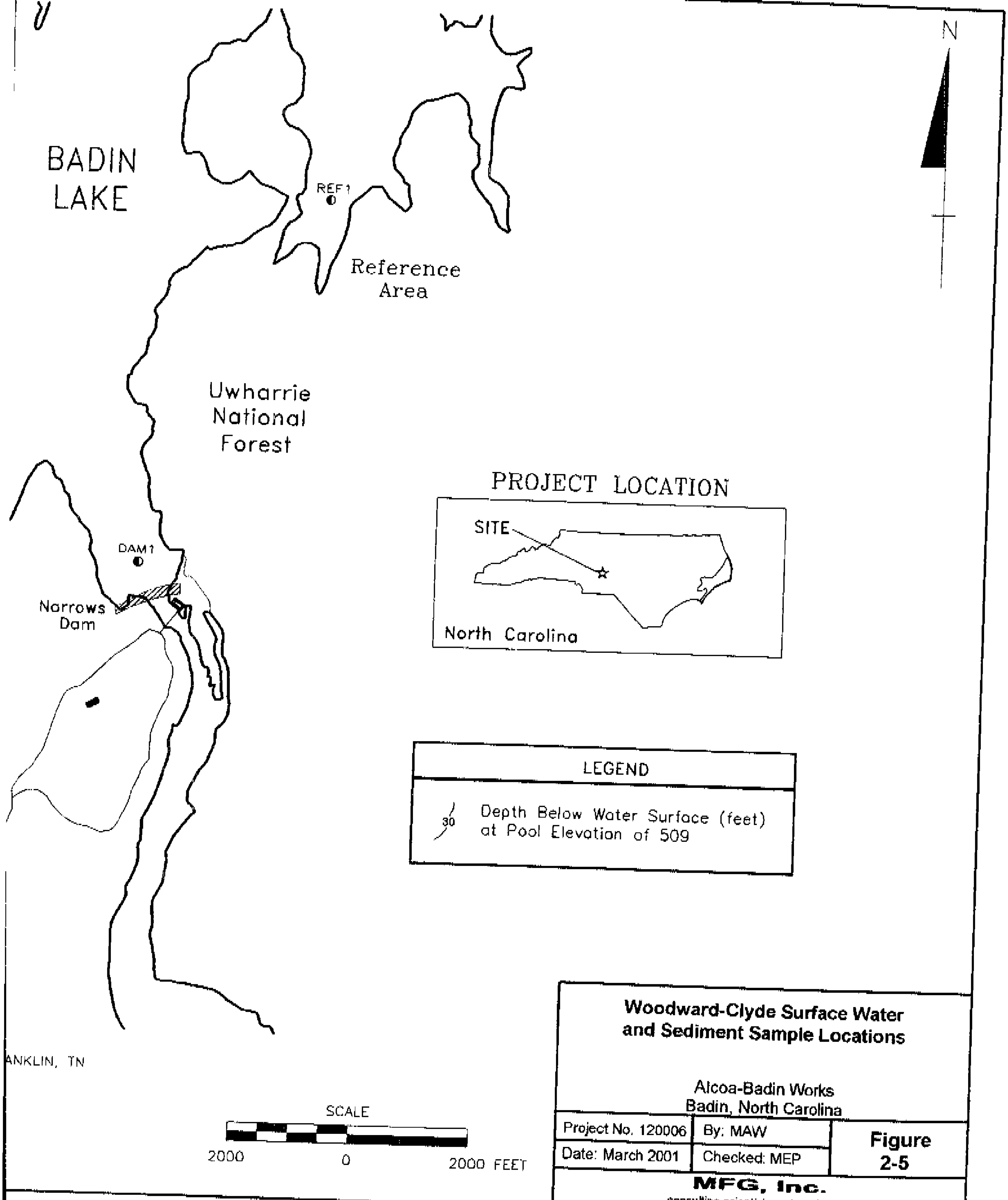

LEGEND:

■ SEDIMENT SAMPLE LOCATION

△ SURFACE WATER SAMPLE LOCATION

◐ SEDIMENT & SURFACE WATER SAMPLE LOCATION

REFERENCE:
DRAWING USED FROM WOODWARD-CLYDE, I
DATED 6/13/97, LAKE10F.DWG, FIGURE 1




**Woodward-Clyde Surface Water and Sediment Sample Locations**

Alcoa-Badin Works
Badin, North Carolina

| | | |
|---|---|---|
| Project No. 120006 | By: MAW | **Figure 2-5** |
| Date: March 2001 | Checked: MEP | |

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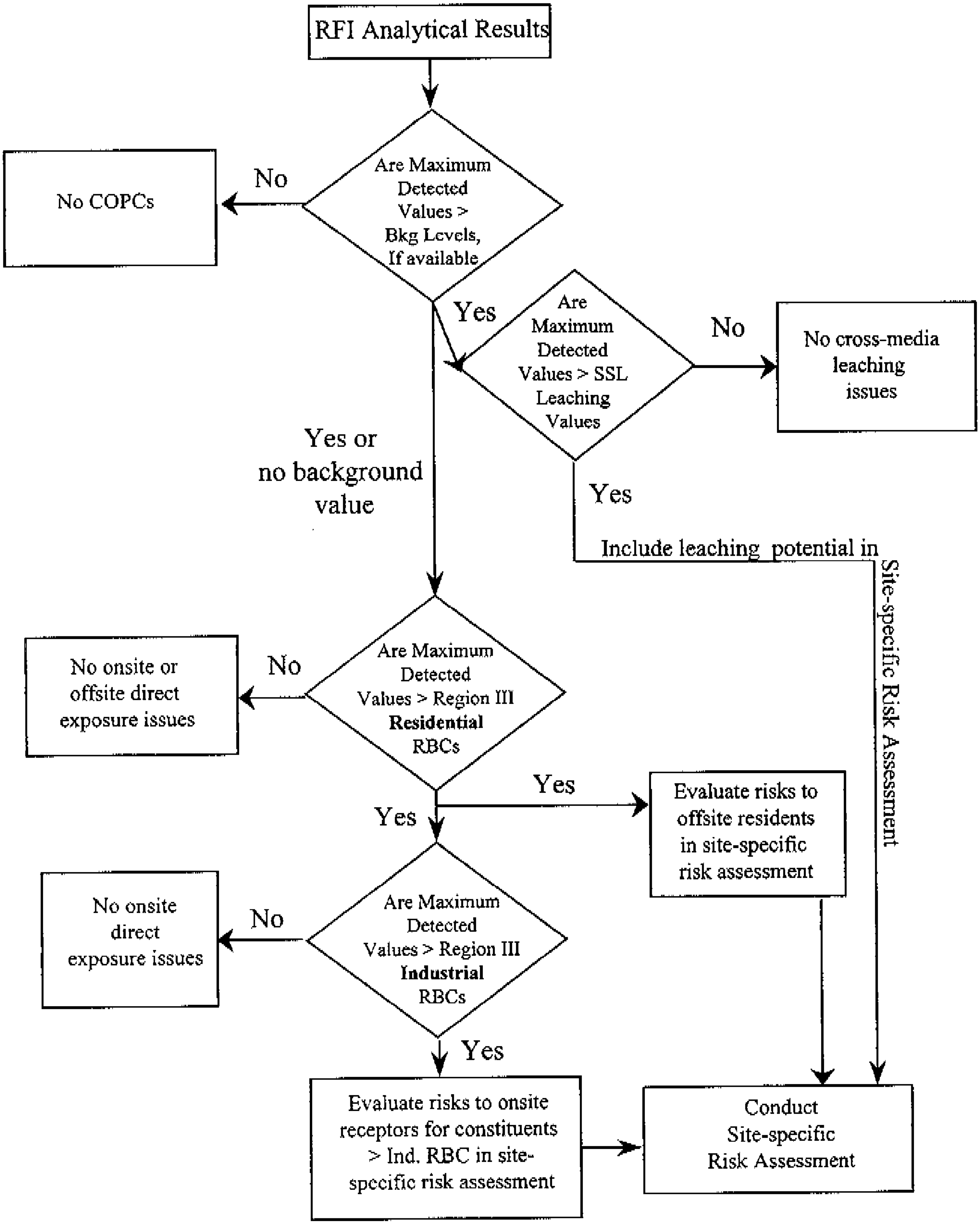
# Figure 3-1
# Decision Tree for Evaluating Soil Data for Site-Specific Risk Assessment

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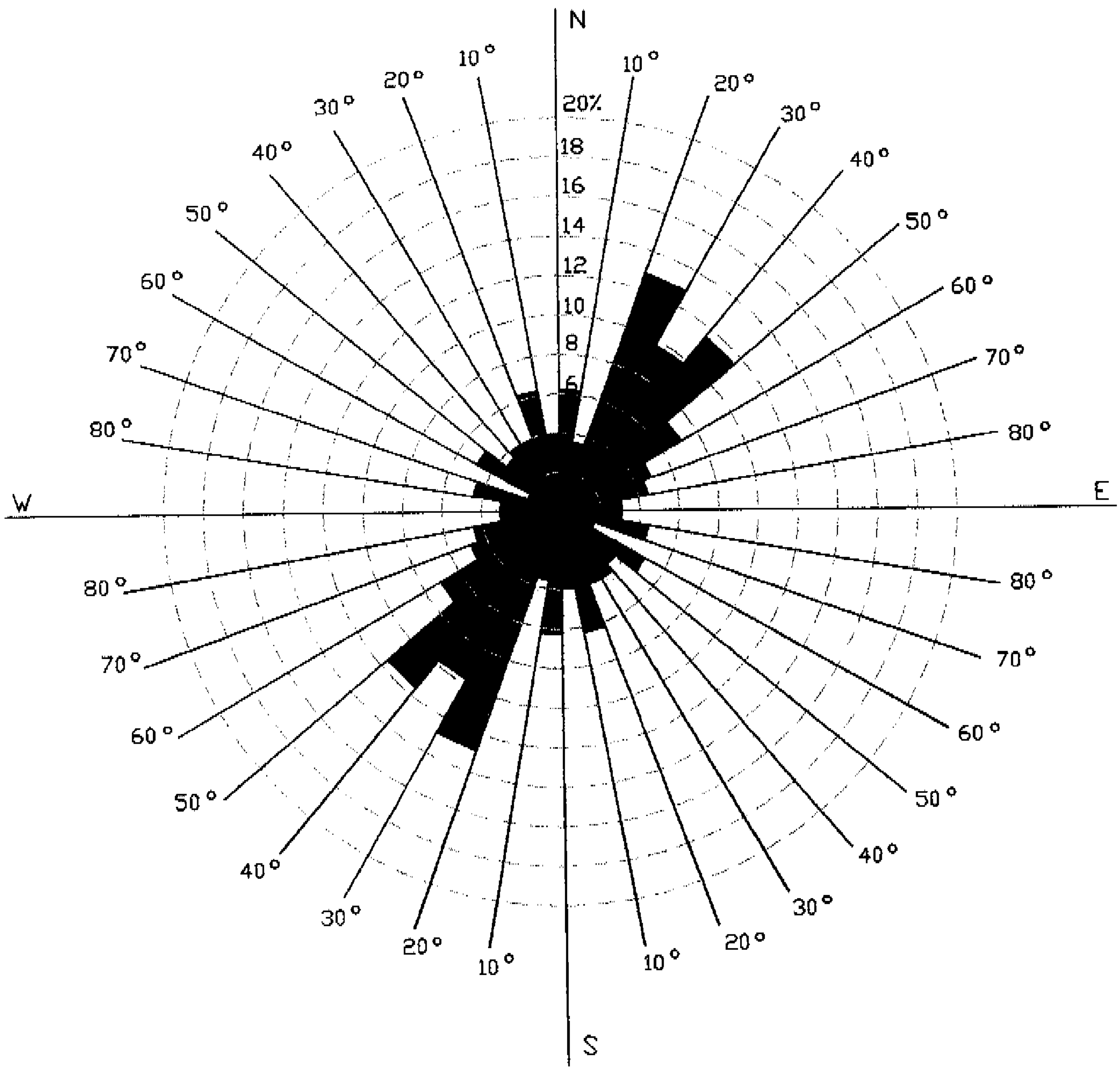
J:\AUTOCAD\0006-3.DWG BY: MW




**Lineament Orientations from Topographic Map**

Alcoa-Badin Works
Badin, North Carolina

| | | |
|---|---|---|
| Project No. 120006 | By: MAW | Figure 4-1 |
| Date: March 2001 | Checked: MEP | |

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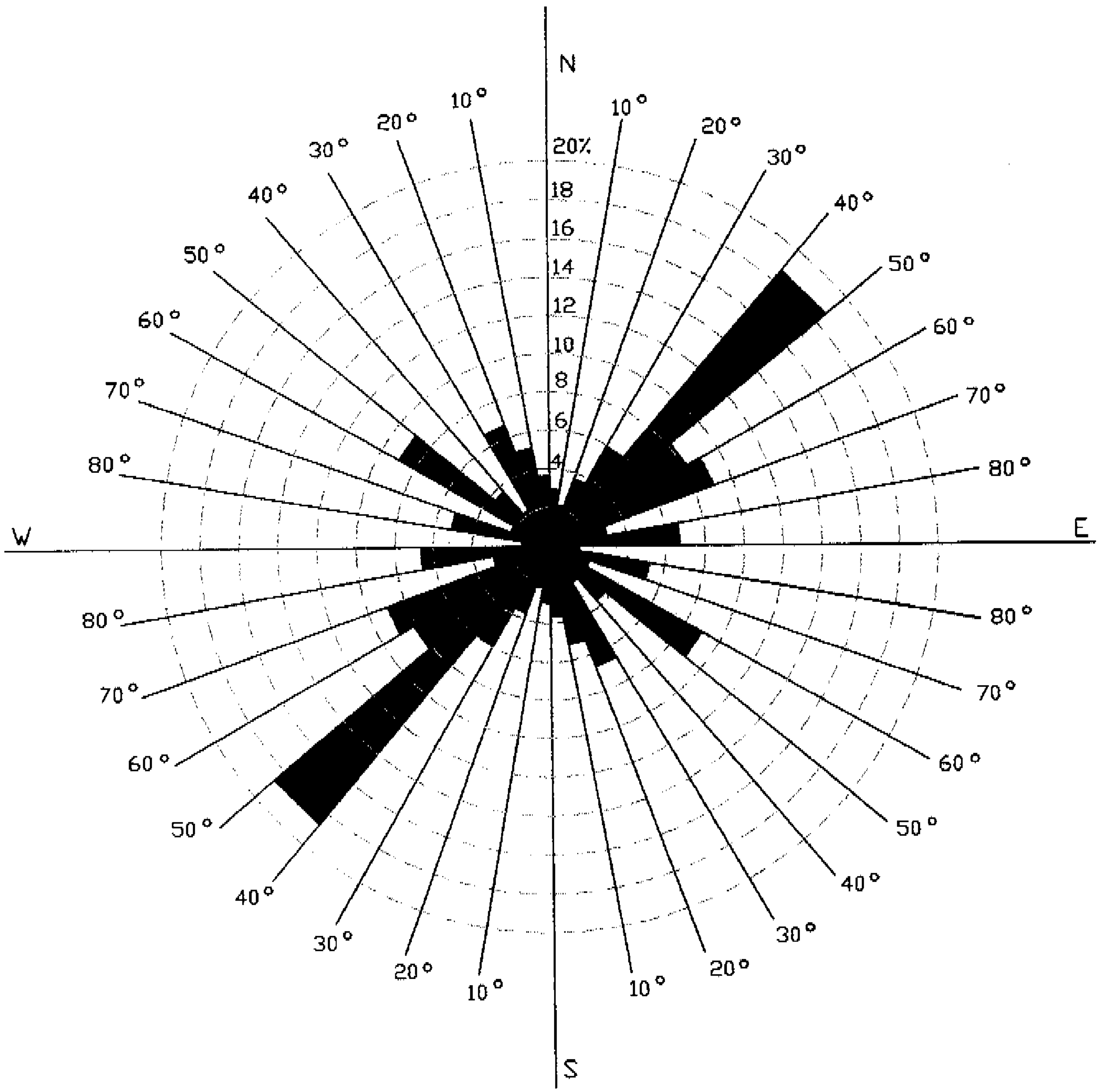
J:\AUTOCAD\0006-4.DWG BY: MW




**Fracture Orientations**
**Field Measurements (Strike)**

Alcoa-Badin Works
Badin, North Carolina

| | | |
|---|---|---|
| Project No. 120006 | By: MAW | **Figure 4-2** |
| Date: March 2001 | Checked: MEP | |

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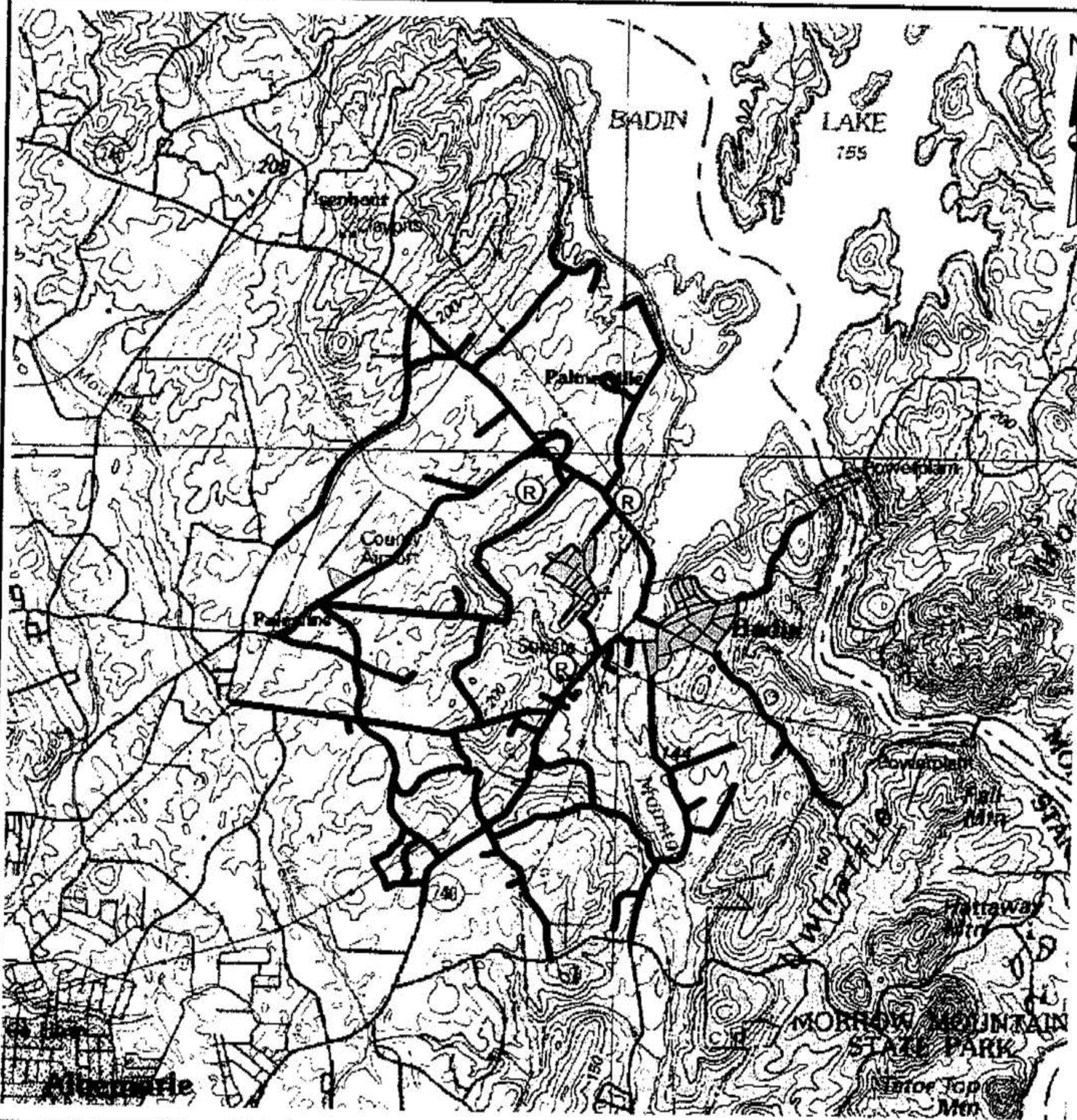
J:\PROJECTS\ALCOA\BADIN\ARCVIEW\RESID-WELLS.APR (figure 4-3 layout)




Produced by the United States Geological Survey

Compiled from USGS 1:24 000-scale topographic maps dated 1956-1981. Planimetry revised from aerial photographs taken 1983-86 and other source data. Revised information not field checked. Map edited 1985

Projection and 10 000-meter grid, zone 17 Universal Transverse Mercator
25 000-foot grid ticks based on North Carolina coordinate system and South Carolina coordinate system, north zone
1927 North American Datum
To place on the predicted North American Datum 1983, move the projection lines 11 meters south and 16 meters west

There may be private inholdings within the boundaries of the National or State reservations shown on this map

CONTOUR INTERVAL 10 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929
ELEVATIONS SHOWN TO THE NEAREST METER

LEGEND:

(R) Approximate Location of Residential Well
Public Water
No Public Water; Wells

**Residential Well Survey Summary**

Alcoa-Badin Works
Badin, North Carolina

| | | |
|---|---|---|
| PROJECT: 120006 | BY: MAW | **Figure 4-3** |
| DATE: March 2001 | CHECKED: MEP | |

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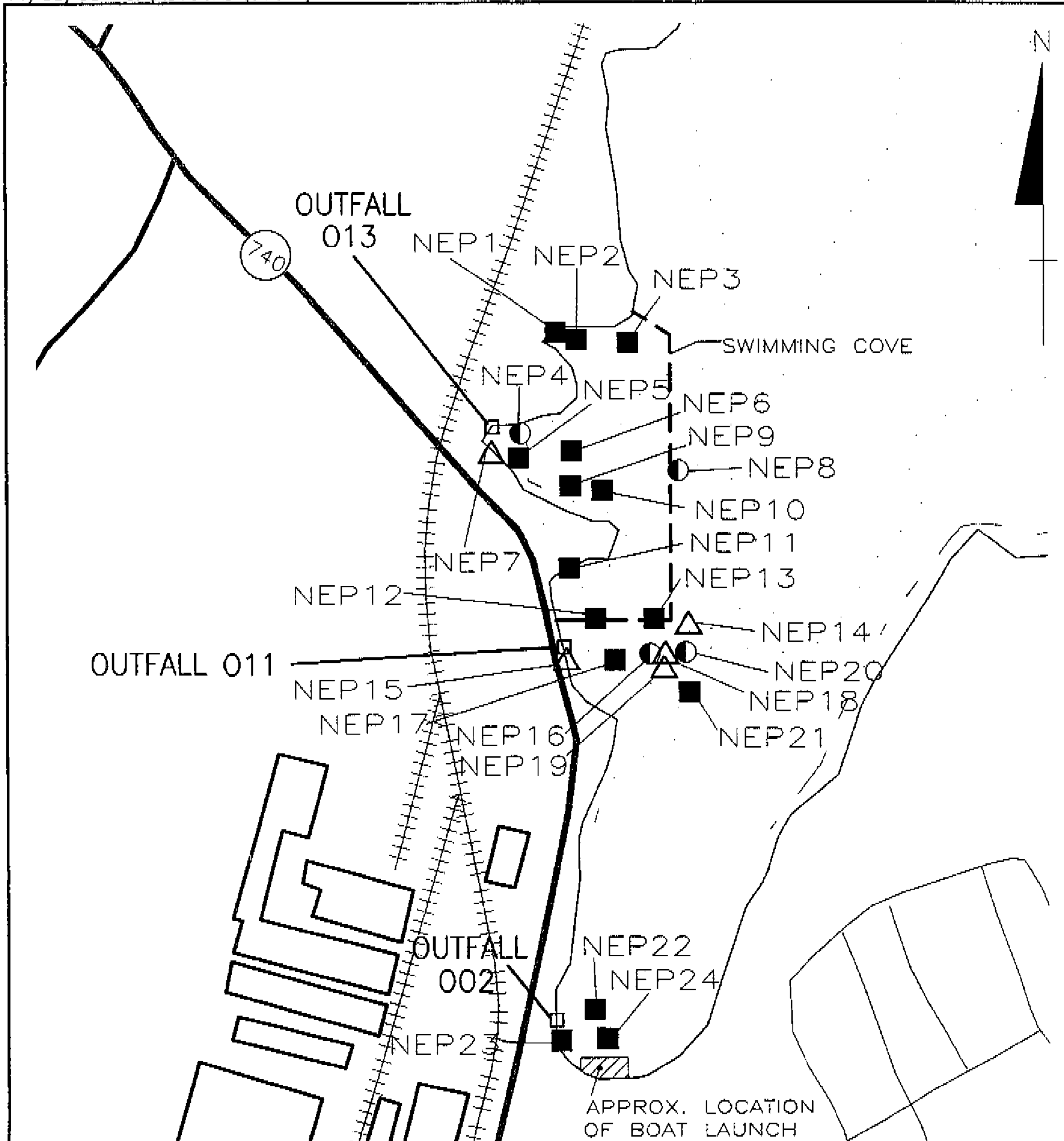
11/03/00 J:\AUTOCAD\0006\0006-34.DWG BY:MAW




LEGEND:

■ SEDIMENT SAMPLE LOCATION

△ SURFACE WATER SAMPLE LOCATION

◐ SEDIMENT & SURFACE WATER SAMPLE LOCATION

REFERENCE:
DRAWING USED FROM WOODWARD-CLYDE, FRANKLIN, TN
DATED 6/13/97, LAKE10F.DWG, FIGURE 1

SCALE

500 0 500 FEET

**Badin Lake Surface Water and Sediment Sample Locations (Plant Area)**

Alcoa-Badin Works
Badin, North Carolina

| Project No. 120006 | By: MAW | **Figure 4-32** |
|---|---|---|
| Date: March 2001 | Checked: MEP | |

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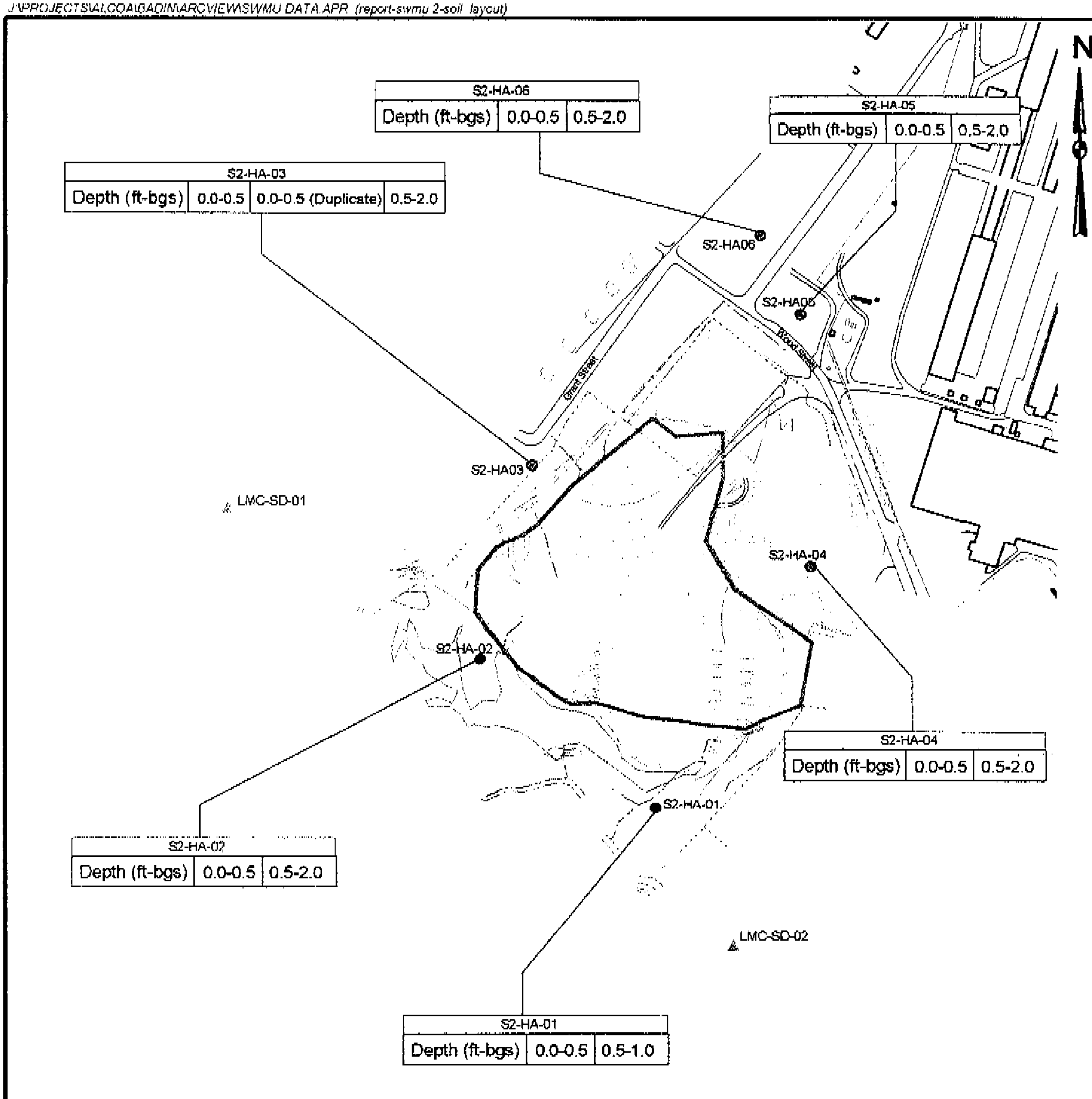
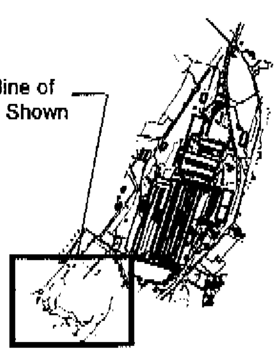
J:\PROJECTS\ALCOA\BADIN\ARCVIEW\SWMU DATA.APR (report-swmu 2-soil layout)




LEGEND:

- Phase I RFI Background Soil Sample Location
- Phase I RFI Soil Sample Location
- Phase I RFI Sediment Sample Location
- SWMU No.2 Boundary

Note:
All detected concentrations of COIs are less than screening values or background.

400 0 400 Feet

**SWMU No. 2 : Alcoa/Badin Landfill**
**Plan View and Soil Sample Locations**

Alcoa-Badin Works
Badin, North Carolina

| PROJECT: 120006 | BY: MAW | Figure 4-34 |
|---|---|---|
| DATE: March 2001 | CHECKED: MEP | |

**MFG, Inc.**
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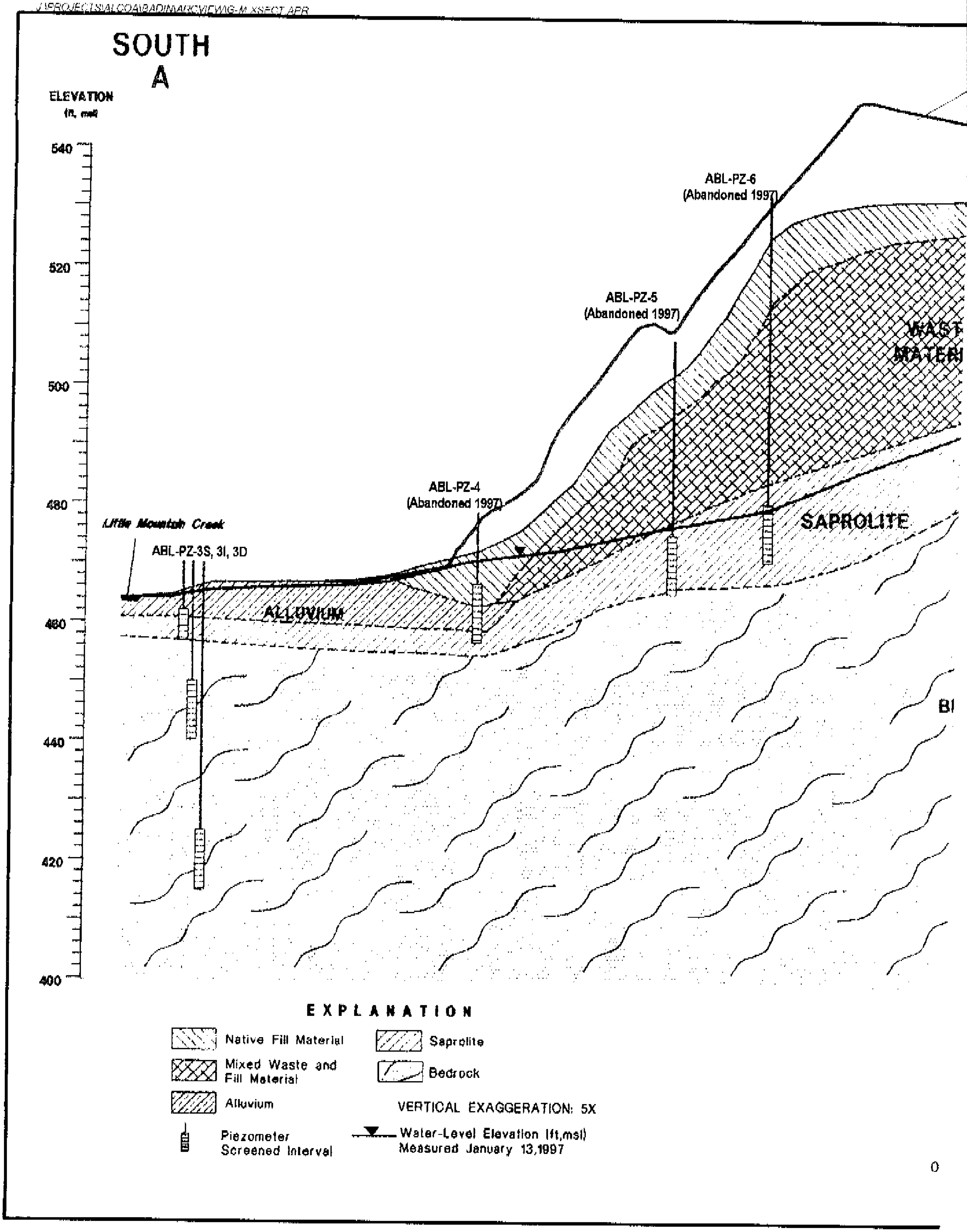
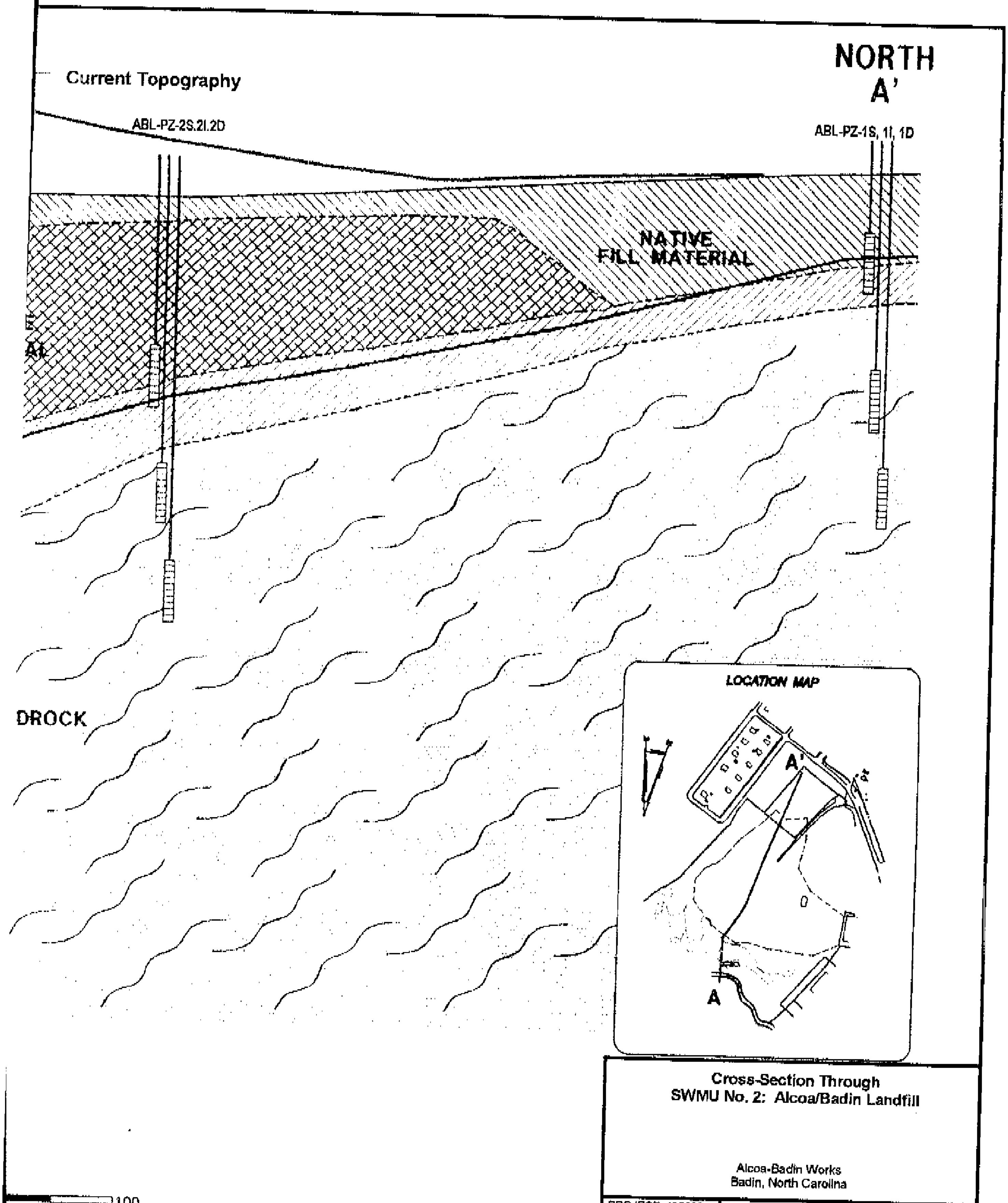
J:\PROJECTS\ALCOA\BADIN\ARCVIEW\G-M XSECT.APR






**Cross-Section Through**
**SWMU No. 2: Alcoa/Badin Landfill**

Alcoa-Badin Works
Badin, North Carolina

| | | |
|---|---|---|
| PROJECT: 120006 | BY: MAW | Figure 4-35 |
| DATE: March 2001 | CHECKED: MEP | |

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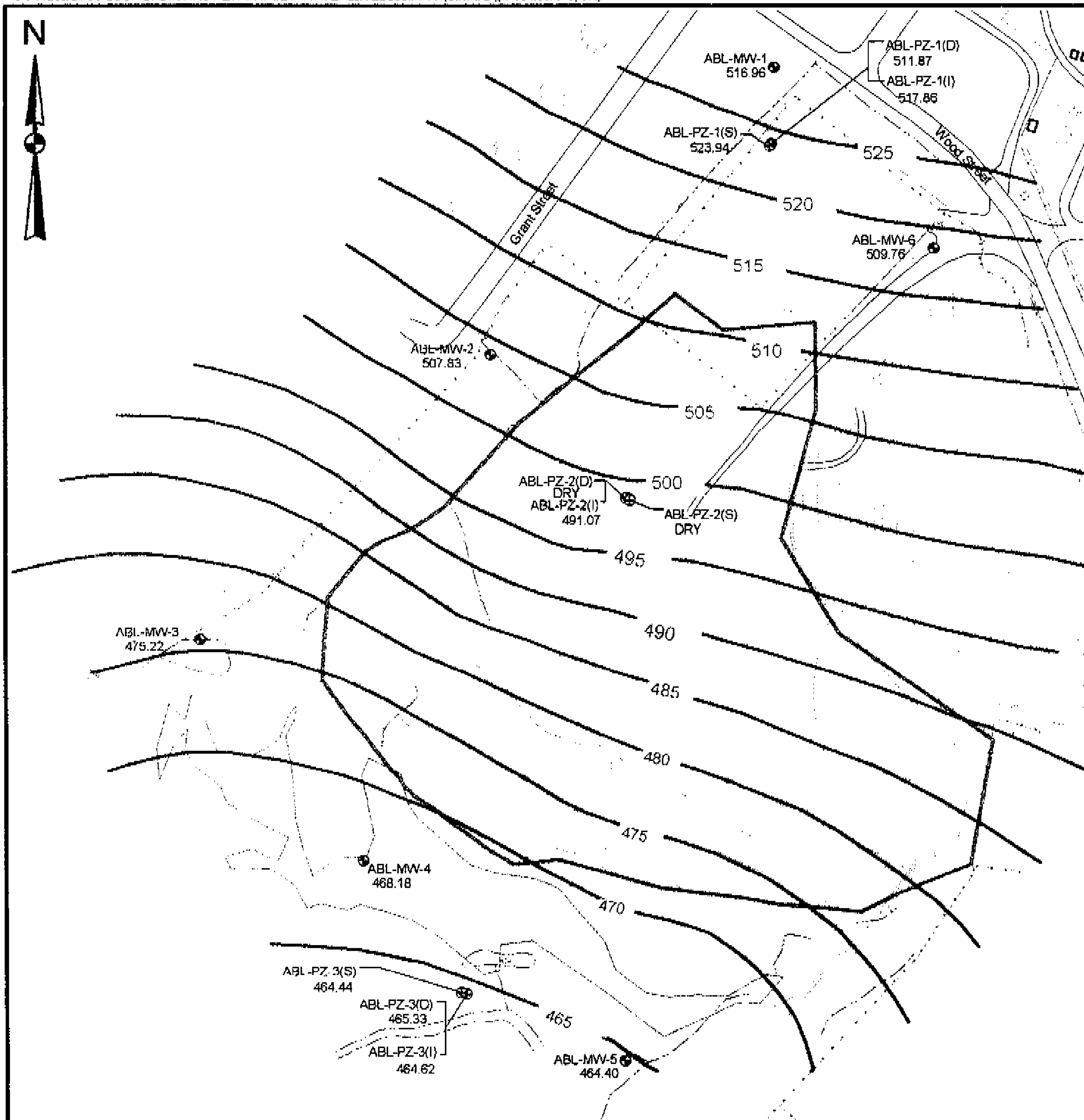
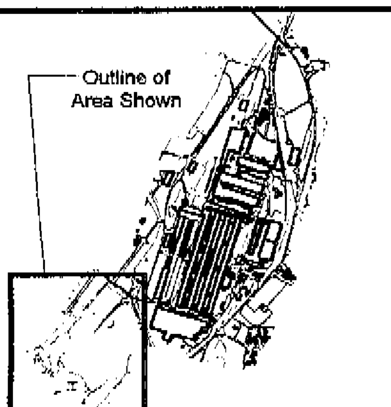
Reference:
Orbital Engineering Inc. 1997;
Geraghty & Miller Inc. 1997.

J:\PROJECTS\ALCOA\BADIN\ARCVIEW\PHASE II\WATERLEVELS00.APR (swmu 2 gw contours layout)




200 0 200 Feet

LEGEND:

- Groundwater Elevation Contours [ft-msl]
- Monitoring Well Location
- Piezometer Location
- SWMU No. 2 Boundary

**SWMU No. 2: Alcoa/Badin Landfill**
**Water Table Elevation Contour Map**
**September 1999**

Alcoa-Badin Works
Badin, North Carolina

| | | |
|---|---|---|
| PROJECT: 120006 | BY: MAW | **Figure** |
| DATE: March 2001 | CHECKED: MEP | **4-36** |

**MFG, Inc.**
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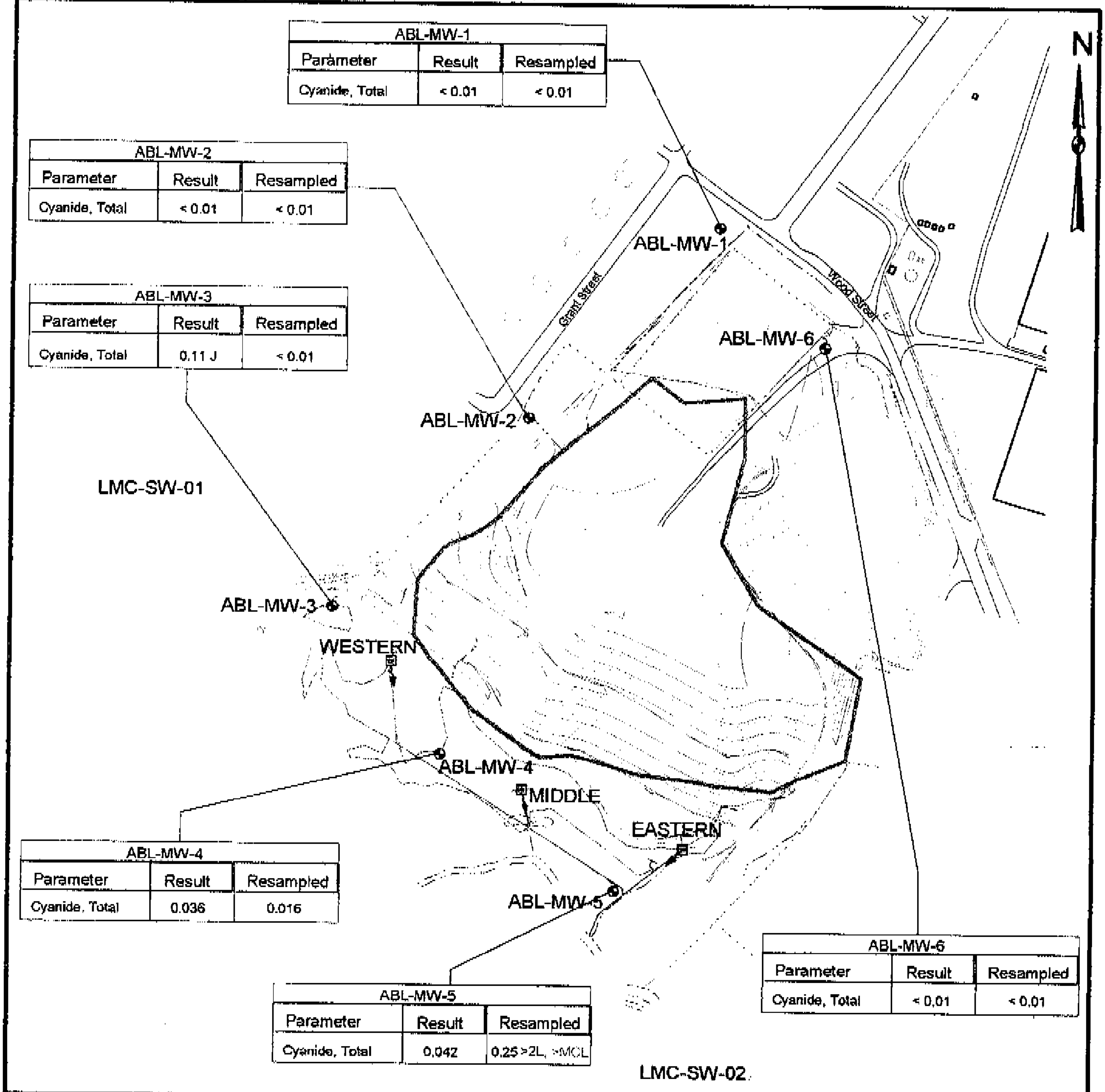
J:\PROJECTS\ALCOA\BADIN\ARCVIEW\PH2-WELL-DATA.APR (report-swmu 2-gw layout)




| ABL-MW-1 | | |
|---|---|---|
| Parameter | Result | Resampled |
| Cyanide, Total | < 0.01 | < 0.01 |

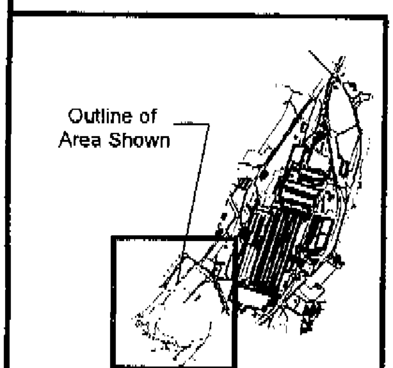
| ABL-MW-2 | | |
|---|---|---|
| Parameter | Result | Resampled |
| Cyanide, Total | < 0.01 | < 0.01 |

| ABL-MW-3 | | |
|---|---|---|
| Parameter | Result | Resampled |
| Cyanide, Total | 0.11 J | < 0.01 |

| ABL-MW-4 | | |
|---|---|---|
| Parameter | Result | Resampled |
| Cyanide, Total | 0.036 | 0.016 |

| ABL-MW-5 | | |
|---|---|---|
| Parameter | Result | Resampled |
| Cyanide, Total | 0.042 | 0.25 >2L, >MCL |

| ABL-MW-6 | | |
|---|---|---|
| Parameter | Result | Resampled |
| Cyanide, Total | < 0.01 | < 0.01 |




LEGEND:

- Monitoring Well Location/RFI Groundwater Sample
- Phase I RFI Surface Water Sample Location
- Seep Location (indicating flow direction)
- Seep Collection System
- SWMU #2 Boundary
- >2L Indicates result exceeds North Carolina groundwater protection standard
- >MCL Indicates result exceeds USEPA Maximum Contaminant Levels

Notes:

All analytical results are in mg/l.

300 0 300 Feet

**SWMU No. 2 : Alcoa/Badin Landfill**
**Plan View and Groundwater Sample Locations**

Alcoa-Badin Works
Badin, North Carolina

| PROJECT: 120006 | BY: MAW | Figure 4-37 |
|---|---|---|
| DATE: March 2001 | CHECKED: MEP | |

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## APPENDIX A

Chain of Custody, Data Validation, and Analytical Data

# REFERENCE 11

35264

4WD-WPB

JUN 5 1991

Pat DeRosa, Head
CERCLA Branch
Waste Management Division
North Carolina Department of Environment,
Health and Natural Resources
Post Office Box 27678
Raleigh, NC 27611-7687

RE: Alcoa Badin Landfill
NCD986171320

Dear Ms. DeRosa:

I have reviewed the Screening Site Inspection report on the above referenced site. The site disposition is no further remedial action planned

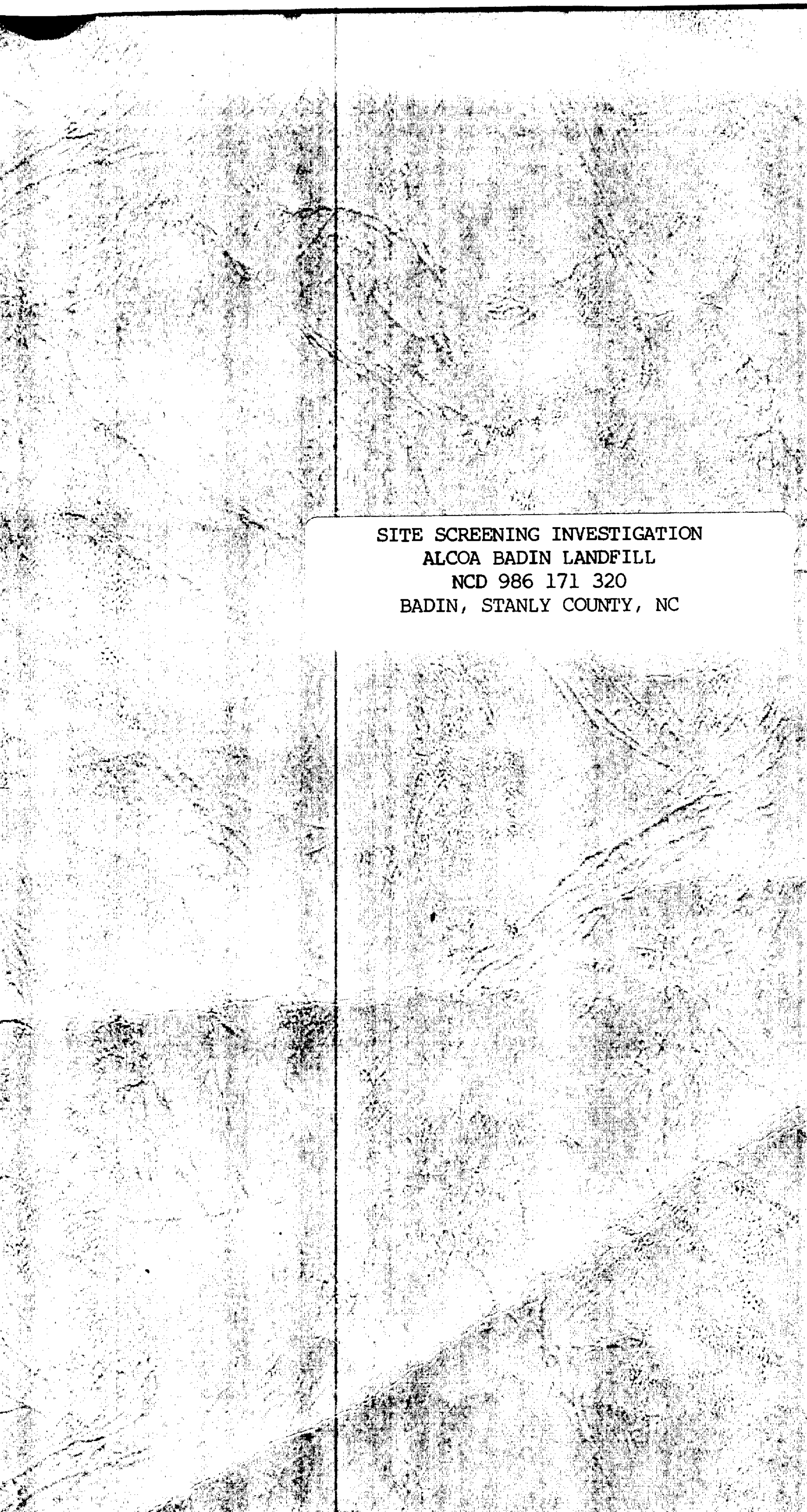
If you have any questions, please call me at (404) 347-5065.

Sincerely yours,

Earl L. Bozeman, Jr.
Site Assessment Manager
Eastern North Carolina

EB:mr:6/4/91x5065 Disk: G drive Doc: epa-nc

BOZEMAN DEIHL



SITE SCREENING INVESTIGATION
ALCOA BADIN LANDFILL
NCD 986 171 320
BADIN, STANLY COUNTY, NC

State of North Carolina
Department of Environment, Health, and Natural Resources
**Division of Solid Waste Management**
**P.O. Box 27687 · Raleigh, North Carolina 27611-7687**

James G. Martin, Governor
William W. Cobey, Jr., Secretary

William L. Meyer
Director

March 21, 1991

Mr. Earl Bozeman
EPA NC CERCLA Project Officer
EPA Region IV Waste Division
345 Courtland Street, N.E.
Atlanta, Georgia 30365

Subject: Alcoa Badin Landfill
NCD 986 171 320
Badin, Stanly County, North Carolina
Screening Site Investigation Report

Dear Mr. Bozeman:

Please find attached the site investigation report for the subject site. Based on data collection and evaluation, on a visit to the site, and on analyses of samples taken from the site, we have concluded the following:

Alcoa Badin Landfill (ABL) is located on the shore of Lake Badin near the town of Badin, in Stanly County, North Carolina. ABL is located in a wooded area and is situated approximately 450 feet from the shore of Lake Badin. The site occupies two to three acres, is unfenced, and is roughly 2000 feet from residential areas of the town of Badin.

ABL is and has been owned by the Aluminum Company of America (Alcoa), Badin Works, since 1915 or 1916. The site was an above-ground waste pile used for the disposal of spent potliners and furnace brick produced during primary aluminum production processes carried out at Alcoa Badin Works. Alcoa Badin Works is a manufacturer of carbon anodes and cathodes, and a smelter of aluminum. Spent potliners are produced during smelting of aluminum, are classified as K088 hazardous waste, and contain cyanide complexes. Alcoa Badin Works produces 4800 tons of K088 waste per year. Reportedly, ABL was used for the disposal of K088 from 1915 or 1916 until 1960. Alcoa Badin Works did not use the site for disposal of K088 waste after 1960 and the waste is now disposed of at an off-site TSD. In 1988 the site was graded and capped with one foot of clay.

Samples taken during the site sampling visit include ground water, surface and subsurface soil, and surface water from Lake Badin. The samples were analyzed for volatiles, extractible organics, inorganics, and cyanide. Cyanide was not found in any of the samples taken during the site investigation sampling visit. Elevated levels of acetone were found in the ground water sample taken from the temporary monitoring well and in the subsurface soil sample taken from the boring for the monitoring well. No other contaminants were found in the samples.

Ground water is the only source of drinking water available to some of the residents within four miles of the site. The population utilizing ground water obtained from wells located within four miles of the site as drinking water is estimated to be 1090 individuals. The majority of the population residing in the surrounding area are served by the county and municipal water systems which use surface water intakes. The first system is a county-wide system serving residents outside of the cities of Albemarle and Badin, providing water obtained from unthreatened surface water intakes. The second is the Greater Badin Water District (GBWD) which serves only the residents of Badin. GBWD obtains its water from an intake located at Badin Dam and provides drinking water to 1900 individuals.

The site and the surrounding areas are drained by the Yadkin-Pee Dee River and its tributaries. The site itself drains 450 feet northeast to Lake Badin, which is a part of the Yadkin-Pee Dee River. There is one surface water intake used to supply drinking water located within the fifteen mile target distance limit, as well as two located immediately upstream and two located downstream of the target distance limit. The surface water intake located inside of the target distance limit is located on the face of Badin Dam, approximately 1.5 miles from the probable point of entry of the site drainage, and serves the GBWD. There are two surface water intakes used to supply drinking water located downstream of the fifteen mile target distance limit. The first is located 16.5 miles from the probable entrance of site drainage and the second is located 19.25 miles downstream of the probable entrance of the site drainage. There are two surface water intakes used to supply drinking water located upstream of Lake Badin on the Yadkin River. These intakes are judged to be located outside of the target distance limit and are not threatened by the site. There are three fisheries located within the target distance limit. The first is Lake Badin, which is an excellent fishery, one of the best and heaviest used in the state of NC. The second fishery is Falls Lake and the third fishery is Lake Tillery. Approximately 50% of the length of Lake Tillery is located inside of the target distance limit, and this is an excellent fishery, comparable to Lake Badin.

Due to the low number of potential targets threatened by the site, no further remedial action is recommended under CERCLA.

If you have any questions, please call me at (919) 733-2801.

Sincerely,

John P. McConney
Environmental Chemist
NC Superfund Section

JM/abl.sil

NORTH
CAROLINA

DEHNR/DSWM

Approved 6/4/91 NFRAP

# Alcoa Badin Landfill
# NCD986171320
# Screening Site Investigation
# March 1991

By: John McConney
Environmental Chemist
Superfund Section
Division of Solid Waste Management

# SCREENING SITE INVESTIGATION

ALCOA BADIN LANDFILL
NCD 986 171 320
BADIN, STANLEY COUNTY, NC

MARCH 1991

SUPERFUND SECTION
SOLID WASTE MANAGEMENT DIVISION
NC DEPARTMENT OF ENVIRONMENT, HEALTH, AND NATURAL RESOURCES


PREPARED BY:

John McConney
Environmental Chemist

REVIEWED BY:

Jack Butler for
Pat DeRosa, Head
CERCLA Branch

## Executive Summary

Alcoa Badin Landfill (ABL) is located on the shore of Lake Badin near the town of Badin, in Stanly County, North Carolina. ABL is located in a wooded area and is situated approximately 450 feet from the shore of Lake Badin. The site occupies two to three acres, is unfenced, and is roughly 2000 feet from residential areas of the town of Badin.

ABL is and has been owned by the Aluminum Company of America (Alcoa), Badin Works, since 1915 or 1916. The site was an above-ground waste pile used for the disposal of spent potliners and furnace brick produced during primary aluminum production processes carried out at Alcoa Badin Works. Alcoa Badin Works is a manufacturer of carbon anodes and cathodes, and a smelter of aluminum. Spent potliners are produced during smelting of aluminum, are classified as K088 hazardous waste, and contain cyanide complexes. Alcoa Badin Works produces 4800 tons of K088 waste per year. Reportedly, ABL was used for the disposal of K088 from 1915 or 1916 until 1960. Alcoa Badin Works did not use the site for disposal of K088 waste after 1960 and the waste is now disposed of at an off-site TSD. In 1988 the site was graded and capped with one foot of clay.

Samples taken during the site sampling visit include ground water, surface and subsurface soil, and surface water from Lake Badin. The samples were analyzed for volatiles, extractible organics, inorganics, and cyanide. Cyanide was not found in any of the samples taken during the site investigation sampling visit. Elevated levels of acetone were found in the ground water sample taken from the temporary monitoring well and in the subsurface soil sample taken from the boring for the monitoring well. No other contaminants were found in the samples.

Ground water is the only source of drinking water available to some of the residents within four miles of the site. The population utilizing ground water obtained from wells located within four miles of the site as drinking water is estimated to be 1090 individuals. The majority of the population residing in the surrounding area are served by the county and municipal water systems which use surface water intakes. The first system is a county-wide system serving residents outside of the cities of Albemarle and Badin, providing water obtained from unthreatened surface water intakes. The second is the Greater Badin Water District (GBWD) which serves only the residents of Badin. GBWD obtains its water from an intake located at Badin Dam and provides drinking water to 1774 individuals.

The site and the surrounding areas are drained by the Yadkin-Pee Dee River and its tributaries. The site itself drains 450 feet northeast to Lake Badin, which is a part of the Yadkin-Pee Dee River. There is one surface water intake used to supply drinking water located within the fifteen mile target

## Table of Contents

# 1.0 Background

## 1.1 Location

Alcoa Badin Landfill (ABL) is located on the shore of Lake Badin near the town of Badin, in Stanly County, North Carolina. The county code is 84 and this is in the Eighth Congressional District. The coordinates are latitude 35° 24' 46" North and longitude 80° 06' 18" West (4).

## 1.2 Site Layout

ABL is located in a wooded area and is situated approximately 450 feet southeast of the shore of Lake Badin. Residential areas of the Town of Badin lie roughly 2000 feet southwest of ABL. There are no buildings on or adjacent to the site. The site occupies two to three acres, is unfenced, and is reached by a dirt access road. This dirt access road goes through a densely wooded area and has two locked gates (4,9,13). A site sketch is included in Appendix A.

## 1.3 Ownership and Site Use History

ABL is and has been owned by the Aluminum Company of America (Alcoa), Badin Works, since 1915 or 1916. The site was an above-ground waste pile used for the disposal of spent potliners and furnace brick produced during primary aluminum production processes carried out at Alcoa Badin Works. Construction debris were also disposed of at the site (13,16).

Alcoa Badin Works is a manufacturer of carbon anodes and cathodes, and a smelter of aluminum. Spent potliners are produced during the smelting of aluminum. Alcoa Badin Works has been in operation since 1915 or 1916 and produces approximately 4800 tons per year of spent potliners (6). Spent potliners are classified as K088 hazardous waste and contain cyanide complexes (17,30). Reportedly, ABL was used for the disposal of K088 from 1915 or 1916 until 1960. Prior to ownership by Alcoa, the site was used as a railroad right-of-way for a railway that was in operation during construction of Badin Dam. After Alcoa purchased the property, the railway was used to transport the spent potliners and construction debris disposed of at ABL (24). In 1988, the site was graded, capped with one foot of clay, and seeded (16).

## 1.4 Permit and Regulatory History

ABL has never had any status under RCRA. The site has no status under the Solid Waste Management Division (7).

## 1.5 Remedial Actions to Date

In 1988, Alcoa retained a contractor to install a cap on the above-ground waste pile. The waste material was regraded prior to installation of the cap. This cap consisted of a subgrade layer to provide a smooth surface, a barrier layer of one foot of silt or silty clay with a compacted permeability of less than $1 \times 10^{-5}$ cm/sec, and a final cover of topsoil. A vegetative cover was installed over the topsoil (24).

## 1.6 Summary Trip Report

On November 14, 1990, the team of John P. McConney and Mark Durway, both of the NC Superfund Section, conducted a site sampling visit as part of the site screening investigation. At 1000 the team met with representatives of Alcoa at Alcoa Badin Works. These representatives were Conrad Carter, Environmental Protection Manager, and Larry McCaskill, Laboratory Supervisor. They provided background information and accompanied the team while sampling. Mr. Carter provided a copy of the engineering report regarding the installation of the clay cap, a detailed topographic map of the landfill, and records of the subsurface exploration performed by Law Engineering in 1987. The team then drove to the site, which is located 0.8 miles from the Alcoa facility (8,9).

The team first toured the site, which was located roughly 400 feet from Lake Badin. The area surrounding the landfill is heavily wooded and hilly. The landfill's access road has locked gates at both the beginning of the access road and at the entrance to the landfill but the landfill itself is unfenced. The landfill itself is mostly well grassed, with several small areas showing only patchy grass. There is one large area of the landfill that showed evidence of erosion, upslope of the toe of the landfill, and erosion control fences had been installed in that area. Downslope of the eroded area, the toe of the landfill is seeping water. This water appeared to be flowing along the pathway of an intermittent creek leading to Lake Badin but the creek bed was dry before reaching Lake Badin (8,9).

Following the tour, the team proceeded to take samples at the landfill. (See site sketch in Appendix A) First, background soil samples were taken. A background sampling location was chosen on a ridge located southwest of the landfill, roughly 30 feet from the boundary of the fill area. A surface soil sample (ABL-S1) was taken, and a subsurface soil sample (ABL-SB1) was taken at a depth of four feet. The team then proceeded to the toe of the landfill and took a surface soil sample (ABL-S2) roughly ten feet downgradient from the toe of the landfill. The team attempted to obtain a subsurface soil sample but the soil was too wet to auger successfully. A two foot deep hole was dug at the base of the toe of the landfill so that the seepage water could collect for later sampling. The team proceeded downgradient from the landfill toe; roughly 100 feet from the landfill toe the soil was dry enough to auger successfully. A six foot deep hole was augered and a subsurface soil sample (ABL-SB2) was taken. In this hole, ground water was reached, and a temporary monitoring well was installed. A ground water sample (ABL-GW1) was taken from this monitoring well. The team then sampled the seepage water (ABL-SW1) from the previously dug hole at the base of the landfill toe (8,9).

Following this, the team proceeded to Lake Badin and took an upstream surface water sample (ABL-SW2). A downstream surface water sample (ABL-SW3) was then taken from near the surface water intake located on the Badin Dam, approximately 1.5 miles from the landfill. This intake serves the Town of Badin and provides drinking water to 1900 people. All samples were taken in duplicate and were split with the Alcoa representatives (8,9).

The team then exited the site and performed an off site well survey. The Town of Badin has had a municipal water distribution system in place since the building of Alcoa Badin Works in 1915. According to the Alcoa representatives, the nearest off-site well is located on the Alcoa Badin Works property and is used as a source of nonpotable water. During the well survey, there was no visible evidence of ground water use inside of the city limits. The nearest off-site drinking water wells found during the survey are located approximately 1.2 miles northeast of the site on Highway 740 (4,8,9).

distance limit, as well as two located immediately upstream and two located downstream of the target distance limit. The surface water intake located inside of the target distance limit is located on the face of Badin Dam, approximately 1.5 miles from the probable point of entry of the site drainage, and serves the GBWD. There are two surface water intakes used to supply drinking water located downstream of the fifteen mile target distance limit. The first is located 16.5 miles from the probable entrance of site drainage and the second is located 19.25 miles downstream of the probable entrance of the site drainage. There are two surface water intakes used to supply drinking water to the City of Albemarle located upstream of Lake Badin on the Yadkin River. These intakes are judged to be located outside of the target distance limit and are not threatened by the site. There are three fisheries located within the target distance limit. The first is Lake Badin, which is an excellent fishery, one of the best and heaviest used in the state of North Carolina. The second fishery is Falls Lake and the third fishery is Lake Tillery. Approximately 50% of the length of Lake Tillery is located inside of the target distance limit, and this is an excellent fishery, comparable to Lake Badin.

Due to the low number of potential targets threatened by the site, no further remedial action is recommended under CERCLA.

## 2.0 Environmental Setting

### 2.1 Topography

Alcoa Badin Lake lies within the upland section of the Piedmont physiographic province, which is an uplifted, submaturely to maturely dissected peneplane. The sedimentary rocks in the area strike generally northeast-southwest. The igneous intrusives are generally elongated and strike northeast-southwest. The relative resistance of the different rock types to erosion determines the topographic expression in the area (10). The site is located in an area of minimal flooding, that is, an area with a greater than 500-year flood hazard (20).

Drainage from the site flows northeast to Lake Badin along the pathway of a small intermittent creek (8,9). The overland flow along this pathway is approximately 450 feet, with a drop of roughly 80 feet (4,13). Therefore the slope of the intervening terrain is 18%.

### 2.2 Surface Waters

The site area and the surrounding area are drained by the Yadkin-Pee Dee River and its tributaries. The site itself drains to Lake Badin, which is a part of the Yadkin-Pee Dee River (4). The end of the fifteen mile target distance limit is reached on the Pee Dee River, near the point where Cedar Creek drains into Lake Tillery (4). Lake Badin and the entire downstream fifteen mile target distance limit are classified as WS-III&B water bodies. These water bodies are suitable for drinking water, primary and secondary recreation, fish and wildlife propagation, and agriculture (12).

There is one surface water intake used to supply drinking water located within the fifteen mile target distance limit, as well as two located immediately upstream and two located downstream of the target distance limit. The surface water intake located inside of the target distance limit is located on the face of Badin Dam, approximately 1.5 miles downstream of the probable point of entry (PPOE) of the site drainage. This intake is owned and operated by Alcoa and is used to supply water for Alcoa Badin Works and the Greater Badin Water District, which serves the residents of the town of Badin. This intake withdraws between 1,000,000 and 1,200,000 gallons per day and supplies water only to the systems previously mentioned (25). The Greater Badin Water District is managed by Stanly County, who reported that 650 meters with a population of 1774 individuals are served by the system (22,30).

There are two surface water intakes located downstream of the fifteen mile target distance limit. The first is located 16.5 miles from the PPOE of the site drainage and is near

Norwood Beach. This intake is operated by the Town of Norwood and withdraws between 500,000 and 600,000 gallons of water daily to supply drinking water to 2,000 individuals. Montgomery County operates a surface water intake located 19.25 miles downstream of the PPOE of the site drainage. This intake withdraws approximately 1,000,000 gallons of water daily (25).

There are two surface water intakes used to supply drinking water located upstream of Lake Badin on the Yadkin River. The first is located at the Tuckertown reservoir and the second is located near where the railroad tracks cross the Yadkin River. These intakes are judged to be located outside of the target distance limit and are not threatened by the site. The City of Albemarle operates these intakes and withdraws 10,000,000 gallons per day, providing drinking water to the 23,400 individuals. This system also provides water to Stanly County (19,25).

There are three fisheries located within the target distance limit. The PPOE of the site drainage is located in the first fishery. This is Lake Badin, which is an excellent fishery, one of the best and heaviest used in the State of North Carolina. This is a large lake, roughly 5,000 acres, and supports 398.26 pounds/acre of fish. There is both sport and commercial fishing at the lake. In 1980 there were 69,408 pounds of fish harvested and consumed and 159,000 hours of fishing pressure. Both the amount harvested and the fishing pressure have increased considerably since 1980. The commercial fishing is mainly catfish trapping and approximately 5,000 pounds per year are harvested.

The other fisheries are located on the Pee Dee River, downstream of Lake Badin. The second fishery is Falls Lake, located immediately upstream of Falls Dam, which is 4.0 miles downstream of the PPOE of the site drainage. There is sport fishing at this lake but no harvest data was available. There is no commercial fishing at this lake. The third fishery is Lake Tillery and approximately 50% of the length of this lake is located inside of the target distance limit. This lake is located immediately upstream of Tillery Dam, which is 19.25 miles downstream of the PPOE of the site drainage. This is also a large lake, roughly 5,000 acres, and this is also an excellent fishery, comparable to Lake Badin. Exact data is not available but both the harvest and the fishing pressure are similar to Lake Badin. The commercial fishing is mainly catfish trapping and approximately 5,000 pounds per year are harvested. There is a yearly migration of white bass through Lake Tillery to the Uwharrie River, which drains into the Pee Dee River 5.5 miles downstream of the probable entrance of the site drainage. The spawning ground of the white bass is located on the Uwharrie River and a large harvest is collected from these white bass (18).

## 2.3 Geology, Soils, and Ground Water

The soil in the site area is a stiff to very stiff red brown fine sandy clayey silt. This soil and the above ground waste pile are underlain by a residual firm red-brown fine sandy silty clay. The thickness of this clay layer beneath the site is not known but it was at least eight feet thick in a soil boring performed near the middle of the landfill (13).

The Carolina volcanic-sedimentary group underlies all of Stanly County. This is a northeast trending band of volcanic, sedimentary, and low rank metamorphic rocks that crop out across the entire State in the eastern and central Piedmont. ABL and the immediate site area are underlain by the laminated argillite unit. This unit is composed primarily of thin beds, or laminae, of clay and silt-sized material. The laminae give the rock a banded or striped appearance. The rock has a well-developed bedding-plane cleavage and sometimes has an incipient axial-plane cleavage. The unweathered rock is dark gray; when weathered the rock is shades of red and yellow and produces light-gray and yellow soils. The area to the west of the site is underlain by the tuffaceous argillite unit. The tuffaceous argillite typically conformably overlies the laminated argillite. This unit is composed of felsic tuffaceous argillite and graywacke, and contains basic tuffaceous argillite, felsic tuff, mafic tuff and flow material. The major rock types have similar hydrologic properties. The area to the east of the site is underlain by the upper volcanic unit. This unit is composed of rhyolite, basaltic tuff and andesitic tuff. The rocks of this unit conformably overlie the rocks of the tuffaceous argillite and laminated argillite units. The rhyolite is typically a dense, fine-grained flow rocks that weathers to soils that are light gray to buff and vermilion in color. The basaltic tuffs are composed of basaltic lithic-crystal tuffs and weathers to a dark-brown clayey soil. The andesitic tuff weathers to produce a clayey, maroon-colored soil (10).

Ground water in the area is contained in the interstices of the soil and in the secondary interstices of the underlying formations. The ground water in the site area flows toward Lake Badin and the Pee Dee River. Average well depths in the area range from 75 to 200 feet below land surface. Well yields may be as high as 200 gallons per minute (gpm) but are more commonly in the 5 to 35 gpm range (7,10). There is one aquifer-of-concern that begins in the saprolite and extends into the crystalline bedrock. A drinking-water well located 1.5 NE of Badin encountered ground water at 23 feet (10). A boring performed at the landfill site encountered ground water approximately 23 feet below the fill material (13). The team from the NC Superfund Section encountered ground water at a depth of approximately 4 feet at a location that was downgradient and 100 feet from the landfill, between the landfill and the lake (8,9).

## 2.4 Climate and Meteorology (1,2)

Seasonal Temperatures:

| (°F) | January | July |
|---|---|---|
| Mean Max. | 56 | 91 |
| Mean Min. | 30 | 66 |
| Mean | 45 | 80+ |

Precipitation: (inches)

| | |
|---|---|
| Mean Annual Precipitation: | 46 |
| Mean Annual Evaporation: | 41 |
| Net Annual precipitation: | 5 |
| Mean Annual snowfall: | 5 |
| One year 24-hr. rainfall: | 3.0 |

Storm Events:

| | |
|---|---|
| Mean days/year with thunderstorms: | 50 |
| Prevailing winds and wind speeds: | SW at 9 |

## 3.5 Land Use and Population Distribution

ABL is located in a rural area, and the immediate site area is heavily wooded. There is no resident population and there are no workers at the site. The population residing within four miles of the site is as follows:

Onsite has a population of zero individuals.
> 0 to 1/4 mile has a population of zero individuals.
> 1/4 to 1/2 mile has a population of 232 individuals.
> 1/2 to 1 miles has a population of 552 individuals.
> 1 to 2 miles has a population of 1231 individuals.
> 2 to 3 miles has a population of 1373 individuals.
> 3 to 4 miles has a population of 1624 individuals (29,31).

The nearest large industry is the Alcoa Badin Works facility, located 0.8 mile southwest of the site. The majority of Badin is located within a mile of the site and the town of Albemarle is located five miles from the site (4).

## 3.6 Water Supply

Ground water is the only source of drinking water available to some of the residents within four miles of the site. However, the majority of the population residing in the surrounding area are provided drinking water by a municipal water system and a county water system. The population utilizing ground water obtained from wells located within four miles of the site as drinking water is as follows:

0 to 1/4 mile has a population of zero individuals.
> 1/4 to 1/2 mile has a population of zero individuals.
> 1/2 to 1 miles has a population of zero individuals.

> 1 to 2 miles has a population of 175 individuals.
> 2 to 3 miles has a population of 396 individuals.
> 3 to 4 miles has a population of 516 individuals (26,31).

The nearest drinking water well is located 1.3 miles from the site (4,8,9).

There are two separate water systems in the area that provide drinking water to the residents. Stanly County operates both of these systems; however, the water source for these systems and the areas served are different. The Stanly County Department of Public Works operates a county-wide system serving residents outside of the City of Albemarle and Badin. This system purchases its water from the City of Albemarle and serves 2,000 meters in the county. The City of Albemarle obtains its water from unthreatened surface water intakes. The Greater Badin Water District (GBWD) is operated by Stanly County under a special commission but this system serves only the residents of the Town of Badin. GBWD obtains its water from an intake located at Badin Dam and provides drinking water to 1900 individuals. Under special circumstances this system can obtain its water from Stanly County (15,22,24,25). The only public water system utilizing ground water obtained from wells located within 4 miles of the site as drinking water is Morrow State Park. These wells serve three residents and the transient population visiting the park. The main well used for the permanent residents, the park rangers, is located within the 2 to 3 mile radius (21,23).

2.7 Sensitive Environments

There are no sensitive environments located within 1/2 mile of the site. There is a National Forest and a State Park located near the site. Uwharrie National Forest is located one mile from the site, east of the site and along the surface water pathway. Morrow Mountain State Park is located 4.25 miles from the site along the surface water pathway (4). There are no wetlands located within 1/4 mile of the site or along the surface water pathway. The nearest critical habitat of an endangered or threatened species is located approximately 40 miles from the site and is for the Cape Fear Shiner (3).

## 3.0 Waste Types and Quantities

### 3.1 Waste Quantities

Alcoa generates one waste stream at its Badin facility, spent potliners from primary aluminum reduction. This is classified as K088 RCRA hazardous waste. The Alcoa Badin facility has been in operation since 1915 or 1916 and reportedly used the site for disposal of K088 waste from the beginning of operations until 1960, a total of 44 to 45 years (16,17). According to the RCRA Part A application filed by Alcoa Badin Works in November of 1980, Alcoa produces 4800 tons per year of spent potliners (6). Assuming a constant rate for the production and disposal of K088 waste over the life of the site, a total of 216,000 tons of K088 waste may have been disposed of at the site.

### 3.2 Waste Disposal Methods and Locations

ABL is an above ground waste pile used for the disposal of K088 waste. Prior to ownership by Alcoa, the site was used as a railroad right-of-way for a railway used during construction of Badin Dam. Alcoa used the railway for transportation of the K088 waste and disposed of the waste beside the railway (24). The waste pile was uncovered until 1988, when the waste pile was graded and one foot cap of clay installed. ABL is two to three acres in extent and consists of the one waste pile (13,16).

### 3.3 Waste Types

The waste disposed of at ABL is K088 waste and contains cyanide complexes (30). This waste is in the form of a solid, either powdered or in the shape of a brick.

Samples taken during the site sampling visit include ground water, surface and subsurface soil, and surface water from Lake Badin. Cyanide was not found in any of the samples taken during the site investigation sampling visit. Elevated levels of acetone were found in the ground water sample taken from the downgradient temporary monitoring well and in the subsurface soil sample taken from the boring for the monitoring well. Due to the site slope, an upgradient ground water sample could not be taken (see waste pile provile map). The upgradient subsurface soil sample did not contain any compounds present above the detection limit. The level of acetone found in the ground water was 100 times the detection limit and the level of acetone found in the downgradient subsurface soil sample was 400 times the detection limit (27).

# 4.0 Laboratory Data

## 4.1 Laboratory Data Summary

| Sample Type and location | Sample Number Field/Lab | Results |
|---|---|---|
| **Background Samples** | | |
| Background surface soil (ABL-S1) | 15915/28180<br>12349/907236 | Inorganics - background levels<br>Organics - all compounds BDL |
| Background subsurface soil (ABL-SB1) | 15916/28181<br>12350/907237 | Inorganics - background levels<br>Organics - all compounds BDL |
| Badin Lake background surface water (ABL-SW2) | 15921/28186<br>12357/907244P&T<br>12358/907245BNA | Inorganics - background levels<br>Organics - all compounds BDL |
| **Source Samples** | | |
| Temporary monitoring well (ABL-GW1) | 15919/28184<br>12353/907240P&T<br>12354/907241BNA | Inorganics - no significant levels *<br>Organics - no significant levels except Acetone at 1014 mg/kg (100 x DL) |
| Landfill Toe surface soil sample (ABL-S2) | 15917/28182<br>12351/907238 | Inorganics - no significant levels<br>Organics - all compounds BDL |
| Downgradient subsurface soil sample (ABL-SB2) | 15918/28183<br>12352/907239 | Inorganics - no significant levels<br>Organics - no significant levels except Acetone at 4091 mg/kg (400 x DL) |
| Landfill Toe - seepage water (ABL-SW1) | 15920/28185<br>12355/907242P&T<br>12356/907243BNA | Inorganics - no significant levels<br>Organics - all compounds BDL |

| | | |
|---|---|---|
| Badin Lake Dam - downstream surface water (ABL-SW3) | 15922/28187<br>12359/907246P&T<br>12360/907247BNA | Inorganics - no significant levels<br>Organics - all compounds BDL |

## Quality Control Samples

| | | |
|---|---|---|
| Trip Blank (VOC only) | 12361/907248 | Organics - all compounds BDL |
| Preservative Blank (Nitric Acid) | 15923/28188 | Inorganics - all compounds BDL |
| Preservative Blank (NaOH) | 15924/28189 | Inorganics - cyanide (only) BDL |

* significant levels = 3 x detection limit (DL) or
3 x background (BKGND)

### 4.2 Quality Assurance Review

During the sampling visit to the site, both a Trip Blank and two Preservative Blanks were transported to the field and were handled and treated in the same manner as the background and source samples. These blanks were prepared as per the Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual, April 1, 1986. Laboratory analysis of the Trip blank and the Preservative blanks indicate that no contamination of these blanks occurred during the sampling visit.

## 5.0 Toxicological/Chemical Characteristics

(taken from Ref. 28)

## ACETONE

CAS RN: 67641 NIOSH #: AL 3150000

mf: $C_3H_6O$; mw: 58.09

Colorless liquid, fragrant mint-like odor. mp: −94.6°, bp: 56.48°, ulc = 90, flash p: 0°F (CC), lel = 2.6%, uel = 12.8%, d: 0.7972 @ 15°, autoign. temp. (color): 869°F, vap. press: 400 mm @ 39.5°, vap. d: 2.00. Misc in water, alc, and ether.

SYNS:

| | |
|---|---|
| ACETON (GERMAN, DUTCH, POLISH) | BETA-KETOPROPANE |
| DIMETHYLFORMALDEHYDE | METHYL KETONE |
| DIMETHYLKETAL | PROPANONE |
| DIMETHYL KETONE | 2-PROPANONE |
| KETONE PROPANE | PYROACETIC ACID |
| | PYROACETIC ETHER |

| TOXICITY DATA: 2-1 | CODEN: |
|---|---|
| ihl-man TDLo:440 μg/M³/6M | GISAAA 42(8)42,77 |
| ihl-man TDLo:10 mg/M³/6H | GISAAA 42(8)42,77 |
| orl-mus LD50:3000 mg/kg | PCJOAU 14,162,80 |
| eye-hmn 500 ppm | JIHTAB 25,282,43 |
| skn-rbt 395 mg open MLD | UCDS** 5/7/70 |
| eye-rbt 3950 ug SEV | AJOPAA 29,1363,46 |
| ihl-hmn TCLo:500 ppm:EYE | JIHTAB 25,282,43 |
| ihl-man TCLo:12000 ppm/4H:CNS | AOHYA3 16,73,73 |
| unk-man LDLo:1159 mg/kg | 85DCAI 2,73,70 |
| orl-rat LD50:9750 mg/kg | UCDS** 5/7/70 |
| ihl-rat LCLo:64000 ppm/4H | AIHQA5 17,129,56 |
| ipr-rat LDLo:500 mg/kg | JPPMAB 11,150,59 |
| ihl-mus LCLo:110000 mg/m3/62M | AGGHAR 5,1,33 |
| ipr-mus LD50:1297 mg/kg | SCCUR* -,1,61 |
| orl-dog LDLo:24 gm/kg | AEXPBL 18,218,1884 |
| ipr-dog LDLo:8 gm/kg | AEXPBL 18,218,1884 |
| scu-dog LDLo:5 gm/kg | AEXPBL 18,218,1884 |
| orl-rbt LD50:5300 mg/kg | 12VXA5 8,7,68 |
| skn-rbt LD50:20 gm/kg | UCDS** 5/7/70 |
| scu-gpg LDLo:5000 mg/kg | AGGHAR 5,1,33 |

Aquatic Toxicity Rating: TLm96:over 1000 ppm WQCHM* 4,-,74.

*TLV:* Air: 750 ppm DTLVS* 4,5,80. *Toxicology Review:* 27ZTAP 3,7,69. OSHA Standard: Air: TWA 1000 ppm (SCP-A) FEREAC 39,23540,74. DOT: Flammable Liquid, Label: Flammable Liquid FEREAC 41, 57018,76. Occupational Exposure to Ketones recm std: Air: TWA 590 mg/m3 NTIS** "NIOSH Manual of Analytical Methods" VOL 1 127, VOL 2 S1. Reported in EPA TSCA Inventory, 1980.

*THR:* A hmn EYE, CNS. A skn, eye irr @ 500 ppm. MOD ipr, unk. LOW orl, ihl, ipr, scu skn. VERY LOW via dermal route. Acetone is narcotic in high conc. In industry, no injurious effects from its use have been reported, other than the occurrence of skn irr resulting from its defatting action, or headache from prolonged inhal. A food additive permitted for human consumption. A common air contaminant.

*Fire Hazard:* Dangerous, when exposed to heat or flame or oxidizers. Incomp: with ($CHCl_3$ + a base), CrO, $Cr(OCl)_2$, (nitric + acetic acid), (nitric + sulfuric acid), NOCl, nitrosyl perchlorate, nitryl perchlorate, permonosulfuric acid, potassium tert-butoxide, NaOBr, (sulfuric acid + potassium dichromate), (thio-diglycol + hydrogen peroxide), trichloromelamine, bromoform, air, $HNO_3$, activated C, chloroform, $H_2SO_4$, $BF_3$, $Br_2$, chromyl chloride, $H_2O_2$, $F_2O_2$, $SCl_2$, thiotrithiazyl perchlorate, $H_2O_5S$.

*Explosion Hazard:* Mod when vapor is exposed to flame.

*Disaster Hazard:* Dangerous, due to fire and explosion hazard, can react vigorously with oxidizing materials.

*To Fight Fire:* $CO_2$, dry chemical, alcohol foam.

For further information see Vol. 1, No. 4 of *DPIM* report.

## CYANIDE

CAS RN: 57125 NIOSH #: GS 7175000
mf: $CN^-$; mw: 26.02

SYN: CYANURE (FRENCH)

TOXICITY DATA: 3 CODEN:
ipr-mus LD50:3 mg/kg NATUAS 228,1315,70

*TLV:* Air: 5 mg/m3 DTLVS* 4,109,80. *Toxicology Review:* CLCHAU 19,361,73. "NIOSH Manual of Analytical Methods" VOL 1 116, VOL 3 S250. Reported in EPA TSCA Inventory, 1980.

*THR:* Cyanide directly stimulates the chemoreceptors of the carotid and aortic bodies with a resultant hyperpnea. Cardiac irregularities are often noted, but the heart invariably outlasts the respirations. Death is due to respiratory arrest of central origin. It can occur within seconds or minutes of the inhalation of high concentrations of hydrogen cyanide gas. Because of slower absorption, death may be more delayed after the ingestion of cyanide salts, but the critical events still occur within the first hour.

Two other sources of cyanide have been responsible for human poisoning. One of these is amygdalin, a cyanogenic glycoside found in apricot, peach, and similar fruit pits and in sweet almonds. Amygdalin is a chemical combination of glucose, benzaldehyde, and cyanide from which the latter can be released by the action of $\beta$-glucosidase or emulsin. Although these enzymes are not found in mammalian tissues, the human intestinal microflora appears to possess these or similar enzymes capable of effecting cyanide release resulting in human poisoning. For this reason amygdalin may be as much as 40 times more toxic by the oral route as compared with intravenous injection. Amygdalin is the major ingredient of Laetrile, and this alleged anticancer drug has also been responsible for human cyanide poisoning. An ethical drug that may also cause cyanide poisoning in overdose is the potent vascular smooth muscle relaxant sodium nitroprusside. Although nitroprusside is related chemically to ferricyanide, unlike the latter it penetrates into erythrocytes and reacts with hemoglobin to release its cyanide (Smith and Kruszyna, 1974). Fortunately, the therapeutic margin for nitroprusside appears to be quite large.

Cyanide is commonly found in certain rat and pest poisons, silver and metal polishes, photographic solutions, and fumigating products. Compounds such as potassium cyanide can also be readily purchased from chemical stores. Cyanide is readily absorbed from all routes, including the skin, mu mem, and by inhal, although alkali salts of cyanide are toxic only when ingested. Death may occur with ingestion of even small amounts of sodium or potassium cyanide and can occur within minutes or hours depending on route of exposure. Inhalation of toxic fumes represents a potentially rapidly fatal type of exposure. Sodium nitroprusside (Smith and Kruszyna, 1974) and apricot seeds (Sayre and Kaymakcalan, 1964) have also caused cyanide poisoning. A blood cyanide level of greater than 0.2 $\mu$g/ml is considered toxic. Lethal cases have usually had levels above 1 $\mu$g/ml. Clinically, cyanide poisoning is reported to produce a bitter, almond odor on the breath of the patient; however, only a small proportion of the population is genetically able to discern this characteristic odor. Typically, cyanide has a bitter, burning taste, and following poisoning, symptoms of salivation, nausea without vomiting, anxiety, confusion, vertigo, giddiness, lower jaw stiffness, convulsions, opisthotonos, paralysis, coma, cardiac arrhythmias, and transient respiratory stimulation followed by respiratory failure may occur. Bradycardia is a common finding, but in most cases heartbeat usually outlasts respiration (Wexler et al., 1947). A prolonged expiratory phase is considered to be characteristic of cyanide poisoning.* The volatile cyanides resemble hydrocyanic acid physiologically, inhibiting tissue oxidation and causing death through asphyxia. Cyanogen is probably as toxic as hydrocyanic acid; the nitriles are generally considered somewhat less toxic, probably because of their lower volatility. The non-volatile cyanide salts appear to be relatively non-toxic systemically, so long as they are not ingested and care is taken to prevent the formation of hydrocyanic acid. Workers, such as electroplaters and picklers, who are daily exposed to cyanide solutions may develop a "cyanide" rash, characterized by itching, and by macular, papular, and vesicular eruptions. Frequently there is secondary infection. Exposure to small amounts of cyanide compounds over long periods of time is reported to cause loss of appetite, headache, weakness, nausea, dizziness, and symptoms of irr of the upper respiratory tract and eyes. See also specific compounds.

*Fire Hazard:* Mod, by chemical reaction with heat, moisture, acid. Many cyanides evolve hydrocyanic acid rather easily. This is a flam gas and is highly toxic. Carbon dioxide from the air is sufficiently acidic to liberate hydrocyanic acid from cyanide solutions. See also hydrocyanic acid.

*Explosion Hazard:* See hydrocyanic acid. Explodes if melted with nitrite or chlorate @ about 450°. Violent reaction with $F_2$, Mg, nitrates, $HNO_3$, nitrites.

*Disaster Hazard:* Dangerous; on contact with acid, acid fumes, water or steam, they will produce toxic and flam vapors.

* Casarett and Doull's, "Toxicology, the basic Science of Poisons" 2nd ed. Doull, Klaassen and Amdur (eds). Macmillan Pub. Co. Inc. New York, N.Y.

**Reference List**
Alcoa Badin Landfill
NCD986171320


1. NC Atlas. The University of NC Press. Chapel Hill, NC.

2. Rainfall Frequency Atlas of the United States. Technical Paper No. 40, US Department of Commerce, US Government Printing Office, Washington, DC. 1963.

3. Parker W.T. US Department of Interior, Fish and Wildlife Service, letter to Pat DeRosa, dated 21 June 1985 with attachments and DeRosa, Pat, NC Superfund Section, memo to Superfund Branch staff "Critical Habitats of Federally Listed Endangered Species in NC", dated May 18, 1989.

4. USGS 7-1/2' Topographic Quadrangles: Morrow Mountain, N.C., 1981 (photoinspected 1983); Albemarle, N.C., 1981; Badin, N.C., 1981; New London N.C., 1980 (photoinspected 1983).

5. Nicholson, Grover. NC Superfund Section. Preliminary Assessment for Alcoa Badin Landfill, NCD986171320, dated January 17, 1990, and EPA Form 2070-12 (7-81) completed January 17, 1990.

6. RCRA Part A Application: Alcoa Badin Works, NCD 003 162 542, November 17, 1980, Permitting file, Solid Waste Management Section, Raleigh, NC.

7. Mallary, McKenzie, NUS Corporation. Preliminary Reassessment for Alcoa Badin Works, NCD003162542, dated March 28, 1989 and attachments.

8. McConney, John P. NC Superfund Section. Logbook notes taken during site investigation visit, dated November 14, 1990.

9. McConney, John P. NC Superfund Section. Screening Site Investigation Start, dated 7 December 1990.

10. Mundorff, M.J. Geology and Ground Water in the Monroe Area, North Carolina. Bulletin No. 5. NC Department of Conservation and Development. Raleigh, 1965.

11. Heath, R.C. Basic Elements of Ground-Water Hydrology With Reference to Conditions in North Carolina. USGS Water-Resources Investigation Report 80-44, 1980.

12. Classifications and Water Quality Standards Assigned to the Waters of the Yadkin-Pee Dee River Basin. NC Dept. of Natural Resources and Community Development, Division of Environmental Management. Raleigh, NC. June 30, 1989.

13. Report of Subsurface Exploration; Off-Site Waste Pile; Badin Works Plant; Badin, North Carolina. Law Engineering, dated November 25, 1987.

14. Richmond, Martin. NC Superfund Section. Memo to file "Telecon with Joan Dupont, NUS Corp. (404) 938-7710, concerning Alcoa Landfill site, NCD 986171320", dated January 12, 1990.

15. Richmond, Martin. NC Superfund Section. Memo to file "Water Distribution in the Greater Badin Water District", dated January 16, 1990.

16. McConney, John P. NC Superfund Section. Memo to file "Background information - Alcoa Badin Landfill NCD 986 171 320", dated October 30, 1990.

17. Durway, Mark. NC Superfund Section. Preliminary Assessment for Alcoa Badin Works, NCD003162542, dated 30 October 1985.

18. McConney, John P. NC Superfund Section. Memo to file "Fishery information regarding Badin Lake and the Pee Dee River", dated January 28, 1991.

19. McConney, John P. NC Superfund Section. Memo to file "City of Albemarle water information", dated January 29, 1991.

20. Flood Insurance Rate Map for Stanly County, North Carolina (Unincorporated Areas), Federal Emergency Management Agency. December 1, 1981.

21. McConney, John P. NC Superfund Section. Memo to file "Morrow Mountain State Park", dated January 31, 1991.

22. McConney, John P. NC Superfund Section. Memo to file "Stanly County water distribution system", dated February 1, 1991.

23. McConney, John P. NC Superfund Section. Memo to file "Community water systems in the Alcoa Badin Landfill area", dated February 5, 1991 and NC Public Water Supply Branch. Listing of community and non-community water systems using ground water. Dated 1/29/91.

24. McConney, John P. NC Superfund Section. Memo to file "Additional background information - Alcoa Badin Landfill NCD986171320", dated February 6, 1991.

25. McConney, John P. NC Superfund Section. Memo to file "Surface water intakes on Lake Badin and the Yadkin - Pee Dee River", dated February 6, 1991.

26. McConney, John P. NC Superfund Section. Memo to file "Ground water use in the area surrounding Alcoa Badin Landfill NCD986171320", dated February 27, 1991.

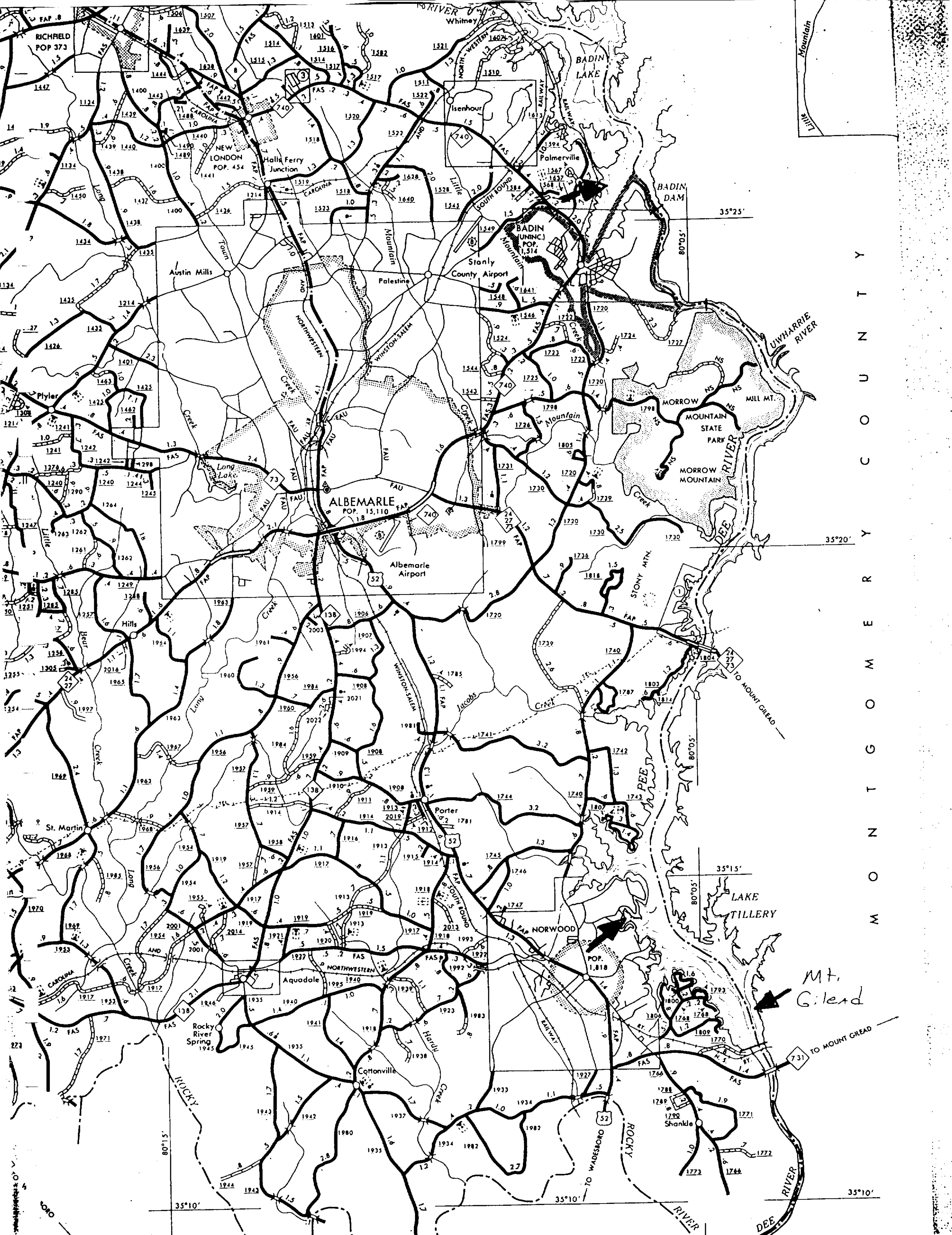
27. Laboratory Data Summary

28. Sax N.I. Dangerous Properties of Industrial Materials. Sixth Edition. Van Nostrand Reinhold Company. New York, NY.

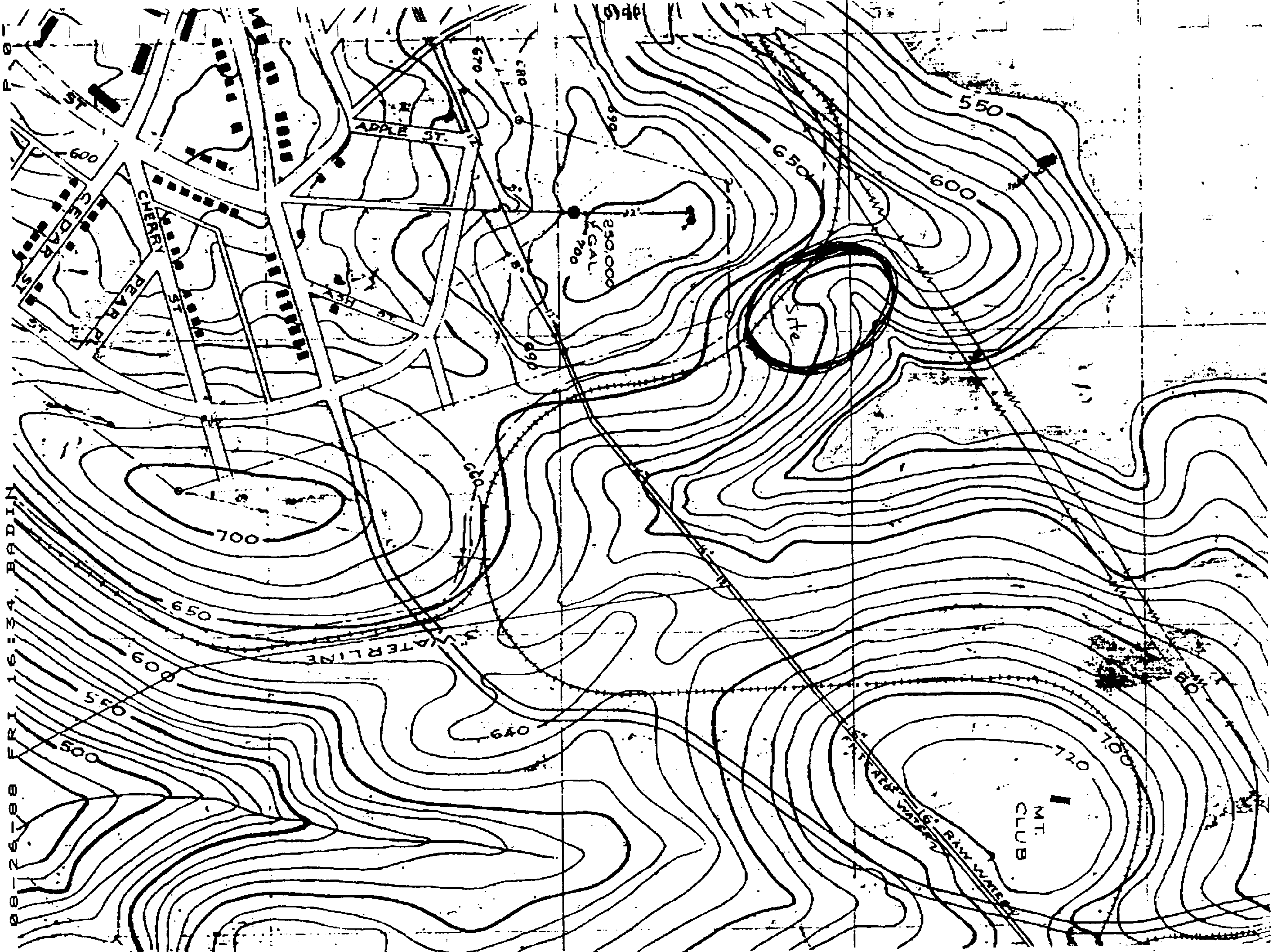
29. McConney, John P. NC Superfund Section. Memo to file "PCGEMS population estimate in the Alcoa Badin Landfill area", dated February 27, 1991.

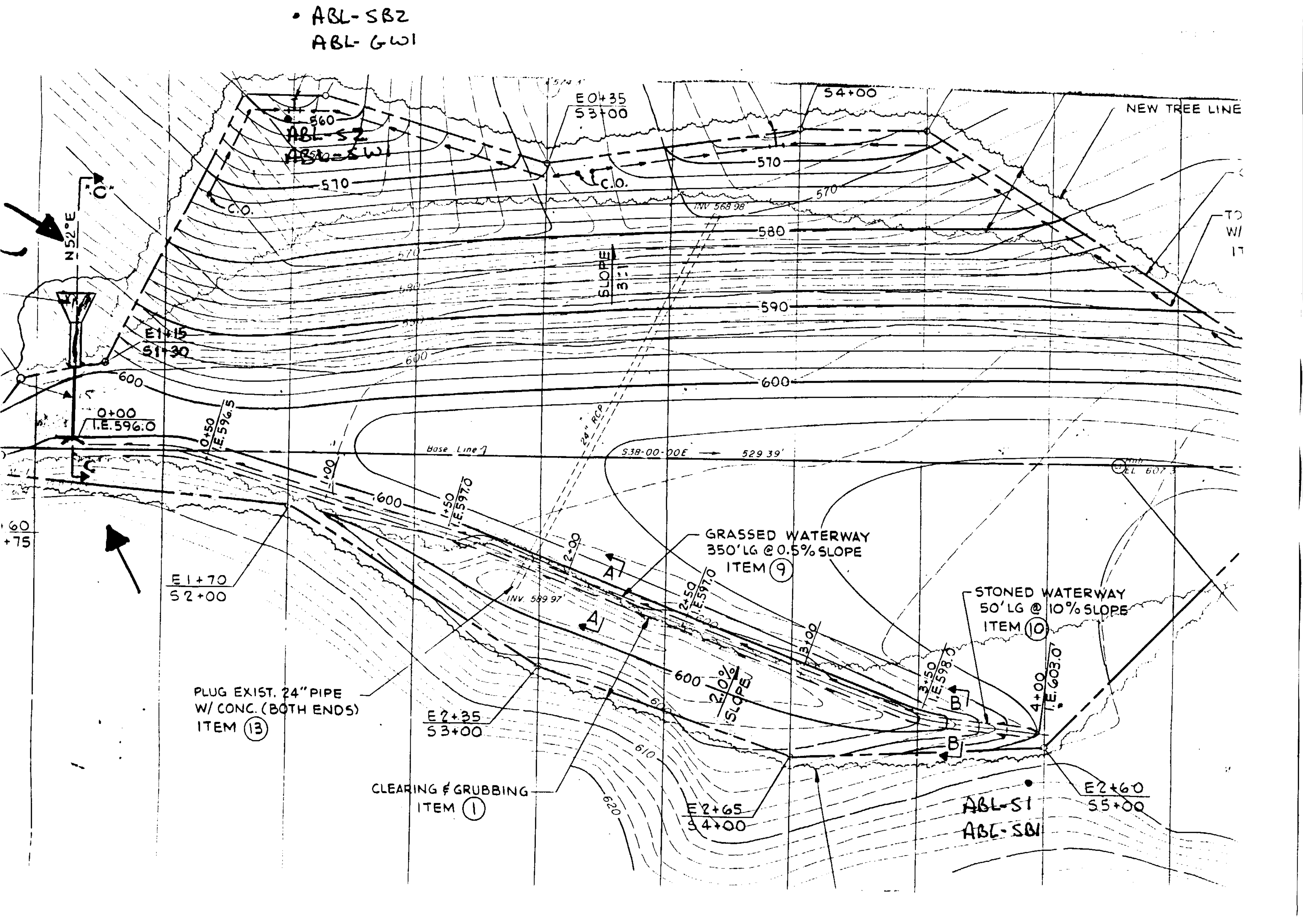
30. NC Hazardous Waste Management Rules and Solid Waste Management Law. Division of Solid Waste Management. Raleigh, NC. Rev. 2/1/91.

31. County and City Data Book. Bureau of the Census, US Department of Commerce. 1983.

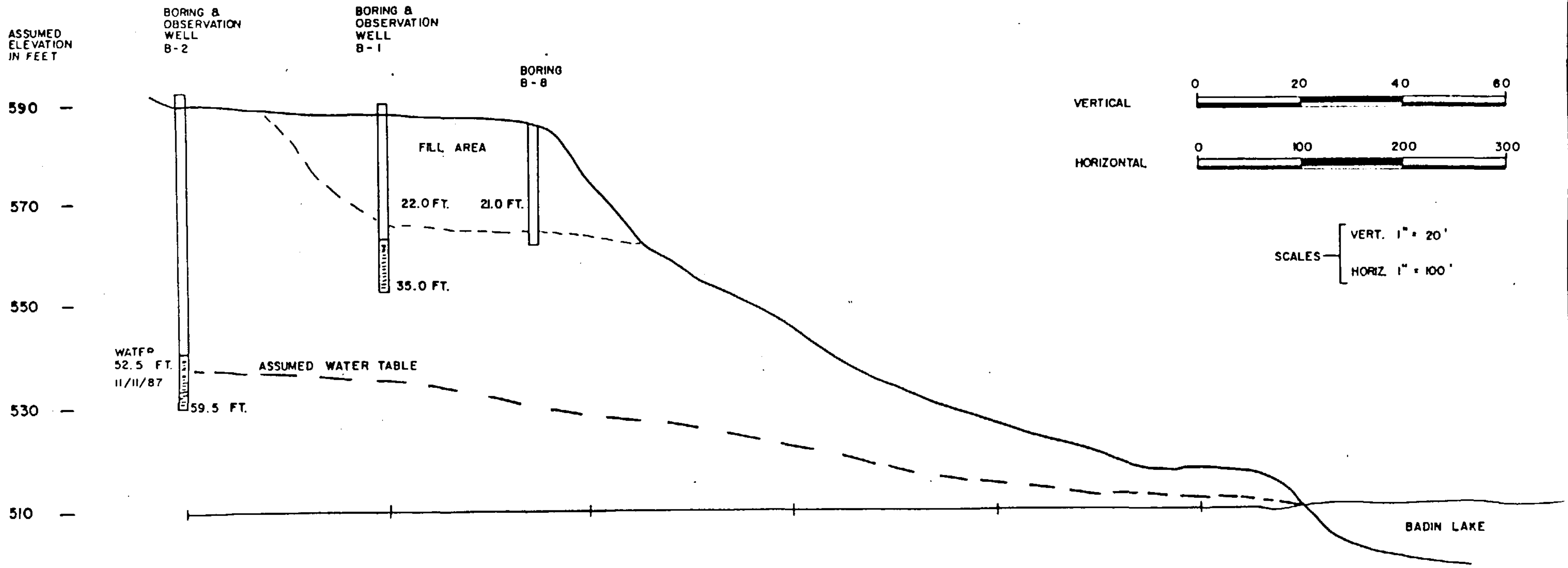

RICHFIELD
POP 373
NEW LONDON
POP. 454
Halls Ferry Junction
Whitney
Isenhour
Palmerville
BADIN LAKE
BADIN DAM
BADIN (UNINC.) POP. 1,514
Stanly County Airport
Austin Mills
Palestine
Ptyler
Long Lake
ALBEMARLE
POP. 15,110
Albemarle Airport
Hills
St. Martin
Porter
NORWOOD
POP. 1,818
Aquadale
Rocky River Spring
Cottonville
Shankle
MORROW MOUNTAIN STATE PARK
MORROW MOUNTAIN
MILL MT.
STONY MTN.
UWHARRIE RIVER
PEE DEE RIVER
LAKE TILLERY
ROCKY RIVER
M O N T G O M E R Y C O U N T Y
TO MOUNT GILEAD
TO WADESBORO
Mt. Gilead
35°25'
35°20'
35°15'
35°10'
80°05'
80°15'

08-26-88 FRI 16:34 BADIN





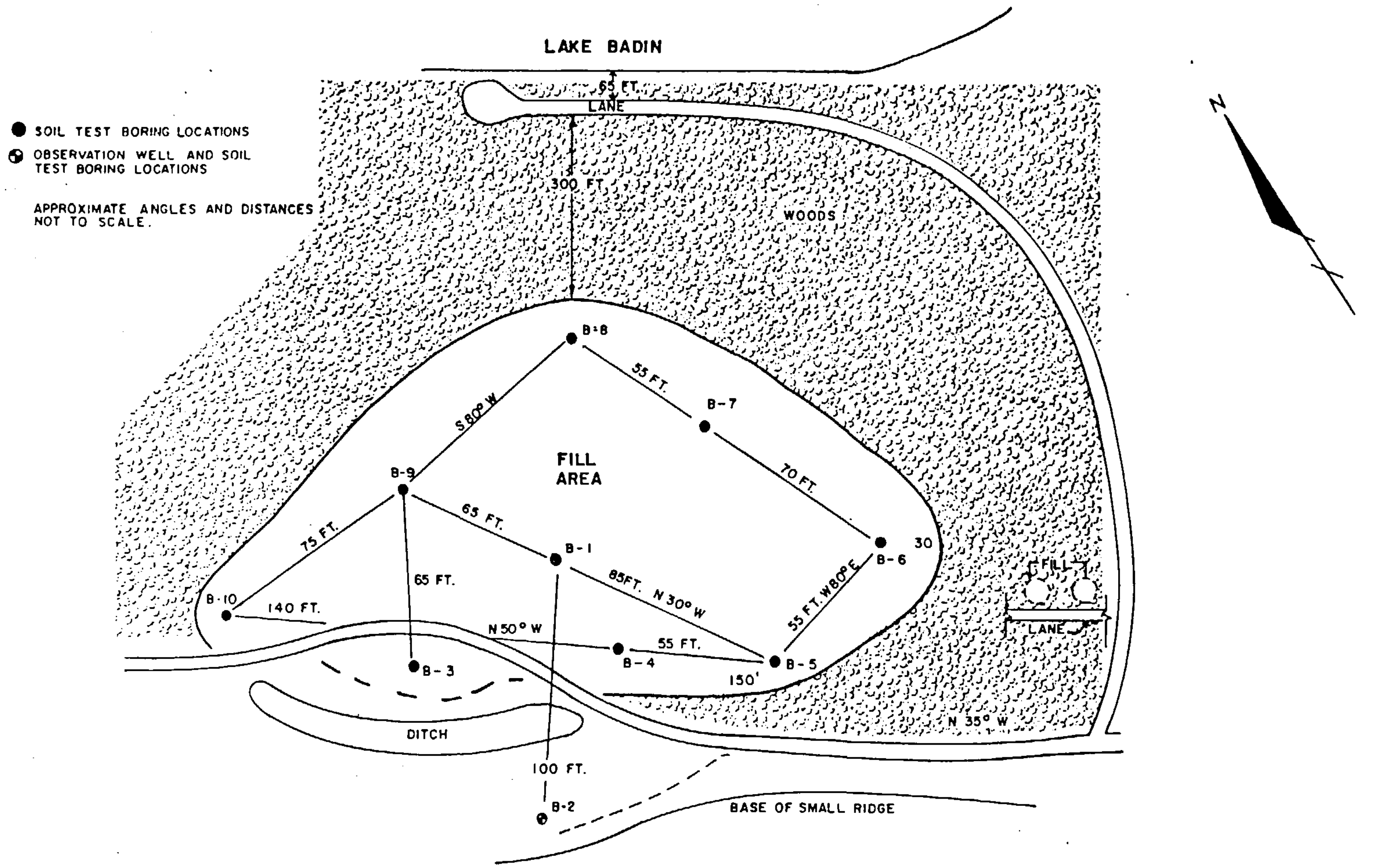
• ABL-SB2
ABL-GW1
ABL-S2
ABL-GW1
E0+35
S3+00
54+00
NEW TREE LINE
560
570
580
590
600
610
620
C.O.
"C"
N52°E
E1+15
S1+30
0+00
I.E.596.0
0+50
I.E.596.5
1+00
1+50
I.E.597.0
2+00
2+50
I.E.597.0
3+00
3+50
I.E.598.0
4+00
I.E.603.0
SLOPE 3:1
INV 568.98
24" RCP
Base Line
S38-00-00E
529.39'
EL 607.3
INV. 589.97'
GRASSED WATERWAY
350'LG @ 0.5% SLOPE
ITEM 9
STONED WATERWAY
50'LG @ 10% SLOPE
ITEM 10
2.0% SLOPE
E1+70
S2+00
PLUG EXIST. 24" PIPE
W/ CONC. (BOTH ENDS)
ITEM 13
E2+35
S3+00
CLEARING & GRUBBING
ITEM 1
E2+65
S4+00
E2+60
S5+00
ABL-S1
ABL-SB1
A
B




LAW ENGINEERING
CHARLOTTE, NORTH CAROLINA

ALCOA OFF-SITE
WASTE PILE PROFILE MAP

JOB NO. CHW - 6057 | FIGURE 2




LAW ENGINEERING
CHARLOTTE, NORTH CAROLINA

OFF-SITE WASTE PILE
BADIN WORKS PLANT
BADIN, NORTH CAROLINA

| | |
|---|---|
| JOB NO. CHW-6057 | FIGURE 1 |

# OVERSIZED

# DOCUMENT

**UNSCANNABLE**

**MEDIA**

**(PHOTOGRAPHS)**

# REFERENCES


1. EPA Site Initialization Form, Alcoa Badin Landfill, Site Number NCD 986171320, August 1, 1989.

2. Martin Richmond, NC Superfund Section, memo to file, Telecon with Joan Dupont, NUS Corporation, concerning Alcoa Landfill site, January 12, 1990.

3. Geologic Map of North Carolina, NC Division of Land Resources, 1985.

4. USGS 7.5 Minute Topographic Quadrangles, Badin (1981), New London (1980), Morrow Mountain (1981), Albemarle (1981).

5. Geology and Groundwater Resources of the Monroe Area, North Carolina, NC Division of Groundwater, Groundwater Bulletin Number 5, Raleigh, 1965.

6. Heath, R.C., Elements of Groundwater Hydrology with Reference to Conditions in North Carolina, US Geologic Survey Open File Report 80-44, Raleigh, 1980.

7. NC Atlas, University of North Carolina Press, Chapel Hill, NC, Figure 5.15, page 101, and Figure 5.20, page 103.

8. Uncontrolled Hazardous Waste Site Ranking System, a User's Manual (HW-10), US Enviromental Protection Agency, Figure 8, page 33.

9. Martin Richmond, NC Superfund Section, memo to file, Water Distribution in the Greater Badin Water District, January 16, 1990.

10. Martin Richmond, NC Superfund Section, memo to file, Population Estimate Within Three Mile Radius of Alcoa Badin Landfill Site, January 16, 1990.

11. Sax, N.I., Dangerous Properties of Industrial Materials, Sixth Edition.

**REFERENCE 12**

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A Member of The IT Group

the IT group

January 18, 2000

Alcoa, Inc.
Badin Works
Highway 740
Badin, North Carolina 28009

Attention: Henk van der Meyden

**Subject: Technical Specifications and Drawings**
**Low Flow Seep Collection System**
**Alcoa Badin Landfill Ceat #2**
**IT Project No. 802173-001**

Dear Henk,

Enclosed for your review is one copy of the Specifications and Drawings for the above-mentioned project. Please review the package and provide comments at your earliest convenience. The Alcoa Standard Specifications have not been included; I am trying to acquire a more recent revision than the 1996 version that I have. I will send them to you under a separate package. If you have any questions, please do not hesitate to contact me at 412-858-3411.

Very Truly Yours,

IT Corporation

Patrick J. Sullivan, Jr., P.E.
Senior Civil/Geoenvironmental Engineer

Cc: Al Burba, Alcoa
Don Nusser, IT

# SPECIFICATION FOR CONSTRUCTION OF LOW FLOW SEEPAGE COLLECTION SYSTEM FOR ALCOA BADIN LANDFILL

**ALCOA**
**BADIN WORKS**
**BADIN, NORTH CAROLINA**

**BADIN ARMI COST NODE 018R00254**

Prepared by

IT Corporation
2790 Mosside Boulevard
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IT Project No. 802175-001

February 17, 2000

**ALCOA**
**BADIN WORKS**
**BADIN, NORTHCAROLINA**

**SPECIFICATIONS FOR CONSTRUCTION OF LOW FLOW SEEPAGE COLLECTION SYSTEM FOR ALCOA BADIN LANDFILL**

**Authorization : ______________**

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## APPENDICES

## I. SCOPE OF WORK/SPECIAL PROVISIONS

### A. GENERAL

These Specifications and the Detail Drawings referenced herein presents the proposed construction of a low flow seepage collection system for the landfill at the Badin Works in Badin, North Carolina. Construction consists of the excavation of three primary areas on the south slope of the Badin landfill where several seeps are located. Following excavation, installation of a passive collection system consisting of perforated plastic pipe, a geomembrane funnel and non-calcareous stone will be performed. Solid wall plastic pipe will transfer the seep flow from each of the three areas to a precast concrete collection basin and weir, where samples may be collected and seep flows determined. Solid wall pipe will be secured within the limits of an existing ditch with screw anchors and metal ties. Some excavation of the ditch will be necessary to obtain a design slope and to provide a straight run of pipe. Disturbed areas at each of the three work areas will then be seeded. Drawings showing the work covered by these Specifications are listed in Section IV. NUMERICAL LIST OF DRAWINGS. Refer to Part H of this section for further discussion of the work to be performed at the site and the anticipated work to be performed at each of the work areas. Any questions on the interpretation of, or any conflicts with, any portion of these Specifications shall be directed to and resolved by Alcoa, or its appointed representative, in writing.

### B. BACKGROUND

Alcoa, Inc. (Alcoa), hereafter referred to as OWNER, owns and operates a manufacturing facility known as the Badin Works in Badin, Stanly County, North Carolina (Site).

Then Site is located on approximately 123 acres of land off Highway 740 in Badin, Stanley County, North Carolina. The fenced active part of the Site is about 90 acres. Figure 1 identifies the general site layout and proposed work areas.

Alcoa operated the Alcoa/Badin Landfill (Landfill) for approximately 70 years as an unlined municipal/industrial solid waste landfill. The landfill is located approximately 500 feet south of the fenced plant area and occupies approximately 8 acres. Alcoa ceased operations at the landfill in the mid-1970's. The landfill was covered in 1998 with a NCDNR cover. The Landfill perimeter is surrounded by a chain link fence with locking gates. The fence extends around the upland sides of the Landfill and also along the southern boundary at Little Mountain Creek.

In 1998, several seeps formed on the outer face of the southern embankment of the Landfill. The location of the seeps are shown on the Drawings. Currently the flow from the seeps enters existing drainage ditches that in turn discharges into Little Mountain Creek.

### C. CONTRACTOR QUALIFICATIONS

The Contractor shall have been in the earthmoving business for a minimum of five (5) years and the Contractor's site superintendent in charge of excavating and grading operations shall have had a minimum of five (5) years practical experience in this trade. The Contractor selected for this work will provide all materials (unless otherwise noted), labor, supervision, tools, construction plant and equipment, loading, unloading, storing and hauling services, taxes, insurance and all other things necessary to complete the work. He shall also comply with the Health and Safety requirements presented in Section V. SITE CONDITIONS.

## D. REASONABLY IMPLIED PARTS OF THE WORK SHALL BE DONE ALTHOUGH NOT SPECIFICALLY CITED IN THESE SPECIFICATIONS

Specific tasks not mentioned or completely detailed in these Specifications that are necessary or normally required as a part of the work described shall be performed by the Contractor as incidental work without extra cost to the Owner, as if fully detailed in these Specifications. The expense of such work shall be included in the applicable lump sum or unit prices for the Work described.

## E. PROJECT POINT OF CONTACT

The primary point of contact at the Site for this project is Henk van der Meyden of Alcoa (704-422-5624). The point of contact at Alcoa in Pittsburgh is Al Burba (724-337-4189). The Owner's Engineer for this project is The IT Corporation (IT). The IT Project Engineer is Patrick J. Sullivan, Jr., P.E. (412-858-3411).

## F. SITE ACCESS

It is anticipated that all required easement and access permits shall be obtained by the Owner prior to the initiation of the Work. However, if the procurement of any easement or access permit is delayed, the Contractor shall schedule the Work in such a way that confines his operations to areas where easements or access permits have been obtained or are not required, or delay the Work until such as time when the access permit has been secured.

The Owner will provide the Contractor with physical and legal access to areas. The Contractor shall confine his excavating, installation and construction operations to the areas indicated on the Drawings.

## G. HEALTH AND SAFETY

The Contractor shall be aware that work may take place in a hazardous environment and the Contractor shall be responsible for the health and safety of employees of the Contractor as well as those of any Subcontractor. All work completed as part of these specifications shall be performed in accordance with Federal, State and Owner requirements pertaining to worker safety. This shall include, but not be limited to, 29 CFR 1910 (General Industry Standards) and 29 CFR 1926 (Construction Industry Standards).

Prior to mobilization to the Site, the Contractor shall prepare for Owner's review in concept, his own detailed, site-specific Health and Safety Plan which shall describe specific procedures to ensure the protection of on-site personnel. This Contractor must designate at least one person on site as the project Health and Safety Officer to ensure the requirements of the Health and Safety Plan are met by all on-site personnel. The project Health and Safety Officer will also interact with the safety personnel of the Owner as required to update the status of the project.

Additional information relative to Health and Safety is presented in SECTION V - SITE CONDITIONS.

## H. SCOPE OF WORK

The following paragraphs present the tasks to be completed and establish the scope of work for the construction of the Low Flow Seep Collection System. Work is to be performed in accordance with United States Army Corps of Engineers Nationwide Permit No. 7- Outfall Structure Installation. The equipment required to perform the work will be selected by the Contractor. The tasks are tentatively presented in the order they are to be completed.

1. **Site Preparation**. Before initiating excavation activities, the Contractor will prepare the site for construction. Site preparation will consist of equipment mobilization, the establishment of a staging area for the limited amount of materials delivered to the site, the installation of Erosion and Sediment Controls and the establishment of a temporary decontamination pad and construction layout controls.

a. Mobilization/Staging Areas- The mobilization process will begin with the delivery to the site of the equipment, materials, manpower and all other facilities required to initiate construction. It is anticipated that the gravel road cul-de-sac located on the sideslope of the landfill embankment can be used for the staging of materials and equipment and for equipment movement between work areas. Additions and modifications to the gravel road to accept delivery of materials will be approved by the Owner. Mobilization will also include the removal of the Site fencing in areas where it interferes with work.

b. Erosion and Sediment Control-In conjunction with equipment mobilization, the Contractor will implement an erosion and sediment control program. Initially, this will consist of the installation of silt fence or staked straw bales in areas where sediment generated from earthmoving activities may be carried offsite. This typically occurs in areas that are lower in elevation than the earthmoving areas and adjacent to waterways. The tentative locations where erosion and sediment control measures are to be implemented are shown on the Drawings.

c. Construction Layout Controls- Construction layout controls will be installed at the three work areas. A construction grid that was established by T.W. Harris during a survey of the landfill contains two benchmarks and that may be used for horizontal and vertical control at the three work areas. As needed, additional construction benchmarks and wood stakes for locating appurtenances may be established by a surveyor, at the Contractor's expense.

d. Decontamination Area - The Contractor will construct a temporary decontamination area at a location adjacent to areas where equipment or personnel decontamination is needed. Possible locations for the decontamination areas is shown on the Drawings. As the decontamination area is temporary, it can be moved to alternate locations, as needed. Decontamination liquids will be managed in accordance with Section K.5 of these Specifications.

2. **Excavation**. Construction efforts will begin with minor clearing and grubbing of vegetation from the ground surface in areas designated for excavation and pipe installation. Selected areas of excavation and pipe installation are to be performed in an area characterized as "wetlands', therefore the Contractor will perform clearing and grubbing only in required areas and in accordance with applicable permits. Cleared and grubbed material will be deposited adjacent to the proposed location of the pipe. Trees that need to be removed will be chipped or shredded outside the limits of the wetlands at the toe of the landfill.

When minor clearing and grubbing have been completed, the Contractor will excavate the area where the seeps are located. The depth of excavation will be based upon the observable flow rate of the seeps. It is anticipated that as excavation towards the origin of the seep continues, the flow rate of the seep will increase, due to the removal of soils that inhibit seep flow. Once a maximum flow is observed, the excavation will be opened and extended to the original ground surface in a manner that promotes positive drainage. Sideslopes of the excavation will be established at a slope of 45 degrees or less, as measured from the horizontal.

Excavation will be performed using a small tire-mounted front end loader or a small hydraulic excavator or a bobcat. The soil will either be loaded into dump trucks staged on the gravel road located above the seeps or deposited on the ground surface adjacent to the seep. If the soil is loaded into trucks, it will be transported to an Alcoa designated landfill for disposal.

3. **Seep Collection System**. Construction of the Seep Collection System will consist of the installation of geomembrane and drainage gravel, perforated and solid wall plastic pipe and anchors to secure the pipe.

a.,b.,d. Geomembrane, Drainage Gravel and Perforated Pipe- When excavation has been completed and the final excavated grades are free of large rocks and protrusions, a geomembrane will be installed on the ground surface and covered with a non-calcareous, well graded drainage stone that promotes drainage. A perforated plastic pipe will be installed on the geomembrane in the area nearest the seep outflow and covered with the drainage stone. The stone will be used as backfill to an elevation 12 to 18 inches below the original ground surface (before excavation). At this elevation a second geomembrane will be installed to prevent surface water from infiltrating the drainage stone. The two geomembrane sheets will be overlapped in a manner that forms a horizontal 'funnel' with the drainage stone filling, allowing only seep flow to enter the perforated pipe.

The two geomembrane sheets will be clamped to the pipe at the downstream end of the excavation. The perforated pipe within the 'funnel' will terminate at this point and solid plastic pipe will be installed to carry seep flow to its final destination. This system will be constructed at three locations on the landfill side slope. These locations are designated as the West Seep, the Middle Seep and the East Seep. Several seep collection systems will be constructed at the East Seep, due to the number of individual seeps identified in that area. One seep collection system will be required at the Middle Seep and West Seep.

c,e.. Plastic Pipe - Solid wall plastic pipe will be installed to carry seep flow from each of the three Seep areas to a precast concrete collection basin and weir. The West Seep and Middle Seep will drain to the collection basin from one pipe while the East Seep will drain to the collection basin from a dedicated pipe. The solid pipe will be installed along the approximate centerline of an existing ditch that currently acts as a drainage ditch for the seep flow. Minor excavating will be performed in the ditch to facilitate a 'straight' run of pipe and to permit the ditch to accept and carry surface water runoff from the undisturbed areas between and downslope of the Seep Areas. From the collection basin, a solid wall plastic pipe of larger diameter will carry flow to Little Mountain Creek.

f.,g. Screw Anchors, Shrouds and Ties -To reduce the potential for uplift of the pipe from buoyancy, screw anchors will be driven into the ground to anchor the pipe to the ground surface. The anchors will be driven into competent soil or to a maximum depth of 10 feet. Screw anchors inserted in mud are designed to use the suction of the mud generated during potential pullout as the confining force to maintain the anchor in place. Metal clamps or straps will be used to secure the pipe to the screw anchors. Pipe shrouds, constructed from heavy duty pipe and in the form of a half-circle will distribute the force of the metal ties over a wider section of the solid wall plastic pipe. The anchors will be used every 10-foot length of pipe.

**4. Final Cover**. After the seep collection system has been installed, a final cover consisting of a woven geotextile filter fabric and riprap will be installed. The geotextile will act as padding and provide protection to the geomembrane from the riprap. The riprap will be installed to a thickness of 12-inches over all areas covered by geomembrane. Riprap will also be installed around the solid pipe just downstream from where the clamp secures the geomembrane to the pipe. This installation is anticipated to reduce erosion of the soil around the pipe.

**5. Concrete Collection Basin**. The two solid pipes that carry flow from the three seep areas will discharge into a precast concrete collection basin with a square aluminum weir. A range of length and width dimensions for the collection basin is given to allow the Contractor some flexibility in obtaining a standard size concrete basin from a local manufacturer. The basin will permit the Owner to calculate seep flow and to collect analytical samples. The 4-inch solid plastic pipes carrying seep flow will enter the basin above the weir, while a 6-inch solid plastic pipe will be installed in a prefabricated hole or punchout in the bottom of the basin to permit seep flow to exit. A square aluminum weir will divide the basin into two pools, and separate the entering seep flow from the exiting seep flow. The weir will be bent at the edges or have angles welded to it to create a surface where anchor bolts can be used to secure the weir to the concrete sidewalls and bottom of the collection basin. The weir will be graduated for depth on at least one side so that calculations for volume runoff based on depth can be performed.

**6. Revegetation**. Upon completion of all work, disturbed areas will be seeded. The seed selected will be native to the area and be sewn in sufficient quantity to promote an adequate stand of grass. The method of sewing will be selected by the Contractor and performed in accordance with applicable specifications.

**7. Demobilization, Site Cleanup, Damage Repair and Landscaping**. This work shall include the cleanup of the site and repair of any incidental damage to the Site. The Contractor shall maintain the revegetated areas for a period of one year, including revegetation of barren areas. A final inspection will be conducted by all interested parties to identify problems or concerns. These will be corrected by the Contractor prior to the Demobilization of his equipment, labor and tools.

**8. Management of Decontamination Liquids** - The Contractor shall provide his own suitable DOT-approved containers for managing the potentially contaminated liquids generated as a result of equipment decontamination operations. The DOT-approved containers that contain such liquids shall be left on-site in an area designated by the Owner's Engineer. The Contractor shall complete the necessary written manifests, as required by the Owner and the Owner's permitted disposal facility and perform the sampling and laboratory analysis of the liquids. The cost of sampling and analysis, and transportation and disposal of the subject liquids will be paid for by the Owner.

## II. BASIS OF PAYMENT

This Contractor will be reimbursed for work covered by these Specifications on the following unit cost and lump sum basis. The Contractor shall utilize the bid quantities listed herein to arrive at his total not to exceed estimated price to perform the work. These bid quantities form the basis from which the Owner can accurately evaluate the schedule of values.

### A. SCHEDULE OF VALUES

| Item No. | Description | Estimated Quantity | Units | Unit Price | Total Price |
|---|---|---|---|---|---|
| **1.** | **Site Preparation** | | | | |
| a. | Mobilization/Staging Areas | Job | Job | Lump Sum | $_________ |
| b. | Erosion/Sediment Controls | Job | Job | Lump Sum | $_________ |
| c. | Construction Layout Controls | Job | Job | Lump Sum | $_________ |
| d. | Decontamination | Job | Job | Lump Sum | $_________ |
| **2.** | **Excavation** | 150 | CY | $_____/CY | $_________ |
| **3.** | **Seep Collection System** | | | | |
| a. | Geomembrane | 1,900 | SF | $_____/SF | $_________ |
| b. | 4" Perforated Pipe & Fittings | 160 | LF | $_____/LF | $_________ |
| c. | 4" Solid Pipe and Fittings | 1200 | LF | $_____/LF | $_________ |
| d. | Backfill | 75 | CY | $_____/CY | $_________ |
| e. | 6" Solid Pipe and Fittings | 50 | LF | $_____/LF | $_________ |
| f. | Screw Anchors (SA) | 120 | SA | $_____/SA | $_________ |
| g. | Pipe Shrouds and Clamps | 120 | Units | $_____/Unit | $_________ |
| **4.** | **Final Cover** | | | | |
| a. | Geotextile Filter Fabric | 1000 | SF | $_____/SF | $_________ |
| b. | Riprap | 40 | CY | $_____/CY | $_________ |
| **5.** | **Concrete Collection Basin** | 1 | Basin | $_______ | $_________ |
| **6.** | **Revegetation** | 2000 | SY | $_____/SY | $_________ |

| | | | | | |
|---|---|---|---|---|---|
| **7.** | **Demobilization, Site Cleanup and Damage Repair** | Job | Job | Lump Sum | $________ |
| **8.** | **Management of Decon Liquids** | Job | Job | Lump Sum | $________ |
| | TOTAL NOT TO EXCEED ESTIMATED PRICE | | | | $____________ |

B. UNIT PRICES FOR CHANGED CONDITIONS

1. Purchase, delivery to Site and placement of topsoil from an approved off-site vendor stockpile area for use outside the limits of the remediation area — $_____/CY

NOTES:

1. Quantities given here and in Section VII. GENERAL MATERIAL SPECIFICATIONS are exact quantities of in-place material. They are to be used for bidding and are subject to the unit prices given above.

2. Payment for unit price items shall be made by actual field measurements. This Contractor shall be responsible for all field measurements before, during and after construction activities, in accordance with these specifications. All quantities shall be approved/verified by the Owner's Representative before payment.

3. Item 3c. includes 5 extra pipe segments with gaskets (100 linear feet), 2 extra 45° elbows and 2 extra 22.5° elbows to be used by Alcoa for future maintenance purposes.

4. Item 3f. includes 5 extra screw anchors to be used by Alcoa for future maintenance purposes.

## III. CONSTRUCTION SCHEDULE

The Contractor shall begin work on or about April 10, 2000. The Contractor shall submit with his bid a detailed project manpower and equipment usage schedules showing build-up requirements for maintaining the overall schedule, or suppliers, and any additional items requested in the invitation to bid.

After acceptance by Owner, the Contractor shall comply with the schedule during the execution of this work. In the event, for any reason, the Contractor fails to meet the detailed schedule, the Owner has the right to require the Contractor to resort to other means to return the work to the previous agreed upon schedule. The Contractor shall not, however, perform any work on a scheduled overtime basis without prior written consent of the Owner's Representative. The following schedule, which includes important activities and the dates of those activities, has been established:

| **Activity** | **Date** |
|---|---|
| Prebid Meeting/ Site Walk | April 10, 2000 |
| Contractor Bids due to Owner | April 24, 2000 |
| Contractor receives "Notice to Proceed" | May 5, 2000 |
| Mobilization | May 15, 2000 |
| Contractor acquires all work permits including grading and vegetation Permit | May 15, 2000 |
| Preconstruction and Safety Meeting | May 15, 2000 |
| Contractor starts work | May 15, 2000 |
| Contractor completes work | June 12, 2000 |
| Contractor submits as-builts and field reports | July 12, 2000 |

pending approval

## IV. NUMERICAL LIST OF DRAWINGS

The following list of seven drawings, hereinafter referred to as Drawings, cover the work to be performed by this Contractor as described in these specifications. These Drawings were last revised January 14, 2000.

| Alcoa Drawing Number | Sheet No. | Drawing Title |
|---|---|---|
| A-052768-BN | 1 of 2 | Plan of Low Flow Seep Collection System |
| A-052769-BN | 2 of 2 | Details for Low Flow Seep Collection System |

The following list of reference drawings are also made part of these Specifications:

| Alcoa Drawing No. | Revision Date | Description |
|---|---|---|
| A-052760-BN | January 30, 1998 | As-Built Survey Plan |
| A-052797-BN | No date | T.W. Harris Survey |
| A-052770-BN | No date | Alcoa coordinate Grid System |

## V. SITE CONDITIONS

## VI. ENGINEERING, INSPECTION AND TESTING

Engineering, inspection and testing requirements for the Work covered by these Specifications shall be in accordance with the Alcoa Engineering Standards under Section VIII. GENERAL WORKMANSHIP SPECIFICATIONS and in accordance with Article 4. Inspections and Tests under Section. IX. GENERAL CONDITIONS.

### A. GENERAL

This Contractor shall furnish, at his own expense, all materials and all labor that may be required to execute the inspection and testing as described herein, unless otherwise noted. Alcoa Grid Benchmarks located west of the Seep Areas and surficial reference features for construction purposes are indicated on the construction drawings. If, for any reason, these monuments are disturbed during the progress of work, it shall be the responsibility of this Contractor to re-establish them without cost to the Owner, as directed by the Owner's Representative. The Owner's Representative may require that construction work be suspended at any time when location and limit marks established by the Contractor are not reasonably adequate to permit inspection of completed work or work in progress. This Contractor shall cooperate with the Owner's Representative when tests are performed and sampling is conducted.

### B. SURVEYING

The Contractor shall make periodic survey checks during the performance of work and shall make a final survey check at the end of the job. Surveys shall be made available to the Owner or the Owner's Engineer upon completion so that any discrepancies can be resolved in the field.

### C. AS-BUILT DRAWINGS

The Contractor shall provide the Owner's Representative with as-built drawings that shall include the following:

- -Location of the solid plastic pipe , specifically connections of two pipes;
- -Location of the screw anchors;
- -Location of gravel backfill areas and the extent of perforated pipe within those areas;
- -Location of the precast collection basin;
- -Location of HDPE Geomembrane.

The information required above shall be presented in either a section or plan format. Sections shall be performed at 25 feet intervals.

### D. CONSTRUCTION REPORT

Within 60 days of the completion of demobilization by the Contractor, The Owner's Representative will submit to the Owner for review a draft Construction Report. The report will contain documentation that the construction was performed in accordance with design specifications. Alcoa workmanship requirements, specifically those relating to piping workmanship, will be referenced in the report. As-built drawings will also be included in the report. The Final Construction Report will be submitted to Alcoa 60 days after completion of demobilization.

# VII. GENERAL MATERIAL SPECIFICATIONS

## A. GENERAL

All materials required for the work covered by these Specifications shall be as specified in the following Alcoa Engineering Standards, State of North Carolina Standard Specifications as specified on the reference drawings and/or as supplemented herein.

## B. OWNER-FURNISHED MATERIALS

The Owner is not required to provide materials for the purposes of implementing the work within these Specifications.

## C. CONTRACTOR-FURNISHED MATERIALS

This Contractor shall furnish all other materials necessary for the work covered by these Specifications unless specifically noted otherwise under B. OWNER-FURNISHED MATERIALS above.

## D. SUPPLEMENTAL SPECIFICATIONS

The materials to be used during this construction and its related appurtenances shall conform to the material specifications listed in this section. Prior to installation of materials specified in this section, the Contractor shall submit a certificate from the manufacturer or material supplier for approval by the Owner's Engineer certifying that the materials are free of contamination and meet all requirements stated in these specifications.

**1.Site Preparation.** Materials to be used in preparing the site shall meet the following requirements:

a. Mobilization/Staging Area:

(1) Crushed Stone: Crushed stone for the access road shall be non-calcareous coarse aggregate, size number 357, conforming to that shown in Table 1 of ASTM D448 "Sizes of Aggregate for Road and Bridge Construction" or an equivalent stone approved by the Owner's Representative. The aggregate shall be angular in shape and free of any organic and deleterious materials. It shall meet the following gradation requirements:

| Sieve Size | Percent Passing |
|---|---|
| 2-1/2 in. | 100 |
| 2 in. | 95-100 |
| 1 in. | 35-70 |
| 1/2 in. | 10-30 |
| No. 4 | 0-5 |

(2) Filter Fabric:The filter fabric used in constructing access roads/staging areas shall be Mirafi 500X, manufactured by The Mirafi Division of Nicolon Corporation (800-234-0484) or an equivalent filter fabric approved by the Owner's Representative. The following minimum average roll values shall be met:

| | |
|---|---|
| Weight | 5.0 oz. |
| Thickness | 20 mil |
| Grab Tensile Strength | 200 lb. |
| Grab Tensile Elongation | 15% |
| Trapezoidal Tear Strength | 90 lb. |
| Mullen Burst Strength | 450 psi |
| Puncture Resistance | 115 lb. |
| Apparent Opening Size | 30-70 |

b. Erosion and Sediment Control.

(1)Silt Fence: Silt Fence to be used to control erosion and sedimentation shall be Amoco No. 2125 filter fabric, or an equivalent filter fabric approved by the Owner's Engineer.

(2)Anchor Posts: Anchor posts for supporting the Silt Fence shall be wood or steel, and be of sufficient length for 18 inch embedment in the ground. Wood posts shall be a nominal 2 inches square; steel posts shall be 1.25 inches by 1.0 inches in the shape of a T-section. 12 gauge wire or 1/4 inch diameter rope shall be strung between the anchor posts to maintain them in an upright position.

(3)Fasteners: Silt Fence shall be fastened to anchor posts using No. 9 staples, 1.5 inches long, or metallic coated tie wires, constructed of 17 gage steel and of an appropriate length.

c. Construction Layout Controls and Surveys.

(1)Survey Stakes: Survey stakes shall be wooden or metal stakes or flags meeting the approval of the Owner's Engineer.

(2)Safety Fencing: Safety fencing to be used around the landfill and north of the borrow area shall be Alpi orange safety fence, 4 ft. high or an equivalent fence approved by the Owner's Engineer.

d. Decontamination.

(1)Geomembrane: Geomembrane for containing decon fluids shall be High Density Polyethylene (HDPE) or Polyvinyl Chloride (PVC) with a minimum thickness of 20 mils.

(2)Berm Material: Material for creating sideslopes of the decon pad shall be soil, railroad ties, sandbags or a material selected by the Contractor and approved by the Owner's Engineer.

**2.Excavation**

a. Clearing/Grubbing. Cleared material shall include all trees and brush removed from the Work Area prior to the execution of any excavation work. Grubbed material shall include any stripped vegetation or tree stumps removed from the Work Area prior to the execution of any excavation work. Areas of clearing and grubbing shall be delineated with stakes.

b. Excavated Material. Excavated material shall include all soil and rock in their natural moisture content. Debris encountered during excavation shall be considered unsuitable for use as backfill and shall be segregated by the Contractor and disposed in accordance with subsection 6 of SECTION V – SITE CONDITIONS.

**3.Seep Collection System.**

a. Geomembrane Liner. The liner shall be a high density polyethylene (HDPE) geomembrane liner manufactured by GSE Gundle Lining Systems, Inc., or an equivalent HDPE geomembrane approved by the Engineer. The geomembrane shall contain no additives, fillers, or extenders. Carbon black 2% ± shall be added to the resin for ultra-violet resistance. The lining system shall be installed by a contractor certified by the geomembrane manufacturer to install the subject liner.

The geomembrane material shall be so produced as to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter. Any such defect shall be repaired using the extrusion fusion welding technique in accordance with manufacturer's recommendations.

The geomembrane shall be manufactured in seamless minimum widths of 22.0 feet. Labels on the roll shall identify thickness, length, width, and manufacturer's mark number. There shall be no factory seams.

Typical physical properties of the HDPE geomembrane are listed below:

| Property | Test Method | Value | Units |
|---|---|---|---|
| Carbon Black Content | ASTM D1603 | 2.0 | % |
| Density | ASTM D1505 | 0.94 | g/cm$^3$ |
| Thickness | ASTM D5199 | 36 40 | mils |
| Coefficient of Linear Thermal Expansion | ASTM D696 | $2 \times 10^{-4}$ | °C-1 |
| Water Absorption | ASTM D570 | 0.10 | %/4 days |
| Tensile Properties | ASTM D638, Type IV, Gauge length (2-in. break, 1.3-in. yield) | | |
| Elongation at Yield | | 13 | % |
| Elongation at Break | | 120 | % |
| Tensile Strength at Yield | | 86 | lb./in.-width |
| Tensile Strength at Break | | 50 | lb./in.-width |
| Puncture Resistance | FTMS 101B Method 2065 | 52 | pounds (min.) |
| Tear Resistance | ASTM D1004 Die C | 30 | pounds (min.) |
| Bonded Seam Strength | ASTM D3083 | 100% Visual in both Peel and Tensile testing | |

The Contractor shall, at the time of bidding, submit a certificate from the manufacturer of the sheeting, stating that the sheeting meets physical property requirements for the intended application.

b.,c.,e. Drainage Pipe. Drainage pipe to be used in the anchor trench shall be 'Sure-Lok F477' 4-inch and 6-inch diameter heavy-duty high density polyethylene corrugated (perforated and non-perforated) pipe with caps and fittings as manufactured by Hancor, Inc., of Findley, Ohio or an equivalent drainage pipe approved by the Owner's Engineer. Outlets to be provided with rodent screens where indicated. Pipe boots shall be provided at points where the pipe passes through geomembrane, where indicated, unless otherwise noted. The 6-inch diameter pipe shall be non-perforated.

d. Backfill. Granular backfill around perforated pipe and within the geomembrane funnel shall be blue slate granite stone. The gradation of the stone shall be the smallest available from the quarry, and shall conform as near as possible to size number 2, number 24 or number3 in Table 1 of ASTM D448 "Sizes of Aggregate for Road and Bridge Construction." The aggregate shall be free of any organic or other deleterious material and contain a minimal amount of fines. Backfill for non-perforated pipe may be material excavated from the trench or sand as per Alcoa Standards for Flexible Conduit.

f. Helical Anchor Screws. The anchor screws to secure the pipe in its location within the ditch shall be Helix Anchors or an equivalent anchor screw provided by the Contractor. The screws shall be at least five feet long and shall possess the capability to be extended to 10 feet long, if necessary, with some type of shear and tension resistant coupling. The top of the helix screw shall be fitted with an eyehook to tie or secure items. The helix screws shall be capable of being drilled into soil vertically or at an angle.

g. Pipe Shroud and Clamps. A half-pipe shroud to be placed over the 4-inch plastic drainage pipe shall be Schedule 40 PVC pipe with a diameter of six (6) inches and a length of two feet.

Ties/clamps for securing the plastic pipe and pipe shroud to the eyehook of the anchor screw shall be 10 gauge stainless steel corrosion resistant clamps with a minimum width of one-inch and be of sufficient length.

**4.Final Cover.**

a. Geotextile. The filter fabric shall be Mirafi 1120N, manufactured by The Mirafi Division of Nicolon Corporation (800-234-0484), or Amoco 4512, manufactured by Amoco Fabrics and Fibers (404-984-4444) or an equivalent filter fabric approved by the Owner's Representative. The following minimum average roll values shall be met:

| | | |
|---|---|---|
| Weight | ASTM D3776 | 12.0 oz. |
| Grab Tensile Strength | ASTM D4632 | 275 lb. |
| Grab Tensile Elongation | ASTM D4632 | 50% |
| Trapezoidal Tear Strength | ASTM D4533 | 115 lb. |
| Mullen Burst Strength | ASTM D3786 | 600 psi |
| Puncture Resistance | ASTM D4833 | 175 lb. |
| Apparent Opening Size | US Sieve | 100 |
| Permittivity | ASTM D4491 | 0.9 $sec^{-1}$ |

b. Riprap. Stone for riprap shall be hard, durable, angular in shape and resistant to weathering and to water action. The breadth or thickness of a single stone shall be more than one-third of its length. Shale and stone with shale seams shall not be acceptable. The minimum weight of the stone shall be 155 pounds per cubic feet. The riprap shall meet type A classification, in accordance with the North Carolina Department of Transportation, Standard Specifications for Roads and Structures, 1995.

**5.Concrete Collection Basin.**

a. Concrete Collection Basin. The collection basin shall be precast concrete with the dimensions indicated on the Drawings. The basin shall be provided with the specified openings or punchouts to accept the various diameters of pipe connecting to it. The basin shall also contain a square aluminum weir with the dimensions shown on the Drawing. The weir shall be held secure in the basin at the location shown on the Drawing. The joint at the weir-concrete interface shall be made as watertight as possible, to the satisfaction of the Owner's Engineer.

b. Mechanical Joints. Mechanical joints for sealing the annular space around pipe in concrete punchouts of the collection basin shall be Link-Seal, Model "C", as manufactured by ThunderLine/Link-Seal of Houston, TX (800-423-2410) or an equivalent seal approved by the Owner's engineer. The seal shall be required to fit around Sure-Lok F477 pipe, manufactured by Hancor, Inc. The pipe has inside diameters of 4-inches and 6-inches and outside diameters of 4.7-inches and 6.9-inches, respectively

c. Anchor Bolts. Anchor bolts for securing the aluminum weir to the sidewalls and bottom of the precast concrete collection basin shall be 'Kwik Bolt' or 'Sleeve Anchor' connectors manufactured by Hilti, or an approved equal. Sizes shall be as indicated on the Drawings.

d. Caulk. Caulk for sealing the concrete/weir interface of the collection basin and for application over non-shrink grout used to seal the annulus space around the pipe entrances to the collection basin shall be SikaSwell S polyurethane sealant, manufactured by Sika USA (800-933-SIKA) or an equivalent sealant approved by the Owner's Engineer.

e. Coarse Aggregate. Coarse aggregate for bedding and backfill of the collection basin shall meet gradation requirements of size number 467 or 57 aggregate as provided in ASTM D448 "Standard Classification for Sizes of Aggregate for Road and Bridge Construction." It shall also meet applicable requirements of Alcoa Engineering Standard Specification for cast-in-place concrete materials, Section 33.121.7.

**6.Revegetation.**

a. Seed. Seed to be used to permanently vegetate all disturbed areas shall be Mix Type I or Mix Type II seed. The seed mixes shall be as follows:

SEED MIX TYPE I

| Name | Amount per Acre |
|---|---|
| Tall Fescue | 120 lbs./acre |
| Sericea | 40 lbs./acre |
| Kobe Lespedeza | 10 lbs./acre |
| Winter Rye | 50lbs./acre |
| Ladino Clover | 5 lbs./acre |

| | |
|---|---|
| TOTAL | 225.0 lbs./acre |

SEED MIX TYPE II

| Name | Amount per Acre |
|---|---|
| Shrub Lespedeza | 20 lbs./acre |
| Partridge Pea | 5 lbs./acre |
| Crimson Clover | 5 lbs./acre |
| TOTAL | 30 lbs./acre |

Seeding dates are as follows:

| Season | Best | Possible |
|---|---|---|
| Spring (TYPEI) | March 1-March 31 | February 15-April 15 |
| Fall (TYPE I) | August 25-September 15 | August 20-October 25 |
| Late Winter (TYPE II) | February 15-March 21 | February 1-April 15 |

b. Fertilizer. Fertilizer to be used in promoting vegetation of all disturbed areas shall meet the requirements of Section 1660 of the North Carolina Department of Transportation, Standard Specifications for Roads and Structures, 1995. The fertilizer shall be applied at a rate of 1,000 lbs. per acre using a proportion of 10-10-10 (Nitrogen-Phosphate-Potash (N-P-K)).

c. Agricultural Limestone. Agricultural limestone to be used in vegetating the cap shall meet the requirements of Section 1660 of the North Carolina Department of Transportation, Standard Specifications for Roads and Structures, 1995. Agricultural Limestone shall be applied at a rate of 4,000 pounds per acre.

d. Mulching Material. Mulching material to be used in vegetating the cap shall meet the requirements of Section 1660 of the North Carolina Department of Transportation, Standard Specifications for Roads and Structures, 1995. Straw mulch shall be applied at a rate of 6,000 pounds per acre during the same time periods in which seed is to be sewn.

# VIII. GENERAL WORKMANSHIP SPECIFICATIONS

## A. GENERAL

All workmanship requirements for the work covered by these Specifications shall be as required in the referenced Standards, the following Alcoa Engineering Standards, the North Carolina Department of Transportation, Standard Specifications for Roads and Structures, as noted on the reference drawings and/or as specified in manufacturer's instructions, and/or as supplemented below.

| Alcoa Engineering Standard Number | Description |
|---|---|
| 18.19 | Excavation, Trenching and Shoring |
| 33.121.8.1 | Excavation and Backfill |
| 33.2121.8 | Site Grading Operations and Workmanship |
| 33.4001.8 | Site Wastewater Disposal Piping Workmanship |
| 33.2601.8 | Specification for Steel Fence Workmanship |

## B. SUPPLEMENTAL WORKMANSHIP SPECIFICATIONS

Contractor shall control drainage and runoff in the construction area to prevent ponding, erosion, and siltation of existing drainage ditches and channels. Contractor shall maintain access roads and return them to a condition approved by Owner's Engineer. Plant roads shall be kept clean and free of mud. Dust shall be controlled by the Contractor during construction through spray application of water from a water truck provided by the Contractor at the Owner's request.

Any areas disturbed by construction activity shall be seeded, fertilized and mulched. Work shall be completed in accordance with the workmanship specifications for Vegetation Covering provided herein.

## C. UTILITIES

1. Locating, Disconnecting and Protecting Utilities - The Contractor shall locate and protect all utilities in or near the construction area, both above ground and underground, prior to construction, and shall conduct this operation in such a manner as to insure they will not be disturbed or endangered. The Contractor shall disconnect electric power from its source at the location shown on the Initial Grading Plan. The disconnection shall be performed safely and in accordance with applicable Alcoa and Electrical codes. The Contractor assumes full responsibility for any damage resulting to such utilities during construction.

2. Cooperation with the Public Utilities and Others - Prior to commencing operations and/or during the course of construction, the Contractor shall contact all public utilities and others in regard to the exact location of existing facilities. He shall make his own arrangements with all public utilities and others affected by the proposed construction in regard to the performance of the work, making required adjustments, temporary connections and relocations, and/or permanent connections and relocations of present facilities and installation of new facilities. All work in connection with the installation of new facilities and/or adjustments to existing facilities of public utilities or others which is not directly affected by the proposed construction shall be done by the respective public utilities, or others, at their own expense and cost.

Any modification or adjustment to the present facilities of any public utilities or other within the limits of construction which increases the quality and/or quantity of service over and above that which exists prior to construction shall be at the expense and cost of the said public utilities or other affected.

No extra compensation shall be allowed to the Contractor on account of any loss, damage or delay caused to the Contractor, by or on account of such work or by failure of any utility, or others, to perform the required work at the proper time.

## D. CONSTRUCTION

### 1.Site Preparation

a. Mobilization/Staging Area

1.Mobilization - The Contractor shall not begin Work until receipt of a written Notice to Proceed is received from the Owner. Upon receipt, the Contractor shall provide all of the necessary equipment, materials, labor and work to perform the work outlined herein. These furnishings shall be staged at the location indicated on the Drawings. The Contractor shall be responsible for obtaining electric power for his facilities.

All work under this item shall be performed in a safe and professional manner.

2. Access Road/Staging Area. After clearing and grubbing have been performed in accordance with these Specifications, Mirafi 500X shall be unrolled directly onto the ground surface where the aggregate is to be placed. A minimum 18-inch overlap shall be maintained at all joints. Aggregate shall then be end dumped onto the fabric and spread in one loose lift 8-inches thick. Compaction shall take place by routing equipment over the stone until nonmovement of the stone is observed by the Owner's Representative below compaction equipment during compaction operations. When completed, the access road/staging area shall exhibit a cross section similar to that shown on the Drawings.

3. Fence Removal. The Contractor shall remove sections of the existing fence to facilitate construction of the pipe system from the seeps to the concrete collection basin. The chain-link fence fabric shall be broken at a location where an end to the chain link fabric exists. The fabric shall be rolled back away from line posts until an adequate right-of-way is established to perform the work. If the location of an existing edge to the chain-link fabric is not in the vicinity of the work, the Owner will recommend cutting the fabric at the location of work. Ten gauge aluminum wire ties shall be used to resecure fabric to line posts or to connect two ends of chain-link fabric.

b. Erosion and Sediment Control

1.Erosion Control Installation - Silt Fence shall be erected at the locations shown on the drawings and according to the details immediately after clearing and grubbing operations have been completed. Posts shall be installed on 8 foot centers and the filter fabric attached. The filter fabric shall be attached to the anchor posts on the upstream side using staples, or tie wires. The bottom 12 inches of the fabric shall be buried in a six-inch trench cut into the ground or covered by six inches of fill material, to prevent sediment escaping under the fence. All earth-work shall be on the upstream side of the fence.

Areas to be used for site preparation shall be located within the clearing and grading limits as indicated on the Drawings. Should the Contractor require additional area to establish facilities incidental to this work, he shall notify the Owner of his needs and await approval of the same.

2.Erosion Control Maintenance - Silt Fence shall be maintained in an erect position and cleaned as required to ensure efficiency. If the Silt Fence bulges by more than 6 inches from sediment buildup, or is observed in a collapsed position due to the height of the sediment, the silt and debris shall be removed and the silt fence repaired or replaced.

c. Construction Layout and Surveys

1.Survey Monuments - The Contractor shall locate survey monuments established by the Owner and shall establish additional bench marks necessary for proper layout of the work. The Contractor shall make all calculations involved and shall furnish and place all layout stakes or markers.

2.Survey Stakes - The location of slope stakes for grading work shall be determined by a calculation method. Elevation control hubs with guard stakes shall be set, at a convenient distance outside the construction limits. The centerline station, distance from centerline, and elevation of the hub shall be recorded on each guard stake. The Contractor shall exercise care in the preservation of stakes and bench marks and shall have them reset at his expense if they are damaged, lost, displaced, or removed.

The Contractor shall be responsible for having stakeout work conform to the lines, grades, elevations, and dimensions called for on the Drawings. The Contractor shall be responsible for reporting any discrepancies to the Owner's Representative for clarification. Minor adjustments to suit field conditions are anticipated and it shall be the responsibility of the Owner's Representative to make decisions regarding adjustments.

3.Survey Records - The Contractor shall furnish a copy of survey records to the Owner's Representative for review and for the Owner's permanent file. These records shall be furnished as they are completed during the progress of work. Any inspection or checking of the Contractor's layout by the Owner's Representative and acceptance of all or any part of it shall not relieve the Contractor of responsibility to secure the proper dimensions, grades, and elevations for the required work.

4.Inspections and Checking of Work - It is not the intention to delay work for checking of lines or grades; but, if necessary, working preparations shall be suspended for such reasonable time as the Owner's Representative may require for this purpose. No special compensation shall be paid for the cost to the Contractor of any of the work or delay occasioned by checking lines and grades or by making other necessary inspection. The Contractor shall keep the Owner's Representative informed, a reasonable time in advance, of the times and places at which he intends to do work in order that necessary checking or inspections can be made with minimum inconvenience to the Engineer and delay to the Contractor.

d. Decontamination – Construction of temporary decontamination pads shall be performed at the locations shown on the Drawings. The Contractor shall review his method of constructing the pad with the Owner's Engineer before proceeding. The geomembrane shall be secured to the berm in a manner that prevents displacement during the movement of equipment over the geomembrane and during wind uplift when it is not being utilized.

**2. Excavation**

a. Clearing/Grubbing. The Contractor shall remove all objectionable material, rubbish, debris, trees, stumps, brush, roots, rotten wood, and any other vegetation from the limits of clearing and grubbing as indicated on the Drawings using methods suitable for such purposes. Cleared material shall be chipped and stockpiled for future use. Stumps and roots of trees or shrubs with main trunk diameters greater than three (3) inches shall be cut to lengths no greater than two (2) feet. All material generated from clearing and grubbing shall be classified as unsatisfactory and disposed by the Contractor.

b. Excavation and Transportation. Excavation for the seep collection system shall be performed at the locations and to the lines, grades and elevations shown on the Drawings and in accordance with Alcoa Engineering Standard 33.121.8.1 Excavation shall be performed in a manner that promotes positive drainage. Excavation shall proceed to a maximum depth of 5 feet below the existing ground surface. If at five feet the expected origin of the seep has not been uncovered, the Contractor shall report his findings to the Owner's Engineer, who will then provide the Contractor with a new maximum depth of excavation or instruct the Contractor to maintain the current depth of excavation. Excavated material shall be loaded into trucks staged adjacent to the excavation area or stockpiled adjacent to the excavation. Trucks shall not be permitted to enter the excavation area. After the trucks have been loaded, the material shall be covered with a tarp, which shall be secured to the truck. The trucks shall transport the waste to a location designated by the Owner.

**3. Seep Collection System**

a. Geomembrane. After excavation of the seep area has been completed, installation of the geomembrane for the seep collection system shall proceed. The manufacturer's installation guide, which shall include complete written instructions for the storage, handling, installation, seaming, quality control and repair of geomembrane, shall be referenced and followed for all aspects of preparation and cleaning. The geomembrane shall be securely held in place by means of a anchor trench as shown on the Drawings. Seaming of geomembrane within the anchor trench (if necessary) shall occur within 45 degrees of a perpendicular to the centerline of the anchor trench. The geomembrane shall be placed in the anchor trench to the extent shown on the Drawings. Geomembrane sheets shall be installed with a minimum 8-inch overlap at material joints, with the upslope liner sheet overlapping the downslope liner sheet.

b. Perforated Pipe Installation. After geomembrane installation, the perforated pipe shall be installed directly over the geomembrane. Pipe installation shall be performed in accordance with Alcoa Engineering Standard 33.4001.8. The Contractor shall use a 2-inch thick bedding of non-calcareous stone to sustain the pipe in its required location on the geomembrane. Install the pipe at the lines and grades shown on the Drawing. Leak testing and deflection testing of the pipe shall not be required.

c.,e. Solid Wall Pipe Installation. After perforated pipe installation has been completed, installation of solid pipe shall be performed at the locations shown on the Drawing. Solid pipe shall be located within the limits of the existing drainage ditch, to the extent possible. Where bends or turns in the existing drainage ditch are present, excavation of material to facilitate installation of a straight run of pipe shall be performed. The excavated material shall be used to backfill the length of drainage ditch associated with the bend or turn that will no longer be used.

The solid pipe shall be joined and accurately fitted together in accordance with the manufacturer's installation manual. Couplers shall be of the same gauge and material composition of the pipe. Proper care shall be exercised in handling of the pipe and couplers so that they are kept free of dents, scratches, cracks and other defects. During installation, the interior of the pipe shall be kept free of debris. Deflection of the pipe shall not exceed the requirements of the manufacturer for 20-feet lengths of pipe.

d. Stone Backfill. After perforated pipe installation, stone backfill shall be installed to the thickness and grades shown on the Drawing. The backfill shall be brought up evenly on both sides of the pipe and shall be lightly compacted around the pipe to reduce large voids in the backfill. Backfill shall proceed in accordance with Drawing A of Alcoa Engineering Standard 121.8.1. Backfill operations shall not disturb the location or the structural integrity of the pipe. Any damage to pipe shall be repaired by the Contractor at his own expense.

Upon completion of stone backfill operations, the Contractor shall install the cover sheet of geomembrane at the locations shown on the Drawing. Installation shall be performed as discussed above. Outlet the pipe from the seep collection system through the geomembrane using one of the two procedures shown on the Drawing.

f. Screw Anchors. After the solid pipe has been located at the correct lines and grades, screw anchors shall be installed on the low elevation side of the pipe at each joint location or every 10 feet, whichever is less. The screw anchors shall be installed in accordance with the manufacturer's installation guide. The anchors shall be installed to a depth at which the Contractor believes the helix is embedded in competent material or to a maximum depth of 10 feet. The top of each correctly installed screw anchor shall be fitted with an eyehook securely attached to the screw anchor.

g. Shroud and Clamps. After the screw anchors have been successfully installed, a pipe shroud shall be placed over each pipe joint. A stainless steel strap/clamp shall be used to tightly secure the pipe shroud and pipe to the eyehook of the screw anchor.

**4. Final Cover**

a. Geotextile. After the seep collection system has been installed and approved by the Owner's engineer, a layer of protective geotextile shall be installed over the geomembrane covering the seep drainage stone. The geotextile shall be placed loosely, not taut, with no wrinkles or folds. A minimum 18-inch overlap shall be maintained at all fabric joints, with the upslope sheet overlapping the downslope sheet, when applicable. If geotextile is damaged during installation or during placement of the riprap on the geotextile, the damaged area shall be cleared and a patch extending at least three feet beyond all sides of the damaged area shall be installed. No stitching shall be required.

b. Riprap. After installation of geotextile, riprap shall be installed. Stone for loose riprap shall be placed by methods that will produce a compact uniform blanket of riprap protection having a reasonably smooth surface. Riprap shall be placed to its full course thickness in one operation and in a manner to avoid displacing or damaging the underlying geosynthetics or other material. Placing of riprap materials by end dumping on the slope or by other methods likely to cause segregation or damage to the slope shall not be permitted. Hand placing or rearranging of individual stones by mechanical equipment may be required to the extent necessary to secure the specified results. The thickness of riprap over the geotextile shall be at least 12-inches. The riprap shall extend a minimum of five feet beyond the location of the pipe boot or clamp indicating the end of the seep collection system. When completed, the riprap shall exhibit a cross-section similar to that shown on the Drawing.

## 5. Concrete Collection Basin

The precast sump shall be installed at the location shown on the Drawing. This location is subject to change by the Owner's Engineer to accommodate changed conditions in the field. The excavation constructed to accept the sump shall be approximately 6-inches deeper than the bottom of the sump and three feet wider than the length and width dimensions of the sump. Side slopes of the excavations shall meet all applicable safety regulations. A six-inch layer of crushed stone shall be installed at the bottom of the excavation to provide uniform support of the sump.

After sump installation, the solid wall pipe shall be connected to the sump using one of the following two methods:

-If a section of pipe was cast into the sidewall of the concrete collection basin, the pipes shall be connected in accordance with the pipe installation manual.

-If a punchout was provided with the concrete collection basin or if no opening was provided, the punchout shall be removed or a circular hole two-inches larger than the outside diameter of the pipe shall be created and the pipe shall be inserted through the punchout or hole, extending a minimum of two inches beyond the inside wall of the sump. After insertion, a mechanical seal shall be installed into the annular space. Installation shall be in accordance with the manufacturer's installation guide.

The aluminum weir shall be delivered to the site with three-inch wide flanges on the sides facing the concrete or 3-nch by 3-inch angles welded at the same location, as indicated on the Drawings. The Contractor shall be responsible for verifying the dimensions of the weir for a snug fit into the collection basin. The weir shall be secured to the concrete using anchor bolts at the locations shown on the Drawing. Holes in the aluminum weir shall either be predrilled or drilled at the Site. The manufacturer's installation guide shall be referenced and followed for all aspects of anchor bolt installation, including diameter and depth of predrilled hole in concrete, diameter of hole in weir and torque required to secure anchor bolt.

After the weir has been installed in the collection basin, a waterproof caulk/sealant shall be installed along the interface of the weir and concrete, on both sides (upstream and downstream) of the weir. The manufacturer's guide shall be referenced and followed for caulk/sealant application.

Backfill shall be brought up evenly on all four sides of the basin. Backfill shall either be gravel meeting the requirements of Section VII, Part 5.e., above or soil stockpiled during excavation of the basin or excavation of the pipe right-of-way. The backfill shall be placed in uniform horizontal layers 8 inches thick, measured when loose, across the entire width or length of the area to be filled, in accordance with Alcoa Engineering Standard 33.2121.8. Each layer, for its full width shall be compacted to not less than 85% of the maximum dry density, as determined by ASTM D698 in accordance with Alcoa Engineering Standard 33.2121.8. Moisture content during compaction shall not be more than two percent above or below the optimum moisture content. In-place densities and moisture contents shall be performed once for every 250 cubic yards of soil placed, in accordance with ASTM D2922 and D3017 respectively. The backfill shall be extended to the elevations shown on the Drawing.

**6. Vegetation**

All areas disturbed during construction activities shall be seeded, mulched and fertilized in accordance with the recommendation of the North Carolina Department of Environment, Health and Natural resources, Erosion and Sediment Control Planning and Design Manual. The location of areas designated for revegetation are shown on the Drawing. The seed bed preparation, application of seed. fertilizer, limestone and mulch shall be in accordance with the North Carolina Department of Transportation, Standard Specifications for Roads and Structures, 1995, Section 1660, unless specified by the Erosion and Sediment Control Planning and Design Manual.

The Contractor shall perform seeding, fertilizing and mulching activities in accordance with the recommended construction sequence provided in the Erosion and Sediment Planning and Design Manual no later than 30 days after final grading of all disturbed areas has been completed. The Contractor shall apply Seed Mix Type I or Seed Mix Type II at the rates per acre indicated and during the seeding periods specified in Section VII. Should the time for seeding fall outside the specified seeding periods, the Contractor shall apply the appropriate temporary seeding mix for the seasonal time period, as follows:

**Temporary Seeding Recommendations for Late Winter or Early Spring**

SEED MIXTURE

| Species | Rate (lbs./acre) |
|---|---|
| Rye (grain) | 120 |
| Annual lespedeza (Kobe in Piedmont And coastal plain, Korean in mountains) | 50 |

Seeding Dates

| | |
|---|---|
| Mountains | Above 2,500 feet; Feb. 15 – May 15. |
| | Below 2,500 feet; Feb. 1 – May 1 |
| Piedmont | Jan. 1 – May 1 |
| Coastal Plain | Dec. 1 – Apr. 15 |

Soil Amendments

Follow recommendations of soil tests or apply 2,000 lbs./acre ground agricultural limestone and 750 lbs./acre 10-10-10 fertilizer.

Mulch

Apply 4,000 lbs./acre straw. Anchor straw by tacking with asphalt, netting or a mulch anchoring tool. A disc with blades set nearly straight can be used as a mulch anchoring tool.

Maintenance

Refertilize if growth is not fully adequate.Reseed, refertilize and mulch immediately following erosion or other damage.

**Temporary Seeding Recommendations for Summer**

SEED MIXTURE

| Species | Rate (lbs./acre) |
|---|---|
| German Millet | 40 |
| Small stemmed Sundangrass | 50 |
| (May be substituted in Piedmont and Mountains) | |

Seeding Dates

| | |
|---|---|
| Mountains | May 15 – Aug. 15 |
| Piedmont | May 1 – Aug. 15 |
| Coastal Plain | Apr. 15 – Aug. 15 |

Soil Amendments

Follow recommendations of soil tests or apply 2,000 lbs./acre ground agricultural limestone and 750 lbs./acre 10-10-10 fertilizer.

Mulch

Apply 4,000 lbs./acre straw. Anchor straw by tacking with asphalt, netting or a mulch anchoring tool. A disc with blades set nearly straight can be used as a mulch anchoring tool.

Maintenance

Refertilize if growth is not fully adequate.Reseed, refertilize and mulch immediately following erosion or other damage.

Even if temporary seeding has been performed, the Contractor shall conduct permanent seeding activities as soon as the first 'Possible' seeding dates specified in Section VII, Subsection arrive. If temporary or permanent seeding activities do not establish an adequate stand of vegetation in the opinion of the Owner, the Contractor shall reseed with a permanent seed mix at the earliest possible time for seeding specified in the Table.

Mulching, fertilizing and the application of limestone shall also be performed by the Contractor at the rate per acre specified in Section VII.

If erosion occurs between the time of final grading and time of seeding, the Contractor shall replace the fine soil materials that were eroded away and regrade all eroded areas to reestablish the final grade. The Contractor may, with the approval of the Owner's Engineer, perform temporary seeding operations in order to maintain finished graded areas until the optimum time for performing permanent seeding.

Due to the unknown quality of the topsoil cover material, the Contractor shall obtain two soil samples from across the subject Site. The samples shall be composited and analyzed prior to liming and fertilizer applications to verify the minimum requirements of the same as set forth in these specifications.

Maintenance and Repairs - The Contractor shall during construction and prior to acceptance, properly care for all areas mulched to establish growth of the seeded areas. Mulch that becomes displaced shall be reapplied at once, together with any necessary reliming, refertilization, or reseeding, all at no expense to the Owner.

The Contractor shall guarantee an adequate vegetative cover twelve months after initial placement, as previously discussed. If the Owner's Engineer determines after the one year inspection that the stand of vegetation is inadequate, the Contractor shall overseed and fertilize using half of the rates originally applied. If stand is over 60% damaged, re-establish the vegetation following original lime, fertilizer, seedbed preparation and seeding recommendations outlined herein. This cost to overseed or to re-establish vegetation shall not be passed on to the Owner.

## H. SITE CLEAN-UP, DAMAGE REPAIR AND MAINTENANCE OF REVEGETATED AREAS

The Contractor shall maintain all revegetated areas in accordance with the requirements of this section until all work under the contract has been completed and has been accepted by the Owner. The maintenance shall consist of refilling rain-washed gullies, with the same or better type of soils that were eroded, or reseeding, reapplying soil supplements and mulch as directed by the Engineer.

Within the one (1) year remedy guarantee period, as specified herein, the Contractor shall reseed or replant in accordance with these specifications any areas where satisfactory growth has not been obtained, in the opinion of the Owner.

## I. FINAL PROJECT INSPECTION AND DEMOBILIZATION

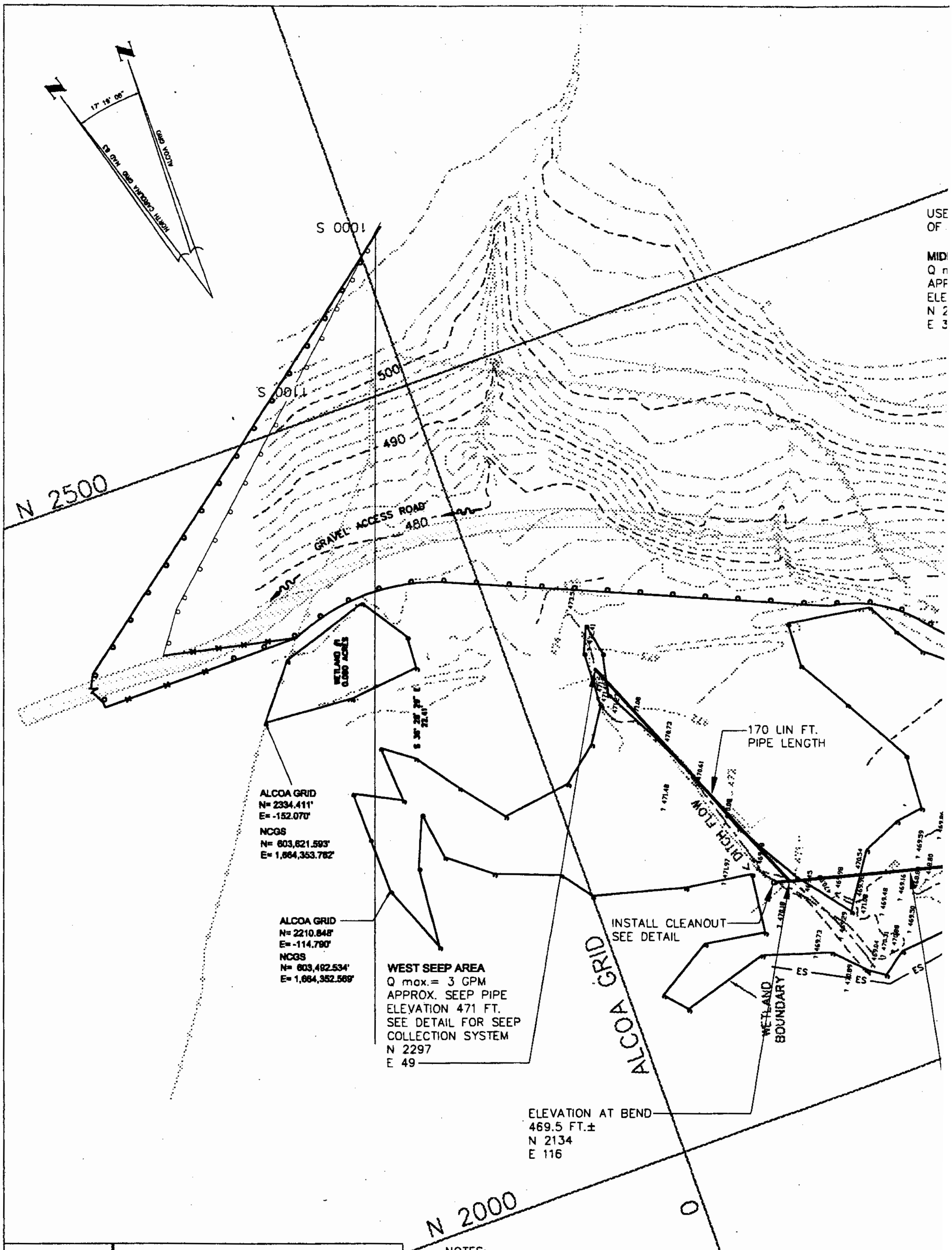
Prior to Contractor demobilization of all equipment, labor, tools and incidentals required to complete the work, a final inspection of the project will be conducted. The Owner, the Owner's Representative, the Contractor and any other interested parties will attend a site walk through to review the work and to identify any problems or concerns, which will be documented by the Owner's Representative and shall be corrected by the Contractor.

## IX. GENERAL CONDITIONS

The General Terms and Conditions (Form 1059R) are being made a part of these Contract Specifications. They are also available from the Owner's Representative, if requested.

# APPENDIX A

# CONSTRUCTION DRAWINGS




**IT CORPORATION**

**ALCOA INC.**

**PLAN VIEW FOR**
**LOW FLOW SEEP COLLECTION SYSTEM**

ALCOA BADIN LDF

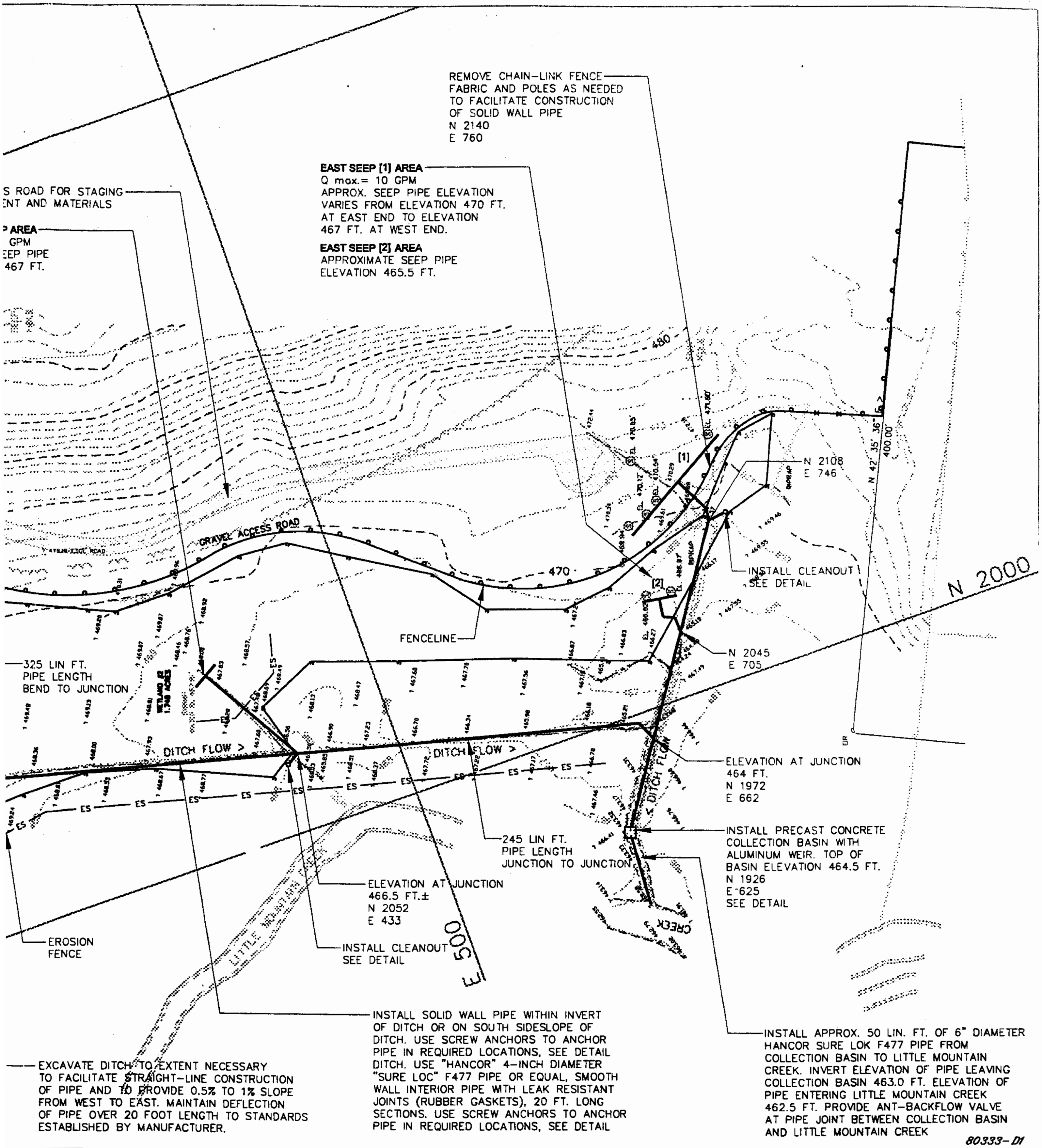
NOTES:

1. USE 22.5° OR 45° WYE ELBOWS AT ALL PIPE INTERSECTIONS.
2. COORDINATES ARE APPROXIMATE AND SUBJECT TO CHANGE BASED ON SEEP LOCATIONS AND FIELD CONDITIONS.
3. SEE TECHNICAL SPECIFICATIONS FOR LIST OF REFERENCE DRAWINGS AND US ARMY CORPS OF ENGINEERS CONSTRUCTION REQUIREMENTS.

SCALE IN FEET

0 40 80 120 FT.

SURVEY LEGEND




| | |
|---|---|
| —ES— | SILT FENCE/STRAW BALES |
| | PIPE CLEANOUT |
| | UTILITY POLE |
| | GUY WIRE |
| LP | LIGHT POLE |
| —G— | GAS LINE |
| 12" RCP | REINFORCED CONCRETE PIPE AND SIZE |
| | RIGHT-OF-WAY |
| FH | FIRE HYDRANT |

TY
E
DEX LINE
TCH
MENT
NCE
CE

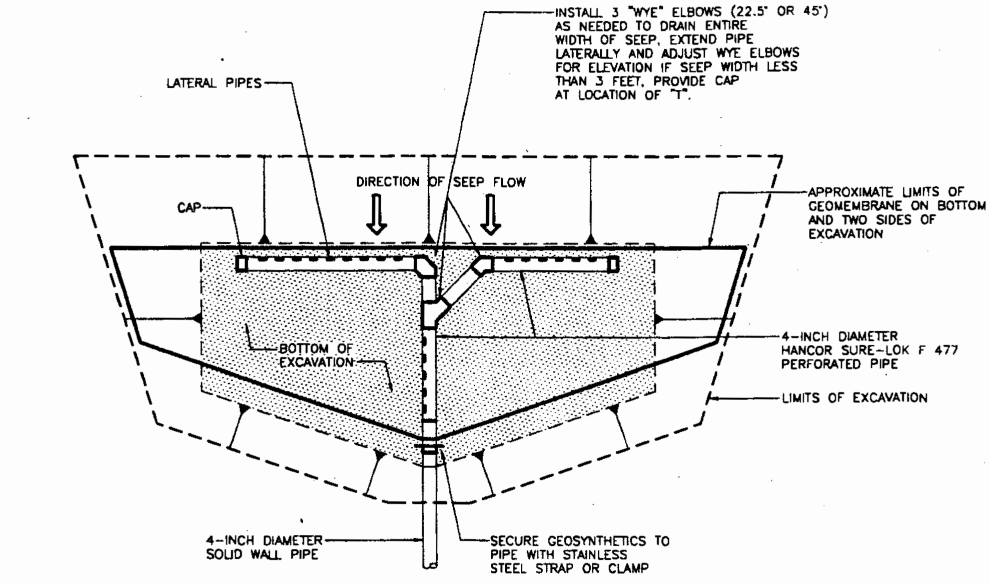
| DAY | MONTH | YEAR | NO. | REVISION RECORD | DR. | CK | ZONE |
|---|---|---|---|---|---|---|---|
| 21 | 2 | 00 | 2 | CONSTRUCTION | | | |
| 17 | 2 | 00 | 1 | PERMITS | | | |



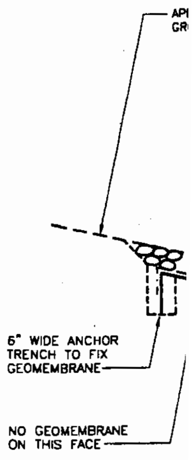
ALCOA, INC.
BADIN WORKS

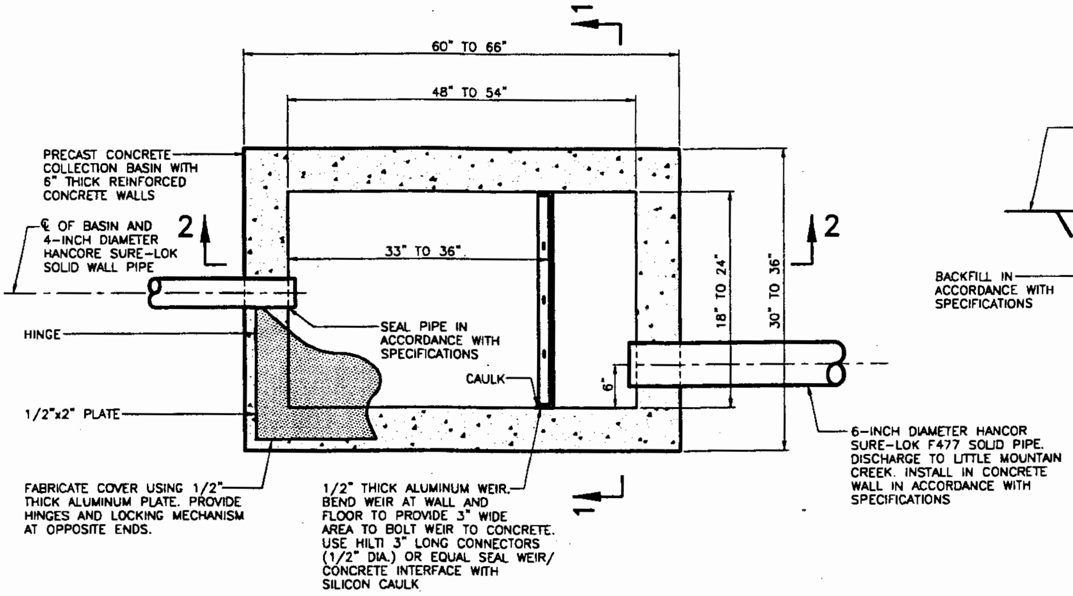
BLDG NO. PLANT SITE
PLAN VIEW FOR
LOW FLOW SEEP COLLECTION SYSTEM
ALCOA BADIN LDF CEAT NO. 2

| | | | |
|---|---|---|---|
| IN CHARGE OF: KISER | | PLANT CODE: BN | DESIGNED BY: P. SULLIVAN |
| SCALE: 1"=40' | ORIGIN | IT GROUP | DRAWN BY: B. SNYDER |
| A-052768-BN | | | CHECKED BY: A. BURBA |
| | | | APPROVED BY: H. VANDERMEYDEN |

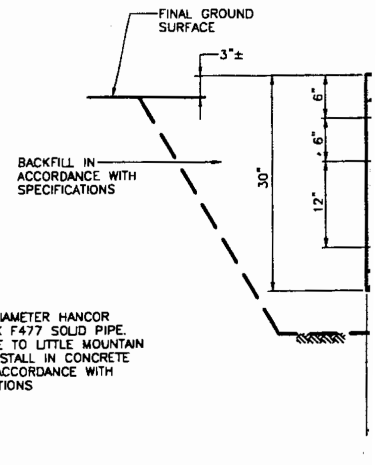


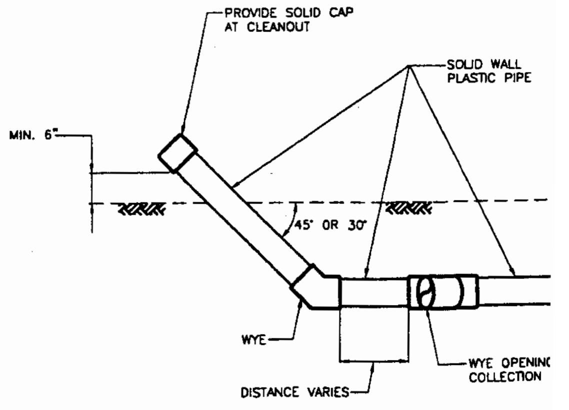

## PLAN
## SEEP COLLECTION SYSTEM
N.T.S.




## PLAN OF COLLECTION BASIN
N.T.S.



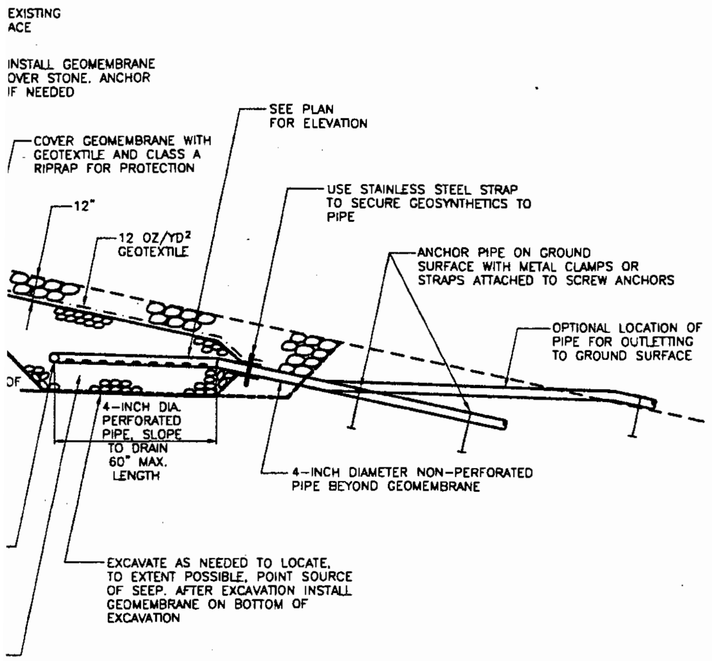




ALCOA INC.

IT CORPORATION

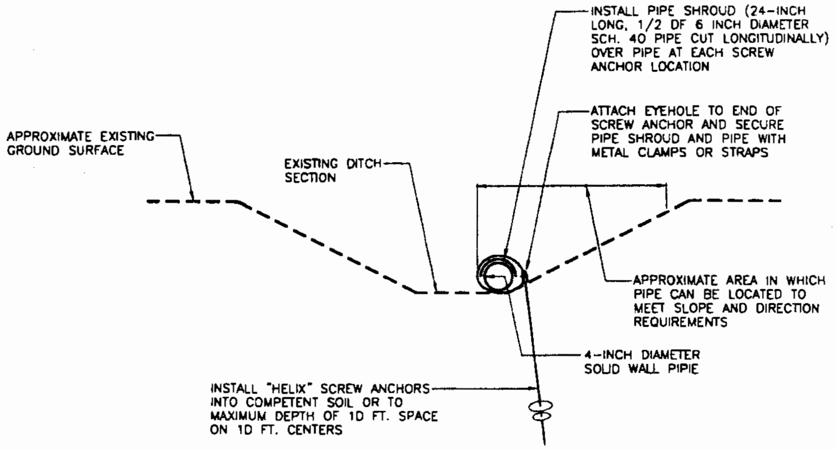
## DETAILS
## LOW FLOW SEEP COLLECTION SYSTEM

ALCOA BADIN LDF



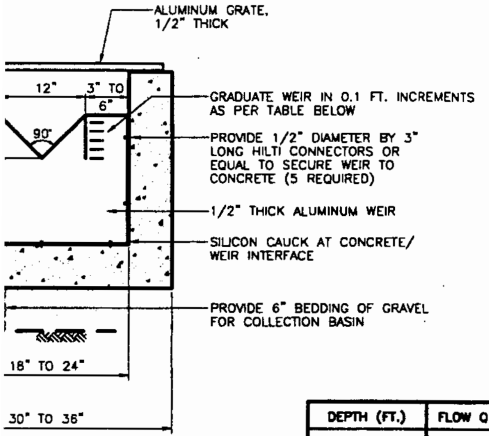

## SECTION
## P COLLECTION SYSTEM

N.T.S.




## DETAIL - PIPE ANCHOR

N.T.S.

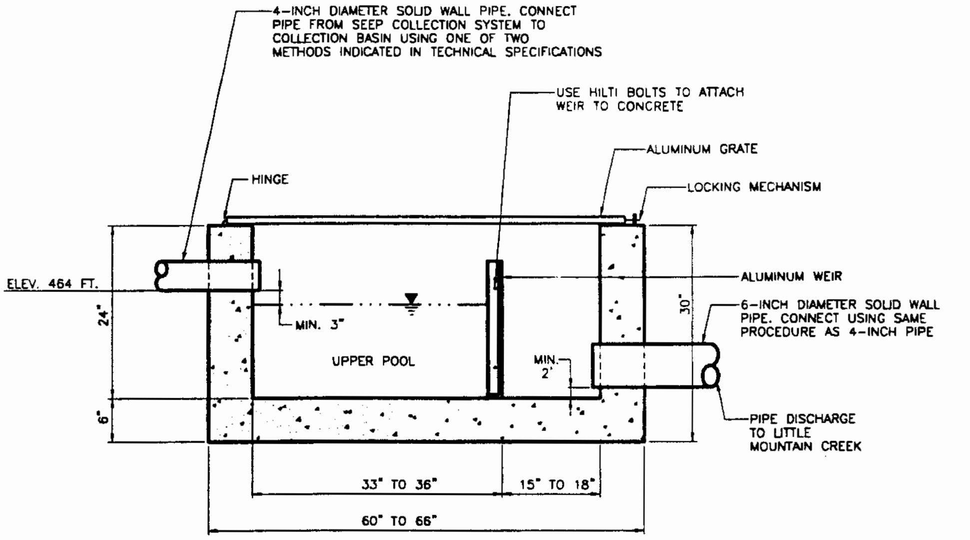



## CTION 1-1

N.T.S.

| DEPTH (FT.) | FLOW Q (gpm) |
|---|---|
| 0.05 | 0.67 |
| 0.1 | 3.8 |
| 0.15 | 9.9 |
| 0.2 | 21.1 |
| 0.3 | 57.9 |
| 0.4 | 117 |
| 0.5 | 204 |

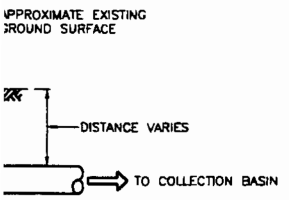
NOTE:
1 cfs = 449 gpm




NOTE:
1. SEE SPECIFICATIONS FOR LIST OF REFERENCE DRAWINGS

## SECTION 2-2

N.T.S.




## UT

802173-D1

| DAY | MONTH | YEAR | NO. | REVISION RECORD | DR. | CK | ZONE |
|---|---|---|---|---|---|---|---|
| 21 | 2 | 00 | 2 | CONSTRUCTION | | | |
| 17 | 2 | 00 | 1 | PERMIT | | | |



ALCOA INC.
BADIN WORKS

BLDG NO. PLANT SITE
DETAILS
LOW FLOW SEEP COLLECTION SYSTEM
ALCOA BADIN LDF CEAT NO. 2

IN CHARGE OF: KISER | PLANT CODE: BN | DESIGNED BY: P. SULLIVAN
SCALE: N.T.S. | ORIGIN: IT GROUP | DRAWN BY: B. SNYDER
CHECKED BY: A. BURBA
APPROVED BY: H. VANDERMEYDEN

A-052769-BN

**REFERENCE 13**

ALCOA BADIN WORKS 7/21/15

(1) LAND FILL/CREEK SAMPLING

NCD 003162542 BADIN, STANLY CO, NC

MET @ LANDFILL ENTRANCE @ 0700

"LEAKY PIPE" HAS BEEN REMOVED, RE-GRADED NO STANDING SURFACE WATER @ IT'S FORMER LOCATION. WEIR BOX ALSO REMOVED.

[PHOTO] FORMER PIPELINE "LEAK" LOCATION

[PHOTO] FORMER PIPELINE ROUTE

[PHOTO] FORMER WEIR BOX LOCATION.

DOUG RANGER STAKED OUT SD006 LOCATION IN EASTERN SEEP SED SW [ABL06]

MIDDLE SEEP SW LOCATION [THE FLOODPLAIN POND W/ MAXIMUM FLUORIDE] IS BARELY WET. [PHOTO]

WESTERN SEEP DOWNWARD SW/SED LOCATION HAS STANDING $H_2O$, DOWNGRADIENT OF PRIOR SAMPLING LOCATION.

NOTE: DUG DITCH, BETWEEN EAST CONCRETE FLUME AND L M CREEK, IS ALSO DIRECT DOWNGRAD FROM EASTERN SEEP. IT IS ABL06/ABLSD006.

0835 BEGAN ~~COLLECTING ABL 10 SW~~, ABL 11 SW.

0835 COLLECTED ABL 10 SD AND 11 SD (DUPLICATE)

[6 VOA 8 AMBER 2 1L HDPE 4 500ml HDPE] [Z072108A]

[6 ENCORE, 2 2OZ, 6 8OZ] STREAM BED ROCKY SED FROM BAR, SILTY GRAVEL

(2)

0955 COLLECT ABL 09 SD ~30 FEET BELOW CONFLUENCE OF MIDDLE SEEP CHANNEL W/ L M CREEK [Z072109A]

1000 COLLECT ABL 09 SW UPSTREAM FROM SEDIMENT. SED IS M-C SAND W/ SOME SILT AND GRAVEL. BEDROCK VISIBLE ON CREEK BED.

---

@ UPSTREAM LOCATION ON L M CREEK

10:55 COLLECT SAMPLE ABL08SW [Z072111A]

11:00 COLLECT SAMPLE ABL08SD

SW: 6 VOA 8 AMBER 1 1L HDPE 2 500ml HDPE

SOIL: 6 ENCORE, 1 2OZ, 3 8OZ

---

@ WESTERN SEEP OVERLAND DRAINAGE

12:10 COLLECTED ABL04SW [Z072112A]

12:15 COLLECTED ABL04SD COARSE-FINE SILTY SAND

---

@ MIDDLE SEEP OVERLAND DRAINAGE

$H_2O$ WAS PACED FROM SEEP COLLECTION POINT TO LITTLE MOUNTAIN CREEK DIST = 120 FT

∴ < 1/10 MILE OF POTENTIAL WETLAND.

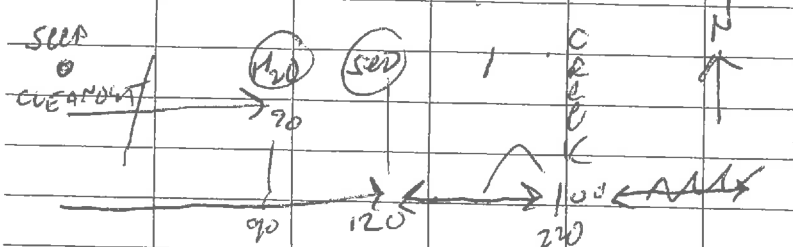
13:15 COLLECT ABL 05 SD IN ~~[illegible]~~ DRAINAGE PATH IMMED DOWN FLOW FROM WHERE PONDED, HI-FLUORIDE $H_2O$ WAS PREVIOUSLY OBSERVED BY PETITIONER SAMPLERS. NO WATER TO SAMPLE

(3) ALCOA BADIN LANDFILL SAMPLING @ LITTLE MTN CREEK
NCD 003 162 542 BADIN STATE OF NC

@ EASTERN SEEP DRAINAGE PATHWAY (ALSO DRAINS THE CONCRETE FLUME ON E SIDE OF LF)
WILL ATTEMPT TO GET $H_2O$ AS WELL AS SED, SINCE $H_2O$ (SHALLOW) IS VISIBLY FLOWING.

1355 COLLECTING ABL 06 SW IN OVERLAND CHANNEL 180 FT FROM CREEK [2072113]

1400 COLLECTED ABL 06 SD, [2072114B] 100 FEET FROM CREEK




14:42 COLLECTED SOIL/SED @ ABL07SD
NO SURFACE WATER TO SAMPLE

15:25 COLLECTED WEST SEEP SAMPLE ABL01GW
INSUFFICIENT YIELD & SHORT TWO (1L) AMBERS/Y
(EPA WAS ABLE TO GET SUFFICIENT VOLUME SEPT 9/17/15)

16:15 COLLECTED MIDDLE SEEP SAMPLE ABL02GW
3 VOA 4 AMBER 1 HDPE 2,1/2L HDPE

MON 930 - 530 7 + 1 LUNCH
TUE 645 - 1115 15 + 1/2 L + 1D (REIMB)

---

ALCOA BADIN BALL FIELD (SOIL, GW + SW/SED SAMPLING) 7/21/15 (4)
NCN 000 404 457

ON SITE 940 MET W/ MIKE WARDEN AND DOUG PARKER OF ENVIRONMENTAL. DRILL CREW ARRIVED AND WERE GIVEN ALCOA H+S BRIEFING PRIOR TO EQUIPMENT [illegible] - DECONTAMINATION. HE PREPPED TMP BLANK (WATER) @ 1035 SOIL 1040

1040 OF DWR ARRIVED WITH BOAT @ BOAT RAMP. (ABF02 SW + SD)

1140 COLLECTED ABF 02 SD W/ EKMAN DREDGE (COARSE SAND/SHALLOW/SOME FINE)

1150 COLLECTED ABF 02 SW

12:09 MIKE RETURNED W/ SOIL FROM EXPLORATION #15 (ABF13SS) 1150 AND 5 (ABF15SS) 1205
REPORTED TOPSOIL 0-6", FILL 6"-2' NATIVE SOIL BELOW 2'

1305 COLLECTED ABF11 SS FROM #20 2072213A

PHOTO: SEDIMENT PHOTO: ABF11 SS

1318 COLLECTED ABF12 SS FROM #24 2072213C

1330 COLLECTED ABF10 SS FROM #29 2072213B

1300 ABF14SS FROM #1 2072[illegible]13D

1430 ABF03 SS FROM #3 2072214A

1445 ABF06 SS FROM #11

1530 DRILL RIG ON ABF03 SE(?) (HOLE 3)
LIMITED (30%) RECOVERY FROM 0-5' AND 5-10' CORES. SOFT MOIST - WET BROWN CLAYEY NATIVE MATERIAL.

5 ALCOA BADIN BALL FIELD 7/27-28/15
NCD 000 404 437 BADIN, STANLY CO NC.

@3, SET TEMP WELL POINT 4-9' 1/4" DEPTH
(ANTICIPATING POOR PRODUCTION DUE TO CLAY)
NATIVE CLAY IS SOFT AND CORE TENDS
TO PUSH IT ASIDE W/OUT CORING / GOOD RECOVERY
MIKE WARDEN referenced WCALAN AS
INTENDING TO SAMPLE NON-NATIVE
MATERIAL & QUESTIONED VALUE OF
SAMPLING NATIVE.

SUMMARY OF SURFICIAL (0.5-2') SOIL
AUGERING: THIN NON-NATIVE ON
BALLFIELD, APPARENTLY DUE TO
CUTTING HILL TO SOUTH AND RE-GRADING
THICKENING TO NORTH. CLAYEY SILT W/
SAND AND SOME GRAVEL, UNDERLAIN
BY SILTY CLAY (BROWN) - NATIVE SUBSTRATE?

COMING @ ABF06 (EXPLORATION # 11)
2nd TRY YIELDED ~50% RECOVERY
at 0-5' DEPTH, DUE TO SLOWER speed.
2nd TRY 5-10' ONLY [illegible] TO BE
BLOCKED BY 2" GRAVEL / COBBLE OF
NATIVE ROCK. (PHOTO) SET WELL 4 1/4' - 9 1/4'

DRILLERS TO TRY USING MACRO CORE
AM TUESDAY. AM - WATER / SED. FROM BASIN
READY @ 7 AM

6

1715 @ MW 3, WATER HAD RISEN TO 3' BGS
Delivered ENCORE VOC Soils to Fed Ex
Back @ 8 IN ACCORDANCE (30 min dinner)
FINISHED @ 9 AM 14 - 1 (meals) = 13 HRS

ON SITE @ 7 AM 7/28/15
07:30 COLLECT CATCH BASIN $H_2O$ ABF 01 SW
3 VOAS 4 AMB 1 HDPE(1L) 2 HDPE(1/2 L) W/ BAILER
0810 PROBED CATCH BASIN W/ AUGER
BUCKET ON EXTENSION: NO SEDIMENT
DETECTED IN BASIN. INSTEAD SAMPLED
SEDIMENT WHERE EASTERN SWALE
APPROACHES BASIN (MORE PROMINENT THAN
SWALE TO SW WHICH DRAINS GRAVEL LOT)
SAMPLE ABF 01-SD, COLLECTED 0815 ENCORES + SOIL JARS
[BROWN SILTY SAND, FINE TO MEDIUM, SOME GRAVEL
[GAS ON BASIN: Z072807A]
MIKE WORDEN REPORTED THAT TEMP MW @
EXPLORATION # 3 WAS PRODUCING GROUND $H_2O$
0900 SAMPLED ABF 03 GW AND ABF 23 GW (DUP)
[0910 DUPLICATE]
[ROB MCDANIEL + ELTON STRAWBRIDGE VISIT 930
DECISION: AFTER DISC. W/ R MCDANIEL
CONCURRED ON NEED FOR SOME SUBSURFACE
SAMPLE DATA. ENVIRONEERING TO DO 2-4' PUSH
CORE CONTINGENCY @ ABF 03 + ABF 02
10:30 - COLLECTION OF ABF06 GW

7

ALCOA BADIN BALL FIELD SAMPLING 7/28/15
NCD 000 404 457 BADIN, STANLY CO NC

ABF 03 SB COLLECTION @ 11:00

1150 @ ABF06, ABANDONED DECIDED TO COLLECT (#11)
SUBSURFACE ABF06 SB BY HAND AUGER
DO TO ZERO CORING RECOVERY @ >2 FT
0-2 FT, GRAVELLY, COBBLY SAND & CLAY
MOISTURE @ 2 FT DEPTH, POSSIBLY FROM HEAVY
RAIN THAT OCCURRED PREVIOUS EVENING.
DIFFICULT HAND AUGERING W/ MINIMAL
RECOVERY BELOW 2 FT

12:15 DRILL CREW EMPLACING MW @ #7 @ 4-9' DEPTH
(ABF 04) IN GRAVEL LOT WEST OF PORT-O-LETS
12:30 MW RETURNED WITH VERY ROCKY SOIL
RECOVERY FROM 2-4' DEPTH @ ABF06 (P)
COLLECT ABF06 SB @ 11:55 → SAPROLITE?
13:20 COLLECT ABF04 GW @ #7 LOCATION
1420 COLLECT ABF04 SB 20728 14 A → GRAVELLY SILTY SAND
14:40/1450 COLLECT ABF04 SS AND ABF05 SS
~~DRILLING CREW USED DIRECT PUSH FOR 0.5-2'~~
(COMPOSITE FROM SEPARATE HOLE FROM SB + GW)
NEXT LOCATION ABF09 SS + SB (w/MED) #38
1520 COLLECT ABF09 SS → ~~[illegible]~~
1530 COLLECT ABF09 SB
ABF ~~09~~ 07 SS + SB S END OF FIELD @ #49
ABF 08 SS + SB SW IN FIELD @ #34

8

ABF 07 0-2' LOOKS LIKE NATIVE SOIL
WILL SAMPLE SS + 2-4' AS BKGND
1600 COLLECT ABF07 SS LT BROWN
1605 COLLECT ABF 07 SB GRAVELLY SAND / META ARGILLITE
(0.5-2'), (2-4')
1650 COLLECT ABF08 SS BROWN SANDY CLAY "NATIVE"
1655 COLLECT ABF08 SB BROWN CLAY, WET 2-10'

LEFT SITE FOR RALEIGH @ 1715 END NOTES
STUART F PARKER, NC SUPERFUND [illegible]

# REFERENCE 14

| RECORD OF COMMUNICATION | ☐ PHONE CALL ☒ DISCUSSION ☐ FIELD TRIP ☐ CONFERENCE ☐ OTHER (SPECIFY) (Record of item checked above) | |
|---|---|---|
| TO: File | FROM: Robert Morris, 515B | DATE 7/18/89 TIME PM |

SUBJECT Alcoa Badin Works, NC

SUMMARY OF COMMUNICATION

Spoke with ~~Alco~~ John Dickinson, RCRA on 7/18/89. Alcoa generates/stores pot liner waste. Pot liners were recently relisted under RCRA. Therefore Alcoa is again a RCRA TSD. SSI cancelled. SSI was to be done on contiguous ldfl. ~~~~ There may be another ldfl. in the area. NUS is checking on that.

CONCLUSIONS, ACTION TAKEN OR REQUIRED

INFORMATION COPIES
TO: File

EPA Form 1300-6 (7-72) REPLACES EPA HQ FORM 5300-3 WHICH MAY BE USED UNTIL SUPPLY IS EXHAUSTED.

**REFERENCE 15**

ENVIRONEERING, INC.

# PHASE 3 – ENGINEERING DATA COLLECTION FOR THE

# CORRECTIVE MEASURES STUDY BADIN WORKS FACILITY BADIN, NORTH CAROLINA

**October 31, 2012**

**Prepared for:**

ALCOA

Alcoa, Inc.
Highway 740
Badin, North Carolina 28009

**Prepared by:**

**ENVIRONEERING, INC.**
**810 Highway 6 South, Suite 200**
**Houston, Texas 77079**
**281-493-9005**

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# 1.0 INTRODUCTION

This report is the next step in advancing the Corrective Measures Study outlined in the Corrective Measures Study ("*CMS*") Work Plan approved March 25, 2009, by the North Carolina Department of Environment and Natural Resources ("*NCDENR*"), Division of Waste Management. This report describes the field activities and results outlined in the Phase 3 Engineering Data Collection Work Plan submitted on April 15, 2011, for collecting information to support or reject potentially identified technical alternatives to be applied to the Alcoa Badin Landfill, Old Brick Landfill, and the Alcoa Badin Works Main Plant ("*Sites*").

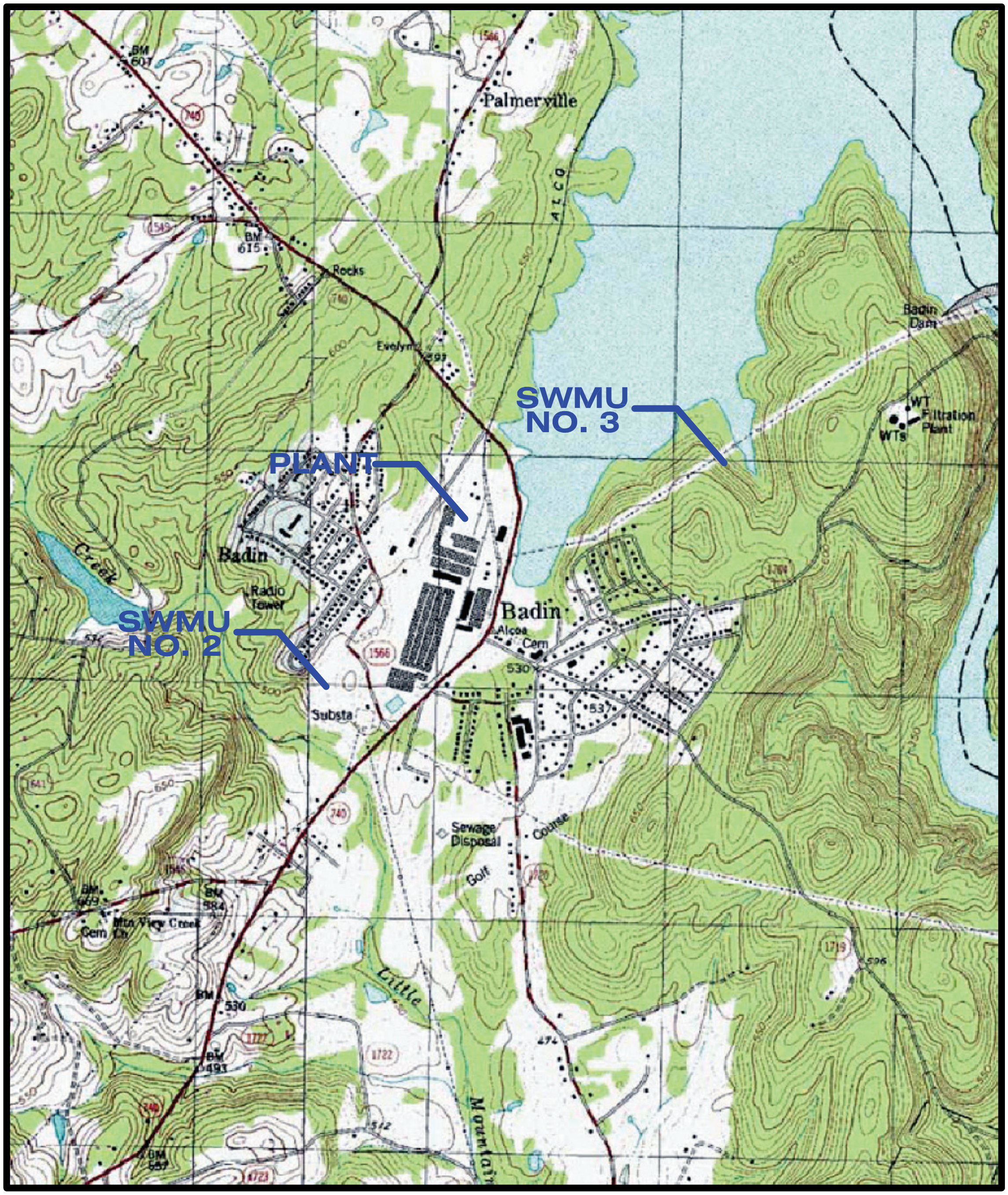
The Alcoa Badin Landfill, Old Brick Landfill, and the Alcoa Badin Works Main Plant are located in the town of Badin, Stanly County, North Carolina. **Figure 1-1** is an excerpt from a United States Geological Survey ("*USGS*") 7.5-minute topographical quadrangle map showing the locations of the Sites as well as topographic features.

## 1.1 Background

In March 1990, Alcoa filed a RCRA Part B permit application with USEPA for the on-site storage of hazardous wastes for greater than 90 days. In response to the permit application, USEPA Region IV performed a RCRA Facility Assessment ("*RFA*") of the Alcoa Badin Works and associated off-site locations. The RFA identified at total of 34 SWMUs and 2 Areas of Concern ("*AOCs*"). Alcoa added an additional twelve SWMUs after the initial RFA was completed. The North Carolina Department of Environment, Health, and Natural Resources Division of Solid Waste Management (now the NCDENR Division of Waste Management), in cooperation with USEPA Region IV, issued the final RCRA Part-B Permit to Alcoa on March 30, 1992. Part VII of Alcoa's RCRA permit outlined the Corrective Action activities to be conducted at Alcoa Badin Works.

The initial step in the Corrective Action process was confirmatory sampling at seven SWMUs to verify if a release had occurred. Based on the results of the RFA and the confirmatory sampling, a RCRA Facility Investigation ("*RFI*") was conducted at 16 SWMUs and AOCs. Alcoa completed the RFI and a report was issued to the NCDENR in March 2001.

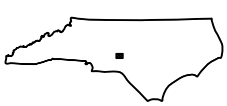
Alcoa conducted Interim Measures activities at a number of the Badin Works SWMUs prior to the RCRA Facility Investigation. The results of these Interim Measures activities were incorporated into the final RFI Report. The RCRA Investigation work findings supported a "No Further Actions" status by the NCDENR for 22 of the facility's SWMUs. The RCRA Facility Investigation report identified groundwater in three areas of the facility as needing further actions. These areas were: the Alcoa/Badin Landfill ("*SWMU No. 2*"); Old Brick Landfill ("*SWMU No. 3*"); and the groundwater northern portion of the Main Plant. NCDENR approved the RCRA Corrective Action Investigation Report in their letter of December 19, 2007.




TOPOGRAPHIC EXCERPT FROM 7.5 MINUTE QUADRANGLE

SOURCE: UNITED STATES GEOLOGICAL SURVEY

BADIN AND NEW LONDON, NORTH CAROLINA QUADRANGLES (1994)



NORTH CAROLINA QUADRANGLE LOCATION

SCALE: 1:24,000

CONTOUR INTERVAL: 2 FEET

N
W E
S

TRUE NORTH APPROXIMATE

**ENVIRONEERING, INC.**

FIGURE 1–1

EXCERPT FROM USGS TOPOGRAPHIC MAP

ALCOA – BADIN WORKS FACILITY

BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|
| | | |

*Alcoa/Badin Landfill ("ABL") (SWMU No. 2)*

The RFI results showed no Constituents of Interest ("COIs") present in soil adjacent to the Alcoa/Badin landfill at concentrations exceeding the conservative risk-based screening values. As a result, soils surrounding SWMU No. 2 do not pose unacceptable risk to potential current or reasonably anticipated future receptors. However, the RFI did show one constituent in groundwater exceeding the screening value in a single well down gradient of the landfill. This constituent was total cyanide. A screening level risk assessment was conducted on the first receptor for groundwater down gradient of the landfill. This receptor is Little Mountain Creek and it showed that no COIs are present at concentrations exceeding applicable human health screening values. The unit was retained in the Corrective Action process because of the detection of total cyanide in one groundwater well above the regulatory standard.

*Old Brick Landfill ("OBL") ("SWMU No. 3")*

The 2001 RFI report demonstrated that there were no COIs present in soils adjacent to the Old Brick Landfill at concentrations exceeding the conservative risk-based screening values. As a result, soils do not present a risk. The RFI results did show groundwater in a few wells contained total cyanide that exceeded the screening values. The unit was retained in the Corrective Action process because of the detection of total cyanide in selected groundwater wells above the regulatory standard. Alcoa upgraded the OBL cover system in 2006 to eliminate point source discharges to surface water under facility's NPDES Permit. This upgrade consisted of cover system reconfiguration to mitigate surface water infiltration, control storm water flow, and manage storm water run-off through infiltration or controlled discharge under the NPDES permit.

*Alcoa Badin Works Main Plant*

Alcoa conducted interim measures activities at a number of SWMUs within the main plant to address residual surface soil impacts prior to the RFI. The subsequent RFI demonstrated that COI impacted soils were addressed by the interim measures work and soil removal activities. No further action was required to address direct contact pathways for soils at the SWMUs and AOCs in the plant area. However, the RFI did identify cyanide, fluoride, arsenic, trichloroethene and trichloromethane (chloroform) as the only constituents of concern in groundwater along the northeast side of the main plant.

Alcoa conducted further site wide investigation of groundwater to characterize fluoride and total cyanide impacts in 2005 and 2006. During this investigation several new groundwater wells were installed at the facility. In February 2005 and February 2006, groundwater samples were collected from new and a number of existing monitoring wells at the facility. Results of this investigation indicated groundwater flow occurs in the Northwest Valley along two axes to the northeast and the east. Primary direction of groundwater flow is to the east and the lesser flow is to the northeast. Fluoride and cyanide distribution in groundwater shows flow is preferential in those directions.

Groundwater within the northern Main Plant area was retained in the Corrective Action process as a result of the RFI and subsequent groundwater investigation. The primary COIs for groundwater are free cyanide and fluoride.

# 2.0 SCOPE OF WORK

The tasks that were performed as part of this study included the following:

1. Fill Assessment – Delineate the lateral and vertical extent of fill through soil borings, soil sample collection, and laboratory analysis. A fill assessment was conducted on the following units:
   a. Alcoa Badin Landfill (SWMU No.2)
   b. Alcoa Badin Works Plant - Waste Oil Storage Area (SWMU No. 35)
   c. Alcoa Badin Works Plant - Pine Tree Grove Area (SWMU No.44)
   d. Alcoa Badin Works Plant - West SPL Area (SWMU No.46)

2. Hydrogeological Assessment – Characterize the correlation of groundwater surface within filled areas through potentiometric monitoring. A hydrogeological assessment was conducted on the following units:
   a. Alcoa Badin Landfill (SWMU No.2)
   b. Alcoa Badin Works Plant - Northwest Valley

3. Water Quality Assessment - Evaluate the water quality through groundwater sampling, surface water sampling, and analysis. A water quality assessment was performed at the following units or area;
   a. Alcoa Badin Landfill (SWMU No.2) Groundwater
   b. Little Mountain Creek Surface Water
   c. Old Brick Landfill (SWMU No.3) Groundwater
   d. Old Brick Landfill Surface Water
   e. Alcoa Badin Works Plant Area Groundwater
   f. Badin Lake Surface Water

A more detailed description of the tasks performed is provided below.

## 2.1 Task 1 – Fill Assessment

A fill assessment was conducted on the Alcoa Badin Landfill, Waste Oil Storage Area, Pine Tree Grove Area, and West SPL Area. The activities conducted to complete this assessment are discussed below.

### 2.1.1 <u>Alcoa Badin Landfill (SWMU No.2)</u>

The ABL fill assessment was undertaken to better understand the fill distribution within the landfill footprint. The investigation strategy for the assessment consisted of the following:

1) A geophysical survey was conducted to determine the location of fill material using an electromagnetic survey ("*EM*"). An EM survey measures the contrasts in subsurface electrical conductivity. The contrasts in subsurface electrical conductivity are indicatory of dissimilar materials such as highly conductive fill against less conductive fill and native soils; and

2) Historical topographic maps were located and geo-referenced to current topographic maps of the area for the purpose of assessing sequential filling activities. In addition, existing boring logs were reviewed to verify the native ground surface profile prior to filling activities. New soil boring/groundwater wells were installed to verify fill-native soil interface as indicated by historical topographic maps.

#### 2.1.2 Alcoa Badin Works Plant - Old Waste Oil Storage Area (SWMU No. 35)

A fill assessment was conducted on the Old Waste Oil Storage Area to identify the extent of fill and further refine characterization of PCB soil impacts within this unit. The results of the assessment were previously submitted to the NCDENR in the SWMU 35 CMS Engineering Investigation Summary Report dated August 31, 2011. Results of the assessment indicated that PCB soil impact was limited in depth and did not impact groundwater beneath the SWMU.

#### 2.1.3 Alcoa Badin Works Plant - Pine Tree Grove Area (SWMU No.44)

A fill assessment at the Pine Tree Grove Area was conducted to determine the nature and extent of the fill and to further understand if fill materials within these areas are impacting groundwater. The investigation strategy for the assessment consisted of the following:

1) A geophysical survey was conducted to determine the location of fill material using multiple geophysical technologies. The technologies applied at this location consisted of EM, ground penetrating radar ("*GPR*"), and seismic refraction ("*seismic*") survey methods. The EM survey method was utilized to identify areas of elevated conductivity that are indicative of dissimilar materials such as highly conductive fill against less conductive fill and native soils. The GPR and seismic methods were deployed to distinguish the structure of fill material areas versus native material areas; and

2) A drilling and sampling investigation was conducted at the Pine Tree Grove Area to verify or "truth" the results of the geophysical survey. Six locations within the Pine Tree Grove were drilled to the fill-native soil interface, and soil cores collected and logged. Discrete soil samples were collected from selected intervals in each soil core for laboratory analysis for fill material characterization. The soil samples were delivered to TestAmerica Laboratories, Inc. in Savannah, Georgia for analysis for the presence of Total Cyanide and Total Fluoride.

#### 2.1.4 Alcoa Badin Works Plant - West SPL Area (SWMU No.46)

A fill assessment at the West SPL Area was conducted to determine the nature and extent of the fill and to further understand if fill materials within these areas are impacting groundwater. The investigation strategy for the assessment consisted of the following:

1) A geophysical survey was conducted to determine the location of fill material using multiple geophysical technologies. The technologies applied at this location consisted of EM, GPR, and seismic survey methods. These technologies were selected based on the rationale discussed in Section 2.1.3; and

2) A drilling and sampling investigation was conducted at the West SPL Area to verify or "truth" the results of the geophysical survey. Eleven locations within the West SPL Area were drilled to the fill-native soil interface, and soil cores collected and logged. Discrete soil samples were collected from selected intervals in each soil core for laboratory analysis for fill material characterization. The soil samples were delivered to TestAmerica Laboratories, Inc. in Savannah, Georgia for analysis for the presence of Total Cyanide and Total Fluoride.

## 2.2 Task 2 – Hydrogeological Assessment

### 2.2.1 Alcoa Badin Landfill (SWMU No.2) Groundwater

The ABL hydrogeological assessment was undertaken to better understand the groundwater within the landfill footprint. The investigation strategy for the assessment consisted of the following:

1) A routine groundwater elevation monitoring program was implemented to collect potentiometric head data from groundwater well network installed within and down gradient of the unit. The purpose of the data collection effort was to evaluate groundwater surface within the fill; and

2) A precipitation monitoring program was implemented to collect rain data at the landfill. The purpose of the precipitation monitoring program was to evaluate inclement weather and seasonal effects on the groundwater surface.

### 2.2.2 Alcoa Badin Works Plant Area Groundwater

The Plant Area hydrogeological assessment was undertaken to better understand facility wide groundwater. The investigation strategy for the assessment consisted of the following:

1) A routine groundwater elevation monitoring program was implemented to collect potentiometric head data from groundwater well network. The purpose of the data collection effort was to determine the groundwater gradient and flow direction at the plant and needed to provide a better understanding of the interaction of the groundwater with Badin Lake.

## 2.3 Task 3 – Water Quality Assessment

### 2.3.1 Alcoa Badin Landfill (SWMU No.2) Groundwater

The Alcoa Badin Landfill underwent significant cover system improvements as an Interim Measures since the commencement of the RFI process. The beneficial effects of this Interim Measures have not been fully evaluated. To gain an understanding of "Post" Interim Measures groundwater conditions, the investigation strategy for the assessment consisted of the following:

1) A routine groundwater monitoring program was implemented to collect water quality data from selected wells in the existing groundwater well network. The purpose of the data collection effort was to evaluate the potential effects of interim measures and cover system improvements on the groundwater water quality.

2.3.2 Little Mountain Creek Water

Results from the RFI showed one constituent in ABL groundwater exceeding the screening value in a single well down gradient of the landfill. As part of the RFI, a screening level risk assessment was conducted on the first down gradient groundwater receptor, Little Mountain Creek. The screening level risk assessment showed that no COIs were present at concentrations exceeding applicable human health screening values. To confirm this current understanding, the investigation strategy for the assessment consisted of the following:

1) A surface water sampling event was performed to collect water quality data from Little Mountain Creek at a downstream location. The purpose of this sampling effort was to determine if the creek has been impacted by the Alcoa Badin Landfill.

2.3.3 Old Brick Landfill (SWMU No. 3) Groundwater

Significant cover system upgrades were performed at the Old Brick Landfill since the commencement of the RFI process. This cover system upgrade was conducted in support of NPDES permit to eliminate a point source discharge. The beneficial effect of the cover system upgrade has not been fully evaluated. Results from the RFI demonstrated that groundwater contained total cyanide that exceeded the screening values. The unit was retained in the Corrective Action process because of the detection of total cyanide in groundwater wells above the regulator standard. To gain an understanding of cover system upgrades on groundwater conditions, the investigation strategy for the assessment consisted of the following:

1) A routine groundwater monitoring program was implemented to collect water quality data from selected wells in the existing groundwater well network. The purpose of the data collection effort was to evaluate the potential effects of cover system upgrades on the groundwater water quality.

2.3.4 Old Brick Landfill Surface Water

Results from the RFI showed constituents in OBL groundwater exceeding the screening value. A screening level risk assessment was conducted on the first down gradient groundwater receptor, Badin Lake. The screening level risk assessment showed that no COIs were present at concentrations exceeding applicable human health screening values. To confirm this current understanding, the investigation strategy for the assessment consisted of the following:

1) A surface water sampling event was performed to collect water quality data from Badin Lake. The purpose of this sampling effort was to determine if the lake has been impacted by the Old Brick Landfill.

### 2.3.5 Alcoa Badin Works Plant Area Groundwater

The RFI identified multiple constituents of concern in groundwater along the northeast side of the main plant primarily within the Northwest Valley. To gain an understanding of the current groundwater conditions for the evaluation of potential alternative treatment technologies, the investigation strategy for the assessment consisted of the following:

1) A groundwater sampling program was implemented to collect water quality data from selected wells in the existing groundwater well network. The purpose of the data collection effort was to evaluate the effects of interim measures, assess current conditions, and provide data to evaluate the potential applicability of monitored natural attenuation, permeable reactive barriers, and other technologies.

### 2.3.6 Badin Lake Surface Water

Results from the RFI showed constituents in Northwest Valley groundwater exceeding the screening values. A screening level risk assessment was conducted on the first down gradient groundwater receptor, Badin Lake. The screening level risk assessment showed that no COIs were present at concentrations exceeding applicable human health screening values. To confirm this current understanding, the investigation strategy for the assessment consisted of the following:

1) A surface water sampling event was performed to collect water quality data from Badin Lake. The purpose of this sampling effort was to determine if the lake has been impacted by the groundwater concentrations present in the Northwest Valley area.

# 3.0 RESULTS

The results of the fill assessment, hydrogeological assessment and water quality assessment are presented below.

## 3.1 Task 1 – Fill Assessment

A fill assessment was conducted on the Alcoa Badin Landfill, Waste Oil Storage Area, Pine Tree Grove Area, and West SPL Area. The results from this assessment are discussed below.

### 3.1.1 Alcoa Badin Landfill (SWMU No.2)

The Alcoa Badin Landfill was utilized Alcoa and the community in Stanly County as a local "dump" for general municipal refuse and industrial debris. The ABL was created by filling in a natural ravine, which extends from south of Wood Street towards Little Mountain Creek. The unlined landfill is located approximately 500 ft south of the fenced plant area and occupies approximately 14 acres. Alcoa ceased operations of the landfill in the mid-1970's. The landfill was graded, covered with native soils, and seeded with grass.

The fill assessment at the ABL was conducted by evaluating the 2007 geophysical survey, installing soil borings and monitoring wells in and around the landfill, and comparing early 20th century topographic maps with current topographic maps of the area.

Geophysical Survey

The original boundary of SWMU No. 2 was determined based upon physical features and investigation data. A portion of the eastern edge of the landfill is bordered by the Alcoa Power and Generating Inc. ("APGI") high voltage electrical substation and switchyard. In 2007, landfill waste material was encountered found in a civil engineering boring advanced within the APGI switchyard. Material encountered in the boring was consistent with the known material managed at the landfill. Geo Solutions, Inc. ("*Geo Solutions*"), an independent geophysical firm, was contracted to conduct a survey to estimate the horizontal footprint of the ABL.

The geophysical surveys incorporated both EM and GPR techniques to determine the horizontal extent of this unit. Details of the 2007 geophysical survey of the ABL area have been previously submitted to the NCDENR in a report entitled "*Investigation Summary Report, Alcoa, Inc. Old Badin Landfill and APGI Switchyard, Badin, North Carolina*" dated February 22, 2008. A copy of the geophysical survey is included in **Appendix A**.

Soil Boring Installation

The geophysical survey results were verified by soil "truthing" borings. A total of 13 soil borings were installed. Municipal/industrial waste-based fill material was observed at approximately 7 to 8 feet below land surface ("bls") in three soil borings (SB-10, SB-11, and SB-12). No municipal/industrial waste-based fill material was observed in the other ten soil borings.

When the geophysical data was correlated with soil boring information, a determination of the horizontal extent of buried fill material within the landfill footprint was made. An updated landfill boundary map based upon this new information showed a slight shift of eastern border into the APGI substation area. Alcoa provided a revised SWMU No. 2 inferred boundary map to NCDENR in the report titled "Investigation Summary Report – Old Badin Municipal Landfill & APGI Switchyard" dated February 22, 2008.

Well Installation

During the course of the investigation, Alcoa elected to install seven new monitor wells at the ABL (PZ-13 through PZ-19) to further assess the hydrogeologic conditions within the landfill. The monitoring wells and soil borings were installed using a track mounted Geoprobe Systems® rig operated by American Environmental Drilling, Inc. of Aberdeen, North Carolina. Soil cores were collected continuously from each soil boring using a Dual Tube or Macro-Core® sampling system. The soil cores were examined and logged by a qualified geologist in the field by describing lithology, mineralization, color, texture, and other relevant features.

After completion of the soil borings, monitoring wells were installed to the fill-native soil interface. Screening intervals were selected based on soil boring lithology to evaluate the presence of groundwater within the fill material. These wells were constructed of 1-inch diameter flush-threaded Schedule 40 PVC screen and casing with the screen machine slotted to 0.010 inch. A sand pack was placed from the bottom of the well to at least 1 foot above the top of the screen. A bentonite plug was installed on top of the sand pack. The remaining annulus was grouted to land surface using cement and bentonite slurry. Boring logs and well construction details are provided in **Appendix B**.

The monitoring wells were completed up-right, locking aluminum protective covers, concrete pads and steel protective bollards. The location of the monitoring wells and soil borings are shown on **Figure 3-1**.

The wells were developed by alternately surging and pumping the wells until the wells produced clear water that was relatively free of suspended solids. The location and elevation of the wells were surveyed by Bateman Civil Survey Company, P.C. ("*BCSC*"), a State of North Carolina licensed surveyor, in March 2010.

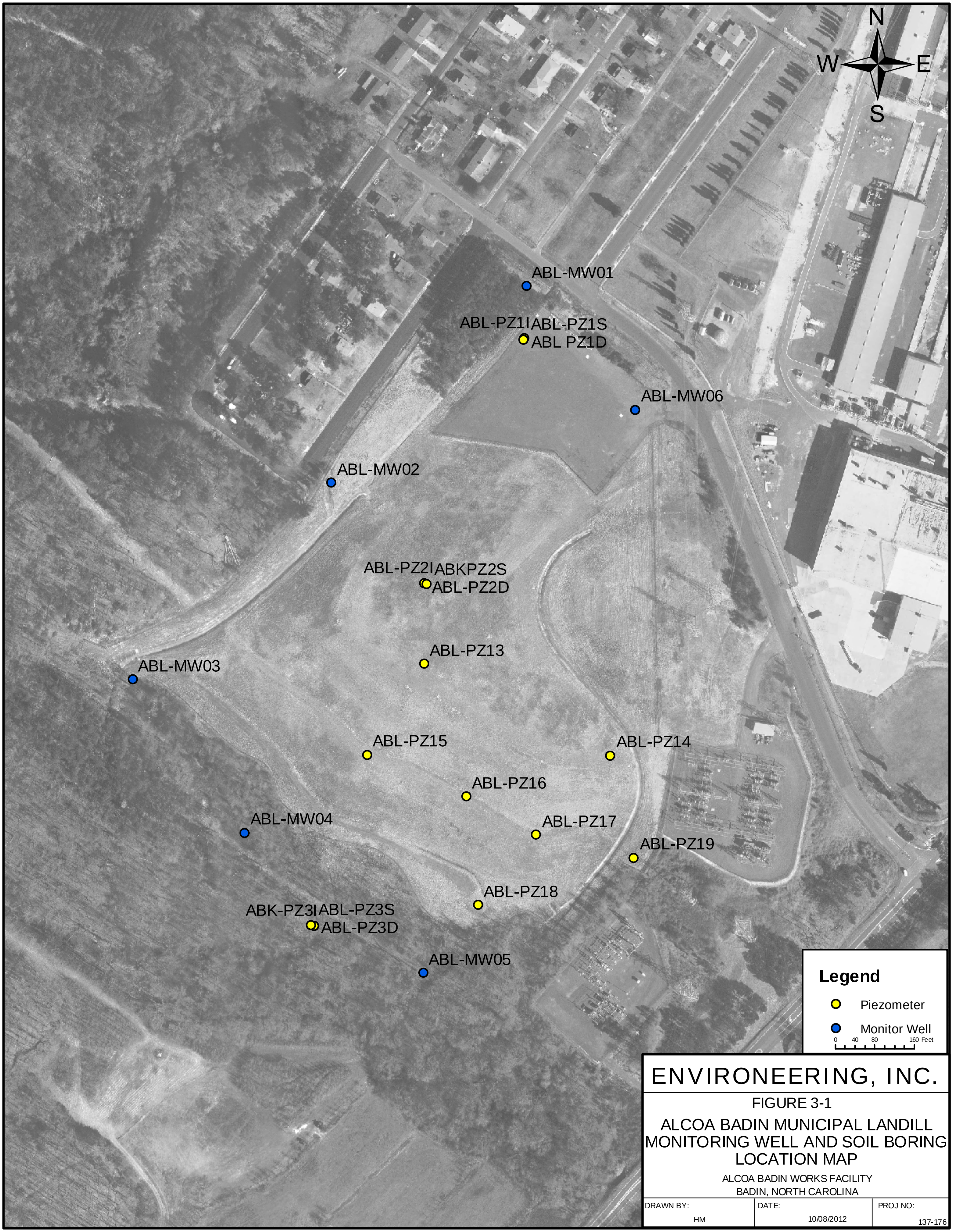



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FIGURE 3-1

ALCOA BADIN MUNICIPAL LANDILL MONITORING WELL AND SOIL BORING LOCATION MAP

ALCOA BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ NO: |
|---|---|---|
| HM | 10/08/2012 | 137-176 |

Topographic Comparison

The ABL is situated in generally rolling terrain near the topographic midpoint, with decreases in elevation towards the southwest, south, and southeast and increases in elevation towards the northwest, north, and northeast. Based upon the USGS topographic and surveyed elevations at SWMU No. 2, elevations at the Site area range from approximately 540 feet above mean sea level ("ft msl") at the crest of the landfill to 470 ft msl near Little Mountain Creek. Badin Lake is located approximately 2,500 feet to the northeast. The Yadkin River is located approximately 7,900 feet to the east at an elevation of approximately 330 ft msl. Regional elevations range from approximately 730 ft msl to 330 ft msl.

Based on available data, a comparative study of historical and current topographic maps was performed. The following topographic maps were used in the comparative study:

Topographic Map of Plant Site at Ebenezer; prepared for Southern Aluminum Company, Whitney, North Carolina; Drawing 3D64 dated September 8, 1913; Scale, 1 inch equals 100 feet.

Topographical Map of Pot Room Site; prepared for Aluminum Company of America, Badin Works; Drawing A214 dated February 23, 1916; Scale, 1 inch equals 100 feet.

Plan of Lots for Laborers' Houses; prepared for Tallahassee Power Company, Badin Works; Drawing A5321 dated January 17, 1917; Scale, 1 inch equals 40 feet.

Alcoa-Badin Landfill Regrading and Cover System Installation Original Site Topography Confirmation Plan; prepared for Aluminum Company of America, Badin Works; Drawing A-052764-BN dated April 2, 1997; Scale, 1 inch equals 50 feet.

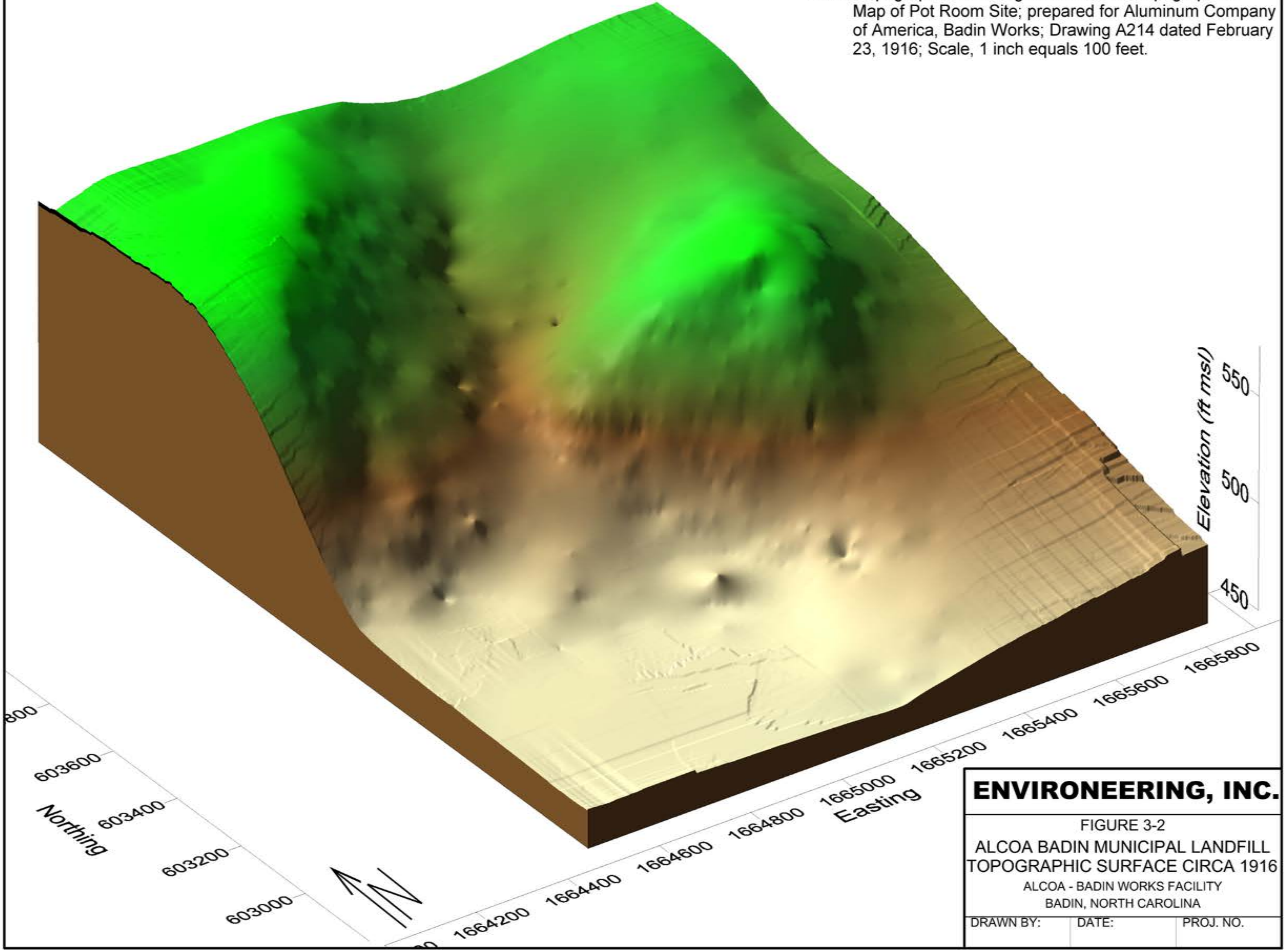
Alcoa-Badin Landfill Regrading and Cover System Installation Geotechnical Investigation Program Site Plan (Rev 1); prepared for Aluminum Company of America, Badin Works; Drawing A-052770-BN dated January 17, 1997, updated April 2, 1997; Scale, 1 inch equals 50 feet.

Drainage Basin Topographic Survey; prepared for ENVIRONEERING, Inc. and Alcoa Inc.; Drawing 080231 dated July 28, 2009; Scale, 1 inch equals 100 feet.

When digital maps or data were not available, prints were digitized for use in AutoCAD. As necessary, the topographic datum was adjusted to align with US Government datum. Raw XYZ coordinates were extracted from the AutoCAD DXF file containing contours and other elevation entities using a utility conversion program (DXF2XYZ 2.0 by Guthrie CAD/GIS Software Pty Ltd.). The most current modern elevation information was used by retrieving raw data from a 2009 topographic survey performed by BCSC.

A pre-fill 3-dimensional (3D) construction of area based on the 1916 topographic map is provided as **Figure 3-2**. A 3D construction of the current topographic surface is provided as **Figure 3-3**. Using a geologic computational program (Surfer Version 11 by Golden Software Inc.), the digitized data sets compared the two databases and extracted the difference. The difference was contoured to produce the thickness data. An interpolated map showing the thickness of the fill material is presented as **Figure 3-4**. The evaluation of the data suggests that capping and fill materials were used to raise a natural ravine to its existing grade, or approximately 13 to 42 feet, depending on location.

Note: Topographic surface generated from Topographical Map of Pot Room Site; prepared for Aluminum Company of America, Badin Works; Drawing A214 dated February 23, 1916; Scale, 1 inch equals 100 feet.

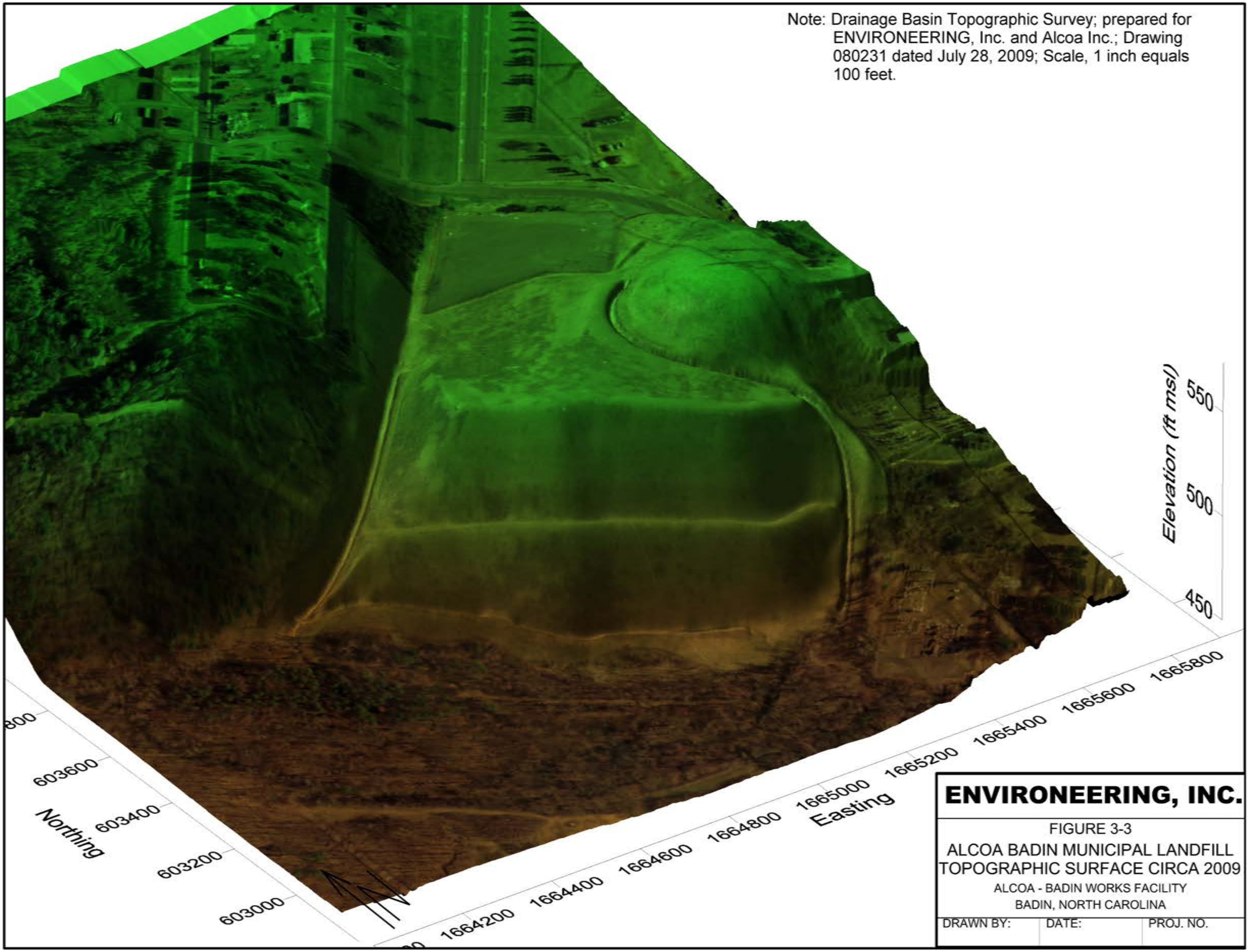



**ENVIRONEERING, INC.**

FIGURE 3-2
ALCOA BADIN MUNICIPAL LANDFILL
TOPOGRAPHIC SURFACE CIRCA 1916
ALCOA - BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|

Note: Drainage Basin Topographic Survey; prepared for ENVIRONEERING, Inc. and Alcoa Inc.; Drawing 080231 dated July 28, 2009; Scale, 1 inch equals 100 feet.



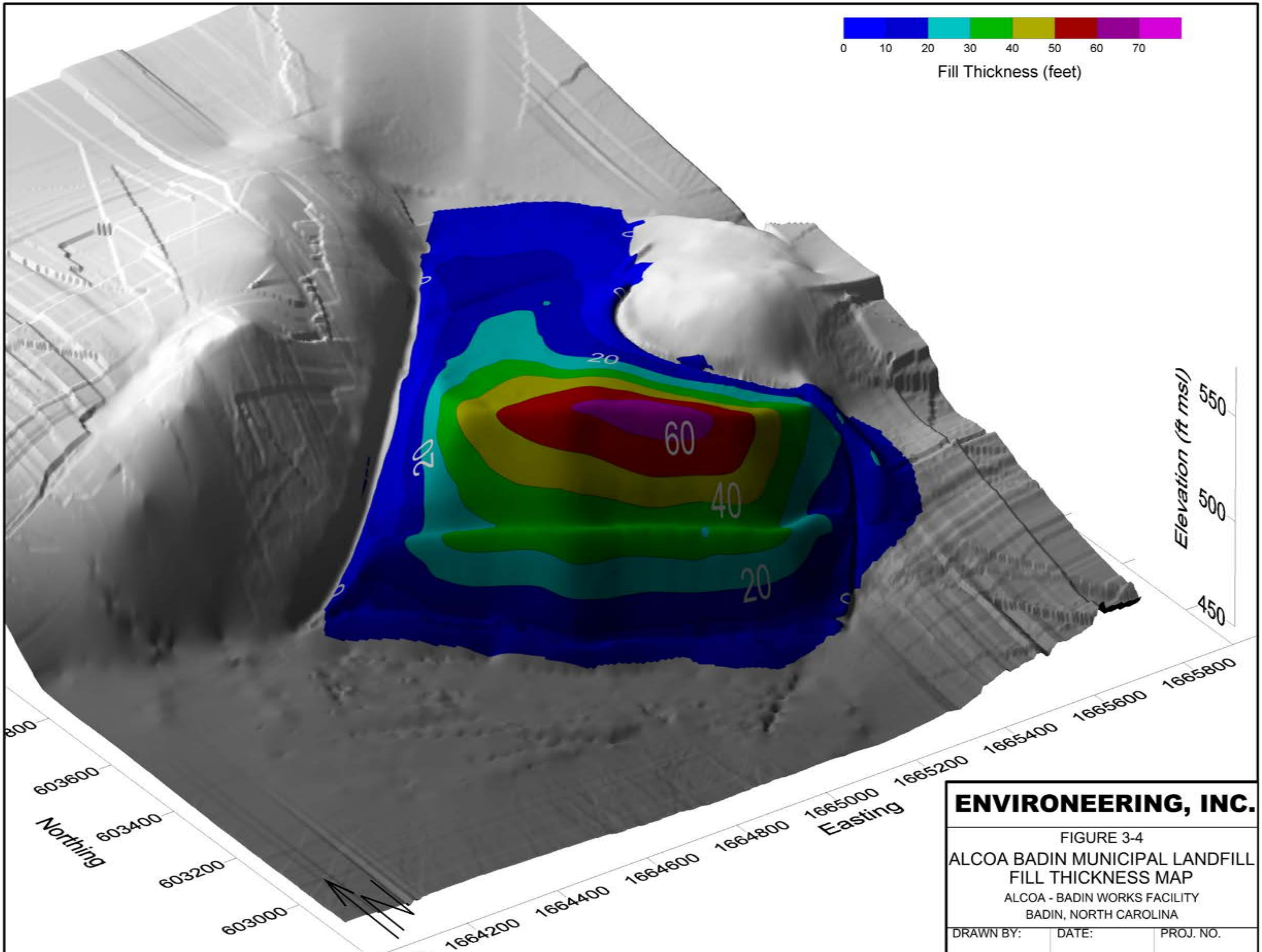

**ENVIRONEERING, INC.**

FIGURE 3-3

ALCOA BADIN MUNICIPAL LANDFILL
TOPOGRAPHIC SURFACE CIRCA 2009

ALCOA - BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
| --- | --- | --- |




**ENVIRONEERING, INC.**

FIGURE 3-4
ALCOA BADIN MUNICIPAL LANDFILL
FILL THICKNESS MAP
ALCOA - BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|

P105-106 1974 Bldg 105 grading & 134 Equip Foundation [photograph]
Photograph direction is approximately NNE

In 2011, the geophysical survey referenced in Section 3.1.4 was performed over the area identified in the RFI as SWMU No. 46. The geophysical survey confirmed the locations of SWMU No. 43's concrete pad and SWMU No. 46 as a highly conductive anomaly. Several borings were installed in the area, which confirmed the presence of carbonaceous material. This carbonaceous material is most likely associated with plant process operations including the storage and transport of coke material to the coke crusher.

A review of historical topographic maps, historical photographs, aerial imagery and recent Site investigative activities confirms that the SWMU No. 46 is a fill area. This data supports a morphology consisting of native fill soils and minor amounts of plant process remnants used to raise the area to its existing grade, or approximately 10 to 20 feet.

## 3.2 Task 2 – Hydrogeological Assessment

### 3.2.1 Alcoa Badin Landfill (SWMU No.2) Groundwater

The ABL hydrogeological assessment was undertaken to better understand the groundwater within the landfill footprint. The investigation strategy for the assessment consisted of a routine groundwater elevation monitoring program and a precipitation monitoring program.

Groundwater Elevation Monitoring

A routine groundwater elevation monitoring program was implemented to collect potentiometric head data from groundwater well network installed within and down gradient of the unit. The purpose of the data collection effort was to evaluate groundwater surface within the fill.

To accomplish this task, pressure transducers were installed in selected wells in March 2010. Each transducer was set up to collect pressure data on ten to fifteen minute intervals. The pressure data was then converted to head data, and adjusted, if necessary, to barometric pressure fluctuations. The head data was compiled and used to determine the maximum, minimum, and median potentiometric heads observed in each well. Potentiometric surface maps were generated using this data. Groundwater contour maps showing the maximum and minimum potentiometric heads at the ABL are provided in **Figures 3-11A and 3-11B**. Maximum and minimum potentiometric head data is presented in **Table 3-3**.

Maximum and minimum potentiometric surfaces were overlain on the pre-fill 3D construction of area originally presented as **Figure 3-2**. The overlay of the two 3D surfaces shows a potential limited area of intersection where groundwater may be on contact with fill materials.

Precipitation Monitoring

A precipitation monitoring program was implemented to collect rain data at the landfill. The purpose of the precipitation monitoring program was to evaluate inclement weather and seasonal effects on the groundwater surface within the landfill.

To accomplish this task, Alcoa purchased and installed a data logging rain gauge and associated equipment to collect rainfall measurements at the landfill. The data logging rain gauge records time and date data with each tip of the rain gauge bucket, or 0.01” rainfall.

Hydrographs displaying potentiometric data and rainfall as a function of time are presented in **Appendix I**. The hydrographs generally indicate that heads observed in upgradient and landfill wells fluctuate seasonally. Heads observed in the floodplain generally demonstrate lower seasonal fluctuations, if any. Heads in the wells located outside the cap area are generally quicker responding to precipitation events versus wells located within the footprint of the landfill cap. These hydrographs indicate that the landfill cap is effective in reducing infiltration through capped areas.

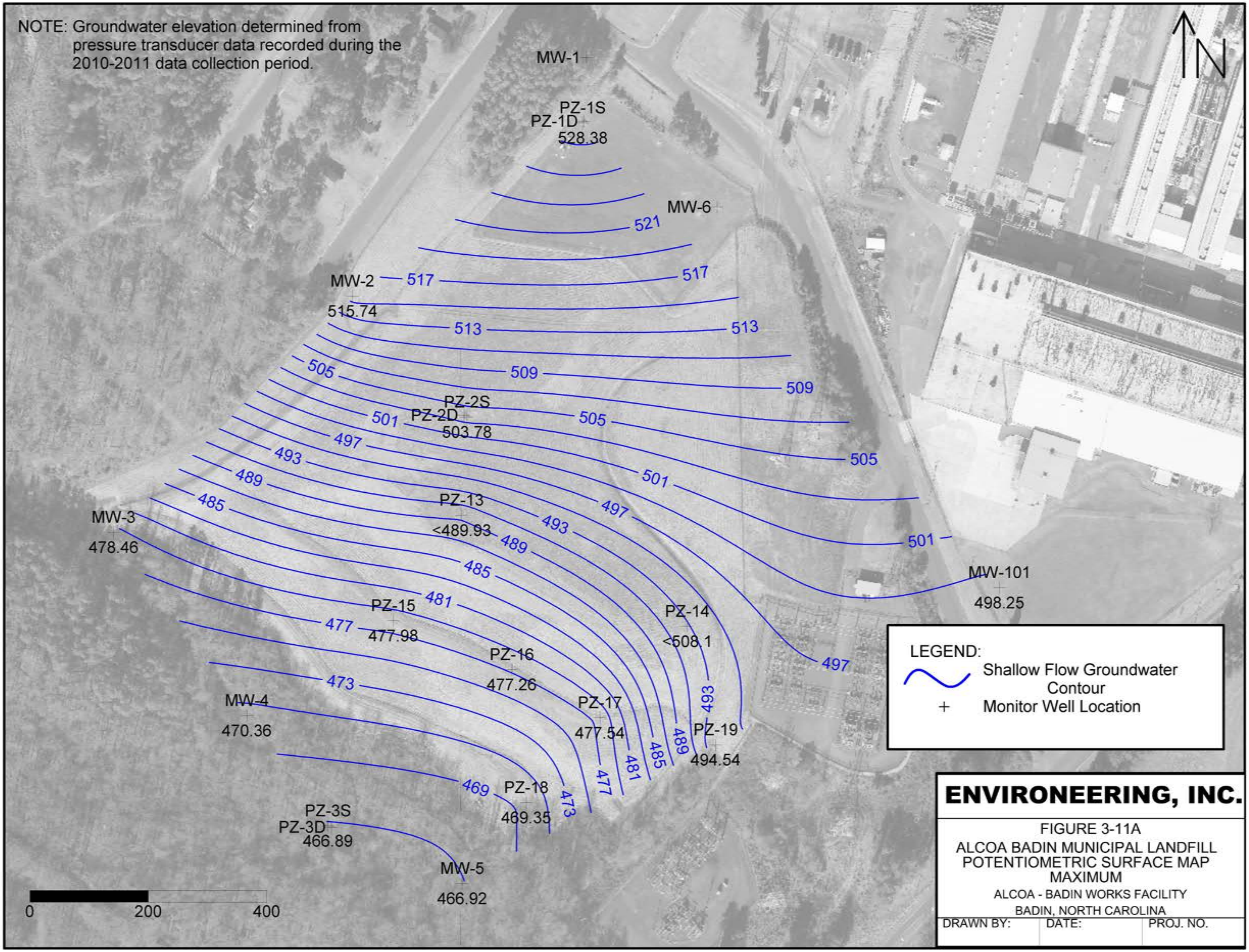
### 3.2.2 Alcoa Badin Works Plant Area Groundwater

The Plant Area hydrogeological assessment was undertaken to better understand the groundwater within the plant boundary with an emphasis on the Northwest Valley. The investigation strategy for the assessment consisted of a routine groundwater elevation monitoring program to collect potentiometric head data from groundwater well network. The purpose of the data collection effort was to determine the groundwater gradient and flow direction at the plant and needed to provide a better understanding of the interaction of the groundwater with Badin Lake.

A total of 36 pressure transducers were installed in groundwater wells distributed throughout the facility. Each transducer was set up to collect pressure data on fifteen minute intervals. The pressure data was then converted to head data, and adjusted, if necessary, to barometric pressure fluctuations. The head data was compiled and used to determine the maximum, minimum, and median potentiometric heads observed in each well. The transducers have been in place collecting data since March of 2011. Potentiometric surface maps were generated using this data.

For the purposes of assessing flow at the site, fill material and native soil/saprolite units were segregated. Details of the monitoring wells located in the Alcoa Badin Works Plant Area screened lithology and potentiometric surface construction are provided in **Table 3-4**.

Groundwater contour maps showing the maximum and minimum potentiometric surfaces within the fill materials and soil/saprolite/weathered rock units in the Northwest Valley are provided as **Figures 3-12A and 3-12B** and **Figures 3-13A and 3-13B**.


NOTE: Groundwater elevation determined from pressure transducer data recorded during the 2010-2011 data collection period.
N
MW-1
PZ-1S
PZ-1D
528.38
MW-6
521
MW-2
515.74
517
517
513
513
509
509
505
505
505
PZ-2S
PZ-2D
503.78
501
501
501
497
497
497
493
493
493
489
489
489
485
485
485
481
481
477
477
473
473
469
MW-3
478.46
PZ-13
<489.93
MW-101
498.25
PZ-14
<508.1
PZ-15
477.98
PZ-16
477.26
PZ-17
477.54
PZ-19
494.54
MW-4
470.36
PZ-18
469.35
PZ-3S
PZ-3D
466.89
MW-5
466.92
0
200
400
LEGEND:
Shallow Flow Groundwater Contour
Monitor Well Location
ENVIRONEERING, INC.
FIGURE 3-11A
ALCOA BADIN MUNICIPAL LANDFILL
POTENTIOMETRIC SURFACE MAP
MAXIMUM
ALCOA - BADIN WORKS FACILITY
BADIN, NORTH CAROLINA
DRAWN BY:
DATE:
PROJ. NO.

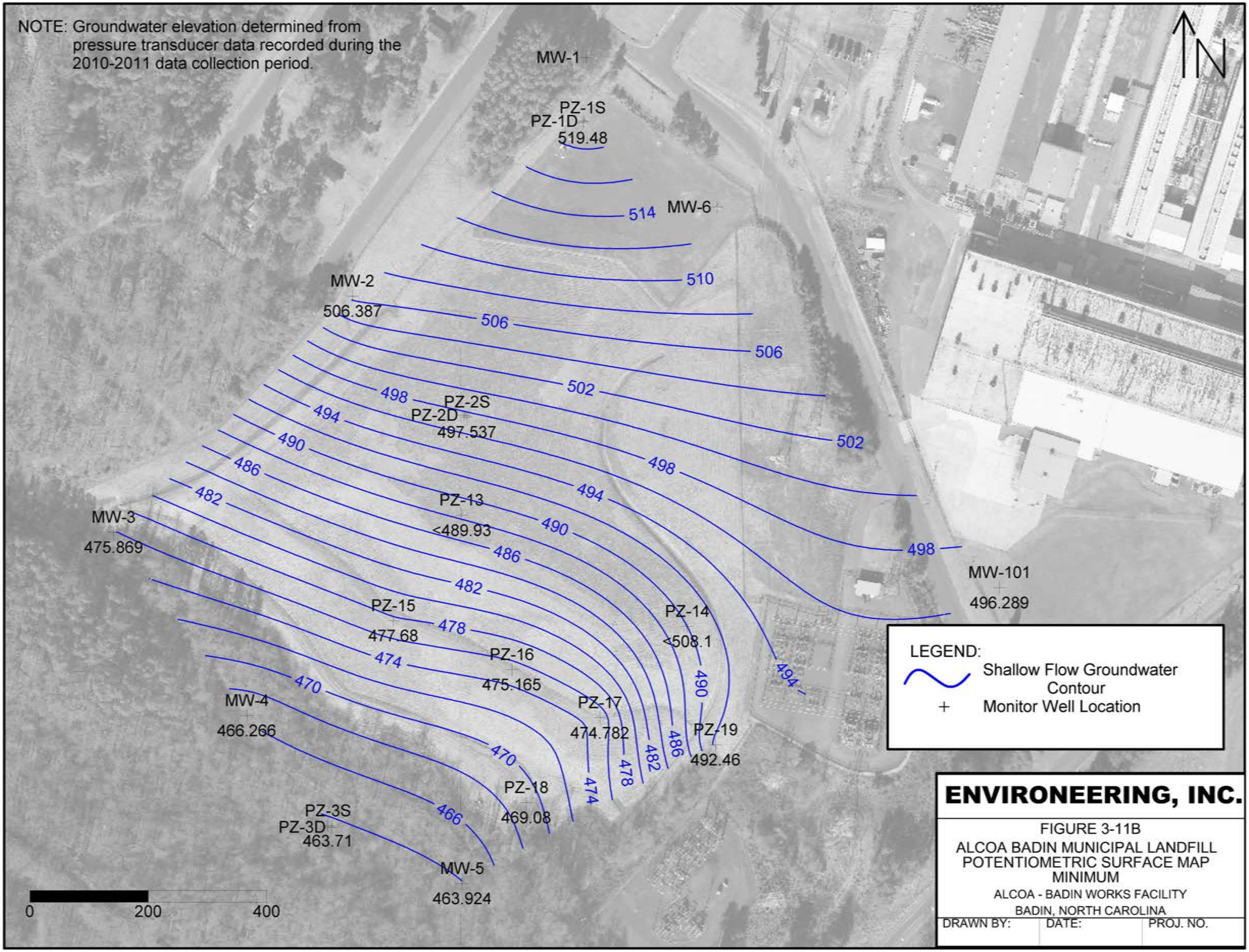

NOTE: Groundwater elevation determined from pressure transducer data recorded during the 2010-2011 data collection period.
N
MW-1
PZ-1S
PZ-1D
519.48
514
MW-6
510
MW-2
506.387
506
506
502
502
498
PZ-2S
PZ-2D
497.537
494
490
486
482
498
494
PZ-13
<489.93
490
486
482
498
MW-3
475.869
MW-101
496.289
PZ-15
477.68
478
474
PZ-14
<508.1
PZ-16
475.165
470
490
494
MW-4
466.266
PZ-17
474.782
PZ-19
492.46
470
486
482
478
474
PZ-18
469.08
466
PZ-3S
PZ-3D
463.71
MW-5
463.924
0
200
400
LEGEND:
Shallow Flow Groundwater Contour
Monitor Well Location
ENVIRONEERING, INC.
FIGURE 3-11B
ALCOA BADIN MUNICIPAL LANDFILL
POTENTIOMETRIC SURFACE MAP
MINIMUM
ALCOA - BADIN WORKS FACILITY
BADIN, NORTH CAROLINA
DRAWN BY:
DATE:
PROJ. NO.

**Table 3-3**
**Compiled Groundwater Elevation Data**
**SWMU No. 2 - Alcoa Badin Municipal Landfill**
**Alcoa-Badin Works Facility**
**Badin, North Carolina**

| Well ID | LOCATION X | Y | Screened Lithology [1] | Top of Casing Elevation [2] | Maximum Elevation [3] | Minimum Elevation [3] |
|---|---|---|---|---|---|---|
| MW-1 | 1665213 | 604448 | HWR/Rock | 541.35 | 524.46 | 513.37 |
| MW-2 | 1664817 | 604045 | Soil | 540.85 | 515.74 | 506.39 |
| MW-3 | 1664414 | 603645 | Soil | 478.22 | 478.46 | 475.87 |
| MW-4 | 1664639 | 603336 | Soil | 472.02 | 470.36 | 466.27 |
| MW-5 | 1665003 | 603052 | Soil | 468.58 | 466.92 | 463.92 |
| MW-6 | 1665433 | 604195 | HWR/Rock | 538.16 | 517.91 | 509.18 |
| PZ-1S | 1665206 | 604337 | Fill/Soil | 538.82 | 528.39 | 519.48 |
| PZ-1I | 1665208 | 604340 | HWR/Rock | 538.84 | 524.31 | 513.24 |
| PZ-1D | 1665208 | 604340 | HWR/Rock | 538.96 | 520.06 | 509.54 |
| PZ-2S | 1665011 | 603840 | Fill/Soil | 542.61 | 503.78 | 497.54 |
| PZ-2I | 1665006 | 603843 | HWR/Rock | 542.87 | PINCHED | PINCHED |
| PZ-2D | 1665006 | 603843 | HWR/Rock | 542.88 | 498.90 | 489.27 |
| PZ-3S | 1664776 | 603149 | Soil | 470.37 | 466.89 | 463.71 |
| PZ-3I | 1664782 | 603147 | HWR/Rock | 469.81 | 468.47 | 464.07 |
| PZ-3D | 1664782 | 603147 | HWR/Rock | 469.82 | 467.93 | 464.60 |
| PZ-13 | 1665002 | 603674 | Fill | 548.13 | DRY | DRY |
| PZ-14 | 1665383 | 603486 | Fill | 537.6 | DRY | DRY |
| PZ-15 | 1664886 | 603496 | Fill | 514.5 | 477.98 | 477.68 |
| PZ-16 | 1665087 | 603413 | Fill | 509.97 | 477.26 | 475.17 |
| PZ-17 | 1665236 | 603332 | Fill | 506.88 | 477.54 | 474.78 |
| PZ-18 | 1665111 | 603189 | Fill | 475.28 | 469.35 | 469.08 |
| PZ-19 | 1665431 | 603286 | Fill | 507.55 | 494.54 | 492.46 |
| MW-101 | 1665910 | 603552 | SWR | 516.37 | 498.25 | 496.29 |

[1] Screened lithologies were determined from boring logs
[2] All elevations are above mean sea level and are based on top of casing data presented in the RFI.
[3] Groundwater data compiled from well logger data collected in 2010 and 2011

**Table 3-4**
**Compiled Groundwater Elevation Data**
**Plant Area**
**Alcoa-Badin Works Facility**
**Badin, North Carolina**

| Well ID | LOCATION X | LOCATION Y | Screened Lithology [1] | Top of Casing Elevation [2] | Maximum Elevation [3] | Minimum Elevation [3] | Potentiometric Surface Construction |
|---|---|---|---|---|---|---|---|
| BF-2 | 1666762 | 605884 | HWR/Rock | 525 22 | 520 29 | 515 27 | -- |
| BF-5 | 1666547 | 605701 | SWR | 523 81 | 514 19 | 511 99 | SOIL/SAPROLITE/SWR |
| BF-6 | 1667258 | 605604 | Fill/Soil | 521 51 | 512 62 | 508 74 | FILL |
| BF-7 | 1666948 | 605418 | HWR/Rock | 523 12 | 523 03 | 511 11 | -- |
| MW-1 | 1666640 | 606261 | SWR | 555 59 | 523 48 | 538 11 | SOIL/SAPROLITE/SWR |
| MW-2 | 1666920 | 606722 | Soil/SWR | 538 67 | 524 14 | 516 76 | SOIL/SAPROLITE/SWR |
| MW-2A | 1666915 | 606713 | Rock | 538 58 | 523 09 | 517 35 | -- |
| MW-3 | 1666868 | 607094 | SWR | 542 02 | 532 91 | 525 56 | SOIL/SAPROLITE/SWR |
| MW-4 | 1667239 | 607071 | Soil/SWR | 524 71 | 518 40 | 510 10 | SOIL/SAPROLITE/SWR |
| MW-5 | 1667396 | 606653 | Fill/Soil/SWR | 517 5 | 509 19 | 507 03 | FILL |
| MW-6 | 1667078 | 606787 | Fill | 526 11 | 516 03 | 515 03 | FILL |
| MW-6A | 1667080 | 606794 | HWR/Rock | 525 05 | 521 16 | 516 87 | -- |
| MW-7 | 1666409 | 606357 | SWR | 565 71 | 551 08 | 538 13 | SOIL/SAPROLITE/SWR |
| MW-8 | 1667335 | 607013 | SWR | 523 01 | 512 86 | 508 45 | SOIL/SAPROLITE/SWR |
| MW-9 | 1667379 | 607179 | SWR | 529 3 | 513 63 | 509 11 | SOIL/SAPROLITE/SWR |
| MW-10 | 1667465 | 606081 | SWR | 531 03 | 516 28 | 508 09 | SOIL/SAPROLITE/SWR |
| MW-11 | 1666732 | 607120 | Fill/SWR | 545 15 | 537 61 | 528 56 | FILL |
| MW-12 | 1666965 | 607178 | SWR | 535 66 | 521 69 | 505 91 | SOIL/SAPROLITE/SWR |
| MW-13 | 1666720 | 606704 | SWR | 549 02 | 537 14 | 524 53 | SOIL/SAPROLITE/SWR |
| MW-14 | 1667156 | 606086 | Fill/SWR | 527 07 | 518 60 | 513 49 | FILL |
| MW-15 | 1667010 | 606321 | SWR | 526 15 | 516 75 | 512 92 | SOIL/SAPROLITE/SWR |
| MW-16 | 1667525 | 607352 | SWR | 520 22 | 509 70 | 506 41 | SOIL/SAPROLITE/SWR |
| MW-17 | 1667614 | 607010 | SWR | 515 1 | 511 01 | 505 97 | SOIL/SAPROLITE/SWR |
| MW-18 | 1666840 | 607272 | SWR | 552 44 | 533 05 | 520 55 | SOIL/SAPROLITE/SWR |
| MW-19 | 1667060 | 607644 | HWR | 547 3 | 520 17 | 514 23 | -- |
| MW-20A | 1666866 | 606910 | HWR | 544 99 | 530 58 | 522 57 | -- |
| MW-25 | 1667583 | 606857 | Fill | 514 45 | 508 34 | 505 64 | FILL |
| MW-25A | 1667583 | 606857 | Undetermined | 515 02 | 509 71 | 505 82 | -- |
| MW-26 | 1667678 | 606741 | Fill | 510 92 | NM | NM | -- |
| MW-27 | 1667331 | 606838 | Fill/Soil | 522 19 | 509 84 | 505 18 | FILL |
| MW-28 | 1666188 | 605926 | SWR | 562 9 | 544 69 | 531 19 | SOIL/SAPROLITE/SWR |
| MW-101 | 1665910 | 603552 | Soil/SWR | 516 37 | 498 25 | 496 29 | SOIL/SAPROLITE/SWR |
| MW-102 | 1666697 | 604115 | Soil/SWR | 520 37 | 514 34 | 504 73 | SOIL/SAPROLITE/SWR |
| MW-103 | 1665803 | 604592 | SWR | 522 4 | 515 71 | 511 35 | SOIL/SAPROLITE/SWR |
| MW-104 | 1666435 | 604474 | SWR | 521 51 | 515 08 | 508 17 | SOIL/SAPROLITE/SWR |
| MW-105 | 1667455 | 605350 | Soil/SWR | 525 23 | 509 46 | 506 33 | SOIL/SAPROLITE/SWR |
| MW-108 | 1667682 | 606620 | SWR | 517 38 | 509 20 | 505 39 | SOIL/SAPROLITE/SWR |
| MW-109 | 1667293 | 607424 | Soil/SWR | 530 39 | 517 28 | 509 25 | SOIL/SAPROLITE/SWR |

[1] Screened lithologies were determined from boring logs

[2] All elevations are above mean sea level  Elevations are either based on top of casing data presented in the RFI or survey data collected in 2006

[3] Groundwater data compiled from well logger data collected in 2011 and 2012

### 3.3 Task 3 - Water Quality Assessment

To assess current conditions for the evaluation potential remedial alternatives, a water quality assessment was conducted by collecting groundwater samples from the Alcoa Badin Landfill, Old Brick Landfill, and Alcoa Badin Works Plant Area, and by collecting surface water samples from Little Mountain Creek, Badin Lake at the Old Brick Landfill, and Badin Lake at the Badin Works Plant Area.

#### 3.3.1 Alcoa Badin Landfill (SWMU No.2) Groundwater

To gain an understanding of "Post" Interim Measures groundwater conditions, a routine groundwater monitoring program was implemented to collect water quality data from selected wells in the existing groundwater well network. The purpose of the data collection effort was to evaluate the potential effects of interim measures and cover system improvements on the groundwater water quality. Groundwater samples were collected in November 2011, May 2012, and August 2012 from monitoring wells ABL-MW-1 through ABL-MW-06 and ABL-PZ-15 through ABL-PZ-19, and analyzed for Available Cyanide, Total Fluoride, and waste indicator parameters (pH, Specific Conductivity, Dissolved Oxygen, Temperature, Turbidity, and TOC). Please note that ABL-PZ-13 and ABL-PZ-14 did not contain measurable groundwater and were not sampled. A summary of the groundwater sampling results are provided in **Tables 3-5A and 3-5B**. A copy of the laboratory reports and completed chain-of-custody forms are presented in **Appendix J**. Well Sampling Logs are included in **Appendix K**.

Available Cyanide was detected in the southwest corner of the ABL at ABL-MW-05, ABL-PZ-16 and ABL-PZ-18. The concentration ranged from 0.001 J mg/L at PZ-18 to 0.027 mg/L at MW-05. All the detected concentrations were below the 2L standard. The results are consistent with the historical sampling results documented in the RFI.

Total Fluoride was detected at concentrations in excess of the 2L standard at PZ-15, PZ-16, PZ-17, PZ-18, and PZ-19. All of these well are located within the waste area of the landfill near deposited waste material. Fluoride has not been previously or currently detected above the 2L standard in the perimeter wells surrounding the ABL (MW-1 through MW-6).

No significant concentrations of waste indicator parameters were noted in any of the wells sampled.

**Table 3-5A**
**Groundwater Sample Analytical Results**
**SWMU No. 2 - Alcoa Badin Municipal Landfill**
**Alcoa - Badin Works Facility**
**Badin, North Carolina**

| Sample ID | Units | ABLMW01F001 | ABLMW02F001 | ABLMW03F001 | ABLMW04F001 | ABLMW05F001 | ABLMW06F001 | ABLPZ15F001 | ABLPZ16F001 | ABLPZ17F001 | ABLPZ18F001 | ABLPZ19F001 | NCDENR 15A NCAC 2L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well ID | | **MW-1** | **MW-2** | **MW-3** | **MW-4** | **MW-5** | **MW-6** | **PZ-15** | **PZ-16** | **PZ-17** | **PZ-18** | **PZ-19** | -- |
| Date | | 8/2/2011 | 8/1/2011 | 8/2/2011 | 8/1/2011 | 8/1/2011 | 8/1/2011 | 8/3/2011 | 8/2/2011 | 8/2/2011 | 8/2/2011 | 8/3/2011 | -- |
| Time | | 8:15 | 15:20 | 8 50 | 10:10 | 11:27 | 16 50 | 10:05 | 13:45 | 14 50 | 15:25 | 10:15 | -- |
| **Total Fluoride** | *mg/L* | 0 17 | 0 05 | 0 1 | 0 19 | 0 26 | 0 07 | 53 | 8 9 | 77 | 31 | 27 | **2** |

| Sample ID | Units | ABLMW1F001 | ABLMW2F001 | ABLMW3F001 | ABLMW4F001 ABLMW4D001 | ABLMW5F001 | ABLMW6F001 | ABLPZ15F001 | ABLPZ16F001 | ABLPZ17F001 ABLPZ17D001 | ABLPZ18F001 | ABLPZ19F001 | NCDENR 15A NCAC 2L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well ID | | **MW-1** | **MW-2** | **MW-3** | **MW-4** | **MW-5** | **MW-6** | **PZ-15** | **PZ-16** | **PZ-17** | **PZ-18** | **PZ-19** | -- |
| Date | | **11/14/2011** | **11/15/2011** | **11/15/2011** | **11/15/2011** | **11/15/2011** | **11/14/2011** | **11/15/2011** | **11/15/2011** | **11/15/2011** | **11/16/2011** | **11/15/2012** | -- |
| Time | | **14:30** | **9:15** | **11:35** | **14:20** | **18:06** | **11:00** | **11:45** | **11:25** | **11:20 / 11:40** | **8:40** | **16:30** | -- |
| **Cyanide, Available** | *mg/L* | ND $_{<0.002}$ | ND $_{<0.002}$ | ND $_{<0.002}$ | ND $_{<0.002}$ / ND $_{<0.002}$ | 0 027 | ND $_{<0.002}$ | ND $_{<0.002}$ | ND $_{<0 002}$ | ND $_{<0.002}$ / ND $_{<0.002}$ | ND $_{<0.002}$ | ND $_{<0.002}$ | **0.07** |
| **Total Fluoride** | *mg/L* | 0 2 | 0 05 J | 0 09 J | 0 1 J / 0 1 J | 0 18 J | 0 09 J | 35 | 9 5 | 57 / 57 | 27 | 41 | **2** |
| **Total Organic Carbon** | *mg/L* | 0 53 J | ND $_{<1.0}$ | ND $_{<1.0}$ | 0 69 J / 0 62 J | 1 1 | ND $_{<1 0}$ | 6 1 | 34 | 77 / 52 | 7 8 | 8 3 | **NE** |
| **pH** | -- | 5 56 | 5 34 | 5 55 | 6 57 | 6 27 | 5 82 | 7 5 | 7 24 | 7 3 | 7 33 | 7 48 | -- |
| **Temperature** | *°C* | 20 61 | 17 93 | 16 9 | 17 41 | 16 02 | 20 83 | 19 52 | 19 2 | 19 85 | 17 71 | 20 3 | -- |
| **Specific Conductance** | *µS* | 93 | 75 | 82 | 337 | 545 | 127 | 2172 | 1187 | 2802 | 1699 | 1704 | -- |
| **Dissolved Oxygen** | *mg/L* | 3 37 | 0 4 | 1 51 | 0 87 | 0 98 | 1 31 | 0 6 | 0 28 | 0 1 | 0 64 | 0 18 | -- |
| **Oxidation-Reduction Poter** | *mV* | 206 3 | 434 1 | 237 4 | 145 8 | 194 | 204 8 | -38 7 | -84 | -99 8 | -93 6 | -145 2 | -- |
| **Turbidity** | *NTU* | 2 39 | 1 17 | 18 8 | 12 2 | 19 2 | 3 09 | >1000 | 20 9 | 24 9 | 19 1 | 28 1 | -- |

| Sample ID | Units | ABLMW1F002 ABLMW1D002 | ABLMW2F002 | ABLMW3F002 | ABLMW4F002 | ABLMW5F002 | ABLMW6F002 | ABLPZ15F002 | ABLPZ16F002 ABLPZ16D002 | ABLPZ17F002 | ABLPZ18F002 | ABLPZ19F002 | NCDENR 15A NCAC 2L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well ID | | **MW-1** | **MW-2** | **MW-3** | **MW-4** | **MW-5** | **MW-6** | **PZ-15** | **PZ-16** | **PZ-17** | **PZ-18** | **PZ-19** | -- |
| Date | | **5/8/2012** | **5/8/2012** | **5/10/2012** | **5/10/2012** | **5/10/2012** | **5/8/2012** | **5/9/2012** | **5/10/2012** | **5/10/2012** | **5/9/2012** | **5/10/2012** | -- |
| Time | | **15:00 / 15:10** | **18:00** | **9:30** | **13:05** | **15:33** | **13:00** | **12:50** | **10:15 / 10:30** | **15:20** | **10:20** | **13:25** | -- |
| **Cyanide, Available** | *mg/L* | ND $_{<0.002}$ / ND $_{<0.002}$ | ND $_{<0.002}$ | ND $_{<0.002}$ | ND $_{<0.002}$ | 0 024 | ND $_{<0.002}$ | ND $_{<0.002}$ | 0 014 / 0 006 | ND $_{<0.002}$ | 0 008 | ND $_{<0.002}$ | **0.07** |
| **Total Fluoride** | *mg/L* | ND $_{<1.0}$ / ND $_{<1.0}$ | ND $_{<1.0}$ | ND $_{<1.0}$ | ND $_{<1.0}$ | ND $_{<1 0}$ | ND $_{<1 0}$ | 66 | 9 7 / 9 6 | 56 | 27 | 37 | **2** |
| **Total Organic Carbon** | *mg/L* | ND $_{<1.0}$ / ND $_{<1.0}$ | ND $_{<1.0}$ | ND $_{<1.0}$ | ND $_{<1.0}$ | 0 61 J | ND $_{<1 0}$ | 7 2 | 2 1 / 1 8 | 4 7 | 9 6 | NA | **NE** |
| **pH** | -- | 5 31 | 5 2 | 5 27 | 6 38 | 6 25 | 5 71 | 7 29 | 7 4 | 7 23 | 7 11 | 7 14 | -- |
| **Temperature** | *°C* | 18 56 | 19 08 | 15 55 | 15 87 | 16 38 | 20 56 | 24 11 | 18 11 | 20 99 | 20 23 | 22 63 | -- |
| **Specific Conductance** | *µS* | 93 | 73 | 79 | 346 | 524 | 136 | 1913 | 1158 | 2509 | 1848 | 2081 | -- |
| **Dissolved Oxygen** | *mg/L* | 2 18 | 0 7 | 2 02 | 0 53 | 0 86 | 2 7 | 1 1 | 0 82 | 0 35 | 0 54 | 0 68 | -- |
| **Oxidation-Reduction Poter** | *mV* | 237 6 | 343 3 | 40 | -144 1 | -59 2 | 297 1 | -38 9 | -90 5 | -68 9 | -120 | -95 7 | -- |
| **Turbidity** | *NTU* | 4 26 | 3 62 | 2 11 | 0 69 | 3 64 | 4 | 23 2 | 9 3 | 7 73 | 177 | 8 05 | -- |

| Sample ID | Units | ABLMW1F003 | ABLMW2F003 | ABLMW3F003 ABLMW3D003 | ABLMW4F003 | ABLMW5F003 | ABLMW6F003 | ABLPZ15F003 | ABLPZ16F003 ABLPZ16D003 | ABLPZ17F003 | ABLPZ18F003 | ABLPZ19F003 | NCDENR 15A NCAC 2L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Well ID | | **MW-1** | **MW-2** | **MW-3** | **MW-4** | **MW-5** | **MW-6** | **PZ-15** | **PZ-16** | **PZ-17** | **PZ-18** | **PZ-19** | -- |
| Date | | **8/3/2012** | **7/30/2012** | **7/31/2012** | **7/31/2012** | **7/31/2012** | **7/30/2012** | **8/3/2012** | **8/3/2012** | **8/3/2012** | **8/3/2012** | **8/3/2012** | -- |
| Time | | **8:10** | **16:00** | **15:10 / 15:15** | **10:05** | **12:50** | **13:05** | **9:25** | **12:15 / 12:25** | **15:00** | **19:15** | -- | -- |
| **Cyanide, Available** | *mg/L* | 0 001 J B | ND $_{<0.002}$ | ND $_{<0.002}$ / ND $_{<0.002}$ | ND $_{<0.002}$ | 0 016 | ND $_{<0.002}$ | ND $_{<0.002}$ | 0 004 / 0 001 J | ND $_{<0.002}$ | 0 001 J | NA | **0.07** |
| **Total Fluoride** | *mg/L* | ND $_{<1.0}$ | ND $_{<1.0}$ | ND $_{<1.0}$ / ND $_{<1.0}$ | ND $_{<1.0}$ | ND $_{<1 0}$ | ND $_{<1 0}$ | 51 | 11 / 10 | 68 | 25 | NA | **2** |
| **Total Organic Carbon** | *mg/L* | ND $_{<1.0}$ | ND $_{<1.0}$ | 0 51 J / 0 50 J | 0 59 J | 0 89 J | ND $_{<1 0}$ | 11 | 2 6 / 2 4 | 5 3 | 11 | NA | **NE** |
| **pH** | -- | 5 69 | 5 48 | 5 67 | 6 51 | 6 34 | 5 94 | 7 38 | 7 4 | 7 43 | 7 04 | NM | -- |
| **Temperature** | *°C* | 19 2 | 19 7 | 19 8 | 17 6 | 18 9 | 28 3 | 22 | 21 1 | 25 9 | 27 4 | NM | -- |
| **Specific Conductance** | *µS* | 95 | 72 | 74 | 345 | 479 | 128 | 351 | 121 | 301 | 179 | NM | -- |
| **Dissolved Oxygen** | *mg/L* | 2 4 | 6 18 | 1 8 | 0 15 | 1 14 | 0 79 | 0 95 | 1 24 | 0 16 | 1 36 | NM | -- |
| **Oxidation-Reduction Poter** | *mV* | -208 | -322 | -170 | -313 | -192 | -257 | -220 | -268 | -364 | -209 | NM | -- |
| **Turbidity** | *NTU* | 1 51 | 2 16 | 3 62 | 4 61 | 3 88 | 0 16 | NM | 17 9 | 153 | 35 4 | NM | -- |

*Notes:*

*ND - The analyte was not detected above laboratory detection limits. Subscript indicates compound-specific MDL in mg/L.*
*NE - Not established.*
*"J" - The associated method blank contained a constituent concentration at a reportable level.*
*"B" - Compound was found in the blank and sample.*
*ABL-PZ-19 resampled on 11/21/11 for available cyanide due to poor recovery on 11/15/12.*
*NA - Not analyzed due to poor well recovery.*
*NM - Not Measured.*
*When a sample duplicate was collected, both results are shown.*

**Table 3-5B**
**Additional Groundwater Sample Analytical Results**
**SWMU No. 2 - Alcoa Badin Municipal Landfill**
**Alcoa - Badin Works Facility**
**Badin, North Carolina**

| Sample ID | Units | ABLMW5F001 | | Units | ABLMW5F001 | | Units | ABLMW5F001 |
|---|---|---|---|---|---|---|---|---|
| Well ID | | **MW-5** | | | **MW-5** | | | **MW-5** |
| Date | | **11/15/2011** | | | **11/15/2011** | | | **11/15/2011** |
| Time | | **18:06** | | | **18:06** | | | **18:06** |
| **Appendix IX VOCs** | | | **Appendix IX SVOCs** | | | **Appendix IX SVOCs (cont'd)** | | |
| **1,1,1,2-Tetrachloroethane** | *ug/L* | ND $_{<1}$ | **1,2,4,5-Tetrachlorobenzene** | *ug/L* | ND $_{<12}$ | **Bis(2-Ethylhexyl) Phthalate** | *ug/L* | ND $_{<12}$ |
| **1,1,1-Trichloroethane** | *ug/L* | ND $_{<1}$ | **1,2,4-Trichlorobenzene** | *ug/L* | ND $_{<12}$ | **Butyl Benzyl Phthalate** | *ug/L* | ND $_{<12}$ |
| **1,1,2,2-Tetrachloroethane** | *ug/L* | ND $_{<1}$ | **1,2-Dichlorobenzene** | *ug/L* | ND $_{<12}$ | **Chrysene** | *ug/L* | ND $_{<12}$ |
| **1,1,2-Trichloroethane** | *ug/L* | ND $_{<1}$ | **1,3,5-Trinitrobenzene** | *ug/L* | ND $_{<12}$ | **Diallate** | *ug/L* | ND $_{<12}$ |
| **1,1-Dichloroethane** | *ug/L* | ND $_{<1}$ | **1,3-Dichlorobenzene** | *ug/L* | ND $_{<12}$ | **Dibenz(A,H)Anthracene** | *ug/L* | ND $_{<12}$ |
| **1,1-Dichloroethene** | *ug/L* | ND $_{<1}$ | **1,3-Dinitrobenzene** | *ug/L* | ND $_{<12}$ | **Dibenzofuran** | *ug/L* | ND $_{<12}$ |
| **1,2-Dichloroethane** | *ug/L* | ND $_{<1}$ | **1,4-Dichlorobenzene** | *ug/L* | ND $_{<12}$ | **Diethyl Phthalate** | *ug/L* | ND $_{<12}$ |
| **1,2-Dichloropropane** | *ug/L* | ND $_{<1}$ | **1,4-Dioxane** | *ug/L* | ND $_{<12}$ | **Dimethoate** | *ug/L* | ND $_{<12}$ |
| **2-Butanone** | *ug/L* | ND $_{<10}$ | **1,4-Naphthoquinone** | *ug/L* | ND $_{<12}$ | **Dimethyl Phthalate** | *ug/L* | ND $_{<12}$ |
| **2-Hexanone** | *ug/L* | ND $_{<10}$ | **1-Naphthylamine** | *ug/L* | ND $_{<12}$ | **Di-N-Butyl Phthalate** | *ug/L* | ND $_{<12}$ |
| **4-Methyl-2-Pentanone** | *ug/L* | ND $_{<10}$ | ***2,3,4,6-Tetrachlorophenol*** | *ug/L* | ND $_{<12}$ | **Di-N-Octyl Phthalate** | *ug/L* | ND $_{<12}$ |
| **Acetone** | *ug/L* | ND $_{<25}$ | ***2,4,5-Trichlorophenol*** | *ug/L* | ND $_{<12}$ | **Dinoseb** | *ug/L* | ND $_{<12}$ |
| **Acetonitrile** | *ug/L* | ND $_{<40}$ | ***2,4,6-Trichlorophenol*** | *ug/L* | ND $_{<12}$ | **Disulfoton** | *ug/L* | ND $_{<12}$ |
| **Acrolein** | *ug/L* | ND $_{<20}$ | ***2,4-Dichlorophenol*** | *ug/L* | ND $_{<12}$ | **Ethyl Methanesulfonate** | *ug/L* | ND $_{<12}$ |
| **Acrylonitrile** | *ug/L* | ND $_{<20}$ | ***2,4-Dimethylphenol*** | *ug/L* | ND $_{<12}$ | **Ethyl Parathion** | *ug/L* | ND $_{<12}$ |
| **Allyl Chloride** | *ug/L* | ND $_{<1}$ | ***2,4-Dinitrophenol*** | *ug/L* | ND $_{<59}$ | **Famphur** | *ug/L* | ND $_{<12}$ |
| **Benzene** | *ug/L* | ND $_{<1}$ | **2,4-Dinitrotoluene** | *ug/L* | ND $_{<12}$ | **Fluoranthene** | *ug/L* | ND $_{<12}$ |
| **Bromodichloromethane** | *ug/L* | ND $_{<1}$ | **2,6-Dichlorophenol** | *ug/L* | ND $_{<12}$ | **Fluorene** | *ug/L* | ND $_{<12}$ |
| **Bromoform** | *ug/L* | ND $_{<1}$ | **2,6-Dinitrotoluene** | *ug/L* | ND $_{<12}$ | **Hexachlorobenzene** | *ug/L* | ND $_{<12}$ |
| **Bromomethane** | *ug/L* | ND $_{<1}$ | **2-Acetylaminofluorene** | *ug/L* | ND $_{<12}$ | **Hexachlorobutadiene** | *ug/L* | ND $_{<12}$ |
| **Carbon Disulfide** | *ug/L* | ND $_{<2}$ | **2-Chloronaphthalene** | *ug/L* | ND $_{<12}$ | **Hexachlorocyclopentadiene** | *ug/L* | ND $_{<12}$ |
| **Carbon Tetrachloride** | *ug/L* | ND $_{<1}$ | **2-Chlorophenol** | *ug/L* | ND $_{<12}$ | **Hexachloroethane** | *ug/L* | ND $_{<12}$ |
| **Chlorobenzene** | *ug/L* | ND $_{<1}$ | **2-Methylnaphthalene** | *ug/L* | ND $_{<12}$ | **Hexachlorophene** | *ug/L* | ND $_{<5900}$ |
| **Chloroethane** | *ug/L* | ND $_{<1}$ | **2-Methylphenol** | *ug/L* | ND $_{<12}$ | **Hexachloropropene** | *ug/L* | ND $_{<12}$ |
| **Chloroform** | *ug/L* | 0.18 J | **2-Naphthylamine** | *ug/L* | ND $_{<12}$ | **Indeno[1,2,3-Cd]Pyrene** | *ug/L* | ND $_{<12}$ |
| **Chloromethane** | *ug/L* | ND $_{<1}$ | **2-Nitroaniline** | *ug/L* | ND $_{<59}$ | **Isophorone** | *ug/L* | ND $_{<12}$ |
| **Chloroprene** | *ug/L* | ND $_{<1}$ | **2-Nitrophenol** | *ug/L* | ND $_{<12}$ | **Isosafrole** | *ug/L* | ND $_{<12}$ |
| **Cis-1,3-Dichloropropene** | *ug/L* | ND $_{<1}$ | **2-Picoline** | *ug/L* | ND $_{<12}$ | **Methapyrilene** | *ug/L* | ND $_{<2400}$ |
| **Dibromochloromethane** | *ug/L* | ND $_{<1}$ | **3 & 4 Methylphenol** | *ug/L* | ND $_{<12}$ | **Methyl Methanesulfonate** | *ug/L* | ND $_{<12}$ |
| **Dibromomethane** | *ug/L* | ND $_{<1}$ | **3,3'-Dichlorobenzidine** | *ug/L* | ND $_{<71}$ | **Methyl Parathion** | *ug/L* | ND $_{<12}$ |
| **Dichlorodifluoromethane** | *ug/L* | ND $_{<1}$ | **3,3'-Dimethylbenzidine** | *ug/L* | ND $_{<24}$ | **Naphthalene** | *ug/L* | ND $_{<12}$ |
| **Ethyl Methacrylate** | *ug/L* | ND $_{<1}$ | **3-Methylcholanthrene** | *ug/L* | ND $_{<12}$ | **Nitrobenzene** | *ug/L* | ND $_{<12}$ |
| **Ethylbenzene** | *ug/L* | ND $_{<1}$ | **3-Nitroaniline** | *ug/L* | ND $_{<59}$ | **N-Nitro-O-Toluidine** | *ug/L* | ND $_{<12}$ |
| **Iodomethane** | *ug/L* | ND $_{<5}$ | **4,6-Dinitro-2-Methylphenol** | *ug/L* | ND $_{<59}$ | **N-Nitrosodiethylamine** | *ug/L* | ND $_{<12}$ |
| **Isobutanol** | *ug/L* | ND $_{<40}$ | **4-Aminobiphenyl** | *ug/L* | ND $_{<12}$ | **N-Nitrosodimethylamine** | *ug/L* | ND $_{<12}$ |
| **Methacrylonitrile** | *ug/L* | ND $_{<20}$ | **4-Bromophenyl Phenyl Ether** | *ug/L* | ND $_{<12}$ | **N-Nitrosodi-N-Butylamine** | *ug/L* | ND $_{<12}$ |
| **Methyl Methacrylate** | *ug/L* | ND $_{<1}$ | **4-Chloro-3-Methylphenol** | *ug/L* | ND $_{<12}$ | **N-Nitrosodi-N-Propylamine** | *ug/L* | ND $_{<12}$ |
| **Methylene Chloride** | *ug/L* | ND $_{<5}$ | **4-Chloroaniline** | *ug/L* | ND $_{<24}$ | **N-Nitrosodiphenylamine** | *ug/L* | ND $_{<12}$ |
| **Pentachloroethane** | *ug/L* | ND $_{<5}$ | **4-Chlorophenyl Phenyl Ether** | *ug/L* | ND $_{<12}$ | **N-Nitrosomethylethylamine** | *ug/L* | ND $_{<12}$ |
| **Propionitrile** | *ug/L* | ND $_{<20}$ | **4-Nitroaniline** | *ug/L* | ND $_{<59}$ | **N-Nitrosomorpholine** | *ug/L* | ND $_{<12}$ |
| **Styrene** | *ug/L* | ND $_{<1}$ | **4-Nitrophenol** | *ug/L* | ND $_{<59}$ | **N-Nitrosopiperidine** | *ug/L* | ND $_{<12}$ |
| **Tetrachloroethene** | *ug/L* | ND $_{<1}$ | **4-Nitroquinoline-1-Oxide** | *ug/L* | ND $_{<24}$ | **N-Nitrosopyrrolidine** | *ug/L* | ND $_{<12}$ |
| **Toluene** | *ug/L* | ND $_{<1}$ | **7,12-Dimethylbenz(A)Anthracene** | *ug/L* | ND $_{<12}$ | **O,O',O''-Triethylphosphorothioate** | *ug/L* | ND $_{<12}$ |
| **Trans-1,2-Dichloroethene** | *ug/L* | ND $_{<1}$ | **Acenaphthene** | *ug/L* | ND $_{<12}$ | **O-Toluidine** | *ug/L* | ND $_{<12}$ |
| **Trans-1,3-Dichloropropene** | *ug/L* | ND $_{<1}$ | **Acenaphthylene** | *ug/L* | ND $_{<12}$ | **P-Dimethylamino Azobenzene** | *ug/L* | ND $_{<12}$ |
| **Trans-1,4-Dichloro-2-Butene** | *ug/L* | ND $_{<2}$ | **Acetophenone** | *ug/L* | ND $_{<12}$ | **Pentachlorobenzene** | *ug/L* | ND $_{<12}$ |
| **Trichloroethene** | *ug/L* | ND $_{<1}$ | **Alpha,Alpha-Dimethyl Phenethylamine** | *ug/L* | ND $_{<2400}$ | **Pentachloronitrobenzene** | *ug/L* | ND $_{<12}$ |
| **Trichlorofluoromethane** | *ug/L* | ND $_{<1}$ | **Aniline** | *ug/L* | ND $_{<24}$ | **Pentachlorophenol** | *ug/L* | ND $_{<59}$ |
| **Vinyl Acetate** | *ug/L* | ND $_{<2}$ | **Anthracene** | *ug/L* | ND $_{<12}$ | **Phenacetin** | *ug/L* | ND $_{<12}$ |
| **Vinyl Chloride** | *ug/L* | ND $_{<1}$ | **Aramite** | *ug/L* | ND $_{<12}$ | **Phenanthrene** | *ug/L* | ND $_{<12}$ |
| **Xylenes, Total** | *ug/L* | ND $_{<2}$ | **Benzo[A]Anthracene** | *ug/L* | ND $_{<12}$ | **Phenol** | *ug/L* | ND $_{<12}$ |
| | | | **Benzo[A]Pyrene** | *ug/L* | ND $_{<12}$ | **Phorate** | *ug/L* | ND $_{<12}$ |
| **Appendix IX Metals** | | | **Benzo[B]Fluoranthene** | *ug/L* | ND $_{<12}$ | **P-Phenylene Diamine** | *ug/L* | ND $_{<2400}$ |
| **Antimony** | *ug/L* | ND $_{<20}$ | **Benzo[G,H,I]Perylene** | *ug/L* | ND $_{<12}$ | **Pronamide** | *ug/L* | ND $_{<12}$ |
| **Arsenic** | *ug/L* | ND $_{<20}$ | **Benzo[K]Fluoranthene** | *ug/L* | ND $_{<12}$ | **Pyrene** | *ug/L* | ND $_{<12}$ |
| **Barium** | *ug/L* | 10 | **Benzyl Alcohol** | *ug/L* | ND $_{<12}$ | **Pyridine** | *ug/L* | ND $_{<59}$ |
| **Beryllium** | *ug/L* | ND $_{<4}$ | **Bis (2-Chloroisopropyl) Ether** | *ug/L* | ND $_{<12}$ | **Safrole** | *ug/L* | ND $_{<12}$ |
| **Cadmium** | *ug/L* | ND $_{<5}$ | **Bis(2-Chloroethoxy)Methane** | *ug/L* | ND $_{<12}$ | **Sulfotepp** | *ug/L* | ND $_{<12}$ |
| **Chromium** | *ug/L* | 1.9 J B | **Bis(2-Chloroethyl)Ether** | *ug/L* | ND $_{<12}$ | **Thionazin** | *ug/L* | ND $_{<12}$ |
| **Cobalt** | *ug/L* | 72 | | | | | | |
| **Copper** | *ug/L* | ND $_{<20}$ | | | | | | |
| **Lead** | *ug/L* | ND $_{<10}$ | | | | | | |
| **Nickel** | *ug/L* | ND $_{<40}$ | | | | | | |
| **Selenium** | *ug/L* | ND $_{<20}$ | | | | | | |
| **Silver** | *ug/L* | ND $_{<10}$ | | | | | | |
| **Thallium** | *ug/L* | ND $_{< 25}$ | | | | | | |
| **Tin** | *ug/L* | ND $_{<50}$ | | | | | | |
| **Vanadium** | *ug/L* | ND $_{<10}$ | | | | | | |
| **Zinc** | *ug/L* | ND $_{<20}$ | | | | | | |
| **Mercury** | *ug/L* | ND $_{<0.2}$ | | | | | | |

*ND - The analyte was not detected above laboratory detection limits. Subscript indicates compound-specific MDL in mg/L.*
*"J"  - Result is less than the Reporting Limit but greater than or equal to the MDL and the concentration is an approximate value*
*"B" - Compound was found in the blank and sample.*

### 3.3.2 Little Mountain Creek Surface Water

The RFI screening level risk assessment showed that no COIs were present at concentrations exceeding applicable human health screening values in Little Mountain Creek. To confirm this current understanding, a surface water sample was collected in November 2011 from Little Mountain Creek adjacent to the Alcoa Badin Landfill, as shown on **Figure 3-14**. The surface water sample was analyzed for Available Cyanide, Total Fluoride, TCE, PAHs, and PCBs. Samples were collected in the same manner as described with the Badin Lake Surface Water Sampling.

The November 2011 results, reported fluoride in the laboratory Method Blank, and samples from this period were noted with a "B" qualifier by the lab. It is believed that the surface water sample from this period did not contain fluoride, and the reported value is the result of a laboratory artifact. Available Cyanide, TCE, PAHs, and PCBs were not detected in the November sampling event. The surface water analytical results are presented in **Table 3-6**. The results are consistent with the historical sampling results documented in the RFI.

### 3.3.3 Old Brick Landfill (SWMU No. 3) Groundwater

To gain an understanding of cover system upgrades on groundwater conditions, a routine groundwater monitoring program was implemented to collect water quality data from selected wells in the existing groundwater well network. The purpose of the data collection effort was to evaluate the potential effects of cover system upgrades on the groundwater water quality. Groundwater samples were collected in November 2011, May 2012, and August 2012 from monitoring wells (OBL-MW-1 through OBL-MW-06) located in and around the Old Brick Landfill. These samples were analyzed for Available Cyanide, Total Fluoride, and waste indicator parameters (pH, Specific Conductivity, Dissolved Oxygen, Temperature, Turbidity, and TOC). A summary of the groundwater sampling results are provided in **Table 3-7**. A copy of the laboratory reports and completed chain-of-custody forms are presented in **Appendix J**. Well Sampling Logs are included in **Appendix L**. A groundwater contour map showing the direction and gradient of groundwater flow at the OBL is provided in **Figure 3-15**.

Available Cyanide was detected at OBL-MW-02, OBL-MW-03, and OBL-MW-04 above the method detection limit. Only MW-02 in November 2011was reported above the NC 2L Standard. In the subsequent sampling events in May 2012 and August 2012, cyanide was detected at concentrations below the 2L standard. The results are generally less than or consistent with the historical sampling results documented in the RFI.

Total Fluoride was detected at OBL-MW-02, OBL-MW-03, OBL-MW-04, and OBL-MW-5. None of the fluoride groundwater concentrations were found in excess of the NC 2L Standard. The results are consistent with the historical sampling results documented in the RFI.


ENVIRONEERING, INC.

FIGURE 3-14

LITTLE MOUNTAIN CREEK
SURFACE WATER SAMPLING
LOCATION MAP

ALCOA BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ NO: |
|---|---|---|
| HM | 10/08/2012 | 137-176 |

**Table 3-6**
**Surface Water Analytical Results**
**Plant Area, SWMU No. 2, and SWMU No. 3**
**Alcoa-Badin Works Facility**
**Badin, North Carolina**

| Sample ID | Units | ABKSWL01F001 | ABKSWL02F001 | ABKSWL03F001 | ABKSWL04F001 | ABKSWL05F001 | ABKSWL06F001 | ABKSWL07F001 | OBLSWL01F001 | ABLSWL01F001 | NCDENR 15A NCAC 2B |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | | **Badin Lake 01** | **Badin Lake 02** | **Badin Lake 03** | **Badin Lake 04** | **Badin Lake 05** | **Badin Lake 06** | **Badin Lake 07** | **OBL** | **LMC** | -- |
| Date | | **11/16/2011** | **11/16/2011** | **11/16/2011** | **11/16/2011** | **11/16/2011** | **11/16/2011** | **11/16/2011** | **11/17/2011** | **11/18/2011** | -- |
| Time | | **16:35** | **16:14** | **15:50** | **15:00** | **14:40** | **14:10** | **15:55** | **9:30** | **8:30** | -- |
| **VOCs** | | | | | | | | | | | |
| **Trichloroethene** | *ug/L* | ND <0.80 | ND <0.80 | ND <0.80 | ND <0.80 | ND <0.80 | ND <0.80 | ND <0.80 | ND <0.80 | ND <0.80 | **2.5** |
| **PAHs** | | | | | | | | | | | |
| **Acenaphthene** | *ug/L* | ND <0.14 | ND <0.14 | ND <0.14 | ND <0.14 | ND <0.14 | ND <0.14 | ND <0.14 | ND <0.14 | ND <0.14 | **20** |
| **Acenaphthylene** | *ug/L* | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | **NE** |
| **Anthracene** | *ug/L* | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | **0.5** |
| **Benzo(a)anthracene** | *ug/L* | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | ND <0.15 | **0.0028** [1] |
| **Benzo(a)pyrene** | *ug/L* | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | **0.0028** [1] |
| **Benzo(b)fluoranthene** | *ug/L* | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | **0.0028** [1] |
| **Benzo(k)fluoranthene** | *ug/L* | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | **0.0028** [1] |
| **Benzo(g,h,i)perylene** | *ug/L* | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | **0.0028** [1] |
| **Chrysene** | *ug/L* | ND <0.55 | ND <0.55 | ND <0.55 | ND <0.55 | ND <0.55 | ND <0.55 | ND <0.55 | ND <0.55 | ND <0.55 | **0.0028** [1] |
| **Dibenz(a,h)anthracene** | *ug/L* | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | **0.0028** [1] |
| **Fluoranthene** | *ug/L* | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | **0.11** |
| **Fluorene** | *ug/L* | ND <0.22 | ND <0.22 | ND <0.22 | ND <0.22 | ND <0.22 | ND <0.22 | ND <0.22 | ND <0.22 | ND <0.22 | **30** |
| **Indeno(1,2,3-cd)pyrene)** | *ug/L* | ND <0.20 | ND <0.20 | ND <0.20 | ND <0.20 | ND <0.20 | ND <0.20 | ND <0.20 | ND <0.20 | ND <0.20 | **0.0028** [1] |
| **Naphthalene** | *ug/L* | ND <0.14 | ND <0.14 | ND <0.14 | ND <0.14 | ND <0.14 | ND <0.14 | ND <0.14 | ND <0.14 | ND <0.14 | **50** |
| **Phenanthrene** | *ug/L* | ND <0.43 | ND <0.43 | ND <0.43 | ND <0.43 | ND <0.43 | ND <0.43 | ND <0.43 | ND <0.43 | ND <0.43 | **0.3** |
| **Pyrene** | *ug/L* | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | ND <0.16 | **830** |
| **PCBs** | | | | | | | | | | | |
| **PCB-1016** | *ug/L* | ND <0.10 | ND <0.10 | ND <0.10 | ND <0.10 | ND <0.10 | ND <0.10 | ND <0.10 | ND <0.10 | ND <0.10 | **0.001** [2] |
| **PCB-1221** | *ug/L* | ND <0.10 | ND <0.10 | ND <0.10 | ND <0.10 | ND <0.10 | ND <0.10 | ND <0.10 | ND <0.10 | ND <0.10 | **0.001** [2] |
| **PCB-1232** | *ug/L* | ND <0.12 | ND <0.12 | ND <0.12 | ND <0.12 | ND <0.12 | ND <0.12 | ND <0.12 | ND <0.12 | ND <0.12 | **0.001** [2] |
| **PCB-1242** | *ug/L* | ND <0.077 | ND <0.077 | ND <0.077 | ND <0.077 | ND <0.077 | ND <0.077 | ND <0.077 | ND <0.077 | ND <0.077 | **0.001** [2] |
| **PCB-1248** | *ug/L* | ND <0.095 | ND <0.095 | ND <0.095 | ND <0.095 | ND <0.095 | ND <0.095 | ND <0.095 | ND <0.095 | ND <0.095 | **0.001** [2] |
| **PCB-1254** | *ug/L* | ND <0.095 | ND <0.095 | ND <0.095 | ND <0.095 | ND <0.095 | ND <0.095 | ND <0.095 | ND <0.095 | ND <0.095 | **0.001** [2] |
| **PCB-1260** | *ug/L* | ND <0.056 | ND <0.056 | ND <0.056 | ND <0.056 | ND <0.056 | ND <0.056 | ND <0.056 | ND <0.056 | ND <0.056 | **0.001** [2] |
| **General Chemistry** | | | | | | | | | | | |
| **Available Cyanide** | *mg/L* | ND <0.00030 | ND <0.00030 | ND <0.00030 | ND <0.00030 | ND <0.00030 | ND <0.00030 | ND <0.00030 | ND <0.00030 | ND <0.00030 | **0.0005** |
| **Total Fluoride** | *mg/L* | 0 13 B | 0 11 B | 0 11 B | 0 12 B | 0 11 B | 0 12 B | 0 12 B | 0 11 B | 0 090 B | **1.8** |
| **pH** | -- | NM | NM | NM | NM | NM | NM | NM | NM | NM | -- |
| **Temperature** | *°C* | 16 15 | 18 3 | 16 04 | 16 68 | 15 76 | 16 72 | 17 22 | 14 63 | 7 35 | -- |
| **Specific Conductance** | *µS* | 99 | 90 | 92 | 93 | 93 | 94 | 93 | 86 | 74 | -- |
| **Dissolved Oxygen** | *mg/L* | NM | NM | NM | NM | NM | NM | NM | NM | 13 44 | -- |
| **Oxidation-Reduction Potential** | *mV* | NM | NM | NM | NM | NM | NM | NM | NM | NM | -- |
| **Turbidity** | *NTU* | 2 83 | 6 51 | 6 19 | 4 45 | 5 31 | 10 1 | 10 6 | NM | NM | -- |

| Sample ID | Units | ABKSWL01F002 | ABKSWL02F002 | ABKSWL03F002 | ABKSWL04F002 | ABKSWL05F002 | ABKSWL06F002 | ABKSWL07F002 | ABKSWL07D002 | NCDENR 15A NCAC 2B |
|---|---|---|---|---|---|---|---|---|---|---|
| Location | | **Badin Lake 01** | **Badin Lake 02** | **Badin Lake 03** | **Badin Lake 04** | **Badin Lake 05** | **Badin Lake 06** | **Badin Lake 07** | **Badin Lake 07** | -- |
| Date | | **5/11/2012** | **5/11/2012** | **5/11/2012** | **5/11/2012** | **5/11/2012** | **5/11/2012** | **5/11/2012** | **5/11/2012** | -- |
| Time | | **10:10** | **10:25** | **10:45** | **11:00** | **11:30** | **11:45** | **12:00** | **12:15** | -- |
| **VOCs** | | | | | | | | | | |
| **Trichloroethene** | *ug/L* | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | ND <0.13 | **2.5** |
| **PAHs** | | | | | | | | | | |
| **Acenaphthene** | *ug/L* | ND <0.72 | ND <0.72 | ND <0.72 | ND <0.72 | ND <0.72 | ND <0.72 | ND <0.72 | ND <0.72 | **20** |
| **Acenaphthylene** | *ug/L* | ND <0.81 | ND <0.81 | ND <0.81 | ND <0.81 | ND <0.81 | ND <0.81 | ND <0.81 | ND <0.81 | **NE** |
| **Anthracene** | *ug/L* | ND <0.66 | ND <0.66 | ND <0.66 | ND <0.66 | ND <0.66 | ND <0.66 | ND <0.66 | ND <0.66 | **0.5** |
| **Benzo(a)anthracene** | *ug/L* | ND <0.52 | ND <0.52 | ND <0.52 | ND <0.52 | ND <0.52 | ND <0.52 | ND <0.52 | ND <0.52 | **0.0028** [1] |
| **Benzo(k)fluoranthene** | *ug/L* | ND <1.1 | ND <1.1 | ND <1.1 | ND <1.1 | ND <1.1 | ND <1.1 | ND <1.1 | ND <1.1 | **0.0028** [1] |
| **Benzo(g,h,i)perylene** | *ug/L* | ND <0.83 | ND <0.83 | ND <0.83 | ND <0.83 | ND <0.83 | ND <0.83 | ND <0.83 | ND <0.83 | **0.0028** [1] |
| **Benzo(a)pyrene** | *ug/L* | ND <0.68 | ND <0.68 | ND <0.68 | ND <0.68 | ND <0.68 | ND <0.68 | ND <0.68 | ND <0.68 | **0.0028** [1] |
| **Benzo(b)fluoranthene** | *ug/L* | ND <2.5 | ND <2.5 | ND <2.5 | ND <2.5 | ND <2.5 | ND <2.5 | ND <2.5 | ND <2.5 | **0.0028** [1] |
| **Chrysene** | *ug/L* | ND <0.49 | ND <0.49 | ND <0.49 | ND <0.49 | ND <0.49 | ND <0.49 | ND <0.49 | ND <0.49 | **0.0028** [1] |
| **Dibenz(a,h)anthracene** | *ug/L* | ND <0.95 | ND <0.95 | ND <0.95 | ND <0.95 | ND <0.95 | ND <0.95 | ND <0.95 | ND <0.95 | **0.0028** [1] |
| **Fluoranthene** | *ug/L* | ND <0.70 | ND <0.70 | ND <0.70 | ND <0.70 | ND <0.70 | ND <0.70 | ND <0.70 | ND <0.70 | **0.11** |
| **Fluorene** | *ug/L* | ND <0.91 | ND <0.91 | ND <0.91 | ND <0.91 | ND <0.91 | ND <0.91 | ND <0.91 | ND <0.91 | **30** |
| **Indeno(1,2,3-cd)pyrene)** | *ug/L* | ND <0.95 | ND <0.95 | ND <0.95 | ND <0.95 | ND <0.95 | ND <0.95 | ND <0.95 | ND <0.95 | **0.0028** [1] |
| **Naphthalene** | *ug/L* | ND <0.67 | ND <0.67 | ND <0.67 | ND <0.67 | ND <0.67 | ND <0.67 | ND <0.67 | ND <0.67 | **50** |
| **1-MethylNaphthalene** | *ug/L* | ND <0.64 | ND <0.64 | ND <0.64 | ND <0.64 | ND <0.64 | ND <0.64 | ND <0.64 | ND <0.64 | **NE** |
| **Phenanthrene** | *ug/L* | ND <0.73 | ND <0.73 | ND <0.73 | ND <0.73 | ND <0.73 | ND <0.73 | ND <0.73 | ND <0.73 | **0.3** |
| **Pyrene** | *ug/L* | ND <0.60 | ND <0.60 | ND <0.60 | ND <0.60 | ND <0.60 | ND <0.60 | ND <0.60 | ND <0.60 | **830** |
| **PCBs** | | | | | | | | | | |
| **PCB-1016** | *ug/L* | ND <0.068 | ND <0.068 | ND <0.068 | ND <0.068 | ND <0.068 | ND <0.068 | ND <0.068 | ND <0.068 | **0.001** [2] |
| **PCB-1221** | *ug/L* | ND <0.27 | ND <0.27 | ND <0.27 | ND <0.27 | ND <0.27 | ND <0.27 | ND <0.27 | ND <0.27 | **0.001** [2] |
| **PCB-1232** | *ug/L* | ND <0.11 | ND <0.11 | ND <0.11 | ND <0.11 | ND <0.11 | ND <0.11 | ND <0.11 | ND <0.11 | **0.001** [2] |
| **PCB-1242** | *ug/L* | ND <0.17 | ND <0.17 | ND <0.17 | ND <0.17 | ND <0.17 | ND <0.17 | ND <0.17 | ND <0.17 | **0.001** [2] |
| **PCB-1248** | *ug/L* | ND <0.35 | ND <0.35 | ND <0.35 | ND <0.35 | ND <0.35 | ND <0.35 | ND <0.35 | ND <0.35 | **0.001** [2] |
| **PCB-1254** | *ug/L* | ND <0.25 | ND <0.25 | ND <0.25 | ND <0.25 | ND <0.25 | ND <0.25 | ND <0.25 | ND <0.25 | **0.001** [2] |
| **PCB-1260** | *ug/L* | ND <0.19 | ND <0.19 | ND <0.19 | ND <0.19 | ND <0.19 | ND <0.19 | ND <0.19 | ND <0.19 | **0.001** [2] |
| **General Chemistry** | | | | | | | | | | |
| **Available Cyanide** | *mg/L* | ND <0.00030 | ND <0.00030 | ND <0.00030 | ND <0.00030 | ND <0.00030 | ND <0.00030 | ND <0.00030 | ND <0.00030 | **0.0005** |
| **Total Fluoride** | *mg/L* | ND <0.20 | ND <0.20 | ND <0.20 | ND <0.20 | ND <0.20 | ND <0.20 | ND <0.20 | ND <0.20 | **1.8** |
| **Total Organic Carbon** | *mg/L* | 2 6 | 7 7 | 3 2 | 2 6 | 2 6 | 3 | 3 1 | 3 2 | **NE** |
| **pH** | -- | 8 23 | 9 3 | 9 25 | 8 82 | 8 94 | 9 25 | 9 3 | 9 32 | -- |
| **Temperature** | *°C* | 20 43 | 20 93 | 19 91 | 22 03 | 22 41 | 21 88 | 21 47 | 22 12 | -- |
| **Specific Conductance** | *µS* | 277 | 83 | 75 | 80 | 81 | 78 | 80 | 80 | -- |
| **Dissolved Oxygen** | *mg/L* | 9 27 | 10 85 | 10 68 | 10 54 | 8 88 | 9 6 | 9 39 | 9 4 | -- |
| **Oxidation-Reduction Potential** | *mV* | 196 3 | 62 9 | 74 3 | 40 7 | -7 4 | -44 4 | -37 6 | -34 7 | -- |
| **Turbidity** | *NTU* | 4 5 | 43 8 | 48 2 | 16 2 | 12 6 | 19 3 | 17 8 | 10 4 | -- |

*ND - The analyte was not detected above laboratory detection limits. Subscript indicates compound-specific MDL in mg/L.*
*NM - Not measured.*
*NE - Not established.*
*[1] - Regulatory limit is for a combined total of all PAHs*
*[2] - Regulatory limit is for a combined total of all PCBs*
*"B" - Compound was found in the blank and sample*
*When a sample duplicate was collected, both results are shown.*

### 3.3.6 Badin Lake at the Alcoa Badin Works Plant Surface Water

The RFI screening level risk assessment showed that no COIs were present at concentrations exceeding applicable human health screening values in Badin Lake at the the Alcoa Badin Works Plant. To confirm this current understanding, a surface water sampling event was performed to collect water quality data from Badin Lake.

Surface water samples were collected from seven targeted locations where groundwater plume(s) migrating from the Northwest Valley could enter Badin Lake, at the locations illustrated on **Figure 3-20**. To determine the most suitable locations to collect samples, temperature and conductivity readings were taken along the shoreline to determine where groundwater is entering the lake. The result of the field readings did not show significant contrast between shoreline location points, and were deemed inconclusive. Grab samples were collected from evenly spaced locations along the shoreline and analyzed for free cyanide, fluoride, TCE, PCBs, PAHs, and standard field parameters (pH, Specific Conductivity, Dissolved Oxygen, Temperature, Turbidity, and Oxidation-Reduction Potential). This monitoring was conducted in November 2011 and again in May 2012.

The surface water samples were analyzed for the presence of Available Cyanide, Total Fluoride, Trichloroethene (TCE), PAHs, and PCBs. The November 2011 results reported fluoride in the laboratory Method Blank, and samples from this period were noted with a "B" qualifier by the lab. It is believed that the surface water sample from this period did not contain fluoride, and the reported value is the result of a laboratory artifact. The subsequent sampling event in May 2012 did not contain detectable concentrations of fluoride. Cyanide, TCE, PAHs, and PCBs were not detected in the November 2011 and May 2012 sampling event. The Badin Lake surface water analytical results are presented in **Table 3-6**.


ENVIRONEERING, INC.

FIGURE 3-20

BADIN LAKE AT ALCOA BADIN WORKS SURFACE WATER SAMPLING LOCATION MAP

ALCOA BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ NO: |
|---|---|---|
| HM | 10/08/2012 | 137-176 |

# 4.0 CURRENT UNDERSTANDING

The additional data collected and actions taken to maintain and/or improve the environmental conditions at the site since the start of the CMS have improved the general understanding of the sites. The following section provides an update of the current understanding at the Badin Works facility and surrounding sites.

## 4.1 SWMU No. 2: Alcoa Badin Landfill

The Alcoa Badin Landfill (ABL) was used as an unlined municipal/industrial solid-waste landfill. This unit was positioned within a natural ravine located southeast of Wood St. extending to the edge of Little Mountain Creek flood plain. Municipal refuse, process material, and native fill material were used to fill the natural ravine approximately 13 to 42 feet.

In 1997, Alcoa completed interim measures at the ABL consisting of re-grading and cover improvements of two additional feet of low permeability clay and six inches of topsoil to establish a vegetative cover. The objectives of the interim measures were to prevent surface run-on, promote surface run-off, and reduce infiltration into the landfill.

Three seeps (western, middle, and eastern) are present at the base of the landfill. Historic analytical data suggested the seeps emanate water that passes through the landfill materials. A portion of the seep water was believed to originate upslope of the landfill due to precipitation infiltration and a portion from recharge from bedrock through the base of the landfill. In 2005, a seep collection system was installed to re-route the discharge to a utility sewer that leads to a Stanly County Utilities POTW. The fill and hydrogeological assessments suggest a more complex hydrological model is taking place. Components of seep water may include components of surficial flow, infiltration through the cap and surrounding areas, and shallow horizontal flow through soil and fill materials. Hydrographs indicate that the cap is impeding infiltration.

Recent groundwater sampling results demonstrate the beneficial effects of the cover system upgrades. In results from all the recent sampling events, available cyanide and fluoride were not reported in any well at concentrations that exceed the NC 2L Standard.

## 4.2 SWMU No. 3: Old Brick Landfill

The OBL has had significant cover system upgrades implemented since the commencement of the RFI process. These efforts were implemented to reduce infiltration through the landfill cap and control storm water run-on and run-off from the cap.

Recent groundwater sampling results demonstrate the beneficial effects of the cover system upgrades. Available Cyanide was reported above the NC 2L Standard in one well during one of the sampling events. In the subsequent sampling events the compound was not detected at concentrations above the 2L standard in any of the wells. In results from all the recent sampling events, fluoride was not reported in any well at concentrations that exceed the NC 2L Standard.

## 4.3 SWMU No. 44: Pine Tree Grove Area and Northwest Valley

The Pine Tree Grove Area is located in the North End of the Badin facility adjacent to Badin Lake and outside of the plant's fenced area. The North End is characterized by a natural west-east trending valley (Northwest Valley) that was progressively filled during the period between 1916 and 1968. The Pine Tree Grove Area, located at the eastern end of the valley, is a former pond that was connected to Badin Lake. Filling of the Pine Tree Grove Area was completed between 1959 and 1961 and contents of the fill material are varied.

Multiple distinct lithological units have been identified in the SWMU No. 44 area. The uppermost unit, fill materials, consisted of decaying organic material, mulch, and wood debris; sand, silt, and clay soils; construction debris including gravel, concrete, brick, and rock fragments; aluminum scrap; and granular carbonaceous material. Residual soils are present beneath fill materials, and at the ground surface where fill is not present. The residual soils are mainly clayey-silt with subordinate sandy silt/silty sand. Residual soils that retain the general structure of the parent rock from which they formed are referred to as saprolite. These soils typically contain some rock fragments and clayey lenses. Partially weathered rock, defined as residual materials with penetration resistances equivalent to or greater than 100 blows per foot, is present at depths of 2 to 20 ft from ground surface in the main plant area. Refusal to soil drilling equipment has been recorded at depths varying from approximately 20 to 45 feet. Where refusal material was sampled by rock coring, the rock consisted of fractured and variable weathered volcanic metamudstone.

Groundwater occurs in fill materials, residual soils (including saprolite), partially weathered bedrock, and bedrock. The groundwater occurs within the fill material where fill material is present at a sufficient thickness and depth. Where fill material is thin or absent, groundwater exists within the residual soils or partially weathered bedrock. Saturated bedrock lies beneath the residual soils or partially weathered bedrock intervals. Historical groundwater contour maps for the facility indicate the horizontal groundwater flow potential in these zones is generally to the east toward Badin Lake.

Concentration isopleth maps for cyanide and fluoride for the fill material and the soil-saprolite-weathered rock zones were presented in Section 3.2.5. The shapes of the constituent plumes within the fill materials are consistent with preferential groundwater flow through the Northwest Valley. The shape of the constituent plume in the soil-saprolite-weathered rock zone is consistent with the overall preferential flow towards Badin Lake.

Based on the data collected, groundwater flow through most of the northern end of the plant is from the west to the east toward the lake. However, in the proximity of the shoreline area recent data collected suggests that groundwater elevations are lower than the lake level. The fact that the lake exerts a higher head pressure on the surrounding area would result in Badin Lake behaving like a hydraulic barrier for groundwater flow towards the lake. The decreased gradient in wells closer to the lake and stabilization of the groundwater constituent plume suggests that surface water is acting as an opposing force to eastern groundwater movement towards the lake. Affected groundwater in the northern portion of the plant may not discharge into Badin Lake, however, this hypothesis will require additional data collection and verification.

## 4.4 SWMU No. 46

Similarly to SWMU No. 44, multiple distinct lithological units have been identified in the SWMU No. 46 area. The uppermost unit, fill materials, consisted primarily of sand, silt, and clay soils with minor lenses of granular carbonaceous material. Residual soils and saprolite are present beneath fill materials, and are mainly clayey-silt with subordinate sandy silt/silty sand.

As written in the RFI, in 1998 Alcoa identified this area as potentially receiving waste materials through a review of historical photographs. A recent review of historical plant drawings and photographs suggests that the morphology of this area may be more related to plant expansion and modernization and not related to deliberate waste disposal.

A review of historical topographic maps, historical photographs, aerial imagery and recent Site investigative activities confirms that the SWMU No. 46 is a fill area related to plant expansion and modernization activities. This recent data supports a morphology consisting of native fill soils and minor amounts of plant process remnants used to raise the area to its existing grade, or approximately 10 to 20 feet. These incidental plant process remnants may contribute to the groundwater 2L exceedance observed in the well located at the SWMU No. 46 (MW-29).

Since a more detailed plant expansion and modernization morphology of the SWMU No. 46 area has been developed, Alcoa believes a more appropriate designation for the SWMU No. 46 is "Coke Management Area".

# APPENDIX A

# ABL GEOPHYSICAL SURVEY

GEOPHYSICAL EVALUATION AT THE ALCOA POWER GENERATING, INC.
YADKIN DIVISION SWITCHYARD AND THE SWMU NO. 2, ALCOA/BADIN
LANDFILL, BADIN, NORTH CAROLINA

PREPARED FOR ENVIRONEERING, INC.

by

Geo Solutions Ltd.

GEO SOLUTIONS LIMITED, INC.
RALEIGH, NORTH CAROLINA

FEBRUARY 2008

Geo Solutions Ltd.

# TABLE OF CONTENTS



# LIST OF FIGURES

Geo Solutions Ltd.

# 1.0 INTRODUCTION

Geo Solutions Limited, Inc. ("*Geo Solutions*") is pleased to submit this report to Environeering, Inc., ("*Environeering*") for a geophysical survey at the Alcoa Power Generating, Inc. - Yadkin Division ("*Yadkin*") Switchyard and the SWMU No. 2: Alcoa/Badin Landfill ("*Badin Landfill*"), Badin, North Carolina.

## 1.1 Background

Environeering requested Geo Solutions complete a two-phase geophysical evaluation of an inactive landfill site (Badin Landfill) situated next to the Alcoa-Badin Works facility in Badin, North Carolina. The purpose of the geophysical survey was to evaluate the extent and nature of buried material along portions of the fenced landfill and portions beneath an active high voltage electrical power switchyard (Figure 1).

The site is located west of the Alcoa Badin Works facility and is situated in a hilly to mountainous terrain. Figure 2 illustrates the location of the site landfill with respect to the area topographic features and the implied complex geologic structures that has controlled the development of the area geomorphology.

## 1.2 Scope of Work

Geophysical activities at the site consisted of an initial electromagnetic ("*EM*") profile mapping of the landfill area and the area inside of the fenced switchyard. The purpose of the EM survey was to identify the distribution of buried material containing metallic-like substances and to identify the distribution of buried material of varying apparent electrical conductivity. Following the completion of the EM survey, Geo Solutions completed a ground-penetrating radar ("*GPR*") survey over most of the landfill area and the area inside of the fenced switchyard. The purpose of this investigation was to evaluate, if possible, the depth vertical distribution of the landfill cap and buried debris beneath the cap and inside of the fenced switchyard. The GPR survey, in particular was concentrated in areas containing anomalous readings from the EM survey.

## 1.3 Field Activities

On August 29 and 30, 2007, Geo Solutions completed field activities at the landfill site and the adjacent electrical switchyard. These activities utilized two geophysical techniques:

1. First, Geo Solutions completed a multifrequency EM survey of the existing Badin Landfill and the existing switchyard. The EM survey was used to evaluate the extent of buried subsurface debris and the distribution of varying conductivity as it is related to the fill.

2. Based on the results of the EM survey, Geo Solutions completed a limited GPR survey at suspected fill boundaries and potential locations of buried material.


## GEOPHYSICAL SURVEY
## BADIN LANDFILL PROJECT
## BADIN, NC

# LOCATION MAP

0 300 FEET

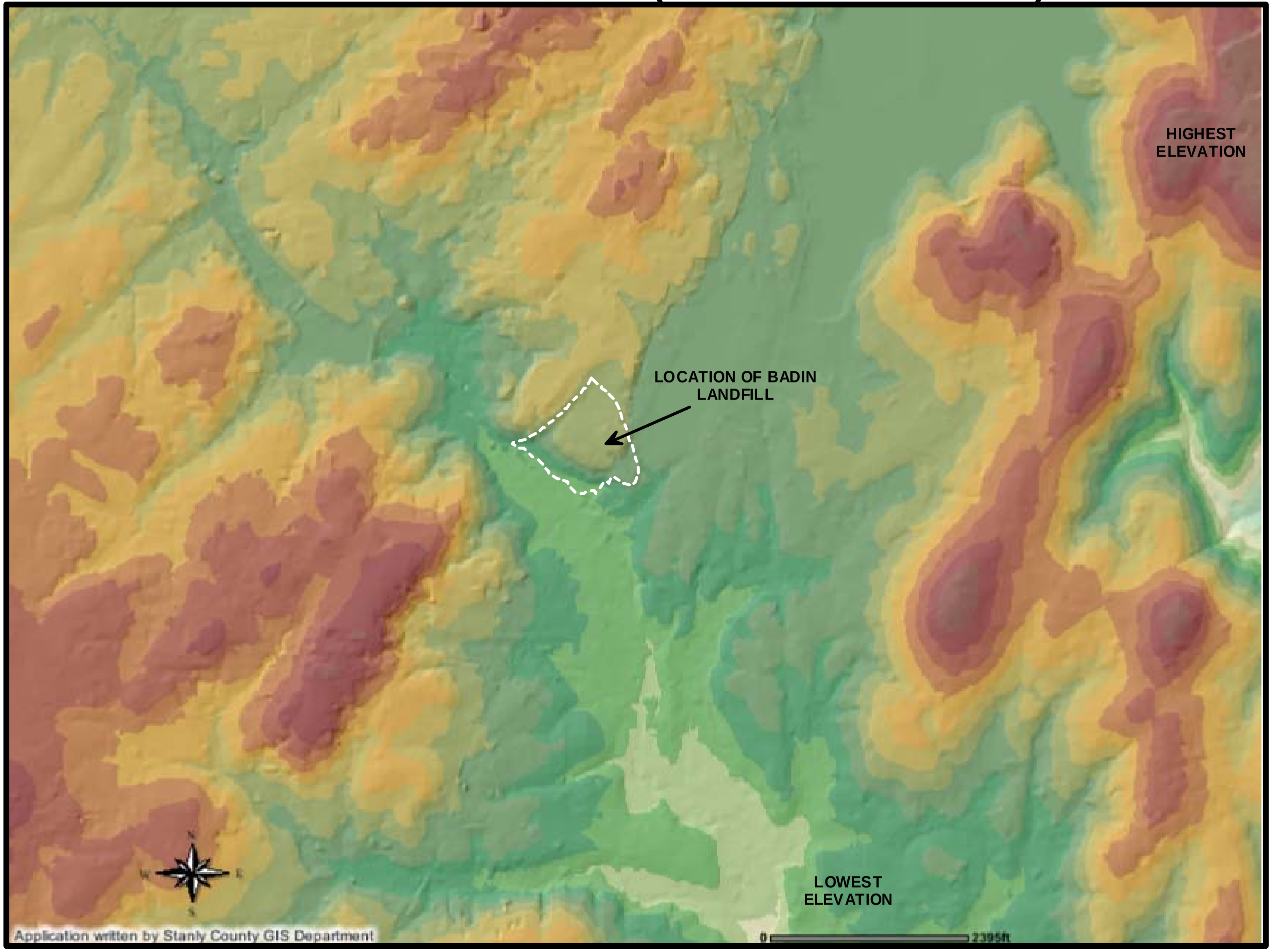
SCALE IN FEET

**FIGURE 1**

**8/30/2007**

**Geo Solutions Ltd.**

# COLOR RENDITION OF AREA ELEVATION USING NC FLOOD LIDAR DATA (STANLY COUNTY GIS)




**BADIN LANDFILL PROJECT**
**GEOPHYSICAL SURVEY**
**BADIN, NC**
**8/30/2007**

**FIGURE 2**

Geo Solutions Ltd.

# 2.0 GEOPHYSICAL TECHNIQUES

## 2.1 Multifrequency Electromagnetic Survey

### 2.1.1 Introduction

The EM Method is a non-contact (uncoupled) geophysical method that utilizes a multiple frequency electromagnetic detector (Geophex Model GEM-2). The EM instrument collects electromagnetic responses in the in-phase (metal detection or magnetic susceptibility mode) and quadrature (conductivity) mode. An object, made partly or wholly of metals or conductive materials, has a characteristic combination of electrical conductivity, magnetic permeability properties, and a geometrical shape and size. When the object is exposed to a low-frequency electromagnetic field, it produces a secondary magnetic field. By measuring the broadband spectrum of the secondary field, it is possible to obtain a distinct spectral signature that may uniquely identify the object. Thus the response spectrum from buried material becomes a clue or a "fingerprint" of the material. This is the basic concept of electromagnetic induction spectroscopy ("*EMIS*") (Won, et. al. 1998).

EMIS technology is useful in characterizing buried material (either metal bearing or conductive). In this case, Geo Solutions was interested in evaluating the distribution of buried material containing electrically highly conductive carbon and metal. Based on our experience with buried carbon debris at an NPL Site located in Tarpon Springs Florida, buried carbon material exhibits very high quadrature (apparent conductivity) values when compared with a non-carbon bearing host material (Benson, et. al., 2004). The high conductivity values are generally exhibited across all EM frequencies. Metal bearing materials (such as steel) tend to have lower conductivity responses and higher in-phase responses. As a result, a comparison of apparent conductivity values with the in-phase (metal detection mode) values provides insight as to the composition and extent of buried material with anomalous high in-phase and apparent conductivity values.

### 2.1.2 EM Field Activities

The EM in-phase and conductivity data were collected simultaneously at five varying frequencies (1530 Hz, 5010 Hz, 9990 Hz, 20010 Hz, and 47010 Hz). By varying the collection frequencies, Geo Solutions is able to better characterize the makeup of buried debris (i.e., distinguish between highly conductive carbon and other metal bearing material), if present.

The GEM-2 was operated in remote control configuration while evaluating the landfill area (using a sled) and switchyard (carried by hand). In this mode the GEM-2 unit is mounted on PVC tubular sled positioned approximately .75 meters from the ground surface, or is held by hand while the land is traversed on foot. The receiving coil (detector coil) is situated directly above the exposed ground surface.

Geo Solutions Ltd.

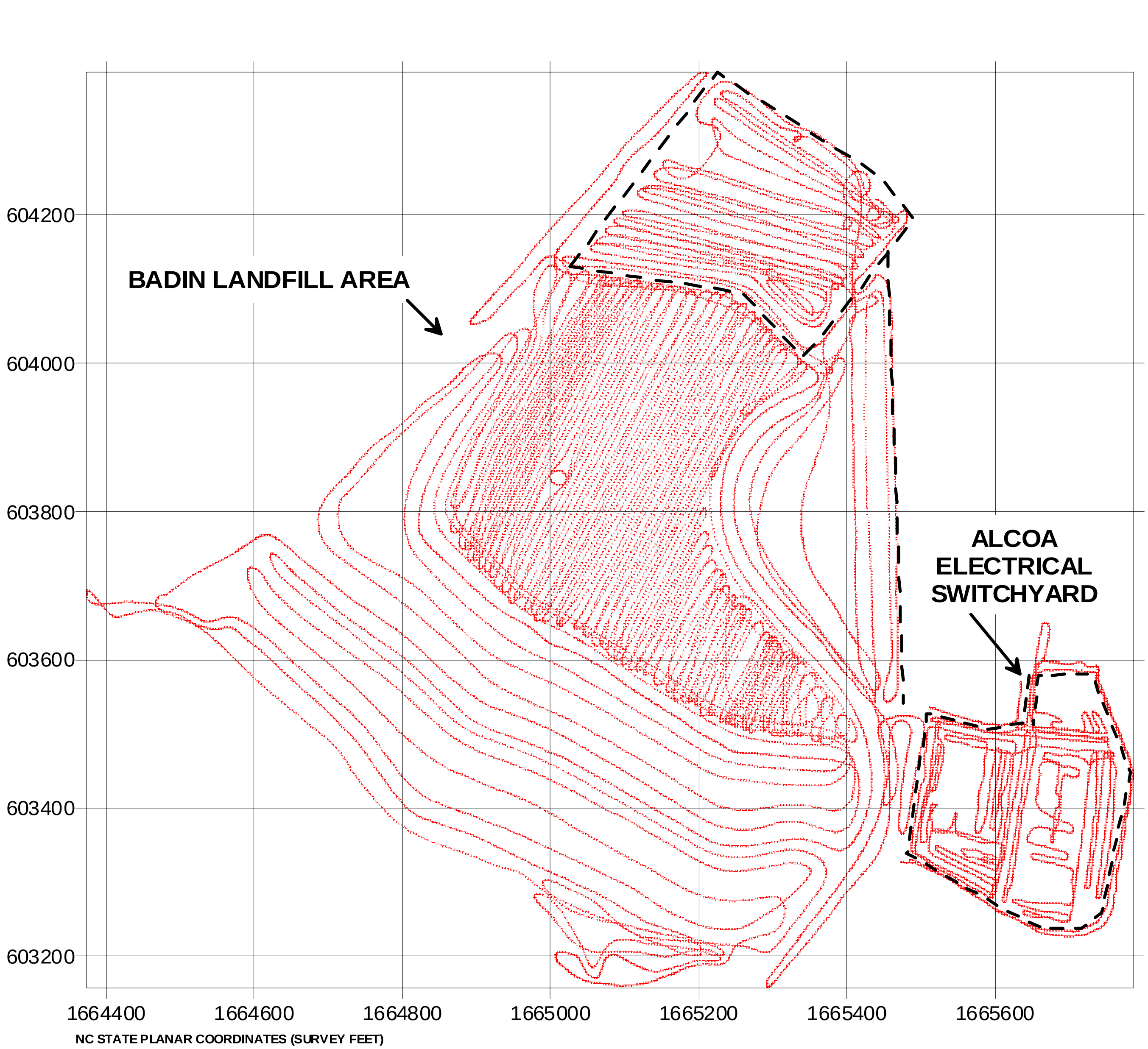
**Photograph showing typical deployment of EM unit mounted on sled (left) or hand carried (right).**

Data was collected at the rate of six samples per second. The position of each sample point was measured utilizing a CSI Wireless SERES global positioning system ("*GPS*") with a data update rate of 6 Hz (Crowson et. al. 2007). These data were transferred from the GEM-2 unit to a portable laptop computer that was carried on board a 4WD vehicle (Polaris Ranger with covered cab area). The sample spacing is thus a function of rate of travel of the sled or pace rate of the person carrying the GEM-2 and rate of data sampling. Here, Geo Solutions collected data along straight survey lines at 1.5 to 2 ft. intervals. The location of the EM data points is presented in Figure 3 for both sites.

The EM data was transferred from the GEM-2 to a laptop computer using the WinGEM Version 3 software provided by the manufacturer. During the transfer process, the WinGEM software assigns UTM metric coordinates to each data collection station, and calculates the apparent conductivity, sum of conductivity, and magnetic susceptibility for each frequency collected using the system software. These data were then transferred to a Microsoft Excel Spread Sheet and reviewed for data anomalies such as poor GPS confidence levels that would likely result in poor coordinate assignments. As a result all data with GPS confidence levels of less than 1 were rejected (approximately 40 records out of 66,020 records collected were rejected). The UTM Coordinates were transformed into the North Carolina State Plane System (in survey feet) using the Corpscon Freeware Software (Version 6.0.1). These data were used to compile a series of maps illustrating various responses using a simple 3D mapping program (Golden Software's Surfer Mapping System Version 8).

### 2.1.3 EM In-Phase Survey – Metal Detection Mode

The results of the EM data were reviewed across all frequencies for both the in-phase (metal detection) and quadrature (conductivity) modes. Based on this review the five collection frequencies, the 9990 Hz frequency in-phase data was selected to identify the location of potentially buried metal debris (Figure 4). The 9990 Hz frequency was chosen because it is the established EM frequency used by the Geonics EM-31, and it appeared to provide a uniform (low noise level) representation of the overall data base in comparison of the other four frequencies. Figure 4A illustrates our interpretation of the extent of buried material potentially containing metal debris. Site coordinates for four areas containing concentrations of potential




LEGEND

**LOCATION OF EM DATA POINTS**

MULTIFREQUENCY EM GEOPHYSICAL SURVEY
BADIN LANDFILL
BADIN, NORTH CAROLINA

SITE PLAN

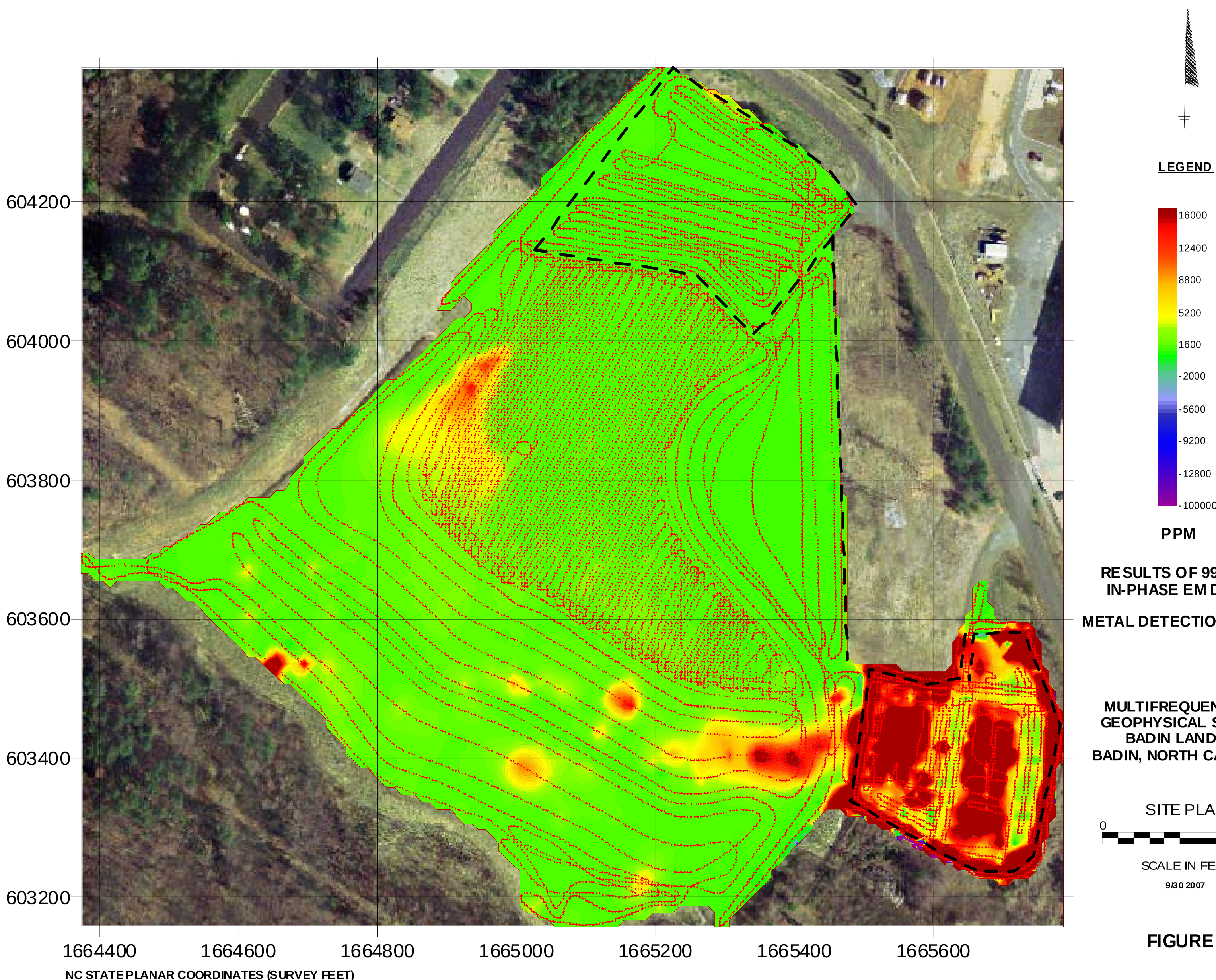
0 300

SCALE IN FEET

9/30 2007

**FIGURE 3**

Geo Solutions Ltd.




RESULTS OF 9990 Hz
IN-PHASE EM DATA

METAL DETECTION MODE

MULTIFREQUENCY EM
GEOPHYSICAL SURVEY
BADIN LANDFILL
BADIN, NORTH CAROLINA

SITE PLAN

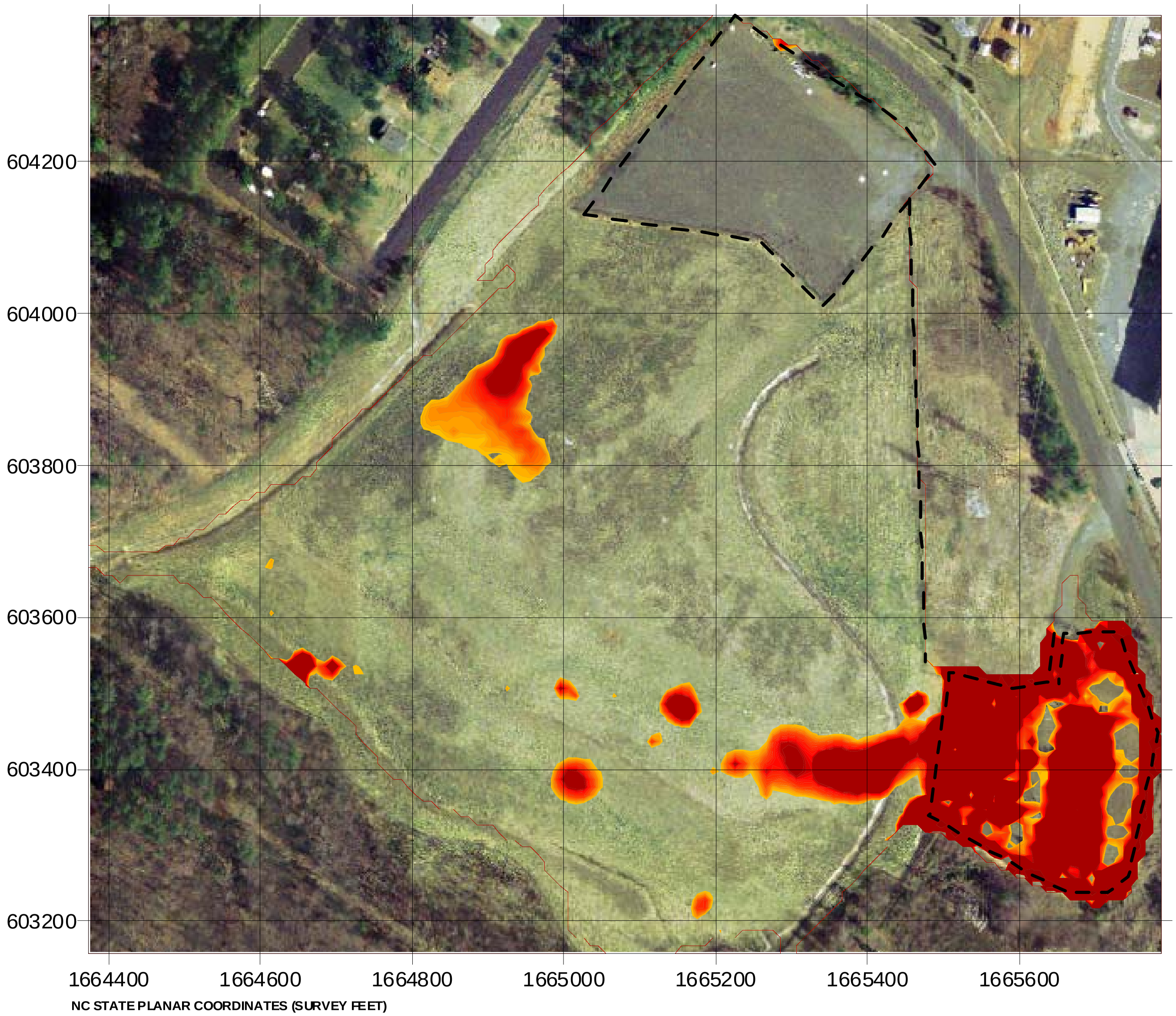
0 300

SCALE IN FEET

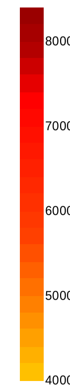
9/30 2007

FIGURE 4

Geo Solutions Ltd.




LEGEND




PPM

RESULTS OF 9990 Hz
IN-PHASE EM DATA

METAL DETECTION MODE
ESTIMATE EXTENT OF
DETECTABLE METAL

MULTIFREQUENCY EM
GEOPHYSICAL SURVEY
BADIN LANDFILL
BADIN, NORTH CAROLINA

SITE PLAN

0 300

SCALE IN FEET

9/30 2007

FIGURE 4A

Geo Solutions Ltd.

buried debris with strong in-phase responses are listed in Table 1, and represents approximately 0.75 acres.

Table 1

| Easting | Northing | Description |
|---|---|---|
| 1664918.7233 | 603905.6874 | Large area where overburden is reportedly greater than 15 feet thick. |
| 1665009.2495 | 603383.582 | Small area near the face of a sloped surface. |
| 1665150.3021 | 603480.4242 | Small area near the face of a sloped surface. |
| 1665386.0917 | 603404.6346 | Large area where area trend suggests potential presence beneath the switchyard. |

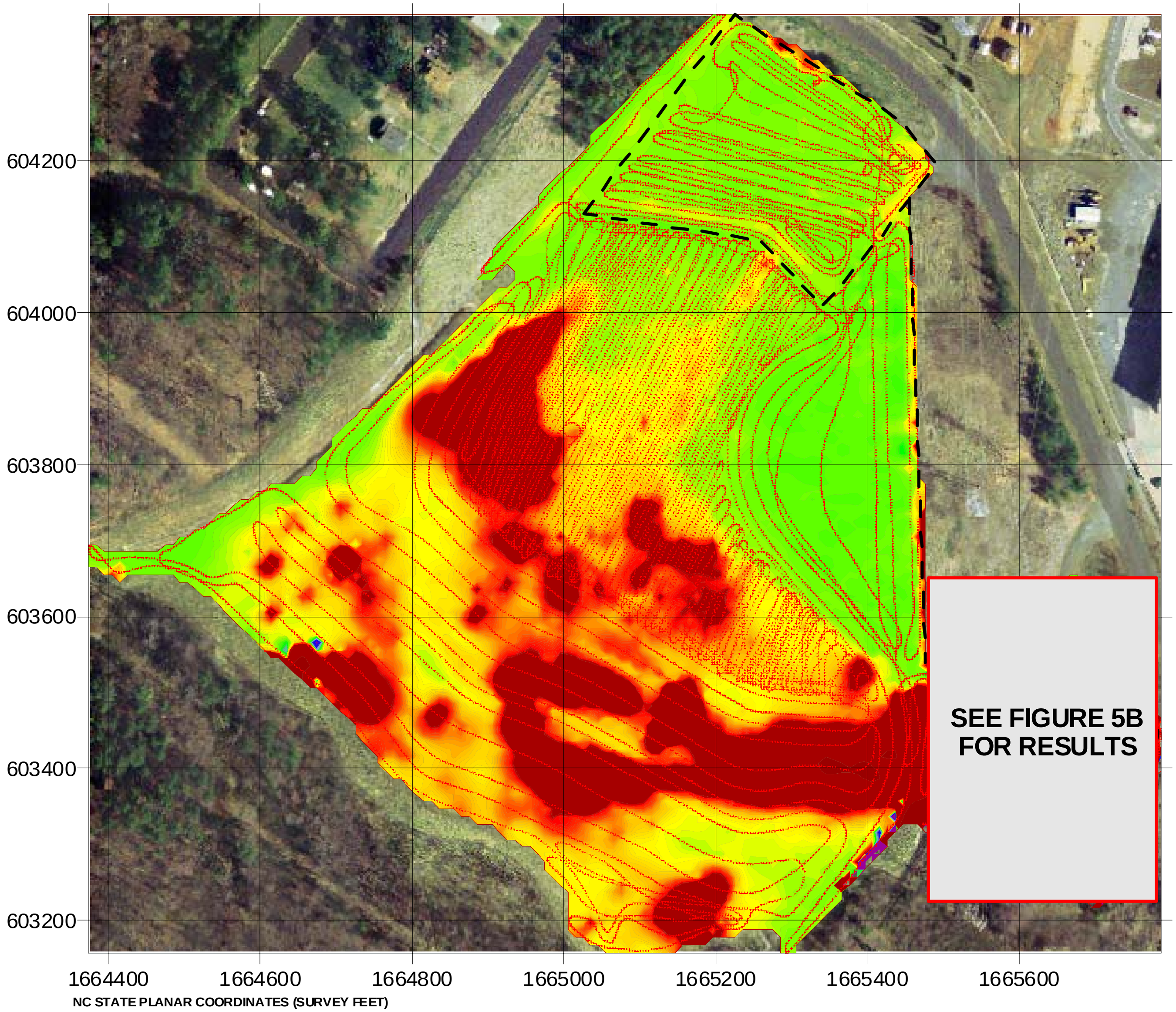
### 2.1.4 EM Quadrature Survey – Conductivity Mode

Similarly, Geo Solutions collected EM data over the site for variations in apparent conductivity. Geo Solutions compiled the sum of conductivity across each frequency, which enables the EM data to reflect subtle changes in conductivity while also showing large anomalous conditions.

A map illustrating the results of the sum of all collected conductivity values is presented as Figure 5. In Figure 5, areas of high soil conductivity are generally more widespread than the distribution of suspected buried metal debris. However, zones of strong positive soil conductivity generally coincide with locations of potentially buried very conductive (electrically) debris. These conductive areas may also reflect changes in the overall conductivity of groundwater. However, given the magnitude of the conductivity values it is more likely a result of highly conductive material such as carbon. In Figure 5A, Geo Solutions has identified the interpreted extent of very high conductivity values shown in the combined landfill and switchyard area. Figure 5B is an enlarged area of just the switchyard with an interpreted outline of the areas containing the highest soil conductivity. Here, Geo Solutions estimates the area of elevated conductivities to be less than one acre. Site coordinates for four areas containing concentrations of high soil conductivities are listed in Table 2, and represent approximately 6.5 acres in area.

Table 2

| Easting | Northing | Description |
|---|---|---|
| 1664910.3021 | 603850.9504 | Large area located near a large In-Phase anomaly |
| 1664722.9337 | 603514.1084 | Area located near the west fence area. |
| 1665350.3021 | 603413.0558 | Very large site extending from the southwest portion of the landfill to the switchyard. |
| 1665165.0391 | 603213.0558 | Anomalies situated near the south edge of the fill near the fence line. |




**LEGEND**

8000
6200
4400
2600
800
-1000
-2800
-4600
-6400
-100000

**SUM OF mS/M**

**RESULTS OF SUM OF CONDUCTIVITY EM DATA**

**SOIL AND GROUNDWATER CONDUCTIVITY**

**MULTIFREQUENCY EM GEOPHYSICAL SURVEY**
**BADIN LANDFILL**
**BADIN, NORTH CAROLINA**

SITE PLAN

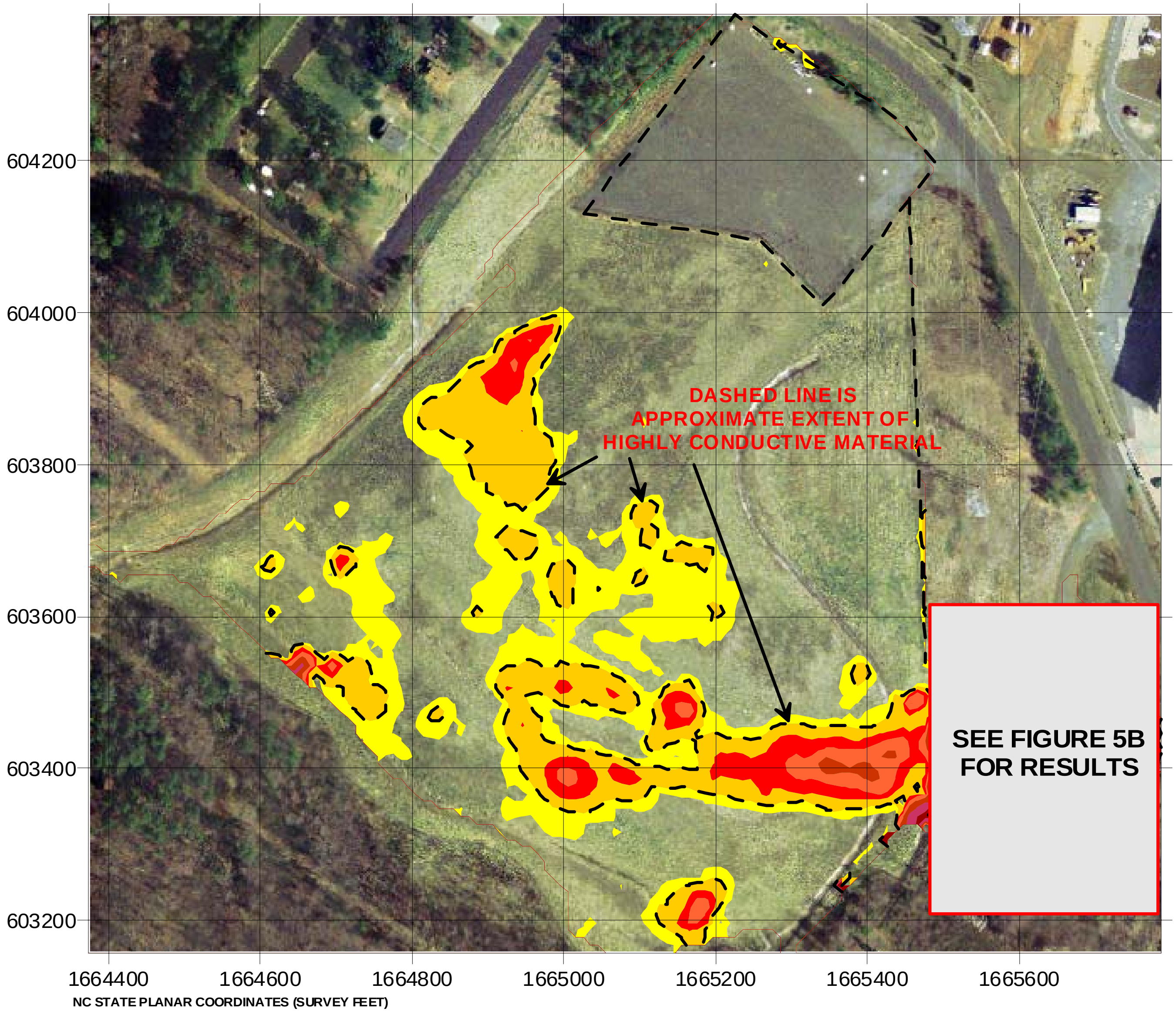
0 300

SCALE N FEET

9/30 2007

**FIGURE 5**

**Geo Solutions Ltd.**




**LEGEND**

8000
6200
4400
2600
800
-1000
-2800
-4600
-6400
-100000

**SUM OF mS/M**

**RESULTS OF SUM OF CONDUCTIVITY EM DATA**

**SOIL AND GROUNDWATER CONDUCTIVITY**

**MULTIFREQUENCY EM GEOPHYSICAL SURVEY**
**BADIN LANDFILL**
**BADIN, NORTH CAROLINA**

SITE PLAN

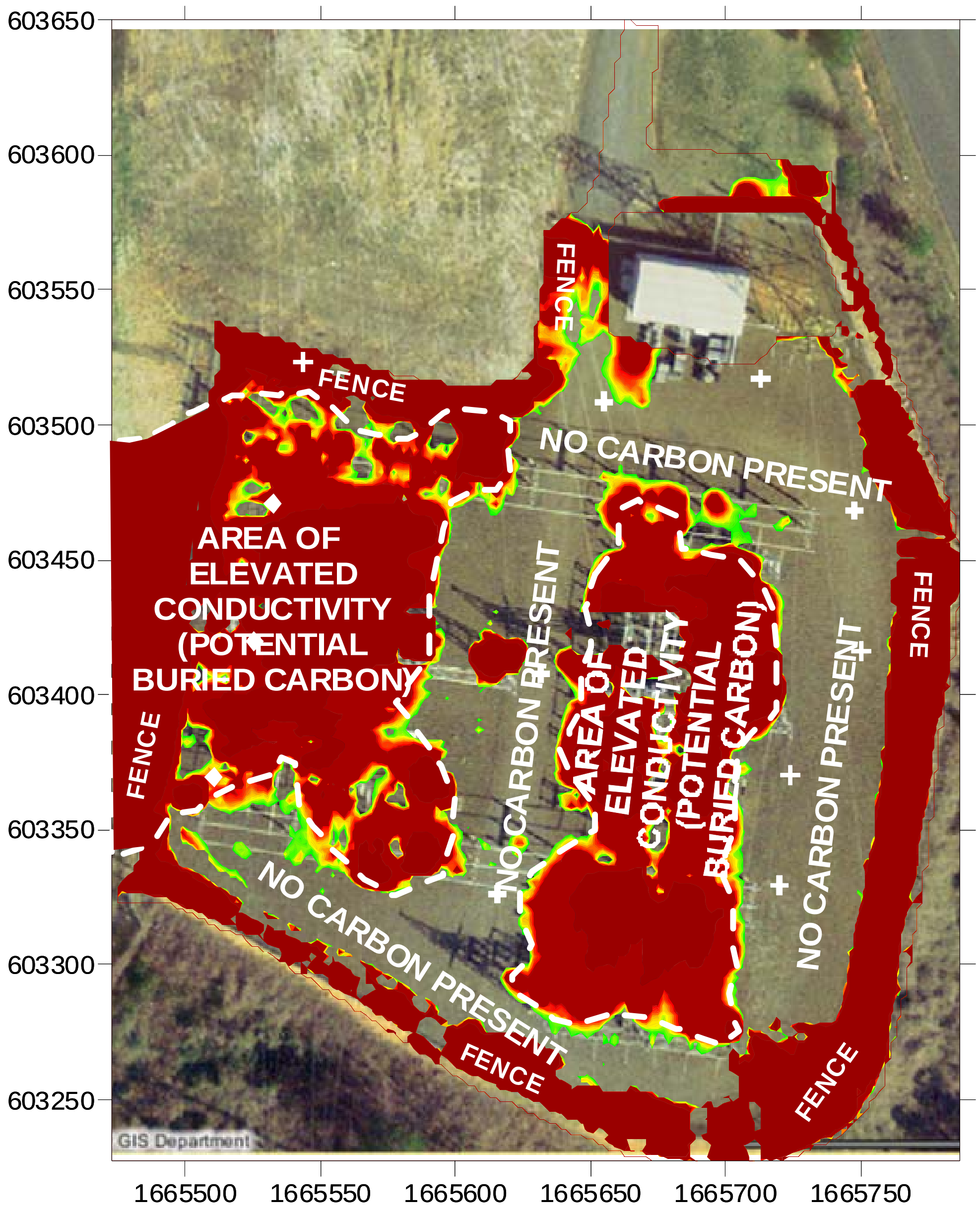
0 300

SCALE IN FEET

9/30 2007

**FIGURE 5A**

**Geo Solutions Ltd.**



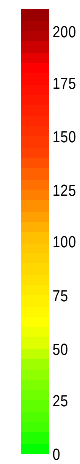

BORING LOCATION AND RESULTS
PROVIDED BY ENVIRONEERING, INC.

NC STATE COORDINATES (SURVEY FEET)

**LEGEND**

✚ LOCATION OF BORING CONTAINING NO CARBON

◆ LOCATION OF BORING CONTAINING CARBON




SUM OF mS/M

RESULTS OF SUM OF CONDUCTIVITY EM DATA

SOIL AND GROUNDWATER CONDUCTIVITY IN THE SWITCHYARD

MULTIFREQUENCY EM GEOPHYSICAL SURVEY
BADIN LANDFILL
BADIN, NORTH CAROLINA

SITE PLAN

0 300

SCALE IN FEET

9/30 2007

**FIGURE 5B**

Geo Solutions Ltd.

## 2.2 Ground-Penetrating Radar

### 2.2.1 Introduction

GPR is an effective geophysical tool used to establish vertical and horizontal variations of certain electrical properties of soil. GPR is a noninvasive electromagnetic geophysical technique that utilizes radio frequency EM energy to detect various layers in the earth's shallow subsurface. It is widely used in environmental site characterization and landfill construction verification. It may be deployed from the surface by hand or vehicle (sled). It has the highest resolution of any geophysical method for imaging the subsurface, with centimeter scale resolution sometimes possible. However, GPR investigations usually are affected by subsurface conditions:

1. Soil composition affects the depth of detection (i.e. higher clay content generally equal lesser depths of penetration of the radar signal and thus the lesser depths of detection).

2. Presence of highly conductive material (i.e., less resistive material) generally equals poorer quality of recovered data. Conductive material enhances the attenuation of the radar signal, thus reducing the depth of penetration.

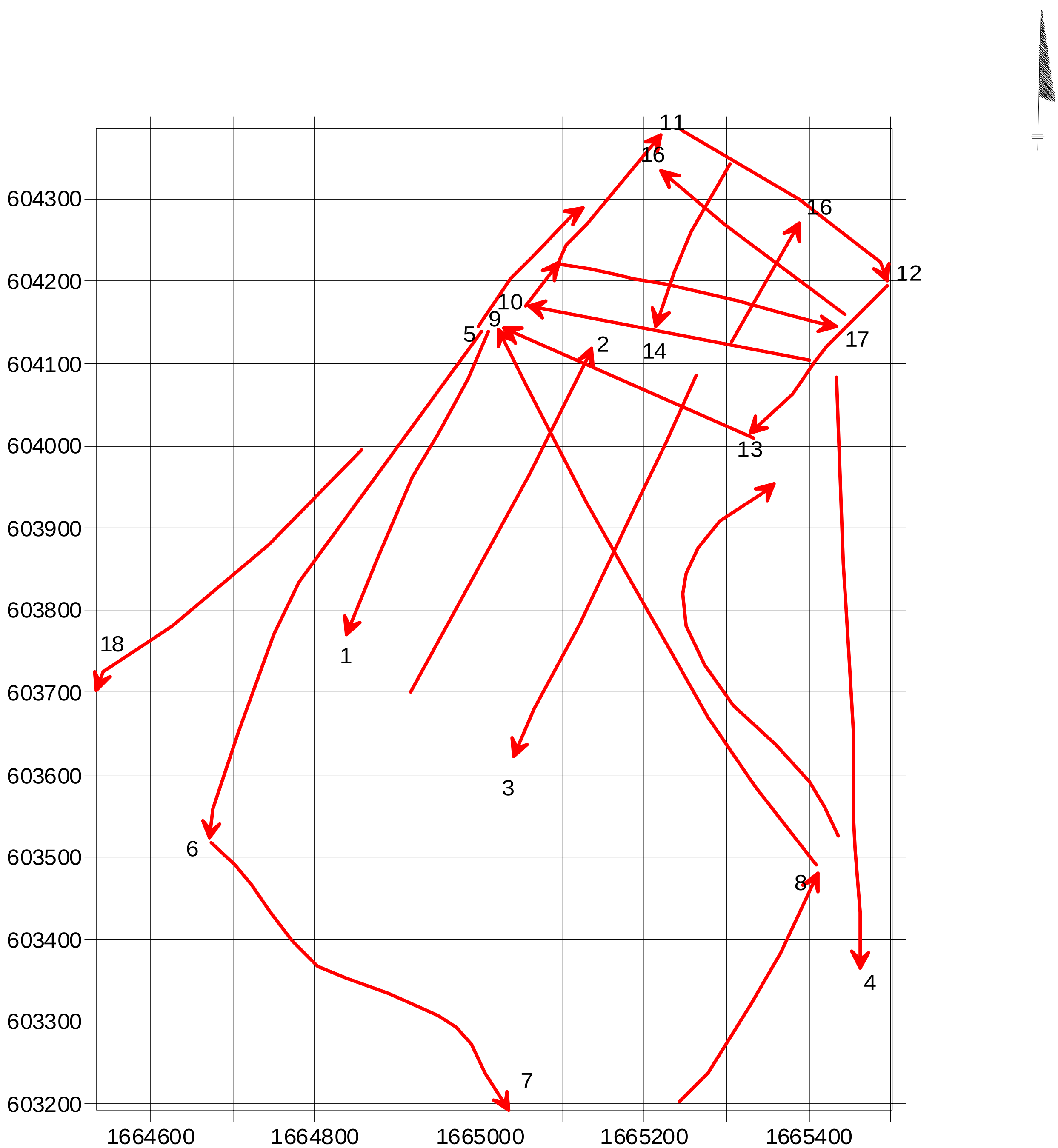

**Typical setup of GPR using a hand-pushed cart (left) and the Model 3000 display (right).**

### 2.2.2 Field Activities

The GPR data was collected on the SIR 3000 data collection unit using a 400 and 200 MHz antennas, and reviewed in the field for completeness and reliability. The SIR 3000 unit uses a digital survey wheel to determine the distance between each vertical survey GPR sounding. These data are also collected along with the time domain records of the GPR. These data were post-processed using GSSI Radar Radan Version 6 software. In general, the GPR records are good with an average depth of detection of 4 feet for the 400 MHz, and 8 feet for the 200 MHz antennas. This depth of detection is more than Geo Solutions anticipated given the presence of a clay cap on the landfill. The presence of clay capping material generally reduces the depth of penetration for GPR.

### 2.2.3 GPR Survey

The location of each GPR profile in relationship the landfill area is presented in Figure 6. Here, a moderate density of GPR profiles was completed across the landfill and parking area. These data were collected to evaluate the presence of shallow buried debris. The results of the profiles are presented in Figures 7A and 7B. No shallow material was detected in the capped landfill. Additional GPR profiles were completed in the fenced area of the electrical switchyard. The location of these GPR profiles is presented in Figure 8. The results of the profiles are presented in Figure 9. GPR penetration in the electrical switchyard was limited on average to 5 feet with localized maximums of 10 feet. Shallow debris was recognized only in areas near the northwestern 1/3$^{rd}$ of the switchyard site.




**LEGEND**

C

LOCATION AND DIRECTION OF GPR PROFILE

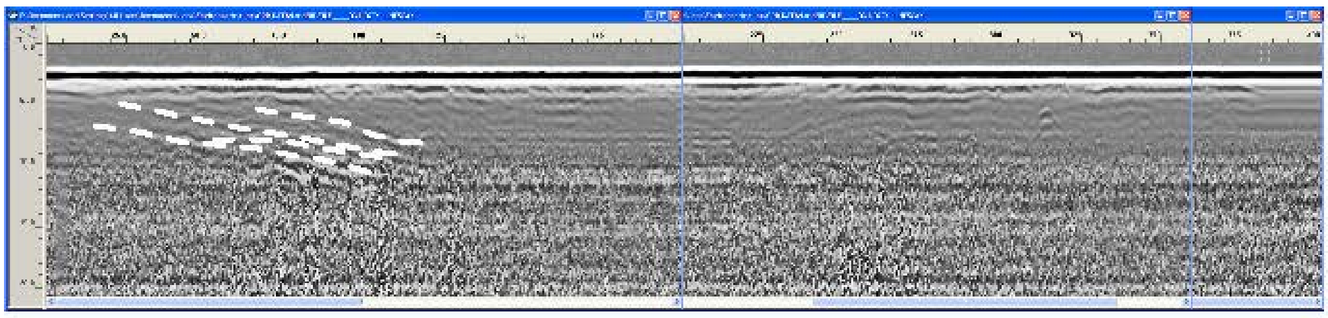
# GEOPHYSICAL SURVEY
# BADIN LANDFILL PROJECT
# BADIN, NC

**LOCATION GPR PROFILES**

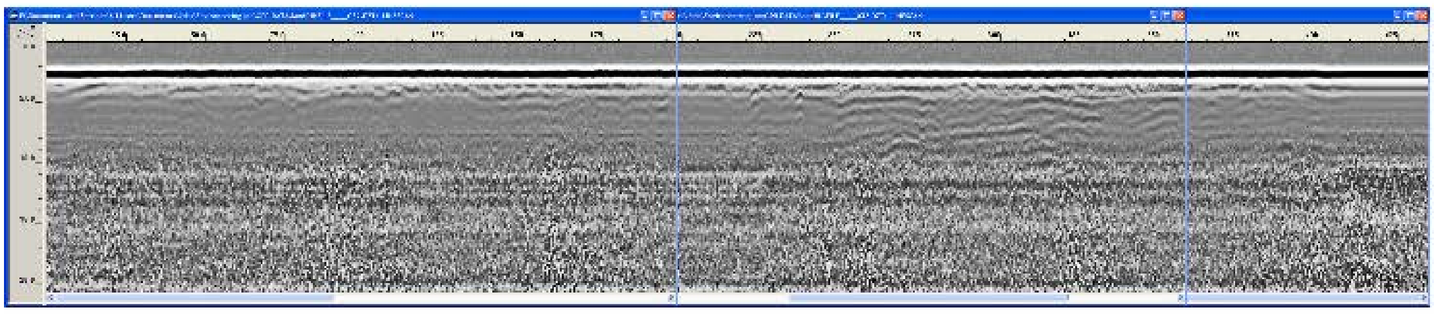
**FIGURE 6**

**8/30/2007**

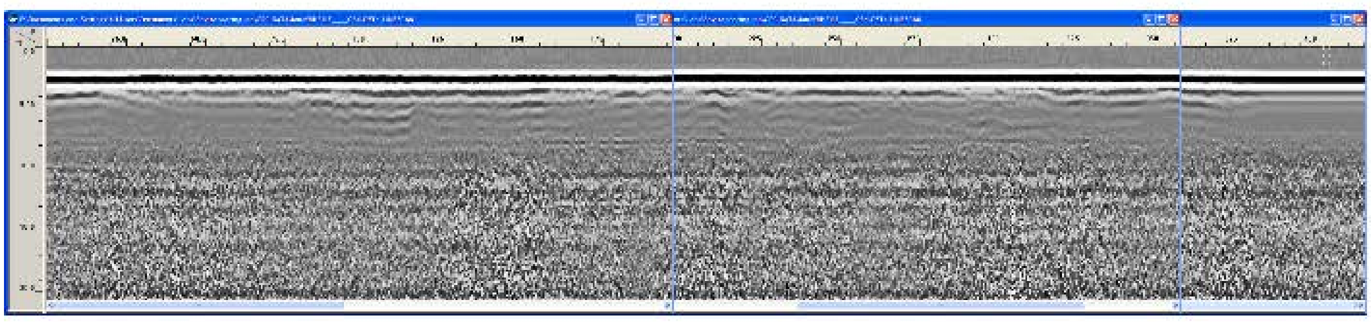
***Geo Solutions Ltd.***



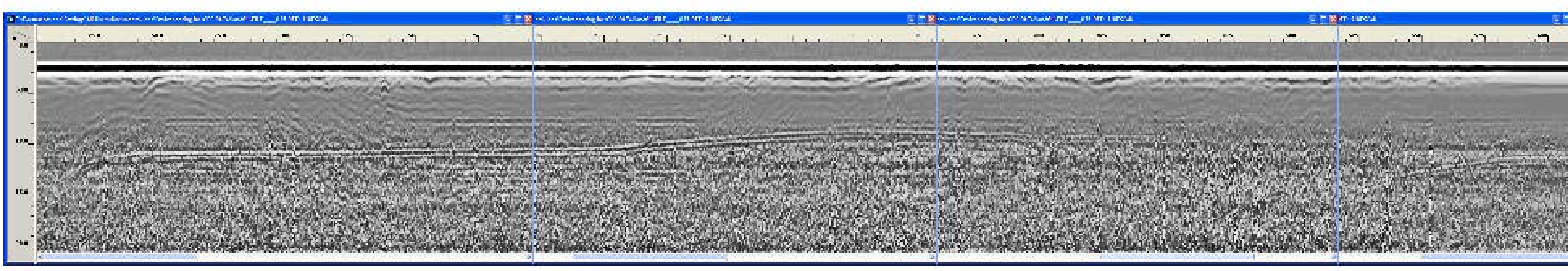
GPR PROFILE 1



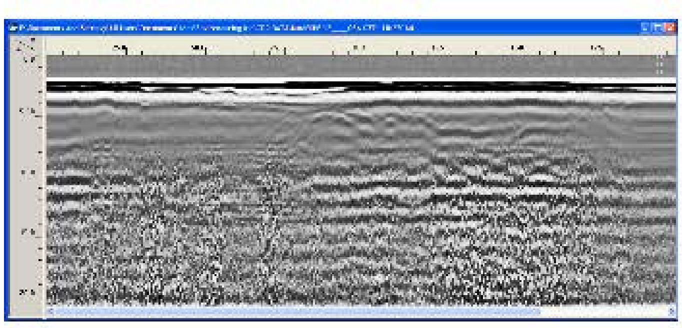
GPR PROFILE 2



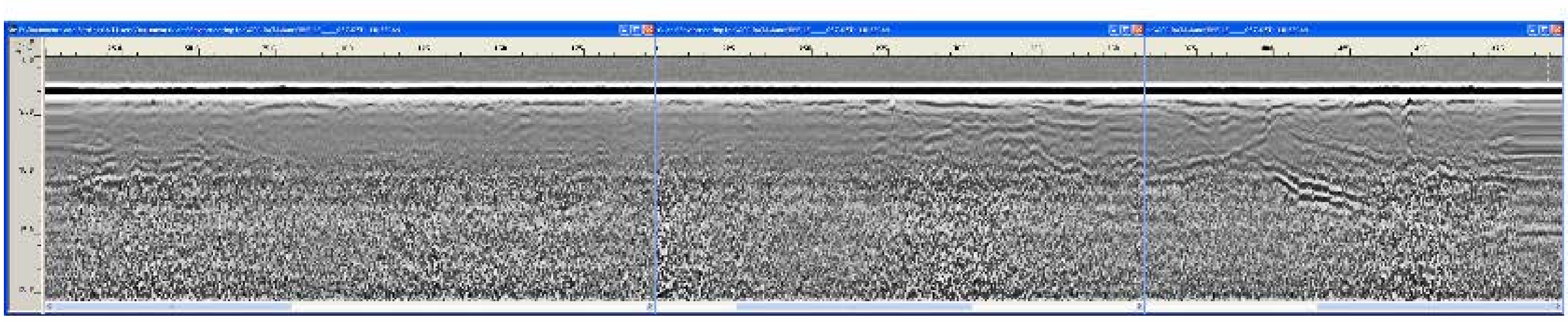
GPR PROFILE 3



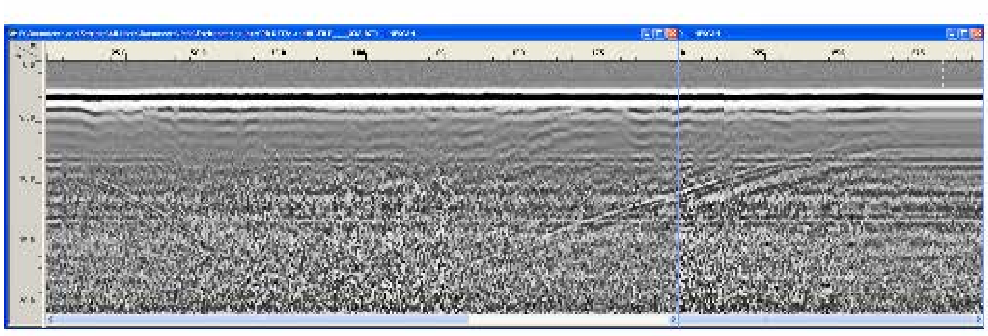
GPR PROFILE 4



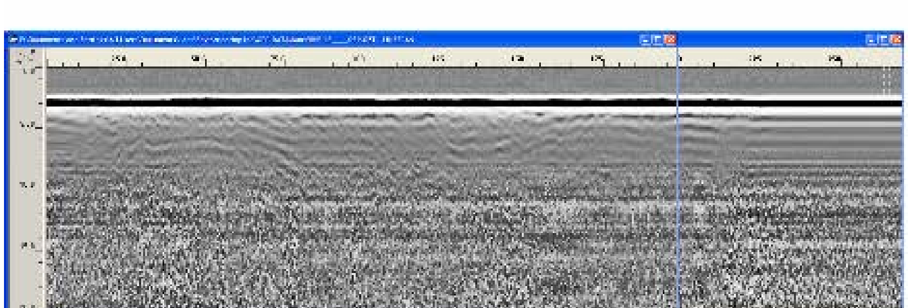
GPR PROFILE 5



GPR PROFILE 6



GPR PROFILE 7



GPR PROFILE 8

GROUND-PENETRATING RADAR
GEOPHYSICAL SURVEY
ALCOA LANDFILL
BADIN, NORTH CAROLINA

**FIGURE 7A**

8/30/2007

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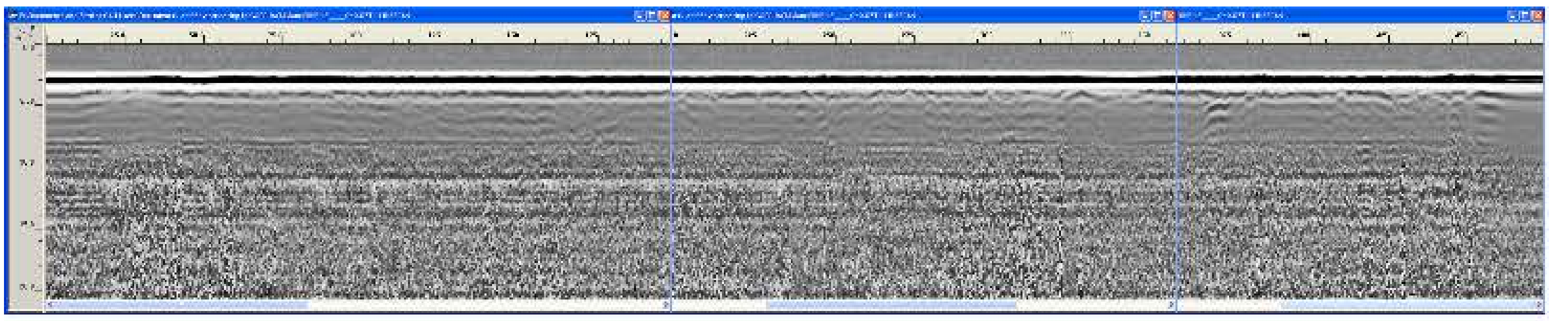
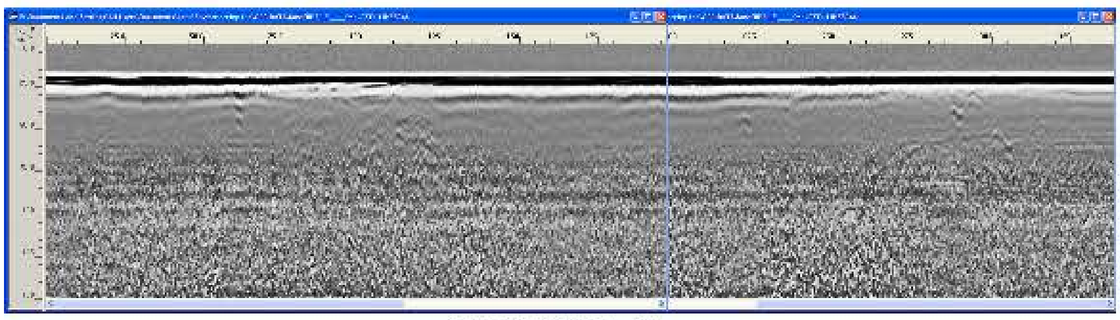
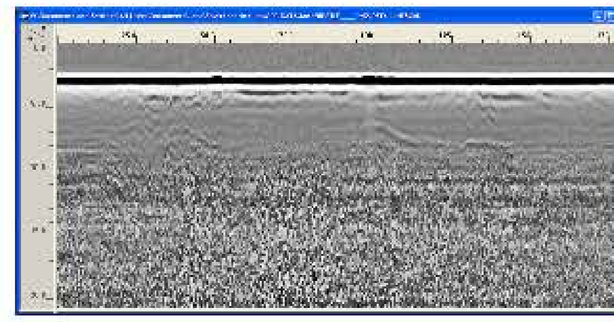


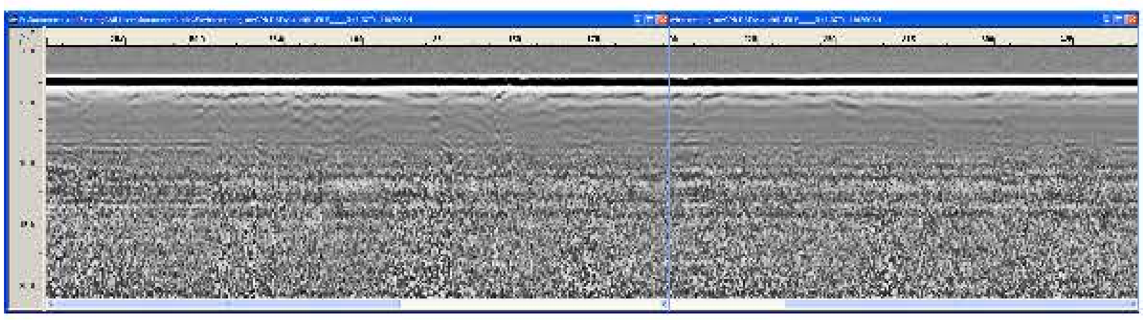
GPR PROFILE 9



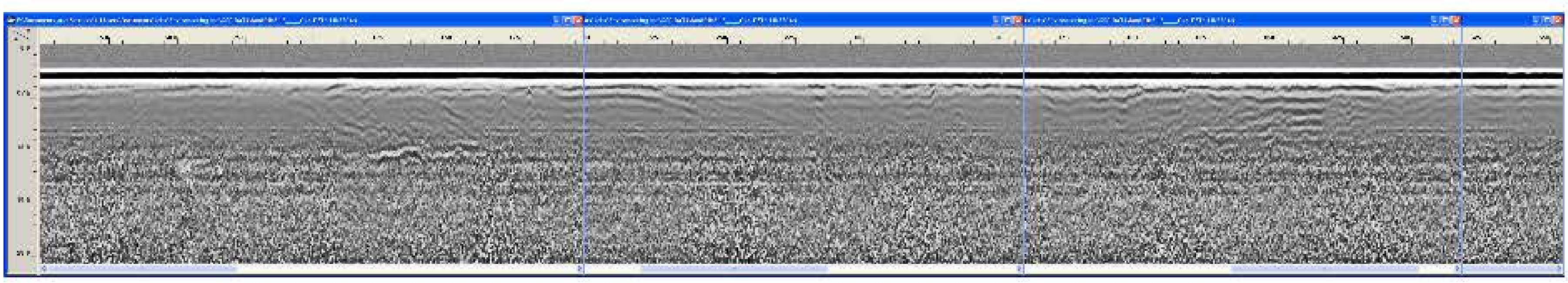
GPR PROFILE 10



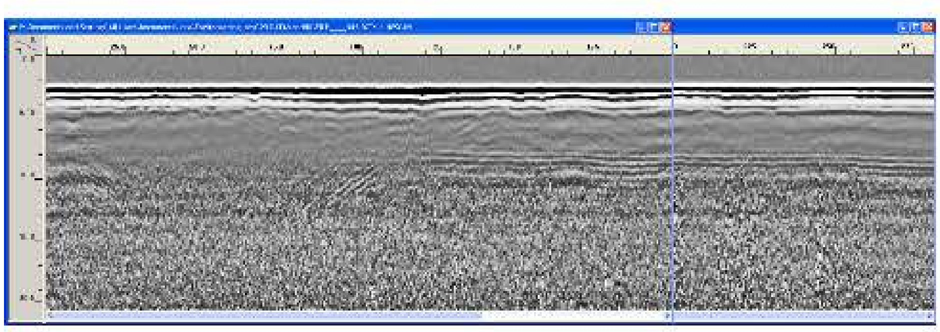
GPR PROFILE 11



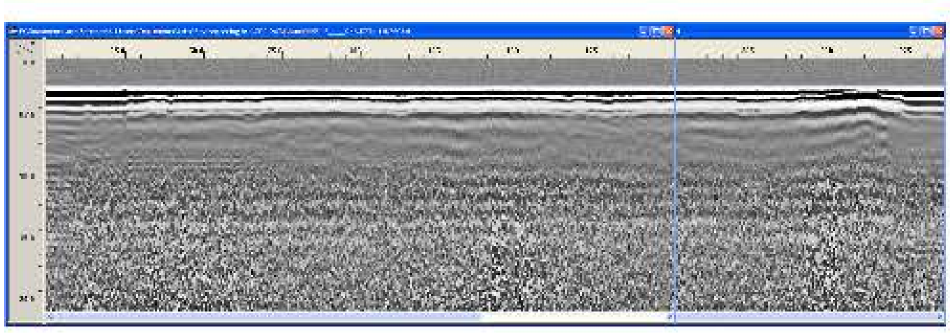
GPR PROFILE 12



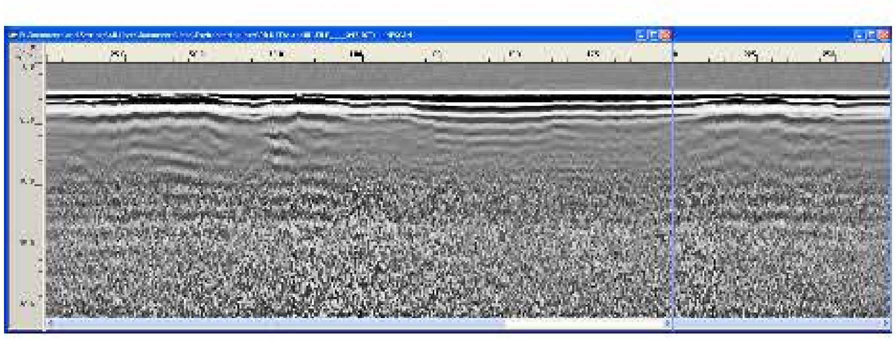
GPR PROFILE 13



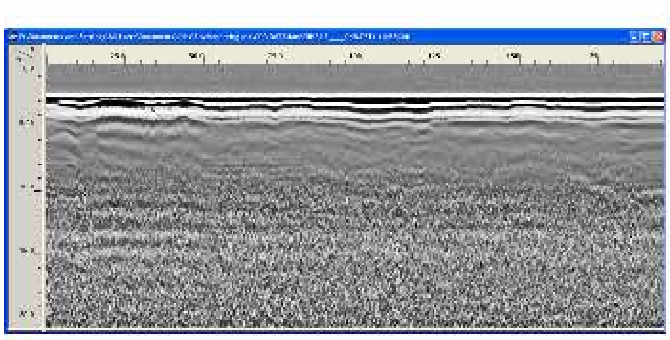
GPR PROFILE 14



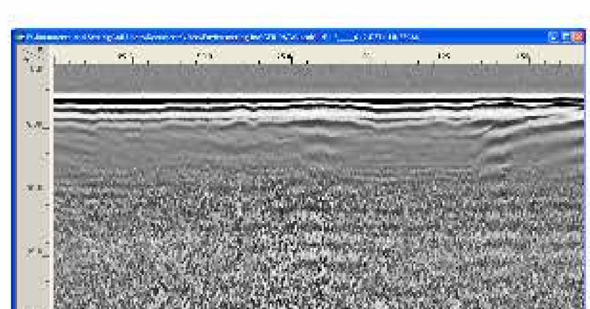
GPR PROFILE 15



GPR PROFILE 16



GPR PROFILE 17



GPR PROFILE 18

GROUND-PENETRATING RADAR
GEOPHYSICAL SURVEY
ALCOA LANDFILL
BADIN, NORTH CAROLINA

**FIGURE 7B**

8/30/2007

Geo Solutions Ltd.


**LEGEND**

→ C LOCATION AND DIRECTION OF GPR PROFILE

RED DASHES INDICATE AREA OF BRIGHT GPR REFLECTORS (PRESENCE OF POTENTIALLY BURIED CARBON)

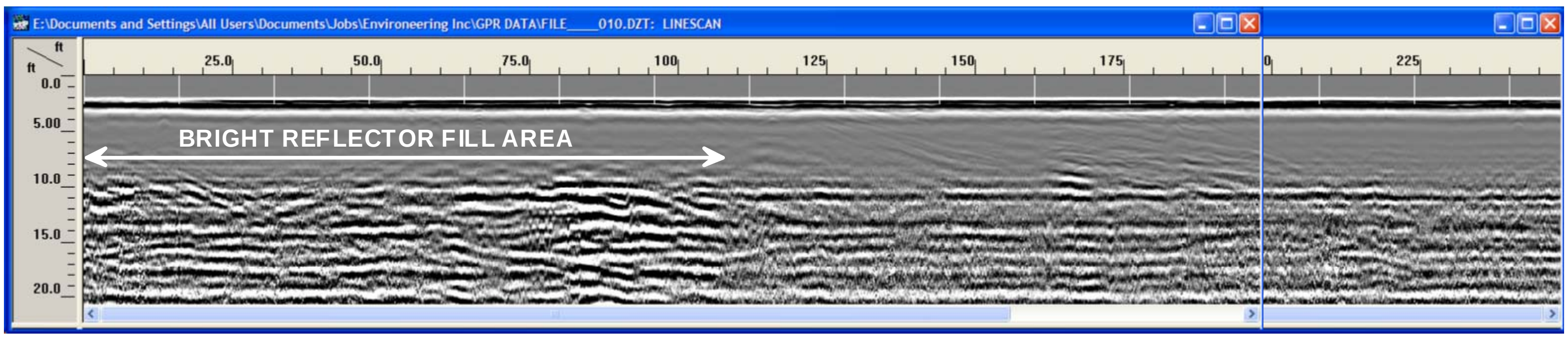
# GEOPHYSICAL SURVEY
# BADIN LANDFILL PROJECT
# BADIN, NC

## LOCATION GPR PROFILES
## ALCOA SUBSTATION

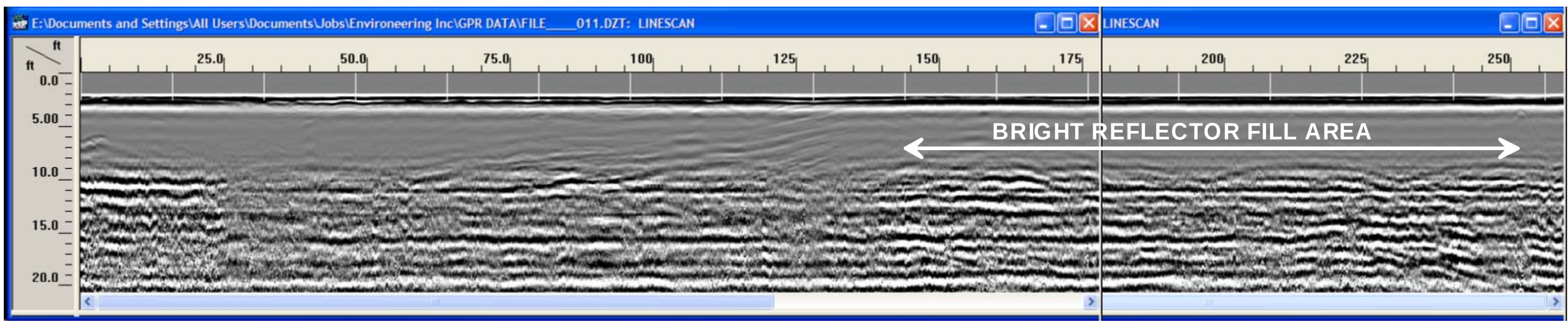
**FIGURE 8**

8/30/2007

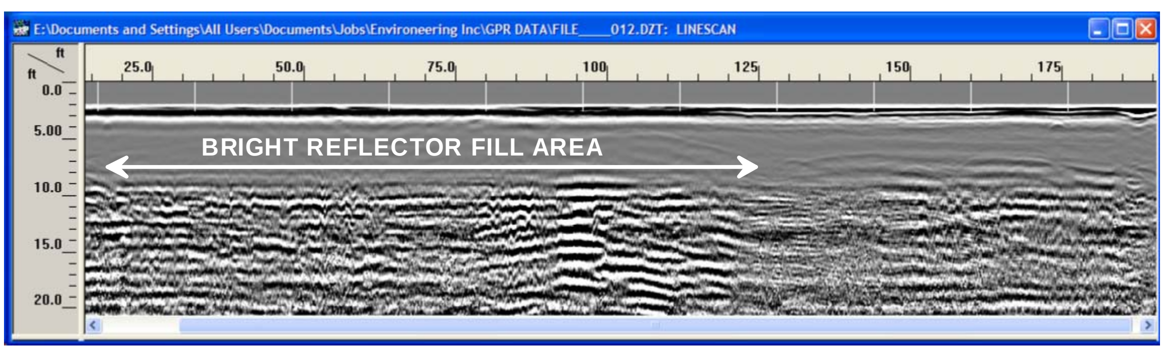
Geo Solutions Ltd.



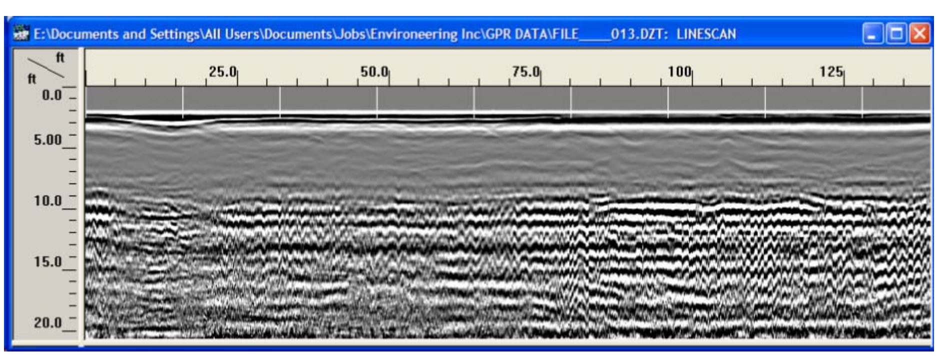

GPR
PROFILE A



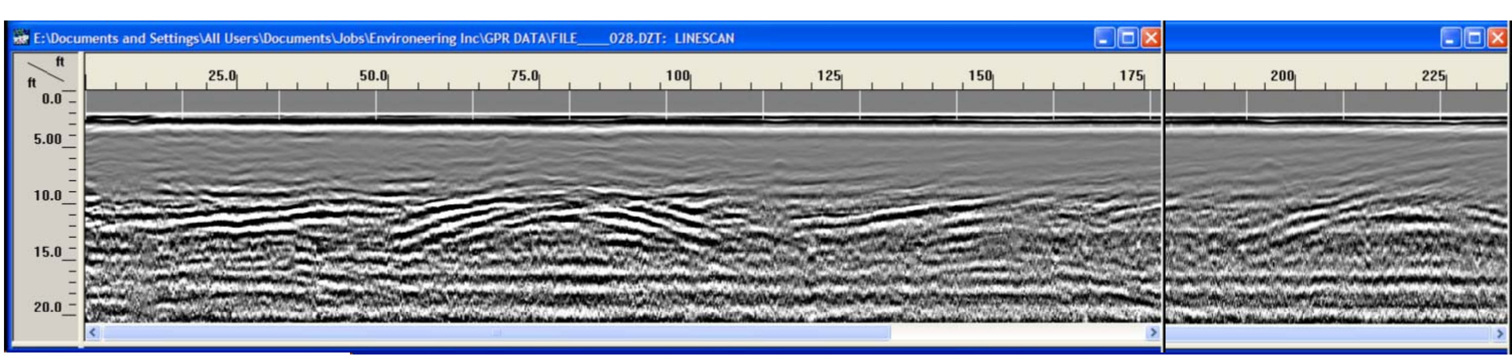

GPR
PROFILE B



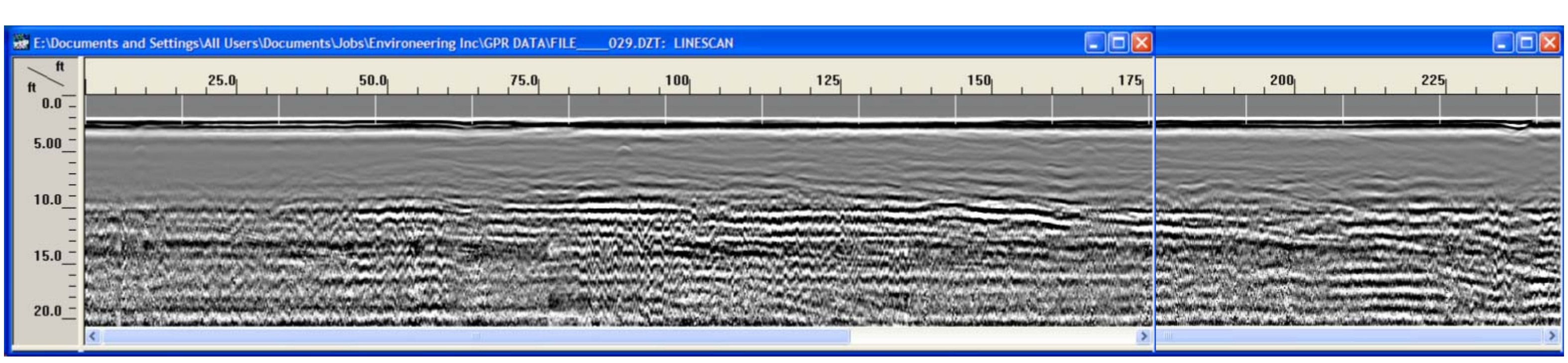

GPR
PROFILE C



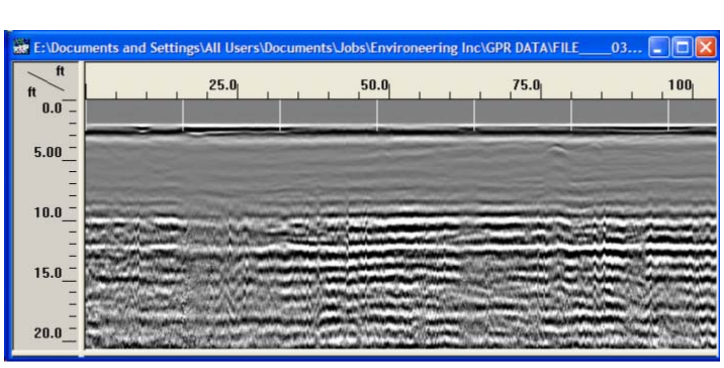
GPR
PROFILE D



GPR
PROFILE E



GPR
PROFILE F



GPR
PROFILE G

**RESULTS OF GPR PROFILES SUBSTATION AREA (SEE FIGURE 8 FOR LOCATIONS)**

8/30/2007

**FIGURE 9**

Geo Solutions Ltd.

# 3.0 EM INTERPRETATION

## 3.1 Introduction

An EM evaluation was completed at the Badin Landfill and Alcoa Switchyard located in Badin, North Carolina. The following is a summary of findings.

## 3.2 Summary of Findings

An EM evaluation was completed at the Badin Landfill site located near Badin, North Carolina. The area of the investigation represented approximately 20 acres in area. The EM profiles were completed and maps produced illustrated the following:

1. Presence of anomalous conditions (areas where the in-phase EM values exceeded background conditions and are not explained by observed surface conditions) in the in-phase data indicated buried metal and metallic like debris within isolated regions of the landfill area. These areas represent approximately 0.75 acres of the whole landfill.

2. Other, smaller EM in-phase anomalies were also present as discrete zones, and represent less than 0.25 acres.

3. EM quadrature data (apparent conductivity) indicates anomalous soil conductivity conditions are present over larger areas than the in-phase EM anomalies (areas where the in-phase EM values exceeded background conditions and are not explained by observed surface conditions). The area affected by elevated conductivity values is in excess of 6.5 acres and is found in the southwestern ½ of the landfill.

4. Additionally, several conductivity anomalies coincide with the location of the boundary fence on the southwest side of the landfill. These data indicate the potential presence of material containing elevated conductivity present beyond the extent of the fenced property.

5. Likewise, elevated subsurface soil conductivity conditions are present at the site of suspected metal anomalies found beneath the Alcoa switchyard. The presence of carbon material found by Environeering in three borings suggests that the elevated conductivity values detected beneath the switching and transformers in the switchyard may be due impart to the presence of buried carbon.

# 4.0 GPR INTERPRETATION

## 4.1 Introduction

A total of 25 GPR survey profiles were collected over portions of the landfill area, and the fenced switchyard area. These profiles were collected to provide a verification of the continuity of the landfill clay cap and to evaluate the potential presence of buried debris within the detection depth of GPR (a depth less than 10 feet).

## 4.2 Landfill Summary of Findings

A total of 18 GPR profiles were collected within the Badin Landfill. Here, the depth of GPR detection was generally less than 10 feet. The continuity of the GPR profile records over the landfill proper is an indication that the cap is continuous. Shallow bed forms, as exhibited in GPR Profile 1 are an indication of the fill process during the construction of the clay cap. Bright GPR reflectors were not observed in the landfill records indicating that potential carbon fill material was not present at depths less than the detection depth of the GPR (generally less than10 feet).

## 4.3 Switchyard Summary of Findings

The GPR evaluation was completed as a series of 7 profiles that covered the accessible areas within the fenced switchyard and over portions of the switchyard where suspected metal and/or highly conductive carbon debris was indicated by the EM evaluation. Here, Geo Solutions found:

1. GPR penetration was limited in depth because of the clayey nature of the soil and the presence of highly conductive material at depth. However, several shallow zones were identified to contain potential buried debris because of the high contrast of the GPR reflectors. These areas are evidenced by bright GPR reflectors (Profiles A, B and C).

2. GPR penetration was sufficient only to evaluate the presence of bright reflectors (potential presence of buried carbon) to a depth of 4 feet.

## 5.0 CONCLUSIONS

EM and GPR evaluations conducted at the Badin landfill and the Alcoa switchyard indicates the following:

- The landfill cap is complete everywhere evaluated.

- Based on the GPR results, the presence of shallow buried debris was not detected in the landfill area.

- Based on the results of the EM Data, approximately 0.75 acres of the landfill contains potential buried metal debris. Smaller areas totaling less than 0.25 acres represent scattered buried metal debris.

- Based on the results of the EM data, approximately 6.5 acres of the landfill contains material with elevated conductivity values. Based on existing site borings, and our experience with carbon debris as other sites, we interpret this material to be buried carbon.

- This same material has been confirmed to be present beneath limited portions of the Alcoa switchyard, and represents less than 1.0 acre in area.

## 6.0 REFERENCES

Benson, R. C., Heckathorne, J. R., 2004, Geophysical Studies Report, Stauffer Chemical Company, Superfund Site, Tarpon Springs, Florida.

I.J. Won, D.A. Keiswetter, and E. Novikova, 1998, Electromagnetic induction spectroscopy, *Journal of Environmental and Engineering Geophysics*, v. 3, Issue 1, pp. 27-40.

Crowson, R. A., Allen, R. C., 2007, Use of Multi-frequency Electromagnetic Profiling in a Remedial Investigation at Camp Kohler, McClellan Air Force Base, Sacramento, California. SAGEEP 2007 Conference.

# APPENDIX B

## ABL BORING LOGS AND
## WELL CONSTRUCTION DETAILS

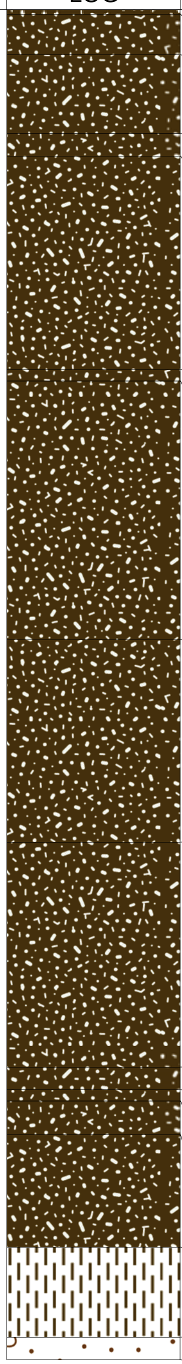
# ENVIRONEERING, INC.
HOUSTON, TEXAS

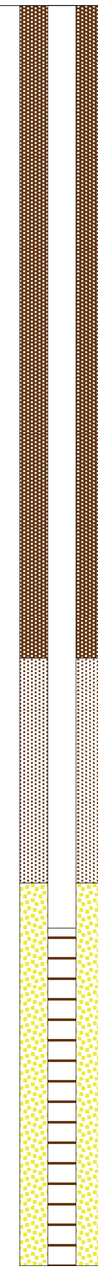
**Log of : P-13**

| | |
|---|---|
| CLIENT: Alcoa | GROUND SURFACE ELEVATION AND DATUM: 546.33' |
| PROJECT: Badin Municipal Landfill - SWMU No. 2 | DATE COMPLETED: 7/19/10 |
| PROJECT LOCATION: Badin, NC | TOTAL DEPTH (ft.): 60' / BOREHOLE DIAMETER: 2.25"/3" |
| DRILLING COMPANY: American Env. Drilling | CASING: 0-41' / SLOT SIZE: 0.010" |
| DRILLER: K. Grant | SCREEN INTERVAL (ft.): 41-56' |
| DRILLING METHOD: Geoprobe; Macrocore; Direct Push Well | GEOLOGIST: M. Worden |

TOC Elevation: 541.94

| DEPTH (feet) | OVM Reading | VISUAL LOG | DESCRIPTION | USCS Symbol | WELL CONSTRUCTION |
|---|---|---|---|---|---|
| 0 | | | FILL: Topsoil with organic fragments | | |
| 2 | | | FILL: Red to orange brown sandy clay, dry, medium stiff | | |
| 4 | | | FILL: Tan brown sandy clay, minor pebble rock fragments, dry, medium stiff | | |
| 6–8 | | | FILL: Dark gray to black silty sand, carbonaceous, red brick fragments (6.5'), dry, loose | | |
| 10–14 | | | FILL: Tan brown sandy clay with intermittent mottled clay saprolite fragments, gravel (12.5-13'), dry, medium stiff | | |
| 16–18 | | | FILL: Dark gray to black silty sand, carbonaceous, minor pebble-sized fragments, dry, loose | | |
| 20–26 | | | FILL: Tan brown sandy clay with intermittent mottled clay saprolite fragments, dry, medium stiff | | |
| 28–36 | | | FILL: Blue gray to medium gray silty sandy clay, increasing organic fragments with depth, plastic sheeting fragments at 30', wood fragments at 33', rubber fragments at 34', dry to moist, medium stiff to very stiff | | |
| 38–46 | | | FILL: Red brown, tan, and blue gray mottled sandy clay, metal fragments (39'), concrete fragments (42.5'), moist, medium to very stiff | | |
| 48 | | | FILL: Blue gray gravel with minor sand/silt/clay, dry, loose | | |
| 50 | | | FILL: Tan to light brown silty sand, poorly sorted, lightly cemented, dry, medium dense | | |
| 52 | | | FILL: Gray and brown mottled silty clay, moist to wet, slight organic odor, soft | | |
| 54 | | | FILL: Red brown, tan, and blue gray mottled sandy clay, minor gravel (54-54.5'), moist to dry, medium to very stiff | | |
| 56–58 | | | SAPROLITE: Red brown sandy clay saprolite, dry, medium to very stiff | | |
| 60 | | | SWR: Soft weathered rock fragments | | |





WELL COMPLETED ABOVE GRADE

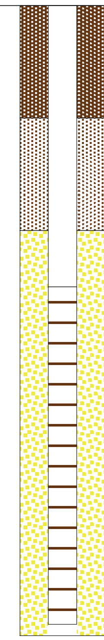
# ENVIRONEERING, INC.
HOUSTON, TEXAS

| | | | |
|---|---|---|---|
| CLIENT: | Alcoa | Log of : | P-14 |
| PROJECT: | Badin Municipal Landfill - SWMU No. 2 | GROUND SURFACE ELEVATION AND DATUM: | 536.1' |
| PROJECT LOCATION: | Badin, NC | DATE COMPLETED: | 7/19/10 |
| DRILLING COMPANY: | American Env. Drilling | TOTAL DEPTH (ft.): | 30' |
| DRILLER: | K. Grant | BOREHOLE DIAMETER: | 2.25"/3" |
| DRILLING METHOD: | Geoprobe; Macrocore; Direct Push Well | CASING: | 0-12.5' |
| | | SLOT SIZE: | 0.010" |
| | | SCREEN INTERVAL (ft.): | 12.5-27.5' |
| | | GEOLOGIST: | M. Worden |

TOC Elevation: 541.94

| DEPTH (feet) | OVM Reading | VISUAL LOG | DESCRIPTION | USCS Symbol | WELL CONSTRUCTION |
|---|---|---|---|---|---|
| 0 | | | FILL: Topsoil with organic fragments | | |
| 0–8 | | | FILL: Red to orange brown sandy clay, dry to moist (4.5'), medium stiff | | |
| 8–13 | | | FILL: Tan brown silty clay, minor sand, moist, medium stiff | | |
| 13 | | | FILL: Dark gray to black silty sand, carbonaceous, moist, loose | | |
| 14 | | | FILL: Tan brown silty clay, minor sand, moist, medium stiff | | |
| 15 | | | FILL: Tan to light brown sand, minor silt. dry, medium dense | | |
| 16.5–26 | | | FILL: Dark gray to black silty sand, carbonaceous, brick fragments (24'), wet to saturated, loose | | |
| 26–30 | | | SAPROLITE: Orange brown sandy clay saprolite, dry, medium to very stiff | | |

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60



WELL COMPLETED ABOVE GRADE

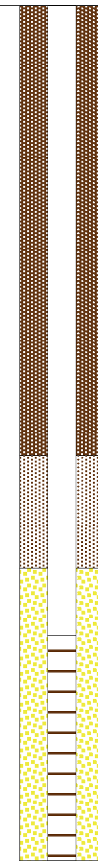
# ENVIRONEERING, INC.
HOUSTON, TEXAS

**Log of : P-15**

| | | | |
|---|---|---|---|
| CLIENT: | Alcoa | GROUND SURFACE ELEVATION AND DATUM: | 511.92' |
| PROJECT: | Badin Municipal Landfill - SWMU No. 2 | DATE COMPLETED: | 7/20/10 |
| PROJECT LOCATION: | Badin, NC | TOTAL DEPTH (ft.): 45' | BOREHOLE DIAMETER: 2.25"/3" |
| DRILLING COMPANY: | American Env. Drilling | CASING: 0-28' | SLOT SIZE: 0.010" |
| DRILLER: | K. Grant | SCREEN INTERVAL (ft.): | 28-38' |
| DRILLING METHOD: | Geoprobe; Macrocore; Direct Push Well | GEOLOGIST: | M. Worden |

TOC Elevation: 541.94

| DEPTH (feet) | OVM Reading | VISUAL LOG | DESCRIPTION | USCS Symbol | WELL CONSTRUCTION |
|---|---|---|---|---|---|
| 0 | | | FILL: Topsoil with organic fragments | | |
| 2 | | | FILL: Red brown sandy clay, dry, medium stiff | | |
| | | | FILL: Orange brown sandy clay, dry, medium stiff | | |
| 4 | | | FILL: Concrete and gravel fragments, dry, loose | | |
| 6 | | | FILL: Orange brown sandy clay, dry, medium stiff | | |
| 8 | | | FILL: Orange brown sandy clay with gravel, dry, medium stiff | | |
| 10–14 | | | FILL: Orange brown sandy clay, dry to moist (12.5'), medium stiff | | |
| | | | FILL: Concrete fragments, minor lime, dry, loose | | |
| 16–18 | | | FILL: Medium brown silty clay, minor pebbles, few organic fragments, moist, medium stiff | | |
| 20–26 | | | FILL: Orange brown sandy clay, few saprolite fragments, trace organic fragments (23-23.5'), moist, medium stiff | | |
| 28–32 | | | FILL: Medium to dark brown silty clay, trace sand, few organic fragments, moist to wet, soft | | |
| 34 | | | FILL: Orange brown silty sand, minor gravel, moist to wet, medium dense | | |
| | | | FILL: Orange brown sandy clay, moist to wet, medium stiff | | |
| 36 | | | FILL: Gravel with minor sand/silt/clay, wet to saturated, loose | | |
| 38 | | | FILL: Medium gray silty clay, few organic fragments, saturated, soft to very soft | | |
| 40–42 | | | SOIL: Red brown silty clay, minor SWR fragments, saturated, soft | | |
| 44 | | | SAPROLITE: Orange brown silty clay saprolite, moist, medium to very stiff | | |
| 46 | | | | | |
| 48 | | | | | |
| 50 | | | | | |
| 52 | | | | | |
| 54 | | | | | |
| 56 | | | | | |
| 58 | | | | | |
| 60 | | | | | |



WELL COMPLETED ABOVE GRADE

# ENVIRONEERING, INC.
HOUSTON, TEXAS

**Log of : P-16**

| | | | |
|---|---|---|---|
| CLIENT: | Alcoa | GROUND SURFACE ELEVATION AND DATUM: | 507.49' |
| PROJECT: | Badin Municipal Landfill - SWMU No. 2 | DATE COMPLETED: | 7/21/10 |
| PROJECT LOCATION: | Badin, NC | TOTAL DEPTH (ft.): 40' | BOREHOLE DIAMETER: 2.25"/3" |
| DRILLING COMPANY: | American Env. Drilling | CASING: 0-30' | SLOT SIZE: 0.010" |
| DRILLER: | K. Grant | SCREEN INTERVAL (ft.): | 30-40' |
| DRILLING METHOD: | Geoprobe; Macrocore; Direct Push Well | GEOLOGIST: | M. Worden |

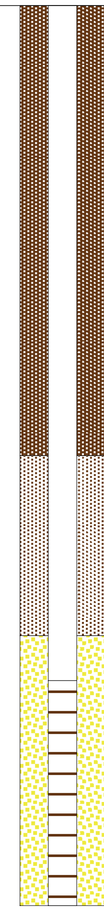
DEPTH (feet) | OVM Reading | VISUAL LOG | DESCRIPTION | USCS Symbol | WELL CONSTRUCTION

TOC Elevation: 541.94

DESCRIPTION:

- FILL: Topsoil with organic fragments
- FILL: Red brown silty clay, dry, medium stiff
- FILL: Orange brown to tan brown sandy clay, minor gravel, 2" organic lens (4.5'), 2" brick fragment (9'), small metal fragments (9.5'), dry, medium stiff
- FILL: Orange brown silty clay saprolite, dry, medium stiff
- FILL: Blue gray sandy clay, dry, medium stiff
- FILL: Orange brown to tan brown sandy clay, minor gravel, dry, medium stiff
- FILL: Light gray gravel with minor sand/silt/clay, dry, loose
- FILL: Orange brown silty clay, brick fragment (19.5'), dry to moist (18'), medium stiff
- FILL: Light gray gravel with minor sand/silt/clay, dry, loose
- FILL: Red brown silty clay, dry to moist, medium stiff
- FILL: Orange brown silty clay, moist, medium stiff
- FILL: Dark gray to black silty sand, carbonaceous, basal gravel, wet to saturated, loose
- FILL: Red brown clayey sand to sandy clay, wet, soft
- SAPROLITE: Orange brown silty clay saprolite, moist to dry, medium to very stiff

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60



WELL COMPLETED ABOVE GRADE

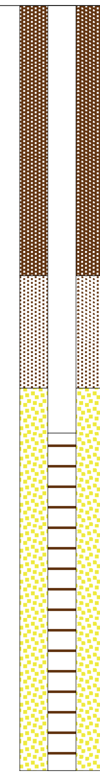
# ENVIRONEERING, INC.
HOUSTON, TEXAS

**Log of : P-17**

| | | | |
|---|---|---|---|
| CLIENT: | Alcoa | GROUND SURFACE ELEVATION AND DATUM: | 504.07' |
| PROJECT: | Badin Municipal Landfill - SWMU No. 2 | DATE COMPLETED: | 7/20/10 |
| PROJECT LOCATION: | Badin, NC | TOTAL DEPTH (ft.): 40' | BOREHOLE DIAMETER: 2.25"/3" |
| DRILLING COMPANY: | American Env. Drilling | CASING: 0-19' | SLOT SIZE: 0.010" |
| DRILLER: | K. Grant | SCREEN INTERVAL (ft.): | 19-34' |
| DRILLING METHOD: | Geoprobe; Macrocore; Direct Push Well | GEOLOGIST: | M. Worden |

| DEPTH (feet) | OVM Reading | VISUAL LOG | DESCRIPTION | USCS Symbol | WELL CONSTRUCTION |
|---|---|---|---|---|---|
| | | | FILL: Topsoil with organic fragments | | |
| | | | FILL: Red brown slightly sandy silty clay, dry, stiff | | |
| | | | FILL: Tan brown to gray brown sandy clay, minor saprolite fragments, dry, stiff | | |
| | | | FILL: Light gray sandy silt, consistency like loose lime, dry, soft | | |
| | | | FILL: Tan brown to gray brown sandy clay, minor saprolite fragments (17.5-18), 1" gravel lens (17' and 18.5'), 1" organic fragment lens (19'), dry to moist (13.5'), stiff | | |
| | | | FILL: Tan brown silty clay, 1" gravel lens (24'), moist to wet, soft | | |
| | | | FILL: Dark gray to black silty sand, carbonaceous, minor localized wood fragments, wet, loose | | |
| | | | FILL: Tan brown, red brown, and orange brown sandy clay, wet to moist, soft | | |
| | | | SOIL: Medium gray silty clay, few root traces, moist, stiff | | |
| | | | SOIL: Medium gray silty sand, wet, medium dense | | |
| | | | SAPROLITE: Red brown silty clay saprolite, moist, medium to very stiff | | |

TOC Elevation: 541.94



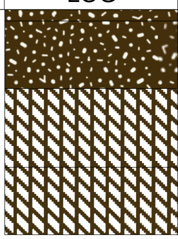
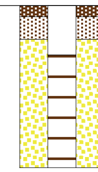
WELL COMPLETED ABOVE GRADE

# ENVIRONEERING, INC.
HOUSTON, TEXAS

**Log of : P-18**

| | | | |
|---|---|---|---|
| CLIENT: | Alcoa | GROUND SURFACE ELEVATION AND DATUM: | 471.2' |
| PROJECT: | Badin Municipal Landfill - SWMU No. 2 | DATE COMPLETED: | 7/20/10 |
| PROJECT LOCATION: | Badin, NC | TOTAL DEPTH (ft.): 10' | BOREHOLE DIAMETER: 2.25"/3" |
| DRILLING COMPANY: | American Env. Drilling | CASING: 0-2.2' | SLOT SIZE: 0.010" |
| DRILLER: | K. Grant | SCREEN INTERVAL (ft.): | 2.2-7.2' |
| DRILLING METHOD: | Geoprobe; Macrocore; Direct Push Well | GEOLOGIST: | M. Worden |

TOC Elevation: 541.94

| DEPTH (feet) | OVM Reading | VISUAL LOG | DESCRIPTION | USCS Symbol | WELL CONSTRUCTION |
|---|---|---|---|---|---|
| | |  | FILL: Topsoil with organic fragments | |  |
| | | | FILL: Orange brown sandy clay, moist to wet, medium stiff | | |
| | | | SOIL: Dark gray silty clay, minor sand, wood fragments (4.5-5'), saturated, soft | | |
| | | | SOIL: Medium gray to blue gray silty clay, minor orange brown mottled lenses, moist, medium stiff | | |

Depth scale (feet): 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60

WELL COMPLETED ABOVE GRADE

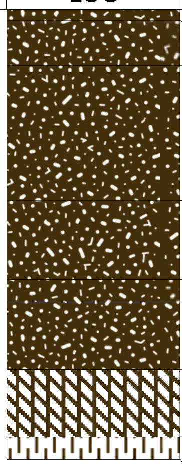
**ENVIRONEERING, INC.**
**HOUSTON, TEXAS**

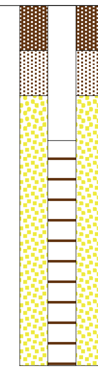
# Log of : P-19

| | | | |
|---|---|---|---|
| CLIENT: | Alcoa | GROUND SURFACE ELEVATION AND DATUM: | 505.07' |
| PROJECT: | Badin Municipal Landfill - SWMU No. 2 | DATE COMPLETED: | 9/30/10 |
| PROJECT LOCATION: | Badin, NC | TOTAL DEPTH (ft.): 20' | BOREHOLE DIAMETER: 2.25"/3" |
| DRILLING COMPANY: | American Env. Drilling | CASING: 0-6' | SLOT SIZE: 0.010" |
| DRILLER: | K. Grant | SCREEN INTERVAL (ft.): | 6-16' |
| DRILLING METHOD: | Geoprobe; Macrocore; Direct Push Well | GEOLOGIST: | M. Worden |

TOC Elevation: 541.94

| DEPTH (feet) | OVM Reading | VISUAL LOG | DESCRIPTION | USCS Symbol | WELL CONSTRUCTION |
|---|---|---|---|---|---|
| 0 | | | FILL: Topsoil with organic fragments | | |
| 2 | | | FILL: Red brown slightly sandy silty clay, moist, stiff | | |
| 4–8 | | | FILL: Orange brown clayey silt, minor saprolite fragments, dry to wet (8'), stiff | | |
| 10 | | | FILL: Dark gray silty clay, minor organic fragments, plastic fragments (9.5'), wood fragments (14'), wet to saturated, soft | | |
| 12 | | | FILL: Red brown silty clay, moist, stiff | | |
| 14 | | | FILL: Dark gray silty clay, minor organic fragments, plastic fragments (9.5'), wood fragments (14'), wet to saturated, soft | | |
| 16–18 | | | SOIL: Red brown silty clay, moist to dry (16.5'), soft to stiff (16.5') | | |
| 20 | | | SAPROLITE: Tan brown to gray silty clay saprolite, dry, medium to very stiff | | |





Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58, 60

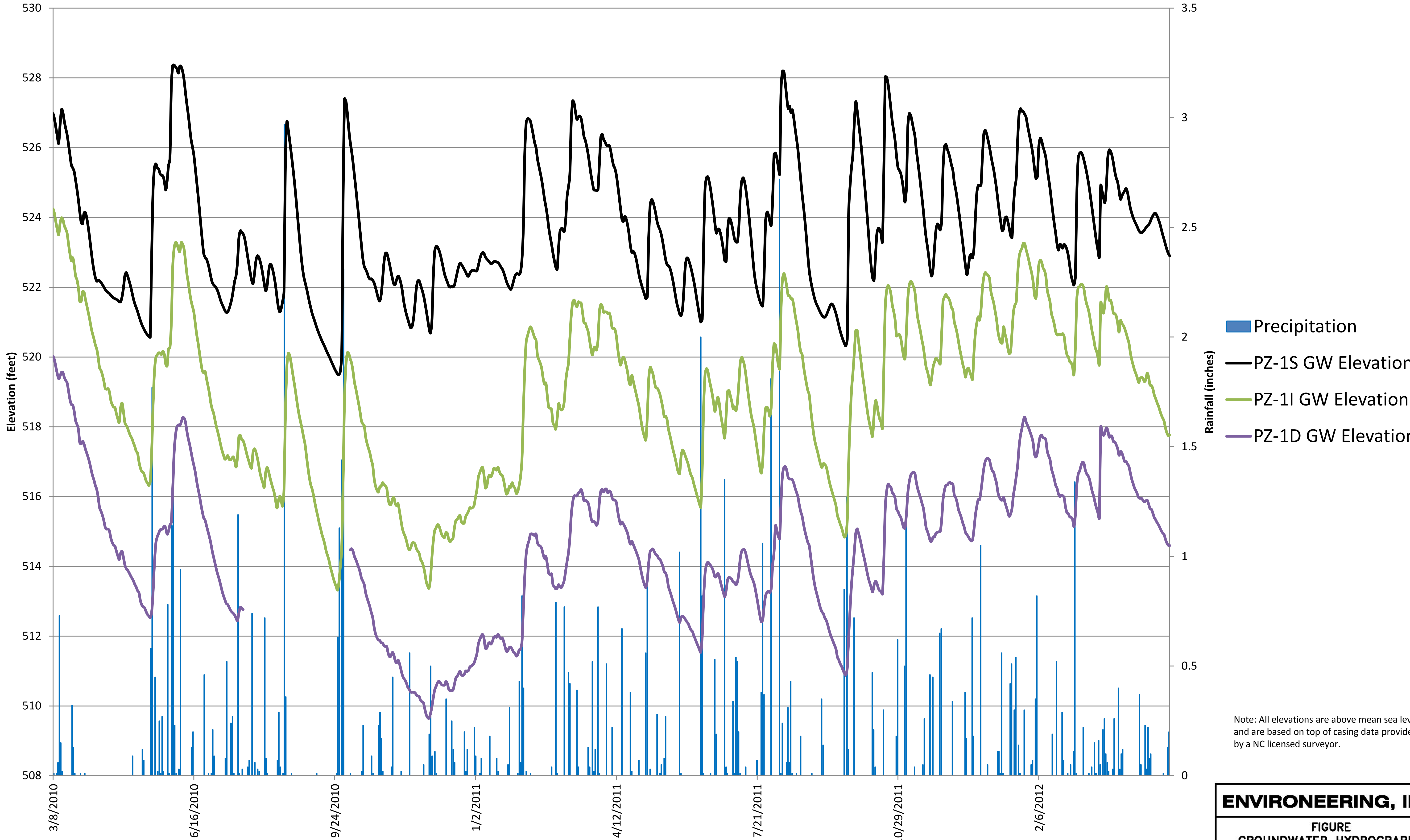
WELL COMPLETED ABOVE GRADE

# APPENDIX C

# ALCOA BADIN WORKS PLANT – PINE TREE GROVE AREA GEOPHYSICAL SURVEY

# APPENDIX I

## ABL GROUNDWATER AND RAINFALL HYDROGRAPHS

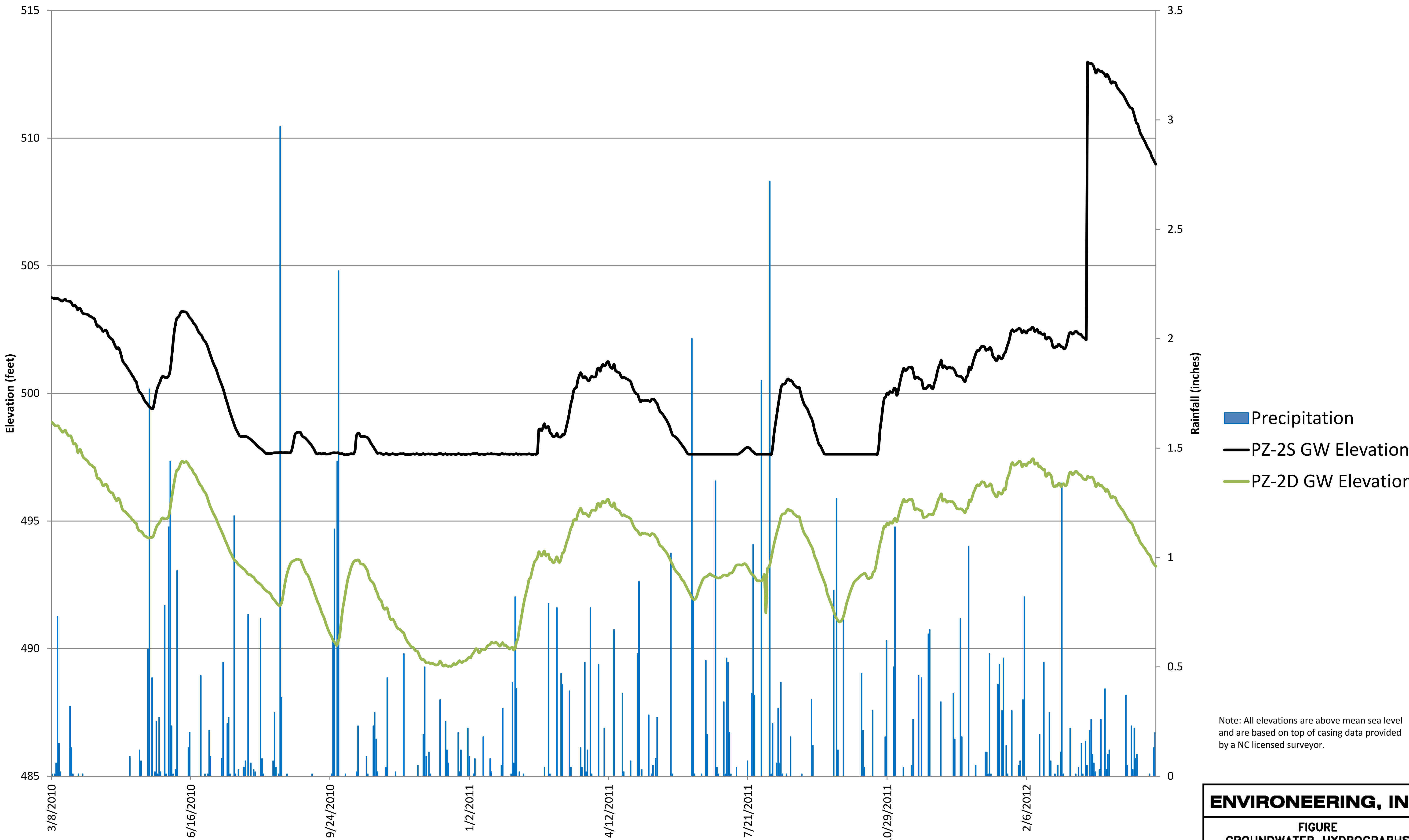



Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

**ENVIRONEERING, INC.**

FIGURE
GROUNDWATER HYDROGRAPHS
BADIN MUNICIPAL LANDFILL
ALCOA–BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|

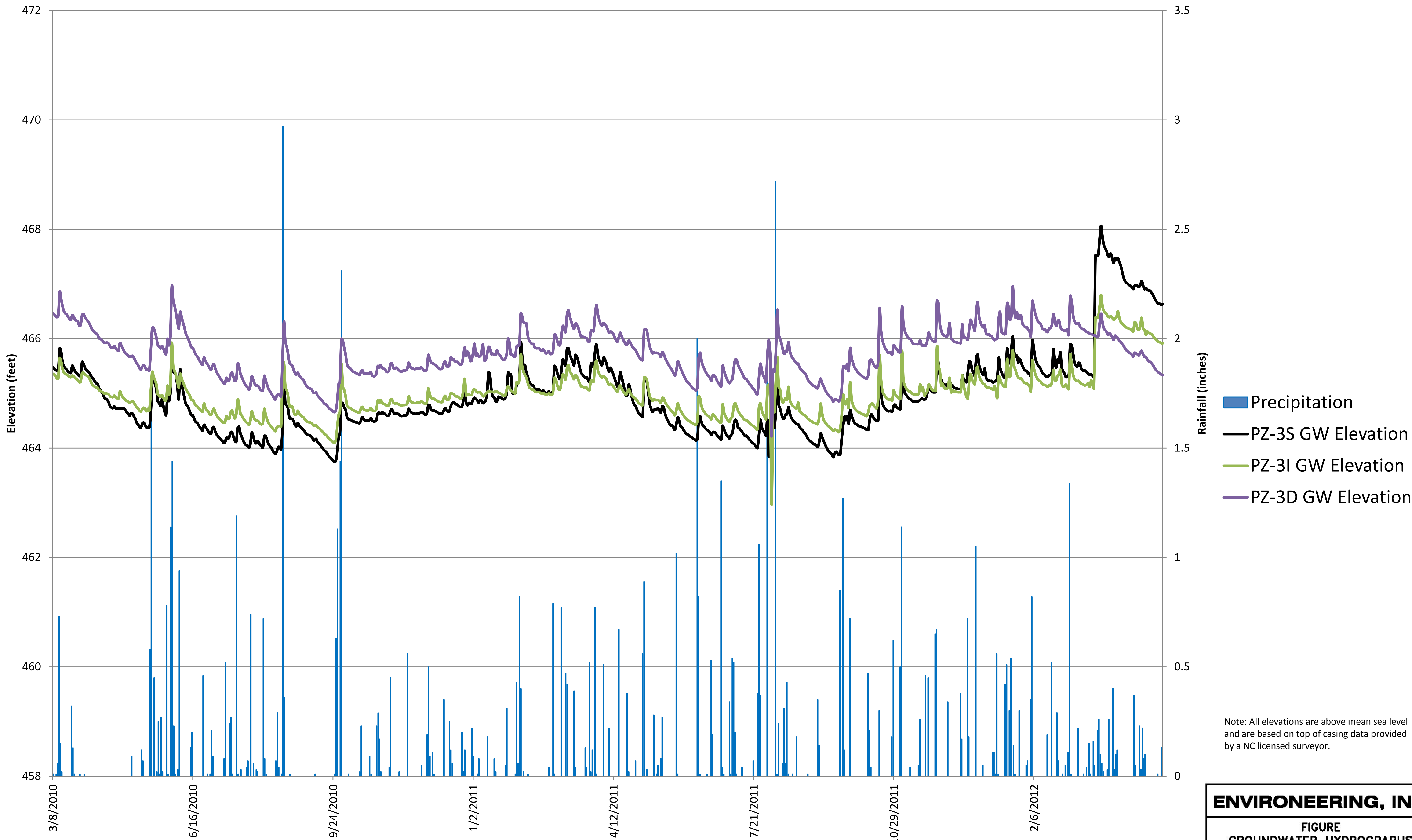



Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

**ENVIRONEERING, INC.**

FIGURE
GROUNDWATER HYDROGRAPHS
BADIN MUNICIPAL LANDFILL
ALCOA–BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
| --- | --- | --- |

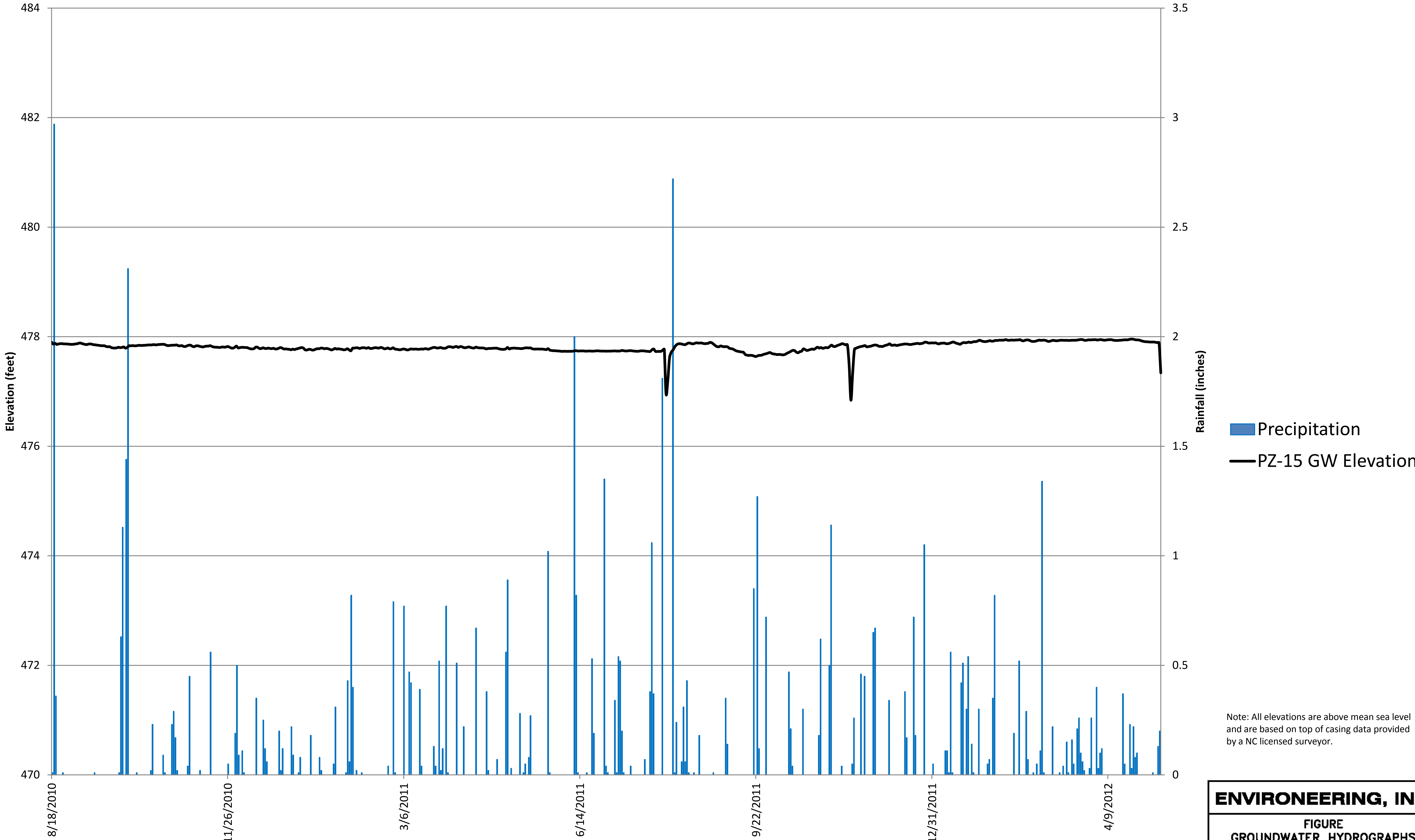



Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

**ENVIRONEERING, INC.**

FIGURE
GROUNDWATER HYDROGRAPHS
BADIN MUNICIPAL LANDFILL
ALCOA–BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|

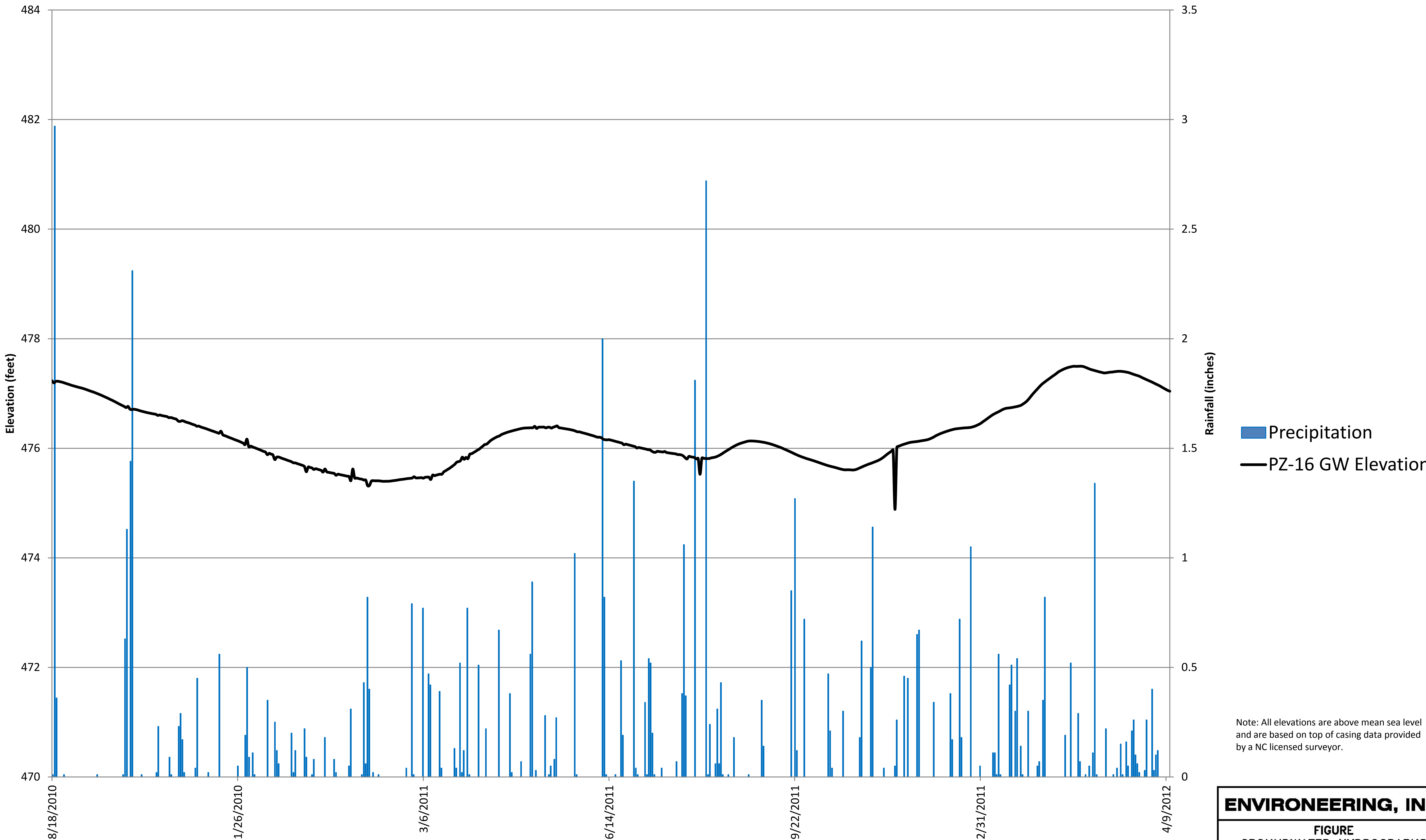



Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

**ENVIRONEERING, INC.**

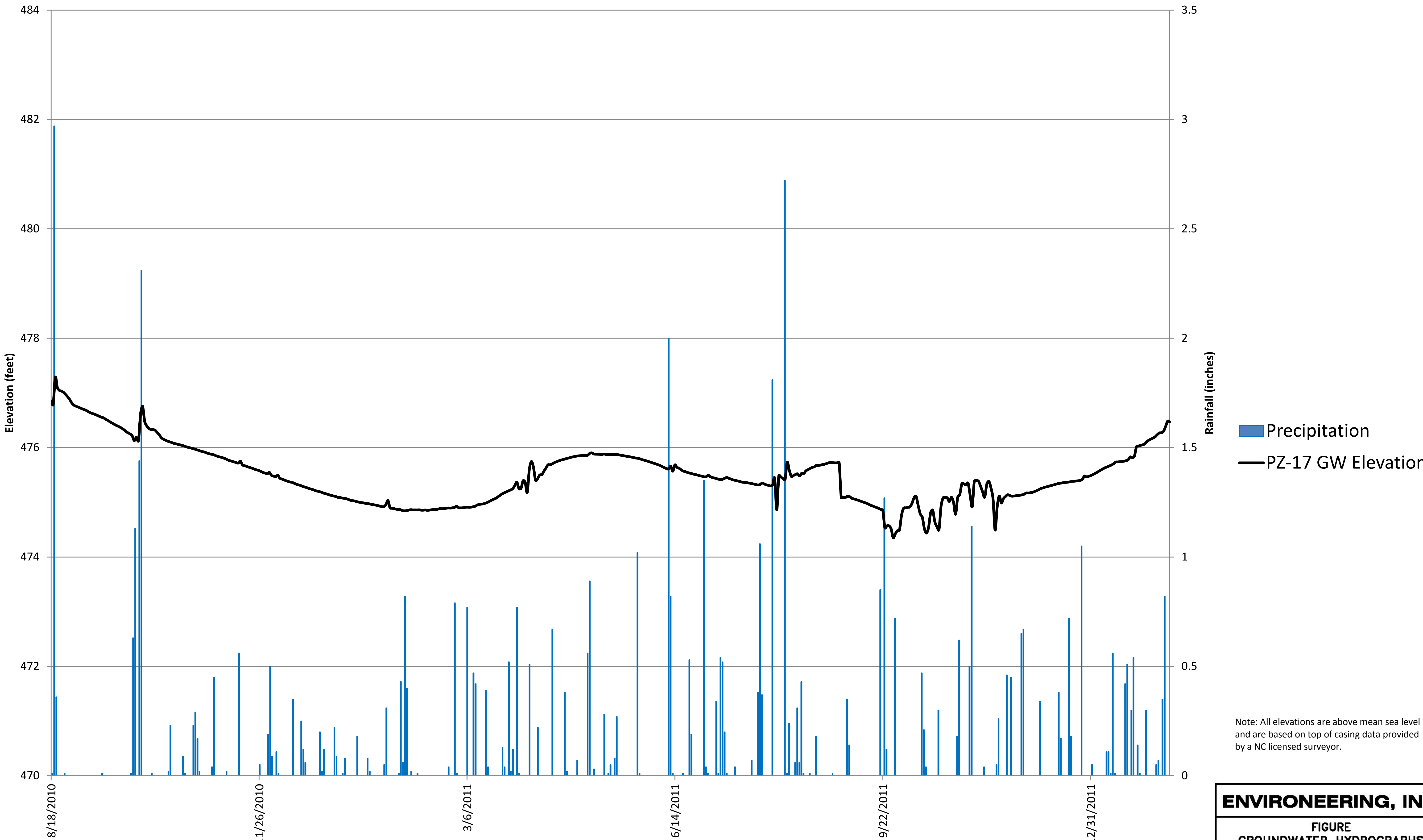
FIGURE
GROUNDWATER HYDROGRAPHS
BADIN MUNICIPAL LANDFILL
ALCOA–BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|




Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

| ENVIRONEERING, INC. | | |
|---|---|---|
| FIGURE<br>GROUNDWATER HYDROGRAPHS<br>BADIN MUNICIPAL LANDFILL<br>ALCOA–BADIN WORKS FACILITY<br>BADIN, NORTH CAROLINA | | |
| DRAWN BY: | DATE: | PROJ. NO. |

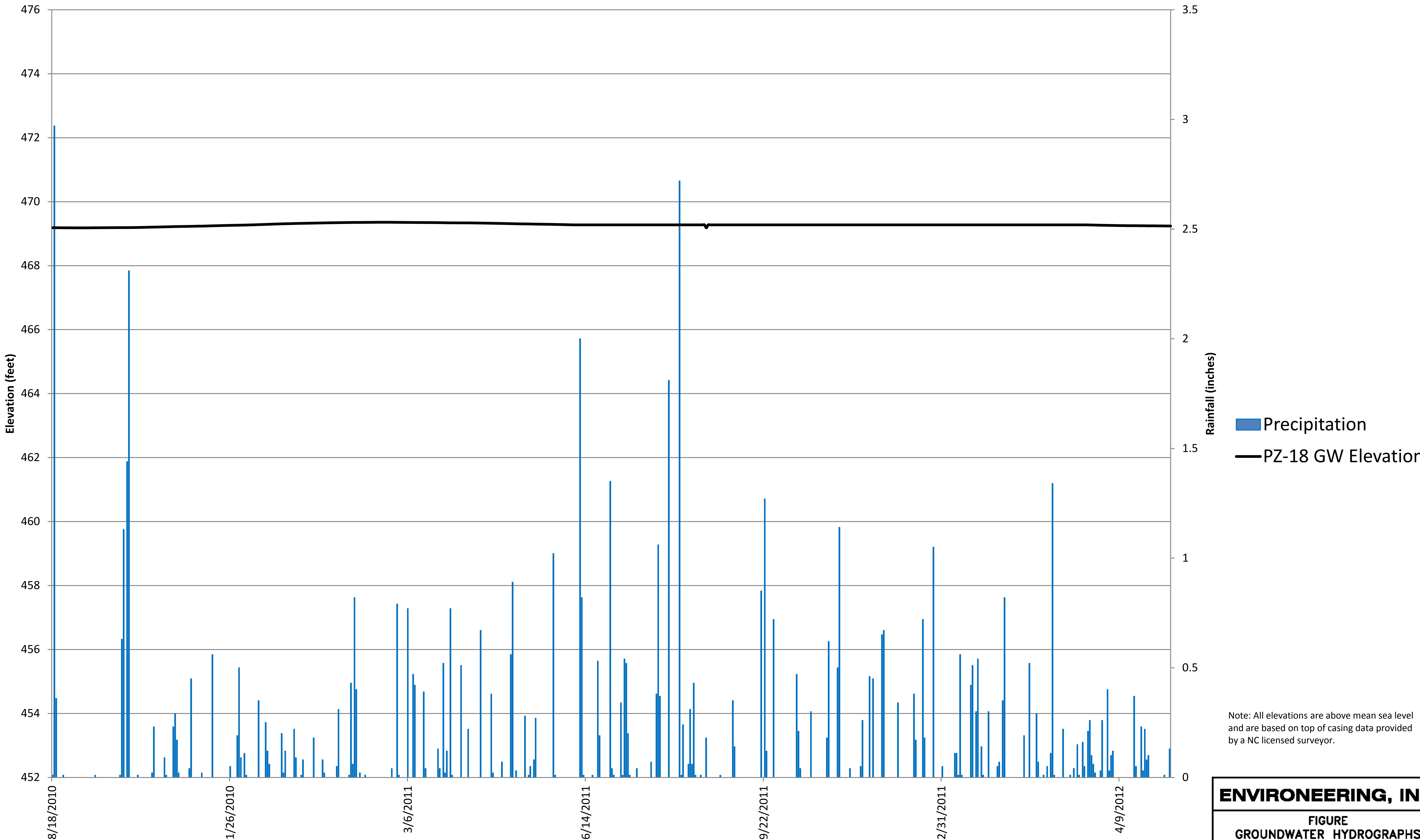



Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

**ENVIRONEERING, INC.**

FIGURE
GROUNDWATER HYDROGRAPHS
BADIN MUNICIPAL LANDFILL
ALCOA-BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|

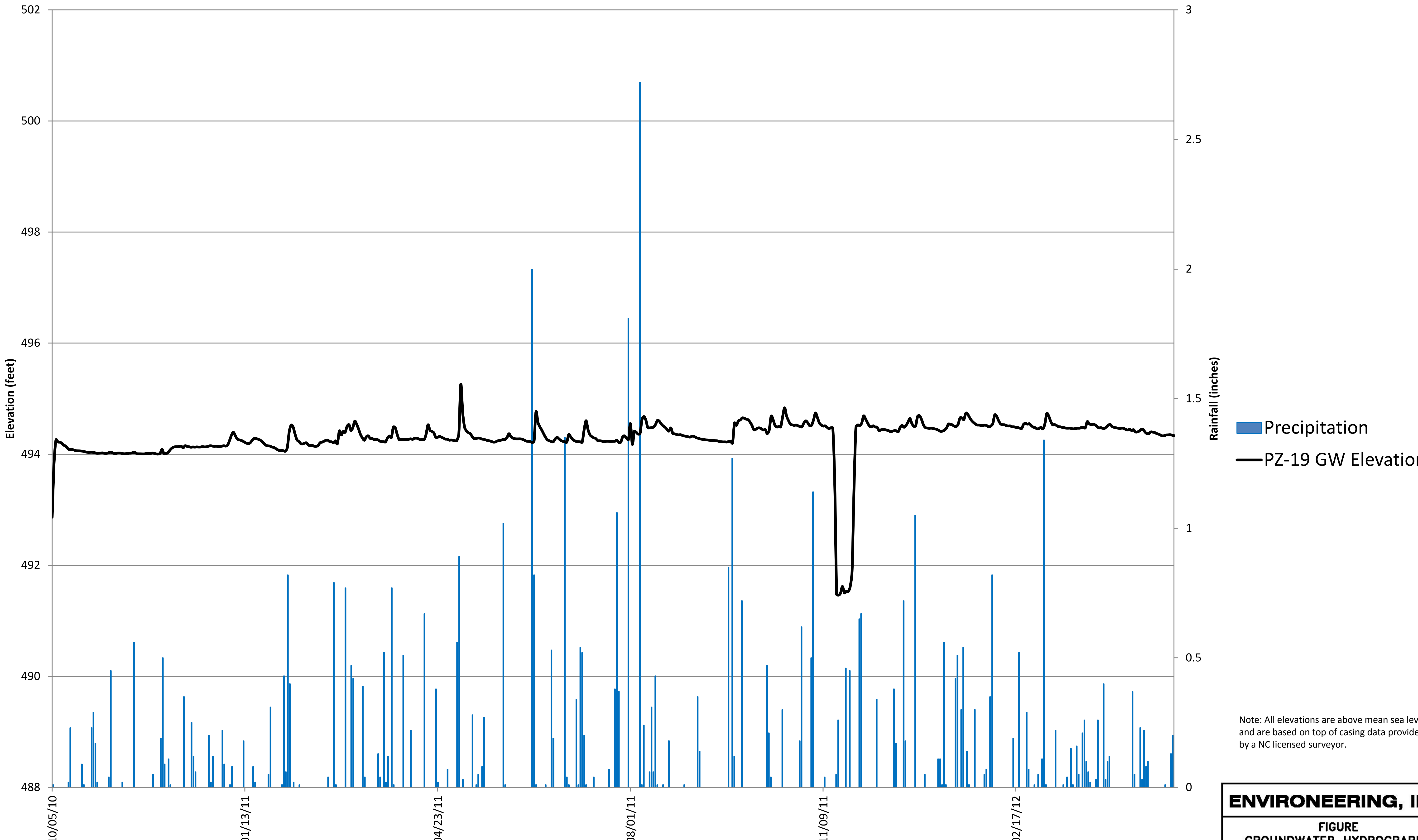



Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

**ENVIRONEERING, INC.**

FIGURE
GROUNDWATER HYDROGRAPHS
BADIN MUNICIPAL LANDFILL
ALCOA-BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|

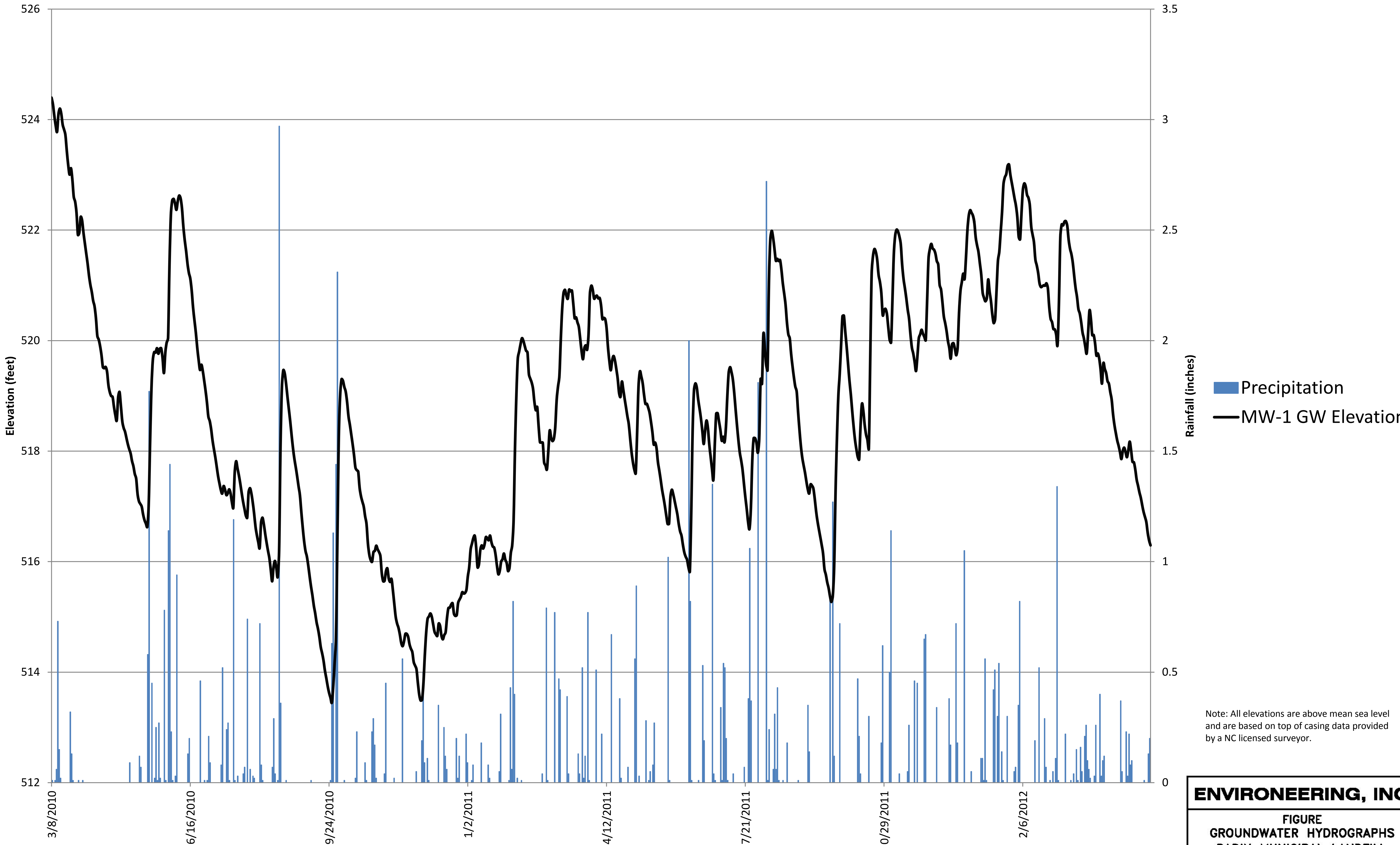



Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

**ENVIRONEERING, INC.**

FIGURE
GROUNDWATER HYDROGRAPHS
BADIN MUNICIPAL LANDFILL
ALCOA-BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|

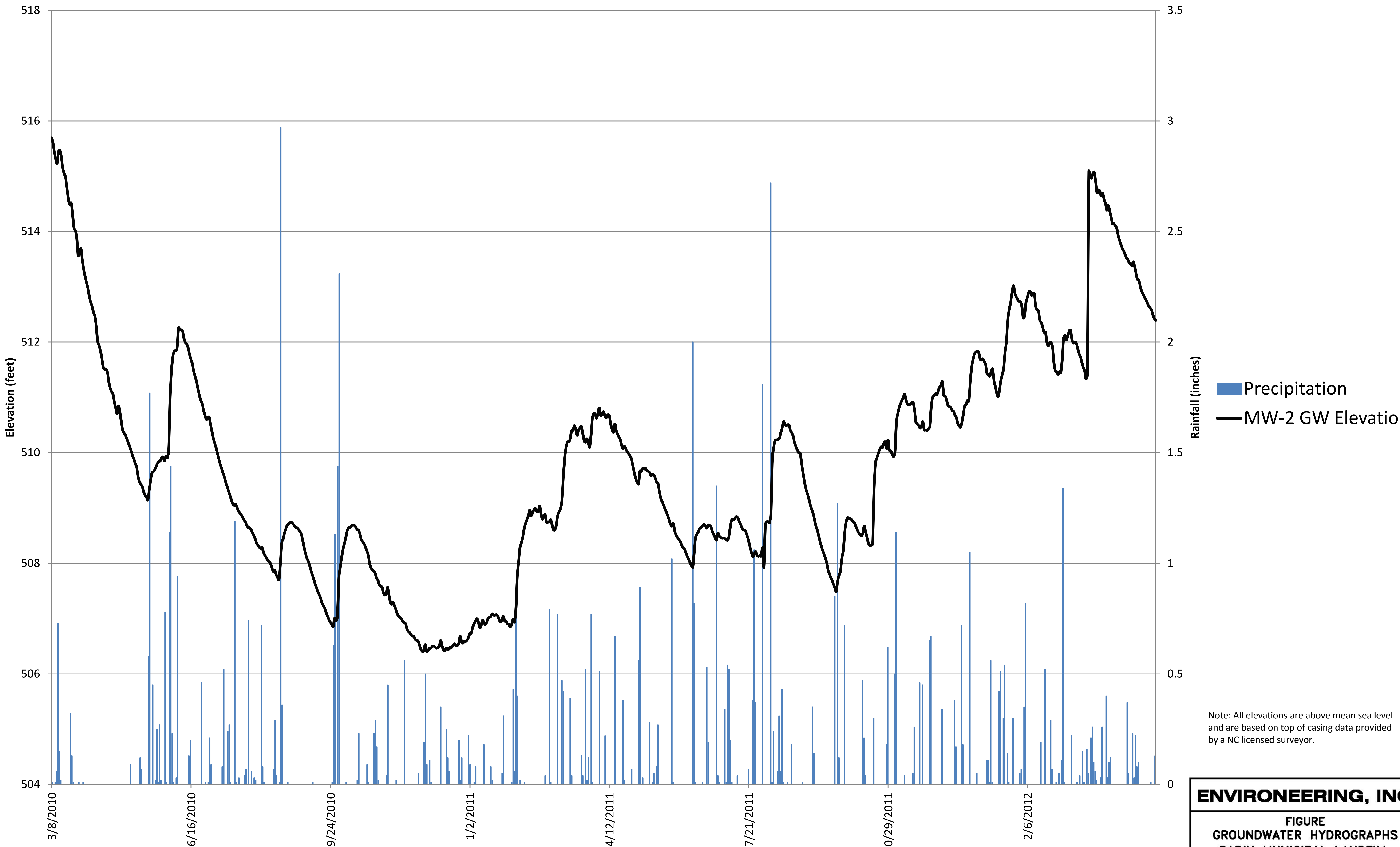



Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

**ENVIRONEERING, INC.**

FIGURE
GROUNDWATER HYDROGRAPHS
BADIN MUNICIPAL LANDFILL
ALCOA–BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|

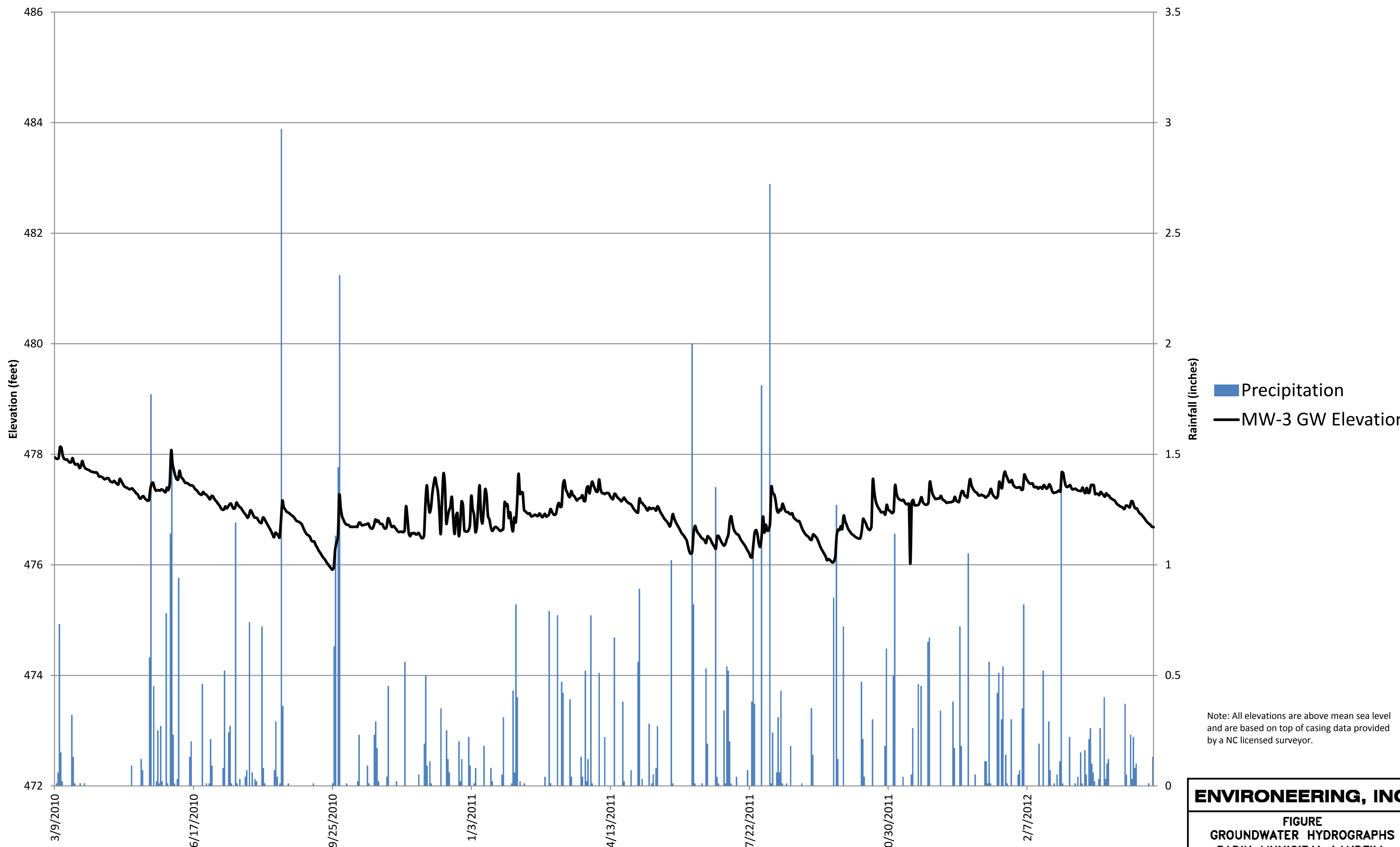



Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

**ENVIRONEERING, INC.**

FIGURE
GROUNDWATER HYDROGRAPHS
BADIN MUNICIPAL LANDFILL
ALCOA–BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|

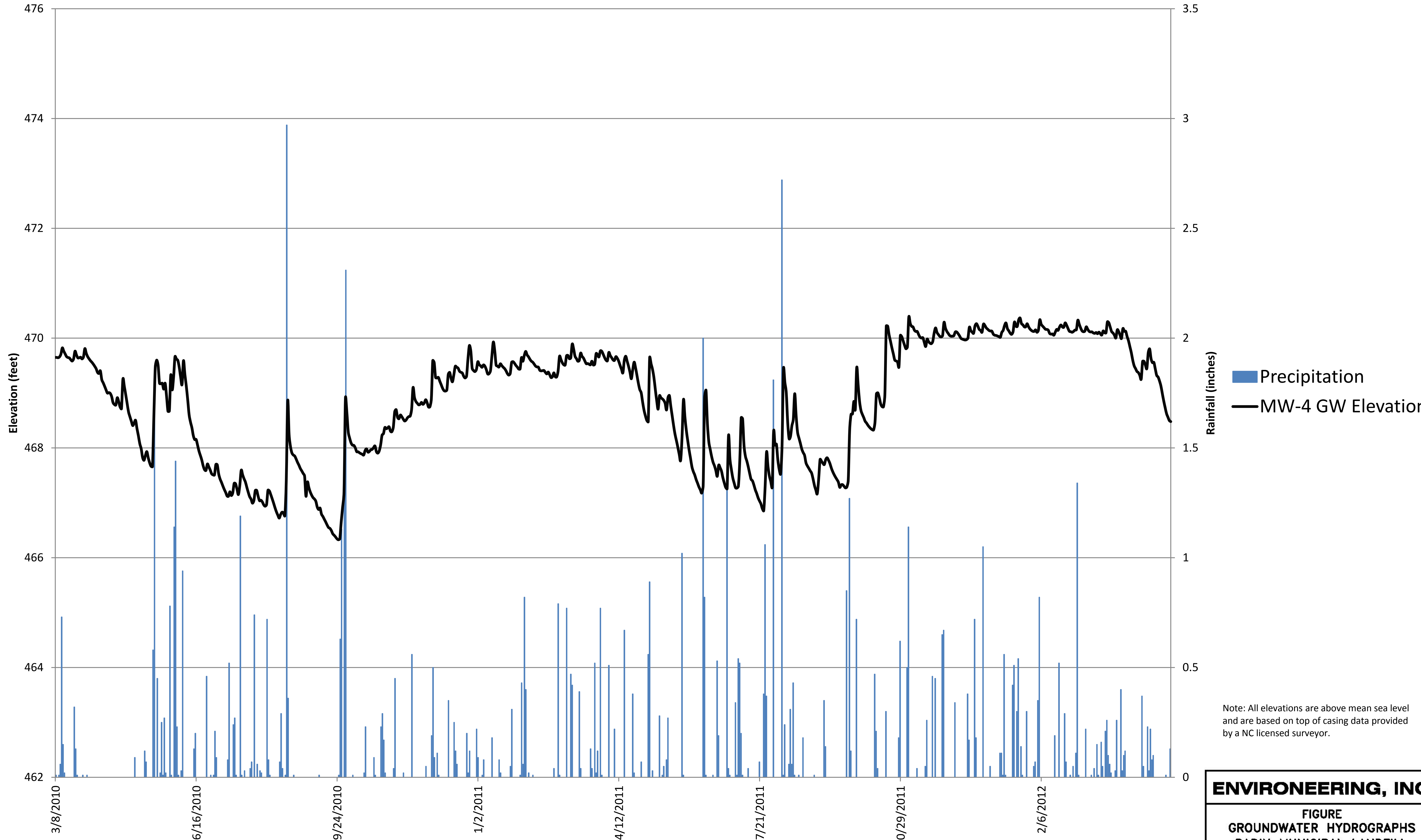



Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

**ENVIRONEERING, INC.**

FIGURE
GROUNDWATER HYDROGRAPHS
BADIN MUNICIPAL LANDFILL
ALCOA–BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|

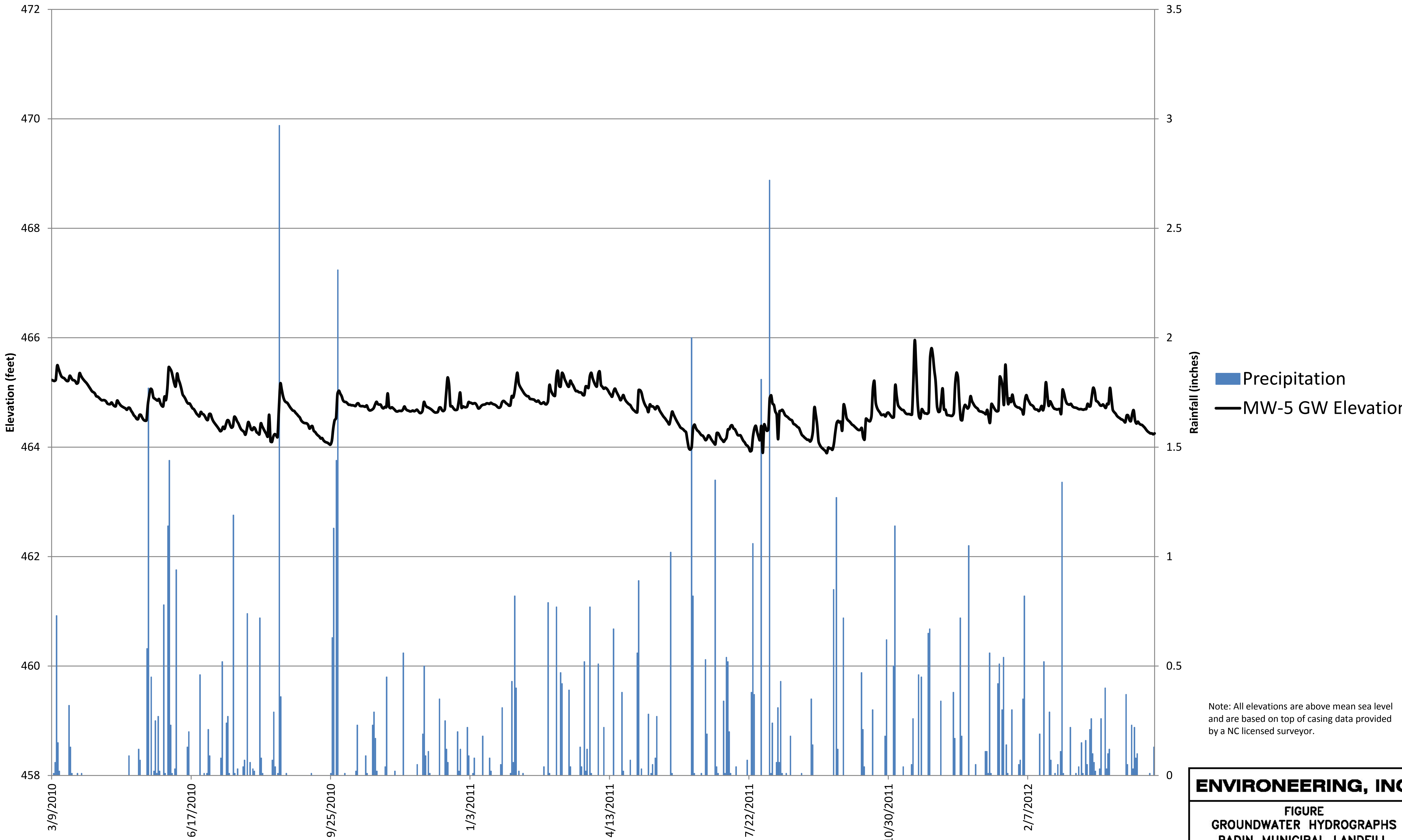



Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

**ENVIRONEERING, INC.**

FIGURE
GROUNDWATER HYDROGRAPHS
BADIN MUNICIPAL LANDFILL
ALCOA–BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|

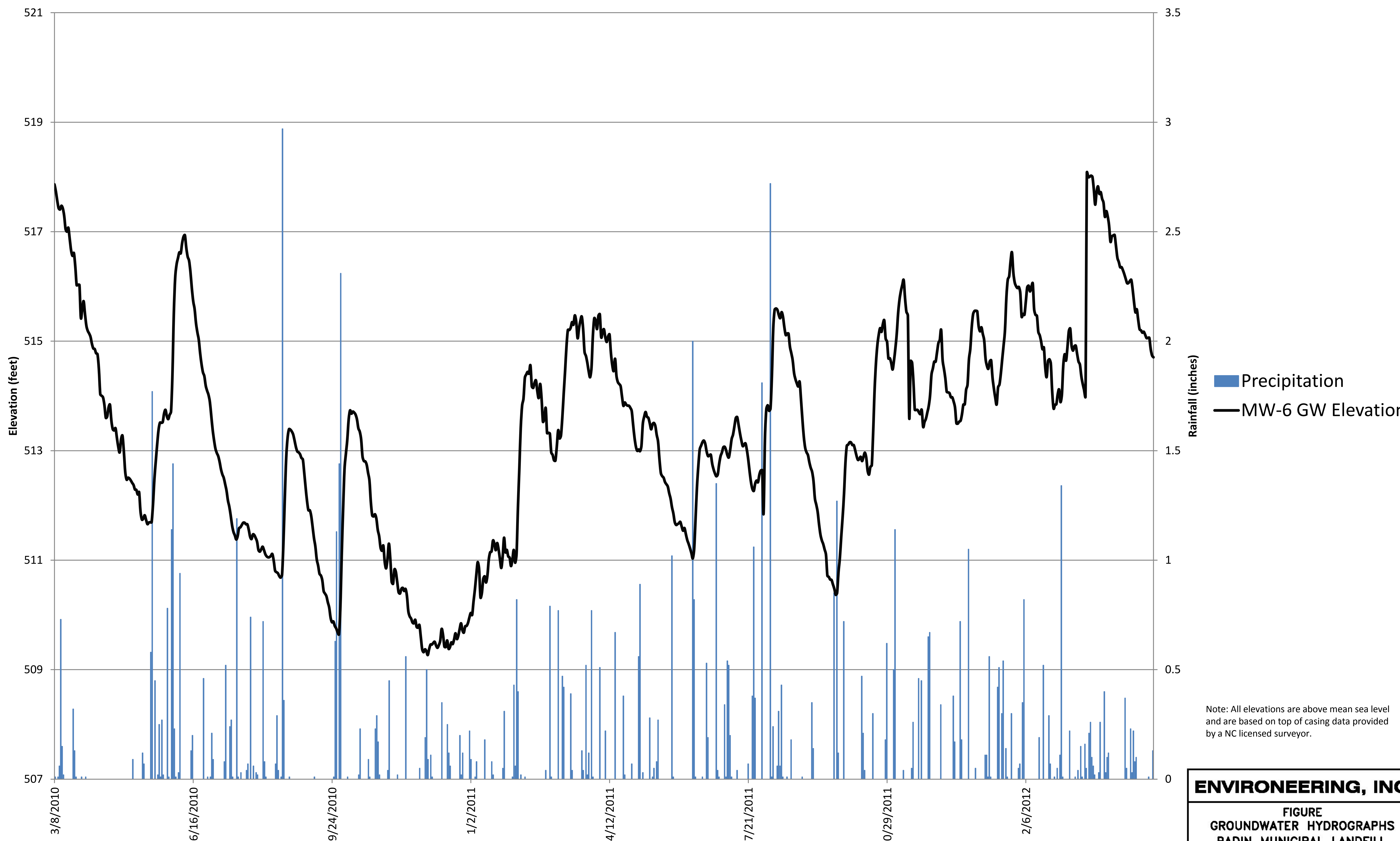



Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

**ENVIRONEERING, INC.**

FIGURE
GROUNDWATER HYDROGRAPHS
BADIN MUNICIPAL LANDFILL
ALCOA–BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|




Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

**ENVIRONEERING, INC.**

FIGURE
GROUNDWATER HYDROGRAPHS
BADIN MUNICIPAL LANDFILL
ALCOA–BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|


Note: All elevations are above mean sea level and are based on top of casing data provided by a NC licensed surveyor.

**ENVIRONEERING, INC.**

FIGURE
GROUNDWATER HYDROGRAPHS
BADIN MUNICIPAL LANDFILL
ALCOA–BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|

# APPENDIX K

# ABL WELL MONITORING WELL SAMPLING LOGS

## Well Sampling Log

| | | | |
|---|---|---|---|
| **Project** | Alcoa Badin: Badin Municipal Landfill | **Personnel** | W. Ramsey, BHE Environmental, Inc |
| **Well Identification** | MW-1 | **Location** | Stanly Co, NC |
| | | **Date** | 11/14/2011 |
| **Screened Interval** | 35-45' below land surface (BLS) | **Pump Type** | 1.66" submersible bladder |
| **Total Well Depth** | 44.84' | **Tubing Type** | 0.17" polyethylene air; 0.25" polyethylene discharge |
| **Depth to Water Prior to Sampling** | 21.08' BTOC | **Bailer Type** | N/A |
| **Well Diameter** | 2" | **String Type** | N/A |
| **Well Volume** | N/A | | |
| **Calculated Purge Volume** | N/A | **Time Purging Started** | 13:00 |
| **Actual Purge Volume** | 1.0 gallons | **Time Purging Ended** | 14:26 |

| Time | Purge Volume (gal) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 13:00 | Start | | | | | | | 21.08 | |
| 13:08 | 0.1 | 5.54 | 18.86 | 92 | 4.03 | 203.4 | 10 | 21.85 | |
| 13:13 | 0.15 | 5.56 | 19.35 | 93 | 3.87 | 20.52 | 9.48 | 21.62 | |
| 13:18 | 0.2 | 5.58 | 19.93 | 93 | 3.79 | 206.1 | 8.74 | 21.55 | |
| 13:23 | 0.25 | 5.58 | 20.46 | 93 | 3.83 | 207.9 | 7.9 | 21.51 | |
| 13:28 | 0.3 | 5.58 | 19.57 | 94 | 4.05 | 209.7 | 8.38 | 21.81 | |
| 13:38 | 0.4 | 5.55 | 19.26 | 93 | 3.66 | 208.4 | 6.57 | 21.68 | |
| 13:48 | 0.5 | 5.55 | 19.64 | 93 | 3.36 | 207.7 | 3.82 | 21.45 | |
| | | | | | | | | | |
| 14:06 | 0.6 | 5.56 | 20.33 | 93 | 3.3 | 206.3 | 4.95 | 21.63 | |
| 14:11 | 0.65 | 5.57 | 20.33 | 93 | 3.3 | 205.4 | 4.18 | 21.56 | |
| 14:16 | 0.7 | 5.57 | 20.54 | 93 | 3.33 | 204.3 | 3.87 | 21.53 | |
| 14:21 | 0.9 | 5.58 | 20.55 | 93 | 3.38 | 204.6 | 3.06 | 21.55 | |
| 14:26 | 1 | 5.56 | 20.61 | 93 | 3.37 | 206.3 | 2.39 | 21.54 | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLMW1F001 (14:30) |

## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** MW-2
**Personnel** W. Ramsey, BHE Environmental, Inc
**Location** Stanly Co, NC
**Date** 11/15/2011

**Screened Interval** 37-47' below land surface (BLS)
**Total Well Depth** 53.33'
**Depth to Water Prior to Sampling** 30.86' BTOC
**Well Diameter** 2"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 2.1 gallons

**Pump Type** 1.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.25" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 8:07
**Time Purging Ended** 9:14

| Time | Purge Volume (gallons) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 8:07 | Start | | | | | | | 30.86 | |
| 8:28 | 0.3 | 5.36 | 17.38 | 82 | 1.43 | 299.6 | 5.68 | 31.75 | |
| 8:33 | 0.4 | 5.36 | 17.65 | 82 | 1.76 | 334.8 | 5.47 | 31.85 | |
| 8:38 | NM | NM | NM | NM | NM | NM | NM | NM | Regulating flow |
| | | | | | | | | | |
| 8:54 | 1 | 5.31 | 17.81 | 76 | 0.56 | 395.5 | 1.89 | 31.8 | |
| 8:59 | 1.3 | 5.34 | 17.82 | 76 | 0.54 | 410.9 | 1.58 | 31.94 | |
| 9:04 | 1.5 | 5.34 | 17.82 | 75 | 0.48 | 424.4 | 1.4 | 31.95 | |
| 9:09 | 1.8 | 5.34 | 17.88 | 75 | 0.44 | 432.8 | 1.31 | 31.96 | |
| 9:14 | 2.1 | 5.34 | 17.93 | 75 | 0.4 | 434.1 | 1.17 | 31.98 | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLMW2F001 (09:15) |

## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** MW-3
**Personnel** W. Ramsey, BHE Environmental, Inc
**Location** Stanly Co, NC
**Date** 11/15/2011

**Screened Interval** 4-14' below land surface (BLS)
**Total Well Depth** 15.27'
**Depth to Water Prior to Sampling** 0.22' BTOC
**Well Diameter** 2"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 6.0 gallons

**Pump Type** 1.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.25" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 10:16
**Time Purging Ended** 11:30

| Time | Purge Volume (gallons) | pH | Temp (°C) | Conduct. (μS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 10:16 | Start | | | | | | | | |
| 10:20 | 1 | 5.42 | 16.4 | 80 | 2.16 | 262.6 | 303 | 2.85 | |
| 10:25 | 2 | 5.44 | 16.66 | 80 | 1.79 | 260.1 | 143 | 2.55 | |
| 10:30 | 2.5 | 5.47 | 16.77 | 81 | 1.69 | 254.9 | 92 | 2.45 | |
| 10:35 | 3 | 5.48 | 16.73 | 81 | 1.61 | 255.1 | 73.9 | 2.5 | |
| 10:40 | 3.3 | 5.48 | 16.74 | 81 | 1.6 | 253.8 | 69.5 | 2.45 | |
| 10:45 | 3.6 | 5.55 | 16.84 | 81 | 1.95 | 246.3 | 54.7 | 2.45 | |
| 10:50 | 3.9 | 5.55 | 16.8 | 81 | 1.61 | 246.7 | 46 | 2.45 | |
| 10:55 | 4.1 | 5.54 | 16.82 | 81 | 1.59 | 245.1 | 36.1 | 2.45 | |
| 11:00 | 4.3 | 5.56 | 16.79 | 81 | 1.64 | 241.7 | 33.2 | 2.45 | |
| 11:05 | 4.5 | 5.55 | 16.85 | 81 | 1.58 | 241.6 | 26.8 | 2.45 | |
| 11:10 | 4.7 | 5.56 | 16.88 | 82 | 1.56 | 240.1 | 23.2 | 2.45 | |
| 11:15 | 5 | 5.54 | 16.88 | 82 | 1.55 | 239.3 | 24.9 | 2.48 | |
| 11:20 | 5.3 | 5.54 | 16.85 | 82 | 1.56 | 239 | 18.7 | 2.52 | |
| 11:25 | 5.6 | 5.55 | 16.88 | 81 | 1.52 | 238.4 | 18.8 | 2.52 | |
| 11:30 | 6 | 5.55 | 16.9 | 82 | 1.51 | 237.4 | 18.8 | 2.52 | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLMW3F001 (11:35) |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
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| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** MW-4

**Personnel** W. Ramsey, BHE Environmental, Inc
**Location** Stanly Co, NC
**Date** 11/15/2011

**Screened Interval** 4-14' below land surface (BLS)
**Total Well Depth** 16.09'
**Depth to Water Prior to Sampling** 2.74' BTOC
**Well Diameter** 2"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 1.8 gallons

**Pump Type** 1.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.25" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 13:20
**Time Purging Ended** 14:15

| Time | Purge Volume (gallons) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 13:20 | Start | | | | | | | 2.74 | |
| 13:25 | 0.1 | 6.63 | 18.46 | 325 | 2.26 | 142.9 | 54.9 | 3.43 | |
| 13:30 | 0.15 | 6.57 | 17.73 | 325 | 6.57 | 134.3 | 46.3 | 3.61 | |
| 13:35 | NM | NM | NM | NM | NM | NM | NM | NM | |
| 13:40 | 0.25 | 6.58 | 17.27 | 326 | 1.05 | 145 | 28.2 | 3.75 | |
| 13:45 | 0.4 | 6.57 | 17.24 | 327 | 1.33 | 141.7 | 22.7 | 3.85 | |
| 13:50 | 0.5 | 6.57 | 17.32 | 329 | 0.87 | 138.9 | 17.4 | 3.8 | |
| 13:55 | 0.6 | 6.57 | 17.41 | 330 | 0.94 | 138.4 | 15.4 | 3.73 | |
| 14:00 | 0.75 | 6.57 | 17.5 | 331 | 0.93 | 136.3 | 13.6 | 3.74 | |
| 14:05 | 1 | 6.57 | 17.47 | 333 | 0.94 | 140.7 | 12.2 | 3.74 | |
| 14:10 | 1.4 | 6.57 | 17.41 | 335 | 0.91 | 142.9 | 12.6 | 3.74 | |
| 14:15 | 1.8 | 6.57 | 17.41 | 337 | 0.87 | 145.8 | 12.2 | 3.75 | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLMW4F001 (14:20) |
| | | | | | | | | | Sampled: ABLMW4D001 (14:20) |

## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** MW-5
**Personnel** W. Ramsey, BHE Environmental, Inc
**Location** Stanly Co, NC
**Date** 11/15/2011

**Screened Interval** 4-14' below land surface (BLS)
**Total Well Depth** 14.49'
**Depth to Water Prior to Sampling** 3.81' BTOC
**Well Diameter** 2"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 5.3 gallons

**Pump Type** 1.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.25" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 15:47
**Time Purging Ended** 18:01

| Time | Purge Volume (gal) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 15:47 | Start | | | | | | | 3.81 | |
| 15:56 | 0.15 | 6.35 | 17.44 | 531 | 2.73 | 89.8 | 667 | 3.91 | |
| 16:01 | 0.25 | 6.3 | 17.31 | 531 | 1.35 | 104.2 | 312 | 3.91 | |
| 16:06 | 0.5 | 6.29 | 17.16 | 533 | 1.22 | 112.4 | 187 | 3.92 | |
| 16:11 | 0.75 | 6.27 | 17.17 | 534 | 1.15 | 125.5 | 147 | 3.93 | |
| 16:16 | 1 | 6.28 | 17.17 | 536 | 1.16 | 134.2 | 125 | 3.94 | |
| 16:21 | 1.25 | 6.28 | 17.08 | 537 | 1.1 | 140.8 | 91.6 | 3.94 | |
| 16:26 | 1.5 | 6.28 | 17.05 | 538 | 1.1 | 147.1 | 81 | 3.96 | |
| 16:31 | 2 | 6.28 | 17.12 | 539 | 1.11 | 150.9 | 69.6 | 3.95 | |
| 16:36 | 2.25 | 6.28 | 17.11 | 540 | 1.08 | 155.7 | 68.7 | 3.95 | |
| 16:41 | 2.5 | 6.29 | 17.14 | 540 | 1.05 | 155.6 | 55.4 | 3.94 | |
| 16:46 | 2.75 | 6.29 | 17.07 | 541 | 1.03 | 156 | 56 | 3.95 | |
| 16:51 | 3 | 6.29 | 16.95 | 541 | 1.06 | 150.7 | 62.5 | 3.95 | |
| 16:56 | 3.25 | 6.3 | 16.81 | 542 | 3.77 | 160.4 | 64.4 | 3.95 | Cleaned cell |
| 17:01 | 3.5 | 6.28 | 16.79 | 543 | 1.47 | 164.1 | 49.8 | 3.95 | |
| 17:06 | 3.75 | 6.28 | 16.76 | 543 | 1.16 | 169.8 | 37.2 | 3.95 | |
| 17:11 | 4 | 6.29 | 16.68 | 543 | 1.07 | 172.3 | 34.2 | 3.95 | |
| 17:16 | 4.1 | 6.27 | 16.62 | 543 | 1.08 | 178.5 | 30.5 | 3.94 | |
| 17:21 | 4.25 | 6.27 | 16.55 | 543 | 1.02 | 180.5 | 29.1 | 3.95 | |
| 17:26 | 4.5 | 6.27 | 16.44 | 544 | 1.01 | 184.6 | 28.6 | 3.95 | |
| 17:31 | 4.6 | 6.26 | 16.36 | 544 | 1 | 186.2 | 26.3 | 3.95 | |
| 17:36 | 4.7 | 6.27 | 16.3 | 544 | 0.99 | 188.5 | 25 | 3.95 | |
| 17:41 | 4.75 | 6.27 | 16.21 | 544 | 1.01 | 189.9 | 24 | 3.95 | |
| 17:46 | 4.8 | 6.27 | 16.13 | 544 | 0.98 | 191.6 | 23.2 | 3.95 | |
| 17:51 | 5 | 6.27 | 16.1 | 544 | 0.99 | 193 | 21.8 | 3.95 | |
| 17:56 | 5.2 | 6.27 | 16.05 | 545 | 0.99 | 193.7 | 20.4 | 3.95 | |
| 18:01 | 5.3 | 6.27 | 16.02 | 545 | 0.98 | 194 | 19.2 | 3.95 | |
| | | | | | | | | | Sampled: ABLMW5F001 (18:06) |
| | | | | | | | | | |

## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** MW-6
**Personnel** W. Ramsey, BHE Environmental, Inc
**Location** Stanly Co, NC
**Date** 11/14/2011

**Screened Interval** 25-35' below land surface (BLS)
**Total Well Depth** 39.63'
**Depth to Water Prior to Sampling** 24.81' BTOC
**Well Diameter** 2"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 0.55 gallons

**Pump Type** 1.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.25" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 9:30
**Time Purging Ended** 10:37

| Time | Purge Volume (gallons) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 9:30 | Start | | | | | | | 24.81 | |
| 9:46 | NM | 5.87 | 18.96 | 145 | 3.42 | 166 | NM | 25.33 | |
| 9:56 | NM | 5.81 | 19.58 | 136 | 2.44 | 201 | 4.58 | 26.13 | |
| 10:12 | 0.3 | 5.77 | 19.66 | 123 | 9.68 | 254.6 | 6.87 | 26.79 | |
| 10:22 | 0.4 | 5.8 | 20.15 | 122 | 1.48 | 225.8 | 3.76 | 26.88 | |
| 10:27 | 0.45 | 5.8 | 20.4 | 125 | 1.34 | 220.5 | 3.24 | 26.74 | |
| 10:32 | 0.5 | 5.81 | 20.56 | 126 | 1.32 | 215.1 | 2.99 | 26.7 | |
| 10:37 | 0.55 | 5.82 | 20.83 | 127 | 1.31 | 204.8 | 3.09 | 26.65 | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLMW6F001 (11:00) |

# Well Sampling Log

| | | | |
|---|---|---|---|
| Project | Alcoa Badin: Badin Municipal Landfill | Personnel | M. Worden, Environeering, Inc |
| Well Identification | PZ-15 | Location | Stanly Co, NC |
| | | Date | 11/14/2011 |
| Screened Interval | 28-38' below land surface (BLS) | Pump Type | 0.66" submersible bladder |
| Total Well Depth | 39.95' | Tubing Type | 0.17" polyethylene air; 0.17" polyethylene discharge |
| Depth to Water Prior to Sampling | 36.57' BTOC | Bailer Type | N/A |
| Well Diameter | 1" | String Type | N/A |
| Well Volume | N/A | | |
| Calculated Purge Volume | N/A | Time Purging Started | 12:35 |
| Actual Purge Volume | 1000 ml | Time Purging Ended | 14:00 |

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 12:35 | Start | | | | | | | 36.57 | |
| 12:50 | 0 | NM | NM | NM | NM | NM | NM | 37.9 | |
| 13:10 | 200 | 7.41 | 21.78 | 2322 | 0.94 | -75.4 | >1000 | >38.5 | |
| 13:20 | 400 | 7.41 | 21.8 | 2366 | 0.31 | -78.7 | >1000 | >38.5 | |
| 13:30 | 600 | 7.52 | 22.36 | 2373 | 0.23 | -77.5 | >1000 | >38.5 | |
| 13:40 | 800 | 7.53 | 23.08 | 2325 | 0.24 | -69.1 | >1000 | >38.5 | |
| 13:50 | 1000 | 7.54 | 23.12 | 2375 | 0.24 | -70.1 | >1000 | >38.5 | |
| 14:00 | 1000 | 7.59 | 24.72 | 2416 | 0.43 | -57 | >1000 | >38.5 | Dry/Recovering |
| | | | | | | | | | |
| | | | | | | | | | |
| 11/15/11 | | | | | | | | | |
| 11:45 | N/A | 7.5 | 19.52 | 2172 | 0.6 | -38.7 | >1000 | 36.91 | Sampled: ABLPZ15F001 (11:45) |
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## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** PZ-16
**Personnel** M. Worden, Environeering, Inc
**Location** Stanly Co, NC
**Date** 11/15/2011

**Screened Interval** 30-40' below land surface (BLS)
**Total Well Depth** 42.9'
**Depth to Water Prior to Sampling** 34.11' BTOC
**Well Diameter** 1"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 3000 ml

**Pump Type** 0.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.17" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 7:55
**Time Purging Ended** 11:25

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 7:55 | Start | | | | | | | 34.11 | |
| 8:30 | 0 | 7.22 | 17.44 | 1484 | 0.2 | -80 | >1000 | 34.15 | |
| | | | | | | | | | Shutdown to return to plant |
| 10:35 | 0 | 7.52 | 21.4 | 1643 | 0.41 | -90.4 | >1000 | 34.11 | |
| 10:40 | 300 | 7.25 | 20 | 1388 | 1.61 | -64.6 | >1000 | 34.15 | |
| 10:45 | 600 | 7.35 | 19.37 | 1423 | 0.59 | -98.8 | >1000 | 34.17 | |
| 10:50 | 900 | 7.35 | 19.2 | 1388 | 0.42 | -100.4 | 502 | 34.15 | |
| 10:55 | 1200 | 7.31 | 19.17 | 1277 | 0.36 | -95.6 | 211 | 34.14 | |
| 11:00 | 1500 | 7.25 | 19.08 | 1230 | 0.38 | -82.7 | 104 | 34.13 | |
| 11:05 | 1800 | 7.25 | 19.1 | 1204 | 0.39 | -82.9 | 64.7 | 34.13 | |
| 11:10 | 2100 | 7.24 | 19.15 | 1190 | 0.37 | -80.5 | 34.5 | 34.13 | |
| 11:15 | 2400 | 7.22 | 19.13 | 1187 | 0.32 | -78.1 | 22.9 | 34.13 | |
| 11:20 | 2700 | 7.22 | 19.15 | 1187 | 0.3 | -79.1 | 23.8 | 34.13 | |
| 11:25 | 3000 | 7.24 | 19.2 | 1187 | 0.28 | -84 | 20.9 | 34.13 | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLPZ16F001 (11:25) |

## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** PZ-17
**Personnel** M. Worden, Environeering, Inc
**Location** Stanly Co, NC
**Date** 11/15/2011

**Screened Interval** 19-34' below land surface (BLS)
**Total Well Depth** 36.7'
**Depth to Water Prior to Sampling** 31.16' BTOC
**Well Diameter** 1"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 3700 ml

**Pump Type** 0.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.17" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 12:00
**Time Purging Ended** 14:20

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 12:00 | Start | | | | | | | 31.16 | |
| 12:20 | 0 | 8.59 | 20.68 | 4124 | 1.11 | -93.8 | >1000 | NM | Water level probe malfunction |
| 12:25 | 100 | 8.13 | 20.47 | 3810 | 0.77 | -144.6 | >1000 | NM | |
| 12:30 | 400 | 7.78 | 20.21 | 3413 | 0.48 | -133.1 | >1000 | NM | |
| 12:35 | 700 | 7.57 | 20 | 3143 | 0.28 | -128.9 | >1000 | NM | |
| 12:40 | 1000 | 7.53 | 19.92 | 3024 | 0.2 | -125.8 | 791 | NM | |
| 12:45 | 1300 | 7.62 | 20.29 | 3104 | 0.14 | -138.4 | 819 | NM | |
| 12:50 | 1600 | 7.73 | 20.56 | 3188 | 0..09 | -142.4 | >1000 | NM | |
| | | | | | | | | | |
| 13:45 | 1600 | 7.78 | 23.7 | 3408 | 0.4 | -127.7 | >1000 | NM | |
| 13:50 | 1900 | 7.57 | 20.99 | 3052 | 0.64 | -100 | 559 | NM | |
| 13:55 | 2200 | 7.43 | 20.12 | 2838 | 0.3 | -114.8 | 140 | NM | |
| 14:00 | 2500 | 7.33 | 19.84 | 2734 | 0.14 | -99.6 | 86.2 | NM | |
| 14:05 | 2800 | 7.3 | 19.59 | 2705 | 0.1 | -97.8 | 78.6 | NM | |
| 14:10 | 3100 | 7.31 | 19.58 | 2709 | 0.1 | -99.4 | 26.7 | NM | |
| 14:15 | 3400 | 7.29 | 19.69 | 2724 | 0.1 | -99.5 | 24.3 | NM | |
| 14:20 | 3700 | 7.3 | 19.85 | 2802 | 0.1 | -99.8 | 24.9 | NM | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLPZ17F001 (14:20) |
| | | | | | | | | | Sampled: ABLPZ17D001 (14:40) |
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## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** PZ-18
**Personnel** M. Worden, Environeering, Inc
**Location** Stanly Co, NC
**Date** 11/16/2011

**Screened Interval** 2.2-7.2' below land surface (BLS)
**Total Well Depth** 9.95'
**Depth to Water Prior to Sampling** 6.20' BTOC
**Well Diameter** 1"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 1150 ml

**Pump Type** 0.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.17" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 7:40
**Time Purging Ended** 8:35

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 7:40 | Start | | | | | | | 6.2 | |
| 7:55 | 0 | 7.05 | 17.01 | 1662 | 1.17 | -52.7 | 57.7 | >6.40 | |
| 8:00 | 200 | 7.32 | 16.92 | 1674 | 0.48 | -93 | 60.2 | >6.40 | |
| 8:05 | 400 | 7.16 | 17.14 | 1693 | 0.51 | -97.3 | 64 | >6.40 | |
| 8:10 | 600 | 7.31 | 17.27 | 1690 | 0.55 | -95.3 | 67.1 | >6.40 | |
| 8:15 | 750 | 7.3 | 17.4 | 1697 | 0.58 | -95.4 | 62.3 | >6.40 | |
| 8:20 | 850 | 7.32 | 17.5 | 1697 | 0.6 | -93.3 | 60.2 | >6.40 | |
| 8:25 | 950 | 7.32 | 17.62 | 1698 | 0.62 | -94.1 | 18.7 | >6.40 | Changed Hach turbidity vial |
| 8:30 | 1050 | 7.34 | 17.7 | 1698 | 0.63 | -93.7 | 19.4 | >6.40 | |
| 8:35 | 1150 | 7.33 | 17.71 | 1699 | 0.64 | -93.6 | 19.1 | >6.40 | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLPZ18F001 (08:40) |

## Well Sampling Log

| | |
|---|---|
| Project | Alcoa Badin: Badin Municipal Landfill |
| Well Identification | PZ-19 |
| Personnel | M. Worden, Environeering, Inc |
| Location | Stanly Co, NC |
| Date | 11/15/2011 |
| Screened Interval | 6-16' below land surface (BLS) |
| Total Well Depth | 17.9' |
| Depth to Water Prior to Sampling | 15.19' BTOC |
| Well Diameter | 1" |
| Well Volume | N/A |
| Calculated Purge Volume | N/A |
| Actual Purge Volume | 600 ml |
| Pump Type | 0.66" submersible bladder |
| Tubing Type | 0.17" polyethylene air; 0.17" polyethylene discharge |
| Bailer Type | N/A |
| String Type | N/A |
| Time Purging Started | 15:10 |
| Time Purging Ended | 16:15 |

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 15:10 | Start | | | | | | | 15.19 | |
| 15:50 | 0 | 7.37 | 21.3 | 1736 | 1.01 | -133.6 | 53.7 | 17.6 | |
| 15:55 | 100 | 7.34 | 20.35 | 1705 | 0.61 | -136.7 | 53.3 | 17.62 | |
| 16:00 | 200 | 7.4 | 20.19 | 1690 | 0.2 | -145.5 | 48.6 | 17.71 | |
| 16:05 | 350 | 7.45 | 20.22 | 1689 | 0.21 | -145.7 | 30.8 | 17.7 | |
| 16:10 | 500 | 7.43 | 20.28 | 1702 | 0.18 | -139.2 | 30.2 | 17.77 | |
| 16:15 | 600 | 7.48 | 20.3 | 1704 | 0.18 | -145.2 | 28.1 | 17.81 | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLPZ19F001 (16:30) |
| | | | | | | | | | Could not complete analyses |
| | | | | | | | | | |
| 11/16/11 | | | | | | | | | Dry to 17.9 |
| 11/17/11 | | | | | | | | | Dry to 17.9 |
| 11/18/11 | | | | | | | | | Depth to water: 17.80; Could not sample |
| 11/21/11 | | | | | | | | | Depth to water: 17.41; Sampled available CN only |

# Well Sampling Log

**Personnel** M Worden, Environeering Inc
**Project** Alcoa Badin: Badin Municipal Landfill
**Location** Badin, NC
**Well Identification** MW-1
**Date** 5/8/2012

**Screened Interval** 35-45' below land surface (BLS)
**Total Well Depth** 44.84'
**Depth to Water Prior to Sampling** 25.61' BTOC
**Well Diameter** 2"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 3400 ml

**Pump Type** 1.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.25" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 13:55
**Time Purging Ended** 14:55

| Time | Purge Volume (gal) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 13:55 | Start | | | | | | | | |
| 14:10 | 0 | 5.50 | 19.61 | 93 | 5.01 | 245.80 | 9.56 | 25.29 | |
| 14:15 | 300 | 5.28 | 19.48 | 93 | 2.96 | 250.80 | 8.01 | 26.01 | |
| 14:20 | 600 | 5.39 | 19.63 | 93 | 2.75 | 242.20 | 7.17 | 26.31 | |
| 14:25 | 1000 | 5.29 | 18.67 | 92 | 2.60 | 248.00 | 8.79 | 26.49 | |
| 14:30 | 1400 | 5.28 | 18.63 | 92 | 2.41 | 246.30 | 8.01 | 26.60 | |
| 14:35 | 1800 | 5.26 | 18.56 | 92 | 2.34 | 241.90 | 7.23 | 26.69 | |
| 14:40 | 2200 | 5.27 | 18.61 | 92 | 2.26 | 240.20 | 5.08 | 26.72 | |
| 14:45 | 2600 | 5.29 | 18.57 | 93 | 2.24 | 239.70 | 4.41 | 26.76 | |
| 14:50 | 3000 | 5.30 | 18.55 | 93 | 2.21 | 238.20 | 4.23 | 26.77 | |
| 14:55 | 3400 | 5.31 | 18.56 | 93 | 2.18 | 237.60 | 4.26 | 26.78 | |
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| | | | | | | | | | Sampled: ABLMW01F002 (15:00) |
| | | | | | | | | | Sampled: ABLMW01D002 (15:10) |
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## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** MW-2
**Personnel** Mike Worden, Environeering Inc
**Location** Badin, NC
**Date** 5/8/2012

**Screened Interval** 37-47' below land surface (BLS)
**Total Well Depth** 53.33'
**Depth to Water Prior to Sampling** 33.23' BTOC
**Well Diameter** 2"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 3800 ml

**Pump Type** 1.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.25" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 17:00
**Time Purging Ended** 17:55

| Time | Purge Volume (gallons) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 17:00 | Start | | | | | | | | |
| 17:10 | 0 | 5.83 | 19.95 | 80 | 7.81 | 213.4 | 10.38 | 33.80 | |
| 17:15 | 400 | 5.53 | 19.86 | 80 | 5.42 | 212 | 7.57 | 33.82 | |
| 17:20 | 800 | 5.14 | 18.70 | 75 | 1.79 | 247.3 | 6.27 | 34.12 | |
| 17:25 | 1300 | 5.06 | 18.46 | 75 | 1.25 | 271.1 | 5.71 | 34.39 | |
| 17:30 | 1800 | 4.92 | 18.40 | 74 | 0.80 | 324.5 | 2.61 | 34.55 | |
| 17:35 | 2200 | 5.15 | 18.90 | 74 | 0.72 | 327.2 | 2.11 | 34.53 | |
| 17:40 | 2600 | 5.17 | 18.91 | 74 | 0.68 | 344.3 | 3.95 | 34.50 | |
| 17:45 | 3000 | 5.16 | 19.01 | 74 | 0.66 | 347.2 | 3.71 | 34.50 | |
| 17:50 | 3400 | 5.18 | 19.11 | 73 | 0.65 | 349.1 | 3.99 | 34.33 | |
| 17:55 | 3800 | 5.20 | 19.08 | 73 | 0.70 | 343.3 | 3.62 | 34.50 | |
| | | | | | | | | | Sampled: ABLMW02F002 (18:00) |

## Well Sampling Log

**Personnel** E Duenkel, BHE Environmental, Inc.
**Project** Alcoa Badin: Badin Municipal Landfill
**Location** Badin, NC
**Well Identification** MW-3
**Date** 5/10/2012

**Screened Interval** 4-14' below land surface (BLS)
**Pump Type** 1.66" submersible bladder
**Total Well Depth** 15.27'
**Tubing Type** 0.17" polyethylene air; 0.25" polyethylene discharge
**Depth to Water Prior to Sampling** 1.49' BTOC
**Bailer Type** N/A
**Well Diameter** 2"
**String Type** N/A
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Time Purging Started** 8:15
**Actual Purge Volume** 7150 ml
**Time Purging Ended** 9:30

| Time | Purge Volume (gallons) | pH | Temp (°C) | Conduct. (μS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | Start | | | | | | | | |
| 8:20 | 0 | 5.36 | 15.6 | 107 | 10.5 | 274.5 | 23.00 | 1.95 | |
| 8:25 | 1000 | 4.35 | 15.41 | 90 | 3.05 | 297.0 | 16.80 | 2.02 | |
| 8:30 | 1800 | 4.18 | 15.15 | 84 | 2.17 | 279.1 | 11.00 | 2.09 | |
| 8:35 | 2300 | 4.43 | 15.07 | 83 | 2.06 | 231.2 | 7.93 | 2.00 | |
| 8:40 | 2850 | 4.72 | 15.07 | 81 | 2.09 | 188.8 | 6.55 | 2.02 | |
| 8:45 | 3350 | 4.85 | 15.03 | 80 | 2.07 | 163.0 | 5.03 | 2.07 | |
| 8:50 | 3900 | 4.97 | 15.03 | 80 | 2.12 | 125.6 | 4.34 | 2.09 | |
| 8:55 | 4400 | 5.03 | 15.09 | 79 | 2.07 | 80.3 | 4.18 | 2.11 | |
| 9:00 | 4900 | 5.14 | 15.26 | 79 | 2.06 | 58.7 | 3.20 | 2.13 | |
| 9:05 | 5450 | 5.23 | 15.49 | 79 | 2.03 | 63.6 | 3.26 | 2.15 | |
| 9:10 | 6050 | 5.30 | 15.64 | 79 | 2.03 | 44.5 | 2.42 | 2.17 | |
| 9:15 | 6600 | 5.30 | 15.66 | 79 | 2.01 | 43.4 | 2.09 | 2.19 | |
| 9:20 | 7150 | 5.27 | 15.55 | 79 | 2.02 | 40.0 | 2.11 | 2.21 | |
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| | | | | | | | | | Sampled: ABLMW03F002 (9:25) |
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# Well Sampling Log

Project: Alcoa Badin: Badin Municipal Landfill
Well Identification: MW-4

Personnel: E Duenkel, BHE Environmental, Inc.
Location: Badin, NC
Date: 5/10/2012

Screened Interval: 4-14' below land surface (BLS)
Total Well Depth: 16.09'
Depth to Water Prior to Sampling: 3.99' BTOC
Well Diameter: 2"
Well Volume: N/A
Calculated Purge Volume: N/A
Actual Purge Volume: 6200 ml

Pump Type: 1.66" submersible bladder
Tubing Type: 0.17" polyethylene air; 0.25" polyethylene discharge
Bailer Type: N/A
String Type: N/A
Time Purging Started: 11:45
Time Purging Ended: 12:55

| Time | Purge Volume (gallons) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 11:45 | Start | | | | | | | | |
| 11:50 | 0 | 6.44 | 16.57 | 434 | 4.27 | -18.8 | 11.20 | 4.75 | |
| 11:55 | 550 | 6.36 | 16.28 | 372 | 2.90 | -57.2 | 8.40 | 4.75 | |
| 12:00 | 1050 | 6.33 | 16.19 | 356 | 2.14 | -81.1 | 4.33 | 4.8 | |
| 12:05 | 1600 | 6.32 | 16.09 | 351 | 1.61 | -92.9 | 2.96 | 4.7 | |
| 12:10 | 2050 | 6.35 | 16.18 | 349 | 1.16 | -107.0 | 1.94 | 4.65 | |
| 12:15 | 2400 | 6.36 | 16.07 | 348 | 1.06 | -134.3 | 1.46 | 4.6 | |
| 12:20 | 2850 | 6.37 | 16.18 | 346 | 0.87 | -131.7 | 1.16 | 4.6 | |
| 12:25 | 3400 | 6.38 | 16.15 | 347 | 0.79 | -147.0 | 1.09 | 4.61 | |
| 12:30 | 3800 | 6.39 | 16.1 | 345 | 0.65 | -147.9 | 1.13 | 4.61 | |
| 12:35 | 4300 | 6.38 | 15.95 | 347 | 0.63 | -152.0 | 1.03 | 4.61 | |
| 12:40 | 4800 | 6.38 | 15.87 | 346 | 0.55 | -157.5 | 0.87 | 4.63 | |
| 12:45 | 5200 | 6.38 | 15.87 | 346 | 0.55 | -139.1 | 0.94 | 4.63 | |
| 12:50 | 5700 | 6.39 | 15.84 | 346 | 0.52 | -141.1 | 0.83 | 4.64 | |
| 12:55 | 6200 | 6.38 | 15.87 | 346 | 0.53 | -144.1 | 0.69 | 4.65 | |
| | | | | | | | | | Sampled: ABLMW04F002 (13:00) |

## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** MW-5
**Personnel** E Duenkel, BHE Environmental, Inc.
**Location** Badin, NC
**Date** 5/10/2012

**Screened Interval** 4-14' below land surface (BLS)
**Total Well Depth** 14.49'
**Depth to Water Prior to Sampling** 4.27' BTOC
**Well Diameter** 2"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 4550 ml

**Pump Type** 1.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.25" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 14:47
**Time Purging Ended** 15:30

| Time | Purge Volume (gal) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 14:37 | Start | | | | | | | | |
| 14:40 | 0 | 6.29 | 16.84 | 1074 | 3.1 | 106.0 | 14.5 | 4.37 | |
| 14:45 | 750 | 6.27 | 16.45 | 637 | 1.36 | 39.5 | 10.4 | 4.38 | |
| 14:50 | 1450 | 6.24 | 16.16 | 551 | 1.27 | 17.2 | 7.31 | 4.39 | |
| 14:55 | 2100 | 6.22 | 16.13 | 531 | 1.08 | -1.9 | 6.09 | 4.37 | |
| 15:00 | 2600 | 6.22 | 16.11 | 526 | 0.84 | -13.8 | 4.06 | 4.34 | |
| 15:05 | 2800 | 6.25 | 16.57 | 525 | 0.86 | -23.9 | 3.29 | 4.31 | |
| 15:10 | 3000 | 6.26 | 16.74 | 539 | 0.84 | -31.9 | 2.91 | 4.29 | |
| 15:15 | 3250 | 6.25 | 17.15 | 527 | 0.88 | -48.1 | 3.76 | 4.29 | |
| 15:20 | 3750 | 6.24 | 16.74 | 525 | 0.81 | -55.5 | 3.62 | 4.32 | |
| 15:25 | 4150 | 6.25 | 16.58 | 525 | 0.85 | -61.0 | 3.86 | 4.33 | |
| 15:30 | 4550 | 6.25 | 16.38 | 524 | 0.86 | -59.2 | 3.64 | 4.34 | |
| | | | | | | | | | Sampled: ABLMW05F002 (1535) |

## Well Sampling Log

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|---|---|---|---|
| **Project** | **Alcoa Badin: Badin Municipal Landfill** | **Personnel** | **Mike Worden Environeering Inc** |
| **Well Identification** | **MW-6** | **Location** | **Badin, NC** |
| | | **Date** | **5/8/2012** |
| **Screened Interval** | **25-35' below land surface (BLS)** | **Pump Type** | **1.66" submersible bladder** |
| **Total Well Depth** | **39.63'** | **Tubing Type** | **0.17" polyethylene air; 0.25" polyethylene discharge** |
| **Depth to Water Prior to Sampling** | **29.23' BTOC** | **Bailer Type** | **N/A** |
| **Well Diameter** | **2"** | **String Type** | **N/A** |
| **Well Volume** | **N/A** | | |
| **Calculated Purge Volume** | **N/A** | **Time Purging Started** | **11:45** |
| **Actual Purge Volume** | **3900 ml** | **Time Purging Ended** | **12:55** |

| Time | Purge Volume (gallons) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 11:45 | Start | | | | | | | | |
| 11:55 | 0 | 5.99 | 22.13 | 165 | 6.76 | 234.4 | 7.32 | 29.70 | |
| 12:00 | 400 | 5.95 | 23.29 | 165 | 4.75 | 235.0 | 5.95 | 29.78 | |
| 12:05 | 600 | 5.99 | 23.81 | 165 | 4.62 | 230.1 | 5.44 | 29.79 | |
| 12:10 | 800 | 6.00 | 24.62 | 163 | 4.44 | 226.5 | 5.10 | 29.80 | |
| 12:15 | 1000 | 6.02 | 25.72 | 162 | 4.00 | 222.9 | 5.12 | 29.81 | |
| 12:20 | 1500 | 5.92 | 21.85 | 148 | 4.02 | 231.6 | 5.00 | 29.92 | |
| 12:25 | 1980 | 5.71 | 20.53 | 141 | 4.20 | 259.7 | 5.77 | 29.99 | |
| 12:30 | 2300 | 5.59 | 20.41 | 134 | 3.67 | 293.0 | 5.32 | 30.11 | |
| 12:35 | 2700 | 5.65 | 20.51 | 128 | 3.22 | 309.2 | 5.15 | 30.14 | |
| 12:40 | 3100 | 5.66 | 20.89 | 130 | 2.91 | 307.2 | 4.82 | 30.31 | |
| 12:45 | 3500 | 5.68 | 21.00 | 131 | 2.86 | 301.5 | 4.95 | 30.51 | |
| 12:50 | 3600 | 5.71 | 20.97 | 134 | 2.72 | 298.0 | 3.12 | 30.68 | |
| 12:55 | 3900 | 5.71 | 20.56 | 136 | 2.70 | 297.1 | 4.00 | 30.79 | |
| | | | | | | | | | Sampled: ABLMW06F002 (13:00) |
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## Well Sampling Log

**Personnel** M. Worden, Environeering, Inc
**Project** Alcoa Badin: Badin Municipal Landfill
**Location** Badin, NC
**Well Identification** PZ-15
**Date** 5/9/2012

**Screened Interval** 28-38' below land surface (BLS)
**Pump Type** 0.66" submersible bladder
**Total Well Depth** 39.95'
**Tubing Type** 0.17" polyethylene air; 0.17" polyethylene discharge
**Depth to Water Prior to Sampling** 36.54' BTOC
**Bailer Type** N/A
**Well Diameter** 1"
**String Type** N/A
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Time Purging Started** 11:30
**Actual Purge Volume** 1000 ml
**Time Purging Ended** 12:40

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 11:30 | Start | | | | | | | | |
| 12:10 | 0 | 7.23 | 23.5 | 1843 | 2.13 | -34.9 | 31.3 | >38.0 | |
| 12:15 | 50 | 7.22 | 23.54 | 1850 | 1.72 | -35.4 | 28.7 | >38.0 | |
| 12:20 | 100 | 7.22 | 23.64 | 1862 | 1.53 | -34.3 | 26.6 | >38.0 | |
| 12:25 | 150 | 7.26 | 23.71 | 1879 | 1.26 | -40.2 | 24.7 | >38.0 | |
| 12:30 | 700 | 7.28 | 23.87 | 1889 | 1.15 | -41.2 | 23.8 | >38.0 | |
| 12:35 | 750 | 7.29 | 24.01 | 1910 | 1.10 | -39.1 | 25.2 | >38.0 | |
| 12:40 | 300 | 7.29 | 24.11 | 1913 | 1.10 | -38.9 | 23.2 | >38.0 | |
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| | | | | | | | | | Sampled: ABLPZ15F002 (12:50) |

## Well Sampling Log

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|---|---|---|---|
| Project | Alcoa Badin: Badin Municipal Landfill | Personnel | M. Worden, Environeering, Inc |
| Well Identification | PZ-16 | Location | Badin, NC |
| | | Date | 5/10/2012 |

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|---|---|---|---|
| Screened Interval | 30-40' below land surface (BLS) | Pump Type | 0.66" submersible bladder |
| Total Well Depth | 42.9' | Tubing Type | 0.17" polyethylene air; 0.17" polyethylene discharge |
| Depth to Water Prior to Sampling | 33.73' BTOC | Bailer Type | N/A |
| Well Diameter | 1" | String Type | N/A |
| Well Volume | N/A | | |
| Calculated Purge Volume | N/A | Time Purging Started | 8:45 |
| Actual Purge Volume | 3000 ml | Time Purging Ended | 10:10 |

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 8:40 | Start | | | | | | | 33.73 | |
| 9:15 | 0 | 7.35 | 17.70 | 1173 | 1.20 | -65.5 | 105 | 33.73 | |
| 9:20 | 250 | 7.48 | 17.71 | 1175 | 1.11 | -69.1 | 123 | 33.73 | |
| 9:25 | 500 | 7.51 | 17.74 | 1177 | 0.92 | -77.6 | 68.8 | 33.73 | |
| 9:30 | 750 | 7.58 | 17.83 | 1175 | 0.91 | -80.1 | 43.2 | 33.73 | |
| 9:35 | 1000 | 7.60 | 17.91 | 1169 | 0.89 | -82.3 | 33.5 | 33.73 | |
| 9:40 | 1250 | 7.58 | 17.95 | 1168 | 0.88 | -84.1 | 27.1 | 33.73 | |
| 9:45 | 1500 | 7.48 | 18.01 | 1164 | 0.91 | -84.3 | 28.1 | 33.73 | |
| 9:50 | 1750 | 7.44 | 18.09 | 1164 | 0.90 | -87.4 | 12.1 | 33.73 | |
| 9:55 | 2000 | 7.43 | 18.05 | 1162 | 0.89 | -86.5 | 7.4 | 33.73 | |
| 10:00 | 2250 | 7.41 | 18.04 | 1161 | 0.86 | -87.3 | 9.9 | 33.73 | |
| 10:05 | 2500 | 7.40 | 18.07 | 1156 | 0.83 | -88.9 | 10.1 | 33.73 | |
| 10:10 | 2750 | 7.40 | 18.11 | 1158 | 0.82 | -90.5 | 9.3 | 33.73 | |
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| | | | | | | | | | Sampled: ABLPZ16F002 (10:15) |
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## Well Sampling Log

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|---|---|---|---|
| **Project** | **Alcoa Badin: Badin Municipal Landfill** | **Personnel** | **M. Worden, Environeering, Inc** |
| **Well Identification** | **PZ-17** | **Location** | **Badin, NC** |
| | | **Date** | **5/10/2012** |

| | | | |
|---|---|---|---|
| **Screened Interval** | **19-34' below land surface (BLS)** | **Pump Type** | **0.66" submersible bladder** |
| **Total Well Depth** | **36.7'** | **Tubing Type** | **0.17" polyethylene air; 0.17" polyethylene discharge** |
| **Depth to Water Prior to Sampling** | **30.78' BTOC** | **Bailer Type** | **N/A** |
| **Well Diameter** | **1"** | **String Type** | **N/A** |
| **Well Volume** | **N/A** | | |
| **Calculated Purge Volume** | **N/A** | **Time Purging Started** | **12:00** |
| **Actual Purge Volume** | **3700 ml** | **Time Purging Ended** | **14:20** |

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 13:00 | Start | | | | | | | 31.18 | |
| 14:10 | 0 | 7.01 | 21.91 | 2498 | 2.30 | 120.9 | 94.4 | 31.24 | |
| 14:15 | 300 | 7.07 | 21.85 | 2500 | 1.31 | 103.9 | 71.2 | 31.25 | |
| 14:20 | 600 | 7.07 | 21.51 | 2500 | 0.78 | 13.4 | 50 | 31.24 | |
| 14:25 | 900 | 7.08 | 20.93 | 2499 | 0.63 | 1.2 | 54.7 | 31.24 | |
| 14:30 | 1200 | 6.93 | 19.75 | 2494 | 0.51 | -26.6 | 32 | 31.24 | |
| 14:35 | 1500 | 6.90 | 19.48 | 2487 | 0.49 | -24.8 | 31.4 | 31.24 | |
| 14:40 | 1800 | 7.00 | 20.11 | 2486 | 0.41 | -30.1 | 12.5 | 31.24 | |
| 14:45 | 2100 | 7.05 | 20.38 | 2481 | 0.42 | -44.0 | 10.4 | 31.24 | |
| 14:50 | 2400 | 7.07 | 20.92 | 2494 | 0.40 | -46.2 | 12.1 | 31.24 | |
| 14:55 | 2700 | 7.18 | 21.18 | 2494 | 0.36 | -54.4 | 8.32 | 31.24 | |
| 15:00 | 3000 | 7.19 | 21.03 | 2500 | 0.36 | -58.9 | 8.7 | 31.25 | |
| 15:05 | 3300 | 7.27 | 21.35 | 2504 | 0.32 | -65.2 | 7.76 | 31.24 | |
| 15:10 | 3600 | 7.27 | 21.11 | 2505 | 0.33 | -73.0 | 8.12 | 31.24 | |
| 15:15 | 3900 | 7.23 | 20.99 | 2509 | 0.35 | -68.9 | 7.73 | 31.24 | |
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## Well Sampling Log

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|---|---|---|---|
| Project | Alcoa Badin: Badin Municipal Landfill | Personnel | M. Worden, Environeering, Inc |
| Well Identification | PZ-18 | Location | Badin, NC |
| | | Date | 5/9/2012 |
| Screened Interval | 2.2-7.2' below land surface (BLS) | Pump Type | 0.66" submersible bladder |
| Total Well Depth | 9.95' | Tubing Type | 0.17" polyethylene air; 0.17" polyethylene discharge |
| Depth to Water Prior to Sampling | 6.12' BTOC | Bailer Type | N/A |
| Well Diameter | 1" | String Type | N/A |
| Well Volume | N/A | | |
| Calculated Purge Volume | N/A | Time Purging Started | 9:15 |
| Actual Purge Volume | 1150 ml | Time Purging Ended | 10:15 |

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 9:15 | Start | | | | | | | 6.34 | |
| 9:35 | 0 | 7.30 | 19.34 | 1829 | 1.13 | -88.9 | 119 | 7.5 | |
| 9:40 | 200 | 6.99 | 19.34 | 1831 | 0.7 | -99.4 | 222 | 7.85 | |
| 9:45 | 300 | 7.00 | 19.61 | 1838 | 0.61 | -108.7 | 214 | NM | Below gaugeable point |
| 9:50 | 400 | 7.02 | 19.82 | 1837 | 0.59 | -111.4 | 137 | NM | |
| 9:55 | 500 | 7.04 | 20.05 | 1844 | 0.57 | -112.8 | 217 | NM | |
| 10:00 | 600 | 7.05 | 20.11 | 1845 | 0.56 | -113.5 | 213 | NM | |
| 10:05 | 700 | 7.08 | 20.14 | 1846 | 0.56 | -116.2 | 165 | NM | |
| 10:10 | 800 | 7.10 | 20.22 | 1848 | 0.54 | -119.6 | 172 | NM | |
| 10:15 | 900 | 7.11 | 20.23 | 1848 | 0.54 | -120.0 | 177 | NM | |
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| | | | | | | | | | Sampled: ABLPZ18F002 (10:20) |

## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** PZ-19

**Personnel** M. Worden, Environeering, Inc
**Location** Badin, NC
**Date** 5/10/2012

**Screened Interval** 6-16' below land surface (BLS)
**Total Well Depth** 17.9'
**Depth to Water Prior to Sampling** 14.99' BTOC
**Well Diameter** 1"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 600 ml

**Pump Type** 0.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.17" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 11:45
**Time Purging Ended** 12:45

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 11:45 | Start | | | | | | | | |
| 12:20 | 0 | 7.08 | 21.87 | 2159 | 1.40 | -90.5 | 16 | >16.0 | |
| 12:25 | 100 | 7.09 | 22.21 | 2132 | 1.03 | -93.3 | 17.5 | >16.0 | |
| 12:30 | 200 | 7.12 | 23.59 | 2097 | 0.71 | -91.2 | 10.6 | >16.0 | |
| 12:35 | 250 | 7.12 | 22.45 | 2089 | 0.69 | -92.5 | 7.3 | >16.0 | |
| 12:40 | 270 | 7.16 | 22.51 | 2086 | 0.66 | -93.2 | 7.73 | >16.0 | |
| 12:45 | 290 | 7.14 | 22.63 | 2081 | 0.68 | -95.7 | 8.05 | >16.0 | |
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| | | | | | | | | | Sampled: ABLPZ19F002 (13:25) |
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## Well Sampling Log

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|---|---|---|---|
| **Project** | **Alcoa Badin: Badin Municipal Landfill** | **Personnel** | **D. Parker Environeering, Inc** |
| **Well Identification** | **MW-1** | **Location** | **Badin, NC** |
| | | **Date** | **8/2/2012** |
| **Screened Interval** | **35-45' below land surface (BLS)** | **Pump Type** | **1.66" submersible bladder** |
| **Total Well Depth** | **44.84'** | **Tubing Type** | **0.17" polyethylene air; 0.25" polyethylene discharge** |
| **Depth to Water Prior to Sampling** | **25.58' BTOC** | **Bailer Type** | **N/A** |
| **Well Diameter** | **2"** | **String Type** | **N/A** |
| **Well Volume** | **N/A** | | |
| **Calculated Purge Volume** | **N/A** | **Time Purging Started** | **7:30** |
| **Actual Purge Volume** | **3250 ml** | **Time Purging Ended** | **8:10** |

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 7:30 | Start | | | | | | | 25.40 | |
| 7:35 | 0 | 5.61 | 18.2 | 95 | 5.73 | -144 | 14.40 | 27.70 | |
| 7:40 | 750 | 5.65 | 18.5 | 93 | 4.2 | -175 | 6.50 | 27.27 | |
| 7:45 | 1200 | 5.70 | 19.1 | 95 | 3.58 | -185 | 3.84 | 26.92 | |
| 7:50 | 1600 | 5.71 | 19.2 | 96 | 3.11 | -196 | 2.04 | 26.74 | |
| 7:55 | 2000 | 5.71 | 19.1 | 96 | 2.82 | -203 | 1.76 | 26.65 | |
| 8:00 | 2450 | 5.70 | 19.1 | 96 | 2.59 | -206 | 2.00 | 26.63 | |
| 8:05 | 2850 | 5.69 | 19.1 | 95 | 2.63 | -207 | 1.88 | 26.59 | |
| 8:10 | 3250 | 5.69 | 19.2 | 95 | 2.4 | -208 | 1.51 | 26.59 | |
| | | | | | | | | | Sampled: ABLMW1F003 (8:10) |

## Well Sampling Log

| | | | |
|---|---|---|---|
| Project | Alcoa Badin: Badin Municipal Landfill | Personnel | D. Parker Environeering, Inc |
| Well Identification | MW-2 | Location | Badin, NC |
| | | Date | 7/30/2012 |
| Screened Interval | 37-47' below land surface (BLS) | Pump Type | 1.66" submersible bladder |
| Total Well Depth | 53.33' | Tubing Type | 0.17" polyethylene air; 0.25" polyethylene discharge |
| Depth to Water Prior to Sampling | 34.50' BTOC | Bailer Type | N/A |
| Well Diameter | 2" | String Type | N/A |
| Well Volume | N/A | | |
| Calculated Purge Volume | N/A | Time Purging Started | 14:50 |
| Actual Purge Volume | 5750 ml | Time Purging Ended | 15:55 |

| Time | Purge Volume (gallons) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 14:50 | Start | | | | | | | 34.3 | |
| 14:55 | 0 | 5.45 | 22.7 | 87 | 2.62 | -183.2 | 7.81 | DRY | |
| | | | | | | | | | Replaced air tube |
| 15:10 | 600 | 5.53 | 23.7 | 77 | 6.7 | -213.1 | 10.6 | 35.1 | |
| 15:15 | 1100 | 5.41 | 21.1 | 75 | 4.67 | -274.1 | 11.3 | 35.3 | |
| 15:20 | 1900 | 5.41 | 19.7 | 74 | 3.66 | -255 | 5.89 | 35.58 | |
| 15:25 | 2250 | 5.48 | 21.2 | 75 | 7 | -246 | 5.19 | 35.46 | |
| 15:30 | 2650 | 5.48 | 21.6 | 74 | 6.6 | -300 | 3.74 | 35.41 | |
| 15:35 | 3250 | 5.48 | 20.7 | 74 | 6.81 | -312 | 2.82 | 35.54 | |
| 15:40 | 3650 | 5.47 | 21.2 | 73 | 5.82 | -310 | 4.98 | 35.4 | |
| 15:45 | 4350 | 5.48 | 19.4 | 73 | 6.24 | -313 | 1.05 | 35.75 | |
| 15:50 | 5050 | 5.47 | 19.6 | 73 | 6.48 | -316 | 1.27 | 35.88 | |
| 15:55 | 5750 | 5.48 | 19.7 | 72 | 6.18 | -322 | 2.16 | 35.9 | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLMW2F003 (16:00) |

# Well Sampling Log

| | | | |
|---|---|---|---|
| **Project** | **Alcoa Badin: Badin Municipal Landfill** | **Personnel** | **D. Parker Environeering, Inc** |
| **Well Identification** | **MW-3** | **Location** | **Badin, NC** |
| | | **Date** | **7/31/2012** |
| **Screened Interval** | **4-14' below land surface (BLS)** | **Pump Type** | **1.66" submersible bladder** |
| **Total Well Depth** | **15.27'** | **Tubing Type** | **0.17" polyethylene air; 0.25" polyethylene discharge** |
| **Depth to Water Prior to Sampling** | 2.48' BTOC | **Bailer Type** | **N/A** |
| **Well Diameter** | **2"** | **String Type** | **N/A** |
| **Well Volume** | **N/A** | | |
| **Calculated Purge Volume** | **N/A** | **Time Purging Started** | **13:55** |
| **Actual Purge Volume** | **11325 ml** | **Time Purging Ended** | **15:10** |

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 13:52 | Start | | | | | | | 2.73 | |
| 13:55 | 0 | 5.65 | 21.30 | 75 | 2.05 | -206 | 96.50 | 2.84 | |
| 14:00 | 750 | 5.66 | 20.90 | 74 | 1.95 | -201 | 78.70 | 2.95 | |
| 14:05 | 1550 | 5.65 | 20.60 | 74 | 1.9 | -192 | 45.90 | 3.04 | |
| 14:10 | 2300 | 5.65 | 20.50 | 74 | 1.82 | -186 | 36.20 | 3.09 | |
| 14:15 | 3050 | 5.65 | 20.30 | 74 | 1.89 | -185 | 20.70 | 3.11 | |
| 14:20 | 3775 | 5.64 | 20.30 | 73 | 1.91 | -183 | 15.10 | 3.15 | |
| 14:25 | 4525 | 5.65 | 20.40 | 73 | 1.87 | -183 | 15.50 | 3.16 | |
| 14:30 | 5250 | 5.65 | 20.20 | 74 | 1.85 | -183 | 11.50 | 3.20 | |
| 14:35 | 6000 | 5.65 | 20.00 | 74 | 1.83 | -183 | 9.40 | 3.21 | |
| 14:40 | 6750 | 5.66 | 20.00 | 74 | 1.83 | -180 | 9.22 | 3.22 | |
| 14:45 | 7450 | 5.66 | 20.00 | 74 | 1.86 | -179 | 7.68 | 3.25 | |
| 14:50 | 8250 | 5.67 | 20.00 | 74 | 1.82 | -179 | 7.44 | 3.27 | |
| 14:55 | 9050 | 5.66 | 19.80 | 74 | 1.89 | -176 | 6.19 | 3.27 | |
| 15:00 | 9900 | 5.67 | 19.60 | 74 | 1.8 | -172 | 3.74 | 3.33 | |
| 15:05 | 10625 | 5.67 | 19.70 | 74 | 1.83 | -171 | 4.02 | 3.31 | |
| 15:10 | 11325 | 5.67 | 19.80 | 74 | 1.8 | -170 | 3.62 | 3.31 | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLMW03F003 (15:10) |
| | | | | | | | | | Sampled: ABLMW03D003 (15:15) |

## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** MW-4
**Personnel** D. Parker Envieroneering, Inc
**Location** Badin, NC
**Date** 7/31/2012

**Screened Interval** 4-14' below land surface (BLS)
**Total Well Depth** 16.09'
**Depth to Water Prior to Sampling** 5.18' BTOC
**Well Diameter** 2"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 16550 ml

**Pump Type** 1.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.25" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 7:20
**Time Purging Ended** 10:05

| Time | Purge Volume (gallons) | pH | Temp (°C) | Conduct. (μS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 7:20 | Start | | | | | | | 5.35 | |
| 7:25 | 0 | 6.49 | 17 | 306 | 1.07 | -67.2 | 25.8 | 6.35 | |
| 7:30 | 1300 | 6.52 | 17.3 | 307 | 0.37 | -166.8 | 15 | 6.4 | |
| 7:35 | 1550 | 6.54 | 18.5 | 307 | 0.4 | -208.8 | 12.9 | 6.22 | |
| 7:40 | 2050 | 6.54 | 18.3 | 310 | 0.3 | -220 | 6.92 | 6.19 | |
| 7:45 | 2550 | 6.54 | 17.8 | 310 | 0.34 | -234.8 | 5.64 | 6.52 | |
| 7:50 | 2650 | 6.54 | 17.3 | 308 | 0.34 | -237.5 | 6.52 | 6.61 | |
| 7:55 | 3500 | 6.53 | 17.5 | 311 | 6.77 | -183.5 | 6.01 | 6.69 | |
| 8:00 | 4250 | 6.53 | 17.5 | 312 | 6.28 | -201.9 | 4.37 | 6.7 | |
| 8:05 | 4750 | 6.53 | 17.7 | 313 | 5.69 | -185 | 3.66 | 6.52 | Bad battery |
| | | | | | | | | | |
| 8:55 | Restart | | | | | | | | |
| 9:00 | 0 | 6.53 | 18 | 313 | 0.54 | -225.9 | 242 | 6.7 | |
| 9:05 | 700 | 6.51 | 18.1 | 219 | 0.39 | -239.7 | 125 | 6.65 | |
| 9:10 | 1300 | 6.51 | 18 | 323 | 0.38 | -244.2 | 118 | 6.65 | |
| 9:15 | 2050 | 6.52 | 17.4 | 325 | 0.81 | -228 | 105 | 6.89 | |
| 9:20 | 3150 | 6.52 | 17.2 | 319 | 0.47 | -236 | 96.6 | 7.12 | |
| 9:25 | 4100 | 6.53 | 17.2 | 310 | 0.7 | -220 | 105 | 7.4 | |
| 9:30 | 5100 | 6.53 | 18 | 311 | 0.87 | -204 | 161 | 7.6 | |
| 9:35 | 6100 | 6.51 | 17.2 | 322 | 0.67 | -208 | 60.4 | 7.84 | |
| 9:40 | 7100 | 6.53 | 17.6 | 316 | 0.49 | -223 | 34.2 | 8.26 | |
| 9:45 | 8100 | 6.51 | 18.1 | 326 | 0.25 | -259 | 17.2 | 8.18 | |
| 9:50 | 9100 | 6.51 | 17.7 | 337 | 0.15 | -299 | 7.87 | 8.14 | |
| 9:55 | 10100 | 6.51 | 17.7 | 341 | 0.14 | -312 | 4.58 | 8.12 | |
| 10:00 | 11000 | 6.5 | 17.6 | 343 | 0.14 | -314 | 4.56 | 8.09 | |
| 10:05 | 11800 | 6.51 | 17.6 | 345 | 0.15 | -313 | 4.61 | 8.09 | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLMW4F003 (10:05) |
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## Well Sampling Log

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|---|---|---|---|
| Project | Alcoa Badin: Badin Municipal Landfill | Personnel | D. Parker Environeering, Inc |
| Well Identification | MW-5 | Location | Badin, NC |
| | | Date | 7/31/2012 |

| | | | |
|---|---|---|---|
| Screened Interval | 4-14' below land surface (BLS) | Pump Type | 1.66" submersible bladder |
| Total Well Depth | 14.49' | Tubing Type | 0.17" polyethylene air; 0.25" polyethylene discharge |
| Depth to Water Prior to Sampling | 4.55' BTOC | Bailer Type | N/A |
| Well Diameter | 2" | String Type | N/A |
| Well Volume | N/A | | |
| Calculated Purge Volume | N/A | Time Purging Started | 11:15 |
| Actual Purge Volume | 12200 ml | Time Purging Ended | 12:50 |

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (μS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 11:12 | Start | | | | | | | 4.62 | |
| 11:15 | 0 | 6.34 | 19.2 | 482 | 2.99 | -95 | 169 | 4.62 | |
| 11:20 | 650 | 6.33 | 18.9 | 481 | 2.24 | -122 | 107 | 4.64 | |
| 11:25 | 1350 | 6.33 | 19 | 479 | 1.86 | -125 | 61.3 | 4.62 | |
| 11:30 | 2050 | 6.34 | 19 | 479 | 1.63 | -135 | 53.5 | 4.62 | |
| 11:35 | 2700 | 6.34 | 18.9 | 479 | 1.44 | -139 | 28.9 | 4.63 | |
| 11:40 | 3400 | 6.34 | 18.7 | 479 | 1.36 | -143 | 20.9 | 4.62 | |
| 11:45 | 4000 | 6.34 | 18.7 | 479 | 1.28 | -147 | 16.9 | 4.62 | |
| 11:50 | 4650 | 6.34 | 18.7 | 479 | 1.23 | -150 | 13 | 4.62 | |
| 11:55 | 5300 | 6.34 | 18.8 | 479 | 1.31 | -149 | 10.5 | 4.63 | |
| 12:00 | 5950 | 6.34 | 18.9 | 479 | 1.2 | -150 | 9.3 | 4.63 | |
| 12:05 | 6600 | 6.34 | 18.8 | 479 | 1.19 | -158 | 8.17 | 4.64 | |
| 12:10 | 7250 | 6.34 | 18.9 | 480 | 1.16 | -167 | 6.94 | 4.62 | |
| 12:15 | 7850 | 6.34 | 18.7 | 479 | 1.15 | -173 | 7.95 | 4.62 | |
| 12:20 | 8500 | 6.34 | 18.7 | 480 | 1.15 | -173 | 6.25 | 4.62 | |
| 12:25 | 9100 | 6.34 | 18.8 | 480 | 1.15 | -177 | 6.29 | 4.62 | |
| 12:30 | 9750 | 6.34 | 18.8 | 480 | 1.14 | -183 | 5.06 | 4.62 | |
| 12:35 | 10400 | 6.34 | 18.8 | 479 | 1.14 | -186 | 5.21 | 4.62 | |
| 12:40 | 11000 | 6.34 | 18.8 | 479 | 1.14 | -194 | 4.05 | 4.62 | |
| 12:45 | 11600 | 6.34 | 18.8 | 479 | 1.14 | -194 | 3.94 | 4.62 | |
| 12:50 | 12200 | 6.34 | 18.9 | 479 | 1.14 | -192 | 3.88 | 4.62 | |
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| | | | | | | | | | Sampled: ABLMW5F003 (12:50) |
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## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** MW-6

**Personnel** M.Worden, D.Parker Environeering, Inc
**Location** Badin, NC
**Date** 7/30/2012

**Screened Interval** 25-35' below land surface (BLS)
**Total Well Depth** 39.63'
**Depth to Water Prior to Sampling** 30.30' BTOC
**Well Diameter** 2"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 9730 ml

**Pump Type** 1.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.25" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 11:10
**Time Purging Ended** 13:00

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 11:10 | Start | | | | | | | 29.40 | |
| 11:15 | 0 | 5.82 | 22.8 | 96 | 6.50 | -119.3 | 3.2 | 30.02 | |
| 11:20 | 650 | 5.82 | 23.0 | 94 | 5.75 | -143.2 | 2.73 | 29.99 | |
| 11:25 | 1250 | 5.81 | 22.6 | 93 | 6.40 | -162.2 | 2.45 | 30.08 | |
| 11:30 | 1900 | 5.81 | 22.8 | 92 | 4.90 | -158.2 | 3.02 | 30.40 | |
| 11:35 | 2500 | 5.81 | 22.9 | 92 | 4.75 | -161.5 | 3.87 | 30.60 | |
| 11:40 | 3100 | 5.83 | 23.0 | 98 | 4.62 | -165.5 | 2.79 | 30.79 | |
| 11:45 | 3680 | 5.85 | 23.1 | 102 | 4.60 | -166.8 | 2.72 | 30.96 | |
| 11:50 | 4230 | 5.86 | 23.0 | 107 | 4.16 | -178 | 2.07 | 31.20 | |
| 11:55 | 4830 | 5.86 | 23.0 | 110 | 3.87 | -194.1 | 2.32 | 31.32 | |
| 12:00 | 5430 | 5.84 | 23.1 | 110 | 3.61 | -204.1 | 2.12 | 31.49 | |
| 12:05 | 6030 | 5.81 | 23 | 108 | 3.22 | -203.1 | 2.11 | 31.65 | |
| 12:10 | 6630 | 5.8 | 23.4 | 109 | 2.82 | -220.2 | 1.1 | 31.7 | |
| 12:15 | 7280 | 5.79 | 23.3 | 109 | 2.44 | -244 | 0.5 | 31.89 | |
| 12:20 | 7830 | 5.78 | 23.4 | 109 | 2.18 | -254.7 | 0.43 | 32.1 | |
| 12:25 | 8080 | 5.8 | 24.1 | 111 | 2.03 | -255.3 | 1.17 | 31.9 | |
| 12:30 | 8480 | 5.8 | 23.5 | 114 | 2.23 | -251 | 0.5 | 32.1 | |
| 12:35 | 8830 | 5.86 | 25.5 | 117 | 5.17 | -217 | 0.65 | >32.10 | |
| 12:40 | 9030 | 5.87 | 26.6 | 142 | 1.48 | -241 | 0.4 | >32.10 | |
| 12:45 | 9280 | 5.89 | 27.4 | 123 | 1.18 | -250 | 0.67 | >32.10 | |
| 12:50 | 9330 | 5.9 | 27.7 | 124 | 0.89 | -250 | 0.37 | >32.10 | |
| 12:55 | 9530 | 5.93 | 28 | 125 | 0.83 | -252.7 | 0.18 | >32.10 | |
| 13:00 | 9730 | 5.94 | 28.3 | 128 | 0.79 | -257 | 0.16 | >32.10 | |
| | | | | | | | | | Sampled: ABLMW6F003 (13:05) |
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## Well Sampling Log

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|---|---|---|---|
| **Project** | **Alcoa Badin: Badin Municipal Landfill** | **Personnel** | **D.Parker, Environeering, Inc** |
| **Well Identification** | **PZ-15** | **Location** | **Badin, NC** |
| | | **Date** | **8/1/2012** |

| | | | |
|---|---|---|---|
| **Screened Interval** | **28-38' below land surface (BLS)** | **Pump Type** | **0.66" submersible bladder** |
| **Total Well Depth** | **39.95'** | **Tubing Type** | **0.17" polyethylene air; 0.17" polyethylene discharge** |
| **Depth to Water Prior to Sampling** | **37.05' BTOC** | **Bailer Type** | **0.75" polyethylene** |
| **Well Diameter** | **1"** | **String Type** | **Nylon** |
| **Well Volume** | **N/A** | | |
| **Calculated Purge Volume** | **N/A** | **Time Purging Started** | **8:09** |
| **Actual Purge Volume** | **100 ml** | **Time Purging Ended** | **8:25** |

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 8:09 | Start | | | | | | | NM | Could not measure DTW |
| 8:15 | 0 | 7.36 | 21.8 | 349 | 1.46 | -189.8 | >1000 | NM | Could not measure DTW |
| 8:20 | 100 | 7.35 | 21.7 | 352 | 1.12 | -208 | >1000 | NM | Could not measure DTW |
| 8:25 | 100 | 7.38 | 22 | 351 | 0.95 | -220 | NM | NM | Could not measure DTW |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| 8/2/2012 | | | | | | | | | |
| 9:20 | | | | | | | | 37.61 | Well sampled to dry - partial fill sampling containers |
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| | | | | | | | | | Sampled: ABLPZ15F003 (9:25) |
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## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** PZ-16
**Personnel** D. Parker, Environeering, Inc
**Location** Badin, NC
**Date** 8/1/2012

**Screened Interval** 30-40' below land surface (BLS)
**Total Well Depth** 42.9'
**Depth to Water Prior to Sampling** 35.15' BTOC
**Well Diameter** 1"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 4775 ml

**Pump Type** 0.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.17" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 10:15
**Time Purging Ended** 12:10

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 9:06 | Start | | | | | | | 35.18 | Clogged Line |
| | | | | | | | | | |
| 10:15 | 0 | | | | | | | 35.18 | Restart |
| 10:35 | 0 | 7.34 | 29.2 | 1.46 | 0.70 | -265 | >1000 | 35.18 | |
| 10:40 | 0 | 7.34 | 29.9 | 1.47 | 0.60 | -265 | >1000 | 35.18 | |
| 10:45 | 50 | 7.34 | 30 | 151 | 0.62 | -270 | >1000 | 35.18 | |
| 10:50 | 125 | 7.37 | 27.8 | 156 | 0.98 | -269 | >1000 | 35.19 | |
| 10:55 | 250 | 7.37 | 24.9 | 153 | 1.16 | -256 | >1000 | 35.18 | |
| 11:00 | 350 | 7.37 | 25.5 | 155 | 0.48 | -288 | >1000 | 35.16 | |
| 11:05 | 525 | 7.46 | 24.1 | 149 | 1.2 | -255 | >1000 | 35.18 | |
| 11:10 | 775 | 7.45 | 21.2 | 139 | 1.6 | -243 | 874 | 35.18 | |
| 11:15 | 1075 | 7.4 | 21.1 | 132 | 1.53 | -243 | 363 | 35.18 | |
| 11:20 | 1425 | 7.39 | 20.8 | 129 | 1.43 | -245 | 117 | 35.16 | |
| 11:25 | 1725 | 7.39 | 21.4 | 127 | 1.44 | -248 | 80.6 | 35.17 | |
| 11:30 | 2075 | 7.4 | 21.1 | 128 | 1.32 | -255 | 77.6 | 35.16 | |
| 11:35 | 2475 | 7.4 | 20.9 | 124 | 1.32 | -260 | 51.2 | 35.16 | |
| 11:40 | 2750 | 7.4 | 21.3 | 123 | 1.31 | -263 | 42.6 | 35.18 | |
| 11:45 | 3025 | 7.4 | 21.4 | 123 | 1.25 | -268 | 33.1 | 35.19 | |
| 11:50 | 3350 | 7.4 | 21.4 | 123 | 1.23 | -270 | 28.6 | 35.18 | |
| 11:55 | 3750 | 7.39 | 21.2 | 121 | 1.23 | -273 | 24.4 | 35.18 | |
| 12:00 | 4075 | 7.39 | 21.4 | 121 | 1.19 | -274 | 21.1 | 35.18 | |
| 12:05 | 4375 | 7.4 | 21.2 | 121 | 1.26 | -272 | 19.4 | 35.19 | |
| 12:10 | 4775 | 7.4 | 21.1 | 121 | 1.24 | -268 | 17.9 | 35.19 | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLPZ16F003 (12:15) |
| | | | | | | | | | Sampled: ABLPZ16D003 (12:25) |
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# Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** PZ-17
**Personnel** D. Parker, Environeering, Inc
**Location** Badin, NC
**Date** 8/1/2012

**Screened Interval** 19-34' below land surface (BLS)
**Total Well Depth** 36.7'
**Depth to Water Prior to Sampling** 31.16' BTOC
**Well Diameter** 1"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 1025 ml
**Pump Type** 0.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.17" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 13:35
**Time Purging Ended** 15:00

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 13:35 | Start | | | | | | | 32.20 | |
| 13:40 | 0 | 7.43 | 24.4 | 306 | 0.67 | -310 | 288 | >34.40 | |
| 13:45 | 100 | 7.47 | 26.2 | 302 | 0.5 | -317 | 258 | >34.40 | |
| 13:50 | 150 | 7.69 | 28.2 | 322 | 0.4 | -321 | 283 | >34.40 | |
| 13:55 | 200 | 7.72 | 30.2 | 337 | 0.45 | -337 | 380 | >34.40 | |
| 14:00 | 275 | 7.68 | 29.9 | 337 | 0.47 | -335 | 409 | >34.40 | |
| 14:05 | 300 | 7.48 | 28.5 | 318 | 0.51 | -318 | NM | >34.40 | Lower pump |
| 14:10 | 325 | 7.47 | 29.3 | 314 | 0.48 | -314 | 175 | 34.83 | |
| 14:15 | 475 | 7.82 | 24.9 | 366 | 0.27 | -53 | >1000 | >35.43 | Turbidity meter issues |
| 14:20 | 575 | 7.71 | 24.8 | 354 | 0.16 | -405 | 530 | >35.43 | |
| 14:25 | 625 | 7.55 | 25.7 | 322 | 0.15 | -387 | 279 | >35.43 | |
| 14:30 | 675 | 7.53 | 26.9 | 314 | 0.15 | -369 | 383 | >35.43 | |
| 14:35 | 750 | 7.6 | 26.9 | 319 | 0.14 | -387 | 597 | >35.43 | |
| 14:40 | 825 | 7.52 | 27.1 | 313 | 0.13 | -393 | 364 | >35.43 | |
| 14:45 | 875 | 7.49 | 27.4 | 309 | 0.14 | -366 | 234 | >35.43 | |
| 14:50 | 925 | 7.48 | 26.6 | 307 | 0.15 | -372 | 278 | >35.43 | |
| 14:55 | 975 | 7.45 | 26.2 | 304 | 0.16 | -368 | 253 | >35.43 | |
| 15:00 | 1025 | 7.43 | 25.9 | 301 | 0.16 | -364 | 153 | >35.43 | |
| | | | | | | | | | |
| 15:50 | | | | | | | 13.3 | 35.80 | Post sampling |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLPZ17F003 (15:00) |
| | | | | | | | | | |
| | | | | | | | | | |

## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** PZ-18
**Personnel** D.Parker, Environeering, Inc
**Location** Badin, NC
**Date** 8/1/2012

**Screened Interval** 2.2-7.2' below land surface (BLS)
**Total Well Depth** 9.95'
**Depth to Water Prior to Sampling** 6.11' BTOC
**Well Diameter** 1"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 1200 ml

**Pump Type** 0.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.17" polyethylene discharge
**Bailer Type** N/A
**String Type** N/A
**Time Purging Started** 17:50
**Time Purging Ended** 19:15

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 17:50 | Start | | | | | | | 6.11 | |
| 17:55 | 0 | 7.18 | 23.4 | 175 | 3.26 | -324 | >1000 | 9.7 | |
| 18:00 | 250 | 7.18 | 25.2 | 185 | 2.63 | -302 | >1000 | 9.68 | |
| 18:05 | 500 | 7.16 | 25.7 | 183 | 2.34 | -277 | 417 | >9.70 | |
| 18:10 | 550 | 7.13 | 25.6 | 179 | 2.19 | -273 | 421 | >9.70 | |
| 18:15 | 600 | 7.03 | 26.4 | 185 | 2.09 | -283 | 703 | >9.70 | |
| 18:20 | 650 | 7.01 | 27.1 | 191 | 2.05 | -245 | 852 | >9.70 | |
| 18:25 | 700 | 6.99 | 27.5 | 193 | 2.01 | -225 | 481 | >9.70 | |
| 18:30 | 750 | 6.99 | 27.9 | 192 | 1.99 | -215 | 338 | >9.70 | |
| 18:35 | 800 | 6.98 | 28 | 190 | 1.89 | -210 | 209 | >9.70 | |
| 18:40 | 850 | 6.99 | 28 | 189 | 1.78 | -213 | 137 | >9.70 | |
| 18:45 | 900 | 6.99 | 27.9 | 186 | 1.68 | -221 | 96.6 | >9.70 | |
| 18:50 | 950 | 7 | 27.8 | 184 | 1.58 | -227 | 71.2 | >9.70 | |
| 18:55 | 1000 | 7.01 | 27.6 | 182 | 1.51 | -225 | 53.8 | >9.70 | |
| 19:00 | 1050 | 7.02 | 27.6 | 181 | 1.48 | -228 | 36.5 | >9.70 | |
| 19:05 | 1100 | 7.03 | 27.6 | 180 | 1.45 | -219 | 27.1 | >9.70 | |
| 19:10 | 1150 | 7.04 | 27.5 | 179 | 1.43 | -213 | 29.3 | >9.70 | |
| 19:15 | 1200 | 7.04 | 27.4 | 179 | 1.36 | -209 | 35.4 | >9.70 | |
| | | | | | | | | | |
| | | | | | | | | | |
| 20:05 | | | | | | | 4.16 | 9.85 | Post sampling |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | Sampled: ABLPZ18F003 (19:15) |
| | | | | | | | | | |
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| | | | | | | | | | |
| | | | | | | | | | |

## Well Sampling Log

**Project** Alcoa Badin: Badin Municipal Landfill
**Well Identification** PZ-19
**Personnel** D. Parker, Environeering, Inc
**Location** Badin, NC
**Date** 8/1/2012

**Screened Interval** 6-16' below land surface (BLS)
**Total Well Depth** 17.9'
**Depth to Water Prior to Sampling** 15.10' BTOC
**Well Diameter** 1"
**Well Volume** N/A
**Calculated Purge Volume** N/A
**Actual Purge Volume** 385 ml

**Pump Type** 0.66" submersible bladder
**Tubing Type** 0.17" polyethylene air; 0.17" polyethylene discharge
**Bailer Type** 0.75" polyethylene
**String Type** Nylon
**Time Purging Started** 16:30
**Time Purging Ended** 17:05

| Time | Purge Volume (ml) | pH | Temp (°C) | Conduct. (µS) | D.O. (mg/L) | ORP (mV) | Turb (NT) | Depth to water (ft) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| 16:30 | Start | | | | | | | 16.50 | |
| 16:35 | 0 | 7.48 | 21.6 | 237 | 0.81 | -376 | 35.8 | > 16.60 | |
| 16:40 | 100 | 7.69 | 23.7 | 240 | 0.47 | -310 | 20.7 | > 16.60 | |
| 16:45 | 150 | 7.75 | 25.5 | 241 | 0.44 | -384 | 17.3 | > 16.60 | |
| 16:50 | 210 | 7.83 | 26.6 | 241 | 0.45 | -364 | 13.2 | > 16.60 | |
| 16:55 | 285 | 7.95 | 26.9 | 240 | 0.44 | -377 | 11.5 | > 16.60 | |
| 17:00 | 335 | 8.01 | 27.1 | 239 | 0.38 | -355 | 11.1 | > 16.60 | |
| 17:05 | 385 | 8.04 | 27.5 | 239 | 0.63 | -369 | 11.5 | > 16.60 | |
| | | | | | | | | | No water production |
| 17:15 | | | | | | | | 17.88 | Post pumping |
| | | | | | | | | | |
| 8/2/2012 | | | | | | | | | |
| 9:05 | | | | | | | | 17.69 | Minimal water retrival via baller |

# APPENDIX N

# BADIN LAKE GROUNDWATER HYDROGRAPHS

# REFERENCE 16

Little Mountain Creek ALCOA leachate: Water Chemistry, Fish and Macroinvertebrate Assessment

Mary Matthews

Environmental Toxicology BIO3542-101/5542-101
6 May 2015
In Collaboration with
Will Scott, Yadkin Riverkeeper Inc.
Shea Tuberty, Appalachian State University
Ryke Longest, Duke University Environmental Law Clinic
Brandon Tate, Appalachian State University
Macy Hinson, Local

AI have not violated the Appalachian State University Academic Integrity Code.@

Mary Matthews

## ABSTRACT

The generation of waste and hazardous material from ALCOA smelting operations has presented a public concern for both the human and environmental health in the Badin community. This concern has been heighted after testing at Badin Lake and Little Mountain Creek revealed heightened levels of cyanide, fluoride, PCBs, and PAHs. An attempt to further investigate the contaminants in Little Mountain Creek was conducted by analyzing water, fish, and sediment samples using IC, ICP-OES, reflux distillation, and GC. Indication of water quality was also analyzed by performing water chemistry tests, and fish and macroinvertebrate IBIs. The levels obtained were compared to both documented criteria and 2014 sampling data. The results revealed elevated levels of fluoride, Pb, cyanide, and PCB throughout three different sites along the creek; however, the stream analysis did not indicate ecological disturbances. Based on the current environmental conditions and levels of contaminants, it was concluded that there is potential for chronic effects due to leachate draining into Little Mountain Creek. The conclusions factored in both previous records and new data on contaminates. At this time, there is not enough data to warrant large scale remediation, but routine monitoring of the elevated contaminants is needed.

## INTRODUCTION

The town of Badin, NC was founded around the aluminum smelting operations of the Aluminum Company of America (ALCOA) (Yadkin Riverkeeper, 2015). The process of smelting requires large amounts of energy in order to dissolve alumina in molten cryolite (Calkins, 2008). The operation results in the extraction of aluminum, but also an immense amount of waste from bauxite residue and spent pot lining (SPL) (Calkins, 2008). To make the process economically feasible, ALCOA utilized hydro-electric power from the Narrows Dam on the Yadkin River and created landfill sites for waste management (ALCOA, 2015). Unfortunately, the waste products present environmental hazards as trace metals are reported in bauxite residue, and fluoride and cyanide are found in the SPL (Calkins, 2008).

The ALCOA smelting operation was ceased in 2007; however the company is currently facing lawsuit by the state of North Carolina over ownership of the riverbed (Yadkin Riverkeeper, 2015). Dispute has been fueled by ALCOA's own economic interest in the power generated by the Narrows Dam, and their "legacy" of environmental pollution (Yadkin Riverkeeper, 2015). In 2013, the state revoked ALCOA's water quality certification required for relicensing of the dam, and in 2014 EPA involvement was initiated to assess potential Superfund allocation for cleanup of the ALCOA smelter site (Yadkin Riverkeeper, 2015). Previous reports on the area have indicated high levels of cyanide, fluoride, PCBs, and PAHs generated by waste pipes leading into Badin Lake and Little Mountain Creek (Yadkin Riverkeeper, 2015).

In an effort to prevent ALOCA's riverbed ownership, and to restore the environmental conditions that may have been impacted by the smelting operations, assessment of the ecological risks is necessary. The purpose of this experiment was to determine the environmental hazards, if any, of the leachate draining from the ALCOA-Badin landfill into Little Mountain Creek using water quality assessments, ICP-OES, IC, reflux distillation, and gas chromatography. Based on the previous history of cyanide, fluoride, and PCB in the area, it was expected that elevated levels of contaminants would be found at the sites.

## MATERIALS AND METHODS

### *Field Sampling*

On-site sampling was conducted on April 11, 2015 at three locations along the portion of Little Mountain Creek adjacent to the Alcoa-Badin Landfill. The downstream site 1 (3.40068'N, 80.12323’W), constructed drainage ditch site 2 (35.40154’N, 80.12444’N), landfill box site 2 (35.40168’ N, 80.12433’W), seep pool site 2 (35.40171’N, 80.12430’W), pbc well site 2 (35.40199’N, 80.12392’W), and upstream reference site 3 (35.40321N’, 80.12767’W) were measured for water quality; sediment and water samples were also collected for testing and analysis. Additional fish and macroinvertebrate samples were collected up- and down-stream at site 1 and 3.

The water quality was measured at all three sites for turbidity, conductivity, dissolved oxygen, temperature, and pH using a calibrated multiparameter meter. Water samples were collected by submerging the mouth of a sample bottle at the water surface to avoid sediment contamination. The bottle was filled, capped, and stored in a cooler for further analysis.

Soil samples were obtained by scooping the finest grained sediments/silt into Whirl-Pak collection bags, and stored in a cooler for further use. The area collected was free of vegetation and sediment disturbances.

Fish data was obtained using NC Standard Operating Procedure for Stream Fish Community Assessment (Division of Water Quality Environmental Sciences, 2001). A battery powered shocking unit set to 350 V was used for a total of 1750 seconds for 100m at each site. A total of 15 species were found at both site 1 and 3. Site 1 and site 3 had a total of 115 and 153 individuals, respectively. Large (TW: 109.4 g) and small (TW: 61.0 g) Lepomis auritis from site 1 were stored. Large (TW: 105.6 g) Lepomis auritis and small (TW:68.7 g) Lepomis gibbosus from site 3 were stored for fish analysis.

Macroinvertebrate data was obtained in accordance to the NC Standard Operating Procedures for Benthic Macroinvertebrates (Division of Water Quality Environmental Sciences, 2006).

*Data Analysis*

Collected water and sediment samples from site 1, site 2 (constructed drainage ditch, seep pool) and site 3 were prepared and analyzed using EPA Standard Operating Procedure 3015 (water) and 3051 (sediment) for ICP-OES. The 3051 method was also used for the fish collected at site 1 and 3. The samples were tested for Al, As, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Se, and Zn.

Water samples from each site were prepared and analyzed using IC according to the EPA Determination of Inorganic Anions in Water by Ion Chromatography Method 300.0 (Environmental Monitoring Systems Laboratory). The samples were tested for $Cl^-$, $NO_3^-$, $SO_4^{-2}$, and $F^-$. In addition, water and sediment samples from each site were sent to CompuChem for cyanide testing using a reflux-distillation in accordance to EPA analytical parameters 9010C and 9012B for water and soil (EPA, 2004).

Samples of the fish and sediments (provided there was enough collected for both cyanide and PCBs) were tested for PCB by ComuChem using gas chromatography in accordance to the EPA analytical parameter GC-8082A.

The collections of macroinvertebrates were keyed to family, and fish were identified by species. Assessment and rating of biological composition was performed using the NC Indices of Biotic Integrity (NCIBI) for benthic macroinvertebrates and fish (Division of Water Quality Environmental Sciences 2006, 2001). Insect IBI scores were corrected (+0.2) for spring collections and then the stream classified by the Piedmont bioregion criteria (<5.19 = excellent).

## RESULTS

Water chemistry analysis reveal fairly consistent results, with few exceptions in conductivity, dissolved oxygen, and turbidity (Table 1). The highest conductivity was recorded at the drainage ditch flowing into the drain field at 897.3 µS/cm. The conductivity at the ditch, seep pool (425.1 µS/cm), and PBC well (744 µS/cm) show a notable elevation from the 109.5 µS/cm (drain field) and 115.6 µS/cm (Site 1) recorded in the actual creek. The temperature was lowest at the PBC well at site 2, 16.6°C, and highest at the seep pool at site 2, 22.7°C. Dissolved oxygen values were considerably depleted at the seep pool (0.86 mg/L) and PBC well (4.6 mg/L). The pH remained nearly neutral at all sites ranging from 6.98 (seep pool) - 8.03 (downstream). Turbidity was low at all sites, and lowest at site 2 (4.50 NTU).

Table 1. Water chemistry testing for conductivity, temperature, pH, dissolved oxygen, and turbidity at testing sites along LMC.

| | Downstream Site 1 | Drainage Ditch Site 2 | Drain Field Site 2 | Seep Pool Site 2 | PBC Well Site 2 | Upstream Site 3 |
|---|---|---|---|---|---|---|
| Conductivity (µS/cm) | 115.6 | 897.3 | 109.5 | 425.1 | 744 | 108.9 |
| Temperature (°C) | 19.5 | 21 | 21.5 | 22.7 | 16.6 | 22.0 |
| Dissolved Oxygen (mg/L) | 9.63 | 11.66 | 9.42 | 0.86 | 4.6 | 9.19 |
| pH | 8.03 | 7.68 | 7.89 | 6.98 | 7.5 | 7.99 |
| Turbidity (NTU) | 5.75 | N/A | 4.50 | N/A | N/A | 6.5 |

The macroinvertebrate IBI ratings demonstrate consistency in Excellent scores between the 2014 and 2015 sampling years (Table 2). A modest increase in the overall IBI value for both 2015 sites was revealed from the collection data.

Table 2. Macroinvertebrate NCIBI ratings and comparison for site 1 and 3 between 2014 and 2015 data.

| | **Upstream Site 3 2014** | **Upstream Site 3 2015** | **Downstream Site 1 2014** | **Downstream Site 1 2015** |
|---|---|---|---|---|
| Total Number | 200 | 156 | 113 | 105 |
| Richness | 22 | 16 | 22 | 16 |
| SUM of Relative Abundance Scores | 95 | 83 | 61 | 81 |
| Overall BI Value | 3.25 | 3.49 | 3.34 | 4.24 |

| | | | | | |
|---|---|---|---|---|---|
| BI Rating | | **Excellent** | **Excellent** | **Excellent** | **Excellent** |

The number of individuals and families represented in the 2015 collections also decreased from the previous year (reduced by 6 families).

The fish collection, scored using the NCIBI criteria for the Yadkin River drainage, revealed consistent results at the upstream site between 2014 and 2015, and slight improvement at the downstream site (Table 3). The difference in results at the downstream site was attributed to an increase in score for number of species found, number of darters, number of intolerant species, percent piscivorous and percent diseased. The 2014 downstream site did score higher than 2015 in the percent omnivorous and herbivorous.

Table 3. Fish NCIBI scores and comparison for site 1 and 3 between 2014 and 2015 data.

| Metric # | Metric Criteria | Upstream Site 1 2014 | Upstream Site 1 2015 | Downstream Site 2 2014 | Downstream Site 2 2015 |
|---|---|---|---|---|---|
| 1 | # of Species | 5 | 5 | 3 | 5 |
| 2 | # of Fish | 5 | 5 | 3 | 3 |
| 3 | # of Darter Species | 5 | 5 | 1 | 5 |
| 4 | # of Sunfish | 5 | 5 | 5 | 3 |
| 5 | # of Suckers | 5 | 5 | 5 | 5 |
| 6 | # of Intolerant Species | 1 | 1 | 1 | 5 |
| 7 | % Tolerant | 3 | 3 | 1 | 1 |
| 8 | % Omnivorous and Herbivorous | 1 | 1 | 5 | 1 |
| 9 | % Insectivorous | 1 | 1 | 5 | 5 |
| 10 | % Piscivorous | 1 | 1 | 1 | 3 |
| 11 | % Diseased | 5 | 5 | 1 | 3 |

| | | | | | |
|---|---|---|---|---|---|
| 12 | % Multiple Age groups | 5 | 5 | 5 | 5 |
| | Total: | 42 | 42 | 36 | 44 |
| | Integrity Classification: | Good-Fair (42 to 46) | Good-Fair (42 to 46) | Fair (36 to 40) | Good-Fair (42 to 46) |

The levels for all anions were elevated at site 2 compared to site 1 and 3 (Table 4 and Figure 1). Levels of fluoride were the only values documented above the criteria level at the drainage ditch and seep pool at site 2 and the upstream reference (yellow). Although there was no criteria listing for sulfate, the level at the drainage ditch was considerably higher than the other samples.

Table 4. The mean IC results for chloride, fluoride, nitrate, and sulfate from water samples at all three sites in comparison to the NC water quality criteria.

| | NC Water Quality Criteria (ppm) | Downstream Site 1 (ppm) | Drainage Ditch Site 2 (ppm) | Seep Pool Site 2 (ppm) | Upstream Site 3 (ppm) |
|---|---|---|---|---|---|
| Chloride | 230 | 8.41 ±0.91 | 13.48 ±0.56 | 24.80 ±0.25 | 8.87 ±0.88 |
| Fluoride | 1.8 | 0.45 ±1.15 | 9.75 ±0.56 | 5.00 ±0.87 | 3.86 ±1.07 |
| Nitrate | 10.0 | 0.61 ±2.31 | 2.11 ±2.24 | 0.37 ±2.19 | 0.63 ±2.30 |
| Sulfate | Limited Data | 9.48 ±1.37 | 79.52 ±2.21 | 6.23 ±1.54 | 9.38 ±1.38 |

Criteria obtained from EPA, 2007.

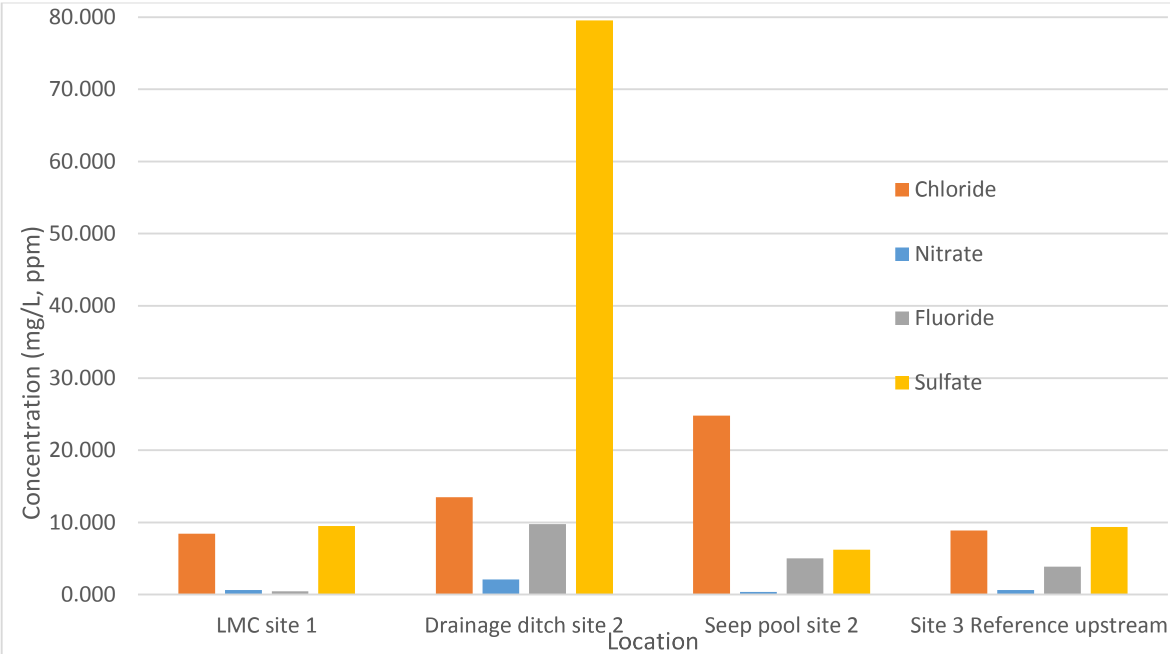



Figure 1. IC of water samples upstream, downstream, and at the drainage site. It can be seen that site 2 has elevated levels of all anions, particularly chloride, sulfate, and fluoride in comparison to site 1 and 3. The upstream and downstream site have comparable levels, with the exception of fluoride, which is higher at the upstream site.

Elevated levels of fluoride from the IC are fairly consistent with data from the previous year, with the exception of considerably elevated levels at the upstream site (Figure 2). There were decreases in the 2015 levels (orange) of fluoride at comparable 2014 (blue) site 2 locations; however, these levels were still sustained above the EPA freshwater criteria.  Downstream levels from both years were well below criteria.

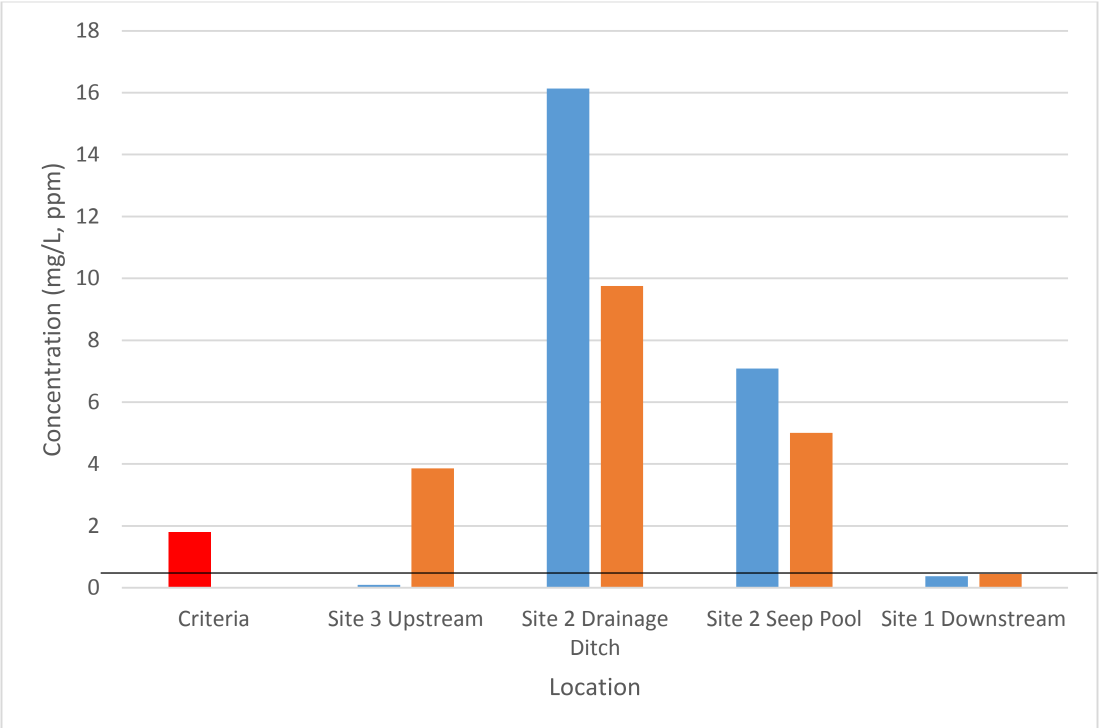



Figure 2. IC values for fluoride in 2014 and 2015 in comparison to the EPA freshwater criteria. The 2014 data (blue) has consistent values with the 2015 data (orange), with the exception of highly elevated levels at the upstream site. Both samples from site 2 and site 3 in 2015 show fluoride above the EPA criteria for freshwater quality. The drainage ditch demonstrates the most notable levels, showing nearly a three-fold difference from the standard.

ICP results reveal elevated levels of Al, Fe, Pb, Se, and Zn in comparison to the EPA aquatic life criteria (yellow) (Table 5). High levels of Al were found in all four samples, and the highest values reside in the drainage ditch (0.42648 ppm) and seep pool (1.12084 ppm) samples. Considerably high levels of Fe were observed at 10.2634 ppm in the seep pool, a value ten-fold higher than the criteria level. Elevated levels Pb were noted across all four samples. The highest level of 0.25956 ppm was represented at the downstream site, and was over 100 times that of the advised criteria. Se was below detection limit (BDL) for most samples, with the exception of a criteria (0.005) exceeding value of 0.00906 ppm at the seep pool. Levels of Zn were consistently below criteria (0.12 ppm) for all samples except for the upstream reference at 0.19147 ppm.

Table 5. Water sample ICP results for Al, As, Cd, Fe, Pb, Se, and Zn at all three sites in comparison to the EPA aquatic life criteria.

| | EPA Aquatic Life Criteria (ppm) | Downstream Site 1 (ppm) | Drainage Ditch Site 2 (ppm) | Seep Pool Site 2 (ppm) | Upstream Site 3 (ppm) |
|---|---|---|---|---|---|
| As | 0.15 | 0.00372 | BDL | 0.00913 | BDL |
| Cd | 0.00025 | 0.00026 | BDL | 0.00022 | 0.00008 |
| Fe | 1 | 0.65019 | 0.66505 | 10.2634 | 0.72223 |
| Pb | 0.0025 | 0.25956 | 0.00713 | 0.01995 | 0.00480 |
| Se | 0.005 | BDL | BDL | 0.00906 | BDL |
| Zn | 0.12 | 0.07131 | 0.06752 | 0.11670 | 0.19147 |

Criteria obtained from EPA, 2014.

The ICP levels for Pb and Se in the water samples were of particular concern and therefore compared to levels of the previous year (Figure 4 and Figure 5). Both Pb and Se from 2014 (blue) were above criteria level in all detectable samples. Other than the cracked pipe sample from 2014, the 2015 data (orange) displays an increase or consistent level of Pb. The downstream and seep pool were substantially higher than their LMC below and test box counterparts. The presence of elevated Pb in the upstream reference in 2015 is also significant as the 2014 levels were undetermined.

The 2015 data for Se demonstrates only one detectable limit above criteria at the seep pool. The concentration decreased in comparison to the previous year data at all detectable sites. Though there is a decrease, the 2015 level is still nearly double that of criteria value.

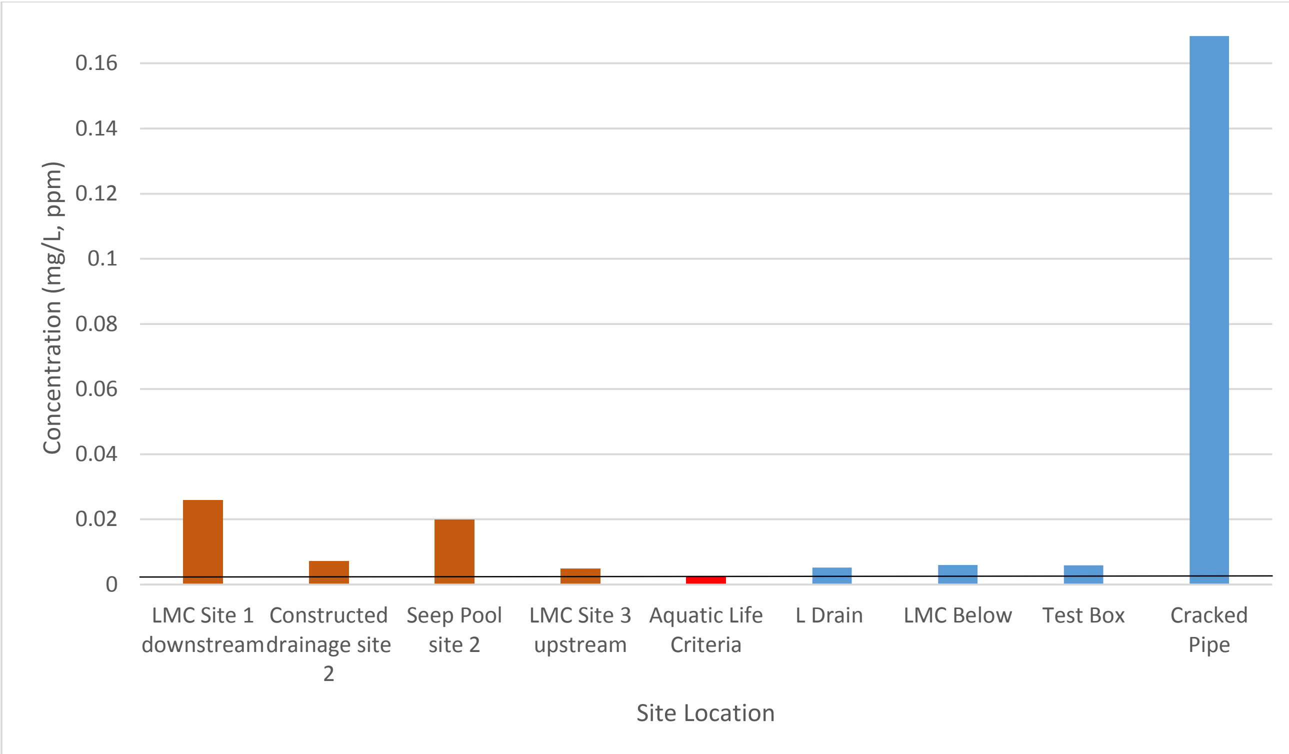



Figure 4. ICP for Pb in 2014 and 2015 in comparison to EPA aquatic life criteria. The 2015 data (orange) demonstrates consistently elevated levels from 2014 (blue). Levels at all sites were over the advised freshwater criteria levels, and the greatest elevation was drawn at- and down- stream of the site.

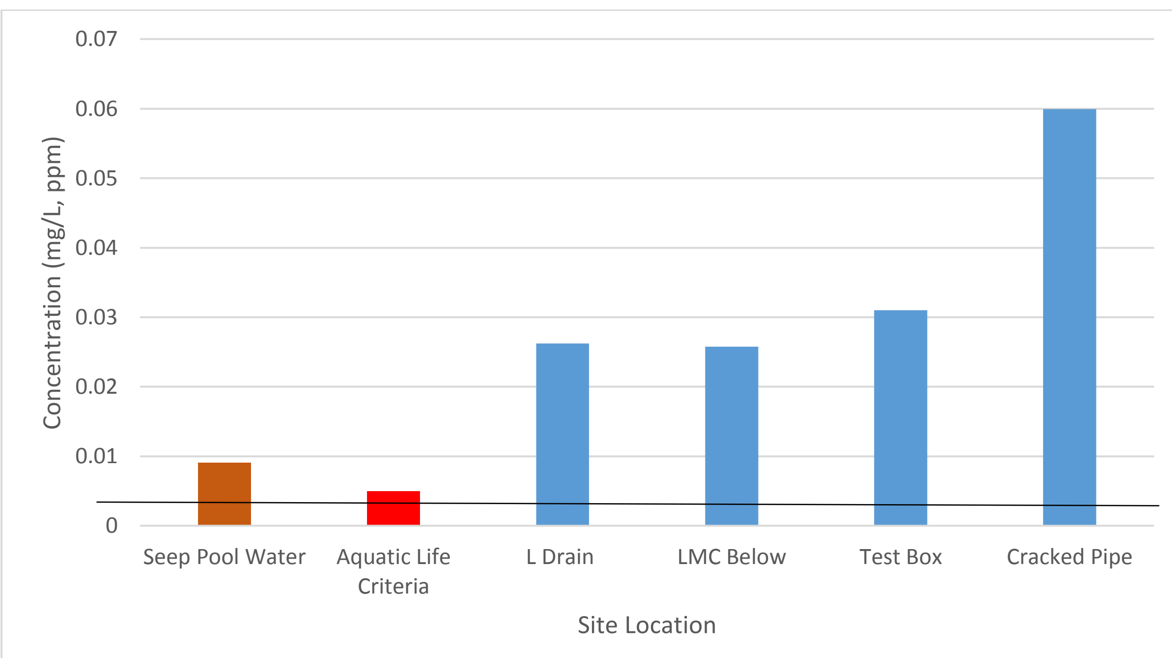


Figure 5. ICP for Se in 2014 and 2015 in comparison to the EPA aquatic life criteria. Only one sample from site 2 in 2015 (orange) had measurable levels which were almost double the EPA advised criteria. In comparison to the 2014 data (blue), there was a notable decrease in Se.

Sediment sample ICP analysis did not detect levels for As, Cd, Pb, Se, and Zn above EPA freshwater sediment criteria benchmarks (Table 6 and Figure 6). The levels were fairly consistent between the two sites, with the exception of Pb; which was slightly higher downstream.

Table 6. Sediment sample ICP results for As, Cd, Fe, Pb, Se, and Zn at site 1 and site 3 in comparison to EPA sediment benchmarks.

| | EPA Freshwater Sediment Benchmarks (ppm) | Downstream Site 1 (ppm) | Upstream Site 3 (ppm) |
|---|---|---|---|
| As | 9.8 | 6.19800 | 5.71941 |
| Cd | 0.99 | 0.44860 | 0.52152 |
| Pb | 35.8 | 23.6836 | 15.7931 |
| Se | 2 | 0.28515 | 1.09705 |
| Zn | 121 | 85.2427 | 88.9298 |

Criteria obtained from EPA 2014[1]

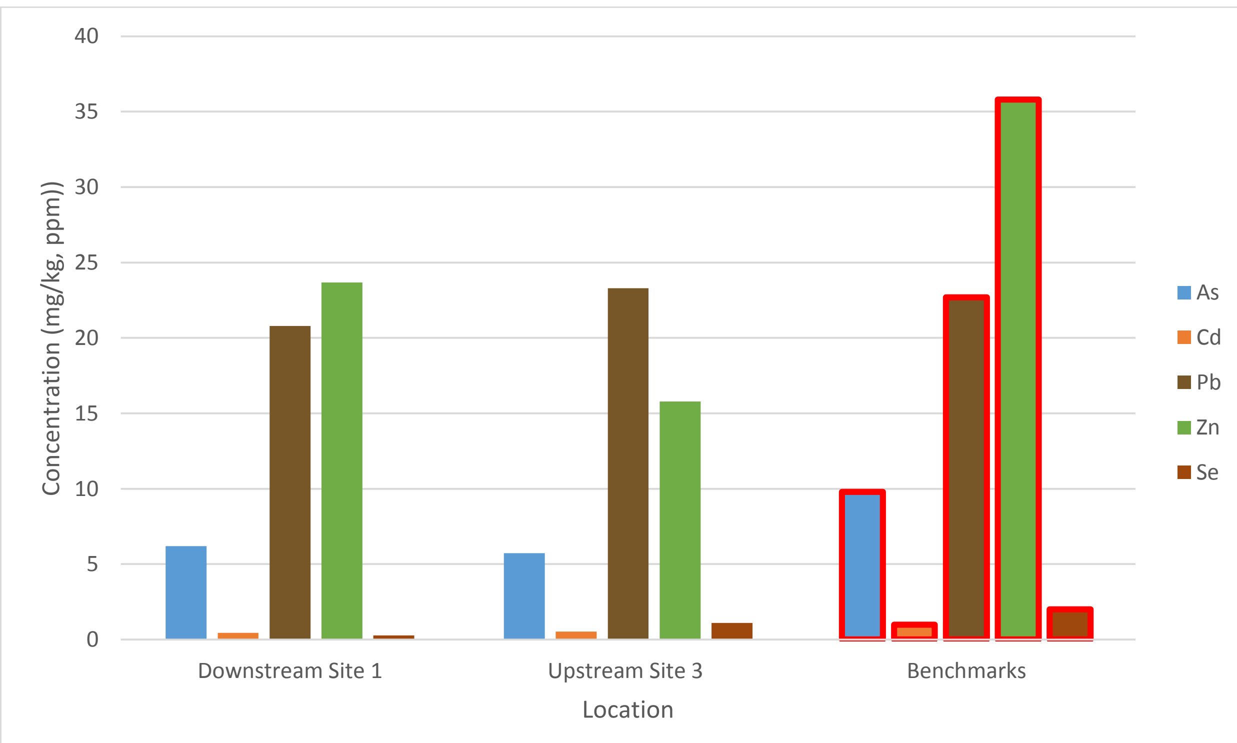



Figure 6. ICP for upstream and downstream sediment samples in comparison to the EPA freshwater sediment criteria (outlined in red). There are no profound levels demonstrated at either sample site; however, Ni and Pb are near criteria limits.

ICP analysis of *L. auritis* and *L. gibbosus* (site 3b) samples upstream and downstream for As, Cd, Pb, Se, and Zn (Table 7). Detected levels were compared to literature values of similar freshwater species demonstrated to impact survival and reproduction. Pb and Zn were indicated to have elevated levels in all samples based on experimentation with *S. fontinalis*. Both Pb and Zn literature concentrations were known to decrease reproductive success. Cd was slightly elevated at site 1a (0.8163 ppm) in comparison to literature on L. marcrochirus- shown to reduce survival at concentrations of 0.35 ppm.

Table 7. Fish sample ICP results for As, Cd, Pb, Se, and Zn at site 1 and site 2 in comparison to known literature concentrations for similar freshwater species.

| | Literature Effect Concentrations (ppm) | Downstream Site 1a *L. auritis* (ppm) | Downstream Site 1b *L. auritis* (ppm) | Upstream Site 3a *L. auritis* (ppm) | Upstream Site 3b *L. gibbosus* (ppm) | Comment |
|---|---|---|---|---|---|---|
| As | 6.7 | 0.8301 | 0.2632 | 0.5676 | 0.5676 | Sodium Arsenate *Lepomis Cyanellus* 5d. Survival reduced death. Whole body. |
| Cd | 0.35 | 0.8163 | 0.2246 | 0.1371 | 0.0471 | $CdSO_4$ *Lepomis macrochirus* 180d. Reduced survival. No growth effect. Whole body. |
| Pb | 0.4 | 3.5551 | 6.6799 | 4.8634 | 7.5551 | Lead Nitrate *Salvelinus frontinalis* 60d. Reproduction reduced. Whole body. |
| Se | 6.49 | 2.1560 | 3.0424 | 2.1405 | 3.0467 | Inorganic Se *L. macrochirus* 44d. Survival reduced 75%. Skeletal muscle. |
| Zn | 76.9 | 102.22 | 116.97 | 103.64 | 87.820 | Zinc Sulfate *S. fontinalis* 140d. |

| | |
|---|---|
| | Reproduction reduced. Gill tissue. |

Criteria obtained from Jarvinen & Ankley 1999.

The elevated levels of Pb across all four samples in the fish sample ICP were compared to the literature criteria previously stated, and similar data from the 2014 collection (Figure 8). The 2015 Pb concentrations (orange) are significantly higher than that of both the criteria and previous collection (blue).

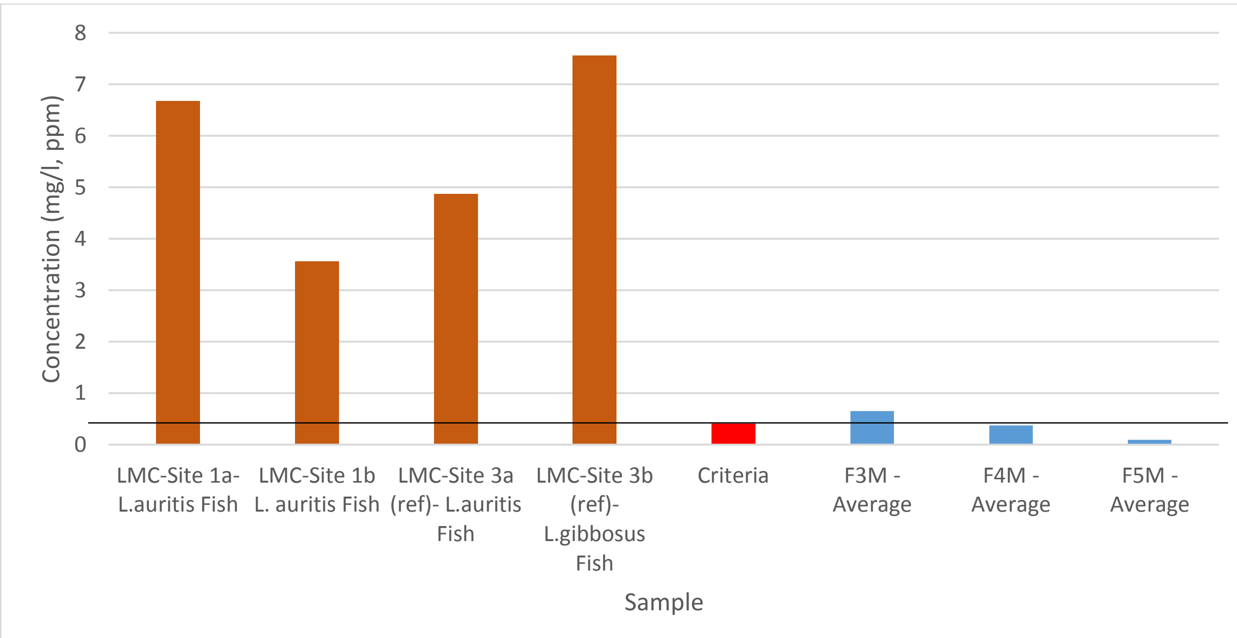



Figure 7. ICP for Pb in fish samples from 2014 and 2015 in comparison to levels documented in *Salvelinus fontinalis* (Brook Trout) to have reproductive effects. The 2015 data (orange) indicates levels of Pb much higher than both the criteria indicated and the 2014 data (blue).

After reflex distillation, cyanide levels were detected in the drainage ditch and seep pool and compared to EPA aquatic life criteria for both acute and chronic levels (Table 8 and Figure 8). Both sites indicated levels more than double that of the chronic criteria. The drainage ditch, 22.6 ppm, is also shown to be considered acute levels (22 ppm).

Table 8. Cyanide levels from water samples at the drainage ditch and seep pool at site 2 in comparison to the EPA aquatic life criteria.

| | EPA Aquatic Life Criteria | Drainage Ditch Site 2 | Seep Pool Site 2 |
|---|---|---|---|

| | Acute/Chronic (ppm) | (ppm) | (ppm) |
|---|---|---|---|
| Cyanide | 22/5.2 | 22.6 | 11 |

Criteria obtained from EPA, 2014[1].

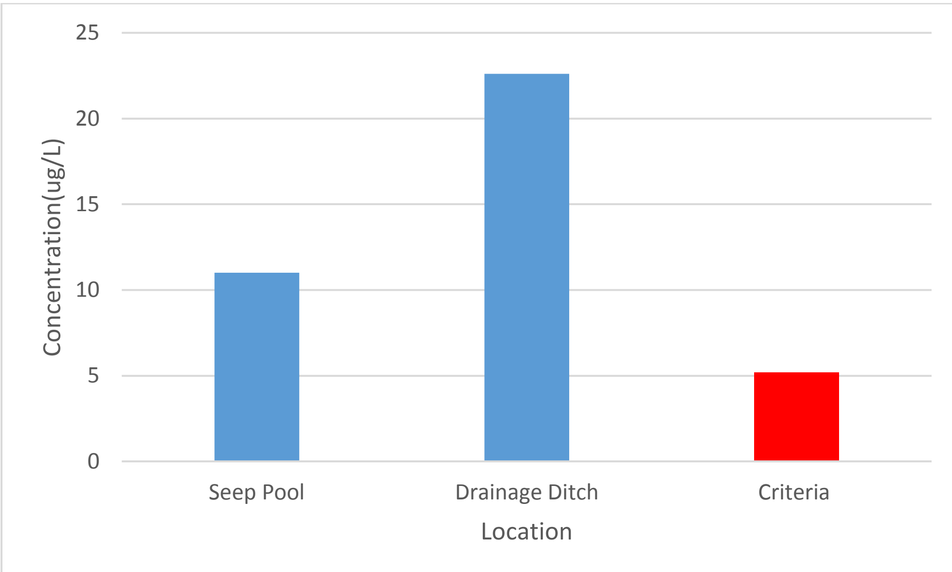



Figure 8. Measurable cyanide levels from the reflux-distillation of water the samples in comparison to EPA freshwater criteria. Both of the detected levels of cyanide were collected at site 2, and are at levels nearly 2-3 times greater than the advised standard.

Results of the reflex distillation for cyanide in the sediment samples revealed three detectable levels at site 1, site 2 (drainage ditch), and site 3 (Table 9). Site 1, 0.227 ppm, and site 3, 0.297 ppm, are slightly above criteria (0.1 ppm). The drainage ditch at site 2, 1.81 ppm, demonstrates a considerably larger difference from site 1 and site 3, and is about 18 times greater than the EPA benchmark criteria. A visual representation of this difference is shown in Figure 9.

Table 9. Cyanide levels from sediment samples at site 1, site 2 (drainage ditch), and site 3 in comparison to EPA freshwater sediment benchmark level.

| | EPA Freshwater Sediment Benchmark (ppm) | Downstream Site 1 (ppm) | Drainage Ditch Site 2 | Upstream Site 3 |
|---|---|---|---|---|
| Cyanide | 0.1 | 0.227 | 1.81 | 0.297 |

Criteria obtained from EPA, 2014[2].

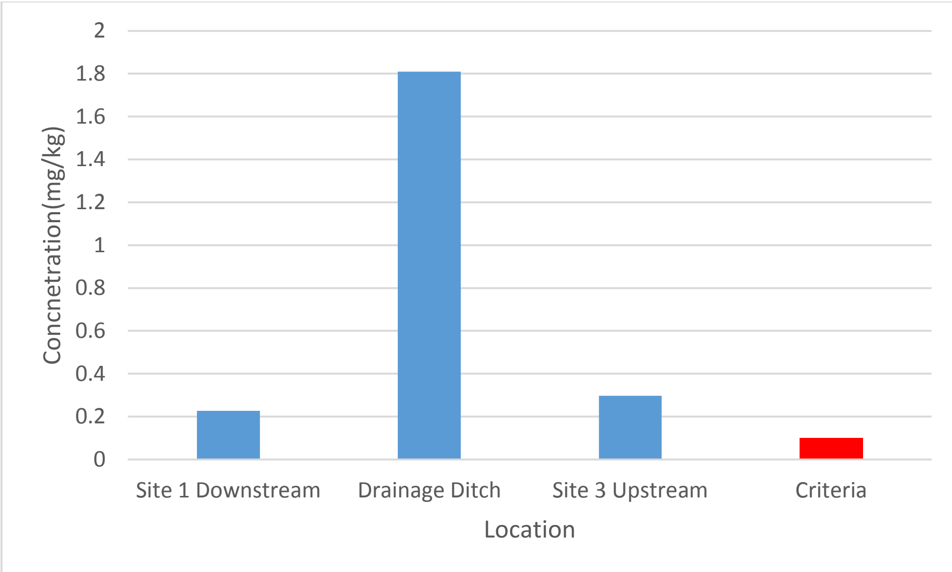



Figure 9. Measureable cyanide levels from the reflux-distillation of soil samples in comparison to EPA freshwater sediment criteria. All three of the sites demonstrate levels above the advised standard, and the most notable levels were presented at site 2.

The GC results of the fish samples for PCB indicated elevated levels of Aroclor-1248 (Table 10). The detected value of 0.34 ppm in the downstream 1a *L. auritus* is over 1.5 times greater than that of the EPA screening value (Figure 10). The screening value is defined as the concentration of PCB in fish tissue that is of potential public health concern.

Table 10. PBC levels detected in *L. auritus* at the downstream site 1A in comparison to the EPA screening value for recreational fishers.

| | EPA Screening Value for Recreational Fishers (ppm) | Downstream Site 1A *L. auritus* (ppm) |
|---|---|---|
| PCB | 0.2 | 0.34 |

Criteria obtained from EPA, 2000.

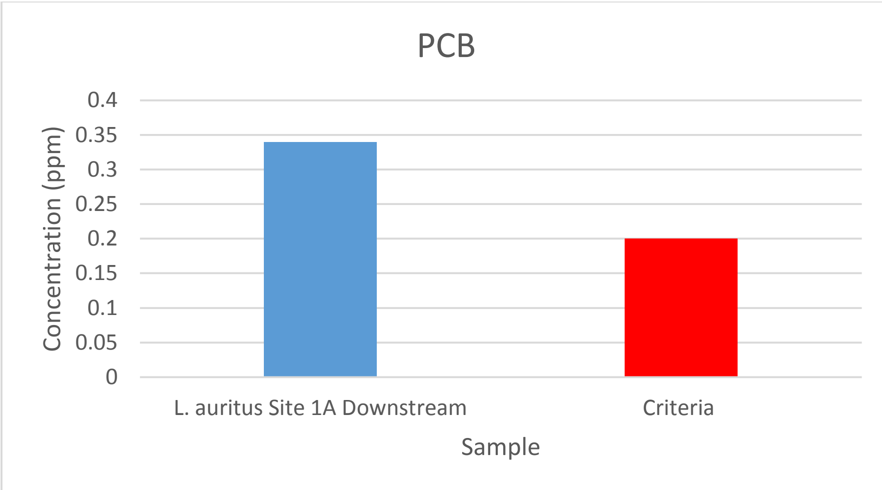



Figure 10. Measurable levels of PCB in fish samples from the gas chromatography in comparison to the EPA screening value for recreational fishers. There is a significant amount of PCBs documented in the fish at the downstream site compared to the advised standard.

## DISCUSSION

Based on the results from the water chemistry and NCIBI for both macroinvertebrates and fish, there is no indication of serious environmental disturbance due to the landfill. Although the elevated conductivity at the drainage ditch compared to site 1, 2 (drain field), and 3 is an indicator of wastewater entrance into the creek, the low turbidity of the water suggests that excessive waste discharge is not causing drastic changes in the water quality. This is supported by the macroinvertebrate and fish IBI as both upstream and downstream collections indicated good-fair to excellent biotic conditions. The decreases in macroinvertibrate total number and family diversity between the 2014 and 2015 data are minor and can be explained by a multitude of factors, such as differences in collection data and time. The fish collection also does not indicate immediate environmental stress as an increase in darter species was observed compared to 2014, in addition to an increase in total species and total number of fish collected.

Although the water quality indicators do not present an immediate environmental threat, the heavy metal, anion, cyanide, and PCB results demonstrate the potential for chronic impacts in the area. Elevated levels of fluoride, Pb, cyanide, and PCBs are of particular importance.

Selenium levels have been documented above criteria in both 2014 and 2015; however, the low detection limits in the creek water as opposed to the stagnant seep pool are not as concerning to the area.

Fluoride levels in the water have been a concern from past testing and are well-over the advised criteria, especially at the drainage ditch flowing directly from the landfill. Levels above criteria were also observed upstream, rather than downstream, which puts into question the point of entry. Fluoride presents a concern to aquatic life as it has the ability to accumulate in the exoskeletons and bone tissue in organisms, inhibiting enzyme activity and altering protein synthesis (Camargo, 2003). The elevated fluoride may be an indication of leachate contamination from the waste sites, as it is a major contaminant in the spent pot lining produced by the smelting operations.

Lead is also an element of concern as levels above criteria were found in both water and fish samples. Elevated levels were also indicated in the soil samples; however these did not exceed the criteria. Lead has no useful function to organisms, and tends to accumulate in the gills, liver, kidney, and bone of fish (Casas & Sordo, 2011). In humans, lead has been implicated with the disruption of $Ca^{2+}$ metabolism, a vital substance for neurological function (Casas & Sordo, 2011). Excessive levels of lead can be an implication of leachate contamination from the plant as smelting produces large amounts of bauxite residue containing trace metals such as Pb.

Cyanide was documented to be elevated in both water and sediment. The levels in the water reached both acute and chronic criteria, which is a concern as cyanide readily evaporates from surface waters (Division of Toxicology and Environmental Medicine Applied Toxicology Branch). In a study by *Dixon & Leduc*, the growth and metabolic rate of juvenile rainbow trout (*Salmo gairdneri*) were shown to be impacted by chronic cyanide toxicity. Persistent levels of cyanide may be traceable to ALCOA's smelting operations as it is also largely found in the spent pot lining waste product.

PCBs have been a past issue with ALCOA as toxic levels were found to be of grave concern for the environment surrounding Badin Lake. The levels were found to be high enough that both capping and sediment removal was warranted for remediation, and a fish consumption advisory was displayed. The high level of PCB found in the fish tissue downstream indicates that this may also be of concern for LMC. PCBs have a high level of accumulation and have been documented to have hepatic, gastrointestinal, endocrine, immune, neurological, and reproductive effects in animal studies (EPA, 1999).

## CONCLUSION

Due to the elevated levels of fluoride, Pb, cyanide, and PCB contaminants associated with ALCOA's smelting operations, it is possible that the production waste housed in the ALCOA-Badin landfill, and other hazardous waste sites, is discharging harmful leachate in the waterway. This is supported by the concentrations found elevated at site 2 in comparison to 1 and 3, suggesting the landfill is a major source. The small number of samples presenting detectable levels, such as cyanide and PCB, indicate that more testing must be conducted to accurately measure toxic risk. In moving forward, it is suggested that routine monitoring of the elevated levels is directed to further assess the ecological impacts.

## REFERENCES

ALCOA. 2015. Alcoa-Yadkin History. ALCOA Power Generating Inc. <https://www.alcoa.com/yadkin/en/info_page/history.asp>. Accessed 29 April 2015.

Camargo, J.A. (2003). Fluoride toxicity to aquatic organisms: a review. Chemosphere; 50(3): 251-64.

Calkins, M. 2008. Materials for Sustainable Sites. Hoboken, NJ: John Wiley & Sons. p. 338.

Casas, J.S. and Sordo, J. (2011). Lead: chemistry, analytical aspects, environmental impacts and health effects. Elsevier. Oxford, UK; p. 167-179.

Division of Water Quality Environmental Sciences. (2006). Standard Operating Procedure for Benthic Macroinvertebrates. NCDENR; p. 1-42.

Division of Toxicology and Environmental Medicine Applied Toxicology Branch. (2006). ToxGuide for Cyanide. U.S. Department of Health and Human Services.

Division of Water Quality Environmental Sciences. (2001). Standard Operating Procedure Biological Monitoring: Stream Fish Community Assessment and Fish Tissue. NCDENR; p. 1-33.

Dixon, D. G. and Leduc, G. (1981). Chronic cyanide poisoning of rainbow trout and its effects on growth, respiration, and liver histopathology. Archives of Environmental Contamination and Toxicology; 10(1): 117-131.

Environmental Monitoring Systems Laboratory. (1993). Determination of Inorganic Anions By Ion Chromatography. U.S. EPA; p. 1-28.

EPA. 2014. National Recommended Water Quality Criteria. <http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm>. Accessed 2015 May 3.

EPA. 2014 Dec 1. Ecological Risk Assessment: Freshwater Sediment Screening Benchmarks. <http://www.epa.gov/reg3hscd/risk/eco/btag/sbv/fwsed/screenbench.htm#notes>. Accessed 2015 May 3.

EPA. (2007). Standard and Priority Pollutants Designated Uses Criteria. U.S. EPA; p. 1-13.

EPA. (2004). Total and Amenable Cyanide: Distillation. EPA; p. 1-10.

EPA. (2004). Total and Amenable Cyanide (Automated Colorimetric, With Off-Line Distillation). EPA; p. 1-13.

EPA. 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. U.S. EPA; 2: p. 1-383.

EPA. (1999). Polychlorinated Biphenyls (PCBs) Update: Impact on Fish Advisories. U.S. EPA; p. 1-7.

Jarvinen A.W. and Ankley G.T. Linkage of Effects to Tissue Residues: Development of a Comprehensive Database for Aquatic Orgranisms Exposed to Inorganic and Organic Chemicals. 1999. Pensacola, FL: SETAC.

Yadkin Riverkeeper. 2015. Yadkin Riverkeeper home page. <http://yadkinriverkeeper.org/>. Accessed 6 May 2015.

# REFERENCE 17

## Parker, Stuart

**From:** Shea Tuberty <tubertysr@appstate.edu>
**Sent:** Tuesday, May 05, 2015 7:30 PM
**To:** Parker, Stuart
**Subject:** Badin - Little Mountain Creek sampling
**Attachments:** List of Little Mountain Creek sampling sites in Badin.docx

Stuart,
Sorry I didn't get back to my office until after 5pm today. I'd like you to call me on my cell 828-263-2443 Wed morning if you have a moment and we can get squared away. I'm also attaching a word file with some info on the sites we sampled. The access to LMC is off Highway 740. You can jump down the bank and head upstream to our site one very easily. It is about a 100m or so walk upstream to LMC site 2 and then another 200-300meters to the upstream reference, LMC3.

Shea

--
Shea Tuberty, PhD
Associate Professor of Biology
Aquatic Ecotoxicology Lab
Appalachian State University ,
Boone, NC 28608 , <'(((=<
828-262-6857 (W) , <'(((=< ,
828-263-2443 (C) <'(((=< <'(((=<
Boone, NC 28608

**Tuberty (ASU) List of Little Mountain Creek (LMC) sampling sites in Badin, NC from 4/4/14 and 4/11/15**

LMC Site 1 – Riffle and pool in Little Mountain Creek downstream of landfill near Hwy 740

35.40068 N 80.12323 W

LMC Site 2 – Landfill Drainage Ditch (aka feeder creek) confluence with Little Mountain Creek and Ground well area below landfill, also cracked pipe and parallel feeder creek were nearby samples on 4/4/14.

Ditch – 35.40154 N 80.12444 N

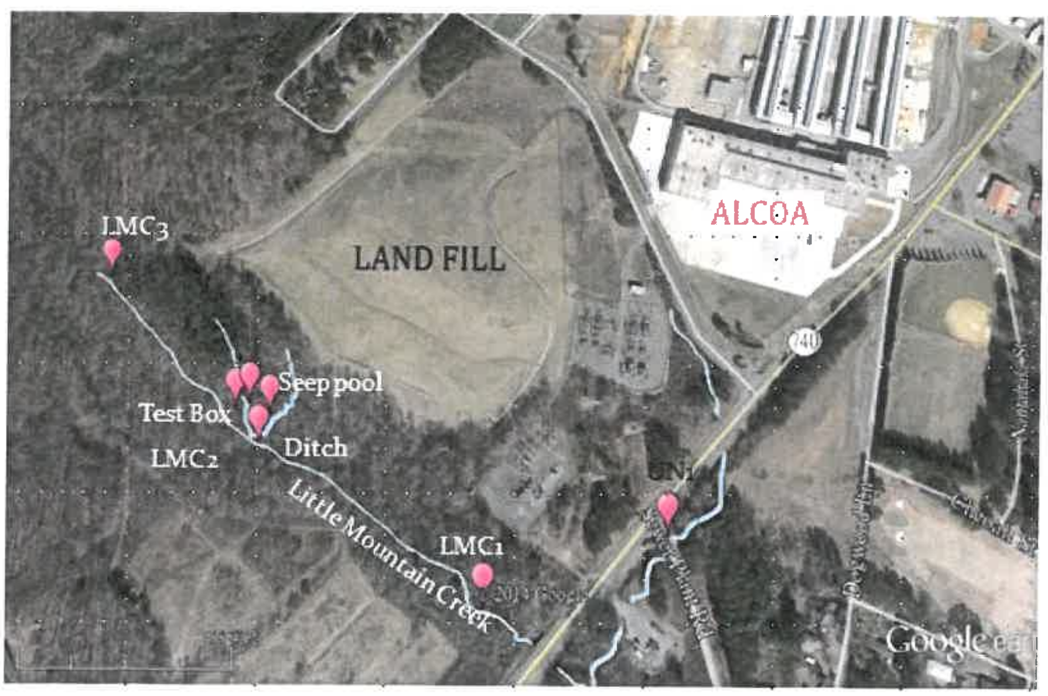
Box – 35.40168 N 80.12433 N

Seep Pool – 35.40171 N 80.12430 N

Well at fence – 35.40199 N 80.12392 W

LMC Site 3 – Riffle and Pools in Little Mt Creek 'upstream' of landfill area (possible that we didn't get far enough upstream based on low cyanide levels here)

35.40321 N 80.12769 W



# REFERENCE 18

DUKE LAW

NICHOLAS SCHOOL OF THE ENVIRONMENT
DUKE UNIVERSITY
*forging a sustainable future*

Ryke Longest, Director
**Environmental Law & Policy Clinic**
**Box 90360**
**Durham, NC 27708-0360**

Michelle Nowlin, Supervising Attorney
Telephone: (919) 613-7169
Toll Free: (888) 600-7274
Fax: (919) 613-7262

October 13, 2014

Franklin E. Hill, Director of Superfund Division
United States Environmental Protection Agency, Region 4
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, GA 30303

**RE: Petition Requesting Preliminary Assessment of Alcoa-Badin Works Site**

Director Hill,

Under the authority of CERCLA Section 105(d), as amended, the Duke Environmental Law and Policy Clinic, on behalf of the petitioner Yadkin Riverkeeper, Inc.,[1] hereby requests that Region 4 of the United States Environmental Protection Agency (EPA) conduct a Preliminary Assessment for Superfund designation of the suspected presence and release of hazardous substances in two areas in the immediate vicinity of the former Alcoa Badin Works[2] aluminum smelting facility (Badin Works) in Badin, North Carolina.[3] Area 1 abuts the Alcoa-Badin Landfill (SWMU 2) and includes, but is not limited to, portions of Little Mountain Creek. This area also is immediately adjacent to the predominantly African American West Badin community, which has borne the brunt of past smelting-related contamination. Area 2, referred to as the "Ball Field," is the large field across from Alcoa's smelting plant and adjacent to Badin Lake, a portion of the Yadkin River.

In December of 1992, Alcoa sued 167 insurers over coverage for cleanup at its 35 plants in the United States. At the Summary Judgment stage, Superior Court Judge Armstrong identified three plants where evidence showed that the environmental clean-

[1] Yadkin Riverkeeper, Inc., 308 Patterson Ave., Winston-Salem, NC 27101, (336)-722-4949, gayle@ggtuchlaw.com.
[2] Alcoa Badin Works, EPA/Handler ID: NCD003162542, FRS ID: 110017425614.
[3] *See* 42 U.S.C. § 9605(d) (2012) (permitting any person to petition for a Preliminary Assessment and requiring a response within 12 months).

up and damages costs would exceed the $50 million threshold triggering additional insurance coverage liability. Badin Works was one such plant. Yet, while the waters and land adjacent to the two other plants were eventually designated as Superfund sites, Badin Works was treated differently. North Carolina's Department of Environment and Natural Resources has allowed Alcoa to run its own cleanup operation under RCRA standards at Badin Works, but has never requested EPA to undertake a Preliminary Assessment of surrounding areas under CERCLA. Conversely, the States of New York and Texas initiated CERCLA actions at the other two plants identified by Judge Armstrong in addition to RCRA activities. Alcoa has spent only a fraction cleaning up Badin Works than it has spent in either Texas or New York to date. The RCRA corrective action measures have not been designed to reverse the damage caused by the industrial activity around Badin Works, but rather to address on-site contamination at SWMUs and AOCs on the Badin Works property itself, primarily through installing caps, fences and limited sampling of a few monitoring wells.

The enclosed petition provides a brief introduction into Badin Works' history and provides a summary of lab results for samples taken from identified Areas 1 and 2. With limited funds for testing and access only to publicly-available land, we obtained test results for water, sediments, rocks, and fish in areas near Badin Works. These results lead us to believe that Little Mountain Creek (Area 1) has been contaminated by past industrial activities and that the Ball Field (Area 2) could be impacted as a past waste handling or disposal site.

Sampling results of water, sediment, and fish species from segments of Little Mountain Creek (Area 1) reveal that the stream is degraded downstream of the Alcoa-Badin Landfill (SWMU 2). The downstream segment was found to have higher levels of fluoride and sulfate, a less diverse population of species, a higher rate of disease, decreased levels of oxygen, and increased silt as compared to the upstream segment. Some sort of pollution is degrading the stream adjacent to and downstream of the Alcoa-Badin Landfill. Such pollution likely emanates from activities related to industrial processes related to the operation of Badin Works since there is no other industrial activity upstream, and the only wastewater treatment plant on this stream has been shuttered for many years. This is especially true given that no accounting has been made for the tens of thousands of tons of spent potliner ("SPL") generated by the Badin Works before the listing SPL as RCRA hazardous waste K088.

Rock, water, and soil samples taken from a drainage area at the Ball Field (Area 2) contain compounds associated with solid wastes generated by aluminum smelting and anode production. Subsequent lab tests on some samples also revealed the presence of hazardous chemicals, including known carcinogens, typically associated with anode production and aluminum smelting operations. These results highlight the need for Preliminary Assessment since the Town of Badin has agreed to accept Alcoa's donation of the Ball Field property to build a waterfront park, including a children's playground.

In addition, PCBs found in fish in water bodies downstream of the former smelter, including Badin Lake, exceed screening levels for fish consumption advisories.[4] But no ecological risk assessment of this residual contamination has been performed. Alcoa has finally submitted its proposal for corrective measures, but lingering pollution outside the RCRA-identified areas is not being addressed. The proposed RCRA corrective measures are limited to remedial activities on the plant site previously identified by Alcoa as SMWUs and AOCs. It is now time for EPA to conduct a Preliminary Assessment of areas surrounding the plant to see which areas need to be remediated under CERCLA. The burden of this lingering toxicity falls on the people of West Badin, a minority population that has been subject to decades of unjust environmental burdens. Residents do not believe that the RCRA corrective measures will protect them, their community, or their surrounding environment.[5] Yadkin Riverkeeper shares this view.

Many residents within the West Badin community, as well as former Badin Works employees and Yadkin Riverkeeper members, have information which may assist EPA in its investigation. This information was previously given to Brian Holtzclaw of EPA Region 4, who was previously assigned to engage the community in the RCRA issues. Regrettably, Mr. Holtzclaw's recommended community involvement proposals were vetoed by NC DENR and he was removed from his advisory role by his superiors.

Other areas beyond those identified as Area 1 and Area 2 need investigation as well. No ecological risk assessment has been conducted regarding the fish contaminated with PCBs downstream. No investigation has been done to document where the tens of thousands of tons of spent potliner were disposed of prior to its listing as a RCRA hazardous waste in 1988. These issues remain a concern for Yadkin Riverkeeper, Inc. and the West Badin community.

Thank you for your service to the people of the United States and especially to Region 4. We look forward to working with you to address the concerns of residents and users of the Yadkin River. The Yadkin River is no less precious than the Grasse River[6]

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[4] See Health Consultation for Badin Lake available at: http://www.atsdr.cdc.gov/HAC/pha/BadinLakeFishTissue/BadinLakeHC09-18-2009.pdf (last visited Oct. 8, 2014).

[5] *See* Comments of North Carolina Environmental Justice Network on Corrective Measures Study, dated Aug. 16, 2013, available at http://ncejn.files.wordpress.com/2013/08/08-16-13-ncejn-comments-corrective-measures-study.pdf (last visited Oct. 8, 2014).

[6] *See* EPA CERCLA Summary for Grasse River, available at http://www2.epa.gov/enforcement/case-summary-alcoa-inc-conduct-243-million-cleanup-grasse-river-superfund-site-new-york#summary (last visited Oct. 8, 2014).

or Lavaca Bay.[7] Its fish, wildlife, residents, and users deserve the same level of protection as those in Region 2 and Region 6. Please contact us to schedule a meeting to discuss this petition. Until then, I remain

Very Truly Yours,

/s/

Ryke Longest, Director
Duke Environmental Law & Policy Clinic
(919) 613-7207
longest@law.duke.edu

ENCL; 2 Sets

CC: Honorable Pat McCrory, Governor of North Carolina
Honorable Bill Daughtridge, Jr. Secretary of NC DOA
Honorable John Skvarla, Secretary of NC DENR
Chandra Taylor, Esquire, Southern Environmental Law Center
Gayle Tuch, Yadkin Riverkeeper, Inc.

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[7] *See* EPA CERCLA Summary for Lavaca Bay, available at http://www.epa.gov/region6/6sf/pdffiles/alcoa-lavacabay-tx.pdf (last visited Oct. 8, 2014).

Franklin E. Hill, Director of Superfund Division
United States Environmental Protection Agency, Region 4
Sam Nunn Atlanta Federal Center
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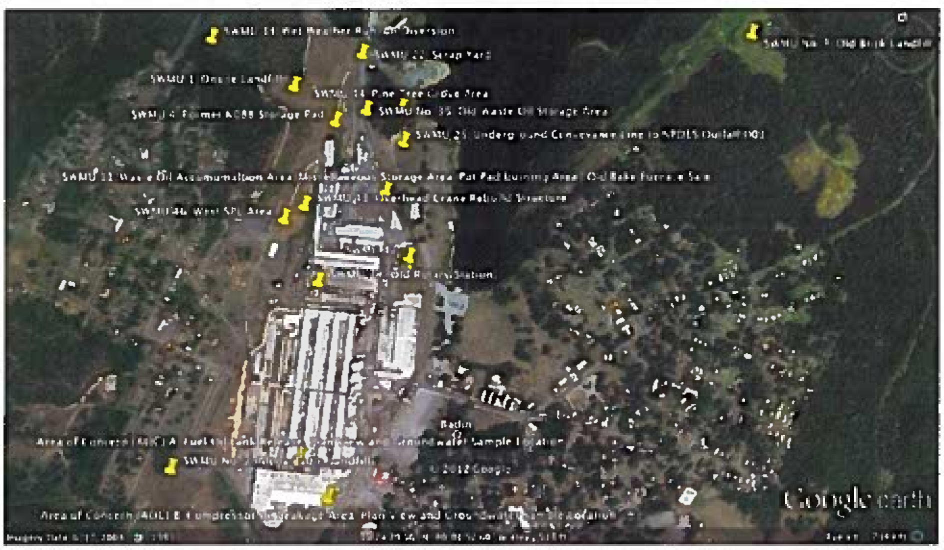
# Request for Preliminary Assessment for Areas Surrounding Alcoa Badin Works Facility in Badin, North Carolina

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Director Hill,

Under the authority of CERCLA Section 105(d), as amended, the Duke Environmental Law and Policy Clinic (the Clinic), on behalf of the petitioner, Yadkin Riverkeeper, Inc.,[1] hereby requests that Region 4 of the United States Environmental Protection Agency (EPA) conduct a Preliminary Assessment of the suspected presence and release of hazardous substances in two areas in the immediate vicinity of the former Alcoa Badin Works[2] aluminum smelting facility in Badin, North Carolina.[3]

The Alcoa Badin Works facility has a long history of environmental degradation and the two sites addressed in this petition are only two of many possible contaminated sites in and around Badin Works. Area 1 abuts the Alcoa-Badin Landfill (SWMU 2) and includes, but is not limited to, portions of Little Mountain Creek (Figure 1). Initial testing results from Area 1 indicate that the Creek has been contaminated with fluoride, sulfate, and a number of other chemicals associated with industrial processes conducted at the nearby facility. Fluoride and sulfate are indicator compounds of hazardous waste contamination associated with spent potliner, a listed hazardous waste also known as K088. Evidence suggests that hazardous potliner has leached from the Alcoa-Badin Landfill and contaminated the adjacent Little Mountain Creek, an impaired water of the United States.

Area 2, referred to as the Ball Field, is the large field east of Alcoa's smelting plant and adjacent to Badin Lake (Figure 1). Preliminary testing by the Clinic has produced results suggesting that this site also has been contaminated with industrial solid wastes.

The Badin Works facility is currently undergoing the Corrective Action approval process pursuant to the Resource Conservation and Recovery Act (RCRA) for a number of identified areas within the facility's boundaries; however, the Corrective Action plan does not address the sites of interest in this petition. Alcoa and the Corrective Action plan have not assessed the environmental contamination and degradation of the area around the Alcoa Badin Works facility. Since Alcoa's corrective measures and investigation have not evaluated the areas we identified, we respectfully request that EPA conduct a preliminary assessment of the two sites identified in this petition, as well as any other site with suspected hazardous contamination. Both of these areas are down-gradient of Alcoa Badin Works.

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[1] Yadkin Riverkeeper Inc., 308 Patterson Avenue, Winston-Salem, NC 27101, (336) 722-4949, gayle@ggtuchlaw.com.

[2] Alcoa Badin Works, EPA/Handler ID: NCD003162542, FRS ID: 110017425614.

[3] *See* 42 U.S.C. § 9605(d) (2012) (permitting any person to petition for a preliminary assessment and requiring a response within twelve months).

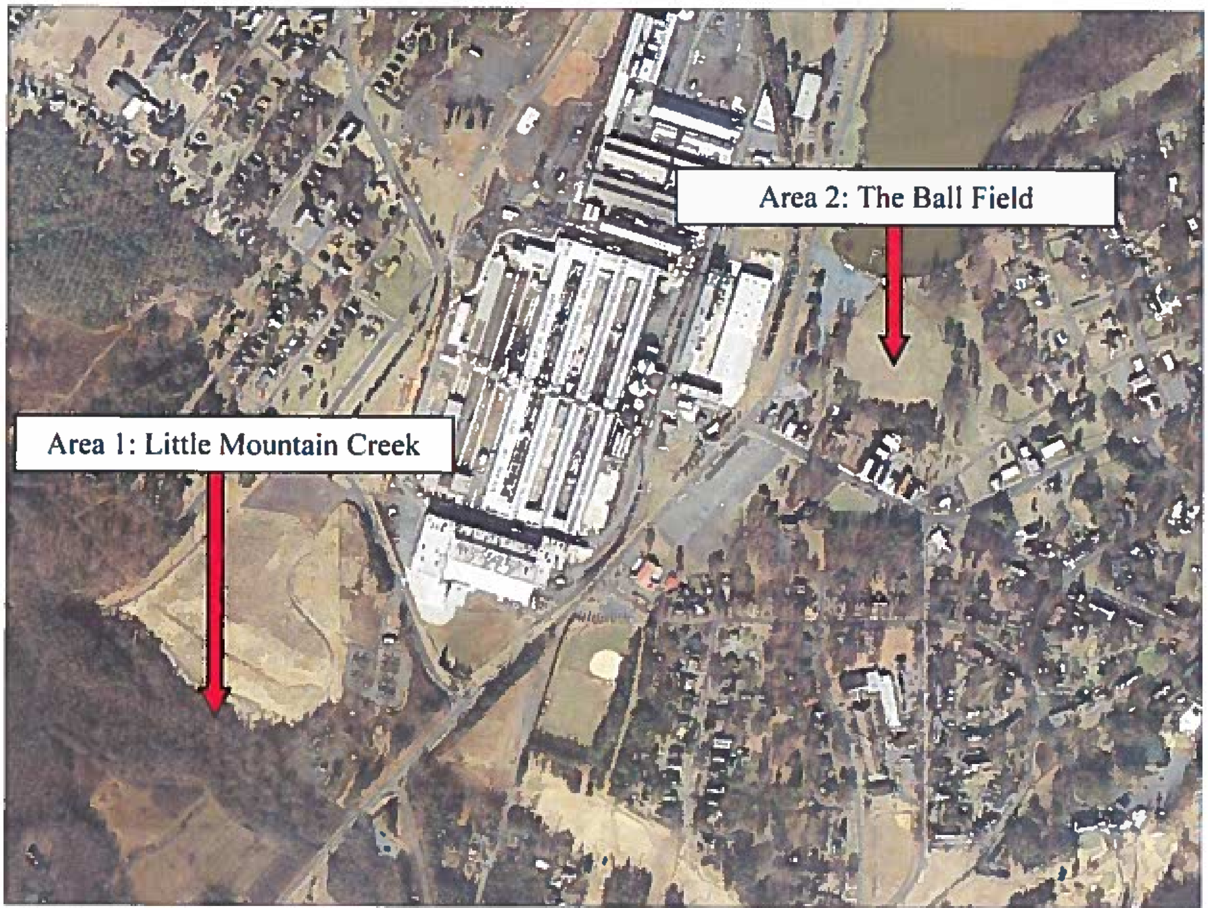


**Figure 1**: Aerial photograph of Alcoa Badin Works Facility in Badin, NC. The location of Areas 1 and 2 are highlighted in relation to the Facility and Badin Lake[4]

[4] U.S. Geological Survey, EarthExplorer. High Resolution Orthoimagery (Jan. 27, 2010). Images patched and prepared with ArcGIS. GPS coordinates of the approximate center of the Ball Field are 35.406757, -80.114336. Google Maps, https://www.google.com/maps/place/35%C2%B024%2724.3%22N+80%C2%B006%2751.6%22W/@35.406757,-80.114336,17z/data=!3m1!4b1!4m2!3m1!1s0x0:0x0 (last visited Oct. 8, 2014). GPS coordinates of the approximate region of Little Mountain Creek where sampling was performed are 35.403470, -80.126345. Google Maps, https://www.google.com/maps/place/35%C2%B024%2712.5%22N+80%C2%B007%2734.8%22W/@35.4034717,-80.1263333,15z/data=!3m1!4b1!4m2!3m1!1s0x0:0x0 (last visited Oct. 8, 2014).

## BACKGROUND

### A History of Environmental Injustice

Badin, North Carolina, began as a company town established by L'Aluminium Française, which constructed a hydroelectric dam in the narrows of the Yadkin River, circa 1913, to power an aluminum smelter.[5] The Aluminum Company of America (Alcoa) bought the partially-finished company town and dam in 1915 and began smelting operations in 1916.[6] Since its founding, Badin has been starkly segregated down its geographic center, with a primarily poor, African-American population residing in West Badin, and a more affluent population—at least historically—residing in the eastern part of town.

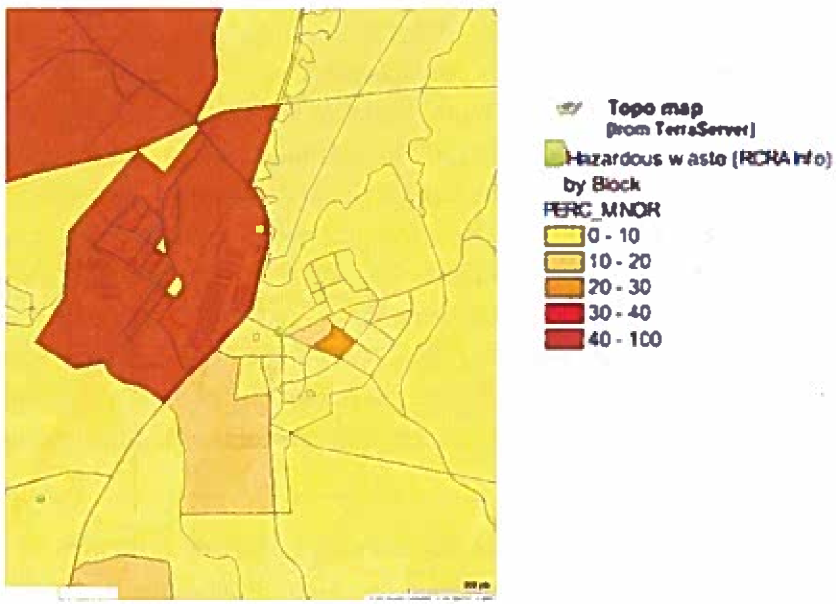


**Figure 2:** EJ View Map of the Alcoa Badin RCRA Site.

While in operation, Alcoa Badin Works used the Hall-Heroult industrial aluminum smelting process to produce aluminum and had an annual production capacity of 115 thousand metric tons.[7] The primary aluminum smelting process requires large volumes of chemical and electrical inputs, and generates a substantial number of hazardous wastes, including but not limited to fluoride, benzo(a)pyrene, mercury,

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[5] Town of Badin, *A Brief History of Badin* (Sept. 25, 2014), *available at* http://www.badin.org/about_badin.html.
[6] *Id.*
[7] DPRA INC., ECONOMIC ASSESSMENT OF THE REVISED LDR TREATMENT STANDARDS FOR SPENT ALUMINUM POTLINER (K088), at 8 (2000), *available at* http://www.epa.gov/epawaste/hazard/tsd/ldr/k088/economic.pdf (prepared for EPA, Office of Solid Waste and Emergency Response, Economics, Methods and Risk Analysis Division).

cyanide, lead, polycyclic aromatic hydrocarbons (PAHs), and spent potliner.[8] Of particular concern due to production volume is spent potliner, which contains leachable cyanide and fluoride compounds.[9] Cyanide is well known for its toxicity and can cause health problems with long-term, low-concentration exposure. Fluoride, while considered safe and even beneficial at low doses, can lead to an increased likelihood of bone fractures and skeletal fluorosis with elevated exposure.[10] Alcoa has been disposing of hazardous wastes in Badin since the plant began operations in 1917, and for the nearly sixty years before the passage of RCRA, this waste disposal was largely unregulated. It was not until EPA finalized its rule for spent potliner disposal in September of 1988 that the large amounts of spent potliner generated at Badin Works finally were covered by the federal regulatory umbrella.

Following this action by EPA, Alcoa sought coverage for damages and cleanup response costs from its insurers. In December of 1992, Alcoa filed a declaratory judgment action in the King County Superior Court in Washington against 167 insurers, seeking coverage for the cost of pollution damage, investigation, and remediation at thirty-five of its sites around the United States.[11] Based on the evidence presented, the trial judge held that multiple Alcoa sites may need environmental remediation. Three sites specifically were highlighted as warranting particularly high cleanup costs, exceeding $50 million. The sites were Massena, New York; Point Comfort, Texas; and Badin, North Carolina. While the New York and Texas sites have already been cleaned up under both RCRA and CERCLA, the Badin Works RCRA cleanup has languished. A CERCLA preliminary analysis is needed to protect the Badin community and speed the RCRA cleanup process along.

## Spent Potliner Regulatory History

RCRA was enacted in 1976,[12] but Alcoa's handling, transportation, and disposal of hazardous wastes did not fall under EPA's RCRA guidelines until 1980. On May 19, 1980, the first RCRA regulations, "Hazardous Waste and Consolidated Permit Regulations," were published in the Federal Register and established the basic "cradle to

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[8] *See* EPA, PROPOSED BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR SPENT ALUMINUM POTLINERS-K088, at iii (2000), http://www.epa.gov/osw/hazard/tsd/ldr/k088/k088back.pdf; EPA ECHO, DETAILED FACILITY REPORT (2013), *available at* http://echo.epa.gov/detailed_facility_report?fid=110017425614; *see also, e.g.*, EPA, TOXICS RELEASE INVENTORY REPORTING, http://oaspub.epa.gov/enviro/trisquery.dcn_details?tris_id=28009LMNMCHWY74 (last visited Oct. 3, 2014).

[9] *Id.*

[10] CDC, *Community Water Fluoridation FAQs* (Dec. 6, 2013), *available at* http://www.cdc.gov/fluoridation/faqs/#overexposure1.

[11] See *Aluminum Co. of Am. v. Aetna*, 998 P.2d 856, 30 Envtl. L. Rep. 20,536 (2000); Aug. 6, 2003 Order of Hon. Sharon Armstrong in *Alcoa, Inc. v. Accident & Casualty Company*, Case No. 92-2-28065-SEA (Sup. Ct. Wash. King Cnty. 2003).

[12] Resource Conversation and Recovery Act, Pub. L. No. 94-580, 90 Stat. 2795 (1976).

grave" approach to hazardous waste management that exists today.[13] On October 21, 1980, Congress enacted the Solid Waste Disposal Act Amendments of 1980,[14] which added, among other amendments, an exemption from RCRA regulation for "[s]olid waste from the extraction, beneficiation, and processing of ores and minerals, including phosphate rock and overburden from the mining of uranium ore."[15] The aluminum smelting process involves the beneficiation and processing of aluminum ore.

EPA subsequently modified its hazardous waste regulations to reflect the October 1980 "mining waste exclusion," and issued a preliminary interpretation of the scope of the exclusion.[16] To be consistent with this interpretation, EPA suspended the listings of "solid waste from the exploration, mining, milling, smelting and refining of ores and minerals," including spent potliner.[17] On September 13, 1988, EPA published the final rule promulgating the hazardous listing for spent potliner (see Appendix, Table A-1).[18]

### Badin Works RCRA Permitting

On November 19, 1980, Alcoa Badin Works submitted a RCRA Part A permit application which indicated that it was storing spent potliner in waste piles, with an estimated annual generation of 4800 tons of waste.[19] Immediately following the relisting of spent potliner, Alcoa Badin Works submitted a Notification of Hazardous Waste Activity and a RCRA Part A permit application indicating the generation of spent potliner.[20] Alcoa buried spent potliner as a means of disposal long before the submission of its Part B RCRA application in March 1990. A 1989 site assessment report prepared by Law Environmental for Alcoa stated that the burying of [spent] potliner began in the early 1900s and continued until the late 1970s. The disposal area locations are not precisely known, although several areas are identified and others are suspected.[21]

### Corrective Action

In 1989, cleanup of the Badin Works site was handed over to Alcoa, which would manage the remediation under RCRA's Corrective Action process. On December 23, 1996, CERCLA enforcement staff noted that further CERCLA activities at the site were

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[13] 45 Fed. Reg. 33066, 33066–72 (May 19, 1980); *see also* EPA, *History of RCRA*, *available at* http://www.epa.gov/osw/laws-regs/rcrahistory.htm.
[14] Pub. L. No. 96-482, 94 Stat. 2334 (Oct. 21, 1980).
[15] 42 U.S.C. § 6921(b)(3)(A)(ii) (2012).
[16] 45 Fed. Reg. 76618, 76618 (Nov. 19, 1980); *see also* EPA, *supra* note 8.
[17] 45 Fed. Reg. 76618, 76619 (Nov. 19, 1980); *see also* EPA, *supra* note 8, at A-1.
[18] 53 Fed. Reg. 35412, 35414 tbl.1 (Sept. 13, 1988); *see also* EPA, *supra* note 16, at A-3.
[19] A.T. KEARNEY, INC. & DPRA, INC., INTERIM RCRA FACILITY ASSESSMENT REPORT, at II-11 (1990) (prepared for Ms. Rowena Sheffield of EPA Region 4).
[20] *Id.* at II-12.
[21] LAW ENVTL., PHASE II GROUND-WATER ASSESSMENT NORTHWEST VALLEY, ALCOA-BADIN WORKS, BADIN, NORTH CAROLINA 1-1 (1990).

"[d]eferred to RCRA."[22] EPA's online Superfund database lists the site as having completed a Preliminary Assessment on November 20, 1985,[23] after which no further actions were taken. This 1985 Preliminary Assessment was conducted by an employee of North Carolina's Division of Health Services who relied only on files already available at his Raleigh, North Carolina office, and on a single day's communications with one employee each from the Department of Environment and Natural Resources (DENR) and from Alcoa.[24] North Carolina conducted no sampling or testing.[25] This 1985 Preliminary Assessment does not meet the standard for a Preliminary Assessment and did not address the issues we bring forward in this petition.

The RCRA Corrective Action procedures are implemented by the North Carolina Department of Environment and Natural Resources Division of Waste Management and consist of five phases. Phases 4 and 5 are currently ongoing.

Phase 1: RCRA Facility Assessment
Phase 2: RCRA Facility Investigation
Phase 3: Corrective Measures Study
Phase 4: Corrective Measures Implementation
Phase 5: Corrective Action Completed.

Areas 1 and 2 identified in this petition show evidence indicative of past disposal and ongoing contamination with hazardous substances, but have not been identified as SWMUs or AOCs under the ongoing RCRA work. Because these areas are not being addressed by Alcoa or DENR under RCRA, the unclaimed contamination near Areas 1 and 2 qualifies for consideration under Superfund. EPA should conduct a Preliminary Assessment that includes actual sampling of potentially-contaminated areas surrounding Alcoa's facility, and should proceed under CERCLA according to the results of that assessment.

The following sections provide a detailed summation of field sampling, testing, and lab results for the two areas, and identify various concerns for human and ecosystem health.

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[22] EPA, *Superfund Site Information – Actions* (Sept. 30, 2014), *available at* http://cumulis.epa.gov/supercpad/cursites/cactinfo.cfm?id=0402612; EPA, *Superfund Site Information - Site Info* (Sept. 30, 2014), *available at* http://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0402612.
[23] EPA, *Superfund Site Information – Actions* (Sept. 30, 2014), *available at* http://cumulis.epa.gov/supercpad/cursites/cactinfo.cfm?id=0402612.
[24] *See* Cover Letter for 1985 RCRA Final Preliminary Assessment Report, *infra* note 26, at 2.
[25] *Id.*

## AREA 1 - LITTLE MOUNTAIN CREEK, ADJACENT TO SWMU 2

The Alcoa-Badin Landfill (SWMU 2) is an unlined landfill that was in operation since the early twentieth century, long before the existence of RCRA. It occupies an area roughly 1000 feet by 950 feet and is located southwest of the facility on the opposite side of Wood Street, outside of the former plant's fence. From the early 1900s into the 1970s, both municipal and industrial wastes were disposed of in this landfill. During this time, unknown quantities of spent potliner were placed in the landfill, especially during the renovation of the smelting facility, circa 1965.[26] Use of SWMU 2 was discontinued in the mid-1970s.[27] Since then, a cap was placed on the landfill to reduce surface water infiltration and monitoring wells were installed. However, the landfill is unlined and therefore offers no protection against groundwater contamination from hazardous constituents such as spent potliner. It lies about 300 feet north and hydraulically up-gradient of Little Mountain Creek, creating the potential for the flow of contaminants down-gradient and into the creek; this relationship is discussed in more detail below.[28]

Nonetheless, the source of this pollution, despite a 2004 recommendation to do so by HDR Engineering in a report addressing Little Mountain Creek's impairment for aquatic life.[29] The HDR report, commissioned by the North Carolina Ecosystem Enhancement Program under DENR, also recommended a monitoring plan under which multiple points in the stream would be regularly monitored through chemical, physical, benthos, and fish tests. Instead, the Division of Water Quality disregarded the HDR report.

The HDR report identified activities associated with Badin Works as likely having contributed to the impairment of Little Mountain Creek, based on reports that the facility continued to discharge into the Little Mountain Creek hydrologic unit (HU) with NPDES permit violations, even though Alcoa's smelting facility closed in 2007.[30] The report concludes that further investigation into the water quality impacts from Alcoa Badin Works should be conducted, yet none was undertaken by DWR.

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[26] N.C. DIV. OF HEALTH SERVS., FINAL PRELIMINARY ASSESSMENT REPORT (1985).

[27] NUS CORP., PRELIMINARY REASSESSMENT 7 (1989); MFG, INC., RCRA FACILITY INVESTIGATION REPORT, VOLUME I OF II, at 103 (2001) (prepared for Alcoa, Inc.).

[28] Little Mountain Creek is a tributary of Mountain Creek, which in turn empties into Lake Tillery on the Yadkin-Pee Dee River (south and downriver of Badin and the Yadkin Project).

[29] HDR ENG'G, INC., PRELIMINARY FINDINGS & RECOMMENDATIONS REPORT - MOUNTAIN CREEK AND LITTLE MOUNTAIN CREEK AND JACOBS CREEK 2-47 (2004) (prepared for the North Carolina Ecosystems Enhancement Program).

[30] *Id.*

## Alcoa-Badin Landfill Geology and Hydrology

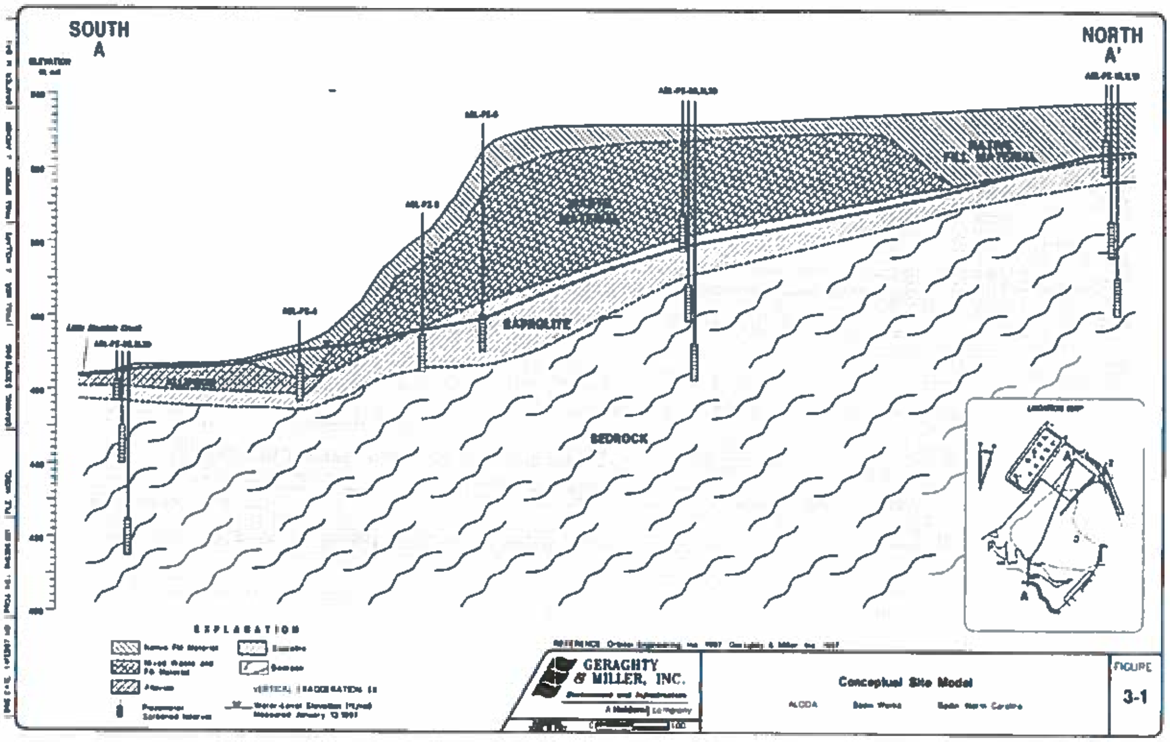


**Figure 3**: Cross-Sectional Diagram of Alcoa-Badin Landfill (SWMU 2).[31]

As shown in Figure 3, the elevation of SWMU 2 ranges from approximately 540 feet above mean sea level (ft-msl) at the north-central end of the landfill to approximately 460 ft-msl at the south end leading towards Little Mountain Creek. Geologically, SWMU 2 overlies a natural ravine, which extends from the Badin Works plant south to Little Mountain Creek.[32] The bedrock below the landfill, shown in Figure 3, consists of argillite/green slate; weathering has altered the uppermost portion of the slate into a silty clay saprolite.[33]

In general, the flow of groundwater through the Alcoa-Badin Landfill follows topography. Groundwater flows from north to south through the Alcoa-Badin Landfill, towards Little Mountain Creek. The water table in this area is relatively close to the surface—in several places it is merely a few feet from the surface. Along the southwestern side of the landfill, groundwater actually intersects with some of the waste material (Figure 3). Notably, at the western tip of the landfill (ABL-MW-3), the water table elevation occasionally rises to just inches below the ground surface. This results in

[31] GERAGHTY & MILLER, INC., GROUNDWATER FLUX DETERMINATION ALUMINUM COMPANY OF AMERICA BADIN LANDFILL BADIN WORKS FACILITY BADIN, NORTH CAROLINA 28 (1997) (included as Appendix A-4 of ALCOA, INTERIM MEASURES WORKPLAN, ALCOA-BADIN LANDFILL (SWMU #2), REGRADING AND COVER SYSTEM INSTALLATION (1997)).
[32] MFG, INC., *supra* note 27, at 105.
[33] *Id.*

an area of deep mud and some standing water. The average hydraulic gradient throughout SWMU 2 is 0.05ft/ft.[34] Hydraulic conductivity throughout the landfill is quite high due to the presence of unconsolidated fill material underneath the compacted soil.

## Little Mountain Creek Sampling and Testing

Given the proximity of Little Mountain Creek (LMC) to the unlined landfill, a sampling team led by Dr. Shea Tuberty[35] collected samples and performed field testing on April 4, 2014, to determine the presence and concentration of hazardous compounds that might be traced back to the landfill. The sampling team collected water samples from six locations to undergo Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES) and Ion Chromatography (IC) chemical analysis.

**April 2014**: Sampling and Testing of Little Mountain Creek near Outfall 018.[36]

Small creek feeding into Little Mountain Creek from direction of Landfill

[34] *Id.* at 106.

[35] Dr. Shea Tuberty. Associate Professor, Aquatic Ecophysiology and Toxicology Lab, Department of Biology, Appalachian State University, Boone, N.C.

[36] GPS Coordinates of Little Mountain Creek Sampling: 35.403470, -80.126345. Google Maps, *supra* note 4.

| Water Sample Result Averages | Concentrations (mg/L) Aluminum | Arsenic | Barium | Cadmium | Chromium | Copper |
|---|---|---|---|---|---|---|
| Badin Lake Drain | 0.286944 | 0.0014082 | 0.029054 | 0.000225 | | 0.002908 |
| LMC Below | 0.3065658 | 0.0024042 | 0.011425 | 0.0001626 | | 0.009875 |
| TestBox | 1.0524966 | 0.0018228 | 0.051422 | 0.0002226 | 0.0372807 | 0.008452 |
| Feeder Cr 1 | 0.2808324 | 0.0024966 | 0.016009 | 0.0001986 | | 0.002187 |
| Feeder Cr 2 | 0.2344536 | 0.0015666 | 0.013398 | 0.0002688 | | 0.003965 |
| Cracked Pipe | 74.3754444 | 0.08505 | 1.060296 | 0.0057426 | 0.1723191 | 0.24975 |

| (*continued*) Water Sample Result Averages | Concentrations (mg/L) Iron | Manganese | Nickel | Lead | Selenium | Strontium | Zinc |
|---|---|---|---|---|---|---|---|
| Badin Lake Drain | 0.5994216 | 0.1797822 | 0.000907 | 0.005154 | 0.0262183 | 0.07043 | 0.0176776 |
| LMC Below | 0.429819 | 0.013662 | 0.000504 | 0.0059376 | 0.0257718 | 0.041786 | 0.0228747 |
| TestBox | 1.9112814 | 2.644722 | 0.004477 | 0.0058764 | 0.0310118 | 0.194459 | 0.0636306 |
| Feeder Cr 1 | 0.4618314 | 0.3400248 | 0.001129 | 0.0015906 | 0.0282870 | 0.154477 | 0.0128333 |
| Feeder Cr 2 | 0.589473 | 0.0456246 | 0.000734 | 0.0011334 | 0.0254446 | 0.047106 | 0.0138634 |
| Cracked Pipe | 169.581825 | 70.563141 | 0.100614 | 0.1684452 | 0.0599751 | 0.51028 | 0.5592018 |

Table 1: Presence and concentration of analytes found in water samples from six study sites. Data prepared by Dr. Shea Tuberty, average metals analysis results by ICP-OES.

While sampling, the team identified a poorly-constructed pipe running along a man-made ditch from the Alcoa-Badin Landfill to a test box near Little Mountain Creek. The pipe was discharging considerable amounts of an unknown fluid through an apparent leak (see below). The team collected samples of the leaking discharge for lab tests.[37]

[37] Dr. Shea Tuberty, *ICP Chemical Analysis Results* (Apr. 2014) (laboratory results are on file with the Duke Environmental Law & Policy Clinic).

**<u>April 2014</u>: Leaking Pipe near Little Mountain Creek.**[38]

The IC results indicated significantly higher levels of fluoride and sulfate downstream of the landfill than upstream. Many of the results of this analysis have analyte levels which far exceed North Carolina's water quality criteria. For example, the cracked pipe observed near Little Mountain Creek had fluoride levels at nearly four times the State's surface water quality criterion, and the test box it connected to the pipe had levels almost fourteen times that criterion. High fluoride levels in particular may be indicative of leaching spent potliner buried nearby. Although there are no State criteria for sulfate, the pipe, drainage ditches, and other areas surrounding the creek had sulfate levels ten times higher than the reference site upstream in Little Mountain Creek.

[38] *Id.*

| Sample Site | Fluoride (mg/L) | Chloride (mg/L) | Sulfate (mg/L) | Nitrate (mg/L) |
|---|---|---|---|---|
| NC Water Criteria | 1.8 | 230 | LD | 10 |
| LMC1 (downstream) | 0.37 | 7.76 | 13.84 | 0.76 |
| LMC3 (upstream ref) | 0.09 | 10.93 | 11.02 | 0.76 |
| Drainage Ditch 1 | 16.14 | 15.7 | 102.28 | 0.87 |
| Drainage Ditch 2 | 0.6 | 8.68 | 13 | 0.4 |
| Test Box | 25.08 | 20.02 | 113.21 | 0.2 |
| Cracked Pipe | 7.09 | 19 | 131.84 | 0.2 |
| Unnamed Feeder Creek | 2.83 | 9.71 | 77.97 | 11.11 |
| Ball Field Drainage | 0.62 | 20.56 | 58.15 | 4.56 |

**Table 2**: Dr. Shea Tuberty sampling results and analysis by IC from Alcoa-Badin site visit.

After reviewing the lab results from prior sampling and site visits, our team again collected samples from Little Mountain Creek on June 27, 2014. The sampling team collected both water and sediment samples from Little Mountain Creek, which underwent a full panel of chemical analyses. The samples were taken from the same approximate location as the April 2014 sampling event.

**June 2014**: LMC sampling location, showing Outfall 018.

The lab results for the Little Mountain Creek surface water samples and the State's criteria are listed in the table below (Table 3). None of the listed results exceeded North Carolina's surface water quality criteria.

| Method | Analyte | Concentration (ug/L) | 15A NCAC 2B Surface Water Criteria (ug/L) |
|---|---|---|---|
| EPA 300.0 | Fluoride | 0.0488 mg/l | 1.8 mg/L |
| EPA 6010C | Aluminum | 79.4 | 87 |
| | Calcium | 8900 | |
| | Cyanide | 2.64 | 5 |
| | Iron | 144 | 1.0 mg/L |
| | Magnesium | 3840 | |
| | Manganese | 56.6 | |
| | Sodium | 8380 | |
| EPA 5030B | Acetone | 1.5 | 2.0 mg/L |
| | Toluene | 0.035 | 11 |

**Table 3**: Water sample test results from Little Mountain Creek, June 2014.

The lab results for the Little Mountain Creek sediment samples are listed in the table below (Table 4); however, North Carolina does not have sediment or soil criteria by which to compare the results.

While Dr. Tuberty's Little Mountain Creek sampling results differed slightly from the Clinic's results, each set of results is based on different testing conditions. A water sample falling below the State criteria on one day may exceed the standard on another day, for example, depending on changes in the weather.

| Method | Analyte | Concentration (mg/kg dry) |
|---|---|---|
| EPA 6010C | Aluminum | 11700 |
| | Antimony | 1.65 |
| | Arsenic | 31.2 |
| | Barium | 40.1 |
| | Beryllium | 1.65 |
| | Calcium | 534 |
| | Chromium | 156 |
| | Cobalt | 17.1 |
| | Copper | 13.4 |
| | Iron | 45200 |
| | Lead | 1.08 |
| | Magnesium | 1760 |
| | Manganese | 1170 |
| | Nickel | 18.4 |
| | Potassium | 278 |
| | Sodium | 140 |
| | Thallium | 13.6 |
| | Vanadium | 80.3 |
| | Zinc | 59.5 |
| EPA 7471B | Mercury | 0.00685 |

Table 4: Sediment sample results from Little Mountain Creek, June 2014.

In the process of collecting the Little Mountain Creek samples, the team noticed a small body of standing water between Little Mountain Creek and the landfill that was presumably groundwater. The water had a peculiar orange/brown tinge, so the team collected a sample for chemical analysis.

**June 2014**: Standing water between Little Mountain Creek and landfill.

Unlike the Little Mountain Creek samples, the water sample collected from the standing pool was only tested for fluoride. In this instance, the Clinic chose fluoride to serve as the "canary in the coal mine," as elevated levels of fluoride in the sample would likely indicate ongoing hazardous waste material discharges from the unlined landfill (SWMU 2), into the groundwater, and ultimately into Little Mountain Creek.

| Method | Analyte | Concentration (mg/L) | 15A NCAC 2L Groundwater Standard (mg/L) |
|---|---|---|---|
| EPA 300.0 | Fluoride | 19.9 | 2 |

**Table 5**: Water sample test results from standing puddle between LMC and Landfill, June 2014.

As there had not been rainfall of more than 0.03 inches for two weeks prior to the June 27$^{th}$ sampling event (see Appendix, Table A-2), our team concluded that the source of this puddle was groundwater intersecting with the land surface. The puddle was located in the alluvium between the landfill and Little Mountain Creek, where the water table occasionally rises to within a few inches of the ground. Due to the unusually high fluoride concentration in the sample and its location hydraulically down-gradient from SWMU 2, the team suspects that hazardous waste materials within the landfill may be leaching into the groundwater.

The presence and extent of SWMU 2 groundwater contamination may be influenced by the amount of rainfall in a given timeframe and the subsequent groundwater elevation. We have seen that the groundwater level is capable of intersecting landfill waste material (Figure 3); however, it is unclear the degree to which rainfall increases the exposure of landfill waste materials to groundwater. Alcoa's Phase 3 Corrective Measures Study included groundwater hydrographs showing the correlation between precipitation and groundwater elevation for SWMU 2 piezometers (PZ) and monitoring wells (MW) over a two-year period (see Appendix, Figure A-1).[39]

MW-3, MW-4, and MW-5 are located near Little Mountain Creek in the alluvium and show separate fluctuations in groundwater elevation resulting from precipitation (see Appendix, Figure A-1).[40] Groundwater elevations measured at MW-4 rose over two feet with nearly three inches of rainfall.[41] Groundwater elevations measured at MW-3 and MW-5 generally exhibited fluctuations of lower magnitude compared to those of MW-4.[42] However, the average groundwater elevations were highest in MW-3 and lowest in MW-5, presumably due to the subterranean geology and landfill composition.[43]

PZ-2S and PZ-2D are located up-gradient from MW-3, -4, and -5 and due north of MW-5 (Figures 3 and 5). The hydrograph for these piezometers indicates a potential intersection of the groundwater level and landfill waste material following moderate to substantial rainfall (see Appendix, Table A-3, Figure A-3).[44] The evidence of contamination in Little Mountain Creek provided below further supports this possibility.

## Bioclassification and Impairment of Little Mountain Creek

The North Carolina Division of Water Quality (now the Division of Water Resources or DWR) has listed Little Mountain Creek as impaired on the Clean Water Act 303(d) list since 1998, yet the source of impairment is still listed as unknown.[45] Though agriculture is listed as a potential source of impairment in the 2002 Integrated 305(b) and 303(d) report,[46] Alcoa's activities have likely exacerbated the creek's impairment.

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[39] TESTAMERICA, TESTAMERICA JOB ID: 680-71611-1, Appendix I (2011) (included as Appendix H of ENVIRONEERING, INC., PHASE 3—ENGINEERING DATA COLLECTION FOR THE CORRECTIVE MEASURES STUDY BADIN WORKS FACILITY BADIN, NORTH CAROLINA (2012)).
[40] *Id.*
[41] *Id.* Precipitation event occurred between June 16, 2010 and September 24, 2010.
[42] *Id.*
[43] *Id.*
[44] *Id.*
[45] HDR ENG'G, INC., *supra* note 29, at 2-25.
[46] N.C. DEPT. OF ENV'T & NATURAL RES., WATER QUALITY ASSESSMENT AND IMPAIRED WATERS LIST (2002 INTEGRATED 305(B) AND 303(D) REPORT) Appendix VI, at 99 of 101(2003), *available at* http://portal.ncdenr.org/c/document_library/get_file?uuid=7cfe0f8a-bde3-4523-9e3e-cdc44e323123&groupId=38364.

A 2013 report by the DWR listed a bioclassification of "Fair" for the creek based on a sample from 2011, a meager improvement from a "Poor" bioclassification from 2004.[47] When the 2011 sample was taken, the water had "a milky tint" and heightened specific conductance.[48] Water quality data collected from the creek between 1998 and 2002 reflected elevated nitrogen and fecal coliform bacteria levels and high conductivity, but adequate dissolved oxygen levels.[49] DWR did not investigate further.

A recent 2014 study by Professor Shea Tuberty of the fish and invertebrate species found in Little Mountain Creek revealed the ecological impact of the creek's impairment. Although the testing was not conducted in accordance with State testing procedures, the test results provided strong evidence of anthropogenic degradation of the stream which requires further investigation. The table below presents the Index of Biotic Integrity (IBI) data taken both upstream and downstream from the landfill (Table 6). A score of five on a particular metric indicates that the metric was similar to that expected for a habitat with little human interference, whereas a score of one indicates a large deviation from the expected condition, and a score of three is intermediate. The integrity classification is calculated by summing the twelve component metrics, and accordingly can range from twelve to sixty.

| **Metric #** | **Metric Criteria** | **Reference Site (Upstream) Score** | **Contaminated Site (Downstream) Score** |
|---|---|---|---|
| 1 | Number of Species | 5 | 3 |
| 2 | Number of Fish | 5 | 3 |
| 3 | Number of Darter Species | 5 | 1 |
| 4 | Number of Centrachids and Trout | 5 | 5 |
| 5 | Number of Sucker Species | 5 | 5 |
| 6 | Number of intolerant Species | 1 | 1 |
| 7 | % Tolerant | 3 | 1 |
| 8 | % Omnivore and Herbivore | 1 | 5 |
| 9 | % Insectivores | 1 | 5 |
| 10 | % Piscivores | 1 | 1 |
| 11 | % Diseased Fish | 5 | 1 |
| 12 | % of Species with Multiple Age Groups | 5 | 5 |
| | **Total:** | **42** | **36** |
| | **Integrity Classification:** | **Good/Fair (42-46)** | **Fair (36 to 40)** |

**Table 6**: Fish IBI Scores from Sampling of Little Mountain Creek (Badin, NC), Dr. Shea Tuberty.

[47] N.C. DEPT. OF WATER RES., BASINWIDE ASSESSMENT REPORT: YADKIN RIVER BASIN 114 (2013), *available at* http://portal.ncdenr.org/c/document_library/get_file?uuid=43a70651-e85f-4330-915f-f13aafbfa99d&groupId=38364.

[48] *Id.*

[49] HDR ENG'G, INC., *supra* note 29, at Appendix C, at 4.

The scores for the upstream portion are generally good, showing a large, diverse population of species with little disease. The downstream site, however, received an integrity classification at the low end of the "Fair" designation, due to small, less diverse populations and higher rates of disease; all of these factors indicate stream degradation. In particular, a portion of the fish tested at the downstream site had obvious erosion on the fins and fungal infections on the skin, neither of which were apparent at the upstream site, which received a five for percentage of diseased fish. These results are highly indicative of stream degradation downstream of the Alcoa-Badin Landfill. In addition, the low score for the number of darter species indicates decreased oxygen levels and increased silt, as these species are especially susceptible to both conditions.[50] These results indicate some form of contamination or impairment down-gradient from the plant site.

### NPDES Permit, Expiration and Continuation

Alcoa has previously held a National Pollutant Discharge Elimination System (NPDES) permit for numerous Outfalls across the Alcoa Badin Works site, including the "stormwater" discharge from the Alcoa-Badin Landfill into Little Mountain Creek, known as Outfall 018 (see Appendix, Figure A-2). The NPDES permit expired on February 28, 2013;[51] however, the facility must comply with the requirements of the expired permit until a new permit is issued. The standing permit does not have any effluent limitations for discharges from Outfall 018 into Little Mountain Creek.[52]

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[50] LYCOMING COLLEGE, CLEAN WATER INSTITUTE, IBI METRICS DESCRIPTIONS (2004), *available at* https://www.lycoming.edu/cwi/pdfs/limestoneRun/ibiMetrics.pdf.
[51] N.C. Div. of Water Quality, NPDES Permit No. NC0004308 (Feb. 22, 2008).
[52] *Id.*

## AREA 2 - THE BALL FIELD

Area 2's nickname, the Ball Field, is attributed to historic aerial photographs showing what appears to be a baseball diamond in the center of the field (Figure 4), though the baseball diamond disappeared from aerial photographs around 1960. The Ball Field abuts the south end of Badin Lake and is across from the Alcoa Badin Works facility.


**Figure 4**: Comparison of Ball Field and SWMU 2, 1956 and 2010.[53]

The Ball Field is not a listed SWMU under the RCRA Corrective Action plan, but given its proximity to Alcoa's smelting facility, other SWMUs, lakebed PCB remediation activity, and first-hand citizen accounts, the Clinic decided to visit the site to determine if further investigation was merited. This determination is especially important given that the Town of Badin has been planning on accepting this land as a gift and using it to construct a waterfront park, with design provided by Alcoa.[54]

### Rock Samples

In September 2012, the Clinic's sampling team visited Badin to collect field samples for lab testing from the Ball Field and Badin Lake Boat Access adjacent to the Ball Field. The sampling team found several unusual rocks, one of which was suspected to be a fragment of spent potliner (Sample *A*, see below). A Powder X-Ray Diffraction (XRD) test was performed on the samples to determine their chemical compositions.

[53] N.C. Geological Survey (NCGS), *Badin, NC (1956)*, *in* North Carolina Historical Aerial Photography Collection; U.S. Geological Survey, *supra* note 4. For more information on accessing NCGS's Historical Aerial Photography Collection, please see http://portal.ncdenr.org/web/lr/geologic-maps-of-north-carolina#atalog_listing.

[54] Visit Badin, *Master Plan*, http://visitbadin.com/wp-content/uploads/2011/12/Badin-Park-Plan-11_08_20111.jpg (last visited Oct. 11, 2014).

**September 2012**: Sample *A*, found near Badin Lake Boat Access.

Sample *B*, found in the Ball Field.[55]

| | Constituent | Composition |
|---|---|---|
| **Sample *A*** | Mullite $((Al_2O_3)_x(SiO_2)_y)$ | 69.70% |
| | Spinel ($MgFe_2O_4$) | 4.10% |
| | Quartz ($SiO_2$) | 2.70% |
| | Cristobalite ($SiO_2$) | 6.50% |
| | Tridymite ($SiO_2$) | 2.00% |
| | Rutile ($TiO_2$) | 0.20% |
| | Amorphous | 14.80% |
| **Sample *B*** | Graphite (C) | 98.60% |
| | Nephaline (Na,K)$AlSiO_4$) | 0.80% |
| | Quartz ($SiO_2$) | 0.30% |
| | Corundum ($Al_2O_3$) | 0.20% |
| | Hematite ($Fe_2O_3$) | 0.10% |

**Table 7**: X-Ray Diffraction test results for Samples *A* and *B* from the Ball Field

The XRD test results revealed that *Sample A* was comprised of 69.7% mullite $[(Al_2O_3)_x (SiO_2)_y]$ (Table 7). Mullite is used as a refractory material in several high-heat applications, such as metal, glass, and ceramics manufacturing. Potliner produced during aluminum smelting operations has characteristically high mullite concentrations.[56] There are no other industrial facilities in the vicinity of Badin that would be expected to use or produce mullite, and the compound does not occur naturally in the region. Given the sample's proximity to the Alcoa Badin Works facility, we concluded that Sample *A* likely

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[55] Approximate GPS Coordinates of Samples *A* and *B*: 35.407758, -80.114432. Google Maps, https://www.google.com/maps/place/35%C2%B024%2727.9%22N+80%C2%B006%2752.0%22W/@35.407758,-80.114432,17z/data=!3m1!4b1!4m2!3m1!1s0x0:0x0 (last visited Oct. 8, 2014).

[56] K. Tschöpe et al., *Chemical Degradation Map for Sodium Attack in Refractory Linings*, LIGHT METALS 871, 871 (2010), *available at* www.material.ntnu.no/ceramics/0871.pdf.

is a fragment of spent potliner from the nearby smelting plant.

The XRD analysis showed that Sample *B* was composed of 98.6% graphite [C] (Table 7). Like mullite, graphite has numerous industrial applications, especially as a refractory material in the metals, glass, and ceramics industries.[57] Apart from Alcoa Badin Works, however, there are no nearby facilities that we would expect to be a source of this graphite sample, and pure graphite does not naturally occur in the region. Based on the sample's composition and the geographic factors surrounding the sample's location, we believe that Sample B is a carbon anode fragment. Carbon anode is a common waste product in smelting operations. Neither Sample A nor Sample B is associated with the current use of the field. As such, the two rock samples may be evidence of past solid waste dumping. None of these items would be associated with baseball or fishing activities.

## TCLP Analysis

After reviewing the XRD results from the rock samples, the Clinic determined that more advanced chemical analyses were necessary to determine the presence and degree of contamination at the Ball Field. In November 2013, our sampling team returned to the Ball Field to collect water, soil, and rock samples for Toxicity Characteristic Leaching Procedure (TCLP) analysis.

<u>November 2013</u>: Water Sampling from Ball Field Drainage

"Rock" Sample from Ball Field.[58]

[57] *Graphite Applications*, MEGA GRAPHITE INC., www.megagraphite.com/products/byapplication/industrialapplications (last visited Oct. 8, 2014).
[58] GPS Coordinates of Ball Field Drainage: 35.407646, -80.114606. Google Maps, https://www.google.com/maps/place/35%C2%B024%2727.5%22N+80%C2%B006%2752.6%22W/@35.407646,-80.114606,17z/data=!3m1!4b1!4m2!3m1!1s0x0:0x0 (last visited Oct. 8, 2014).

The TCLP analyses of the Ball Field drainage water sample revealed the presence of a number of hazardous compounds associated with industrial processes, rather than baseball and fishing (Table 8).

| Method | Analyte | Sample (ug/L) | 15A NCAC 2L Groundwater Standard (ug/L) |
|---|---|---|---|
| SVOC 8270D | 2-Fluorophenol | 58 | |
| | Phenol-d5 | 34 | 30 |
| | Nitrobenzene-d5 | 81 | |
| | 2-Fluorobiphenyl | 77 | |
| | 2,4,6 Tribromophenol | 86 | |
| | Terphenyl-d14 | 83 | |
| | 1,4-Dicholorobenzene-d4 | 158 | 6 |
| | Napthalene-d8 | 164 | 6 |
| | Acenaphthene-d10 | 182 | 80 |
| | Phenanthrene-d10 | 183 | 200 |
| | Chrysene-d12 | 176 | 5 |
| | Perylene-d12 | 182 | |
| VOA 8260B | Bibromofluoromethane | 123 | |
| | 1,2 Dicholoroethane-d4 | 138 | 0.4 |
| | Toluene-d8 | 106 | 600 |
| | Bromofluorobenzene | 105 | |
| | Fluorobenzene | 82 | |
| | Chlorobenzene-d5 | 83 | 50 |
| | 1,4-Dicholorobenzene-d4 | 78 | 6 |
| EPA 300.0 | Fluoride | 0.0796 mg/l | 2 mg/l |
| EPA 6010C | Aluminum | 119 | |
| | Calcium | 5600 | |
| | Iron | 83.6 | 300 |
| | Magnesium | 2070 | |
| | Manganese | 27.7 | 50 |
| | Potassium | 2880 | |
| | gamma-Chlordane | 0.454 | |
| | Methoxychlor | 15.64 | |

<u>Table 8</u>: TCLP test results for water sample from Ball Field drainage unit, November 2013.

We used State groundwater quality standards for this comparison although the samples were taken from a surface drainage unit. We are aware that the content of this sample might not accurately mirror the content of the groundwater; however, it serves as an example of the constituents that are capable of leaching into groundwater. The TCLP analysis of the rock and soil samples detected a number of hazardous compounds, some of which are known carcinogens associated with the aluminum smelting process (Table 9).

| **Analyte** | **Concentration (ug/L)** | |
|---|---|---|
| | **Soil** | **"Rock"** |
| Arsenic | 7.81 | 11.8 |
| Barium | 264 | 224 |
| Cadmium | 3.1 | |
| Chromium | 16 | |
| Lead | 82.4 | 11.3 |
| Selenium | 7.71 | 5.12 |
| Mercury | 0.058 | 0.075 |
| 2-Fluorophenol | 58 | 61 |
| Phenol-d5 | 39 | 43 |
| Nitrobenzene-d5 | 68 | 71 |
| 2-Fluorobiphenyl | 75 | 73 |
| 2,4,6-Tribromophenol | 80 | 75 |
| Terphenyl-d14 | 87 | 83 |
| 1,4-Dichlorobenzene-d4 | 89 | 110 |
| Naphthalene-d8 | 90 | 115 |
| Acenaphthene-d10 | 85 | 115 |
| Phenanthrene-d10 | 81 | 105 |
| Chrysene-d12 | 81 | 103 |
| Perylene-d12 | 76 | 99 |

**Table 9**: TCLP test results for soil and "rock" samples from the Ball Field.

All of the analytes fell below EPA's maximum concentration of contaminants for TCLP.[59] However, the presence of carcinogenic and otherwise toxic substances, as well as rock fragments which are likely byproducts of industrial processes, indicates a need for further investigation of the site. These compounds did not come from recreational boating and fishing activities or kids playing baseball.

[59] 40 C.F.R. § 261.24 (2011).

## Further Considerations

Due to limited testing site access and resources, only the two sites identified in this petition were examined by the Clinic. Nonetheless, other sites within and around the Badin Works site may also be contaminated. Alcoa and DENR records both suggest that environmental contamination may be present in other areas not identified in the RCRA Corrective Action plan or in this petition. Members of the Badin community have likewise mentioned that waste from the plant had been deposited outside of the areas identified by Alcoa for a number of years dating back to the early 1950s. We believe that a number of sites beyond those identified in this petition warrant inclusion in the requested Preliminary Assessment.

### Preliminary Assessment –New Monitoring Wells: SWMU 2

As part of the Preliminary Assessment, we recommend that EPA locate, install, and monitor three additional monitoring wells to be placed south of the landfill (in the alluvium) to determine whether the unlined landfill may be a source of the contamination in Little Mountain Creek. Approximately forty wells actively monitor the groundwater flowing into Badin Lake. However, we believe that the groundwater in the southern part of the plant, flowing from beneath SWMU 2 into Little Mountain Creek, is insufficiently monitored. Of the six monitoring wells around the perimeter of the landfill, only three (ABL-MW03, ABL-MW04, and ABL-MW05) are located in positions that allow for monitoring of water *leaving* the landfill (Figure 5).

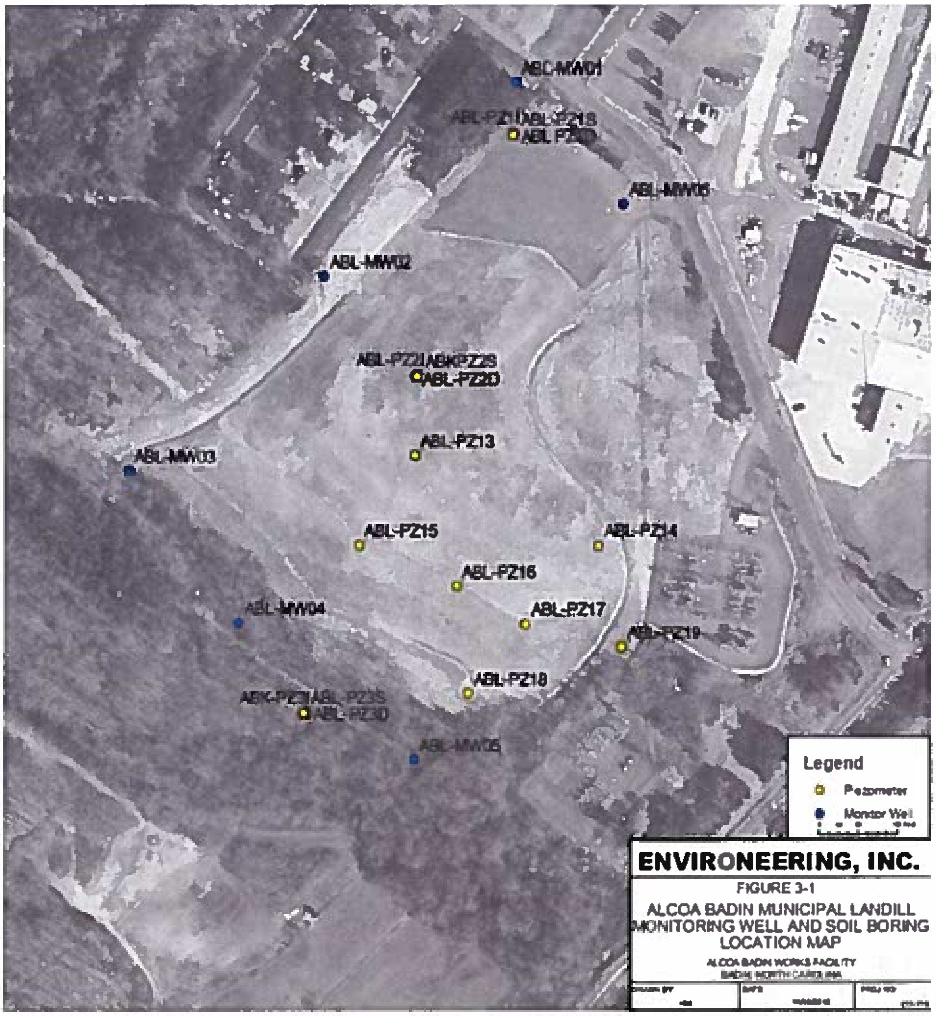


**Figure 5:** Locations of piezometers and monitoring wells in and around the Alcoa-Badin Landfill.[60]

## CONCLUSION AND REQUEST

Having conducted several rounds of testing, we believe that the two areas discussed in this petition warrant further investigation by EPA. Additional areas around the Badin Works site may also warrant investigation and should be sampled during the Preliminary Assessment. Numerous Alcoa Badin sites are already being investigated under RCRA; however the Ball Field has not been previously identified as a potential disposal site, and though Little Mountain Creek has been listed as "impaired" in the past, it still shows signs of degradation downstream of Outfall 018.

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[60] ENVIRONEERING, INC., PHASE 3—ENGINEERING DATA COLLECTION FOR THE CORRECTIVE MEASURES STUDY BADIN WORKS FACILITY BADIN, NORTH CAROLINA 11 (2012).

NC DENR has a history of dismissing the concerns of West Badin's environmental justice community and the Yadkin Riverkeeper without independent investigation. Alcoa has a history of improperly disposing of hazardous wastes around its facility. For these reasons, we request that EPA further investigate the areas discussed in this petition in order to determine the presence, extent, and impact of hazardous materials, and the eligibility of the areas to be listed as Superfund sites. Because Alcoa and North Carolina have not investigated or addressed the presence of hazardous wastes in surrounding areas during the RCRA process, EPA should now conduct a Preliminary Assessment of the contamination under CERCLA. Please contact us if you have any questions about this request. Thank you again for your attention.

Sincerely,
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# Appendix

## Table A-1. Summary of Previous K088 Rulemakings & Recent Litigation and Petitions

| Regulatory Event | Federal Register Notice | Date |
|---|---|---|
| Listed as a hazardous waste | 45 FR 47832 | July 16, 1980 |
| Listing suspended | 46 FR 4615 | January 16, 1981 |
| Environmental group challenged EPA's failure to complete the required studies under Sections 8002(f) and (p) | N/A | 1984 |
| Proposed relist | 50 FR 40292 | October 2, 1985 |
| Withdrawal of proposal of relist | 51 FR 36233 | October 9, 1986 |
| Court removed suspension of K088 listing (EDF vs. EPA) | N/A | July 1988 |
| Re-enact original listing of K088 | 53 FR 35412 | September 13, 1988 |
| Proposed LDR for K088 | 60 FR 11702 | March 2, 1995 |
| Final LDR for K088 | 61 FR 15566 | April 8, 1996 |
| Reynolds challenged EPA's decision of nine months of national capacity variance and sought the court's expedited review of the case | N/A | May 1996 |
| Generators from Northwest region petitioned for a two-year national capacity variance | N/A | July 9, 1996 |
| EPA extended the national capacity variance for an additional six months until July 8, 1997 | 62 FR 1992 | January 14, 1997 |
| LDR became effective with three months of capacity variance | 62 FR 37693 | July 14, 1997 |
| Court decision to vacate land disposal prohibition and treatment standards for two constituents (fluoride and arsenic) | N/A | April 1998 |
| EPA gained four months to stay its mandate after filing a motion to move the court for a stay in May 1998 and promulgated an interim final rule | 63 FR 51254 | September 24, 1998 |

**Source:** EPA, *Land Disposal Restrictions – Background Document to Establish Effective Date for Amended Treatment Standards for Spent Aluminum Potliners (Proposed Rule)* (2000), *available at* http://www.epa.gov/osw/hazard/tsd/ldr/k088/landdisp.pdf.

## Table A-2. Weather Conditions in Badin, NC 28009 before June 2014 Little Mountain Creek Sampling

| | High | Low | Precip | Snow | Avg. Hi | Avg. Lo |
|---|---|---|---|---|---|---|
| Thu 6/19/2014 | 91° | 71° | 0 in | 0 in | 85° | 66° |
| Fri 6/20/2014 | 89° | 67° | 0 in | 0 in | 86° | 66° |
| Sat 6/21/2014 | 87° | 69° | 0 in | 0 in | 86° | 66° |
| Sun 6/22/2014 | 84° | 69° | 0 in | 0 in | 86° | 66° |
| Mon 6/23/2014 | 83° | 67° | 0 in | 0 in | 86° | 67° |
| Tue 6/24/2014 | 82° | 69° | 0 in | 0 in | 86° | 67° |
| Wed 6/25/2014 | 88° | 71° | 0.01 in | 0 in | 86° | 67° |
| Thu 6/26/2014 | 89° | 67° | 0 in | 0 in | 86° | 67° |
| Fri 6/27/2014 | 87° | 69° | 0.02 in | 0 in | 87° | 67° |

**Source:** ACCUWEATHER.COM, *Badin, NC Local Weather for June 2014*, http://www.accuweather.com/en/us/badin-nc/28009/driving-june-weather/2132788?monyr=6/1/2014&view=table.

## Table A-3. SWMU 2 Monitoring Well and Piezometer Construction Details

**Table 3-2. Monitor-Well Construction Details**

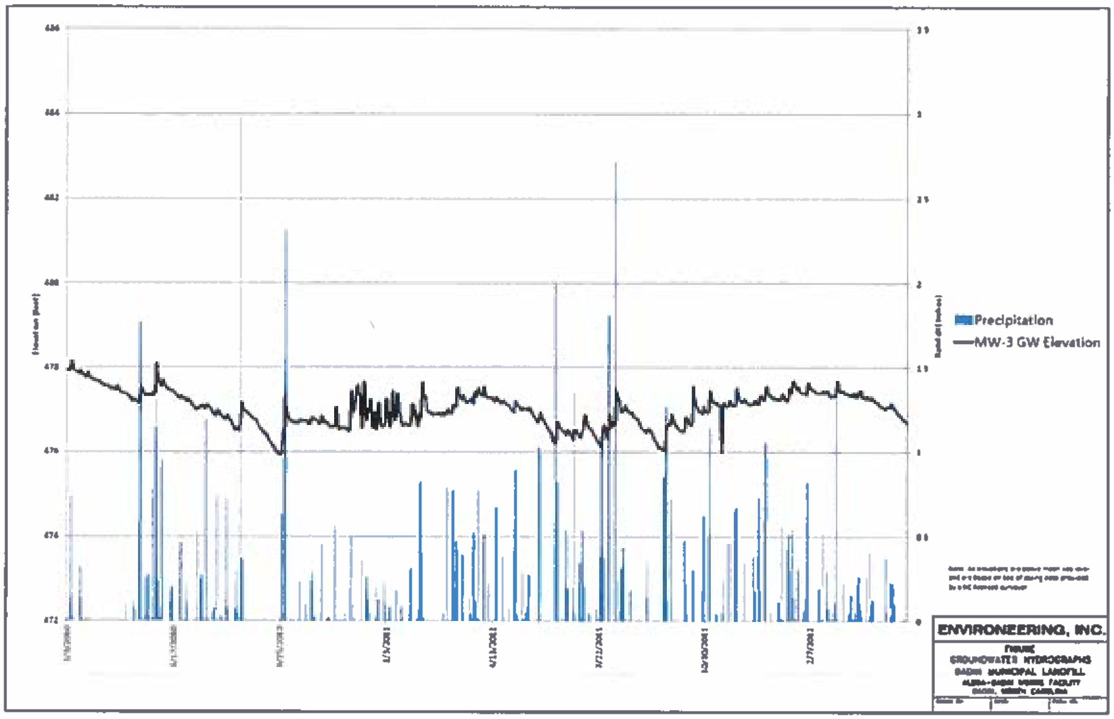
ALCOA Badin Works Badin, North Carolina

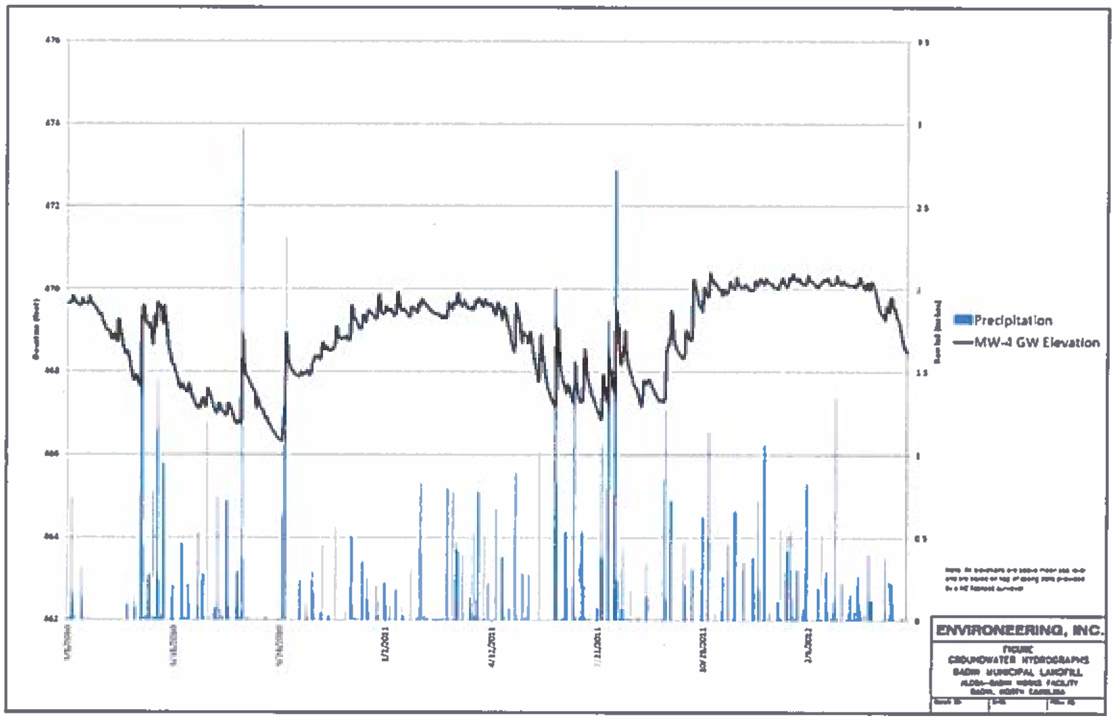
| Well Identification | Elevation Ground Surface (ft. msl) | Casing Elevation (TOC) (ft, msl) | Depth to Screened Interval from TOC (ft) | Depth of Screened Interval (ft, msl) |
|---|---|---|---|---|
| ABL-MW-1 | 539.40 | 541.46 | 35-45 | 504.40-494.40 |
| ABL-MW-2 | 538.73 | 541.04 | 37-47 | 501.73-491.73 |
| ABL-MW-3 | 476.52 | 478.46 | 4-14 | 472.52-462.52 |
| ABL-MW-4 | 470.41 | 472.11 | 4-14 | 466.41-456.41 |
| ABL-MW-5 | 467.08 | 468.75 | 4-14 | 463.08-453.08 |
| ABL-MW-6 | 536.20 | 538.03 | 25-35 | 511.20-501.20 |
| ABL-PZ-1S | 537.00* | 539.10 | 8-18 | 529.00-519.00 |
| ABL-PZ-1I | 537.00* | 538.98 | 30-40 | 507.00-497.00 |
| ABL-PZ-1D | 537.00* | 539.03 | 46-56 | 491.00-481.00 |
| ABL-PZ-2S | 532.00* | 534.68 | 24-34 | 508.00-498.00 |
| ABL-PZ-2I | 532.00* | 534.81 | 43-53 | 489.00-479.00 |
| ABL-PZ-D | 532.00* | 534.93 | 60-70 | 472.00-462.00 |
| ABL-PZ-3S | 468.00* | 470.37 | 3-8 | 465.00-460.00 |
| ABL-PZ-3I | 467.00* | 469.81 | 15-25 | 452.00-442.00 |
| ABL-PZ-3D | 467.00* | 469.82 | 40-50 | 427.00-417.00 |
| ABL-PZ-4 | 477.13 | 479.63 | 5-15 | 472.13-462.13 |
| ABL-PZ-5 | 512.24 | 515.50 | 37-47 | 475.24-465.24 |
| ABL-PZ-6 | 525.24 | 529.37 | 45.8-55.8 | 479.44-469.44 |
| ABL-PZ-10 | 481.35 | 484.12 | 10-20 | 471.35-461.35 |
| ABL-PZ-11 | 500.27 | 503.26 | 25-35 | 475.27-465.27 |
| ABL-PZ-12 | 526.14 | 530.24 | 42-52 | 484.14-474.14 |

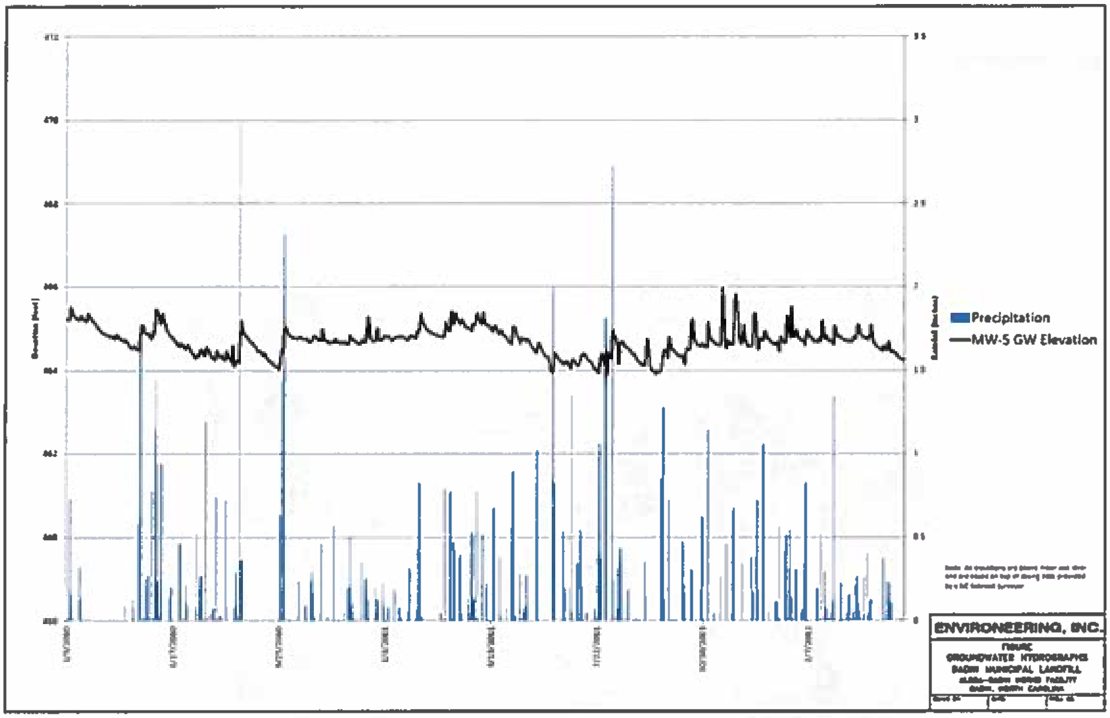
ft - feet
msl- mean sea level
TOC - top of casing
* - approximate

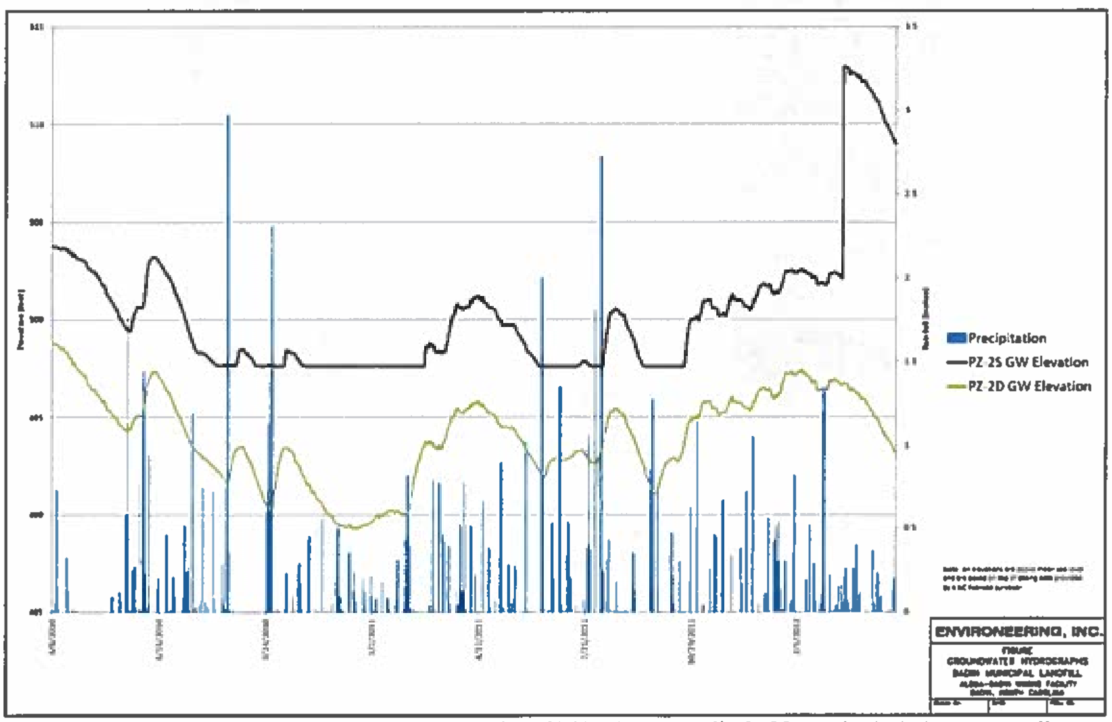
**Source:** GERAGHTY & MILLER, INC., GROUNDWATER FLUX DETERMINATION ALUMINUM COMPANY OF AMERICA BADIN LANDFILL BADIN WORKS FACILITY BADIN, NORTH CAROLINA 22 (1997) (included as Appendix A-4 of ALCOA, INTERIM MEASURES WORKPLAN, ALCOA-BADIN LANDFILL (SWMU #2), REGRADING AND COVER SYSTEM INSTALLATION (1997)).

## Figure A-1. Groundwater Hydrographs for SWMU 2/Badin Municipal Landfill



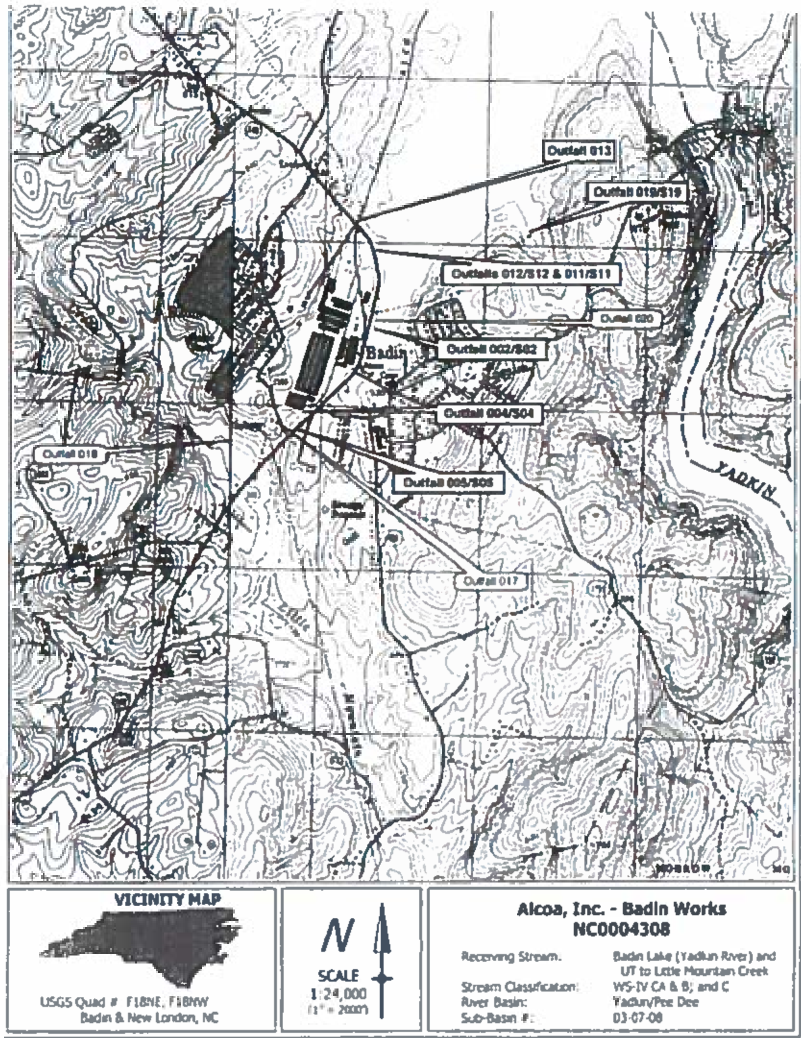





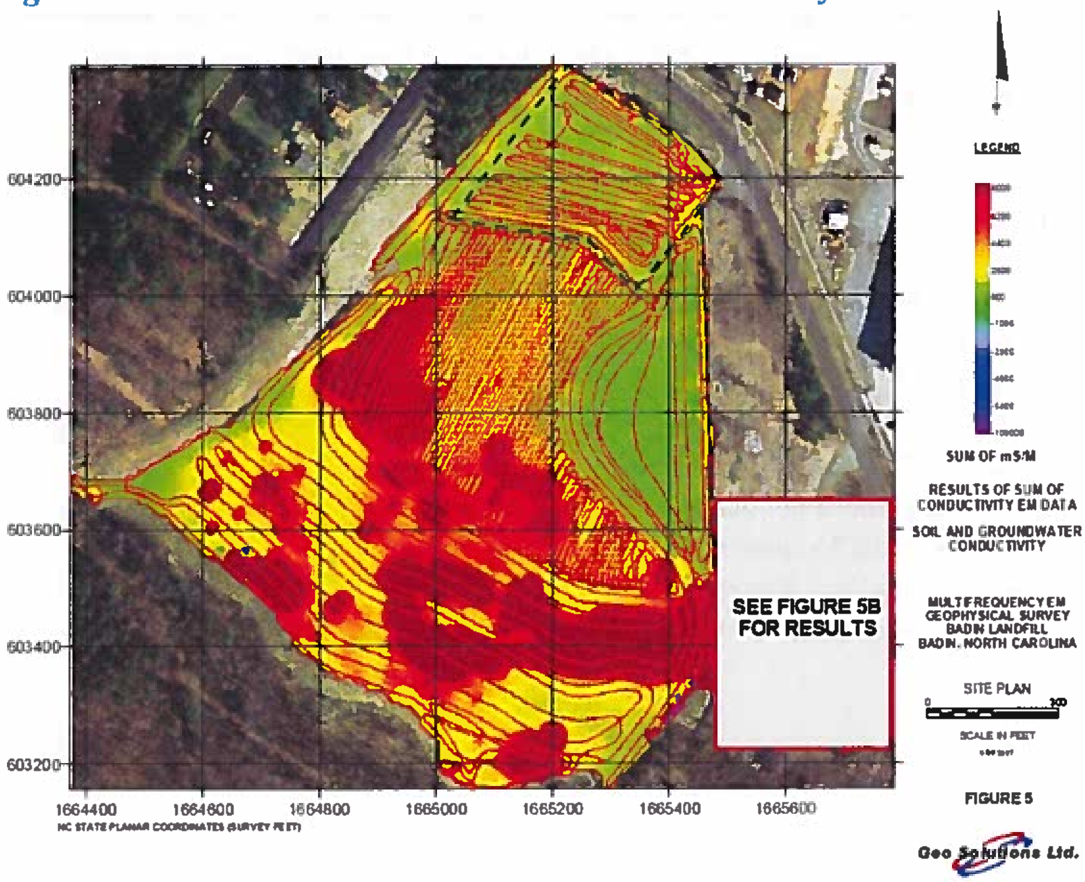

**Source:** TESTAMERICA, TESTAMERICA JOB ID: 680-71611-1, Appendix I (2011) (included as Appendix H within ENVIRONEERING, INC., PHASE 3—ENGINEERING DATA COLLECTION FOR THE CORRECTIVE MEASURES STUDY BADIN WORKS FACILITY BADIN, NORTH CAROLINA (2012)).

## Figure A-2. Map of Alcoa Badin Works and NPDES Permit Discharge Locations




**Source:** NPDES Permit No. NC0004308, originally issued Oct. 25, 1995. Subsequent permit issued Feb. 22, 2008. Modified in 2010.

## Figure A-3. SWMU 2 Soil and Groundwater Conductivity




**Source:** Geo Solutions Ltd., Inc., Geophysical Evaluation at the Alcoa Power Generating, Inc. Yadkin Division Switchyard and the SWMU No. 2, Alcoa/Badin Landfill, Badin, North Carolina 10 (2008) (included as Appendix A within Environeering, Inc., Phase 3—Engineering Data Collection for the Corrective Measures Study Badin Works Facility Badin, North Carolina (2012)).

## Index for Electronic Appendix

1. Cover Letter & Report, N.C. Div. of Health Servs., Final Preliminary Assessment Report (1985).
2. NUS Corp., Preliminary Reassessment (1989).
3. A.T. Kearney, Inc. & DPRA, Inc., Interim RCRA Facility Assessment Report (1990).
4. Law Envtl., Phase II Ground-water Assessment Northwest Valley, Alcoa-Badin Works, Badin, North Carolina (1990).
5. Alcoa, Interim Measures Workplan, Alcoa-Badin Landfill (SWMU #2), Regrading and Cover System Installation (1997).
6. MFG, Inc., RCRA Facility Investigation Report, Volume I of II (2001).
7. Order of Hon. Sharon Armstrong in Alcoa, Inc. v. Accident & Casualty Company, Case No. 92-2-28065-SEA (Sup. Ct. Wash. King Cnty. 2003).
8. HDR Eng'g, Inc., Preliminary Findings & Recommendations Report - Mountain Creek and Little Mountain Creek and Jacobs Creek (2004).
9. Environeering, Inc., Phase 3—Engineering Data Collection for the Corrective Measures Study Badin Works Facility Badin, North Carolina (2012).

# REFERENCE 19

Alcoa Badin Works
April/May 2015

| Sample Location | Cyanide (mg/L) | | Fluoride (mg/L) | | Arsenic (μg/L) | | Chloride (mg/L) | Bromide (mg/L) | Sulfate (mg/L) | Aluminum (μg/L) | Cadmium (μg/L) | Chromium (μg/L) | Copper (μg/L) | Iron (μg/L) | Mercury (μg/L) | Sodium (mg/L) | Nickel (μg/L) | Lead (μg/L) | Zinc (μg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upstream LMC - 4/23/15 | <0.02 | <0.005 | <0.4 | <0.1 | <2.0 | <20 | 7.5 | <0.4 | 8.3 | 430 | <0.5 | <10 | <2 | 760 | <0.2 | 7.4 | <2.0 | <2.0 | <10.0 |
| Upstream LMC - 5/27/15 | <0.01 | <0.005 | <0.4 | <0.1 | <2.0 | <20 | 6.7 | <0.4 | 8.1 | 1300 | <0.5 | <10 | 3.8 | 1800 | <0.2 | 6.8 | 2.4 | <2.0 | <10 |
| Background GW Seep - 4/23/15 | <0.02 | <0.005 | 0.6 | <0.1 | <2.0 | <20 | 7.4 | <0.4 | 2.8 | 1100 | <0.5 | <10 | 3 | 2300 | <0.2 | 7.1 | 2.4 | <2.0 | 11.0 |
| Background GW Seep - 5/27/15 | <0.01 | <0.005 | <0.4 | <1.0 | <2.0 | <20 | 3 | <0.4 | <2.0 | 1000 | <0.5 | <10 | 3 | 1800 | <0.2 | 6.4 | 3 | <2.0 | <10 |
| West Toe Channel LMC - 4/23/15 | <0.02 | <0.005 | 0.8 | 0.64 | 5.1 | <20 | 7.8 | <0.4 | 9.6 | 3700 | <0.5 | <10 | 9.9 | 36000 | <0.2 | 38 | 9.4 | 6.5 | 18.0 |
| West Toe Wetland Area - 5/27/15 | | 0.0093 | 30 | 28 | 3.3 | <20 | 19 | <0.4 | 210 | 1300 | <0.5 | <10 | 6.3 | 2100 | <0.2 | 470 | 3.1 | <2.0 | <10 |
| Middle Toe Channel - 4/23/15 | <0.02 | 0.0089 | 21 | 20 | 5.2 | <20 | 17 | <0.4 | 66 | 6600 | <0.5 | <10 | 14 | 6000 | <0.2 | 310 | 9 | 5.8 | 19.0 |
| East Toe Channel - 4/23/15 | <0.02 | 0.016 | 6.3 | 6.4 | <2.0 | <20 | 12 | <0.4 | 72 | 1700 | <0.5 | <10 | 4.2 | 1400 | <0.2 | 230 | <2.0 | <2.0 | <10 |
| East Toe Channel - 5/27/15 | 0.016 | 0.025 | 12 | 11 | 3.7 | <20 | 15 | <0.4 | 110 | 6700 | <0.5 | <10 | 12 | 5400 | <0.2 | 330 | 3.8 | 3.9 | 11.0 |
| East Lower Toe Channel - 5/27/15 | 0.105J | 0.045 | 5.1 | 5.1 | 2.8 | <20 | 14 | <0.4 | 93 | 2600 | <0.5 | <10 | 5.7 | 2900 | <0.2 | 180 | 2.7 | 2.1 | <10 |
| Downstream LMC - 4/23/15 | <0.02 | <0.005 | <0.4 | <0.1 | <2.0 | <20 | 7.4 | <0.4 | 8.6 | 370 | <0.5 | <10 | <2.0 | 740 | <0.2 | 8 | <2.0 | <2.0 | <10 |
| Downstream LMC - 5/27/15 | <0.01 | <0.005 | <0.4 | <0.1 | <2.0 | <20 | 7.1 | <0.4 | 7.5 | 860 | <0.5 | <10 | 2.8 | 1500 | <0.2 | 8.2 | <2.0 | <2.0 | <10 |
| Landfill PS - 4/23/15 | <0.02 | <0.005 | 24 | 20 | <2.0 | <20 | 19 | 0.7 | 150 | 510 | <0.5 | <10 | 2.3 | 900 | <0.2 | 320 | <2.0 | <2.0 | <10 |
| Landfill PS - 5/27/15 | 0.014 | <0.005 | 26 | 20 | <2.0 | <20 | 24.0 | <0.4 | 160 | 280 | <0.5 | <10 | 2.1 | 860 | <0.2 | 380 | <2.0 | <2.0 | <10 |

LMC - Little Mountain Creek
PS - Pump Station
DWR - Blue text
Alcoa - Green text

West and Middle Toe Channels were dry on 5/27/15
J - denotes estimated value

Checking with lab regarding missing Tin and Titanium values for 4/23/15 upstream and downstream

Alcoa Badin Works
April/May 2015

| Sample Location | Antimony (µg/L) | Barium (µg/L) | Beryllium (µg/L) | Calcium (mg/L)* | Cobalt (µg/L) | Manganese (µg/L) | Potassium (mg/L) | Lithium (µg/L) | Magnesium (mg/L) | Molybdenum (µg/L) | Selenium (µg/L) | Silver (µg/L) | Strontium (µg/L) | Thallium (µg/L) | Tin (µg/L) | Titanium (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upstream LMC - 4/23/15 | <10.0 | 14 | <5.0 | 6.1 | <50 | 35 | 0.84 | <25 | 3.2 | <10.0 | <5.0 | <1.0 | 34 | <2.0 | | |
| Upstream LMC - 5/27/15 | | | | | | | | | | | | | | | | |
| Background GW Seep - 4/23/15 | <10.0 | 19 | <5.0 | 5.9 | <50 | 220 | 1.1 | <25 | 2.4 | <10.0 | <5.0 | <1.0 | 44 | <2.0 | <10 | <10 |
| Background GW Seep - 5/27/15 | | | | | | | | | | | | | | | | |
| West Toe Channel LMC - 4/23/15 | <10 | 73 | <5.0 | 8.6 | <50 | 6100 | 1 | <25 | 5.3 | <10 | <5.0 | <1.0 | 40 | <2.0 | <10 | 25 |
| West Toe Wetland Area - 5/27/15 | | | | | | | | | | | | | | | | |
| Middle Toe Channel - 4/23/15 | <10 | 83 | <5.0 | 27 | <50 | 3400 | 6 | <25 | 12 | <10 | <5.0 | <1.0 | 160 | <2.0 | <10 | 39 |
| East Toe Channel - 4/23/15 | <10 | 24 | <5.0 | 24 | <50 | 1100 | 4.4 | <25 | 7.2 | <10 | <5.0 | <1.0 | 83 | <2.0 | <10 | 18 |
| East Toe Channel - 5/27/15 | | | | | | | | | | | | | | | | |
| East Lower Toe Channel - 5/27/15 | | | | | | | | | | | | | | | | |
| Downstream LMC - 4/23/15 | <10 | 13 | <5.0 | 6.1 | <50 | 38 | 0.85 | <25 | 3.2 | <10 | <5.0 | <1.0 | 34 | <2.0 | | |
| Downstream LMC - 5/27/15 | | | | | | | | | | | | | | | | |
| Landfill PS - 4/23/15 | <10 | 27 | <5.0 | 51 | <50 | 760 | 9.4 | <25 | 11 | <10 | <5.0 | <1.0 | 220 | <2.0 | <10 | <10 |
| Landfill PS - 5/27/15 | | | | | | | | | | | | | | | | |

LMC - Little Mountain Creek
PS - Pump Station
DWR - Blue text
Alcoa - Green text

West and Middle Toe Channels were c
J - denotes estimated value

Checking with lab regarding missing Ti

Alcoa Badin Works
April/May 2015

| Sample Location | Vanadium ($\mu$g/L) |
|---|---|
| Upstream LMC - 4/23/15 | <25.0 |
| Upstream LMC - 5/27/15 | |
| Background GW Seep - 4/23/15 | <25.0 |
| Background GW Seep - 5/27/15 | |
| West Toe Channel LMC - 4/23/15 | <25 |
| West Toe Wetland Area - 5/27/15 | |
| Middle Toe Channel - 4/23/15 | <25 |
| East Toe Channel - 4/23/15 | <25 |
| East Toe Channel - 5/27/15 | |
| East Lower Toe Channel - 5/27/15 | |
| Downstream LMC - 4/23/15 | <25 |
| Downstream LMC - 5/27/15 | |
| Landfill PS - 4/23/15 | <25 |
| Landfill PS - 5/27/15 | |

LMC - Little Mountain Creek
PS - Pump Station
DWR - Blue text
Alcoa - Green text

West and Middle Toe Channels were c
J - denotes estimated value

Checking with lab regarding missing Ti

Landfill
Upstream-Little Mtn Creek and Background GW Samples were all <detection for Fl, Cn, & As
Channel below West Toe Drain: Fl, Cn, & As all < detection
Leachate Pump Station: Fl - 20ppm, < detection for Cn & As
Channel below Middle Toe Drain: Fl - 20 ppm, Cn - 8.9ppb, <detection - As
Little Mountain Creek
Channel below East Toe Drain System: Fl - 6.4ppm, Cn - 16ppb, < detection - As
Downstream Little Mtn Creek: Fl, Cn, & As < detection
© 2015 Google

**REFERENCE 20**

ENVIRONEERING, INC.

# SAMPLING WORK PLAN

# FOR THE

# ALCOA BADIN LANDFILL AND FORMER BALL FIELD
# FORMER BADIN WORKS FACILITY
# BADIN, NORTH CAROLINA

**February 23, 2015**
**REVISED: June 5, 2015**

**Prepared for:**

ALCOA

Alcoa, Inc.
Highway 740
Badin, North Carolina 28009

**Prepared by:**


**ENVIRONEERING, INC.**
**810 Highway 6 South, Suite 200**
**Houston, Texas 77079**
**281-493-9005**

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# 1.0 INTRODUCTION

On January 22, 2015, a letter was submitted from North Carolina Department of Environment and Natural Resources ("*NCDENR*") Hazardous Waste Section to Alcoa determined under its regulatory authority regarding Solid Waste Management Units that additional samples are required along Little Mountain Creek near the Alcoa / Badin Landfill and the baseball field in Badin near the boat ramp. NCDENR made this determination based upon their review of the undated document titled *Request for Preliminary Assessment for Areas Surrounding Alcoa Badin Works Facility in Badin, North Carolina*. This document was prepared by the Duke Environmental Law and Policy Clinic, on behalf of the Yadkin Riverkeeper, Inc. as a petition to Region 4 of the United States Environmental Protection Agency ("*USEPA*").

On February 23, 2015, Alcoa developed a work plan to meet the requirements of the January 22, 2015, letter from NCDENR Hazardous Waste Section. On May 14, 2015, Alcoa received comments from NCDENR Hazardous Waste Section. Alcoa incorporated these comments into this revised work plan, which provides a background for the sampling and outlines the procedures for collecting samples to further assess the selected areas surrounding the Alcoa Badin Works Main Plant.

## 1.1 Alcoa Badin Works Background

In March 1990, Alcoa filed a RCRA Part B permit application with USEPA to store waste on-site in an enclosed storage building for greater than 90 days. In response to the permit application, USEPA Region IV performed a RCRA Facility Assessment ("*RFA*") of the Alcoa Badin Works and associated off-site locations. The RFA identified at total of 34 SWMUs and 2 Areas of Concern ("*AOCs*"). Twelve additional SWMUs were added after the initial RFA was completed. The Alcoa/Badin Landfill was identified as SWMU No. 2. The former Ball Field was not identified as a SWMU. The North Carolina Department of Environment, Health, and Natural Resources Division of Solid Waste Management (now the NCDENR Division of Waste Management), in cooperation with USEPA Region IV, issued the final RCRA Part-B Permit to Alcoa on March 30, 1992.

Part VII of Alcoa's RCRA permit outlined the corrective action activities to be conducted. The initial step in the process required that confirmatory sampling be conducted at seven SWMUs. Based on the results of the RFA and the confirmatory sampling a RCRA Facility Investigation ("*RFI*") was conducted at 16 SWMUs and AOCs. The RFI Report was submitted to the NCDENR in March 2001. Interim Measures activities have been conducted at a number of the Badin SWMUs, including the Alcoa/Badin Landfill. The RFI report identified groundwater at the Alcoa/Badin Landfill as needing further action.

## 1.2 Alcoa/Badin Landfill Background

The Alcoa/Badin Landfill was used as an unlined municipal/industrial solid-waste landfill. This unit was positioned within a natural ravine located southeast of Wood St. extending to the edge of Little Mountain Creek flood plain. Municipal refuse, process material, and native fill material were used to fill the natural ravine approximately 13 to 42 feet.

In 1997, Alcoa completed interim measures at the landfill consisting of re-grading and cover improvements of two additional feet of low permeability clay and six inches of topsoil to establish a vegetative cover. The objectives of the interim measures were to prevent surface run-on, promote surface run-off, and reduce infiltration into the landfill.

Three seeps (western, middle, and eastern) are present at the base of the landfill. Historic analytical data suggested the seeps emanate water that passes through the landfill materials. A portion of the seep water was believed to originate upslope of the landfill due to precipitation infiltration and a portion from recharge from bedrock through the base of the landfill. In 2005, a seep collection system was installed to re-route the discharge to a utility sewer that leads to a Stanly County Utilities POTW. The fill and hydrogeological assessments suggest a more complex hydrological model is taking place. Components of seep water may include components of surficial flow, infiltration through the cap and surrounding areas, and shallow horizontal flow through soil and fill materials. Hydrographs indicate that the cap is impeding infiltration.

Recent groundwater sampling results demonstrate the beneficial effects of the cover system upgrades. In results from all the recent sampling events, available cyanide and fluoride were not reported in any well at concentrations that exceed the NC 2L Standard.

### 1.2.1 Little Mountain Creek Background

A part of the RFI, a screening level risk assessment was conducted on Little Mountain Creek. Results of the screening level risk assessment indicated that no Constituents of Interest ("*COIs*") were present at concentrations exceeding applicable human health screening values in Little Mountain Creek. To confirm that understanding, a surface water sample was collected in November 2011 from Little Mountain Creek adjacent to the Alcoa/Badin Landfill. The surface water sample was analyzed for Available Cyanide, Total Fluoride, trichloroethylene, polychlorinated biphenyls ("*PCBs*"), and polycyclic aromatic hydrocarbons ("*PAHs*"). The November 2011 results, reported fluoride in the laboratory Method Blank, and samples from this period were noted with a "B" qualifier by the lab. It is believed that the surface water sample from this period did not contain fluoride, and the reported value is the result of a laboratory artifact. Available Cyanide, TCE, PAHs, and PCBs were not detected in the November sampling event. The November 2011 results were consistent with the historical sampling results documented in the RFI.

## 1.3 Former Ball Field Background

The RFA and follow up investigations identified at total of 46 SWMUs and 2 AOCs. The former Ball Field was not identified as a SWMU. The above referenced report, *Request for Preliminary Assessment for Areas Surrounding Alcoa Badin Works Facility in Badin, North Carolina*, asserts "the baseball diamond disappeared from aerial photographs around 1960". Alcoa does not believe this statement to be accurate.

The current understanding is that the former Ball Field was either undeveloped or historically used as a recreational area through almost all of the 20th century. To illustrate Alcoa's understanding of the area, a chronology of the site was assembled using historical topographic maps, historical photographs, and aerial imagery. The following information was used in developing this chronology:

P31 1916 Plant before lake filled [photograph]. December 1, 1916. from: Alcoa Inc.

Topographic Map, Badin and Vicinity; prepared for Tallahassee Power Company, Badin Works; Drawing A1500BN dated October 25, 1917; Scale, 1 inch equals 400 feet.

Panoramic photographs of the Yadkin Pee Dee River Valley [photograph]. November 15, 1919. Data available from the North Carolina Digital Heritage Center.

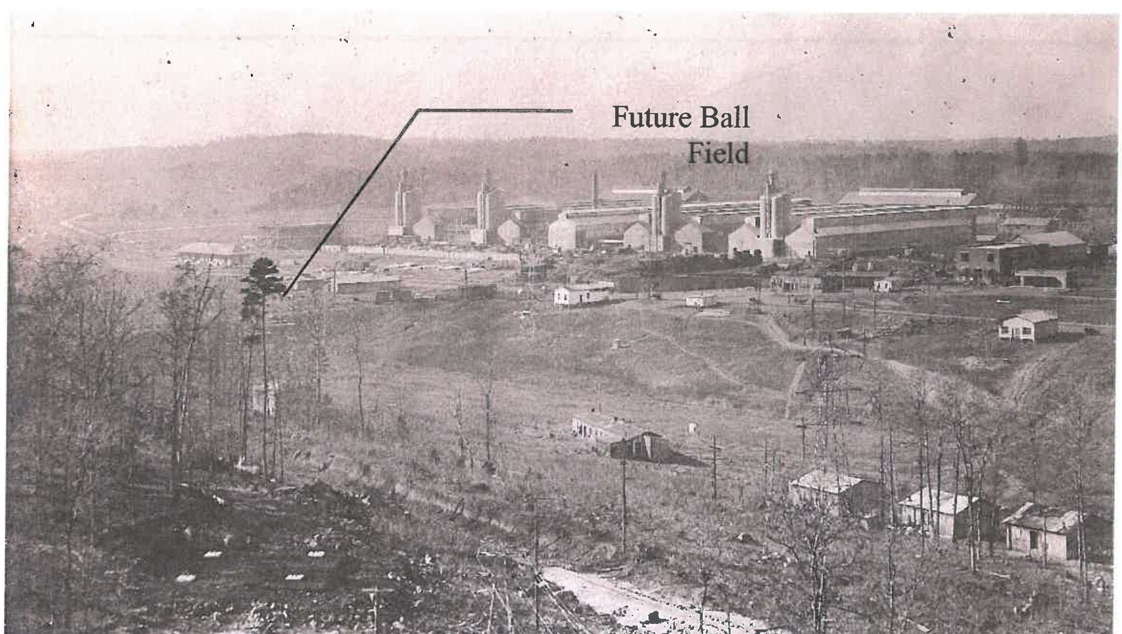
Aerial Photography Single Frame Records. October 14, 1950, February 23, 1951, April 16, 1955, September 1, 1964, February 2, 1984, January 23, 1993, March 10, 1998, and January 27, 2010. Data available from the U.S. Geological Survey.

Aerial Photography Single Frame Records. 1938 and 1999. from: Alcoa Inc.

The following section gives an overview of the facts contained in the historical maps and imagery.

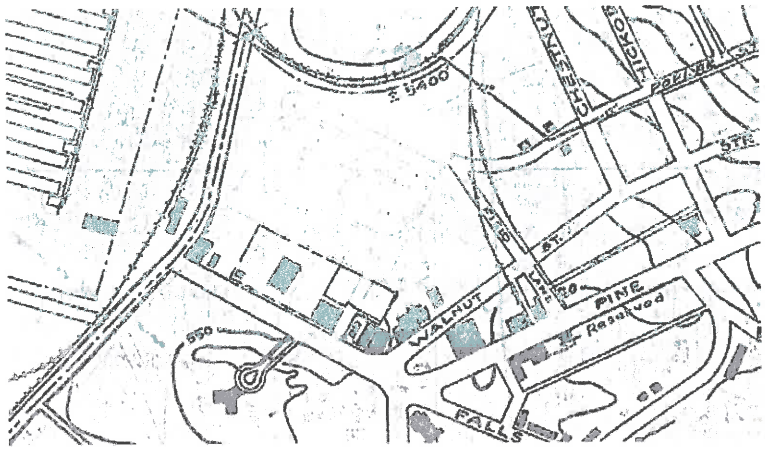
1.3.1 Former Ball Field Background

In 1915, the Aluminum Company of America purchased an unfinished aluminum smelting complex. Two years later, the company had completed the plant and begun to produce aluminum. A planned community was built to serve the workers of the construction crews and the plant. One photograph of the plant during the construction phase, dated December 1, 1916, shows the topographic surface of the area prior to creating the lake. The approximate location of the future Ball Field is indicated on the photograph.



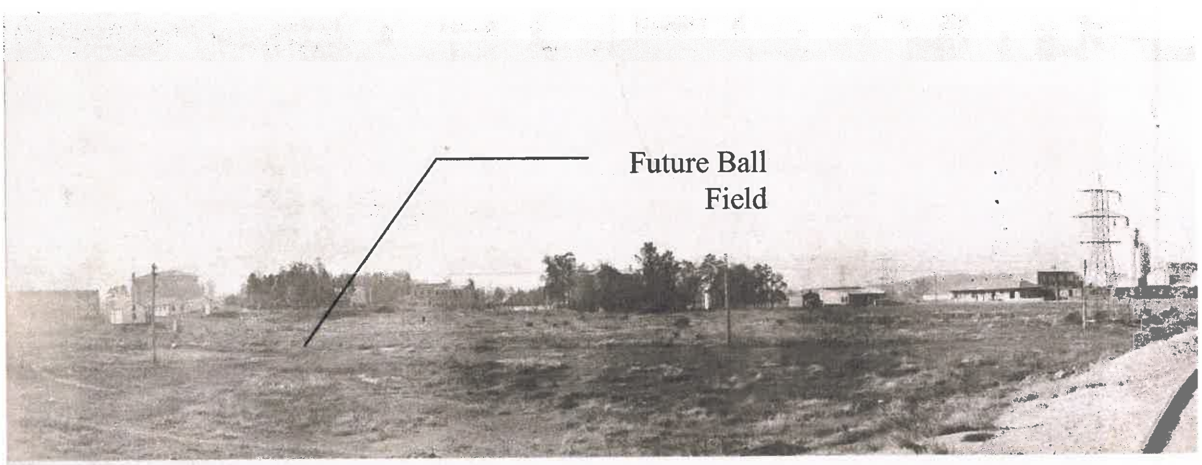

Excerpt from December 1, 1916, photograph. Photograph direction is approximately SW

The October 25, 1917, drawing shows the earliest indication of the intent to use the area for recreational purposes. Faded text on the drawing reads "Proposed Athletic Field" at the end of Field Lane.




Excerpt from October 25, 1917, drawing A1500BN [drawing]

A second photograph, dated November 15, 1919, shows the detailed surface of the future Ball Field. The approximate location of the future Ball Field is indicated on the photograph. The limited vegetative cover is believed to be due to the recent construction activities in the area. Topographic relief between the ground surface and the railroad appears to be on the order of a few feet.




Excerpt from November 15, 1919, photograph. Photograph direction is approximately W

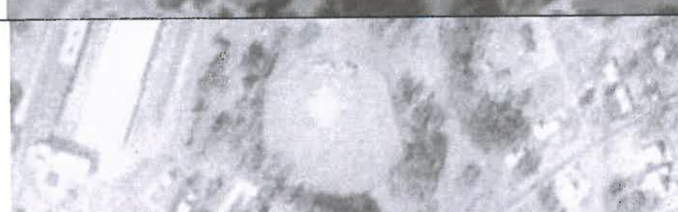
A 1938 aerial photograph shows the establishment of a vegetative cover at the future Ball Field.

| Date | Aerial Photograph |
| --- | --- |
| 1938 |  |

An undated oblique aerial photograph, believed to be captured between 1938 and 1950, show an increasing vegetative cover over the future Ball Field. The date range was determined through a comparison of vegetative cover at the future Ball Field and the plant features between the 1938 and 1950 aerials.

Excerpt from undated oblique aerial photograph of Badin [photograph]
Photograph direction is approximately NE

An October 14, 1950, aerial photograph shows the first appearance of the Ball Field, which is also visible in aerial photographs through 1998.

| Date | Aerial Photograph |
|---|---|
| October 14, 1950 |  |
| February 23, 1951 |  |
| April 16, 1955 |  |
| September 1, 1964 |  |
| February 2, 1984 |  |
| January 23, 1993 |  |

| Date | Aerial Photograph |
|---|---|
| March 10, 1998 |  |

Between the March 10, 1998, and 1999, the Ball Field and grandstands were removed. The former Ball Field has remained relatively unchanged since 1999, as seen in the 2010 aerial photo.

| Date | Aerial Photograph |
|---|---|
| 1999 |  |
| January 27, 2010 |  |

A review of historical topographic maps, historical photographs, and aerial imagery confirms that the former Ball Field was either undeveloped or historically used as a recreational area through almost all of the 20th century. Based on available photographs, the ball field was installed between 1938 and 1950, and has been unutilized since the late 1990s.

# 2.0 SCOPE AND TASKS

## 2.1 Project Scope

The purpose of this Work Plan is to provide a guidance document to meet the requirements of the January 22, 2015, letter from NCDENR Hazardous Waste Section. The January 22, 2015, letter required additional sampling along Little Mountain Creek near the Alcoa/Badin Landfill and the former Ball Field near the boat ramp.

## 2.2 Project Tasks

The scope will be met through the completion of the following tasks:

### 2.2.1 Task 1 – Alcoa/Badin Landfill Area

To determine if constituents of concern may be leaching from the Alcoa/Badin Landfill into nearby Little Mountain Creek, the following samples will be collected:

- Sediment and surface water samples will be collected in Little Mountain Creek
    - Upstream of the Alcoa/Badin Landfill;
    - Downstream of the Middle seep; and
    - Downstream of the Alcoa/Badin Landfill.
- Groundwater samples will be collected from the collection system piping at each of the seeps at the toe of the Alcoa/Badin Landfill (Western, Middle, and Eastern seeps).
- Surface water samples will be collected from one area of standing or flowing water between each of the Western, Middle, and Eastern seeps and Little Mountain Creek.
- A surface water sample will also be collected at the area of an alleged pipe failure as identified on pages 12 and 13 of the third party report, *Request for Preliminary Assessment for Areas Surrounding Alcoa Badin Works Facility in Badin, North Carolina.*

Per NCDENR request, the sediment and water samples associated with the Little Mountain Creek sampling will be analyzed for the following constituents:

- Total Cyanide (Sediment and Surface Water Samples Only)
- Available Cyanide (Groundwater Samples Only)
- Total Fluoride
- RCRA Metals (with Hg)
- Volatile Organic Compounds ("*VOCs*"),
- Semi-volatile Organic Compounds ("*SVOCs*"),
- PCBs, and
- PAHs (via SVOCs).

For the selected SVOC method, PAHs are a subset of SVOCs, and will be reported through the SVOC method.

### 2.2.2 Task 2 – Former Ball Field

To determine if the former Ball Field has been affected by historical industrial activity, Alcoa will collect surface and sub-surface soil, sediment, surface water, and groundwater samples. If there is no visible evidence of contamination on the surface of the former Ball Field, a grid will be established with line intersections (nodes) spaced approximately eighty feet apart. Figure 2-2 shows the anticipated grid layout which will be established for the former Ball Field.

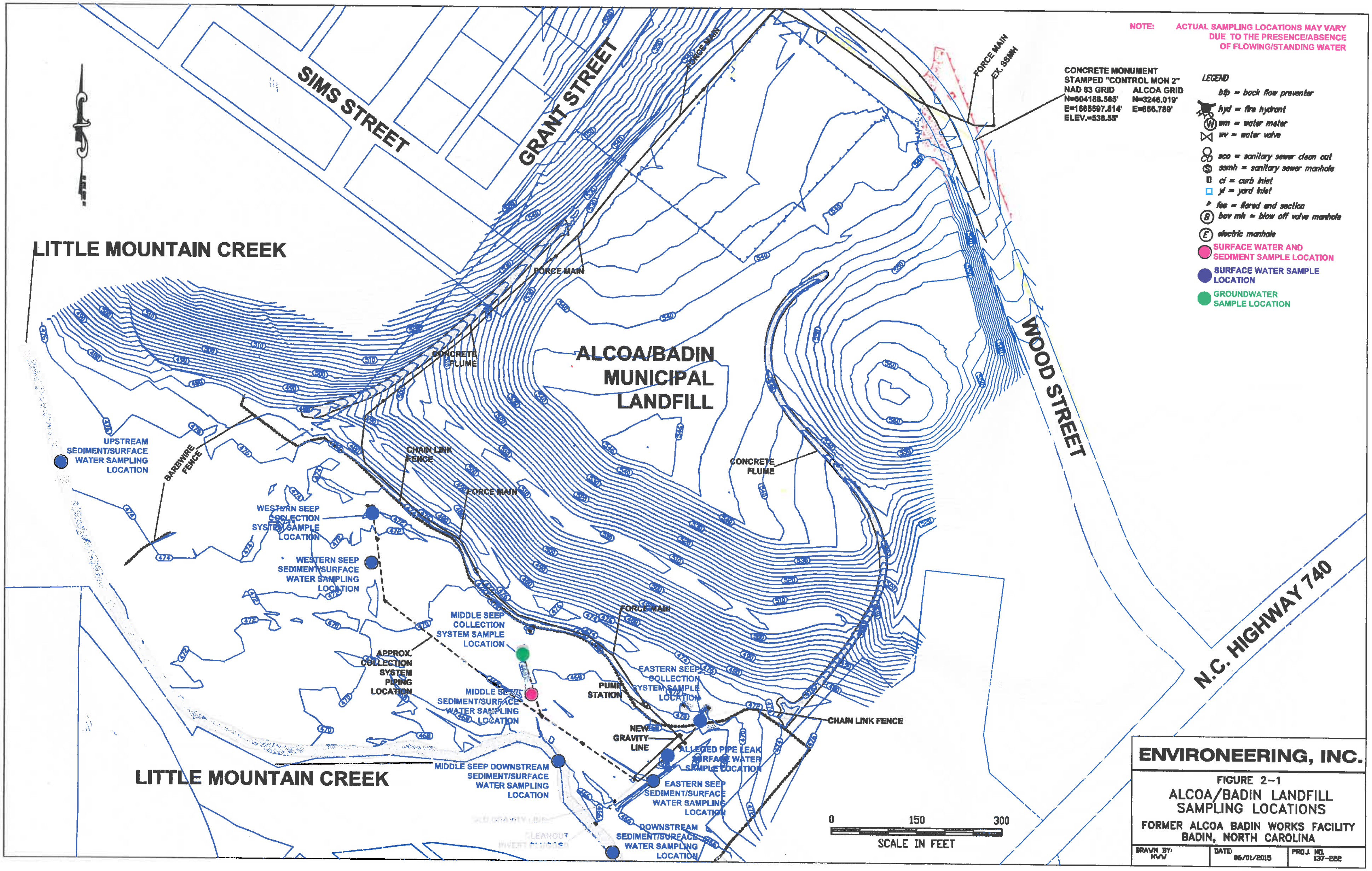
Surface soil samples will be collected at each grid node from the upper 24-inches of soil after the grass is removed using either a stainless steel hand trowel or hand auger. In addition, eight deep soil samples (six to ten feet below ground surface) will be collected at selected locations in the former Ball Field using a small portable Geoprobe®-like system. If native soil is encountered prior to reaching the targeted depth, the soil sample will be collected from uppermost non-native interval. Figure 2-3 shows the anticipated layout of the deep soil samples.

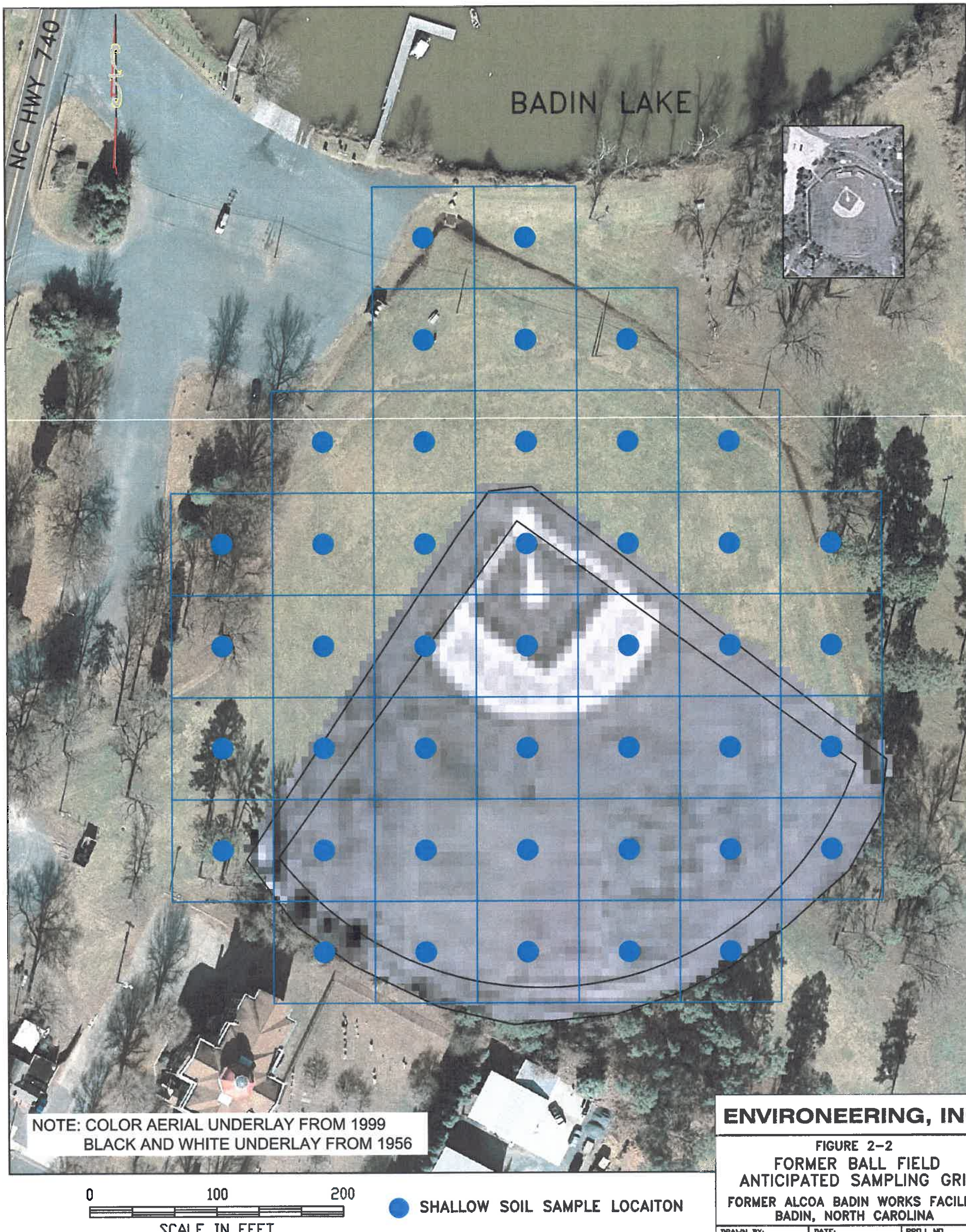
Shallow water samples will be collected in the area between Badin Lake and the Former Ball Field from three of the eight deep soil sample locations. Three shallow groundwater sampling points will be installed using the portable Geoprobe®-like system. A temporary monitor well will be installed to facilitate the collection of groundwater samples. Prior to collecting each sample, the temporary wells will be purged and monitored with a portable water quality meter until 5 well volumes or at least two parameters from the measurements of the water quality meter have stabilized. Figure 2-3 shows the anticipated layout of the groundwater samples.

The concrete surface water collection box at the north end of the Former Ball Field will be sampled. Water and sediment, if present, will be collected from the box and submitted for analyses. In addition, a surface water and sediment sample will be collected near the discharge point of the box in Badin Lake. Figure 2-4 shows the anticipated layout of the sediment and surface water samples.

Per NCDENR request, the soil and water samples associated with the Former Ball Field sampling will be analyzed for the following constituents:

- Total Cyanide (Soil, Sediment, and Surface Water Samples Only)
- Available Cyanide (Groundwater Samples Only)
- Total Fluoride
- RCRA Metals (with Hg),
- VOCs,
- SVOCs,
- PCBs, and
- PAHs (via SVOCs).

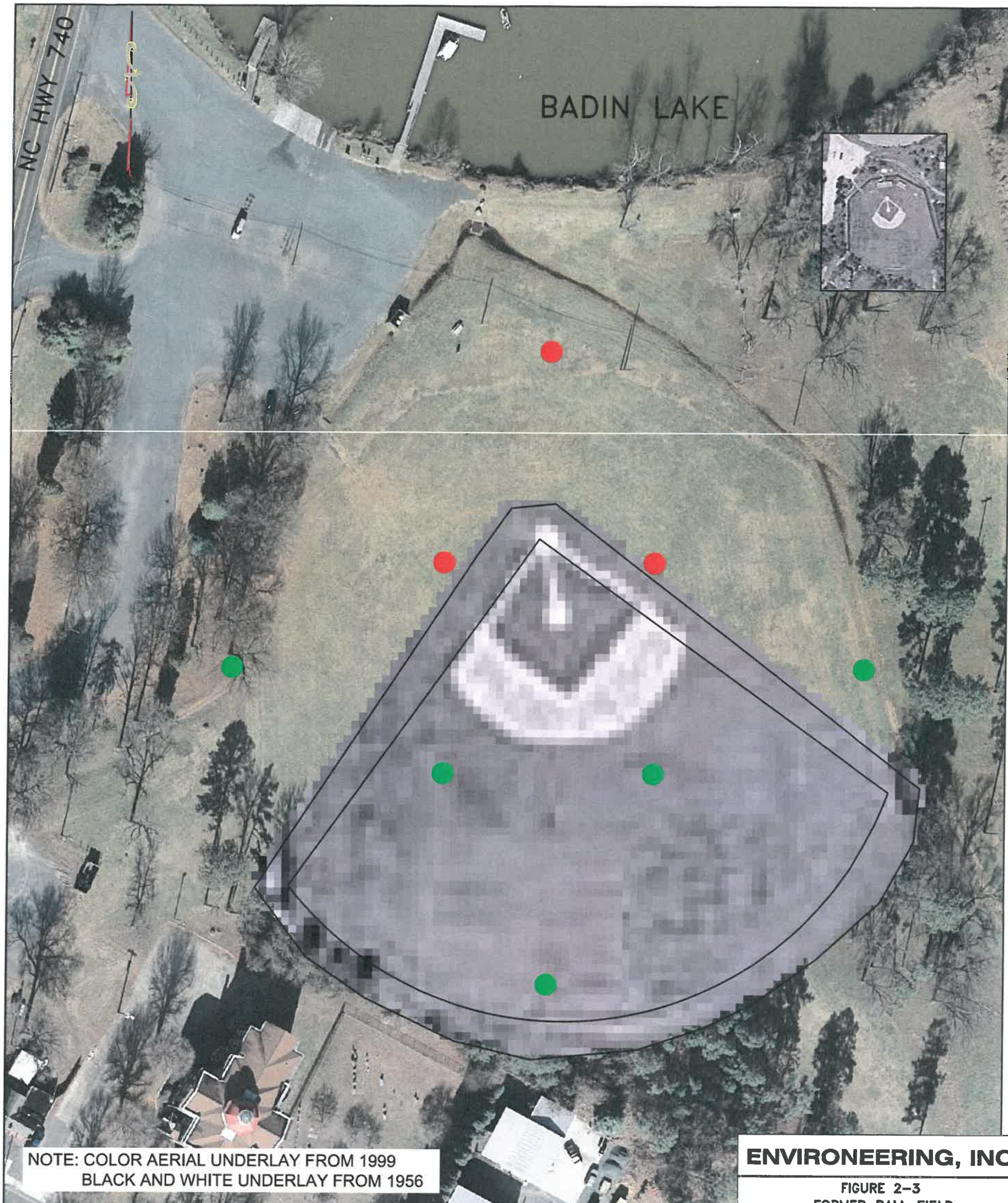

NOTE: ACTUAL SAMPLING LOCATIONS MAY VARY DUE TO THE PRESENCE/ABSENCE OF FLOWING/STANDING WATER
LEGEND
bfp = back flow preventer
hyd = fire hydrant
wm = water meter
wv = water valve
sco = sanitary sewer clean out
ssmh = sanitary sewer manhole
ci = curb inlet
yi = yard inlet
fes = flared end section
bov mh = blow off valve manhole
electric manhole
SURFACE WATER AND SEDIMENT SAMPLE LOCATION
SURFACE WATER SAMPLE LOCATION
GROUNDWATER SAMPLE LOCATION
CONCRETE MONUMENT STAMPED "CONTROL MON 2"
NAD 83 GRID N=604188.565' E=1665597.814' ELEV.=536.55'
ALCOA GRID N=3246.019' E=666.789'
FORCE MAIN
EX. SSMH
SIMS STREET
GRANT STREET
WOOD STREET
N.C. HIGHWAY 740
LITTLE MOUNTAIN CREEK
ALCOA/BADIN MUNICIPAL LANDFILL
CONCRETE FLUME
CHAIN LINK FENCE
BARBWIRE FENCE
UPSTREAM SEDIMENT/SURFACE WATER SAMPLING LOCATION
WESTERN SEEP COLLECTION SYSTEM SAMPLE LOCATION
WESTERN SEEP SEDIMENT/SURFACE WATER SAMPLING LOCATION
MIDDLE SEEP COLLECTION SYSTEM SAMPLE LOCATION
APPROX. COLLECTION SYSTEM PIPING LOCATION
MIDDLE SEEP SEDIMENT/SURFACE WATER SAMPLING LOCATION
MIDDLE SEEP DOWNSTREAM SEDIMENT/SURFACE WATER SAMPLING LOCATION
PUMP STATION
EASTERN SEEP COLLECTION SYSTEM SAMPLE LOCATION
NEW GRAVITY LINE
ALLEGED PIPE LEAK SURFACE WATER SAMPLE LOCATION
EASTERN SEEP SEDIMENT/SURFACE WATER SAMPLING LOCATION
DOWNSTREAM SEDIMENT/SURFACE WATER SAMPLING LOCATION
0 150 300
SCALE IN FEET
ENVIRONEERING, INC.
FIGURE 2-1
ALCOA/BADIN LANDFILL SAMPLING LOCATIONS
FORMER ALCOA BADIN WORKS FACILITY BADIN, NORTH CAROLINA
DRAWN BY: HVV
DATE: 06/01/2015
PROJ. NO. 137-222




ENVIRONEERING, INC.

FIGURE 2–2
FORMER BALL FIELD
ANTICIPATED SAMPLING GRID
FORMER ALCOA BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: HVV | DATE: 06/01/2015 | PROJ. NO. 137-222 |
|---|---|---|




0 100 200

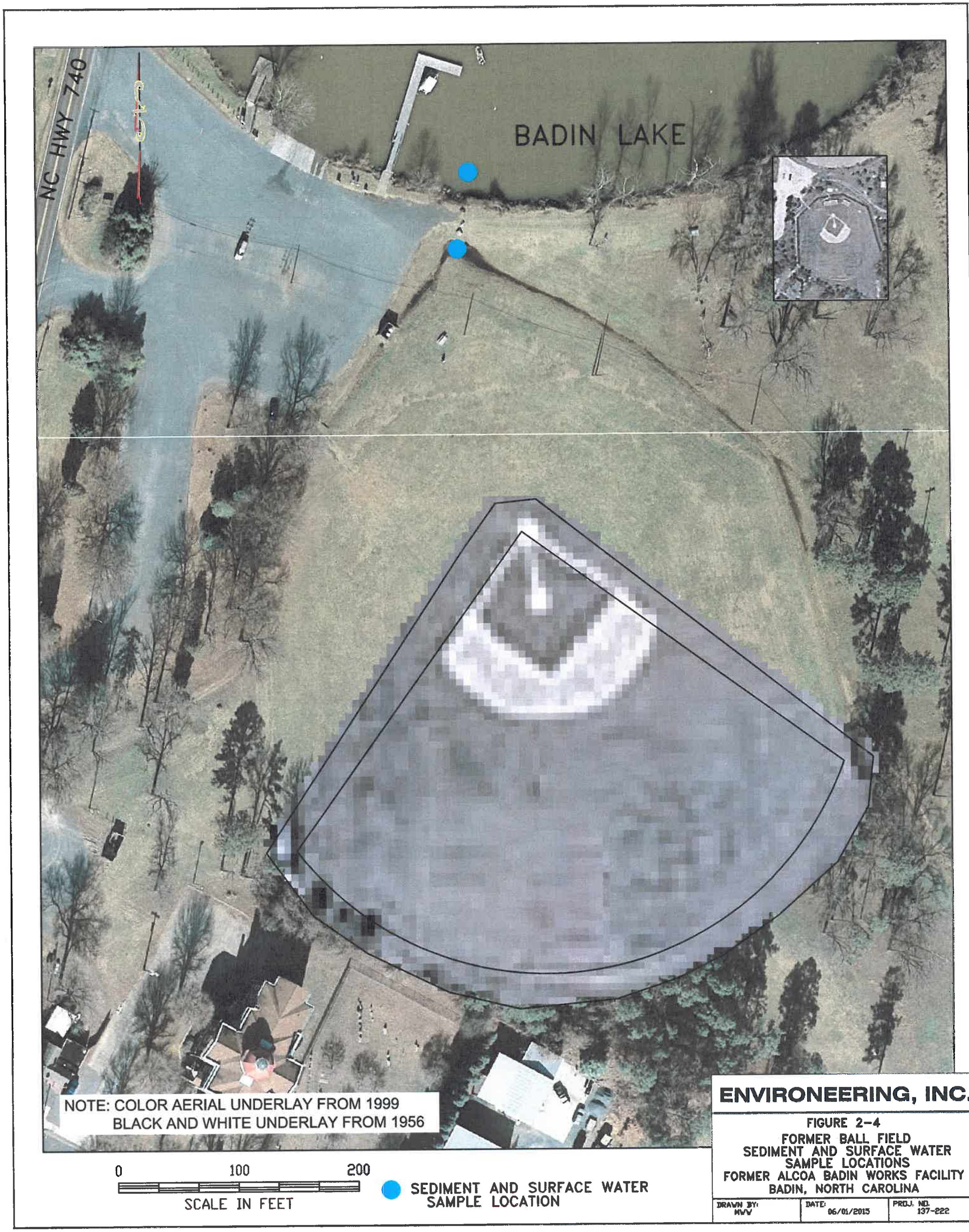
SCALE IN FEET

- DEEP SOIL SAMPLE LOCATION
- DEEP SOIL AND GROUNDWATER SAMPLE LOCATION

**ENVIRONEERING, INC.**

FIGURE 2-3
FORMER BALL FIELD
DEEP SOIL AND GROUNDWATER SAMPLE LOCATIONS
FORMER ALCOA BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: | DATE: | PROJ. NO. |
|---|---|---|
| HWV | 06/01/2015 | 137-222 |




**ENVIRONEERING, INC.**

FIGURE 2-4
FORMER BALL FIELD
SEDIMENT AND SURFACE WATER SAMPLE LOCATIONS
FORMER ALCOA BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: MVV | DATE: 06/01/2015 | PROJ. NO. 137-222 |
|---|---|---|

# 3.0 FIELD PROCEDURES

## 3.1 Sample Collection and Decontamination

Surface water and sediment samples will be collected starting with the farthest downstream sampling location. Surface water samples will be collected using a device constructed of non-reactive material (i.e. glass, stainless steel or Teflon) and transferred to the laboratory provided sample containers. Seep samples will be collected from the piping of the seep collection system utilizing a peristaltic pump and disposable tubing. Sediment samples will be collected using a stainless steel hand corer, scoop, trowel, spoon or ladle. Soil samples will be collected using either a stainless steel hand trowel or hand auger, or using a small portable Geoprobe®-like system. All equipment used will be decontaminated between each sample.

### 3.1.1 Decontamination of Equipment

Decontamination of sampling equipment will be per EPA Region IV Standard Operating Procedures. For sample collection equipment contaminated with environmental media, one or more of the following options will be used for field cleaning based on the condition of the sampling equipment:

1. Clean with tap water and Alconox® detergent using a brush, if necessary, to remove particulate matter and surface films. Equipment may be steam cleaned (detergent and high pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. PVC or plastic items should not be steam cleaned.
2. Rinse thoroughly with tap or distilled water.
3. Rinse thoroughly with distilled water and place on a clean foil-wrapped surface to air-dry.
4. All equipment must be wrapped with foil. If the equipment is to be stored overnight before it is wrapped in foil, it should be covered and secured with clean, unused plastic sheeting.

For well sounders (water level indicators) and tapes, the following procedures will be followed:

1. Wash with detergent and tap water.
2. Rinse with tap water.
3. Rinse with distilled water.

Unless conditions warrant, it is only necessary to decontaminate the wetted portion of the sounder or tape.

For downhole drilling equipment (augers, drill stems, rods, tools, and associated equipment) used for drilling activities involving the collection of soil samples for trace organic and inorganic constituent analyses and for the construction of monitoring wells to be used for the collection of groundwater, the following procedures will be followed:

1. Cleaning and decontamination of all equipment should occur at a designated area (decontamination pad) on the site. Tap water brought on the site for drilling and cleaning purposes should be contained in a pre-cleaned tank. A steam cleaner and/or high pressure hot

water washer capable of generating a pressure of at least 2500 PSI and producing hot water and/or steam (200° F plus), with a detergent compartment, should be obtained.

2. Prior to arrival, drilling equipment should be clean of any contaminants that may have been transported from off-site to minimize the potential for cross-contamination.
3. Equipment will be washed with tap water and detergent, using a brush if necessary, to remove particulate matter and surface films. Steam cleaning (high pressure hot water with detergent) may be necessary to remove matter that is difficult to remove with the brush. Drilling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. Hollow-stem augers, drill rods, etc., that are hollow or have holes that transmit water or drilling fluids, should be cleaned on the inside with vigorous brushing.
4. Rinse thoroughly with tap water.
5. Remove from the decontamination pad and cover with clean, unused plastic. If stored overnight, the plastic should be secured to ensure that it stays in place.

For downhole drilling equipment that contacts the sample media (piston sampler points and shoes, screen point sampler screens and sheaths, and the drive rods when used for groundwater sampling), the following procedures will be followed:

1. Clean with tap water and Alconox® detergent using a brush, if necessary, to remove particulate matter and surface films. Equipment may be steam cleaned (detergent and high pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. PVC or plastic items should not be steam cleaned.
2. Rinse thoroughly with tap or distilled water.
3. Rinse thoroughly with distilled water and place on a clean foil-wrapped surface to air-dry.
4. All equipment must be wrapped with foil. If the equipment is to be stored overnight before it is wrapped in foil, it should be covered and secured with clean, unused plastic sheeting.

After decontamination, sampling equipment will be handled only by personnel wearing clean gloves to prevent re-contamination. In addition, the equipment should be moved away (preferably upwind) from the decontamination area to prevent re-contamination. If the equipment is not to be immediately re-used it should be covered with plastic sheeting to prevent re-contamination. The area where the equipment is kept prior to re-use must be free of contaminants.

### 3.1.2 Sample Collection

Precautions will be taken so that sampling materials do not contact the ground or other potentially impacted surfaces. Each soil, sediment, surface water, and groundwater sample will be retrieved from the sampling location and placed into a clean sample container. Upon completion of the field measurements, samples will be collected from the sample location for laboratory analyses, and placed in laboratory-prepared containers appropriate for the analyses to be performed. Each sample container will be labeled with the sample number; the identity of the sampler; the time and date of collection; the preservatives (if any); and the required analyses. All samples collected will be placed into laboratory-prepared containers and preserved as noted on Table 3-1.

**Table 3-1 Bottling and Preservative Parameters**

| Analyte | Bottle | Preservative | Holding Time |
|---|---|---|---|
| **Soil and Sediment** | | | |
| Total Cyanide | 4 oz. Glass | 0-4°C | 14 days |
| Fluoride | 4 oz. Glass | 0-4°C | 28 days |
| RCRA Metals (with Hg) | 4 oz. Glass | 0-4°C | 28 days |
| VOCs | VOC Kit: One 40-mL V-TSL w/ MeOH, Two 40-mL V-TSL w/ $NaHSO_4$, Two 40-mL V-TSL w/ DI water, 2 oz. bulk jar | $NaHSO_4$; MeOH, 0-4°C | 48 hours to freeze, 14 days to analyze |
| SVOCs (with PAHs) | 4 oz. Glass | 0-4°C | 14 days |
| PCBs | 4 oz. Glass | 0-4°C | 1 year |
| **Surface Water** | | | |
| Total Cyanide | 250 ml Plastic | NaOH, 0-4°C | 14 days |
| Fluoride | 250 ml Plastic | 0-4°C | 28 days |
| RCRA Metals (with Hg) | 250 ml Plastic | $HNO_3$, 0-4°C | 28 days |
| VOCs | 3 x 40ml V-TSL | HCl, 0-4°C | 14 days |
| SVOCs (with PAHs) | Two x 1 liter Amber Glass | 0-4°C | 7 days |
| PCBs | 1 liter Amber Glass | 0-4°C | 1 year |
| **Groundwater** | | | |
| Available Cyanide | 250 ml Amber Plastic | Lead Carbonate/ Filtration, NaOH, 0-4°C | 14 days |
| Fluoride | 250 ml Plastic | 0-4°C | 28 days |
| RCRA Metals (with Hg) | 250 ml Plastic | $HNO_3$, 0-4°C | 28 days |
| VOCs | 3 x 40ml V-TSL | HCl, 0-4°C | 14 days |
| SVOCs (with PAHs) | Two x 1 liter Amber Glass | 0-4°C | 7 days |
| PCBs | 1 liter Amber Glass | 0-4°C | 1 year |

ml – milliliters
V-TSL – Glass Vial Teflon-lined Septum

For the selected SVOC method, PAHs are a subset of SVOCs, and will be reported through the SVOC method.

Sample collection points will be geolocated and placed on an aerial photograph base map and incorporated into a georeferenced database for the site. The ArcView® visualization program will be used to integrate the database and geo-referenced aerial photographs and topographic map set.

## 3.2 Sample Analysis

Samples will be analyzed in accordance with the EPA methods, listed in Table 3-2 or an equivalent procedure, by a North Carolina-certified laboratory. All collected samples will be analyzed for the presence of the following parameters:

**Table 3-2 Analytical Parameters**

| Analyte | Method Number | Laboratory Reportable Detection Limit |
|---|---|---|
| **Soil and Sediment** | | |
| Total Cyanide | 9012 | 0.25 mg/kg |
| Fluoride | 9056 | 5 mg/kg |
| RCRA Metals (with Hg) | 6020/7471 | 0.006 - 5 mg/kg |
| PCBs | 8082 | 0.033 mg/kg |
| VOCs | 8260 | 0.005-0.05 mg/kg |
| SVOCs (with PAHs) | 8270 | 0.33-1.7 mg/kg |
| **Surface Water** | | |
| Total Cyanide | 9012 | 0.01 mg/l |
| Fluoride | 4500FL-C | 0.5 mg/l |
| RCRA Metals (with Hg) | 6020/7471 | 0.0001 - 0.050 mg/l |
| VOCs | 8260 | 0.001-0.025 mg/l |
| SVOCs (with PAHs) | 8270 | 0.010-0.060 mg/l |
| PCBs | 8082 | 0.001-0.002 mg/l |
| **Groundwater** | | |
| Available Cyanide | OIA-1677-09 | 0.002 mg/l |
| Fluoride | 4500FL-C | 0.5 mg/l |
| RCRA Metals (with Hg) | 6020/7471 | 0.0001 - 0.050 mg/l |
| VOCs | 8260 | 0.001-0.025 mg/l |
| SVOCs (with PAHs) | 8270 | 0.010-0.060 mg/l |
| PCBs | 8082 | 0.001-0.002 mg/l |

NA – Not Applicable

## 3.3 Field Quality Control

The quality of data for the collection of samples will be ensured by the use of trip blanks, and equipment blanks (not required if dedicated materials are used), and replicate samples. Trip blanks measure any cross-contamination of the samples during transport, handling, and storage. Equipment blanks demonstrate that the sample equipment is free of contamination and that adequate decontamination was performed after the use of the sample equipment. Replicate samples indicate the precision of the sampling process by calculating the relative percent difference in the results for a sample and its replicate. Each sampling event will include at least one trip blank, and one equipment blank (if required), and one replicate sample. Trip blanks will be analyzed for VOCs in the same manner as the accompanying samples. Equipment blanks and replicate samples will be analyzed for the same analytes and in the same manner as the accompanying samples.

### 3.4 Sample Shipment

All samples will be packaged securely and placed on ice to cool (reduce the sample temperature to below 4° C), and transported to the analytical laboratory following strict chain-of-custody protocol.

### 3.5 Chain-Of-Custody

Each sample container will be individually identified as to sample number, date and time collected, and source of sample. A chain-of-custody record will be prepared which will include:

- The name of the person collecting the samples;
- The identity of each sample;
- Analytical requirements; and
- Name of person accepting sample.

Custody transfers of samples will be recorded on the chain-of-custody form by signatures of the transferor (relinquisher) and the transferee (receiver). This procedure will be repeated, as necessary, until final delivery is made to the analytical laboratory.

### 3.6 Laboratory Quality Control

The quality of data from the laboratory will be ensured by the use of instrument tuning, initial calibration, continuing calibration, internal standards, method blanks, surrogate recoveries, and matrix spike/spike duplicate analyses.

## 4.0 SCHEDULE

All activities shall be implemented according to a schedule agreed upon by Alcoa and NCDENR. Sampling activities in the Sampling Work Plan for the Alcoa Badin Landfill and Former Ball Field will be coordinated with Division of Waste Management for the collection of split samples. Within 15 days of the NCDENR's approval of the WP, Alcoa will begin implementation of the plan. Field activities will be completed within the following estimated timeframe:

- Task 1 – Little Mountain Creek Sampling completed in 2 weeks; and
- Task 2 – Ball Field Sampling completed in 4 weeks.

Alcoa will notify NCDENR 7 days prior to commencing field activities to coordinate schedules. Per the request of NCDENR, Alcoa will make the best available effort to submit results and findings of the work plan to the Division of Waste Management by September 15, 2015. Should unforeseen delays occur, Alcoa will notify the Division of Waste Management and present a revised schedule.

*ALCOA INC.*
**2300 North Wright Rd.**
**Alcoa TN, 37701**

July 8, 2015

Robert C. McDaniel
Facility Management Branch
Hazardous Waste Section
North Carolina Department of Environmental and Natural Resources
1646 Mail Service Center
Raleigh, NC 27699-1646

VIA ELECTRONIC MAIL

**Re: Response to Comments and Notification of Sampling Activities, Sampling Work Plan for the Alcoa Badin Landfill and Former Ball Field; Alcoa, Inc.; Badin, North Carolina; NCD 003 162 542**

Dear Mr. McDaniel:

In conjunction with EPA Region 4, the Division of Waste Management's (DWM) approved the Sampling Work Plan for the Alcoa Badin Landfill and Former Ball Field with amendments in a June 18, 2015, letter to Alcoa. For ease of discussion and mutual understanding, each of the amendments is presented below in italics and followed by Alcoa's response.

***NCDENR Amendment 1***

> *Section 2.2.1 Task 1 - Alcoa/Badin Landfill Area: Alcoa states that surface water samples will be collected between the Western, Middle, and Eastern seeps and Little Mountain Creek. Sediment samples must also be collected in an area of standing or flowing water between the seeps and Little Mountain Creek as identified on Figure 2-1.*

**Alcoa Response to Amendment 1**

> Alcoa will add sediment samples collected in an area of standing or flowing water between the Western, Middle, and Eastern seeps and Little Mountain Creek as identified on Figure 2-1.

***NCDENR Amendment 2***

> *Section 2.2.2 Task 2 - Former Ball Field: The grid system in Figure 2-2 must be extended to Badin Lake and samples collected in the area between the Former Ball Field and the lake. The three eastern sampling grid lines and the second sampling grid line from the west side of the Former Ball Field must be extended to Badin Lake. Soil samples must be collected in these areas near the former railroad track.*

**Alcoa Response to Amendment 2**

A revised Figure 2-2 is provided as an attachment to this document.

***NCDENR Amendment 3***

*In Figure 2-3, deep soil and groundwater sampling locations must also include the area between the ditches leading to the concrete water collection basin and Badin Lake. The three deep soil and groundwater sample locations proposed on Figure 2-3 must be moved to this area to determine the soil and groundwater quality between the Former Ball Field and Badin Lake. A deep soil sample must be collected in the area between the Former Ball Field and the ditches leading to the concrete water collection basin.*

**Alcoa Response to Amendment 3**

A revised Figure 2-3 is provided as an attachment to this document.

***NCDENR Amendment 4***

*4.0 - Schedule: Alcoa should notify the DWM two weeks prior to the collection of samples.*

**Alcoa Response to Amendment 4**

Alcoa will notify the DWM two weeks prior to the collection of samples. Assuming DWM or EPA Region 4 have no additional amendments, this document serves as the two week notification prior to the collection of samples. Collection of samples are scheduled to begin on July 23, 2015.

Alcoa appreciates the time and effort your office has spent on this project and we look forward to working with you and your staff in the future. Should you have any questions or comments, please contact me at (865) 977-3811 at your convenience.

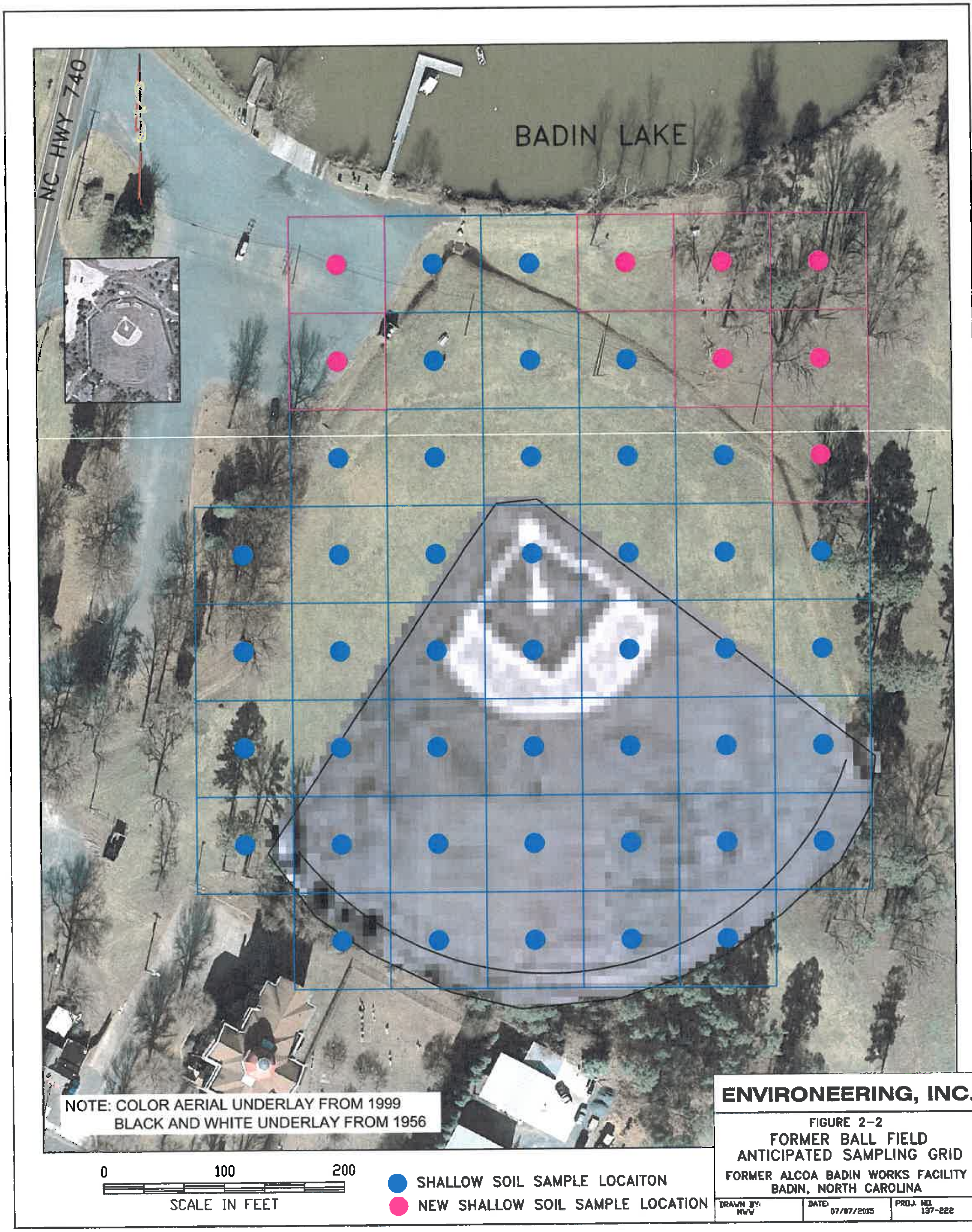
Sincerely,

Michael Worden
for

Robert A. Prezbindowski
Alcoa Remediation

Attachments

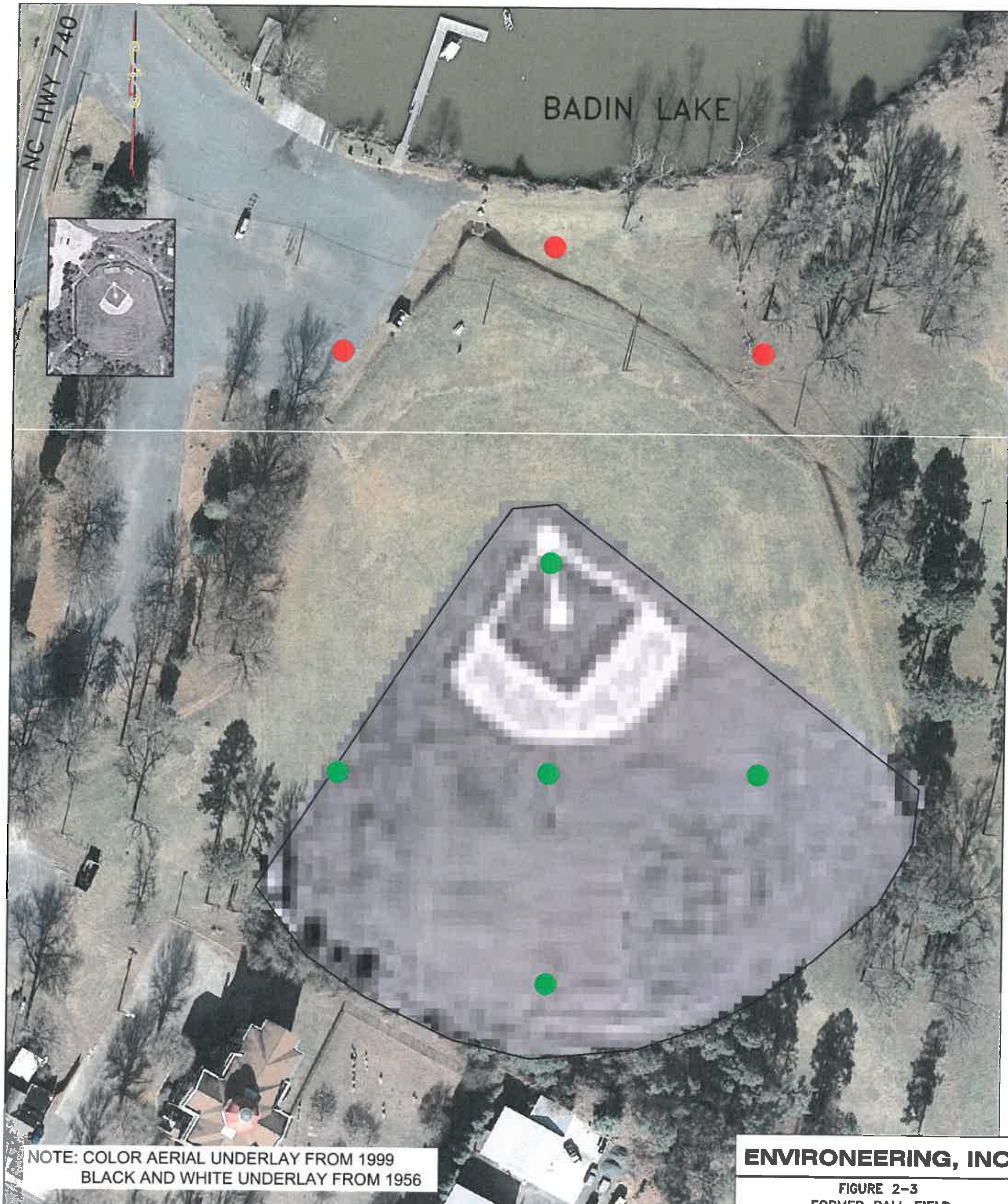
# Figures




ENVIRONEERING, INC.

FIGURE 2-2
FORMER BALL FIELD
ANTICIPATED SAMPLING GRID
FORMER ALCOA BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: NWV | DATE: 07/07/2015 | PROJ. NO. 137-222 |
|---|---|---|




0 100 200
SCALE IN FEET

DEEP SOIL SAMPLE LOCATION

DEEP SOIL AND GROUNDWATER SAMPLE LOCATION

**ENVIRONEERING, INC.**

FIGURE 2-3
FORMER BALL FIELD
DEEP SOIL AND GROUNDWATER SAMPLE LOCATIONS
FORMER ALCOA BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: MWV | DATE: 07/07/2015 | PROJ. NO. 137-222 |
|---|---|---|

**REFERENCE 21**

ENVIRONEERING, INC.

# ALCOA BADIN LANDFILL AND FORMER BALL FIELD SAMPLING ACTIVITES

# FORMER BADIN WORKS FACILITY BADIN, NORTH CAROLINA

**September 15, 2015**

**Prepared for:**

ALCOA

Alcoa, Inc.
Highway 740
Badin, North Carolina 28009

**Prepared by:**

**ENVIRONEERING, INC.**
**138 Fort Jackson Road**
**Morrisville, North Carolina 27560**
**919-341-6492**

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# 1.0 INTRODUCTION

The North Carolina Department of Environment and Natural Resources ("*NCDENR*") Hazardous Waste Section directed Alcoa to collect environmental samples along Little Mountain Creek near the Alcoa / Badin Landfill ("*ABL*") and the baseball field in the Town of Badin located across the street from the plant. NCDENR made this request by letter dated January 22, 2015 based upon their review of the undated document titled *Request for Preliminary Assessment for Areas Surrounding Alcoa Badin Works Facility in Badin, North Carolina.* This document was prepared by the Duke Environmental Law and Policy Clinic, on behalf of the Yadkin Riverkeeper, Inc. as a petition to the United States Environmental Protection Agency Region 4 ("*USEPA*").

On February 23, 2015, Alcoa submitted a work plan to NCDENR Hazardous Waste Section. On May 14, 2015, Alcoa received comments from NCDENR Hazardous Waste Section. Alcoa incorporated these comments into their June 5, 2015, revised work plan, which provided the rationale for the sampling and outlined the procedures for collecting samples to further assess the selected areas surrounding the Alcoa Badin Works Main Plant. In conjunction with USEPA Region 4, the NCDENR Division of Waste Management's ("*DWM*") approved the Alcoa Sampling Work Plan for the ABL and Former Ball Field with amendments in a June 18, 2015, letter to Alcoa. The June 18, 2015, approval letter to Alcoa is provided as Appendix A. Alcoa submitted a *Response to Comments and Notification of Sampling Activities* on July 8, 2015.

## 1.1 Alcoa Badin Works Background

In March 1990, Alcoa filed a RCRA Part B permit application with USEPA to store waste on-site in an enclosed storage building for greater than 90 days. In response to the permit application, USEPA Region IV performed a RCRA Facility Assessment ("*RFA*") of the Alcoa Badin Works and associated off-site locations. The RFA identified at total of 34 SWMUs and 2 Areas of Concern ("*AOCs*"). Twelve additional SWMUs were added after the initial RFA was completed. The ABL was identified as SWMU No. 2. The former Ball Field was not identified as a SWMU. The North Carolina Department of Environment, Health, and Natural Resources Division of Solid Waste Management (now the NCDENR Division of Waste Management), in cooperation with USEPA Region IV, issued the final RCRA Part-B Permit to Alcoa on March 30, 1992.

Part VII of Alcoa's RCRA permit outlined the corrective action activities to be conducted. The initial step in the process required that confirmatory sampling be conducted at seven SWMUs. Based on the results of the RFA and the confirmatory sampling a RCRA Facility Investigation ("*RFI*") was conducted at 16 SWMUs and AOCs. The RFI Report was submitted to the NCDENR in March 2001. Interim Measures activities have been conducted at a number of the Badin SWMUs, including the ABL. The RFI report identified groundwater at the ABL as needing further action.

## 1.2 ABL Background

The ABL was used as an unlined municipal/industrial solid-waste landfill. This unit was positioned within a natural ravine located southeast of Wood St. extending to the edge of Little Mountain Creek flood plain. Municipal refuse, process material, and native fill material were used to fill the natural ravine approximately 13 to 42 feet. The start of operation of the unit is not specifically known, however the landfill was closed in the 1970s.

In 1997, Alcoa completed interim measures at the landfill consisting of re-grading and cover improvements of two additional feet of low permeability clay and six inches of topsoil to establish a vegetative cover. The operational period of the landfill is not specifically known. Alcoa closed the unit in the mid-1970s.

Alcoa conducted interim measures under RCRA Corrective action in the mid-1990s. The objectives of the interim measures were to prevent surface run-on, promote surface run-off, and reduce infiltration into the landfill. In addition a leaking natural gas line traversing the landfill was rerouted around the landfill.

Three seeps (western, middle, and eastern) developed at the base of the landfill after the interim measures were completed. Historic analytical data suggested the seeps emanate water that passes through the landfill materials. A portion of the seep water was believed to originate upslope of the landfill due to precipitation infiltration and a portion from recharge from bedrock through the base of the landfill. A toe drain seep collection system was installed at three seep locations in 2001. The toe drain seep collection system modified and discharge was rerouted to a newly installed lift station in 2005. This lift station discharged seep collection system flow to the Stanly County Utilities POTW.

Recent groundwater sampling results demonstrate the beneficial effects of the cover system upgrades. In results from past sampling events, available cyanide and fluoride were not reported in any well at concentrations that exceed the NC 2L Standard.

### 1.2.1 Little Mountain Creek Background

A part of the RFI, a screening level risk assessment was conducted on Little Mountain Creek. Results of the screening level risk assessment indicated that no Constituents of Interest ("*COIs*") were present at concentrations exceeding applicable human health screening values in Little Mountain Creek. To confirm that understanding, a surface water sample was collected in November 2011 from Little Mountain Creek adjacent to the ABL. The surface water sample was analyzed for Available Cyanide, Total Fluoride, trichloroethylene, polychlorinated biphenyls ("*PCBs*"), and polycyclic aromatic hydrocarbons ("*PAHs*"). The November 2011 results, reported fluoride in the laboratory Method Blank, and samples from this period were noted with a "B" qualifier by the lab. It is believed that the surface water sample from this period did not contain fluoride, and the reported value is the result of a laboratory artifact. Available Cyanide, TCE, PAHs, and PCBs were not detected in the November sampling event. The November 2011 results were consistent with the historical sampling results documented in the RFI.

## 1.3 Former Ball Field Background

The RFA and follow up investigations identified at total of 46 SWMUs and 2 AOCs. The former Ball Field was not identified as a SWMU. The above referenced report, *Request for Preliminary Assessment for Areas Surrounding Alcoa Badin Works Facility in Badin, North Carolina*, asserts "the baseball diamond disappeared from aerial photographs around 1960". Alcoa does not believe this statement to be accurate.

The current understanding is that the former Ball Field was either undeveloped or historically used as a recreational area through almost all of the 20th century. To illustrate Alcoa's understanding of the area, a chronology of the site was assembled using historical topographic maps, historical photographs, and aerial imagery. This chronology was presented in the June 5, 2015, Sampling Work Plan provided to NCDENR. Based on available photographs, the area was undeveloped prior to 1938; the ball field was installed between 1938 and 1950, and has been underutilized since the late 1990s.

# 2.0 SCOPE AND TASKS

## 2.1 Project Scope

The Sampling Work Plan provided an outline document designed to meet the requirements of the January 22, May 14, and June 18, 2015, letters from NCDENR. In conjunction with USEPA Region 4, the DWM approved the Alcoa Sampling Work Plan for the ABL and Former Ball Field with amendments in the June 18, 2015, letter to Alcoa. Alcoa submitted a Response to Comments and Notification of Sampling Activities on July 8, 2015.

## 2.2 Project Tasks

### 2.2.1 Task 1 – ABL Area

To determine if constituents of concern may be leaching from the ABL into nearby Little Mountain Creek, the following samples were collected in conjunction with personnel from NCDENR on July 21 and 22, 2015:

- Sediment and surface water samples were collected in Little Mountain Creek
  - Upstream of the ABL;
  - Downstream of the Middle seep; and
  - Downstream of the ABL.
- Surface water samples were collected from one area of standing or flowing water between each of the Western and Eastern seeps and Little Mountain Creek. During the sampling event, no standing or flowing water between the Middle seep and Little Mountain Creek was observed, and no surface water sample was collected.
- Surficial soil samples were collected between each of the Western, Middle, and Eastern seeps and Little Mountain Creek.
- Groundwater samples were collected from the Seep Collection Area ("*SCA*") collection system piping at each of the seeps at the toe of the ABL (Western, Middle, and Eastern seeps).
- The Work Plan proposed the collection of a surface water sample at the area of an alleged pipe failure as identified on pages 12 and 13 of the third party report, *Request for Preliminary Assessment for Areas Surrounding Alcoa Badin Works Facility in Badin, North Carolina*. During the sampling event, no standing or flowing water was observed in the area of an alleged pipe failure, and no surface water sample was collected.

Per NCDENR request, the sediment and water samples associated with the Little Mountain Creek sampling were analyzed for the following constituents:

- Total Cyanide (Sediment and Surface Water Samples Only)
- Available Cyanide (Groundwater Samples Only)
- Total Fluoride
- RCRA Metals (with Hg)
- Volatile Organic Compounds ("*VOCs*"),

- Semi-volatile Organic Compounds ("*SVOCs*"),
- PCBs, and
- PAHs (via SVOCs).

For the selected SVOC method, PAHs are a subset of SVOCs, and were reported through the SVOC method.

### 2.2.2 Task 2 – Former Ball Field

To determine if the former Ball Field has been affected by historical industrial activity, surface and sub-surface soil, sediment, surface water, and groundwater samples were collected in conjunction with representatives from NCDENR on July 27 through 29, 2015. Since there was no visible evidence of historical waste filling activities on the ground surface of the former Ball Field, a grid was established with line intersections (nodes) spaced approximately eighty feet apart. Figure 2-2 shows the grid layout which was established for the former Ball Field.

Surface soil samples were collected at each grid node from the upper 24-inches of soil (after the grass was removed) using a small portable Geoprobe® system. In addition, eight deep soil samples containing the uppermost non-native interval were collected at selected locations in the former Ball Field using the portable Geoprobe® system. Figure 2-3 shows the layout of the deep soil samples.

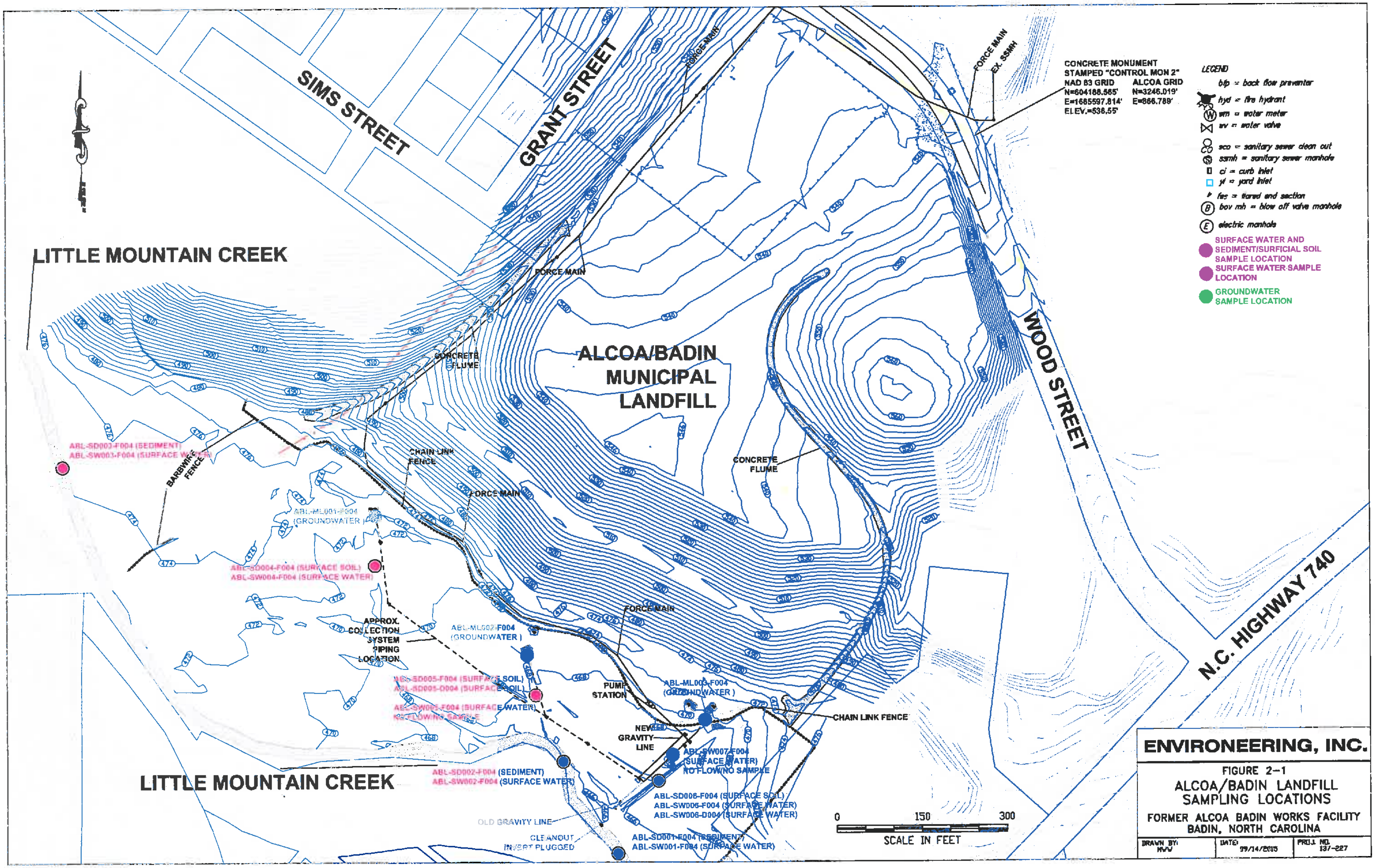
Shallow water samples were collected in the area between Badin Lake and the Former Ball Field from three of the eight deep soil sample locations. Three shallow groundwater sampling points were installed using the portable Geoprobe® system. A temporary monitor well was installed at each location to facilitate the collection of groundwater samples. Prior to collecting each sample, the temporary wells were purged until at least 5 well volumes were removed. Figure 2-3 shows the layout of the groundwater samples.

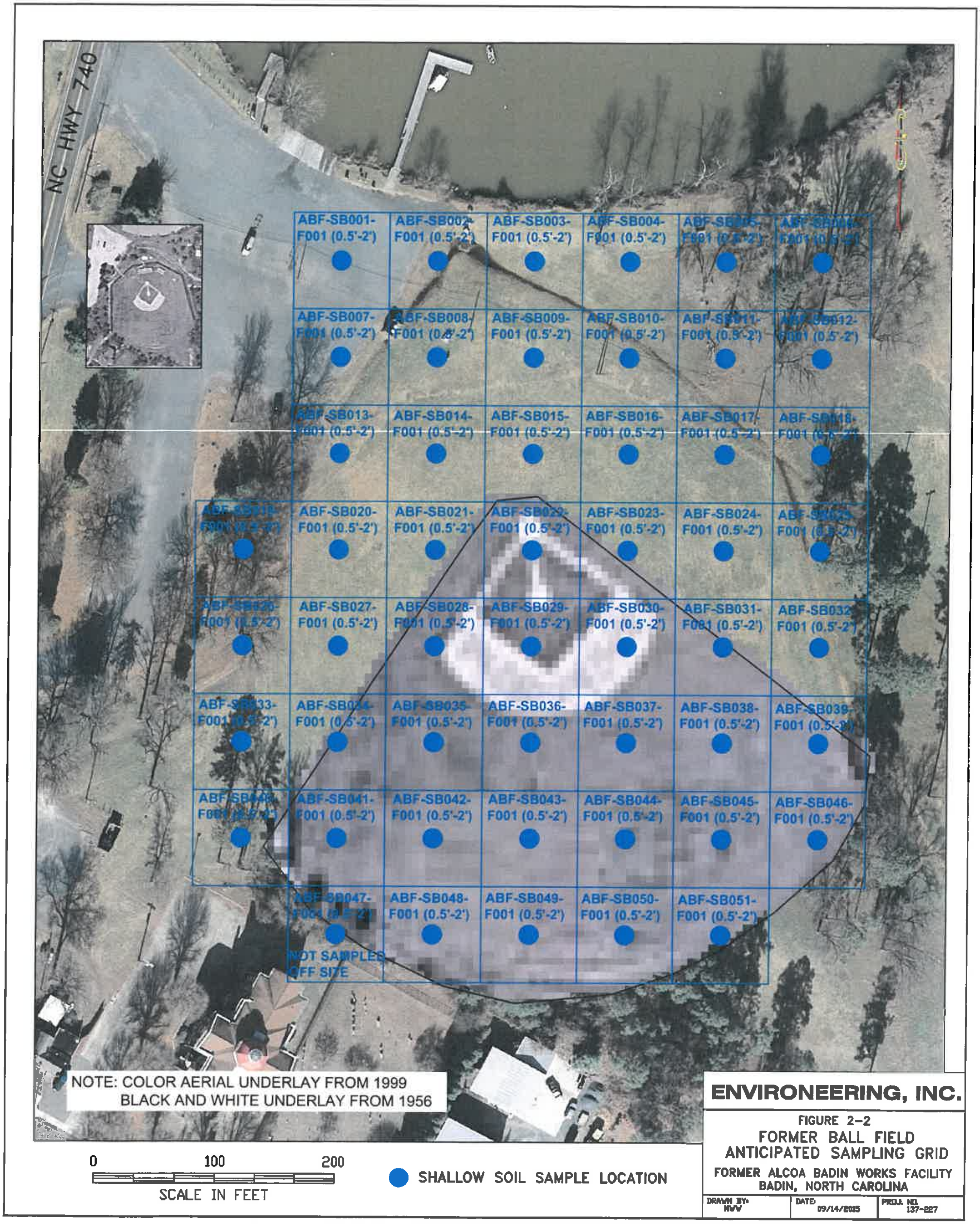
The concrete surface water collection box at the north end of the Former Ball Field was sampled at the direction of the agency. Water was collected from the box and submitted for analysis. Sediment was not present in the box, however a sediment sample was collected from the area immediately outside the box and submitted for analysis. In addition, a surface water and sediment sample was collected near the discharge point of the box in Badin Lake. Figure 2-4 shows the layout of the sediment and surface water samples.

Per NCDENR request, the sediment, soil, and water samples associated with the Former Ball Field sampling were analyzed for the following constituents:

- Total Cyanide (Soil, Sediment, and Surface Water Samples Only)
- Available Cyanide (Groundwater Samples Only)
- Total Fluoride
- RCRA Metals (with Hg),
- VOCs,
- SVOCs,

- PCBs, and
- PAHs (via SVOCs).


LITTLE MOUNTAIN CREEK
SIMS STREET
GRANT STREET
WOOD STREET
N.C. HIGHWAY 740
ALCOA/BADIN MUNICIPAL LANDFILL
FORCE MAIN
EX. SSMH
CONCRETE FLUME
CHAIN LINK FENCE
BARBWIRE FENCE
ABL-SD003-F004 (SEDIMENT)
ABL-SW003-F004 (SURFACE WATER)
ABL-ML001-F004 (GROUNDWATER)
ABL-SD004-F004 (SURFACE SOIL)
ABL-SW004-F004 (SURFACE WATER)
APPROX. COLLECTION SYSTEM PIPING LOCATION
ABL-ML002-F004 (GROUNDWATER)
ABL-SD005-F004 (SURFACE SOIL)
ABL-SD005-D004 (SURFACE SOIL)
ABL-SW005-F004 (SURFACE WATER)
NO FLOW/NO SAMPLE
PUMP STATION
ABL-ML003-F004 (GROUNDWATER)
NEW GRAVITY LINE
ABL-SW007-F004 (SURFACE WATER) NO FLOW/NO SAMPLE
ABL-SD002-F004 (SEDIMENT)
ABL-SW002-F004 (SURFACE WATER)
ABL-SD006-F004 (SURFACE SOIL)
ABL-SW006-F004 (SURFACE WATER)
ABL-SW006-D004 (SURFACE WATER)
OLD GRAVITY LINE
CLEANOUT INVERT PLUGGED
ABL-SD001-F004 (SEDIMENT)
ABL-SW001-F004 (SURFACE WATER)
LITTLE MOUNTAIN CREEK
CONCRETE MONUMENT STAMPED "CONTROL MON 2"
NAD 83 GRID
N=604188.565'
E=1685597.814'
ELEV.=536.55'
ALCOA GRID
N=3246.019'
E=866.789'
LEGEND
bfp = back flow preventer
hyd = fire hydrant
wm = water meter
wv = water valve
sco = sanitary sewer clean out
ssmh = sanitary sewer manhole
ci = curb inlet
yi = yard inlet
fes = flared end section
bov mh = blow off valve manhole
electric manhole
SURFACE WATER AND SEDIMENT/SURFICIAL SOIL SAMPLE LOCATION
SURFACE WATER SAMPLE LOCATION
GROUNDWATER SAMPLE LOCATION
0
150
300
SCALE IN FEET
ENVIRONEERING, INC.
FIGURE 2-1
ALCOA/BADIN LANDFILL SAMPLING LOCATIONS
FORMER ALCOA BADIN WORKS FACILITY
BADIN, NORTH CAROLINA
DRAWN BY: MVV
DATE: 09/14/2015
PROJ. NO. 137-227


NC HWY 740
ABF-SB001-F001 (0.5'-2')
ABF-SB002-F001 (0.5'-2')
ABF-SB003-F001 (0.5'-2')
ABF-SB004-F001 (0.5'-2')
ABF-SB005-F001 (0.5'-2')
ABF-SB006-F001 (0.5'-2')
ABF-SB007-F001 (0.5'-2')
ABF-SB008-F001 (0.5'-2')
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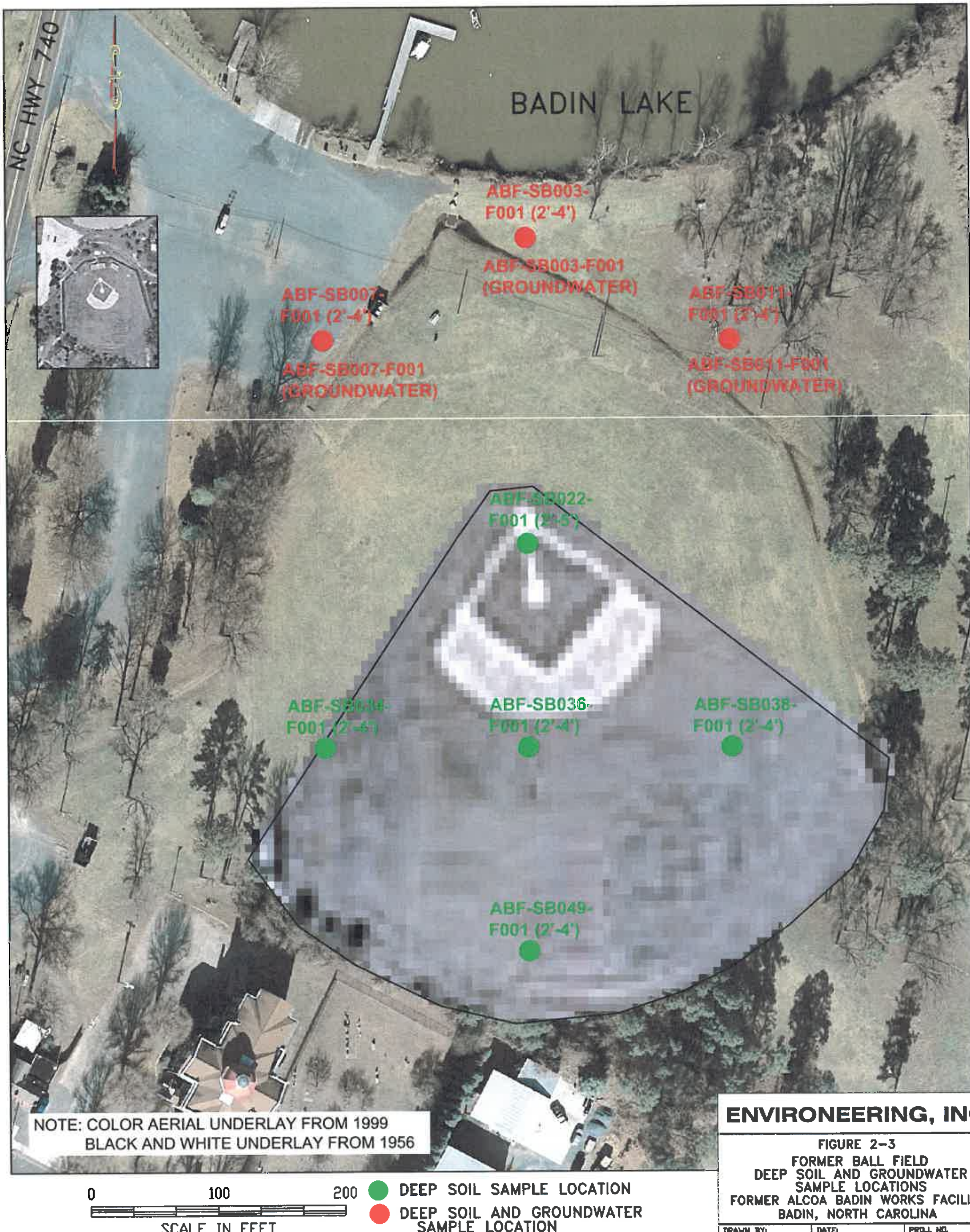
ABF-SB027-F001 (0.5'-2')
ABF-SB028-F001 (0.5'-2')
ABF-SB029-F001 (0.5'-2')
ABF-SB030-F001 (0.5'-2')
ABF-SB031-F001 (0.5'-2')
ABF-SB032-F001 (0.5'-2')
ABF-SB033-F001 (0.5'-2')
ABF-SB034-F001 (0.5'-2')
ABF-SB035-F001 (0.5'-2')
ABF-SB036-F001 (0.5'-2')
ABF-SB037-F001 (0.5'-2')
ABF-SB038-F001 (0.5'-2')
ABF-SB039-F001 (0.5'-2')
ABF-SB040-F001 (0.5'-2')
ABF-SB041-F001 (0.5'-2')
ABF-SB042-F001 (0.5'-2')
ABF-SB043-F001 (0.5'-2')
ABF-SB044-F001 (0.5'-2')
ABF-SB045-F001 (0.5'-2')
ABF-SB046-F001 (0.5'-2')
ABF-SB047-F001 (0.5'-2')
NOT SAMPLED OFF SITE
ABF-SB048-F001 (0.5'-2')
ABF-SB049-F001 (0.5'-2')
ABF-SB050-F001 (0.5'-2')
ABF-SB051-F001 (0.5'-2')
NOTE: COLOR AERIAL UNDERLAY FROM 1999
BLACK AND WHITE UNDERLAY FROM 1956
0 100 200
SCALE IN FEET
SHALLOW SOIL SAMPLE LOCATION
ENVIRONEERING, INC.
FIGURE 2-2
FORMER BALL FIELD
ANTICIPATED SAMPLING GRID
FORMER ALCOA BADIN WORKS FACILITY
BADIN, NORTH CAROLINA
DRAWN BY: NVV
DATE: 09/14/2015
PROJ. NO. 137-227




**ENVIRONEERING, INC.**

FIGURE 2-3
FORMER BALL FIELD
DEEP SOIL AND GROUNDWATER
SAMPLE LOCATIONS
FORMER ALCOA BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

| DRAWN BY: MWV | DATE: 09/14/2015 | PROJ. NO. 137-227 |
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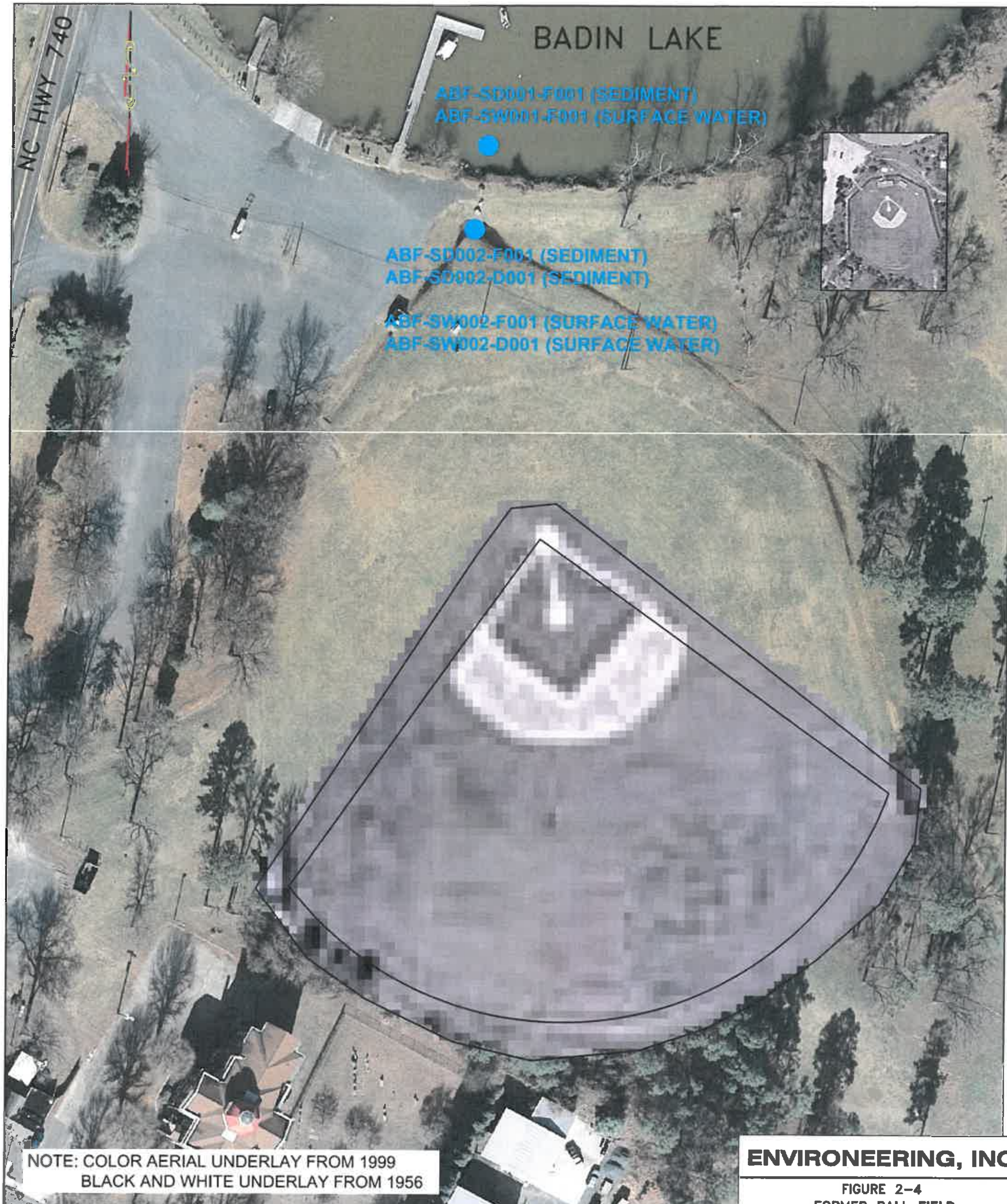


0 100 200

SCALE IN FEET

● SEDIMENT AND SURFACE WATER SAMPLE LOCATION

**ENVIRONEERING, INC.**

FIGURE 2-4
FORMER BALL FIELD
SEDIMENT AND SURFACE WATER
SAMPLE LOCATIONS
FORMER ALCOA BADIN WORKS FACILITY
BADIN, NORTH CAROLINA

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# 3.0 FIELD PROCEDURES

## 3.1 Sample Collection and Decontamination

Surface water and sediment samples were collected in Little Mountain Creek starting with the farthest downstream sampling location, continuing up stream to the last sample location. Surface water samples were collected using a device constructed of non-reactive material (i.e. glass or polyethylene containers) and transferred to the laboratory provided sample containers. Sediment samples were collected using a stainless steel trowel.

At the ABL, seep samples were collected from the piping of the seep collection system utilizing a peristaltic pump and disposable silicone and polyethylene tubing. Dedicated tubing was used at each sample location.

At Badin Lake, sediment samples were collected using either stainless steel Ekman dredge or a hand auger. Soil samples were collected using a sample core from the Geoprobe® system. All equipment used was decontaminated prior to each sample being collected.

### 3.1.1 Decontamination of Equipment

Decontamination of sampling equipment was per EPA Region IV Standard Operating Procedures. For sample collection equipment contaminated with environmental media, one or more of the following options were used for field cleaning based on the condition of the sampling equipment:

1. Clean with tap water and Alconox® detergent using a brush, if necessary, to remove particulate matter and surface films. Selected equipment was steam cleaned (detergent and high pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned was placed on racks or saw horses at least two feet above the floor of the decontamination pad. PVC or plastic items were not steam cleaned.
2. Rinse thoroughly with tap or distilled water.
3. Rinse thoroughly with distilled water and place on a clean foil-wrapped surface to air-dry.
4. All equipment was wrapped with foil. If the equipment is to be stored overnight before it is wrapped in foil, it was covered and secured with clean, unused plastic sheeting.

For well sounders (water level indicators) and tapes, the following procedures were followed:

1. Wash with detergent and distilled water.
2. Rinse with distilled water.
3. Second rinse with distilled water.

For downhole drilling equipment (augers, drill stems, rods, tools, and associated equipment) used for drilling activities involving the collection of soil samples for trace organic and inorganic constituent analysis and for the construction of monitoring wells to be used for the collection of groundwater, the following procedures were followed:

1. Cleaning and decontamination of all equipment occurred at a designated area (decontamination pad) on the site. Tap water brought on the site for drilling and cleaning purposes was contained in a pre-cleaned tank.
2. Prior to arrival, drilling equipment was cleaned of any contaminants that may have been transported from off-site to minimize the potential for cross-contamination.
3. Equipment was washed with tap water and detergent, using a brush if necessary, to remove particulate matter and surface films. Selected equipment was steam cleaned to remove matter that was difficult to remove with the brush. Drilling equipment that is steam cleaned was placed on racks or saw horses at least two feet above the floor of the decontamination pad. Hollow-stem augers, drill rods, etc., that are hollow or have holes that transmit water or drilling fluids, were cleaned on the inside.
4. Rinse thoroughly with tap water.
5. Remove from the decontamination pad and cover with clean, unused plastic. If stored overnight, the plastic was secured to ensure that it stays in place.

For downhole drilling equipment that contacts the sample media (piston sampler points and shoes, screen point sampler screens and sheaths, and the drive rods when used for groundwater sampling), the following procedures were followed:

1. Clean with tap water and Alconox® detergent using a brush, if necessary, to remove particulate matter and surface films. Selected equipment was steam cleaned to remove matter that was difficult to remove with the brush. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. PVC or plastic items should not be steam cleaned.
2. Rinse thoroughly with tap or distilled water.
3. Rinse thoroughly with distilled water and place on a clean foil-wrapped surface to air-dry.
4. All equipment must be wrapped with foil. If the equipment was to be stored overnight before it is wrapped in foil, it was covered and secured with clean, unused plastic sheeting.

#### 3.1.2 Sample Collection

Precautions were taken so that sampling materials did not contact the ground or other potentially impacted surfaces. Each soil, sediment, surface water, and groundwater sample was retrieved from the sampling location and placed into a clean sample container. Upon completion of the field measurements, samples were collected from the sample location for laboratory analysis, and placed in laboratory-prepared containers appropriate for the analyses to be performed. Each sample container were labeled with the sample number; the identity of the sampler; the time and date of collection; the preservatives (if any); and the required analysis. All samples collected were placed into laboratory-prepared containers and preserved as applicable. Samples were analyzed in accordance with the EPA methods or an equivalent procedure by a North Carolina-certified laboratory.

### 3.2 Field Quality Control

The quality of data for the collection of samples were ensured by the use of trip blanks, and equipment blanks (not required if dedicated materials were used), and replicate samples. Trip blanks measure any cross-contamination of the samples during transport, handling, and storage. Equipment blanks demonstrate that the sample equipment is free of contamination and that adequate decontamination was performed after the use of the sample equipment. Replicate samples indicate the precision of the sampling process by calculating the relative percent difference in the results for a sample and its replicate. Each sampling event included at least one trip blank, one equipment blank (if required), and one replicate sample. Trip blanks were analyzed for VOCs in the same manner as the accompanying samples. Equipment blanks and replicate samples were analyzed for the same analytes and in the same manner as the accompanying samples.

### 3.3 Sample Shipment

All samples were packaged securely and placed on ice to cool (reduce the sample temperature to below 4° C), and transported to the analytical laboratory following strict chain-of-custody protocol.

### 3.4 Chain-Of-Custody

Each sample container was individually identified as to sample number, date and time collected, and source of sample. A chain-of-custody record was prepared which will included:

- The name of the person collecting the samples;
- The identity of each sample;
- Analytical requirements; and
- Name of person accepting sample.

Custody transfers of samples were recorded on the chain-of-custody form by signatures of the transferor (relinquisher) and the transferee (receiver). This procedure was repeated, as necessary, until final delivery was made to the analytical laboratory.

### 3.5 Laboratory Quality Control

The quality of data from the laboratory was ensured by the use of instrument tuning, initial calibration, continuing calibration, internal standards, method blanks, surrogate recoveries, and matrix spike/spike duplicate analysis.

# 4.0 ANALYTICAL RESULTS

## 4.1 ABL Area

Per the request of NCDENR, Alcoa collected surface soil, sediment, surface water, and groundwater samples from the ABL area for laboratory analysis. Laboratory reports and completed chain of custody forms are provided in Appendix B. A Data Usability Summary for the ABL samples is provided in Appendix C.

### 4.1.1 LMC Sediment and Surface Water Samples

Three sediment (ABL-SD001-F004, ABL-SD002-F004, and ABL-SD003-F004) and three surface water (ABL-SW001-F004, ABL-SW002-F004, and ABL-SW003-F004) samples were collected in Little Mountain Creek and submitted for laboratory analyses. These samples were collected upstream of the ABL, downstream of the Middle seep, and downstream of the ABL.

Laboratory analytical results indicated concentrations of cyanide and metals were detected in sediment samples above laboratory detection limits including the background sediment sample (ABL-SD003-F004). No concentrations of fluoride, PCBs, VOCs, and SVOCs were detected in any sediment sample from Little Mountain Creek. Sediment analytical results are summarized in **Table 4-1**.

Laboratory analytical results indicated concentrations of total cyanide and two metals (barium and chromium) were detected in surface water samples above laboratory detection limits including the background surface water sample (ABL-SW003-F004). All concentrations were below the 15A NCAC 02B Surface Water Standards. No concentrations of fluoride, PCBs, VOCs, and SVOCs were detected in any surface water sample from Little Mountain Creek. Surface water analytical results are summarized in **Table 4-2**.

### 4.1.2 Surficial Soil Samples

Three surficial soil samples (ABL-SD004-F004, ABL-SD005-F004/ABL-SD005-D004, and ABL-SD006-F004) were collected between each of the seeps and Little Mountain Creek and submitted for laboratory analysis. Sample ABL-SD005-D004 was a duplicate for sample ABL-SD005-F004. Laboratory analytical results indicated concentrations of fluoride, cyanide, metals, one VOC (methylene chloride), and selected SVOCs were detected in surficial soil samples above laboratory detection limits. No concentrations of PCBs were detected in any surficial soil samples.

Per guidance from USEPA, certain organic chemicals (considered by EPA to be acetone, 2-butanone, methylene chloride, toluene, and the phthalate esters) are designated as common laboratory contaminants. Common laboratory contaminants are commonly used in the laboratory and thus may be introduced into a sample from laboratory cross-contamination and not from the site. Surficial soil analytical results are summarized in **Table 4-3**.

#### 4.1.3 Surface Water Samples

Two surface water samples (ABL-SW004-F004 and ABL-SW006-F004/ABL-SW006-D004) were collected between the seeps and Little Mountain Creek and submitted for laboratory analysis. Sample ABL-SW006-D004 was a duplicate for sample ABL-SW006-F004. During the sampling event, no standing or flowing water between the Middle seep and Little Mountain Creek was observed, and no surface water sample (ABL-SW005-F004) was collected. Laboratory analytical results indicated concentrations of fluoride, total cyanide, and metals were detected surface water samples above laboratory detection limits. No concentrations of PCBs, VOCs, and SVOCs were detected in any surface water samples. Surface water analytical results are summarized in **Table 4-4**.

The approved Work Plan proposed the collection of a surface water sample (ABL-SW007-F004) at the area of an alleged pipe failure as identified on pages 12 and 13 of the third party report, *Request for Preliminary Assessment for Areas Surrounding Alcoa Badin Works Facility in Badin, North Carolina*. As indicated earlier, no standing or flowing water was observed in the area of an alleged pipe failure, and no surface water sample was collected.

#### 4.1.4 SCA Groundwater Samples

Three groundwater samples (ABL-ML001-F004, ABL-ML002-F004, and ABL-ML003-F004) were collected from the seep collection area ("*SCA*") near the collection system piping at each of the seeps at the toe of the ABL and submitted for laboratory analysis. Laboratory analytical results indicated concentrations of fluoride, metals, one VOC (acetone) and one SVOC (bis(2-Ethylhexyl)phthalate) were detected in groundwater samples above laboratory detection limits. No concentrations of available cyanide or PCBs were detected in any groundwater samples. Acetone and bis(2-ethylhexyl)phthalate are common laboratory contaminants. Groundwater analytical results are summarized in **Table 4-5**.

### 4.2 Former Ball Field Area

To determine if the former Ball Field has been affected by historical industrial activity, Alcoa collected surface and sub-surface soil, sediment, surface water, and groundwater samples using a grid system established with line intersections (nodes) spaced approximately eighty feet apart. Laboratory reports and completed chain of custody forms are provided in Appendix A. A Data Usability Summary for the Former Ball Field Area samples is provided in Appendix D.

#### 4.2.1 Badin Lake Sediment and Surface Water Samples

One sediment sample (ABF-SD001-F001) and one surface water sample (ABF-SW001-F001) were collected from the Former Ball Field Area where surface water discharges into Badin Lake and submitted for laboratory analysis. These samples were collected immediately outside the culvert connecting the concrete surface water collection box to Badin Lake.

Laboratory analytical results indicated concentrations of cyanide, metals, one VOC (methylene chloride), and some SVOCs were detected in the sediment sample above laboratory detection limits. No concentrations of fluoride or PCBs were detected in the sediment sample. As discussed above, methylene chloride is a common laboratory contaminant and is believed not to be present at the site. In the March 2001 RFI Report, background soil concentrations of SVOCs, metals, cyanide, and fluoride were indentified in the area at levels similar to those found in the most recent sampling event. Concentrations are believed to be either naturally occurring or anthropogenic as a result of widespread urbanization. Sediment analytical results are summarized in **Table 4-6**.

Laboratory analytical results indicated that a concentration of one metal (barium) was detected in the surface water sample above laboratory detection limits. The concentration was below the 15A NCAC 02B Surface Water Standards. No concentrations of fluoride, total cyanide, PCBs, VOCs, and SVOCs were detected in the surface water sample. Surface water analytical results are summarized in **Table 4-7**.

#### 4.2.2 Inlet Sediment and Surface Water Samples

One sediment sample (ABF-SD002-F001/ABF-SD002-D001) and one surface water sample (ABF-SW002-F001/ABF-SW002-D001) were collected from the concrete surface water collection box next to Badin Lake and submitted for laboratory analysis. Sample ABF-SD002-D001 was a duplicate for sample ABF-SD002-F001. Sample ABF-SW002-D001 was a duplicate for sample ABF-SW002-F001. Water was collected from the box and submitted for analysis. Sediment was not present in the box, however a sediment sample was collected from immediately outside the box and submitted for analysis.

Laboratory analytical results indicated concentrations of metals, three VOCs (2-butanone, acetone, and naphthalene), and one SVOC (fluoranthene) were detected in the sediment sample above laboratory detection limits. 2-Butanone, naphthalene, and fluoranthene were reported as a "J" flagged values, indicating an estimated value. This flag is used when the mass spectral data indicate the presence of an analyte meeting the identification criteria but the result is less than the Contract Required Quantitation Limit ("*CRQL*"). 2-Butanone and acetone are common laboratory contaminants. No concentrations of fluoride, cyanide, and PCBs were detected in the sediment sample. Sediment analytical results are summarized in **Table 4-8**.

Laboratory analytical results indicated concentrations of fluoride and two metals (barium and mercury) were detected in the surface water sample above laboratory detection limits. Mercury was reported as a "J" flagged value, indicating that the reported value was obtained from a reading that was less than the CRQL but greater than or equal to the Method Detection Limit ("*MDL*"). All remaining concentrations were below the 15A NCAC 02B Surface Water Standards. No concentrations of total cyanide, PCBs, VOCs, and SVOCs were detected in the surface water sample. Surface water analytical results are summarized in **Table 4-9**.

#### 4.2.3 Surficial Soil Samples

Fifty surficial soil samples (ABF-SB001-F001 (0.5'-2') through ABF-SB046-F001 (0.5'-2'), and ABF-SB048-F001 (0.5'-2') through ABF-SB051-F001 (0.5'-2')) were collected from the upper 24-inches of soil and submitted for laboratory analysis. Soil sample ABF-SB047-F001 (0.5'-2') was not collected as it is believed to be located on an adjacent property not owned by Alcoa. Laboratory analytical results indicated concentrations of fluoride, total cyanide, one PCB Aroclor (PCB-1248), VOCs, and SVOCs were detected in surficial soil samples above laboratory detection limits. The one reported PCB Aroclor was reported as a "J" flagged value, indicating an estimated value. As stated above, background soil concentrations of SVOCs, metals, cyanide, and fluoride are present in the area. Concentrations are believed to be either naturally occurring or anthropogenic as a result of widespread urbanization. Surficial soil analytical results are summarized in **Tables 4-10 through 4-14**.

### 4.2.4 Soil Samples

Eight soil samples (ABF-SB003-F001 (2'-4'), ABF-SB007-F001 (2'-4'), ABF-SB011-F001 (2'-4'), ABF-SB022-F001 (2'-5'), ABF-SB034-F001 (2'-4'), ABF-SB036-F001 (2'-4'), ABF-SB038-F001 (2'-4'), and ABF-SB049-F001 (2'-4')) were collected at selected locations from the uppermost non-native interval and submitted for laboratory analysis. Laboratory analytical results indicated concentrations of cyanide, metals, three VOCs (2-butanone, acetone, and methylene chloride), and selected SVOCs were detected in soil samples above laboratory detection limits. No concentrations of fluoride or PCBs were detected in any soil samples. As stated above, background soil concentrations of SVOCs, metals, cyanide, and fluoride are present in the area. Concentrations are believed to be either naturally occurring or anthropogenic as a result of widespread urbanization. Soil analytical results are summarized in **Table 4-15**.

### 4.2.5 Groundwater Samples

Three groundwater samples (ABF-SB003-F001, ABF-SB007-F001, and ABF-SB011-F001) were collected from three of the eight deep soil sample locations and submitted for laboratory analysis. Laboratory analytical results indicated concentrations of fluoride and two metals (barium and mercury) were detected in groundwater samples above laboratory detection limits. Mercury was reported as a "J" flagged value. All remaining concentrations were below the 15A NCAC 02L Groundwater Standards. No concentrations of available cyanide, PCBs, VOCs, and SVOCs were detected in any groundwater soil samples. Groundwater analytical results are summarized in **Table 4-16**.

### 4.2.6 Conclusions

The current understanding is that the former Ball Field was either undeveloped or historically used as a recreational area through most of the 20th century. Based on available photographs, the area was undeveloped prior to 1938, the ball field was installed between 1938 and 1950, and has been underutilized since the late 1990s.

Recent analytical data support the current understanding of the former Ball Field Area. Concentrations of constituents were detected in samples collected at the site, however concentrations of similar constituents were detected background soil samples. Concentrations are believed to be either naturally occurring or anthropogenic as a result of urbanization of the area throughout the $20^{th}$ and $21^{st}$ century.

**Table 4-1**
**LMC Sediment Analytical Results**
**SWMU No. 2 (Alcoa Badin Municipal Landfill)**
**Former Alcoa-Badin Works Facility**
**Badin, North Carolina**

| Sample ID | Method | CAS | Units | ABL-SD001-F004 | ABL-SD002-F004 | ABL-SD003-F004 |
|---|---|---|---|---|---|---|
| Location | | | | Downstream LMC | LMC Downstream of Middle SCA | Upstream LMC |
| Date | | | | 7/21/2015 | 7/21/2015 | 7/21/2015 |
| Time | | | | 9:00 | 9:55 | 11:00 |
| Percent Moisture | ASTM D2974-87 | | % | 14.6 | 12.7 | 13.9 |
| Fluoride | EPA 9056 | 16984-48-8 | mg/kg | ND <14.8 | ND <14.2 | ND <14.4 |
| Cyanide | SM 4500-CN-E | 57-12-5 | mg/kg | 0.54 | 0.17 J | 0.13 |
| Arsenic | EPA 6010 | 7440-38-2 | mg/kg | 8.4 | 14.9 | 6.5 |
| Barium | EPA 6010 | 7440-39-3 | mg/kg | 33.1 | 58.4 | 89.3 |
| Cadmium | EPA 6010 | 7440-43-9 | mg/kg | 0.16 | 0.23 | 0.17 |
| Chromium | EPA 6010 | 7440-47-3 | mg/kg | 66.7 | 79.5 | 108 |
| Lead | EPA 6010 | 7439-92-1 | mg/kg | 12.7 | 20.0 | 18.4 |
| Selenium | EPA 6010 | 7782-49-2 | mg/kg | ND <0.33 | ND <0.37 | ND <0.35 |
| Silver | EPA 6010 | 7440-22-4 | mg/kg | 0.42 | 0.59 | 0.49 |
| Mercury | EPA 7471 | 7439-97-6 | mg/kg | 0.0087 | 0.014 | 0.010 |
| PCB-1016 (Aroclor 1016) | EPA 8082 | 12674-11-2 | mg/kg | ND <0.0176 | ND <0.0172 | ND <0.0174 |
| PCB-1221 (Aroclor 1221) | EPA 8082 | 11104-28-2 | mg/kg | ND <0.0176 | ND <0.0172 | ND <0.0174 |
| PCB-1232 (Aroclor 1232) | EPA 8082 | 11141-16-5 | mg/kg | ND <0.0176 | ND <0.0172 | ND <0.0174 |
| PCB-1242 (Aroclor 1242) | EPA 8082 | 53469-21-9 | mg/kg | ND <0.0176 | ND <0.0172 | ND <0.0174 |
| PCB-1248 (Aroclor 1248) | EPA 8082 | 12672-29-6 | mg/kg | ND <0.0176 | ND <0.0172 | ND <0.0174 |
| PCB-1254 (Aroclor 1254) | EPA 8082 | 11097-69-1 | mg/kg | ND <0.0176 | ND <0.0172 | ND <0.0174 |
| PCB-1260 (Aroclor 1260) | EPA 8082 | 11096-82-5 | mg/kg | ND <0.0176 | ND <0.0172 | ND <0.0174 |
| Total PCBs | EPA 8082 | -- | mg/kg | ND | ND | ND |
| 1,1,1,2-Tetrachloroethane | EPA 8260 | 630-20-6 | mg/kg | ND <0.0020 | ND <0.0022 | ND <0.0026 |
| 1,1,1-Trichloroethane | EPA 8260 | 71-55-6 | mg/kg | ND <0.0017 | ND <0.0018 | ND <0.0022 |
| 1,1,2,2-Tetrachloroethane | EPA 8260 | 79-34-5 | mg/kg | ND <0.0018 | ND <0.0019 | ND <0.0024 |
| 1,1,2-Trichloroethane | EPA 8260 | 79-00-5 | mg/kg | ND <0.0020 | ND <0.0022 | ND <0.0026 |
| 1,1-Dichloroethane | EPA 8260 | 75-34-3 | mg/kg | ND <0.0014 | ND <0.0015 | ND <0.0019 |
| 1,1-Dichloroethene | EPA 8260 | 75-35-4 | mg/kg | ND <0.0017 | ND <0.0018 | ND <0.0022 |
| 1,1-Dichloropropene | EPA 8260 | 563-58-6 | mg/kg | ND <0.0014 | ND <0.0015 | ND <0.0019 |
| 1,2,3-Trichlorobenzene | EPA 8260 | 87-61-6 | mg/kg | ND <0.0021 | ND <0.0023 | ND <0.0027 |
| 1,2,3-Trichloropropane | EPA 8260 | 96-18-4 | mg/kg | ND <0.0015 | ND <0.0016 | ND <0.0020 |
| 1,2,4-Trichlorobenzene | EPA 8260 | 120-82-1 | mg/kg | ND <0.0015 | ND <0.0016 | ND <0.0020 |
| 1,2,4-Trimethylbenzene | EPA 8260 | 95-63-6 | mg/kg | ND <0.0019 | ND <0.0020 | ND <0.0025 |
| 1,2-Dibromo-3-chloropropane | EPA 8260 | 96-12-8 | mg/kg | ND <0.0034 | ND <0.0037 | ND <0.0045 |
| 1,2-Dibromoethane (EDB) | EPA 8260 | 106-93-4 | mg/kg | ND <0.0017 | ND <0.0018 | ND <0.0022 |
| 1,2-Dichlorobenzene | EPA 8260 | 95-50-1 | mg/kg | ND <0.0018 | ND <0.0019 | ND <0.0024 |
| 1,2-Dichloroethane | EPA 8260 | 107-06-2 | mg/kg | ND <0.0021 | ND <0.0023 | ND <0.0027 |
| 1,2-Dichloropropane | EPA 8260 | 78-87-5 | mg/kg | ND <0.0016 | ND <0.0017 | ND <0.0021 |
| 1,3,5-Trimethylbenzene | EPA 8260 | 108-67-8 | mg/kg | ND <0.0017 | ND <0.0018 | ND <0.0022 |
| 1,3-Dichlorobenzene | EPA 8260 | 541-73-1 | mg/kg | ND <0.0019 | ND <0.0020 | ND <0.0025 |
| 1,3-Dichloropropane | EPA 8260 | 142-28-9 | mg/kg | ND <0.0018 | ND <0.0019 | ND <0.0024 |
| 1,4-Dichlorobenzene | EPA 8260 | 106-46-7 | mg/kg | ND <0.0016 | ND <0.0017 | ND <0.0021 |
| 2,2-Dichloropropane | EPA 8260 | 594-20-7 | mg/kg | ND <0.0016 | ND <0.0017 | ND <0.0021 |
| 2-Butanone (MEK) | EPA 8260 | 78-93-3 | mg/kg | ND <0.0027 | ND <0.0030 | ND <0.0036 |
| 2-Chlorotoluene | EPA 8260 | 95-49-8 | mg/kg | ND <0.0016 | ND <0.0017 | ND <0.0021 |
| 2-Hexanone | EPA 8260 | 591-78-6 | mg/kg | ND <0.0036 | ND <0.0040 | ND <0.0048 |
| 4-Chlorotoluene | EPA 8260 | 106-43-4 | mg/kg | ND <0.0017 | ND <0.0018 | ND <0.0022 |
| 4-Methyl-2-pentanone (MIBK) | EPA 8260 | 108-10-1 | mg/kg | ND <0.0035 | ND <0.0038 | ND <0.0046 |
| Acetone | EPA 8260 | 67-64-1 | mg/kg | ND <0.0093 | ND <0.0102 | ND <0.0124 |
| Benzene | EPA 8260 | 71-43-2 | mg/kg | ND <0.0015 | ND <0.0016 | ND <0.0020 |
| Bromobenzene | EPA 8260 | 108-86-1 | mg/kg | ND <0.0019 | ND <0.0020 | ND <0.0025 |
| Bromochloromethane | EPA 8260 | 74-97-5 | mg/kg | ND <0.0016 | ND <0.0017 | ND <0.0021 |
| Bromodichloromethane | EPA 8260 | 75-27-4 | mg/kg | ND <0.0018 | ND <0.0019 | ND <0.0024 |
| Bromoform | EPA 8260 | 75-25-2 | mg/kg | ND <0.0021 | ND <0.0024 | ND <0.0029 |
| Bromomethane | EPA 8260 | 74-83-9 | mg/kg | ND <0.0023 | ND <0.0026 | ND <0.0031 |
| Carbon tetrachloride | EPA 8260 | 56-23-5 | mg/kg | ND <0.0024 | ND <0.0027 | ND <0.0032 |
| Chlorobenzene | EPA 8260 | 108-90-7 | mg/kg | ND <0.0018 | ND <0.0019 | ND <0.0024 |
| Chloroethane | EPA 8260 | 75-00-3 | mg/kg | ND <0.0022 | ND <0.0025 | ND <0.0030 |
| Chloroform | EPA 8260 | 67-66-3 | mg/kg | ND <0.0015 | ND <0.0016 | ND <0.0020 |
| Chloromethane | EPA 8260 | 74-87-3 | mg/kg | ND <0.0022 | ND <0.0025 | ND <0.0030 |
| Dibromochloromethane | EPA 8260 | 124-48-1 | mg/kg | ND <0.0017 | ND <0.0018 | ND <0.0022 |
| Dibromomethane | EPA 8260 | 74-95-3 | mg/kg | ND <0.0023 | ND <0.0026 | ND <0.0031 |
| Dichlorodifluoromethane | EPA 8260 | 75-71-8 | mg/kg | ND <0.0034 | ND <0.0037 | ND <0.0045 |
| Diisopropyl ether | EPA 8260 | 108-20-3 | mg/kg | ND <0.0016 | ND <0.0017 | ND <0.0021 |
| Ethylbenzene | EPA 8260 | 100-41-4 | mg/kg | ND <0.0017 | ND <0.0018 | ND <0.0022 |
| Hexachloro-1,3-butadiene | EPA 8260 | 87-68-3 | mg/kg | ND <0.0019 | ND <0.0020 | ND <0.0025 |
| Isopropylbenzene (Cumene) | EPA 8260 | 98-82-8 | mg/kg | ND <0.0018 | ND <0.0019 | ND <0.0024 |
| Methyl-tert-butyl ether | EPA 8260 | 1634-04-4 | mg/kg | ND <0.0014 | ND <0.0015 | ND <0.0019 |
| Methylene Chloride | EPA 8260 | 75-09-2 | mg/kg | ND <0.0028 | ND <0.0031 | ND <0.0037 |
| Naphthalene | EPA 8260 | 91-20-3 | mg/kg | ND <0.0011 | ND <0.0012 | ND <0.0015 |
| Styrene | EPA 8260 | 100-42-5 | mg/kg | ND <0.0017 | ND <0.0018 | ND <0.0022 |
| Tetrachloroethene | EPA 8260 | 127-18-4 | mg/kg | ND <0.0016 | ND <0.0017 | ND <0.0021 |
| Toluene | EPA 8260 | 108-88-3 | mg/kg | ND <0.0017 | ND <0.0018 | ND <0.0022 |
| Trichloroethene | EPA 8260 | 79-01-6 | mg/kg | ND <0.0020 | ND <0.0022 | ND <0.0026 |
| Trichlorofluoromethane | EPA 8260 | 75-69-4 | mg/kg | ND <0.0021 | ND <0.0023 | ND <0.0027 |
| Vinyl acetate | EPA 8260 | 108-05-4 | mg/kg | ND <0.0082 | ND <0.0090 | ND <0.0109 |
| Vinyl chloride | EPA 8260 | 75-01-4 | mg/kg | ND <0.0017 | ND <0.0018 | ND <0.0022 |
| Xylene (Total) | EPA 8260 | 1330-20-7 | mg/kg | ND <0.0034 | ND <0.0037 | ND <0.0045 |
| cis-1,2-Dichloroethene | EPA 8260 | 156-59-2 | mg/kg | ND <0.0013 | ND <0.0014 | ND <0.0017 |
| cis-1,3-Dichloropropene | EPA 8260 | 10061-01-5 | mg/kg | ND <0.0017 | ND <0.0018 | ND <0.0022 |
| m&p-Xylene | EPA 8260 | 179601-23-1 | mg/kg | ND <0.0034 | ND <0.0037 | ND <0.0045 |
| n-Butylbenzene | EPA 8260 | 104-51-8 | mg/kg | ND <0.0017 | ND <0.0018 | ND <0.0022 |
| n-Propylbenzene | EPA 8260 | 103-65-1 | mg/kg | ND <0.0016 | ND <0.0017 | ND <0.0021 |
| o-Xylene | EPA 8260 | 95-47-6 | mg/kg | ND <0.0018 | ND <0.0019 | ND <0.0024 |
| p-Isopropyltoluene | EPA 8260 | 99-87-6 | mg/kg | ND <0.0016 | ND <0.0017 | ND <0.0021 |
| sec-Butylbenzene | EPA 8260 | 135-98-8 | mg/kg | ND <0.0015 | ND <0.0016 | ND <0.0020 |
| tert-Butylbenzene | EPA 8260 | 98-06-6 | mg/kg | ND <0.0019 | ND <0.0020 | ND <0.0025 |
| trans-1,2-Dichloroethene | EPA 8260 | 156-60-5 | mg/kg | ND <0.0018 | ND <0.0019 | ND <0.0024 |
| trans-1,3-Dichloropropene | EPA 8260 | 10061-02-6 | mg/kg | ND <0.0014 | ND <0.0015 | ND <0.0019 |

**Table 4-1**
**LMC Sediment Analytical Results**
**SWMU No. 2 (Alcoa Badin Municipal Landfill)**
**Former Alcoa-Badin Works Facility**
**Badin, North Carolina**

| Sample ID | Method | CAS | Units | ABL-SD001-F004 | ABL-SD002-F004 | ABL-SD003-F004 |
|---|---|---|---|---|---|---|
| Location | | | | Downstream LMC | LMC Downstream of Middle SCA | Upstream LMC |
| Date | | | | 7/21/2015 | 7/21/2015 | 7/21/2015 |
| Time | | | | 9:00 | 9:55 | 11:00 |
| 1,2,4-Trichlorobenzene | EPA 8270 | 120-82-1 | mg/kg | ND <0.0750 | ND <0.0733 | ND <0.0743 |
| 1,2-Dichlorobenzene | EPA 8270 | 95-50-1 | mg/kg | ND <0.103 | ND <0.101 | ND <0.102 |
| 1,3-Dichlorobenzene | EPA 8270 | 541-73-1 | mg/kg | ND <0.0879 | ND <0.0859 | ND <0.0871 |
| 1,4-Dichlorobenzene | EPA 8270 | 106-46-7 | mg/kg | ND <0.109 | ND <0.107 | ND <0.108 |
| 1-Methylnaphthalene | EPA 8270 | 90-12-0 | mg/kg | ND <0.101 | ND <0.0985 | ND <0.0998 |
| 2,4,5-Trichlorophenol | EPA 8270 | 95-95-4 | mg/kg | ND <0.120 | ND <0.117 | ND <0.118 |
| 2,4,6-Trichlorophenol | EPA 8270 | 88-06-2 | mg/kg | ND <0.0855 | ND <0.0836 | ND <0.0847 |
| 2,4-Dichlorophenol | EPA 8270 | 120-83-2 | mg/kg | ND <0.0844 | ND <0.0825 | ND <0.0836 |
| 2,4-Dimethylphenol | EPA 8270 | 105-67-9 | mg/kg | ND <0.152 | ND <0.149 | ND <0.151 |
| 2,4-Dinitrophenol | EPA 8270 | 51-28-5 | mg/kg | ND <0.0633 | ND <0.0619 | ND <0.0627 |
| 2,4-Dinitrotoluene | EPA 8270 | 121-14-2 | mg/kg | ND <0.0726 | ND <0.0710 | ND <0.0720 |
| 2,6-Dinitrotoluene | EPA 8270 | 606-20-2 | mg/kg | ND <0.0808 | ND <0.0790 | ND <0.0801 |
| 2-Chloronaphthalene | EPA 8270 | 91-58-7 | mg/kg | ND <0.0762 | ND <0.0745 | ND <0.0755 |
| 2-Chlorophenol | EPA 8270 | 95-57-8 | mg/kg | ND <0.105 | ND <0.103 | ND <0.104 |
| 2-Methylnaphthalene | EPA 8270 | 91-57-6 | mg/kg | ND <0.0832 | ND <0.0813 | ND <0.0824 |
| 2-Methylphenol(o-Cresol) | EPA 8270 | 95-48-7 | mg/kg | ND <0.117 | ND <0.115 | ND <0.116 |
| 2-Nitroaniline | EPA 8270 | 88-74-4 | mg/kg | ND <0.120 | ND <0.117 | ND <0.118 |
| 2-Nitrophenol | EPA 8270 | 88-75-5 | mg/kg | ND <0.0937 | ND <0.0916 | ND <0.0929 |
| 3&4-Methylphenol(m&p Cresol) | EPA 8270 | | mg/kg | ND <0.152 | ND <0.149 | ND <0.151 |
| 3,3'-Dichlorobenzidine | EPA 8270 | 91-94-1 | mg/kg | ND <0.0844 | ND <0.0825 | ND <0.0836 |
| 3-Nitroaniline | EPA 8270 | 99-09-2 | mg/kg | ND <0.105 | ND <0.103 | ND <0.104 |
| 4,6-Dinitro-2-methylphenol | EPA 8270 | 534-52-1 | mg/kg | ND <0.0773 | ND <0.0756 | ND <0.0766 |
| 4-Bromophenylphenyl ether | EPA 8270 | 101-55-3 | mg/kg | ND <0.0703 | ND <0.0687 | ND <0.0696 |
| 4-Chloro-3-methylphenol | EPA 8270 | 59-50-7 | mg/kg | ND <0.0797 | ND <0.0779 | ND <0.0789 |
| 4-Chloroaniline | EPA 8270 | 106-47-8 | mg/kg | ND <0.108 | ND <0.105 | ND <0.107 |
| 4-Chlorophenylphenyl ether | EPA 8270 | 7005-72-3 | mg/kg | ND <0.0797 | ND <0.0779 | ND <0.0789 |
| 4-Nitroaniline | EPA 8270 | 100-01-6 | mg/kg | ND <0.109 | ND <0.107 | ND <0.108 |
| 4-Nitrophenol | EPA 8270 | 100-02-7 | mg/kg | ND <0.0691 | ND <0.0676 | ND <0.0685 |
| Acenaphthene | EPA 8270 | 83-32-9 | mg/kg | ND <0.0890 | ND <0.0871 | ND <0.0882 |
| Acenaphthylene | EPA 8270 | 208-96-8 | mg/kg | ND <0.0914 | ND <0.0894 | ND <0.0905 |
| Aniline | EPA 8270 | 62-53-3 | mg/kg | ND <0.104 | ND <0.102 | ND <0.103 |
| Anthracene | EPA 8270 | 120-12-7 | mg/kg | ND <0.0867 | ND <0.0848 | ND <0.0859 |
| Benzo(a)anthracene | EPA 8270 | 56-55-3 | mg/kg | ND <0.0715 | ND <0.0699 | ND <0.0708 |
| Benzo(a)pyrene | EPA 8270 | 50-32-8 | mg/kg | ND <0.0738 | ND <0.0722 | ND <0.0731 |
| Benzo(b)fluoranthene | EPA 8270 | 205-99-2 | mg/kg | ND <0.0668 | ND <0.0653 | ND <0.0662 |
| Benzo(g,h,i)perylene | EPA 8270 | 191-24-2 | mg/kg | ND <0.0984 | ND <0.0962 | ND <0.0975 |
| Benzo(k)fluoranthene | EPA 8270 | 207-08-9 | mg/kg | ND <0.0762 | ND <0.0745 | ND <0.0755 |
| Benzoic Acid | EPA 8270 | 65-85-0 | mg/kg | ND <0.0703 | ND <0.0687 | ND <0.0696 |
| Benzyl alcohol | EPA 8270 | 100-51-6 | mg/kg | ND <0.0773 | ND <0.0756 | ND <0.0766 |
| Butylbenzylphthalate | EPA 8270 | 85-68-7 | mg/kg | ND <0.0820 | ND <0.0802 | ND <0.0813 |
| Chrysene | EPA 8270 | 218-01-9 | mg/kg | ND <0.0516 | ND <0.0504 | ND <0.0511 |
| Di-n-butylphthalate | EPA 8270 | 84-74-2 | mg/kg | ND <0.0633 | ND <0.0619 | ND <0.0627 |
| Di-n-octylphthalate | EPA 8270 | 117-84-0 | mg/kg | ND <0.0808 | ND <0.0790 | ND <0.0801 |
| Dibenz(a,h)anthracene | EPA 8270 | 53-70-3 | mg/kg | ND <0.0820 | ND <0.0802 | ND <0.0813 |
| Dibenzofuran | EPA 8270 | 132-64-9 | mg/kg | ND <0.0633 | ND <0.0619 | ND <0.0627 |
| Diethylphthalate | EPA 8270 | 84-66-2 | mg/kg | ND <0.0598 | ND <0.0584 | ND <0.0592 |
| Dimethylphthalate | EPA 8270 | 131-11-3 | mg/kg | ND <0.0785 | ND <0.0767 | ND <0.0778 |
| Fluoranthene | EPA 8270 | 206-44-0 | mg/kg | ND <0.0562 | ND <0.0550 | ND <0.0557 |
| Fluorene | EPA 8270 | 86-73-7 | mg/kg | ND <0.0797 | ND <0.0779 | ND <0.0789 |
| Hexachloro-1,3-butadiene | EPA 8270 | 87-68-3 | mg/kg | ND <0.0668 | ND <0.0653 | ND <0.0662 |
| Hexachlorobenzene | EPA 8270 | 118-74-1 | mg/kg | ND <0.0492 | ND <0.0481 | ND <0.0488 |
| Hexachlorocyclopentadiene | EPA 8270 | 77-47-4 | mg/kg | ND <0.0715 | ND <0.0699 | ND <0.0708 |
| Hexachloroethane | EPA 8270 | 67-72-1 | mg/kg | ND <0.102 | ND <0.0997 | ND <0.101 |
| Indeno(1,2,3-cd)pyrene | EPA 8270 | 193-39-5 | mg/kg | ND <0.0797 | ND <0.0779 | ND <0.0789 |
| Isophorone | EPA 8270 | 78-59-1 | mg/kg | ND <0.0867 | ND <0.0848 | ND <0.0859 |
| N-Nitroso-di-n-propylamine | EPA 8270 | 621-64-7 | mg/kg | ND <0.0738 | ND <0.0722 | ND <0.0731 |
| N-Nitrosodimethylamine | EPA 8270 | 62-75-9 | mg/kg | ND <0.125 | ND <0.123 | ND <0.124 |
| N-Nitrosodiphenylamine | EPA 8270 | 86-30-6 | mg/kg | ND <0.115 | ND <0.112 | ND <0.114 |
| Naphthalene | EPA 8270 | 91-20-3 | mg/kg | ND <0.0949 | ND <0.0928 | ND <0.0940 |
| Nitrobenzene | EPA 8270 | 98-95-3 | mg/kg | ND <0.105 | ND <0.103 | ND <0.104 |
| Pentachlorophenol | EPA 8270 | 87-86-5 | mg/kg | ND <0.0703 | ND <0.0687 | ND <0.0696 |
| Phenanthrene | EPA 8270 | 85-01-8 | mg/kg | ND <0.0644 | ND <0.0630 | ND <0.0638 |
| Phenol | EPA 8270 | 108-95-2 | mg/kg | ND <0.116 | ND <0.113 | ND <0.115 |
| Pyrene | EPA 8270 | 129-00-0 | mg/kg | ND <0.0656 | ND <0.0641 | ND <0.0650 |
| bis(2-Chloroethoxy)methane | EPA 8270 | 111-91-1 | mg/kg | ND <0.0902 | ND <0.0882 | ND <0.0894 |
| bis(2-Chloroethyl) ether | EPA 8270 | 111-44-4 | mg/kg | ND <0.0984 | ND <0.0962 | ND <0.0975 |
| bis(2-Chloroisopropyl) ether | EPA 8270 | 108-60-1 | mg/kg | ND <0.103 | ND <0.101 | ND <0.102 |
| bis(2-Ethylhexyl)phthalate | EPA 8270 | 117-81-7 | mg/kg | ND <0.105 | ND <0.103 | ND <0.104 |

*ND - The analyte was not detected above laboratory detection limits. Subscript indicates compound-specific MDL in mg/kg.*
*"J" - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.*

**Table 4-2**
**LMC Surface Water Analytical Results**
**SWMU No. 2 (Alcoa Badin Municipal Landfill)**
**Former Alcoa-Badin Works Facility**
**Badin, North Carolina**

| Sample ID | Method | CAS | Units | ABL-SW001-F004 | ABL-SW002-F004 | ABL-SW003-F004 |
|---|---|---|---|---|---|---|
| Location | | | | Downstream LMC | LMC Downstream of Middle SCA | Upstream LMC |
| Date | | | | 7/21/2015 | 7/21/2015 | 7/21/2015 |
| Time | | | | 8:55 | 10:00 | 11:05 |
| Fluoride | EPA 300.0 | 16984-48-8 | mg/L | ND <0.25 | ND <0.25 | ND <0.25 |
| Cyanide | SM 4500-CN-E | 57-12-5 | mg/L | 0.0049 J | ND <0.0040 | ND <0.0040 |
| Arsenic | EPA 6010 | 7440-38-2 | mg/L | ND <0.0050 | ND <0.0050 | ND <0.0050 |
| Barium | EPA 6010 | 7440-39-3 | mg/L | 0.0109 | 0.0098 | 0.0100 |
| Cadmium | EPA 6010 | 7440-43-9 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| Chromium | EPA 6010 | 7440-47-3 | mg/L | ND <0.0025 | ND <0.0025 | 0.0033 J |
| Lead | EPA 6010 | 7439-92-1 | mg/L | ND <0.0025 | ND <0.0025 | ND <0.0025 |
| Selenium | EPA 6010 | 7782-49-2 | mg/L | ND <0.0050 | ND <0.0050 | ND <0.0050 |
| Silver | EPA 6010 | 7440-22-4 | mg/L | ND <0.0025 | ND <0.0025 | ND <0.0025 |
| Mercury | EPA 7470 | 7439-97-6 | mg/L | ND <0.00010 | ND <0.00010 | ND <0.00010 |
| PCB-1016 (Aroclor 1016) | EPA 8082 | 12674-11-2 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| PCB-1221 (Aroclor 1221) | EPA 8082 | 11104-28-2 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| PCB-1232 (Aroclor 1232) | EPA 8082 | 11141-16-5 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| PCB-1242 (Aroclor 1242) | EPA 8082 | 53469-21-9 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| PCB-1248 (Aroclor 1248) | EPA 8082 | 12672-29-6 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| PCB-1254 (Aroclor 1254) | EPA 8082 | 11097-69-1 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| PCB-1260 (Aroclor 1260) | EPA 8082 | 11096-82-5 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| Total PCBs | EPA 8082 | -- | mg/L | ND | ND | ND |
| 1,1,1,2-Tetrachloroethane | EPA 8260 | 630-20-6 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,1,1-Trichloroethane | EPA 8260 | 71-55-6 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| 1,1,2,2-Tetrachloroethane | EPA 8260 | 79-34-5 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 1,1,2-Trichloroethane | EPA 8260 | 79-00-5 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,1-Dichloroethane | EPA 8260 | 75-34-3 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| 1,1-Dichloroethene | EPA 8260 | 75-35-4 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| 1,1-Dichloropropene | EPA 8260 | 563-58-6 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,2,3-Trichlorobenzene | EPA 8260 | 87-61-6 | mg/L | ND <0.0020 | ND <0.0020 | ND <0.0020 |
| 1,2,3-Trichloropropane | EPA 8260 | 96-18-4 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 1,2,4-Trichlorobenzene | EPA 8260 | 120-82-1 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,2,4-Trimethylbenzene | EPA 8260 | 95-63-6 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 1,2-Dibromo-3-chloropropane | EPA 8260 | 96-12-8 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,2-Dibromoethane (EDB) | EPA 8260 | 106-93-4 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,2-Dichlorobenzene | EPA 8260 | 95-50-1 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 1,2-Dichloroethane | EPA 8260 | 107-06-2 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| 1,2-Dichloroethene (Total) | EPA 8260 | 540-59-0 | mg/L | ND <0.0044 | ND <0.0044 | ND <0.0044 |
| 1,2-Dichloropropane | EPA 8260 | 78-87-5 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,3,5-Trimethylbenzene | EPA 8260 | 108-67-8 | mg/L | ND <0.0013 | ND <0.0013 | ND <0.0013 |
| 1,3-Dichlorobenzene | EPA 8260 | 541-73-1 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 1,3-Dichloropropane | EPA 8260 | 142-28-9 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,4-Dichlorobenzene | EPA 8260 | 106-46-7 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 2,2-Dichloropropane | EPA 8260 | 594-20-7 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| 2-Butanone (MEK) | EPA 8260 | 78-93-3 | mg/L | ND <0.0049 | ND <0.0049 | ND <0.0049 |
| 2-Chlorotoluene | EPA 8260 | 95-49-8 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 2-Hexanone | EPA 8260 | 591-78-6 | mg/L | ND <0.0038 | ND <0.0038 | ND <0.0038 |
| 4-Chlorotoluene | EPA 8260 | 106-43-4 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| 4-Methyl-2-pentanone (MIBK) | EPA 8260 | 108-10-1 | mg/L | ND <0.0036 | ND <0.0036 | ND <0.0036 |
| Acetone | EPA 8260 | 67-64-1 | mg/L | ND <0.0100 | ND <0.0100 | ND <0.0100 |
| Benzene | EPA 8260 | 71-43-2 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Bromobenzene | EPA 8260 | 108-86-1 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| Bromochloromethane | EPA 8260 | 74-97-5 | mg/L | ND <0.0022 | ND <0.0022 | ND <0.0022 |
| Bromodichloromethane | EPA 8260 | 75-27-4 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Bromoform | EPA 8260 | 75-25-2 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| Bromomethane | EPA 8260 | 74-83-9 | mg/L | ND <0.0025 | ND <0.0025 | ND <0.0025 |
| Carbon tetrachloride | EPA 8260 | 56-23-5 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| Chlorobenzene | EPA 8260 | 108-90-7 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Chloroethane | EPA 8260 | 75-00-3 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| Chloroform | EPA 8260 | 67-66-3 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| Chloromethane | EPA 8260 | 74-87-3 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| Dibromochloromethane | EPA 8260 | 124-48-1 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Dibromomethane | EPA 8260 | 74-95-3 | mg/L | ND <0.0020 | ND <0.0020 | ND <0.0020 |
| Dichlorodifluoromethane | EPA 8260 | 75-71-8 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| Diisopropyl ether | EPA 8260 | 108-20-3 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Ethylbenzene | EPA 8260 | 100-41-4 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| Hexachloro-1,3-butadiene | EPA 8260 | 87-68-3 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Isopropylbenzene (Cumene) | EPA 8260 | 98-82-8 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| Methyl-tert-butyl ether | EPA 8260 | 1634-04-4 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Methylene Chloride | EPA 8260 | 75-09-2 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| Naphthalene | EPA 8260 | 91-20-3 | mg/L | ND <0.0020 | ND <0.0020 | ND <0.0020 |
| Styrene | EPA 8260 | 100-42-5 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| Tetrachloroethene | EPA 8260 | 127-18-4 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Toluene | EPA 8260 | 108-88-3 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| Trichloroethene | EPA 8260 | 79-01-6 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Trichlorofluoromethane | EPA 8260 | 75-69-4 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Vinyl acetate | EPA 8260 | 108-05-4 | mg/L | ND <0.0023 | ND <0.0023 | ND <0.0023 |
| Vinyl chloride | EPA 8260 | 75-01-4 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| cis-1,2-Dichloroethene | EPA 8260 | 156-59-2 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| cis-1,3-Dichloropropene | EPA 8260 | 10061-01-5 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| m&p-Xylene | EPA 8260 | 179601-23-1 | mg/L | ND <0.0031 | ND <0.0031 | ND <0.0031 |
| n-Butylbenzene | EPA 8260 | 104-51-8 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| n-Propylbenzene | EPA 8260 | 103-65-1 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| o-Xylene | EPA 8260 | 95-47-6 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| p-Isopropyltoluene | EPA 8260 | 99-87-6 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| sec-Butylbenzene | EPA 8260 | 135-98-8 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| tert-Butyl Alcohol | EPA 8260 | 75-65-0 | mg/L | ND <0.0577 | ND <0.0577 | ND <0.0577 |
| tert-Butylbenzene | EPA 8260 | 98-06-6 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| trans-1,2-Dichloroethene | EPA 8260 | 156-60-5 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| trans-1,3-Dichloropropene | EPA 8260 | 10061-02-6 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| 1,2,4-Trichlorobenzene | EPA 8270 | 120-82-1 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| 1,2-Dichlorobenzene | EPA 8270 | 95-50-1 | mg/L | ND <0.0012 | ND <0.0012 | ND <0.0012 |

**Table 4-2**
**LMC Surface Water Analytical Results**
**SWMU No. 2 (Alcoa Badin Municipal Landfill)**
**Former Alcoa-Badin Works Facility**
**Badin, North Carolina**

| Sample ID | Method | CAS | Units | ABL-SW001-F004 | ABL-SW002-F004 | ABL-SW003-F004 |
|---|---|---|---|---|---|---|
| Location | | | | Downstream LMC | LMC Downstream of Middle SCA | Upstream LMC |
| Date | | | | 7/21/2015 | 7/21/2015 | 7/21/2015 |
| Time | | | | 8:55 | 10:00 | 11:05 |
| 1,3-Dichlorobenzene | EPA 8270 | 541-73-1 | mg/L | ND <0.0011 | ND <0.0011 | ND <0.0011 |
| 1,4-Dichlorobenzene | EPA 8270 | 106-46-7 | mg/L | ND <0.0012 | ND <0.0012 | ND <0.0012 |
| 1-Methylnaphthalene | EPA 8270 | 90-12-0 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| 2,4,5-Trichlorophenol | EPA 8270 | 95-95-4 | mg/L | ND <0.0022 | ND <0.0022 | ND <0.0022 |
| 2,4,6-Trichlorophenol | EPA 8270 | 88-06-2 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| 2,4-Dichlorophenol | EPA 8270 | 120-83-2 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 2,4-Dimethylphenol | EPA 8270 | 105-67-9 | mg/L | ND <0.0022 | ND <0.0022 | ND <0.0022 |
| 2,4-Dinitrophenol | EPA 8270 | 51-28-5 | mg/L | ND <0.0065 | ND <0.0065 | ND <0.0065 |
| 2,4-Dinitrotoluene | EPA 8270 | 121-14-2 | mg/L | ND <0.0012 | ND <0.0012 | ND <0.0012 |
| 2,6-Dinitrotoluene | EPA 8270 | 606-20-2 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 2-Chloronaphthalene | EPA 8270 | 91-58-7 | mg/L | ND <0.0022 | ND <0.0022 | ND <0.0022 |
| 2-Chlorophenol | EPA 8270 | 95-57-8 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 2-Methylnaphthalene | EPA 8270 | 91-57-6 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 2-Methylphenol(o-Cresol) | EPA 8270 | 95-48-7 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 2-Nitroaniline | EPA 8270 | 88-74-4 | mg/L | ND <0.0028 | ND <0.0028 | ND <0.0028 |
| 2-Nitrophenol | EPA 8270 | 88-75-5 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 3&4-Methylphenol(m&p Cresol) | EPA 8270 | | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 3,3'-Dichlorobenzidine | EPA 8270 | 91-94-1 | mg/L | ND <0.0014 | ND <0.0014 | ND <0.0014 |
| 3-Nitroaniline | EPA 8270 | 99-09-2 | mg/L | ND <0.0024 | ND <0.0024 | ND <0.0024 |
| 4,6-Dinitro-2-methylphenol | EPA 8270 | 534-52-1 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 4-Bromophenylphenyl ether | EPA 8270 | 101-55-3 | mg/L | ND <0.0013 | ND <0.0013 | ND <0.0013 |
| 4-Chloro-3-methylphenol | EPA 8270 | 59-50-7 | mg/L | ND <0.0042 | ND <0.0042 | ND <0.0042 |
| 4-Chloroaniline | EPA 8270 | 106-47-8 | mg/L | ND <0.0034 | ND <0.0034 | ND <0.0034 |
| 4-Chlorophenylphenyl ether | EPA 8270 | 7005-72-3 | mg/L | ND <0.0021 | ND <0.0021 | ND <0.0021 |
| 4-Nitroaniline | EPA 8270 | 100-01-6 | mg/L | ND <0.0025 | ND <0.0025 | ND <0.0025 |
| 4-Nitrophenol | EPA 8270 | 100-02-7 | mg/L | ND <0.0058 | ND <0.0058 | ND <0.0058 |
| Acenaphthene | EPA 8270 | 83-32-9 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Acenaphthylene | EPA 8270 | 208-96-8 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Aniline | EPA 8270 | 62-53-3 | mg/L | ND <0.0013 | ND <0.0013 | ND <0.0013 |
| Anthracene | EPA 8270 | 120-12-7 | mg/L | ND <0.0011 | ND <0.0011 | ND <0.0011 |
| Benzo(a)anthracene | EPA 8270 | 56-55-3 | mg/L | ND <0.00072 | ND <0.00072 | ND <0.00072 |
| Benzo(a)pyrene | EPA 8270 | 50-32-8 | mg/L | ND <0.00071 | ND <0.00071 | ND <0.00071 |
| Benzo(b)fluoranthene | EPA 8270 | 205-99-2 | mg/L | ND <0.00081 | ND <0.00081 | ND <0.00081 |
| Benzo(g,h,i)perylene | EPA 8270 | 191-24-2 | mg/L | ND <0.00097 | ND <0.00097 | ND <0.00097 |
| Benzo(k)fluoranthene | EPA 8270 | 207-08-9 | mg/L | ND <0.00087 | ND <0.00087 | ND <0.00087 |
| Benzoic Acid | EPA 8270 | 65-85-0 | mg/L | ND <0.0111 | ND <0.0111 | ND <0.0111 |
| Benzyl alcohol | EPA 8270 | 100-51-6 | mg/L | ND <0.0034 | ND <0.0034 | ND <0.0034 |
| Butylbenzylphthalate | EPA 8270 | 85-68-7 | mg/L | ND <0.00075 | ND <0.00075 | ND <0.00075 |
| Chrysene | EPA 8270 | 218-01-9 | mg/L | ND <0.00065 | ND <0.00065 | ND <0.00065 |
| Di-n-butylphthalate | EPA 8270 | 84-74-2 | mg/L | ND <0.0011 | ND <0.0011 | ND <0.0011 |
| Di-n-octylphthalate | EPA 8270 | 117-84-0 | mg/L | ND <0.00086 | ND <0.00086 | ND <0.00086 |
| Dibenz(a,h)anthracene | EPA 8270 | 53-70-3 | mg/L | ND <0.00070 | ND <0.00070 | ND <0.00070 |
| Dibenzofuran | EPA 8270 | 132-64-9 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Diethylphthalate | EPA 8270 | 84-66-2 | mg/L | ND <0.0013 | ND <0.0013 | ND <0.0013 |
| Dimethylphthalate | EPA 8270 | 131-11-3 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| Fluoranthene | EPA 8270 | 206-44-0 | mg/L | ND <0.00087 | ND <0.00087 | ND <0.00087 |
| Fluorene | EPA 8270 | 86-73-7 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| Hexachloro-1,3-butadiene | EPA 8270 | 87-68-3 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Hexachlorobenzene | EPA 8270 | 118-74-1 | mg/L | ND <0.0011 | ND <0.0011 | ND <0.0011 |
| Hexachlorocyclopentadiene | EPA 8270 | 77-47-4 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Hexachloroethane | EPA 8270 | 67-72-1 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| Indeno(1,2,3-cd)pyrene | EPA 8270 | 193-39-5 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Isophorone | EPA 8270 | 78-59-1 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| N-Nitroso-di-n-propylamine | EPA 8270 | 621-64-7 | mg/L | ND <0.0021 | ND <0.0021 | ND <0.0021 |
| N-Nitrosodimethylamine | EPA 8270 | 62-75-9 | mg/L | ND <0.0013 | ND <0.0013 | ND <0.0013 |
| N-Nitrosodiphenylamine | EPA 8270 | 86-30-6 | mg/L | ND <0.0013 | ND <0.0013 | ND <0.0013 |
| Naphthalene | EPA 8270 | 91-20-3 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| Nitrobenzene | EPA 8270 | 98-95-3 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Pentachlorophenol | EPA 8270 | 87-86-5 | mg/L | ND <0.0023 | ND <0.0023 | ND <0.0023 |
| Phenanthrene | EPA 8270 | 85-01-8 | mg/L | ND <0.0010 | ND <0.0010 | ND <0.0010 |
| Phenol | EPA 8270 | 108-95-2 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Pyrene | EPA 8270 | 129-00-0 | mg/L | ND <0.00053 | ND <0.00053 | ND <0.00053 |
| bis(2-Chloroethoxy)methane | EPA 8270 | 111-91-1 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| bis(2-Chloroethyl) ether | EPA 8270 | 111-44-4 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| bis(2-Chloroisopropyl) ether | EPA 8270 | 108-60-1 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| bis(2-Ethylhexyl)phthalate | EPA 8270 | 117-81-7 | mg/L | ND <0.00085 | ND <0.00085 | ND <0.00085 |

*NA - Not analyzed.*
*ND - The analyte was not detected above laboratory detection limits. Subscript indicates compound-specific MDL in mg/l.*
*"J" - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.*

Table 4-3
Soil and Sediment Analytical Results
SWMU No. 2 (Alcoa Badin Municipal Landfill)
Former Alcoa-Badin Works Facility
Badin, North Carolina

| Sample ID | Method | CAS | Units | ABL-SD004-F004 | ABL-SD005-F004 | ABL-SD005-D004 | ABL-SD006-F004 |
|---|---|---|---|---|---|---|---|
| Location | | | | Between West SCA and LMC | Between Middle SCA and LMC | Between Middle SCA and LMC | Between East SCA and LMC |
| Date | | | | 7/21/2015 | 7/21/2015 | 7/21/2015 | 7/21/2015 |
| Time | | | | 12:15 | 13:15 | 13:15 | 14:00 |
| **Percent Moisture** | **ASTM D2974-87** | | *%* | 36.5 | 42.5 | 48.4 | 60.5 |
| **Fluoride** | **EPA 9056** | **16984-48-8** | *mg/kg* | ND <20.1 | 144 | 101 | ND <31.7 |
| **Cyanide** | **SM 4500-CN-E** | **57-12-5** | *mg/kg* | 0.42 J | 0.43 J | ND <0.34 | 1.4 |
| **Arsenic** | **EPA 6010** | **7440-38-2** | *mg/kg* | 10.4 | 15.8 | 12.9 | 12.4 |
| **Barium** | **EPA 6010** | **7440-39-3** | *mg/kg* | 54.9 | 187 | 177 | 85.8 |
| **Cadmium** | **EPA 6010** | **7440-43-9** | *mg/kg* | 0.18 | 0.55 J | 0.37 | 0.19 |
| **Chromium** | **EPA 6010** | **7440-47-3** | *mg/kg* | 54.7 | 29.3 | 25.1 | 20.4 |
| **Lead** | **EPA 6010** | **7439-92-1** | *mg/kg* | 24.4 | 23.9 | 18.4 | 21.7 |
| **Selenium** | **EPA 6010** | **7782-49-2** | *mg/kg* | ND <0.49 | ND <4.6 | ND <0.65 | ND <0.88 |
| **Silver** | **EPA 6010** | **7440-22-4** | *mg/kg* | 0.60 | ND <2.3 | 0.97 | ND <0.44 |
| **Mercury** | **EPA 7471** | **7439-97-6** | *mg/kg* | 0.019 | 0.016 | 0.028 | 0.024 |
| **PCB-1016 (Aroclor 1016)** | **EPA 8082** | **12674-11-2** | *mg/kg* | ND <0.0236 | ND <0.0261 | ND <0.0291 | ND <0.0380 |
| **PCB-1221 (Aroclor 1221)** | **EPA 8082** | **11104-28-2** | *mg/kg* | ND <0.0236 | ND <0.0261 | ND <0.0291 | ND <0.0380 |
| **PCB-1232 (Aroclor 1232)** | **EPA 8082** | **11141-16-5** | *mg/kg* | ND <0.0236 | ND <0.0261 | ND <0.0291 | ND <0.0380 |
| **PCB-1242 (Aroclor 1242)** | **EPA 8082** | **53469-21-9** | *mg/kg* | ND <0.0236 | ND <0.0261 | ND <0.0291 | ND <0.0380 |
| **PCB-1248 (Aroclor 1248)** | **EPA 8082** | **12672-29-6** | *mg/kg* | ND <0.0236 | ND <0.0261 | ND <0.0291 | ND <0.0380 |
| **PCB-1254 (Aroclor 1254)** | **EPA 8082** | **11097-69-1** | *mg/kg* | ND <0.0236 | ND <0.0261 | ND <0.0291 | ND <0.0380 |
| **PCB-1260 (Aroclor 1260)** | **EPA 8082** | **11096-82-5** | *mg/kg* | ND <0.0236 | ND <0.0261 | ND <0.0291 | ND <0.0380 |
| **Total PCBs** | **EPA 8082** | **--** | *mg/kg* | ND | ND | ND | ND |
| **1,1,1,2-Tetrachloroethane** | **EPA 8260** | **630-20-6** | *mg/kg* | ND <0.0027 | ND <0.0040 | ND <0.0047 | ND <0.0052 |
| **1,1,1-Trichloroethane** | **EPA 8260** | **71-55-6** | *mg/kg* | ND <0.0023 | ND <0.0034 | ND <0.0040 | ND <0.0045 |
| **1,1,2,2-Tetrachloroethane** | **EPA 8260** | **79-34-5** | *mg/kg* | ND <0.0024 | ND <0.0036 | ND <0.0043 | ND <0.0047 |
| **1,1,2-Trichloroethane** | **EPA 8260** | **79-00-5** | *mg/kg* | ND <0.0027 | ND <0.0040 | ND <0.0047 | ND <0.0052 |
| **1,1-Dichloroethane** | **EPA 8260** | **75-34-3** | *mg/kg* | ND <0.0019 | ND <0.0028 | ND <0.0034 | ND <0.0037 |
| **1,1-Dichloroethene** | **EPA 8260** | **75-35-4** | *mg/kg* | ND <0.0023 | ND <0.0034 | ND <0.0040 | ND <0.0045 |
| **1,1-Dichloropropene** | **EPA 8260** | **563-58-6** | *mg/kg* | ND <0.0019 | ND <0.0028 | ND <0.0034 | ND <0.0037 |
| **1,2,3-Trichlorobenzene** | **EPA 8260** | **87-61-6** | *mg/kg* | ND <0.0028 | ND <0.0042 | ND <0.0049 | ND <0.0055 |
| **1,2,3-Trichloropropane** | **EPA 8260** | **96-18-4** | *mg/kg* | ND <0.0020 | ND <0.0030 | ND <0.0036 | ND <0.0040 |
| **1,2,4-Trichlorobenzene** | **EPA 8260** | **120-82-1** | *mg/kg* | ND <0.0020 | ND <0.0030 | ND <0.0036 | ND <0.0040 |
| **1,2,4-Trimethylbenzene** | **EPA 8260** | **95-63-6** | *mg/kg* | ND <0.0025 | ND <0.0038 | ND <0.0045 | ND <0.0050 |
| **1,2-Dibromo-3-chloropropane** | **EPA 8260** | **96-12-8** | *mg/kg* | ND <0.0046 | ND <0.0068 | ND <0.0081 | ND <0.0090 |
| **1,2-Dibromoethane (EDB)** | **EPA 8260** | **106-93-4** | *mg/kg* | ND <0.0023 | ND <0.0034 | ND <0.0040 | ND <0.0045 |
| **1,2-Dichlorobenzene** | **EPA 8260** | **95-50-1** | *mg/kg* | ND <0.0024 | ND <0.0036 | ND <0.0043 | ND <0.0047 |
| **1,2-Dichloroethane** | **EPA 8260** | **107-06-2** | *mg/kg* | ND <0.0028 | ND <0.0042 | ND <0.0049 | ND <0.0055 |
| **1,2-Dichloropropane** | **EPA 8260** | **78-87-5** | *mg/kg* | ND <0.0022 | ND <0.0032 | ND <0.0038 | ND <0.0042 |
| **1,3,5-Trimethylbenzene** | **EPA 8260** | **108-67-8** | *mg/kg* | ND <0.0023 | ND <0.0034 | ND <0.0040 | ND <0.0045 |
| **1,3-Dichlorobenzene** | **EPA 8260** | **541-73-1** | *mg/kg* | ND <0.0025 | ND <0.0038 | ND <0.0045 | ND <0.0050 |
| **1,3-Dichloropropane** | **EPA 8260** | **142-28-9** | *mg/kg* | ND <0.0024 | ND <0.0036 | ND <0.0043 | ND <0.0047 |
| **1,4-Dichlorobenzene** | **EPA 8260** | **106-46-7** | *mg/kg* | ND <0.0022 | ND <0.0032 | ND <0.0038 | ND <0.0042 |
| **2,2-Dichloropropane** | **EPA 8260** | **594-20-7** | *mg/kg* | ND <0.0022 | ND <0.0032 | ND <0.0038 | ND <0.0042 |
| **2-Butanone (MEK)** | **EPA 8260** | **78-93-3** | *mg/kg* | ND <0.0037 | ND <0.0055 | ND <0.0065 | ND <0.0072 |
| **2-Chlorotoluene** | **EPA 8260** | **95-49-8** | *mg/kg* | ND <0.0022 | ND <0.0032 | ND <0.0038 | ND <0.0042 |
| **2-Hexanone** | **EPA 8260** | **591-78-6** | *mg/kg* | ND <0.0050 | ND <0.0074 | ND <0.0087 | ND <0.0097 |
| **4-Chlorotoluene** | **EPA 8260** | **106-43-4** | *mg/kg* | ND <0.0023 | ND <0.0034 | ND <0.0040 | ND <0.0045 |
| **4-Methyl-2-pentanone (MIBK)** | **EPA 8260** | **108-10-1** | *mg/kg* | ND <0.0047 | ND <0.0070 | ND <0.0083 | ND <0.0092 |
| **Acetone** | **EPA 8260** | **67-64-1** | *mg/kg* | ND <0.0127 | ND <0.0190 | ND <0.0224 | ND <0.0250 |
| **Benzene** | **EPA 8260** | **71-43-2** | *mg/kg* | ND <0.0020 | ND <0.0030 | ND <0.0036 | ND <0.0040 |
| **Bromobenzene** | **EPA 8260** | **108-86-1** | *mg/kg* | ND <0.0025 | ND <0.0038 | ND <0.0045 | ND <0.0050 |
| **Bromochloromethane** | **EPA 8260** | **74-97-5** | *mg/kg* | ND <0.0022 | ND <0.0032 | ND <0.0038 | ND <0.0042 |
| **Bromodichloromethane** | **EPA 8260** | **75-27-4** | *mg/kg* | ND <0.0024 | ND <0.0036 | ND <0.0043 | ND <0.0047 |
| **Bromoform** | **EPA 8260** | **75-25-2** | *mg/kg* | ND <0.0029 | ND <0.0044 | ND <0.0051 | ND <0.0057 |
| **Bromomethane** | **EPA 8260** | **74-83-9** | *mg/kg* | ND <0.0032 | ND <0.0047 | ND <0.0056 | ND <0.0062 |
| **Carbon tetrachloride** | **EPA 8260** | **56-23-5** | *mg/kg* | ND <0.0033 | ND <0.0049 | ND <0.0058 | ND <0.0065 |
| **Chlorobenzene** | **EPA 8260** | **108-90-7** | *mg/kg* | ND <0.0024 | ND <0.0036 | ND <0.0043 | ND <0.0047 |
| **Chloroethane** | **EPA 8260** | **75-00-3** | *mg/kg* | ND <0.0031 | ND <0.0046 | ND <0.0054 | ND <0.0060 |
| **Chloroform** | **EPA 8260** | **67-66-3** | *mg/kg* | ND <0.0020 | ND <0.0030 | ND <0.0036 | ND <0.0040 |
| **Chloromethane** | **EPA 8260** | **74-87-3** | *mg/kg* | ND <0.0031 | ND <0.0046 | ND <0.0054 | ND <0.0060 |
| **Dibromochloromethane** | **EPA 8260** | **124-48-1** | *mg/kg* | ND <0.0023 | ND <0.0034 | ND <0.0040 | ND <0.0045 |
| **Dibromomethane** | **EPA 8260** | **74-95-3** | *mg/kg* | ND <0.0032 | ND <0.0047 | ND <0.0056 | ND <0.0062 |
| **Dichlorodifluoromethane** | **EPA 8260** | **75-71-8** | *mg/kg* | ND <0.0046 | ND <0.0068 | ND <0.0081 | ND <0.0090 |
| **Diisopropyl ether** | **EPA 8260** | **108-20-3** | *mg/kg* | ND <0.0022 | ND <0.0032 | ND <0.0038 | ND <0.0042 |
| **Ethylbenzene** | **EPA 8260** | **100-41-4** | *mg/kg* | ND <0.0023 | ND <0.0034 | ND <0.0040 | ND <0.0045 |
| **Hexachloro-1,3-butadiene** | **EPA 8260** | **87-68-3** | *mg/kg* | ND <0.0025 | ND <0.0038 | ND <0.0045 | ND <0.0050 |
| **Isopropylbenzene (Cumene)** | **EPA 8260** | **98-82-8** | *mg/kg* | ND <0.0024 | ND <0.0036 | ND <0.0043 | ND <0.0047 |
| **Methyl-tert-butyl ether** | **EPA 8260** | **1634-04-4** | *mg/kg* | ND <0.0019 | ND <0.0028 | ND <0.0034 | ND <0.0037 |
| **Methylene Chloride** | **EPA 8260** | **75-09-2** | *mg/kg* | ND <0.0038 | 0.0099 J | ND <0.0067 | ND <0.0075 |
| **Naphthalene** | **EPA 8260** | **91-20-3** | *mg/kg* | ND <0.0015 | ND <0.0023 | ND <0.0027 | ND <0.0030 |
| **Styrene** | **EPA 8260** | **100-42-5** | *mg/kg* | ND <0.0023 | ND <0.0034 | ND <0.0040 | ND <0.0045 |
| **Tetrachloroethene** | **EPA 8260** | **127-18-4** | *mg/kg* | ND <0.0022 | ND <0.0032 | ND <0.0038 | ND <0.0042 |
| **Toluene** | **EPA 8260** | **108-88-3** | *mg/kg* | ND <0.0023 | ND <0.0034 | ND <0.0040 | ND <0.0045 |
| **Trichloroethene** | **EPA 8260** | **79-01-6** | *mg/kg* | ND <0.0027 | ND <0.0040 | ND <0.0047 | ND <0.0052 |
| **Trichlorofluoromethane** | **EPA 8260** | **75-69-4** | *mg/kg* | ND <0.0028 | ND <0.0042 | ND <0.0049 | ND <0.0055 |
| **Vinyl acetate** | **EPA 8260** | **108-05-4** | *mg/kg* | ND <0.0112 | ND <0.0167 | ND <0.0197 | ND <0.0220 |
| **Vinyl chloride** | **EPA 8260** | **75-01-4** | *mg/kg* | ND <0.0023 | ND <0.0034 | ND <0.0040 | ND <0.0045 |
| **Xylene (Total)** | **EPA 8260** | **1330-20-7** | *mg/kg* | ND <0.0046 | ND <0.0068 | ND <0.0081 | ND <0.0090 |
| **cis-1,2-Dichloroethene** | **EPA 8260** | **156-59-2** | *mg/kg* | ND <0.0018 | ND <0.0027 | ND <0.0031 | ND <0.0035 |
| **cis-1,3-Dichloropropene** | **EPA 8260** | **10061-01-5** | *mg/kg* | ND <0.0023 | ND <0.0034 | ND <0.0040 | ND <0.0045 |
| **m&p-Xylene** | **EPA 8260** | **179601-23-1** | *mg/kg* | ND <0.0046 | ND <0.0068 | ND <0.0081 | ND <0.0090 |
| **n-Butylbenzene** | **EPA 8260** | **104-51-8** | *mg/kg* | ND <0.0023 | ND <0.0034 | ND <0.0040 | ND <0.0045 |
| **n-Propylbenzene** | **EPA 8260** | **103-65-1** | *mg/kg* | ND <0.0022 | ND <0.0032 | ND <0.0038 | ND <0.0042 |
| **o-Xylene** | **EPA 8260** | **95-47-6** | *mg/kg* | ND <0.0024 | ND <0.0036 | ND <0.0043 | ND <0.0047 |
| **p-Isopropyltoluene** | **EPA 8260** | **99-87-6** | *mg/kg* | ND <0.0022 | ND <0.0032 | ND <0.0038 | ND <0.0042 |
| **sec-Butylbenzene** | **EPA 8260** | **135-98-8** | *mg/kg* | ND <0.0020 | ND <0.0030 | ND <0.0036 | ND <0.0040 |
| **tert-Butylbenzene** | **EPA 8260** | **98-06-6** | *mg/kg* | ND <0.0025 | ND <0.0038 | ND <0.0045 | ND <0.0050 |
| **trans-1,2-Dichloroethene** | **EPA 8260** | **156-60-5** | *mg/kg* | ND <0.0024 | ND <0.0036 | ND <0.0043 | ND <0.0047 |
| **trans-1,3-Dichloropropene** | **EPA 8260** | **10061-02-6** | *mg/kg* | ND <0.0019 | ND <0.0028 | ND <0.0034 | ND <0.0037 |

**Table 4-3**
**Soil and Sediment Analytical Results**
**SWMU No. 2 (Alcoa Badin Municipal Landfill)**
**Former Alcoa-Badin Works Facility**
**Badin, North Carolina**

| Sample ID | Method | CAS | Units | ABL-SD004-F004 | ABL-SD005-F004 | ABL-SD005-D004 | ABL-SD006-F004 |
|---|---|---|---|---|---|---|---|
| Location | | | | Between West SCA and LMC | Between Middle SCA and LMC | Between Middle SCA and LMC | Between East SCA and LMC |
| Date | | | | 7/21/2015 | 7/21/2015 | 7/21/2015 | 7/21/2015 |
| Time | | | | 12:15 | 13:15 | 13:15 | 14:00 |
| 1,2,4-Trichlorobenzene | EPA 8270 | 120-82-1 | mg/kg | ND <0.101 | ND <0.111 | ND <0.124 | ND <0.162 |
| 1,2-Dichlorobenzene | EPA 8270 | 95-50-1 | mg/kg | ND <0.139 | ND <0.153 | ND <0.171 | ND <0.223 |
| 1,3-Dichlorobenzene | EPA 8270 | 541-73-1 | mg/kg | ND <0.118 | ND <0.131 | ND <0.145 | ND <0.190 |
| 1,4-Dichlorobenzene | EPA 8270 | 106-46-7 | mg/kg | ND <0.146 | ND <0.162 | ND <0.180 | ND <0.236 |
| 1-Methylnaphthalene | EPA 8270 | 90-12-0 | mg/kg | ND <0.135 | ND <0.150 | ND <0.167 | ND <0.218 |
| 2,4,5-Trichlorophenol | EPA 8270 | 95-95-4 | mg/kg | ND <0.161 | ND <0.178 | ND <0.198 | ND <0.258 |
| 2,4,6-Trichlorophenol | EPA 8270 | 88-06-2 | mg/kg | ND <0.115 | ND <0.127 | ND <0.142 | ND <0.185 |
| 2,4-Dichlorophenol | EPA 8270 | 120-83-2 | mg/kg | ND <0.113 | ND <0.125 | ND <0.140 | ND <0.182 |
| 2,4-Dimethylphenol | EPA 8270 | 105-67-9 | mg/kg | ND <0.205 | ND <0.226 | ND <0.252 | ND <0.329 |
| 2,4-Dinitrophenol | EPA 8270 | 51-28-5 | mg/kg | ND <0.0851 | ND <0.0940 | ND <0.105 | ND <0.137 |
| 2,4-Dinitrotoluene | EPA 8270 | 121-14-2 | mg/kg | ND <0.0977 | ND <0.108 | ND <0.120 | ND <0.157 |
| 2,6-Dinitrotoluene | EPA 8270 | 606-20-2 | mg/kg | ND <0.109 | ND <0.120 | ND <0.134 | ND <0.175 |
| 2-Chloronaphthalene | EPA 8270 | 91-58-7 | mg/kg | ND <0.102 | ND <0.113 | ND <0.126 | ND <0.165 |
| 2-Chlorophenol | EPA 8270 | 95-57-8 | mg/kg | ND <0.142 | ND <0.157 | ND <0.174 | ND <0.228 |
| 2-Methylnaphthalene | EPA 8270 | 91-57-6 | mg/kg | ND <0.112 | ND <0.124 | ND <0.138 | ND <0.180 |
| 2-Methylphenol(o-Cresol) | EPA 8270 | 95-48-7 | mg/kg | ND <0.158 | ND <0.174 | ND <0.194 | ND <0.253 |
| 2-Nitroaniline | EPA 8270 | 88-74-4 | mg/kg | ND <0.161 | ND <0.178 | ND <0.198 | ND <0.258 |
| 2-Nitrophenol | EPA 8270 | 88-75-5 | mg/kg | ND <0.126 | ND <0.139 | ND <0.155 | ND <0.203 |
| 3&4-Methylphenol(m&p Cresol) | EPA 8270 | | mg/kg | ND <0.205 | ND <0.226 | ND <0.252 | ND <0.329 |
| 3,3'-Dichlorobenzidine | EPA 8270 | 91-94-1 | mg/kg | ND <0.113 | ND <0.125 | ND <0.140 | ND <0.182 |
| 3-Nitroaniline | EPA 8270 | 99-09-2 | mg/kg | ND <0.142 | ND <0.157 | ND <0.174 | ND <0.228 |
| 4,6-Dinitro-2-methylphenol | EPA 8270 | 534-52-1 | mg/kg | ND <0.104 | ND <0.115 | ND <0.128 | ND <0.167 |
| 4-Bromophenylphenyl ether | EPA 8270 | 101-55-3 | mg/kg | ND <0.0945 | ND <0.104 | ND <0.116 | ND <0.152 |
| 4-Chloro-3-methylphenol | EPA 8270 | 59-50-7 | mg/kg | ND <0.107 | ND <0.118 | ND <0.132 | ND <0.172 |
| 4-Chloroaniline | EPA 8270 | 106-47-8 | mg/kg | ND <0.145 | ND <0.160 | ND <0.178 | ND <0.233 |
| 4-Chlorophenylphenyl ether | EPA 8270 | 7005-72-3 | mg/kg | ND <0.107 | ND <0.118 | ND <0.132 | ND <0.172 |
| 4-Nitroaniline | EPA 8270 | 100-01-6 | mg/kg | ND <0.146 | ND <0.162 | ND <0.180 | ND <0.236 |
| 4-Nitrophenol | EPA 8270 | 100-02-7 | mg/kg | ND <0.0929 | ND <0.103 | ND <0.114 | ND <0.149 |
| Acenaphthene | EPA 8270 | 83-32-9 | mg/kg | ND <0.120 | ND <0.132 | ND <0.147 | ND <0.193 |
| Acenaphthylene | EPA 8270 | 208-96-8 | mg/kg | ND <0.123 | ND <0.136 | ND <0.151 | ND <0.198 |
| Aniline | EPA 8270 | 62-53-3 | mg/kg | ND <0.140 | ND <0.155 | ND <0.173 | ND <0.225 |
| Anthracene | EPA 8270 | 120-12-7 | mg/kg | ND <0.117 | ND <0.129 | ND <0.143 | ND <0.187 |
| Benzo(a)anthracene | EPA 8270 | 56-55-3 | mg/kg | ND <0.0961 | 0.139 J | ND <0.118 | 0.361 J |
| Benzo(a)pyrene | EPA 8270 | 50-32-8 | mg/kg | ND <0.0992 | 0.191 J | ND <0.122 | 0.485 J |
| Benzo(b)fluoranthene | EPA 8270 | 205-99-2 | mg/kg | ND <0.0898 | 0.246 J | 0.187 J | 0.609 J |
| Benzo(g,h,i)perylene | EPA 8270 | 191-24-2 | mg/kg | ND <0.132 | ND <0.146 | ND <0.163 | 0.325 J |
| Benzo(k)fluoranthene | EPA 8270 | 207-08-9 | mg/kg | ND <0.102 | ND <0.113 | ND <0.126 | 0.217 J |
| Benzoic Acid | EPA 8270 | 65-85-0 | mg/kg | ND <0.0945 | 0.187 J | ND <0.116 | ND <0.152 |
| Benzyl alcohol | EPA 8270 | 100-51-6 | mg/kg | ND <0.104 | ND <0.115 | ND <0.128 | ND <0.167 |
| Butylbenzylphthalate | EPA 8270 | 85-68-7 | mg/kg | ND <0.110 | ND <0.122 | ND <0.136 | ND <0.177 |
| Chrysene | EPA 8270 | 218-01-9 | mg/kg | ND <0.0693 | 0.161 J | 0.103 J | 0.406 J |
| Di-n-butylphthalate | EPA 8270 | 84-74-2 | mg/kg | ND <0.0851 | ND <0.0940 | ND <0.105 | ND <0.137 |
| Di-n-octylphthalate | EPA 8270 | 117-84-0 | mg/kg | ND <0.109 | ND <0.120 | ND <0.134 | ND <0.175 |
| Dibenz(a,h)anthracene | EPA 8270 | 53-70-3 | mg/kg | ND <0.110 | ND <0.122 | ND <0.136 | ND <0.177 |
| Dibenzofuran | EPA 8270 | 132-64-9 | mg/kg | ND <0.0851 | ND <0.0940 | ND <0.105 | ND <0.137 |
| Diethylphthalate | EPA 8270 | 84-66-2 | mg/kg | ND <0.0803 | ND <0.0888 | ND <0.0989 | ND <0.129 |
| Dimethylphthalate | EPA 8270 | 131-11-3 | mg/kg | ND <0.106 | ND <0.117 | ND <0.130 | ND <0.170 |
| Fluoranthene | EPA 8270 | 206-44-0 | mg/kg | ND <0.0756 | 0.201 J | 0.147 J | 0.632 J |
| Fluorene | EPA 8270 | 86-73-7 | mg/kg | ND <0.107 | ND <0.118 | ND <0.132 | ND <0.172 |
| Hexachloro-1,3-butadiene | EPA 8270 | 87-68-3 | mg/kg | ND <0.0898 | ND <0.0992 | ND <0.111 | ND <0.144 |
| Hexachlorobenzene | EPA 8270 | 118-74-1 | mg/kg | ND <0.0662 | ND <0.0731 | ND <0.0814 | ND <0.106 |
| Hexachlorocyclopentadiene | EPA 8270 | 77-47-4 | mg/kg | ND <0.0961 | ND <0.106 | ND <0.118 | ND <0.155 |
| Hexachloroethane | EPA 8270 | 67-72-1 | mg/kg | ND <0.137 | ND <0.151 | ND <0.169 | ND <0.220 |
| Indeno(1,2,3-cd)pyrene | EPA 8270 | 193-39-5 | mg/kg | ND <0.107 | ND <0.118 | ND <0.132 | 0.247 J |
| Isophorone | EPA 8270 | 78-59-1 | mg/kg | ND <0.117 | ND <0.129 | ND <0.143 | ND <0.187 |
| N-Nitroso-di-n-propylamine | EPA 8270 | 621-64-7 | mg/kg | ND <0.0992 | ND <0.110 | ND <0.122 | ND <0.160 |
| N-Nitrosodimethylamine | EPA 8270 | 62-75-9 | mg/kg | ND <0.169 | ND <0.186 | ND <0.207 | ND <0.271 |
| N-Nitrosodiphenylamine | EPA 8270 | 86-30-6 | mg/kg | ND <0.154 | ND <0.171 | ND <0.190 | ND <0.248 |
| Naphthalene | EPA 8270 | 91-20-3 | mg/kg | ND <0.128 | ND <0.141 | ND <0.157 | ND <0.205 |
| Nitrobenzene | EPA 8270 | 98-95-3 | mg/kg | ND <0.142 | ND <0.157 | ND <0.174 | ND <0.228 |
| Pentachlorophenol | EPA 8270 | 87-86-5 | mg/kg | ND <0.0945 | ND <0.104 | ND <0.116 | ND <0.152 |
| Phenanthrene | EPA 8270 | 85-01-8 | mg/kg | ND <0.0866 | 0.0978 J | ND <0.107 | 0.386 J |
| Phenol | EPA 8270 | 108-95-2 | mg/kg | ND <0.156 | ND <0.172 | ND <0.192 | ND <0.251 |
| Pyrene | EPA 8270 | 129-00-0 | mg/kg | ND <0.0882 | 0.199 J | 0.137 J | 0.553 J |
| bis(2-Chloroethoxy)methane | EPA 8270 | 111-91-1 | mg/kg | ND <0.121 | ND <0.134 | ND <0.149 | ND <0.195 |
| bis(2-Chloroethyl) ether | EPA 8270 | 111-44-4 | mg/kg | ND <0.132 | ND <0.146 | ND <0.163 | ND <0.213 |
| bis(2-Chloroisopropyl) ether | EPA 8270 | 108-60-1 | mg/kg | ND <0.139 | ND <0.153 | ND <0.171 | ND <0.223 |
| bis(2-Ethylhexyl)phthalate | EPA 8270 | 117-81-7 | mg/kg | ND <0.142 | ND <0.157 | ND <0.174 | ND <0.228 |

*ND - The analyte was not detected above laboratory detection limits. Subscript indicates compound-specific MDL in mg/kg.*
*"J" - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.*

Table 4-4
Surface Water Analytical Results
SWMU No. 2 (Alcoa Badin Municipal Landfill)
Former Alcoa-Badin Works Facility
Badin, North Carolina

| Sample ID | Method | CAS | Units | ABL-SW004-F004 | ABL-SW005-F004 | ABL-SW006-F004 | ABL-SW006-D004 | ABL-SW007-F004 |
|---|---|---|---|---|---|---|---|---|
| Location | | | | Between West SCA and LMC | Between Middle SCA and LMC | Between East SCA and LMC | Between East SCA and LMC | Alleged Pipe Break |
| Date | | | | 7/21/2015 | 7/21/2015 | 7/21/2015 | 7/21/2015 | 7/21/2015 |
| Time | | | | 12:05 | N/A | 13:55 | 13:55 | N/A |
| Fluoride | EPA 300.0 | 16984-48-8 | mg/L | ND <0.25 | NA - DRY | 8.8 | 9.2 | NA - DRY |
| Cyanide | SM 4500-CN-E | 57-12-5 | mg/L | ND <0.0040 | NA - DRY | 0.069 | 0.069 | NA - DRY |
| Arsenic | EPA 6010 | 7440-38-2 | mg/L | ND <0.0050 | NA - DRY | ND <0.0050 | ND <0.0050 | NA - DRY |
| Barium | EPA 6010 | 7440-39-3 | mg/L | 0.0146 | NA - DRY | 0.0276 | 0.0247 | NA - DRY |
| Cadmium | EPA 6010 | 7440-43-9 | mg/L | ND <0.00050 | NA - DRY | ND <0.00050 | ND <0.00050 | NA - DRY |
| Chromium | EPA 6010 | 7440-47-3 | mg/L | 0.0029 J | NA - DRY | 0.0039 J | 0.0032 J | NA - DRY |
| Lead | EPA 6010 | 7439-92-1 | mg/L | ND <0.0025 | NA - DRY | 0.0037 J | 0.0043 J | NA - DRY |
| Selenium | EPA 6010 | 7782-49-2 | mg/L | ND <0.0050 | NA - DRY | ND <0.0050 | ND <0.0050 | NA - DRY |
| Silver | EPA 6010 | 7440-22-4 | mg/L | ND <0.0025 | NA - DRY | ND <0.0025 | ND <0.0025 | NA - DRY |
| Mercury | EPA 7470 | 7439-97-6 | mg/L | ND <0.00010 | NA - DRY | ND <0.00010 | ND <0.00010 | NA - DRY |
| PCB-1016 (Aroclor 1016) | EPA 8082 | 12674-11-2 | mg/L | ND <0.0010 | NA - DRY | ND <0.00050 | ND <0.00050 | NA - DRY |
| PCB-1221 (Aroclor 1221) | EPA 8082 | 11104-28-2 | mg/L | ND <0.0010 | NA - DRY | ND <0.00050 | ND <0.00050 | NA - DRY |
| PCB-1232 (Aroclor 1232) | EPA 8082 | 11141-16-5 | mg/L | ND <0.0010 | NA - DRY | ND <0.00050 | ND <0.00050 | NA - DRY |
| PCB-1242 (Aroclor 1242) | EPA 8082 | 53469-21-9 | mg/L | ND <0.0010 | NA - DRY | ND <0.00050 | ND <0.00050 | NA - DRY |
| PCB-1248 (Aroclor 1248) | EPA 8082 | 12672-29-6 | mg/L | ND <0.0010 | NA - DRY | ND <0.00050 | ND <0.00050 | NA - DRY |
| PCB-1254 (Aroclor 1254) | EPA 8082 | 11097-69-1 | mg/L | ND <0.0010 | NA - DRY | ND <0.00050 | ND <0.00050 | NA - DRY |
| PCB-1260 (Aroclor 1260) | EPA 8082 | 11096-82-5 | mg/L | ND <0.0010 | NA - DRY | ND <0.00050 | ND <0.00050 | NA - DRY |
| Total PCBs | EPA 8082 | -- | mg/L | ND | NA - DRY | ND | ND | NA - DRY |
| 1,1,1,2-Tetrachloroethane | EPA 8260 | 630-20-6 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| 1,1,1-Trichloroethane | EPA 8260 | 71-55-6 | mg/L | ND <0.0019 | NA - DRY | ND <0.0019 | ND <0.0019 | NA - DRY |
| 1,1,2,2-Tetrachloroethane | EPA 8260 | 79-34-5 | mg/L | ND <0.0015 | NA - DRY | ND <0.0015 | ND <0.0015 | NA - DRY |
| 1,1,2-Trichloroethane | EPA 8260 | 79-00-5 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| 1,1-Dichloroethane | EPA 8260 | 75-34-3 | mg/L | ND <0.0018 | NA - DRY | ND <0.0018 | ND <0.0018 | NA - DRY |
| 1,1-Dichloroethene | EPA 8260 | 75-35-4 | mg/L | ND <0.0019 | NA - DRY | ND <0.0019 | ND <0.0019 | NA - DRY |
| 1,1-Dichloropropene | EPA 8260 | 563-58-6 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| 1,2,3-Trichlorobenzene | EPA 8260 | 87-61-6 | mg/L | ND <0.0020 | NA - DRY | ND <0.0020 | ND <0.0020 | NA - DRY |
| 1,2,3-Trichloropropane | EPA 8260 | 96-18-4 | mg/L | ND <0.0015 | NA - DRY | ND <0.0015 | ND <0.0015 | NA - DRY |
| 1,2,4-Trichlorobenzene | EPA 8260 | 120-82-1 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| 1,2,4-Trimethylbenzene | EPA 8260 | 95-63-6 | mg/L | ND <0.0015 | NA - DRY | ND <0.0015 | ND <0.0015 | NA - DRY |
| 1,2-Dibromo-3-chloropropane | EPA 8260 | 96-12-8 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| 1,2-Dibromoethane (EDB) | EPA 8260 | 106-93-4 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| 1,2-Dichlorobenzene | EPA 8260 | 95-50-1 | mg/L | ND <0.0015 | NA - DRY | ND <0.0015 | ND <0.0015 | NA - DRY |
| 1,2-Dichloroethane | EPA 8260 | 107-06-2 | mg/L | ND <0.0018 | NA - DRY | ND <0.0018 | ND <0.0018 | NA - DRY |
| 1,2-Dichloroethene (Total) | EPA 8260 | 540-59-0 | mg/L | ND <0.0044 | NA - DRY | ND <0.0044 | ND <0.0044 | NA - DRY |
| 1,2-Dichloropropane | EPA 8260 | 78-87-5 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| 1,3,5-Trimethylbenzene | EPA 8260 | 108-67-8 | mg/L | ND <0.0013 | NA - DRY | ND <0.0013 | ND <0.0013 | NA - DRY |
| 1,3-Dichlorobenzene | EPA 8260 | 541-73-1 | mg/L | ND <0.0015 | NA - DRY | ND <0.0015 | ND <0.0015 | NA - DRY |
| 1,3-Dichloropropane | EPA 8260 | 142-28-9 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| 1,4-Dichlorobenzene | EPA 8260 | 106-46-7 | mg/L | ND <0.0015 | NA - DRY | ND <0.0015 | ND <0.0015 | NA - DRY |
| 2,2-Dichloropropane | EPA 8260 | 594-20-7 | mg/L | ND <0.0016 | NA - DRY | ND <0.0016 | ND <0.0016 | NA - DRY |
| 2-Butanone (MEK) | EPA 8260 | 78-93-3 | mg/L | ND <0.0049 | NA - DRY | ND <0.0049 | ND <0.0049 | NA - DRY |
| 2-Chlorotoluene | EPA 8260 | 95-49-8 | mg/L | ND <0.0015 | NA - DRY | ND <0.0015 | ND <0.0015 | NA - DRY |
| 2-Hexanone | EPA 8260 | 591-78-6 | mg/L | ND <0.0038 | NA - DRY | ND <0.0038 | ND <0.0038 | NA - DRY |
| 4-Chlorotoluene | EPA 8260 | 106-43-4 | mg/L | ND <0.0016 | NA - DRY | ND <0.0016 | ND <0.0016 | NA - DRY |
| 4-Methyl-2-pentanone (MIBK) | EPA 8260 | 108-10-1 | mg/L | ND <0.0036 | NA - DRY | ND <0.0036 | ND <0.0036 | NA - DRY |
| Acetone | EPA 8260 | 67-64-1 | mg/L | ND <0.0100 | NA - DRY | ND <0.0100 | ND <0.0100 | NA - DRY |
| Benzene | EPA 8260 | 71-43-2 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| Bromobenzene | EPA 8260 | 108-86-1 | mg/L | ND <0.0015 | NA - DRY | ND <0.0015 | ND <0.0015 | NA - DRY |
| Bromochloromethane | EPA 8260 | 74-97-5 | mg/L | ND <0.0022 | NA - DRY | ND <0.0022 | ND <0.0022 | NA - DRY |
| Bromodichloromethane | EPA 8260 | 75-27-4 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| Bromoform | EPA 8260 | 75-25-2 | mg/L | ND <0.0015 | NA - DRY | ND <0.0015 | ND <0.0015 | NA - DRY |
| Bromomethane | EPA 8260 | 74-83-9 | mg/L | ND <0.0025 | NA - DRY | ND <0.0025 | ND <0.0025 | NA - DRY |
| Carbon tetrachloride | EPA 8260 | 56-23-5 | mg/L | ND <0.0019 | NA - DRY | ND <0.0019 | ND <0.0019 | NA - DRY |
| Chlorobenzene | EPA 8260 | 108-90-7 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| Chloroethane | EPA 8260 | 75-00-3 | mg/L | ND <0.0016 | NA - DRY | ND <0.0016 | ND <0.0016 | NA - DRY |
| Chloroform | EPA 8260 | 67-66-3 | mg/L | ND <0.0019 | NA - DRY | ND <0.0019 | ND <0.0019 | NA - DRY |
| Chloromethane | EPA 8260 | 74-87-3 | mg/L | ND <0.0015 | NA - DRY | ND <0.0015 | ND <0.0015 | NA - DRY |
| Dibromochloromethane | EPA 8260 | 124-48-1 | mg/L | ND <0.0018 | NA - DRY | ND <0.0018 | ND <0.0018 | NA - DRY |
| Dibromomethane | EPA 8260 | 74-95-3 | mg/L | ND <0.0020 | NA - DRY | ND <0.0020 | ND <0.0020 | NA - DRY |
| Dichlorodifluoromethane | EPA 8260 | 75-71-8 | mg/L | ND <0.0016 | NA - DRY | ND <0.0016 | ND <0.0016 | NA - DRY |
| Diisopropyl ether | EPA 8260 | 108-20-3 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| Ethylbenzene | EPA 8260 | 100-41-4 | mg/L | ND <0.0016 | NA - DRY | ND <0.0016 | ND <0.0016 | NA - DRY |
| Hexachloro-1,3-butadiene | EPA 8260 | 87-68-3 | mg/L | ND <0.0018 | NA - DRY | ND <0.0018 | ND <0.0018 | NA - DRY |
| Isopropylbenzene (Cumene) | EPA 8260 | 98-82-8 | mg/L | ND <0.0016 | NA - DRY | ND <0.0016 | ND <0.0016 | NA - DRY |
| Methyl-tert-butyl ether | EPA 8260 | 1634-04-4 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| Methylene Chloride | EPA 8260 | 75-09-2 | mg/L | ND <0.0019 | NA - DRY | ND <0.0019 | ND <0.0019 | NA - DRY |
| Naphthalene | EPA 8260 | 91-20-3 | mg/L | ND <0.0020 | NA - DRY | ND <0.0020 | ND <0.0020 | NA - DRY |
| Styrene | EPA 8260 | 100-42-5 | mg/L | ND <0.0016 | NA - DRY | ND <0.0016 | ND <0.0016 | NA - DRY |
| Tetrachloroethene | EPA 8260 | 127-18-4 | mg/L | ND <0.0018 | NA - DRY | ND <0.0018 | ND <0.0018 | NA - DRY |
| Toluene | EPA 8260 | 108-88-3 | mg/L | ND <0.0016 | NA - DRY | ND <0.0016 | ND <0.0016 | NA - DRY |
| Trichloroethene | EPA 8260 | 79-01-6 | mg/L | ND <0.0018 | NA - DRY | ND <0.0018 | ND <0.0018 | NA - DRY |
| Trichlorofluoromethane | EPA 8260 | 75-69-4 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| Vinyl acetate | EPA 8260 | 108-05-4 | mg/L | ND <0.0023 | NA - DRY | ND <0.0023 | ND <0.0023 | NA - DRY |
| Vinyl chloride | EPA 8260 | 75-01-4 | mg/L | ND <0.0015 | NA - DRY | ND <0.0015 | ND <0.0015 | NA - DRY |
| cis-1,2-Dichloroethene | EPA 8260 | 156-59-2 | mg/L | ND <0.0018 | NA - DRY | ND <0.0018 | ND <0.0018 | NA - DRY |
| cis-1,3-Dichloropropene | EPA 8260 | 10061-01-5 | mg/L | ND <0.0016 | NA - DRY | ND <0.0016 | ND <0.0016 | NA - DRY |
| m&p-Xylene | EPA 8260 | 179601-23-1 | mg/L | ND <0.0031 | NA - DRY | ND <0.0031 | ND <0.0031 | NA - DRY |
| n-Butylbenzene | EPA 8260 | 104-51-8 | mg/L | ND <0.0019 | NA - DRY | ND <0.0019 | ND <0.0019 | NA - DRY |
| n-Propylbenzene | EPA 8260 | 103-65-1 | mg/L | ND <0.0015 | NA - DRY | ND <0.0015 | ND <0.0015 | NA - DRY |
| o-Xylene | EPA 8260 | 95-47-6 | mg/L | ND <0.0016 | NA - DRY | ND <0.0016 | ND <0.0016 | NA - DRY |
| p-Isopropyltoluene | EPA 8260 | 99-87-6 | mg/L | ND <0.0016 | NA - DRY | ND <0.0016 | ND <0.0016 | NA - DRY |
| sec-Butylbenzene | EPA 8260 | 135-98-8 | mg/L | ND <0.0017 | NA - DRY | ND <0.0017 | ND <0.0017 | NA - DRY |
| tert-Butyl Alcohol | EPA 8260 | 75-65-0 | mg/L | ND <0.0577 | NA - DRY | ND <0.0577 | ND <0.0577 | NA - DRY |
| tert-Butylbenzene | EPA 8260 | 98-06-6 | mg/L | ND <0.0016 | NA - DRY | ND <0.0016 | ND <0.0016 | NA - DRY |
| trans-1,2-Dichloroethene | EPA 8260 | 156-60-5 | mg/L | ND <0.0018 | NA - DRY | ND <0.0018 | ND <0.0018 | NA - DRY |
| trans-1,3-Dichloropropene | EPA 8260 | 10061-02-6 | mg/L | ND <0.0016 | NA - DRY | ND <0.0016 | ND <0.0016 | NA - DRY |
| 1,2,4-Trichlorobenzene | EPA 8270 | 120-82-1 | mg/L | ND <0.0019 | NA - DRY | ND <0.0019 | ND <0.0019 | NA - DRY |
| 1,2-Dichlorobenzene | EPA 8270 | 95-50-1 | mg/L | ND <0.0012 | NA - DRY | ND <0.0012 | ND <0.0012 | NA - DRY |

**Table 4-4**
**Surface Water Analytical Results**
**SWMU No. 2 (Alcoa Badin Municipal Landfill)**
**Former Alcoa-Badin Works Facility**
**Badin, North Carolina**

| Sample ID | Method | CAS | Units | ABL-SW004-F004 | ABL-SW005-F004 | ABL-SW006-F004 | ABL-SW006-D004 | ABL-SW007-F004 |
|---|---|---|---|---|---|---|---|---|
| Location | | | | Between West SCA and LMC | Between Middle SCA and LMC | Between East SCA and LMC | Between East SCA and LMC | Alleged Pipe Break |
| Date | | | | 7/21/2015 | 7/21/2015 | 7/21/2015 | 7/21/2015 | 7/21/2015 |
| Time | | | | 12:05 | N/A | 13:55 | 13:55 | N/A |
| 1,3-Dichlorobenzene | EPA 8270 | 541-73-1 | mg/L | $ND_{<0.0011}$ | NA - DRY | $ND_{<0.0011}$ | $ND_{<0.0011}$ | NA - DRY |
| 1,4-Dichlorobenzene | EPA 8270 | 106-46-7 | mg/L | $ND_{<0.0012}$ | NA - DRY | $ND_{<0.0012}$ | $ND_{<0.0012}$ | NA - DRY |
| 1-Methylnaphthalene | EPA 8270 | 90-12-0 | mg/L | $ND_{<0.0018}$ | NA - DRY | $ND_{<0.0018}$ | $ND_{<0.0018}$ | NA - DRY |
| 2,4,5-Trichlorophenol | EPA 8270 | 95-95-4 | mg/L | $ND_{<0.0022}$ | NA - DRY | $ND_{<0.0022}$ | $ND_{<0.0022}$ | NA - DRY |
| 2,4,6-Trichlorophenol | EPA 8270 | 88-06-2 | mg/L | $ND_{<0.0019}$ | NA - DRY | $ND_{<0.0019}$ | $ND_{<0.0019}$ | NA - DRY |
| 2,4-Dichlorophenol | EPA 8270 | 120-83-2 | mg/L | $ND_{<0.0017}$ | NA - DRY | $ND_{<0.0017}$ | $ND_{<0.0017}$ | NA - DRY |
| 2,4-Dimethylphenol | EPA 8270 | 105-67-9 | mg/L | $ND_{<0.0022}$ | NA - DRY | $ND_{<0.0022}$ | $ND_{<0.0022}$ | NA - DRY |
| 2,4-Dinitrophenol | EPA 8270 | 51-28-5 | mg/L | $ND_{<0.0065}$ | NA - DRY | $ND_{<0.0065}$ | $ND_{<0.0065}$ | NA - DRY |
| 2,4-Dinitrotoluene | EPA 8270 | 121-14-2 | mg/L | $ND_{<0.0012}$ | NA - DRY | $ND_{<0.0012}$ | $ND_{<0.0012}$ | NA - DRY |
| 2,6-Dinitrotoluene | EPA 8270 | 606-20-2 | mg/L | $ND_{<0.0017}$ | NA - DRY | $ND_{<0.0017}$ | $ND_{<0.0017}$ | NA - DRY |
| 2-Chloronaphthalene | EPA 8270 | 91-58-7 | mg/L | $ND_{<0.0022}$ | NA - DRY | $ND_{<0.0022}$ | $ND_{<0.0022}$ | NA - DRY |
| 2-Chlorophenol | EPA 8270 | 95-57-8 | mg/L | $ND_{<0.0015}$ | NA - DRY | $ND_{<0.0015}$ | $ND_{<0.0015}$ | NA - DRY |
| 2-Methylnaphthalene | EPA 8270 | 91-57-6 | mg/L | $ND_{<0.0017}$ | NA - DRY | $ND_{<0.0017}$ | $ND_{<0.0017}$ | NA - DRY |
| 2-Methylphenol(o-Cresol) | EPA 8270 | 95-48-7 | mg/L | $ND_{<0.0017}$ | NA - DRY | $ND_{<0.0017}$ | $ND_{<0.0017}$ | NA - DRY |
| 2-Nitroaniline | EPA 8270 | 88-74-4 | mg/L | $ND_{<0.0028}$ | NA - DRY | $ND_{<0.0028}$ | $ND_{<0.0028}$ | NA - DRY |
| 2-Nitrophenol | EPA 8270 | 88-75-5 | mg/L | $ND_{<0.0017}$ | NA - DRY | $ND_{<0.0017}$ | $ND_{<0.0017}$ | NA - DRY |
| 3&4-Methylphenol(m&p Cresol) | EPA 8270 | | mg/L | $ND_{<0.0017}$ | NA - DRY | $ND_{<0.0017}$ | $ND_{<0.0017}$ | NA - DRY |
| 3,3'-Dichlorobenzidine | EPA 8270 | 91-94-1 | mg/L | $ND_{<0.0014}$ | NA - DRY | $ND_{<0.0014}$ | $ND_{<0.0014}$ | NA - DRY |
| 3-Nitroaniline | EPA 8270 | 99-09-2 | mg/L | $ND_{<0.0024}$ | NA - DRY | $ND_{<0.0024}$ | $ND_{<0.0024}$ | NA - DRY |
| 4,6-Dinitro-2-methylphenol | EPA 8270 | 534-52-1 | mg/L | $ND_{<0.0017}$ | NA - DRY | $ND_{<0.0017}$ | $ND_{<0.0017}$ | NA - DRY |
| 4-Bromophenylphenyl ether | EPA 8270 | 101-55-3 | mg/L | $ND_{<0.0013}$ | NA - DRY | $ND_{<0.0013}$ | $ND_{<0.0013}$ | NA - DRY |
| 4-Chloro-3-methylphenol | EPA 8270 | 59-50-7 | mg/L | $ND_{<0.0042}$ | NA - DRY | $ND_{<0.0042}$ | $ND_{<0.0042}$ | NA - DRY |
| 4-Chloroaniline | EPA 8270 | 106-47-8 | mg/L | $ND_{<0.0034}$ | NA - DRY | $ND_{<0.0034}$ | $ND_{<0.0034}$ | NA - DRY |
| 4-Chlorophenylphenyl ether | EPA 8270 | 7005-72-3 | mg/L | $ND_{<0.0021}$ | NA - DRY | $ND_{<0.0021}$ | $ND_{<0.0021}$ | NA - DRY |
| 4-Nitroaniline | EPA 8270 | 100-01-6 | mg/L | $ND_{<0.0025}$ | NA - DRY | $ND_{<0.0025}$ | $ND_{<0.0025}$ | NA - DRY |
| 4-Nitrophenol | EPA 8270 | 100-02-7 | mg/L | $ND_{<0.0058}$ | NA - DRY | $ND_{<0.0058}$ | $ND_{<0.0058}$ | NA - DRY |
| Acenaphthene | EPA 8270 | 83-32-9 | mg/L | $ND_{<0.0017}$ | NA - DRY | $ND_{<0.0017}$ | $ND_{<0.0017}$ | NA - DRY |
| Acenaphthylene | EPA 8270 | 208-96-8 | mg/L | $ND_{<0.0018}$ | NA - DRY | $ND_{<0.0018}$ | $ND_{<0.0018}$ | NA - DRY |
| Aniline | EPA 8270 | 62-53-3 | mg/L | $ND_{<0.0013}$ | NA - DRY | $ND_{<0.0013}$ | $ND_{<0.0013}$ | NA - DRY |
| Anthracene | EPA 8270 | 120-12-7 | mg/L | $ND_{<0.0011}$ | NA - DRY | $ND_{<0.0011}$ | $ND_{<0.0011}$ | NA - DRY |
| Benzo(a)anthracene | EPA 8270 | 56-55-3 | mg/L | $ND_{<0.00072}$ | NA - DRY | $ND_{<0.00072}$ | $ND_{<0.00072}$ | NA - DRY |
| Benzo(a)pyrene | EPA 8270 | 50-32-8 | mg/L | $ND_{<0.00071}$ | NA - DRY | $ND_{<0.00071}$ | $ND_{<0.00071}$ | NA - DRY |
| Benzo(b)fluoranthene | EPA 8270 | 205-99-2 | mg/L | $ND_{<0.00081}$ | NA - DRY | $ND_{<0.00081}$ | $ND_{<0.00081}$ | NA - DRY |
| Benzo(g,h,i)perylene | EPA 8270 | 191-24-2 | mg/L | $ND_{<0.00097}$ | NA - DRY | $ND_{<0.00097}$ | $ND_{<0.00097}$ | NA - DRY |
| Benzo(k)fluoranthene | EPA 8270 | 207-08-9 | mg/L | $ND_{<0.00087}$ | NA - DRY | $ND_{<0.00087}$ | $ND_{<0.00087}$ | NA - DRY |
| Benzoic Acid | EPA 8270 | 65-85-0 | mg/L | $ND_{<0.0111}$ | NA - DRY | $ND_{<0.0111}$ | $ND_{<0.0111}$ | NA - DRY |
| Benzyl alcohol | EPA 8270 | 100-51-6 | mg/L | $ND_{<0.0034}$ | NA - DRY | $ND_{<0.0034}$ | $ND_{<0.0034}$ | NA - DRY |
| Butylbenzylphthalate | EPA 8270 | 85-68-7 | mg/L | $ND_{<0.00075}$ | NA - DRY | $ND_{<0.00075}$ | $ND_{<0.00075}$ | NA - DRY |
| Chrysene | EPA 8270 | 218-01-9 | mg/L | $ND_{<0.00065}$ | NA - DRY | $ND_{<0.00065}$ | $ND_{<0.00065}$ | NA - DRY |
| Di-n-butylphthalate | EPA 8270 | 84-74-2 | mg/L | $ND_{<0.0011}$ | NA - DRY | $ND_{<0.0011}$ | $ND_{<0.0011}$ | NA - DRY |
| Di-n-octylphthalate | EPA 8270 | 117-84-0 | mg/L | $ND_{<0.00086}$ | NA - DRY | $ND_{<0.00086}$ | $ND_{<0.00086}$ | NA - DRY |
| Dibenz(a,h)anthracene | EPA 8270 | 53-70-3 | mg/L | $ND_{<0.00070}$ | NA - DRY | $ND_{<0.00070}$ | $ND_{<0.00070}$ | NA - DRY |
| Dibenzofuran | EPA 8270 | 132-64-9 | mg/L | $ND_{<0.0018}$ | NA - DRY | $ND_{<0.0018}$ | $ND_{<0.0018}$ | NA - DRY |
| Diethylphthalate | EPA 8270 | 84-66-2 | mg/L | $ND_{<0.0013}$ | NA - DRY | $ND_{<0.0013}$ | $ND_{<0.0013}$ | NA - DRY |
| Dimethylphthalate | EPA 8270 | 131-11-3 | mg/L | $ND_{<0.0015}$ | NA - DRY | $ND_{<0.0015}$ | $ND_{<0.0015}$ | NA - DRY |
| Fluoranthene | EPA 8270 | 206-44-0 | mg/L | $ND_{<0.00087}$ | NA - DRY | $ND_{<0.00087}$ | $ND_{<0.00087}$ | NA - DRY |
| Fluorene | EPA 8270 | 86-73-7 | mg/L | $ND_{<0.0016}$ | NA - DRY | $ND_{<0.0016}$ | $ND_{<0.0016}$ | NA - DRY |
| Hexachloro-1,3-butadiene | EPA 8270 | 87-68-3 | mg/L | $ND_{<0.0018}$ | NA - DRY | $ND_{<0.0018}$ | $ND_{<0.0018}$ | NA - DRY |
| Hexachlorobenzene | EPA 8270 | 118-74-1 | mg/L | $ND_{<0.0011}$ | NA - DRY | $ND_{<0.0011}$ | $ND_{<0.0011}$ | NA - DRY |
| Hexachlorocyclopentadiene | EPA 8270 | 77-47-4 | mg/L | $ND_{<0.0018}$ | NA - DRY | $ND_{<0.0018}$ | $ND_{<0.0018}$ | NA - DRY |
| Hexachloroethane | EPA 8270 | 67-72-1 | mg/L | $ND_{<0.0015}$ | NA - DRY | $ND_{<0.0015}$ | $ND_{<0.0015}$ | NA - DRY |
| Indeno(1,2,3-cd)pyrene | EPA 8270 | 193-39-5 | mg/L | $ND_{<0.0018}$ | NA - DRY | $ND_{<0.0018}$ | $ND_{<0.0018}$ | NA - DRY |
| Isophorone | EPA 8270 | 78-59-1 | mg/L | $ND_{<0.0018}$ | NA - DRY | $ND_{<0.0018}$ | $ND_{<0.0018}$ | NA - DRY |
| N-Nitroso-di-n-propylamine | EPA 8270 | 621-64-7 | mg/L | $ND_{<0.0021}$ | NA - DRY | $ND_{<0.0021}$ | $ND_{<0.0021}$ | NA - DRY |
| N-Nitrosodimethylamine | EPA 8270 | 62-75-9 | mg/L | $ND_{<0.0013}$ | NA - DRY | $ND_{<0.0013}$ | $ND_{<0.0013}$ | NA - DRY |
| N-Nitrosodiphenylamine | EPA 8270 | 86-30-6 | mg/L | $ND_{<0.0013}$ | NA - DRY | $ND_{<0.0013}$ | $ND_{<0.0013}$ | NA - DRY |
| Naphthalene | EPA 8270 | 91-20-3 | mg/L | $ND_{<0.0015}$ | NA - DRY | $ND_{<0.0015}$ | $ND_{<0.0015}$ | NA - DRY |
| Nitrobenzene | EPA 8270 | 98-95-3 | mg/L | $ND_{<0.0017}$ | NA - DRY | $ND_{<0.0017}$ | $ND_{<0.0017}$ | NA - DRY |
| Pentachlorophenol | EPA 8270 | 87-86-5 | mg/L | $ND_{<0.0023}$ | NA - DRY | $ND_{<0.0023}$ | $ND_{<0.0023}$ | NA - DRY |
| Phenanthrene | EPA 8270 | 85-01-8 | mg/L | $ND_{<0.0010}$ | NA - DRY | $ND_{<0.0010}$ | $ND_{<0.0010}$ | NA - DRY |
| Phenol | EPA 8270 | 108-95-2 | mg/L | $ND_{<0.0017}$ | NA - DRY | $ND_{<0.0017}$ | $ND_{<0.0017}$ | NA - DRY |
| Pyrene | EPA 8270 | 129-00-0 | mg/L | $ND_{<0.00053}$ | NA - DRY | $ND_{<0.00053}$ | $ND_{<0.00053}$ | NA - DRY |
| bis(2-Chloroethoxy)methane | EPA 8270 | 111-91-1 | mg/L | $ND_{<0.0017}$ | NA - DRY | $ND_{<0.0017}$ | $ND_{<0.0017}$ | NA - DRY |
| bis(2-Chloroethyl) ether | EPA 8270 | 111-44-4 | mg/L | $ND_{<0.0015}$ | NA - DRY | $ND_{<0.0015}$ | $ND_{<0.0015}$ | NA - DRY |
| bis(2-Chloroisopropyl) ether | EPA 8270 | 108-60-1 | mg/L | $ND_{<0.0016}$ | NA - DRY | $ND_{<0.0016}$ | $ND_{<0.0016}$ | NA - DRY |
| bis(2-Ethylhexyl)phthalate | EPA 8270 | 117-81-7 | mg/L | $ND_{<0.00085}$ | NA - DRY | $ND_{<0.00085}$ | $ND_{<0.00085}$ | NA - DRY |

*NA - Not analyzed.*
*ND - The analyte was not detected above laboratory detection limits. Subscript indicates compound-specific MDL in mg/l.*
*"J" - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.*

**Table 4-5**
**Seep Collection Area (SCA) Water Sample Analytical Results**
**SWMU No. 2 (Alcoa Badin Municipal Landfill)**
**Former Alcoa-Badin Works Facility**
**Badin, North Carolina**

| Sample ID | Method | CAS | Units | ABL-ML001-F004 | ABL-ML002-F004 | ABL-ML003-F004 |
|---|---|---|---|---|---|---|
| Location | | | | West SCA | Middle SCA | East SCA |
| Date | | | | 7/21/2015 | 7/21/2015 | 7/21/2015 |
| Time | | | | 15:25 | 16:15 | 17:15 |
| Fluoride | EPA 300.0 | 16984-48-8 | mg/L | 0.31 J | 28.9 | 23.8 |
| Cyanide, Available | OIA-1677 | 57-12-5 | mg/L | ND <0.0011 | ND <0.0011 | ND <0.0011 |
| Arsenic | EPA 6010 | 7440-38-2 | mg/L | ND <0.0050 | ND <0.0050 | ND <0.0050 |
| Barium | EPA 6010 | 7440-39-3 | mg/L | 0.0465 | 0.0481 | 0.0236 |
| Cadmium | EPA 6010 | 7440-43-9 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| Chromium | EPA 6010 | 7440-47-3 | mg/L | ND <0.0025 | ND <0.0025 | ND <0.0025 |
| Lead | EPA 6010 | 7439-92-1 | mg/L | ND <0.0025 | ND <0.0025 | ND <0.0025 |
| Selenium | EPA 6010 | 7782-49-2 | mg/L | ND <0.0050 | ND <0.0050 | ND <0.0050 |
| Silver | EPA 6010 | 7440-22-4 | mg/L | ND <0.0025 | ND <0.0025 | ND <0.0025 |
| Mercury | EPA 7470 | 7439-97-6 | mg/L | ND <0.00010 | ND <0.00010 | ND <0.00010 |
| PCB-1016 (Aroclor 1016) | EPA 8082 | 12674-11-2 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| PCB-1221 (Aroclor 1221) | EPA 8082 | 11104-28-2 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| PCB-1232 (Aroclor 1232) | EPA 8082 | 11141-16-5 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| PCB-1242 (Aroclor 1242) | EPA 8082 | 53469-21-9 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| PCB-1248 (Aroclor 1248) | EPA 8082 | 12672-29-6 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| PCB-1254 (Aroclor 1254) | EPA 8082 | 11097-69-1 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| PCB-1260 (Aroclor 1260) | EPA 8082 | 11096-82-5 | mg/L | ND <0.00050 | ND <0.00050 | ND <0.00050 |
| Total PCBs | EPA 8082 | -- | mg/L | ND | ND | ND |
| 1,1,1,2-Tetrachloroethane | EPA 8260 | 630-20-6 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,1,1-Trichloroethane | EPA 8260 | 71-55-6 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| 1,1,2,2-Tetrachloroethane | EPA 8260 | 79-34-5 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 1,1,2-Trichloroethane | EPA 8260 | 79-00-5 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,1-Dichloroethane | EPA 8260 | 75-34-3 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| 1,1-Dichloroethene | EPA 8260 | 75-35-4 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| 1,1-Dichloropropene | EPA 8260 | 563-58-6 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,2,3-Trichlorobenzene | EPA 8260 | 87-61-6 | mg/L | ND <0.0020 | ND <0.0020 | ND <0.0020 |
| 1,2,3-Trichloropropane | EPA 8260 | 96-18-4 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 1,2,4-Trichlorobenzene | EPA 8260 | 120-82-1 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,2,4-Trimethylbenzene | EPA 8260 | 95-63-6 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 1,2-Dibromo-3-chloropropane | EPA 8260 | 96-12-8 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,2-Dibromoethane (EDB) | EPA 8260 | 106-93-4 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,2-Dichlorobenzene | EPA 8260 | 95-50-1 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 1,2-Dichloroethane | EPA 8260 | 107-06-2 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| 1,2-Dichloroethene (Total) | EPA 8260 | 540-59-0 | mg/L | ND <0.0044 | ND <0.0044 | ND <0.0044 |
| 1,2-Dichloropropane | EPA 8260 | 78-87-5 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,3,5-Trimethylbenzene | EPA 8260 | 108-67-8 | mg/L | ND <0.0013 | ND <0.0013 | ND <0.0013 |
| 1,3-Dichlorobenzene | EPA 8260 | 541-73-1 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 1,3-Dichloropropane | EPA 8260 | 142-28-9 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 1,4-Dichlorobenzene | EPA 8260 | 106-46-7 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 2,2-Dichloropropane | EPA 8260 | 594-20-7 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| 2-Butanone (MEK) | EPA 8260 | 78-93-3 | mg/L | ND <0.0049 | ND <0.0049 | ND <0.0049 |
| 2-Chlorotoluene | EPA 8260 | 95-49-8 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 2-Hexanone | EPA 8260 | 591-78-6 | mg/L | ND <0.0038 | ND <0.0038 | ND <0.0038 |
| 4-Chlorotoluene | EPA 8260 | 106-43-4 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| 4-Methyl-2-pentanone (MIBK) | EPA 8260 | 108-10-1 | mg/L | ND <0.0036 | ND <0.0036 | ND <0.0036 |
| Acetone | EPA 8260 | 67-64-1 | mg/L | ND <0.0100 | ND <0.0100 | 0.0100 J |
| Benzene | EPA 8260 | 71-43-2 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Bromobenzene | EPA 8260 | 108-86-1 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| Bromochloromethane | EPA 8260 | 74-97-5 | mg/L | ND <0.0022 | ND <0.0022 | ND <0.0022 |
| Bromodichloromethane | EPA 8260 | 75-27-4 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Bromoform | EPA 8260 | 75-25-2 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| Bromomethane | EPA 8260 | 74-83-9 | mg/L | ND <0.0025 | ND <0.0025 | ND <0.0025 |
| Carbon tetrachloride | EPA 8260 | 56-23-5 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| Chlorobenzene | EPA 8260 | 108-90-7 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Chloroethane | EPA 8260 | 75-00-3 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| Chloroform | EPA 8260 | 67-66-3 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| Chloromethane | EPA 8260 | 74-87-3 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| Dibromochloromethane | EPA 8260 | 124-48-1 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Dibromomethane | EPA 8260 | 74-95-3 | mg/L | ND <0.0020 | ND <0.0020 | ND <0.0020 |
| Dichlorodifluoromethane | EPA 8260 | 75-71-8 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| Diisopropyl ether | EPA 8260 | 108-20-3 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Ethylbenzene | EPA 8260 | 100-41-4 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| Hexachloro-1,3-butadiene | EPA 8260 | 87-68-3 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Isopropylbenzene (Cumene) | EPA 8260 | 98-82-8 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| Methyl-tert-butyl ether | EPA 8260 | 1634-04-4 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Methylene Chloride | EPA 8260 | 75-09-2 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| Naphthalene | EPA 8260 | 91-20-3 | mg/L | ND <0.0020 | ND <0.0020 | ND <0.0020 |
| Styrene | EPA 8260 | 100-42-5 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| Tetrachloroethene | EPA 8260 | 127-18-4 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Toluene | EPA 8260 | 108-88-3 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| Trichloroethene | EPA 8260 | 79-01-6 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Trichlorofluoromethane | EPA 8260 | 75-69-4 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Vinyl acetate | EPA 8260 | 108-05-4 | mg/L | ND <0.0023 | ND <0.0023 | ND <0.0023 |
| Vinyl chloride | EPA 8260 | 75-01-4 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| cis-1,2-Dichloroethene | EPA 8260 | 156-59-2 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| cis-1,3-Dichloropropene | EPA 8260 | 10061-01-5 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| m&p-Xylene | EPA 8260 | 179601-23-1 | mg/L | ND <0.0031 | ND <0.0031 | ND <0.0031 |
| n-Butylbenzene | EPA 8260 | 104-51-8 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| n-Propylbenzene | EPA 8260 | 103-65-1 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| o-Xylene | EPA 8260 | 95-47-6 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| p-Isopropyltoluene | EPA 8260 | 99-87-6 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| sec-Butylbenzene | EPA 8260 | 135-98-8 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| tert-Butyl Alcohol | EPA 8260 | 75-65-0 | mg/L | ND <0.0577 | ND <0.0577 | ND <0.0577 |
| tert-Butylbenzene | EPA 8260 | 98-06-6 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| trans-1,2-Dichloroethene | EPA 8260 | 156-60-5 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| trans-1,3-Dichloropropene | EPA 8260 | 10061-02-6 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |

Table 4-5
**Seep Collection Area (SCA) Water Sample Analytical Results**
**SWMU No. 2 (Alcoa Badin Municipal Landfill)**
**Former Alcoa-Badin Works Facility**
**Badin, North Carolina**

| Sample ID | Method | CAS | Units | ABL-ML001-F004 | ABL-ML002-F004 | ABL-ML003-F004 |
|---|---|---|---|---|---|---|
| Location | | | | West SCA | Middle SCA | East SCA |
| Date | | | | 7/21/2015 | 7/21/2015 | 7/21/2015 |
| Time | | | | 15:25 | 16:15 | 17:15 |
| 1,2,4-Trichlorobenzene | EPA 8270 | 120-82-1 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| 1,2-Dichlorobenzene | EPA 8270 | 95-50-1 | mg/L | ND <0.0012 | ND <0.0012 | ND <0.0012 |
| 1,3-Dichlorobenzene | EPA 8270 | 541-73-1 | mg/L | ND <0.0011 | ND <0.0011 | ND <0.0011 |
| 1,4-Dichlorobenzene | EPA 8270 | 106-46-7 | mg/L | ND <0.0012 | ND <0.0012 | ND <0.0012 |
| 1-Methylnaphthalene | EPA 8270 | 90-12-0 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| 2,4,5-Trichlorophenol | EPA 8270 | 95-95-4 | mg/L | ND <0.0022 | ND <0.0022 | ND <0.0022 |
| 2,4,6-Trichlorophenol | EPA 8270 | 88-06-2 | mg/L | ND <0.0019 | ND <0.0019 | ND <0.0019 |
| 2,4-Dichlorophenol | EPA 8270 | 120-83-2 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 2,4-Dimethylphenol | EPA 8270 | 105-67-9 | mg/L | ND <0.0022 | ND <0.0022 | ND <0.0022 |
| 2,4-Dinitrophenol | EPA 8270 | 51-28-5 | mg/L | ND <0.0065 | ND <0.0065 | ND <0.0065 |
| 2,4-Dinitrotoluene | EPA 8270 | 121-14-2 | mg/L | ND <0.0012 | ND <0.0012 | ND <0.0012 |
| 2,6-Dinitrotoluene | EPA 8270 | 606-20-2 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 2-Chloronaphthalene | EPA 8270 | 91-58-7 | mg/L | ND <0.0022 | ND <0.0022 | ND <0.0022 |
| 2-Chlorophenol | EPA 8270 | 95-57-8 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| 2-Methylnaphthalene | EPA 8270 | 91-57-6 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 2-Methylphenol(o-Cresol) | EPA 8270 | 95-48-7 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 2-Nitroaniline | EPA 8270 | 88-74-4 | mg/L | ND <0.0028 | ND <0.0028 | ND <0.0028 |
| 2-Nitrophenol | EPA 8270 | 88-75-5 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 3&4-Methylphenol(m&p Cresol) | EPA 8270 | | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 3,3'-Dichlorobenzidine | EPA 8270 | 91-94-1 | mg/L | ND <0.0014 | ND <0.0014 | ND <0.0014 |
| 3-Nitroaniline | EPA 8270 | 99-09-2 | mg/L | ND <0.0024 | ND <0.0024 | ND <0.0024 |
| 4,6-Dinitro-2-methylphenol | EPA 8270 | 534-52-1 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| 4-Bromophenylphenyl ether | EPA 8270 | 101-55-3 | mg/L | ND <0.0013 | ND <0.0013 | ND <0.0013 |
| 4-Chloro-3-methylphenol | EPA 8270 | 59-50-7 | mg/L | ND <0.0042 | ND <0.0042 | ND <0.0042 |
| 4-Chloroaniline | EPA 8270 | 106-47-8 | mg/L | ND <0.0034 | ND <0.0034 | ND <0.0034 |
| 4-Chlorophenylphenyl ether | EPA 8270 | 7005-72-3 | mg/L | ND <0.0021 | ND <0.0021 | ND <0.0021 |
| 4-Nitroaniline | EPA 8270 | 100-01-6 | mg/L | ND <0.0025 | ND <0.0025 | ND <0.0025 |
| 4-Nitrophenol | EPA 8270 | 100-02-7 | mg/L | ND <0.0058 | ND <0.0058 | ND <0.0058 |
| Acenaphthene | EPA 8270 | 83-32-9 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Acenaphthylene | EPA 8270 | 208-96-8 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Aniline | EPA 8270 | 62-53-3 | mg/L | ND <0.0013 | ND <0.0013 | ND <0.0013 |
| Anthracene | EPA 8270 | 120-12-7 | mg/L | ND <0.0011 | ND <0.0011 | ND <0.0011 |
| Benzo(a)anthracene | EPA 8270 | 56-55-3 | mg/L | ND <0.00072 | ND <0.00072 | ND <0.00072 |
| Benzo(a)pyrene | EPA 8270 | 50-32-8 | mg/L | ND <0.00071 | ND <0.00071 | ND <0.00071 |
| Benzo(b)fluoranthene | EPA 8270 | 205-99-2 | mg/L | ND <0.00081 | ND <0.00081 | ND <0.00081 |
| Benzo(g,h,i)perylene | EPA 8270 | 191-24-2 | mg/L | ND <0.00097 | ND <0.00097 | ND <0.00097 |
| Benzo(k)fluoranthene | EPA 8270 | 207-08-9 | mg/L | ND <0.00087 | ND <0.00087 | ND <0.00087 |
| Benzoic Acid | EPA 8270 | 65-85-0 | mg/L | ND <0.0111 | ND <0.0111 | ND <0.0111 |
| Benzyl alcohol | EPA 8270 | 100-51-6 | mg/L | ND <0.0034 | ND <0.0034 | ND <0.0034 |
| Butylbenzylphthalate | EPA 8270 | 85-68-7 | mg/L | ND <0.00075 | ND <0.00075 | ND <0.00075 |
| Chrysene | EPA 8270 | 218-01-9 | mg/L | ND <0.00065 | ND <0.00065 | ND <0.00065 |
| Di-n-butylphthalate | EPA 8270 | 84-74-2 | mg/L | ND <0.0011 | ND <0.0011 | ND <0.0011 |
| Di-n-octylphthalate | EPA 8270 | 117-84-0 | mg/L | ND <0.00086 | ND <0.00086 | ND <0.00086 |
| Dibenz(a,h)anthracene | EPA 8270 | 53-70-3 | mg/L | ND <0.00070 | ND <0.00070 | ND <0.00070 |
| Dibenzofuran | EPA 8270 | 132-64-9 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Diethylphthalate | EPA 8270 | 84-66-2 | mg/L | ND <0.0013 | ND <0.0013 | ND <0.0013 |
| Dimethylphthalate | EPA 8270 | 131-11-3 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| Fluoranthene | EPA 8270 | 206-44-0 | mg/L | ND <0.00087 | ND <0.00087 | ND <0.00087 |
| Fluorene | EPA 8270 | 86-73-7 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| Hexachloro-1,3-butadiene | EPA 8270 | 87-68-3 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Hexachlorobenzene | EPA 8270 | 118-74-1 | mg/L | ND <0.0011 | ND <0.0011 | ND <0.0011 |
| Hexachlorocyclopentadiene | EPA 8270 | 77-47-4 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Hexachloroethane | EPA 8270 | 67-72-1 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| Indeno(1,2,3-cd)pyrene | EPA 8270 | 193-39-5 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| Isophorone | EPA 8270 | 78-59-1 | mg/L | ND <0.0018 | ND <0.0018 | ND <0.0018 |
| N-Nitroso-di-n-propylamine | EPA 8270 | 621-64-7 | mg/L | ND <0.0021 | ND <0.0021 | ND <0.0021 |
| N-Nitrosodimethylamine | EPA 8270 | 62-75-9 | mg/L | ND <0.0013 | ND <0.0013 | ND <0.0013 |
| N-Nitrosodiphenylamine | EPA 8270 | 86-30-6 | mg/L | ND <0.0013 | ND <0.0013 | ND <0.0013 |
| Naphthalene | EPA 8270 | 91-20-3 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| Nitrobenzene | EPA 8270 | 98-95-3 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Pentachlorophenol | EPA 8270 | 87-86-5 | mg/L | ND <0.0023 | ND <0.0023 | ND <0.0023 |
| Phenanthrene | EPA 8270 | 85-01-8 | mg/L | ND <0.0010 | ND <0.0010 | ND <0.0010 |
| Phenol | EPA 8270 | 108-95-2 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| Pyrene | EPA 8270 | 129-00-0 | mg/L | ND <0.00053 | ND <0.00053 | ND <0.00053 |
| bis(2-Chloroethoxy)methane | EPA 8270 | 111-91-1 | mg/L | ND <0.0017 | ND <0.0017 | ND <0.0017 |
| bis(2-Chloroethyl) ether | EPA 8270 | 111-44-4 | mg/L | ND <0.0015 | ND <0.0015 | ND <0.0015 |
| bis(2-Chloroisopropyl) ether | EPA 8270 | 108-60-1 | mg/L | ND <0.0016 | ND <0.0016 | ND <0.0016 |
| bis(2-Ethylhexyl)phthalate | EPA 8270 | 117-81-7 | mg/L | ND <0.00085 | 0.0141 | ND <0.00085 |

*ND - The analyte was not detected above laboratory detection limits. Subscript indicates compound-specific MDL in mg/l.*
*"J" - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.*
*Sample ABL-ML003-F004 was sampled for Available Cyanide on 07/22/15*

# Appendix A
# June 18, 2015, Work Plan Approval Letter from NCDENR to Alcoa

NCDENR
North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

Donald R. van der Vaart
Secretary

June 18, 2015

**CERTIFIED MAIL**
**RETURN RECEIPT REQUESTED**

Mr. Robert A. Prezbindowski
Alcoa Remediation
2300 North Wright Road
Alcoa, Tennessee 37701

Reference: Sampling Work Plan for the Alcoa Badin Landfill and Former Ball Field
Alcoa, Inc.
Badin, North Carolina
NCD 003 162 542

Dear Mr. Prezbindowski:

The Division of Waste Management, in conjunction with EPA Region 4, has completed its review of the *Sampling Work Plan for the Alcoa Badin Landfill and Former Ball Field* for the former Alcoa facility (NCD 003 162 542) in Badin, North Carolina.

The *Sampling Work Plan for the Alcoa Badin Landfill and Former Ball Field* is approved with the following amendments:

Section 2.2.1 Task 1 – Alcoa/Badin Landfill Area

Alcoa states that surface water samples will be collected between the Western, Middle, and Eastern seeps and Little Mountain Creek. Sediment samples must also be collected in an area of standing or flowing water between the seeps and Little Mountain Creek as identified on Figure 2-1.

Section 2.2.2 Task 2 – Former Ball Field

The grid system in Figure 2-2 must be extended to Badin Lake and samples collected in the area between the Former Ball Field and the lake. The three eastern sampling grid lines and the second sampling grid line from the west side of the Former Ball Field must be extended to Badin Lake. Soil samples must be collected in these areas near the former railroad track.

In Figure 2-3, deep soil and groundwater sampling locations must also include the area between the ditches leading to the concrete water collection basin and Badin Lake. The three deep soil aand groundwater sample locations proposed on Figure 2-3 must be moved to this area to determine the soil and groundwater quality between the Former Ball Field and Badin Lake.

A deep soil sample must be collected in the area between the Former Ball Field and the ditches leading to the concrete water collection basin.

4.0 – Schedule

Alcoa should notify the DWM two weeks prior to the collection of samples.

If you have any questions, please contact Rob McDaniel at 919-707-8215 or robert.mcdaniel@ncdenr.gov.

Sincerely,

Robert C. McDaniel

Robert C. McDaniel
Hazardous Waste Section
Facility Management Branch

Enclosure

ec: John E. Johnston
Harold A. McCarty
Julie S. Woosley
Jim Bateson
Dave Lown
Carolyn Callihan
Stuart Parker
Mark Burnette
Kirk J. Gribben
Teresa Rodriguez
Ryke Longest
Amy Axon
Robert C. McDaniel

# Appendix B
# Laboratory Reports and Chain of Custody Forms

# REFERENCE 22

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

# Basic Elements of Ground-Water Hydrology With Reference to Conditions in North Carolina

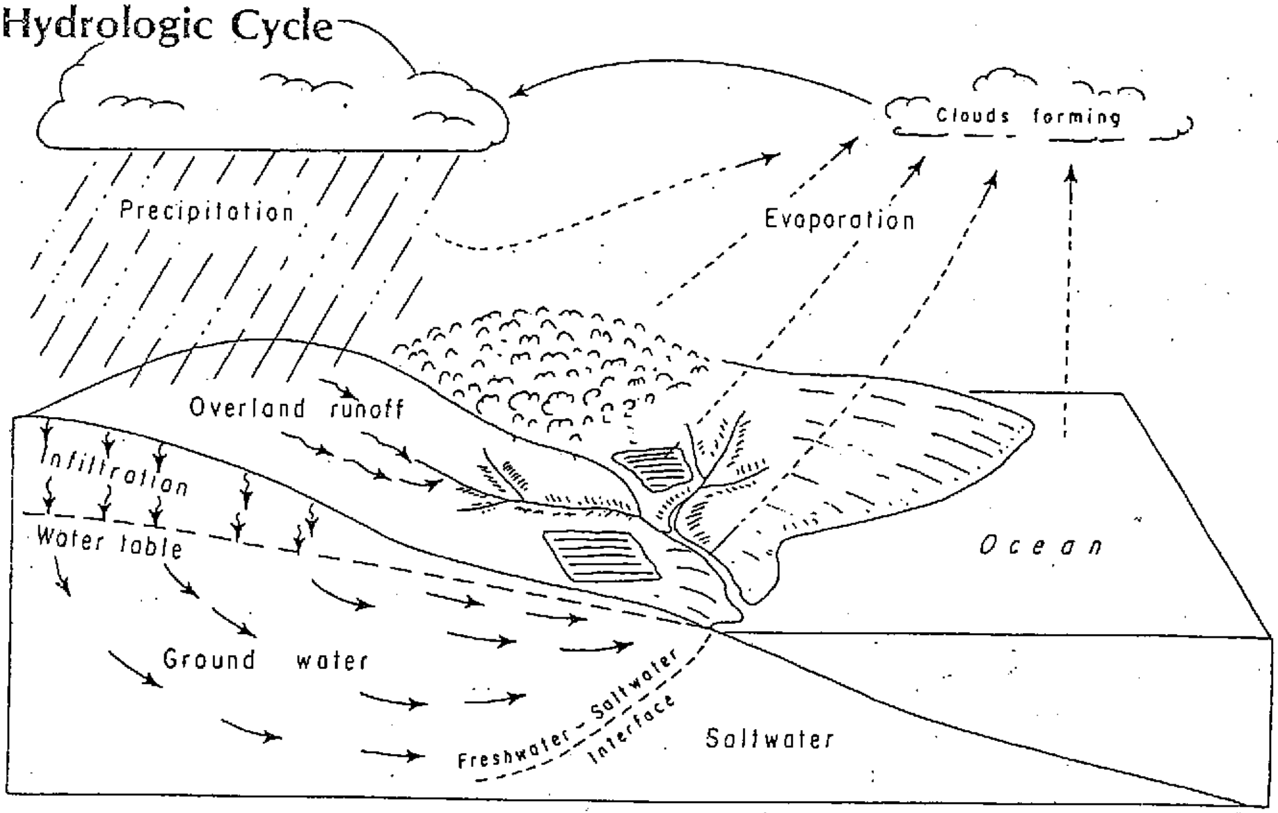
*By Ralph C. Heath*

U.S. Geological Survey
Water-Resources Investigations
Open-File Report 80-44

*Prepared in cooperation with the North Carolina Department of Natural Resources and Community Development*

Raleigh, North Carolina
1980

Hydrologic Cycle




The term *hydrologic cycle* is used to refer to the constant movement of water above, on, and below the Earth's surface. The concept of the hydrologic cycle is central to an understanding of the occurrence of water and the development and management of water supplies.

Although the hydrologic cycle has neither a beginning nor an end, it is convenient to discuss its principal features by starting with evaporation from vegetation, from exposed surfaces including the land surface, and from the ocean. This moisture forms clouds which, under favorable conditions, return the water to the land surface or oceans in the form of precipitation.

Precipitation occurs in several forms, including rain, snow, and hail, but we will consider only rain in this discussion. The first rain wets vegetation and other surfaces and then begins to infiltrate into the ground. *Infiltration* rates vary widely, depending on land use, from possibly as much as an inch per hour in mature forests to a tenth of an inch per hour in silty soils under cultivation. When and if the rate of precipitation exceeds the rate of infiltration, *overland flow* occurs.

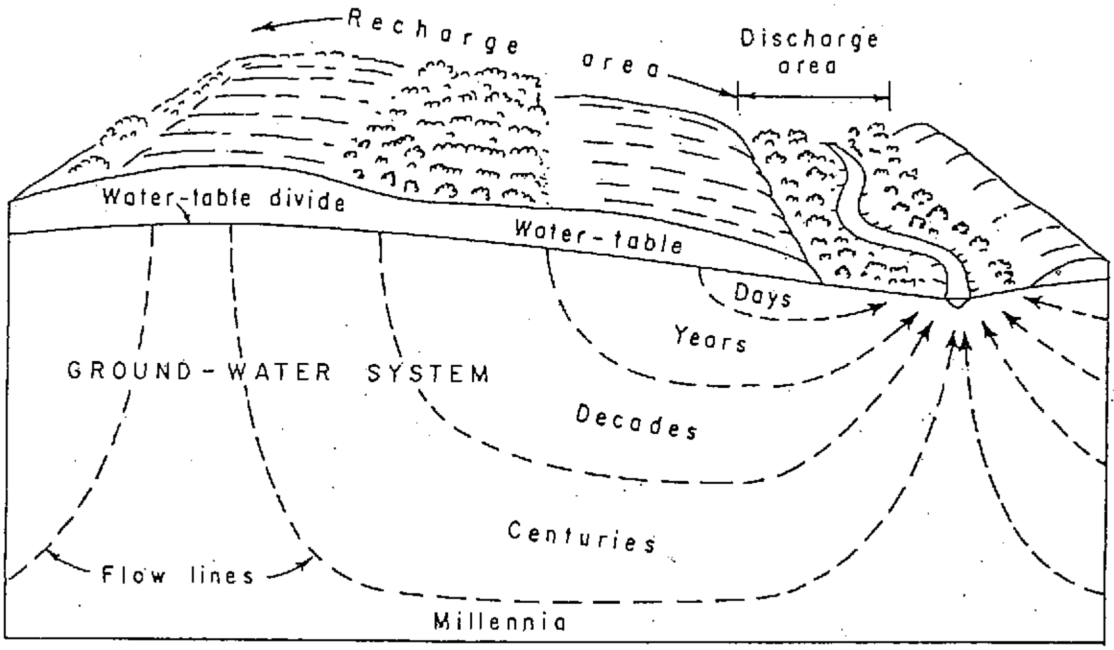
The first infiltration replaces soil moisture and thereafter the excess percolates slowly across the intermediate zone to the zone of saturation. The water in the zone of saturation moves downward and laterally to sites of ground-water discharge such as springs on hillsides or seeps in the bottoms of streams and lakes or beneath the ocean.

Water reaching streams, both by overland flow and from ground-water discharge, moves to the sea where it is again evaporated to perpetuate the cycle.

Movement is, of course, the key element in the concept of the hydrologic cycle. Some "typical" rates of movement are shown in the following table, along with the distribution of the Earth's water supply.

| Location | Rate of movement | Distribution of Earth's water supply (percent) |
|---|---|---|
| Atmosphere | 100s of miles per day | 0.001 |
| Water on land surface | 10s of miles per day | .02 |
| Water below the land surface | feet per day | .52 |
| Ice caps and glaciers | feet per day | 1.88 |
| Oceans | -------- | 97.58 |

# Functions of Ground-Water Systems




The aquifers and confining beds underlying any area comprise the *ground-water system* of the area. Hydraulically, this system serves two functions: (1) it stores water to the extent of its porosity, and (2) it transmits water from recharge areas to discharge areas. Thus, a ground-water system serves both as a reservoir and as a pipeline. With the exception of cavernous limestones and lava flows, ground-water systems are more effective as reservoirs than as pipelines.

Water enters ground-water systems in *recharge areas* and moves through them, as dictated by hydraulic gradients and hydraulic conductivities, to *discharge areas*.

The identification of recharge areas is becoming increasingly important because of the expanding use of the land surface for waste disposal. In a humid area, such as North Carolina, recharge occurs in all interstream areas - that is, in all areas except along streams and their adjoining flood plains. The streams and flood plains are, under most conditions, discharge areas.

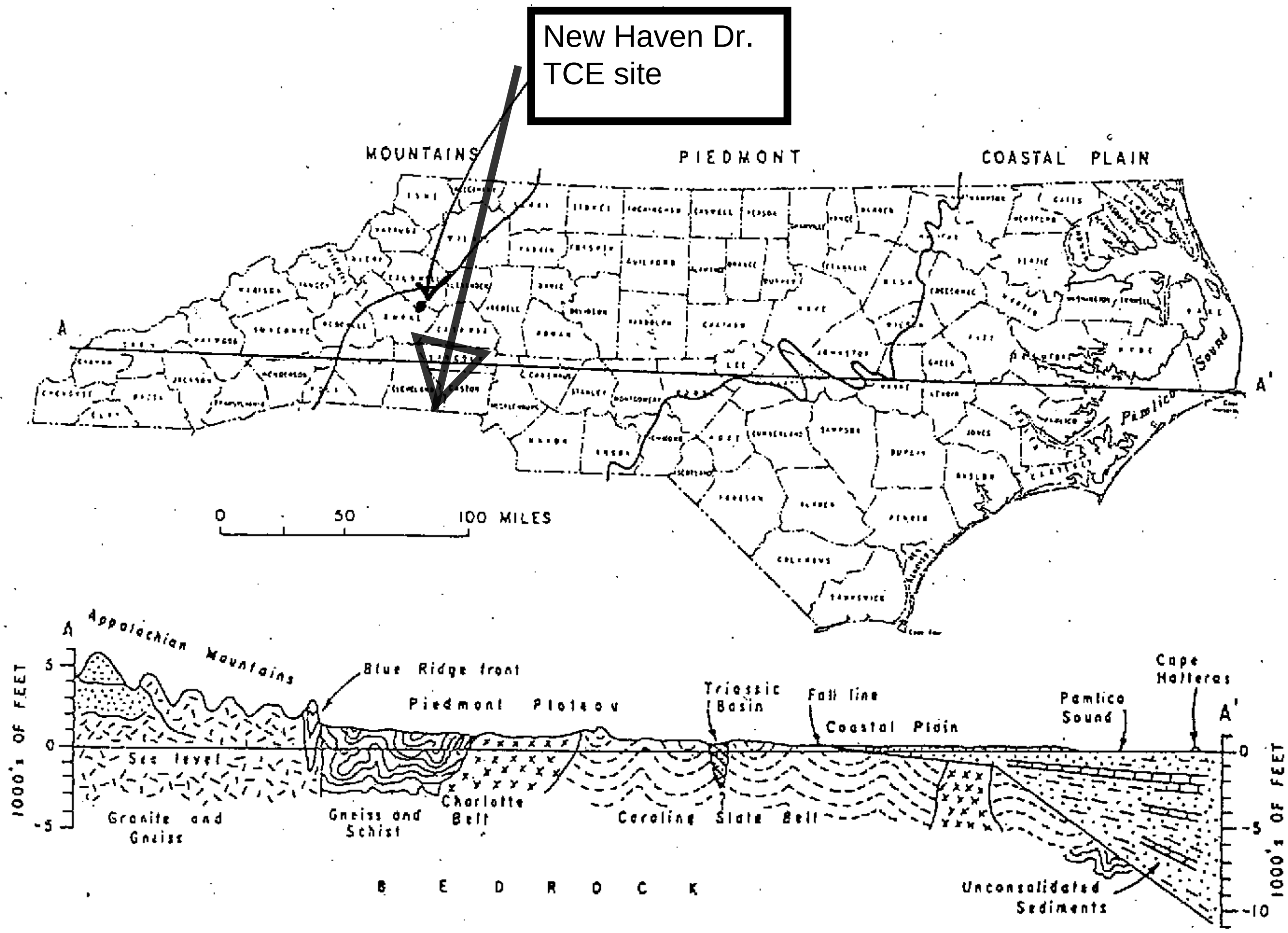
Recharge rates are generally expressed in terms of volume (such as gallons or $ft^3$), per unit of time (such as a day or a year), and per unit of area (such as a square mile or acre). When the units are reduced to their simpliest form, the result is recharge expressed as a depth of water on the land surface per unit of time. Recharge rates vary from year to year, depending on the amount of precipitation, its seasonal distribution, air temperature, and other factors. Among the other factors are land use. For example, recharge rates are much higher in forest than in cities.

# PART II. GROUND-WATER GEOLOGY OF NORTH CAROLINA

*"It is time that we return to examining hydrologic systems and attempting to describe the systems in a more realistic, quantitative manner. When one comes to solving problems of chemical contamination, it is necessary to quantify the distribution of porosity, dispersivity, and other factors. Dispersivity measured at only a few field locations tends to be large; from three to more than five orders of magnitude larger than those measured in the laboratory. This suggests that the geologic complexity of real aquifers greatly complicates the flow field, causing increased hydrodynamic dispersion.*

-From remarks by Dr. John Bredehoeft at hearings on "Ground-water quality research and development" before the Subcommittee on Environment and the Atmosphere, 95th Congress, 2nd Session, April 1978, p. 236.

# Physical Setting of the Ground-Water System




From the standpoint of ground-water hydrology, North Carolina may be divided into two zones, one zone consisting of the Coastal Plain and the other consisting of the Piedmont Plateau and the Appalachian Mountains. Because differences in the ground-water system coincide with the different topographic divisions of the State, it will be useful to briefly review these divisions.

As Jasper L. Stuckey, former North Carolina State Geologist, has said, "The State of North Carolina extends from the crest of the Great Smoky and Unaka mountains on the west, to the Atlantic Ocean on the east and lies across three major topographic provinces of the United States. As a result, it is divided into three natural divisions—the Coastal Plain on the east, the Piedmont Plateau in the center, and the Appalachian Mountains on the west. Beginning at sea level at the eastern edge of the State the surface of North Carolina rises gradually in elevation and increases in irregularity until it reaches its maximum height and ruggedness in the Appalachian Mountains on the west."

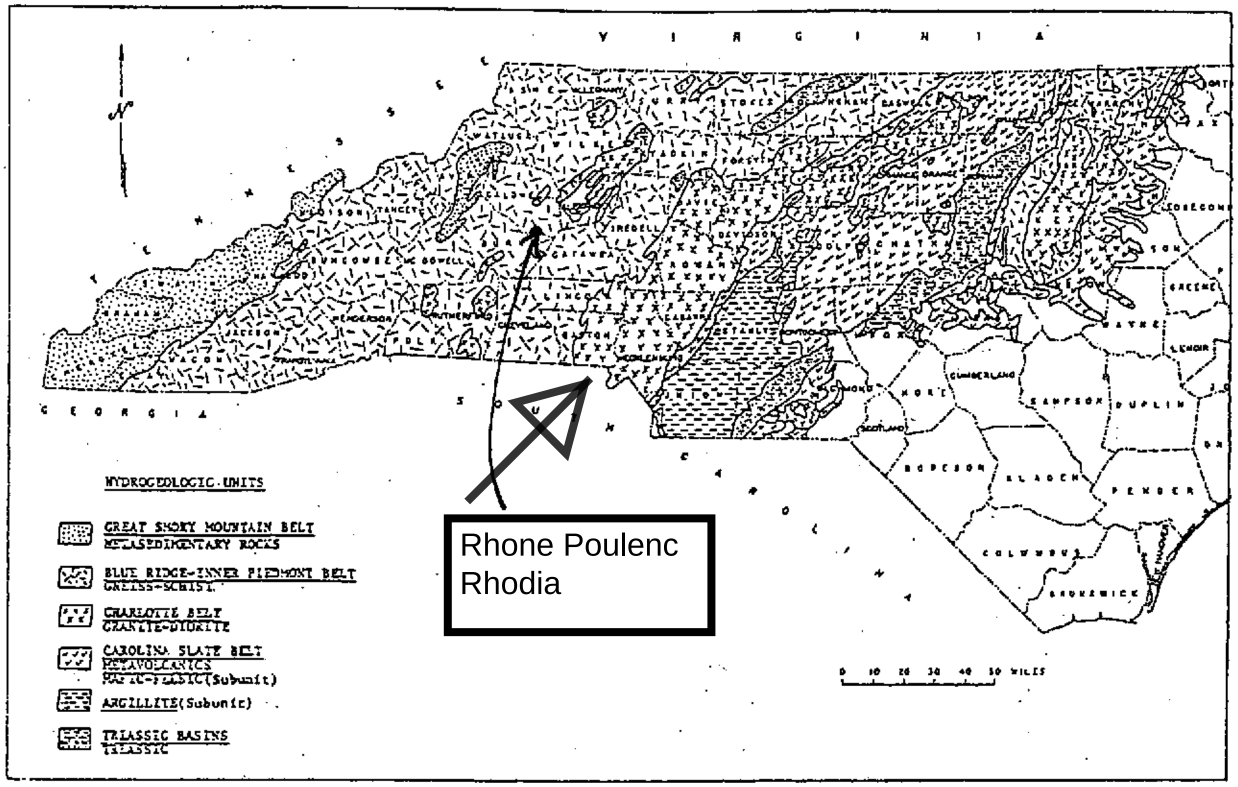
The *Coastal Plain* includes almost one-half of the area of the State and extends west from the Atlantic Ocean to the *Fall Line*. The Fall Line is not a line but a zone 30 to 40 miles wide that is marked by discontinuous rapids where major streams leave the bedrock areas of the Piedmont and flow onto the unconsolidated sediments of the Coastal Plain. Altitudes in the Coastal Plain range from sea level at the coast to about 300 to 500 ft. along the Fall Line. The Coastal Plain can conveniently be divided into the Tidewater Region, in which the effect of tides and other oceanic influences are apparent, and the Inner Coastal Plain which, though underlain by unconsolidated (Coastal Plain) sediments, is not subject to direct oceanic effect.

The *Piedmont Plateau* contains about 20,000 mi², or two-fifths of the land area of the State. It lies between the Coastal Plain on the east and the Appalachian Mountains on the west. Altitudes in the Piedmont range from about 500 ft above sea level along the Fall Line to about 1500 to 2000 ft. along its western border. The Piedmont consists of well-rounded hills and long-rolling ridges with a northeast-southwest trend. Parts of the Piedmont contain prominent hills referred to as mountains, including the Uwharrie Mountains in Montgomery and Randolph Counties, the South Mountains in Burke and Rutherford Counties, and the Brushy Mountains in Wilkes County.

The Appalachian Mountains are bounded on the east by the Blue Ridge Mountains and on the west by the Great Smoky and Unaka Mountains. The mountain slopes are gentle, presenting smooth rounded outlines. The mountain region of North Carolina contains the highest peak east of the Mississippi, Mt. Mitchell at 6,684 ft., 43 peaks above 6,000 ft. and 82 peaks between 5,000 and 6,000 ft. in altitude. The eastern Continental Divide follows the Blue Ridge Mountains so that most of the mountain area drains west to the Gulf of Mexico. The streams are well graded and cascades and waterfalls are only locally abundant.

Reference: Stuckey, Jasper L., 1965, North Carolina: its geology and mineral resources: North Carolina Department of Conservation and Development, 550 p.

# Rock Units and Aquifers in the Piedmont and Mountains




The rocks underlying the Piedmont and mountains can be divided into two groups: (1) bedrock, and (2) saprolite (or residuum). The saprolite underlies the land surface and ranges in thickness from a foot or two near bedrock outcrops to more than 100 ft. Bedrock underlies the saprolite and is the parent rock from which the saprolite was derived in the process referred to as weathering.

Many stream valleys, especially those of larger streams, are underlain by a layer of material similar in composition to saprolite. This material, which has been deposited by the streams during floods, is correctly referred to as *alluvium*. However, to avoid unnecessary complications, we will lump the alluvium in with the saprolite for the purpose of this discussion.

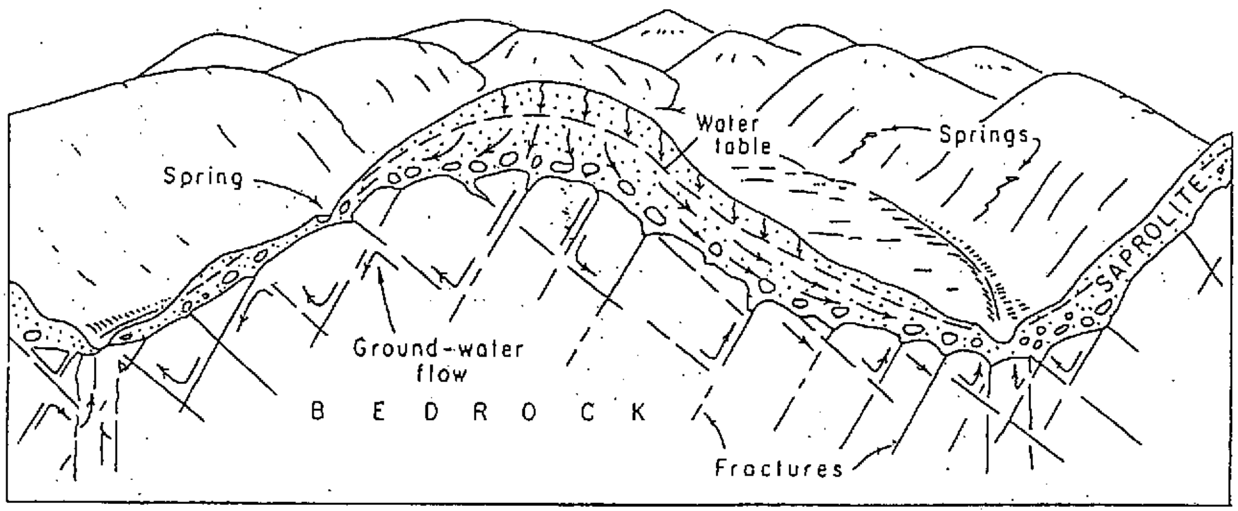
The bedrock underlying the Piedmont and mountains consists of many different types of igneous and metamorphosed igneous and sedimentary rocks. The Generalized Geological Map of North Carolina accompanying the discussion of WATER-BEARING ROCKS divides the bedrock in the Piedmont and mountains into six units. The 1:500,000 scale Geologic Map of North Carolina, published in 1958, divides the bedrock in the same area into 48 different units. But, a much larger number of units have been identified and are shown on large scale geologic maps.

The bedrock units differ from each other in mineral composition and other geologic characteristics. Fortunately, these differences do not result in large differences in hydraulic characteristics so that it is possible to combine the bedrock units into a relatively small number of hydrogeologic units.

The accompanying map shows the hydrogeologic units into which the bedrock in the Piedmont and mountains has been divided by the U.S. Geological Survey and the North Carolina Groundwater Section.

The most productive hydrogeologic units are the Great Smoky Mountain belt and the Blue Ridge-Inner Piedmont belt. The least productive units are the Carolina Slate Belt and the Triassic Basins. The Charlotte Belt is intermediate in productivity.

# Ground-Water Situation in the Piedmont and Mountains




The *saprolite* (weathered rock) that forms the land surface in the Piedmont and mountains consists of unconsolidated granular material. It thus contains water in the pore spaces between rock particles.

The *bedrock*, on the other hand, does not have any significant intergranular (primary) porosity. It contains water, instead, in sheet-like openings formed along fractures (that is, breaks in the otherwise "solid" rock). Fractures in bedrock are of two types: (1) *joints*, which are breaks along which there has been no differential movement; and (2) *faults*, which are breaks along which the adjacent rocks have undergone differential movement.

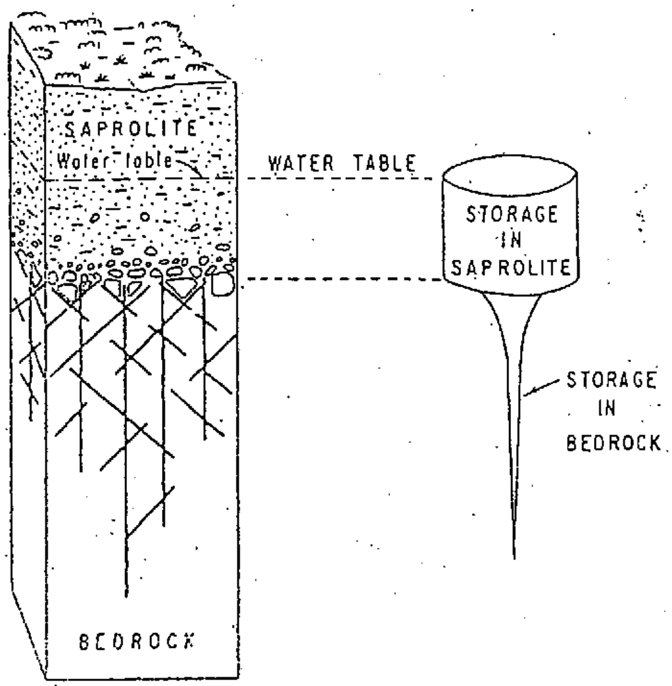
Faults are formed during earthquakes and generally contain larger and more extensive openings than those developed along joints. Joints, however, are far more numerous than faults.

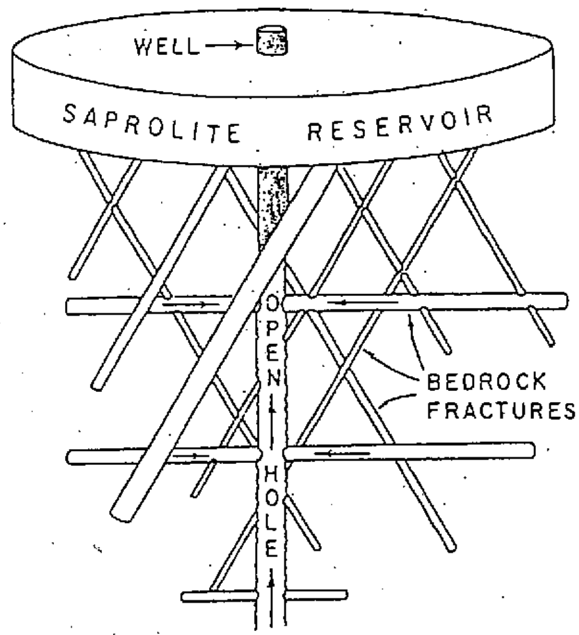
Fractures (joints and faults) are more abundant under valleys, draws, and other surface depressions than under hills. In fact, geologists assume that it is the presence of fractures that determined the position of valleys in the first place. Fractures tend to be more closely-spaced and the openings developed along them tend to be larger near the surface of the bedrock. Most fractures appear to be non water-bearing below a depth of 300 to 400 ft. Large water-bearing openings, penetrated below this depth are probably associated with faults.

The ground-water system in the Piedmont and mountains is recharged by precipitation on the interstream areas. A part of the precipitation infiltrates through the unsaturated zone to the water table, which normally occurs in the saprolite.

Ground water moves laterally and downward through the saprolite to points of ground-water seepage (springs) on the hillsides and to the streams in the adjacent valleys. Some of the water in the saprolite also moves downward into the bedrock and, thereafter, through the fractures to the adjacent valleys.

# Hydraulic Characteristics of the Piedmont and Mountain Ground-Water System




One of the most basic concepts of ground-water hydrology is that aquifers function both as reservoirs, in which water is in storage, and as pipelines, which transmit water from one point to another. This is referred to as the *reservoir-pipeline concept*. This concept forms a useful basis on which to discuss the hydraulic characteristics of the Piedmont and mountain ground-water system.

The reservoir (storage) function of aquifers depends on the porosity. The pipeline function depends on the hydraulic conductivity and the thickness of the aquifer. The approximate range in porosity and hydraulic conductivity for the saprolite and bedrock is shown in the following table.

| Rock type | Porosity in percent | Hydraulic conductivity in feet per day |
|---|---|---|
| Saprolite | 20-30 | 1-20 |
| Bedrock | 0.1-1 | 1-20 |

The above values suggest that the principal difference between saprolite and bedrock is in water-storage capacity. In other words, the saprolite has the capacity to store a much larger quantity of water than does the bedrock. This is not the entire story, however.

As we noted above, the capacity of an aquifer to transmit water depends both on hydraulic conductivity and on aquifer thickness. The part of the bedrock containing water-bearing fractures is several times thicker than the saprolite.

**REFERENCE 23**

# GEOLOGIC MAP OF THE CHARLOTTE 1° x 2° QUADRANGLE, NORTH CAROLINA AND SOUTH CAROLINA

By Richard Goldsmith, Daniel J. Milton and J. Wright Horton, Jr.

## INTRODUCTION

The Charlotte 1° x 2° quadrangle extends across four lithotectonic belts of the Piedmont from the Coastal Plain and Wadesboro Triassic basin on the east to the Blue Ridge belt in the vicinity of the Grandfather Mountain window on the west (see tectonic map). Because these belts differ in geologic character, the geology of each is described separately.

### WADESBORO BASIN

The southeast corner of the Charlotte quadrangle lies within the Wadesboro basin, which is filled with Upper Triassic continental sedimentary rocks: fanglomerates, conglomerates, arkosic sandstones, and siltstones. Beds dip gently toward a major normal fault on the southeast margin of the basin. Within the Charlotte quadrangle the northwest margin of the basin is marked by a series of minor faults bounding small sediment-filled troughs and grabens. A basal conglomerate at the updip northwest margin of the basin contains debris from a granite pluton cut by the southeast marginal fault. These relations indicate that faulting and tilting were at least in part postdepositional. Poorly consolidated sands of the Upper Cretaceous Middendorf (?) Formation (**Km**) form outliers of the Coastal Plain unconformably overlying Triassic strata (**Ŧss** and **Ŧcg**) in the Wadesboro basin. The Upper Triassic Davie County basin barely extends across the northern border into the quadrangle, between the Charlotte and Inner Piedmont belts.

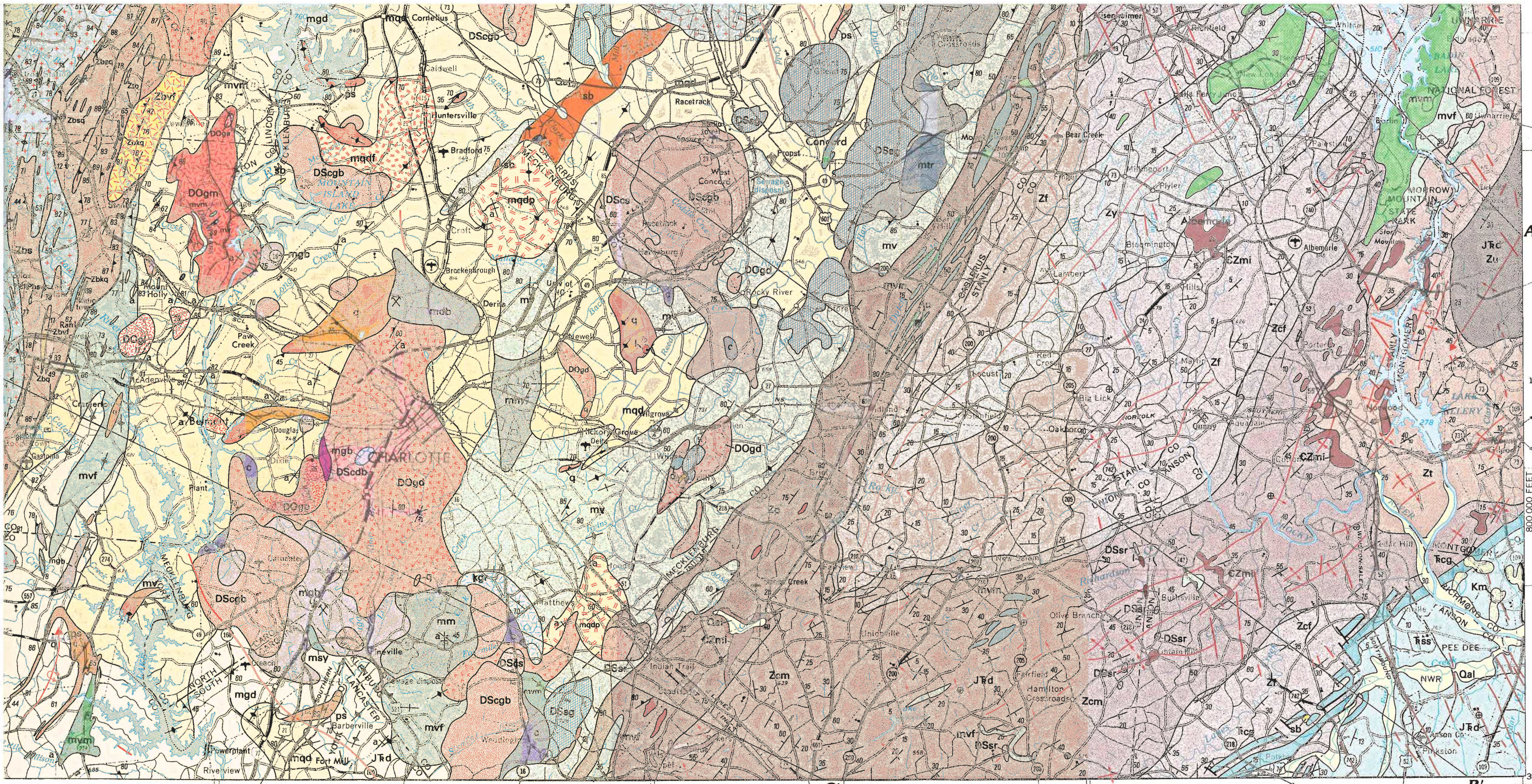
Diabase dikes (**JŦd**) of Triassic and Jurassic age, generally with north-northwesterly trends, occur throughout the quadrangle, but are particularly abundant in the Wadesboro basin and the nearby Carolina slate belt. Another swarm crosses the Charlotte and Kings Mountain belt between Charlotte, N.C., and Gaffney, S.C., and extends into the Inner Piedmont in Cleveland, Gaston, and Lincoln Counties. One of these dikes crosses the Brevard fault zone into the Blue Ridge.

### CAROLINA SLATE BELT

The Carolina slate belt consists of weakly metamorphosed sedimentary and volcanic rocks. The lowest stratigraphic unit, the Uwharrie Formation (**Zu**), of which only the upper part crops out near the eastern edge of the quadrangle, is composed primarily of rhyolitic volcanics. The overlying Albemarle Group is a mostly sedimentary sequence five or six kilometers thick (Stromquist and Sundelius, 1969; Milton, 1984). The grain sizes of this sequence show a general increase upward from the argillite of the Tillery Formation (**Zt**), at the base, through the mudstone and siltstone of the Cid Formation (**Zcm**), the siltstone of the Floyd Church Formation (**Zf**), to the graywacke sandstone of the Yadkin Formation (**Zy**) at the top. A quarter to a third of the volume of the Albemarle Group consists of metavolcanic rocks (**mvf, mvm**, and **mv**) which, together with the metavolcanics of the Uwharrie Formation, compose a chemically bimodal calc-alkaline suite, in which rocks of basaltic and rhyolitic compositions predominate over those of intermediate composition (Seiders, 1978). There are several volcanic centers in the Albemarle Group, at Flat Swamp (High Rock) Mountain west of Denton, tn the Mt. Morrow-Badin area, and elsewhere. These are thick piles of tuffs, agglomerates, and hypabyssal intrusives that extend distally into thinner and finer grained tuff beds. The Flat Swamp Member of the Cid Formation (**Zcf**), makes a conspicuous marker bed that can be traced for 150 km. The Carolina slate belt may have formed in an island-arc environment, in which slow deep-water deposition of sediments, largely of distant volcanic derivation (although there is evidence of some material of continental provenance; Milton and Reinhardt, 1980) was locally and intermittently interrupted by massive deposition of volcanic material from nearby volcanoes.

Recent finds (Gibson, 1984) in the Floyd Church Formation of *Pteridinium* (or a closely related form), a metazoan fossil diagnostic of the Ediacaran or Vendian fauna of latest Precambrian age, and reinterpretation as *Pteridinium* of fossils earlier identified as Cambrian *Paradoxides* (St. Jean, 1973) indicate a Late Proterozoic age for the Albemarle Group. This dating is supported by a U-Pb date of 586 ± 10 m.y. for zircon from the uppermost Uwharrie Formation (**Zu**) (Wright and Seiders, 1980).

Most of the rocks in the slate belt in the Charlotte quadrangle describe open folds about northeast-southwest-trending axes, forming two major anticlines, two major synclines, and many smaller folds. Beds dip gently to moderately, less commonly steeply, and are rarely overturned. Widely spaced axial plane cleavage is generally present. In contrast, a zone 3–5 km wide on the west edge of the slate belt (the "Gold Hill shear zone") consists largely of phyllite (**Zp**) with cleavage vertical or dipping steeply west-northwest. The phyllite, and tuffaceous interbeds within it, are probably strongly sheared and recrystallized beds of the Tillery or Cid Formations. Earlier detailed maps (Stromquist and others, 1971; Stromquist and Sundelius, 1975; Sundelius and Stromquist, 1978) portray the shear zone as bounded by the Silver Hill fault on the east and Gold Hill fault on the west. Some units (notably the Flat Swamp Member) are truncated abruptly along the Silver Hill line which indicates that it is indeed a fault. Nevertheless, the Denton anticline extends across the Silver Hill fault, and changes from a gently plunging fold on the east to a steeply plunging fold in the shear zone; thus, any major




81°00' ROCK HILL 7 MI. LANCASTER 22 MI. WAXHAW 6 MI. 45' MONROE 1 MI. C' 30' MARSHVILLE 1 MI. 2 200 000 FEET (S.C. NORTH) 15' WADESBORO 7 MI. B' 80°00'

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1986

Compiled in 1982

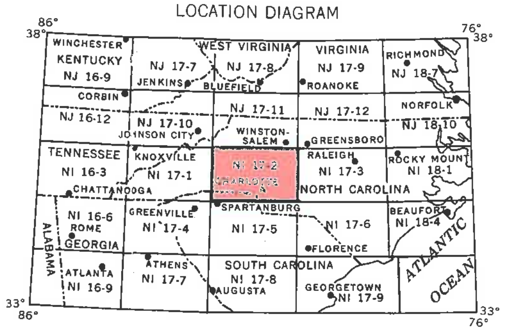
SCALE 1:250 000

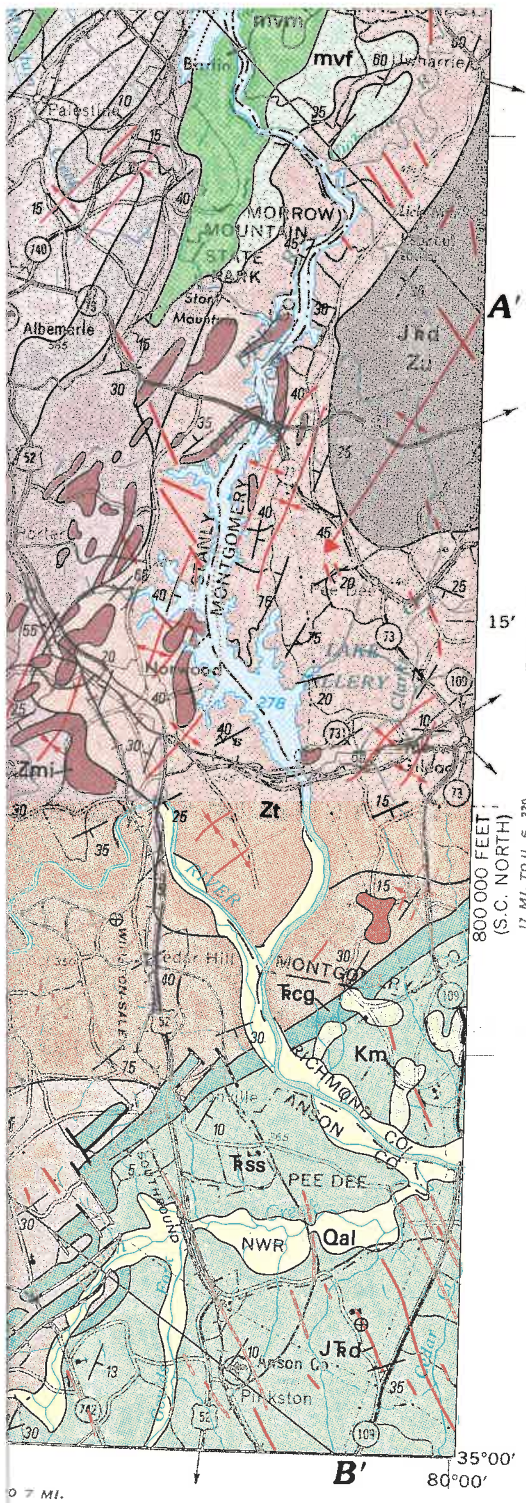
5 10 15 20 25 MILES

5 10 15 20 25 30 35 KILOMETERS

CONTOUR INTERVAL 100 FEET
WITH SUPPLEMENTARY CONTOURS AT 50 FOOT INTERVALS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

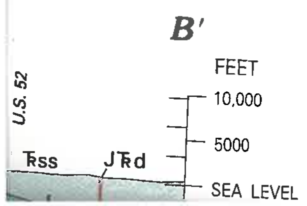
LOCATION DIAGRAM






INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1988

Compiled in 1982




Yec | Yebr | Yew (Yewm)

## DESCRIPTION OF MAP UNITS

Newly adopted stratigraphic names are indicated by an asterisk (*) and are explained at the end of this section

### Sedimentary and volcanic rocks and their metamorphosed equivalents

Qal — **Alluvium (Holocene)**—Gravel, sand and silt deposits on flood plains of major streams. Higher-level Quaternary or Tertiary deposits, mostly gravel with minor sand and silt, occur locally on terraces as high as 50 m above level of larger rivers, but have not been mapped

Km — **Middendorf(?) Formation (Late Cretaceous)**—White and tan, weakly consolidated sandstone and conglomerate of rounded quartz pebbles. Contains carbonized plant fragments

### WADESBORO AND DAVIE COUNTY BASINS

R̄ss — **Arkosic Sandstone and Siltstone (Late Triassic)**—Includes minor conglomerate and argillite. Commonly dark red

R̄cg — **Conglomerate and Fanglomerate (Late Triassic)**—Poorly sorted to moderately sorted, rounded to subrounded clasts, locally up to boulder size, derived from units occurring nearby, in a sandy matrix

### CAROLINA SLATE BELT AND CHARLOTTE BELT

Zy — **Yadkin Formation (Late Proterozoic)**—Graywacke, dark greenish-gray sandstone and minor siltstone, composed chiefly of quartz, plagioclase and lithic fragments in a chlorite- and sericite-rich matrix. Predominantly of volcanic provenance

Zf — **Floyd Church Formation (Late Proterozoic)**—Gray, commonly pink-weathering, siltstone and argillite; mainly in graded beds 20–60 cm thick. Contains minor tuff beds

**Cid Formation (Late Proterozoic)**

Zcf — Flat Swamp Member—Gray crystal and lithic tuffs, predominantly rhyolitic and rhyodacitic. Coarser phase west of Denton, N.C., may include ash-flow tuff and tuff breccia, but the bulk of the unit consists of water-lain deposits

Zcm — Mudstone Member—Gray, typically tan-weathering. Commonly in graded beds 10–40 cm thick consisting of a lower, ripple-marked, cross-bedded, stratified siltstone and an upper, laminated siltstone-mudstone unit. Contains minor tuff beds

Zt — **Tillery Formation (Late Proterozoic)**—Gray, or locally green, siltstone and mudstone laminated on a scale of millimeters. Hemipelagic sediments or deposits of low-velocity, low-density distal turbidity currents. Contains minor tuff beds

Zp — **Phyllite (Late Proterozoic)**—Fine-grained sericitic rock with pervasive cleavage and a silky luster. Probably equivalent to Tillery Formation (Zt) and Mudstone Member of Cid Formation (Zcm) but shearing and recrystallization have destroyed bedding features characteristic of these units

Zu — **Uwharrie Formation (Late Proterozoic)**—Felsic metavolcanic rocks, dominantly lavas and tuffs of rhyolitic composition

**Metavolcanic Rocks**—Metavolcanic units within the Albemarle Group formally are members of the enclosing formations, but patterns (except Zcf) on this map indicate lithology regardless of stratigraphic level

mvf — Felsic Metavolcanic Rocks—Fine- to medium-grained, locally coarse-grained or agglomeratic rhyolitic and rhyodacitic metatuffs. May include some hypabyssal intrusives. Contains minor intermediate and mafic metavolcanic rocks. Probably correlative, at least in part, with felsic metavolcanic rocks of the Battleground Formation (Zbvf)

mvm — Mafic and Intermediate Metavolcanic Rocks—Fine- to medium-grained, locally coarse-grained or agglomeratic rocks of basaltic, andesitic and dacitic composition. Mostly tuffs, but includes flows and perhaps hypabyssal intrusives. Metamorphosed to actinolite- and chlorite-rich rocks in the Carolina slate belt and to epidote amphibolite in Charlotte belt. Contains minor felsic metavolcanic rocks. Probably correlative, at least in part, with mafic to intermediate metavolcanic rocks of the Battleground Formation (Zbvm)

mv — Metavolcanic Rocks, undivided—Rocks of either felsic metavolcanic (mvf) and mafic and intermediate metavolcanic (mvm) type or commonly both interbedded. Those of Charlotte belt are probably correlative, at least in part, with felsic metavolcanic rocks (Zbvf) and mafic to intermediate metavolcanic rocks (Zbvm) of the Battleground Formation

ps — **Phyllite and schist**—Fine- to medium-grained rock composed mainly of muscovite and quartz, with or without minor feldspar, biotite, pyrite, sillimanite, or other minerals. Includes some quartzite. Possibly correlative, at least in part, with phyllite and schist of the Battleground Formation (Zbs)

**REFERENCE 24**

United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
North Carolina
Department of Natural
Resources and
Community Development,
North Carolina
Agricultural Research
Service, North Carolina
Agricultural Extension
Service, and Stanly
County Board of
Commissioners

# Soil Survey of Stanly County, North Carolina

# Contents



Issued September 1989

# Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses. Key physical and chemical properties are mentioned in the map units. Additional properties information is provided in tables 14, 15, 16, and 17.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Tatum channery silt loam is one phase in the Tatum series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils, or of one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Badin-Urban land complex, 2 to 8 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Urban land is an example. Miscellaneous areas are shown on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

**BaB—Badin channery silt loam, 2 to 8 percent slopes.** This soil is well drained. It is on narrow, undulating upland ridges that are highly dissected by intermittent drainageways. This soil is mainly on slate formations throughout the county. The areas are irregular in shape and are mostly 5 to 35 acres; however, some areas are as much as 100 acres.

Typically, this Badin soil has a brown channery silt loam surface layer 6 inches thick. The subsoil extends to a depth of 25 inches. The upper part is strong brown channery silty clay loam, the middle part is yellowish red silty clay, and the lower part is mottled red, yellowish red, and strong brown channery silty clay loam. Weathered bedrock extends to a depth of 40 inches and is highly fractured slate. Silt loam is in cracks and seams. Unweathered fractured slate is at a depth of 40 inches.

This soil will erode where areas are bare and unprotected. In these areas, surface runoff is medium, and susceptibility to erosion is severe. The flat slate channers on the surface provide a mulch effect, however, and help to hold water and reduce erosion. The permeability and shrink-swell potential of the subsoil are moderate. The available water capacity is low to moderate. Depth to bedrock is 20 to 40 inches.

Included with this soil in mapping are small areas of Enon, Goldston, Misenheimer, Kirksey, and Tatum soils. The Enon soils have a cobbly surface layer. The Goldston soils are in areas where the topography is most broken, typically on knolls and short side slopes. The Misenheimer and Kirksey soils are in depressions and along the intermittent drainageways. The Tatum soils have smoother, less variable slopes and are near the center of ridges. Also included are small eroded areas of Badin soils that have a channery silty clay loam surface layer. The included soils make up 15 to 30 percent of this map unit.

This Badin soil is used mainly for crops or pasture. The rest is used as woodland or for urban development.

The main crops are corn, soybeans, and small grains. Steepness of slope, the available water capacity, surface runoff, and the hazard of erosion are the main limitations for crop production. Conservation practices are needed to control erosion and runoff and to maintain soil tilth.

Where this soil is used for hay or pasture, proper management is needed, including maintaining a protective plant cover to control runoff and erosion.

Where this soil is used as woodland, the dominant trees are red oak, white oak, post oak, chestnut oak, yellow poplar, hickory, loblolly pine, shortleaf pine, and Virginia pine. The main understory plants are dogwood, sweetgum, blackgum, sourwood, American holly, cedar, black cherry, redbud, and red maple. There are no major limitations for woodland use and management.

Depth to bedrock, the clayey subsoil, the moderate shrink-swell potential, and low strength for roads and streets are the main limitations for building site development. Erosion is a hazard at construction sites, and conservation practices are needed. For most recreational uses, the main limitations are small stones on the surface and dustiness.

This Badin soil is in capability subclass IIIe. The woodland ordination symbol is 8A.

**BaD—Badin channery silt loam, 8 to 15 percent slopes.** This soil is well drained. It is on side slopes along intermittent drainageways on highly dissected, rolling uplands. This soil is mainly on slate formations throughout most of the county but is also on sandstone formations between Locust and New London. The overall surface contour of this soil is convex; however, slopes are complex and can change shape or length within short distances. The areas are irregular in shape and range from 4 to more than 50 acres.

Typically, this Badin soil has a brown channery silt loam surface layer 6 inches thick. The subsoil extends to a depth of 25 inches. The upper part is strong brown channery silty clay loam. The middle part is yellowish red silty clay. The lower part is mottled red, yellowish red, and strong brown channery silty clay loam. Weathered bedrock extends to a depth of 40 inches and is highly fractured slate. Silt loam is in cracks and seams. Unweathered fractured slate is at a depth of 40 inches.

This soil will erode where areas are bare and unprotected. In these areas, surface runoff is very rapid and susceptibility to erosion is very severe. Surface channers provide a mulch effect, however, and help to hold water and control erosion. The permeability and shrink-swell potential of the subsoil are moderate. The available water capacity is low to moderate. Depth to bedrock is 20 to 40 inches.

Included with this soil in mapping are some small areas of Goldston, Misenheimer, Kirksey, and Tatum soils. The Goldston soils are in areas where the topography is most broken, typically on knolls and short side slopes where ledges of bedrock are near the surface. The Misenheimer and Kirksey soils are along the intermittent drainageways. The Tatum soils have smoother, wider slopes. In places are a few small eroded areas of Badin soils that have a channery silty clay loam surface layer. The included soils make up 20 to 30 percent of this map unit.

Badin soil is used mainly as woodland. In some areas, it is used for crops, hay, or pasture.

In woodland areas, the dominant trees are red oak, white oak, post oak, chestnut oak, yellow poplar, hickory, loblolly pine, shortleaf pine, and Virginia pine The main understory plants are dogwood, sweetgum, blackgum, sourwood, American holly, cedar, black cherry, redbud, and red maple. The depth to fractured bedrock and the windthrow hazard are the main limitations for woodland use and management.

Corn, soybeans, small grains, and milo are the main crops. Steepness of slope, surface runoff, and the hazard of erosion are the main limitations for crop production. Conservation practices are needed to control erosion and runoff and to maintain soil tilth.

Where this soil is used for hay or pasture, proper management is needed, including maintaining a protective plant cover to control runoff and erosion.

The clayey subsoil, depth to bedrock, steepness of slope, and the moderate shrink-swell potential are the severely limit this soil for crop production. In areas where this soil is used for pasture or hay, steepness of slope, surface runoff, and the hazard of erosion are the main limitations. Proper management is needed to maintain a protective plant cover to control runoff and erosion.

This soil has severe limitations for most urban uses. Steepness of slope and low strength for road and streets are the main limitations for building sites and recreational uses. The moderate shrink-swell potential and the clayey texture of this soil are additional limitations. The hazard of erosion is very severe at construction sites, and conservation practices are needed.

This Tatum soil is in capability subclass VIe. The woodland ordination symbol is 8R.

**TbB—Tatum channery silt loam, 2 to 8 percent slopes.** This soil is well drained and is on gently sloping uplands. Most of the larger areas, in the vicinity of Plyler, are on broad, smooth ridges and range from 4 to more than 200 acres. Other areas, in the vicinity of Norwood, are on narrower, slightly more dissected ridges. These areas are irregular in shape and generally are less than 100 acres.

Typically, this Tatum soil has a brown channery silt loam surface layer 7 inches thick. The subsoil extends to a depth of 44 inches. The upper part is strong brown silty clay loam, and the middle part is red silty clay. The lower part is red channery silty clay loam that has yellow mottles. Weathered bedrock is at a depth of 44 to 60 inches. Hard sandstone bedrock is at a depth of 60 inches.

This soil will erode where areas are bare and unprotected; however, the channers on the surface provide a mulch effect that controls erosion. Surface runoff is medium. The permeability and shrink-swell potential of the subsoil are moderate. The available water capacity is moderate. Depth to soft bedrock is 40 to 60 inches.

Included with this soil in mapping are some small areas of Georgeville, Badin, and Kirksey soils. The Georgeville soils are on the broader, smoother parts of the landscape. The Badin soils are on narrow ridges and knolls. The Kirksey soils are along the intermittent drainageways and in small depressions. Also included are small areas of soils that have a cobbly surface layer, soils that do not have channers on the surface, and small eroded areas of soils that have a channery silty clay loam surface layer. In places are small areas of soils similar to the Tatum soil except they have a yellowish red or strong brown subsoil. The included soils make up 20 to 25 percent of this map unit.

Most of this Tatum soil is used as cropland. The rest is used mainly as woodland, although some is used for hay or pasture.

The main crops are corn, soybeans, grain sorghum, and small grains; however, tomatoes, cucumbers, cantaloupes, sweet corn, green beans, and peas are also grown. Steepness of slope, surface runoff, and the hazard of erosion are the main limitations for crop production. This soil is easy to keep in good tilth and can be worked throughout a fairly wide range in moisture content. A crust forms on the surface after hard rains, however, and clods form if the soil is worked when wet. The clods and channers interfere with seed germination. Conservation practices are needed to control erosion and runoff and to maintain soil tilth.

This soil is suitable for hay and pasture grasses. Proper management, including maintaining a protective plant cover to control erosion, is needed.

Where this soil is used as woodland, the dominant trees are loblolly pine, shortleaf pine, Virginia pine, sycamore, yellow poplar, hickory, white oak, red oak, and post oak. The main understory plants are dogwood, blackgum, sourwood, redbud, American holly, cedar, black cherry, red maple, and sassafras. There are no major limitations for woodland use and management.

The moderate permeability, clayey subsoil, and low strength for roads and streets are the main limitations for urban uses. Erosion is a hazard at construction sites, and conservation practices are needed. There are no significant limitations for recreational uses.

This Tatum soil is in capability subclass IIe. The woodland ordination symbol is 8A.

**TbD—Tatum channery silt loam, 8 to 15 percent slopes.** This soil is strongly sloping and well drained. It is on upland side slopes that are along intermittent drainageways. Most of the larger areas are in the vicinity of Plyler. Smaller areas are in the vicinity of Norwood. The areas generally are long, irregular in width, and 4 to more than 30 acres.

Typically, this Tatum soil has a brown channery silt loam surface layer 7 inches thick. The subsoil extends to a depth of 44 inches. The upper part is strong brown silty clay loam. The middle part is red silty clay. The lower part is red channery silty clay loam that has yellow mottles. Weathered bedrock is at a depth of 40 to 60 inches. Hard sandstone bedrock is at a depth of 60 inches.

This soil will erode where areas are bare and unprotected. Surface runoff is rapid. Permeability and the shrink-swell potential are moderate. The available

Georgeville, Badin, Hiwassee, and Kirksey soils. Georgeville soils are intermingled with the Tatum soil in broad, smooth areas. Badin soils are on knolls and narrow, more sloping parts of the landscape. Kirksey soils are in depressional areas where surface water collects. Hiwassee soils are in the towns of New London and Badin and in areas where the soil formed from mixed acid and basic rocks. Also included are small cut and fill areas where the natural soil has been altered or covered. These areas are commonly adjacent to Urban land.

Recommendations for use and management of the areas of this map unit generally require onsite investigation.

This map unit has not been assigned a capability subclass nor a woodland ordination symbol.

**Ud—Udorthents, loamy.** This map unit consists of areas where natural soils have been altered by earth-moving operations. The remaining soil has a loamy surface layer and is variable in composition, depth, slope, and ability to grow plants. Borrow pits, leveled land, sanitary landfills, and gold mines make up this map unit. Small patches of undisturbed natural soils are in many places. The areas are 4 to more than 50 acres.

Borrow pits are areas where all the original soil and much of the underlying layers have been removed for use as fill material or construction aggregate. Cuts are 3 to 25 feet deep. These areas are low in natural fertility and have poor physical properties to support plant growth. The surface generally is uneven and many areas are shallow to bedrock. Steep side slopes are on one or more sides of most of these areas.

Most areas are naturally reseeded in wild grasses, weeds, shortleaf pine, and Virginia pine. Plant growth generally is poor quality, and major reclamation is necessary to prepare these areas for economic production of plants or development for most other purposes.

Leveled land is where the soil has been altered by grading to achieve a particular land conformation. In cut areas, more than two feet of soil has been removed, and in fill areas, more than two feet of fill has been placed over the natural soil. Most of these areas are in school yards with athletic fields, major highway interchanges, or industrial sites. Several areas are used for agricultural purposes. Most of these areas are reclaimed and seeded to grass or are used for crop production. Buildings and pavement cover up to 15 percent of some areas.

Landfills are areas where the natural soil has been altered by land fill operations. The excavated trenches are filled with alternate layers of solid refuse and soil material. A final cover of about 2 feet of soil is on the surface. After final cover is added, the surface ranges from nearly level to gently sloping. These areas are designated as landfill on the soil map.

Gold mines are areas where surface and subsurface digging has occurred. Shafts can be several feet deep. Very little of the original soil is left undisturbed and most areas have highly irregular surfaces. Abandoned mining areas may have partly stabilized under pine, cedar, and other vegetation. Active mining areas are bare and subject to accelerated erosion.

Included in mapping is a small acreage of undisturbed soil. This soil is suited to plant growth; however, natural fertility and the available water capacity generally are low. Permanent vegetative cover protects these areas from erosion.

The characteristics of the soil material within the mapped areas vary to such a degree that onsite examination of the individual areas is needed to determine use and management.

This map unit has not been assigned a capability subclass nor a woodland ordination symbol.

**Ur—Urban land.** This map unit consists of areas where more than 85 percent of the land is covered by streets, buildings, parking lots, and railroad yards. The soils around these facilities are used for parks, lawns, playgrounds, and drainageways. During urbanization, the natural soils have been greatly altered by cutting, filling, grading, and shaping. The original topography, landscape, and drainage pattern have been changed. Slopes generally are 0 to 10 percent.

Most of the acreage of this map unit is in the business districts of Albemarle, Norwood, and Badin.

The major concern in management is the excessive runoff from roofs, roads, and parking lots, which increases the hazard of flooding in low-lying areas. Waterways are subject to siltation from areas that are graded and not immediately stabilized.

The characteristics of the soil material within the mapped areas vary to such a degree that onsite examination of the individual areas is needed to determine use and management.

This map unit has not been assigned a capability subclass nor a woodland ordination symbol.

**UwC—Uwharrie stony loam, 4 to 15 percent slopes, very bouldery.** This soil is gently sloping to strongly sloping and is well drained. It is on high, prominent rolling hills. Some of the larger areas are in the vicinity of New London. To a moderate extent, the main limitations for building site development. Erosion is a hazard at construction sites, and conservation practices are needed. Steepness of slope, small stones on the surface, and dustiness are the main limitations for most recreational uses.

This Badin soil is in capability subclass IVe. The woodland ordination symbol is 8A.

**BaF—Badin channery silt loam, 15 to 45 percent slopes.** This soil is well drained and is hilly to steep. It is on upland side slopes adjacent to major drainageways. This soil is mainly on slate formations throughout most of the county but is also on sandstone formations between Locust and New London. Upper slopes are convex, and lower slopes are concave. The areas are broken by many intermediate drainageways; they are elongated, and most range from 3 to 35 acres.

Typically, this Badin soil has a brown channery silt loam surface layer 6 inches thick. The subsoil extends to a depth of 25 inches. The upper part is strong brown channery silty clay loam. The middle part is yellowish red silty clay. The lower part is mottled red, yellowish red, and strong brown channery silty clay loam. Weathered bedrock extends to a depth of 40 inches and is highly fractured slate. Silt loam is in cracks and seams. Unweathered fractured slate is at a depth of 40 inches.

This soil will erode where areas are bare and unprotected. In these areas, surface runoff is very rapid and susceptibility to erosion is very severe. The permeability and shrink-swell potential of the subsoil are moderate. The available water capacity is low to moderate. Depth to bedrock is 20 to 40 inches.

Included with this soil in mapping are some small areas of Enon, Goldston, Misenheimer, Kirksey, and Tatum soils. The Enon soils are intermingled in areas that are underlain by less acid rock that generally runs from northeast to southwest. The Goldston soils are in areas where the topography is most broken, especially on knolls and short side slopes where ledges of bedrock are near the surface. The Misenheimer and Kirksey soils are along intermittent drainageways. The Tatum soils have smoother, longer slopes and are adjacent to ridges of Badin soils. In places are a few small eroded areas of Badin soils that have a channery silty clay loam surface layer. Bedrock outcrops are in some areas, especially where the landscape breaks sharply. The included soils make up 15 to 25 percent of this map unit.

Most of this Badin soil is used as woodland. The rest is used mainly for pasture or hay.

In woodland areas, the dominant trees are red oak, white oak, post oak, chestnut oak, yellow poplar, hickory, loblolly pine, shortleaf pine, and Virginia pine. The main understory plants are dogwood, sweetgum, blackgum, sourwood, holly, cedar, black cherry, and red maple. Steepness of slope, depth to bedrock, and the windthrow hazard are the main limitations for woodland use and management.

Where this soil is used for pasture and hay, steepness of slope, surface runoff, and the hazard of erosion are the main limitations. Proper management includes maintaining a protective plant cover to control runoff and erosion.

Steepness of slope and depth to bedrock are severe limitations for building site development and recreational uses. Additional limitations are the moderate shrink-swell potential and the clayey texture of the subsoil. The hazard of erosion is very severe at construction sites.

This Badin soil is in capability subclass VIIe. The woodland ordination symbol is 8R.

**BbB—Badin-Urban land complex, 2 to 8 percent slopes.** This map unit consists of intermingled areas of Badin soil and Urban land mainly in the vicinity of Albemarle. Badin soil is well drained and undulating. An area typically consists of about 50 to 70 percent Badin soil and 15 to 35 percent Urban land.

Typically, this Badin soil has a brown channery silt loam surface layer 6 inches thick. The subsoil extends to a depth of 25 inches. The upper part is strong brown channery silty clay loam. The middle part is yellowish red silty clay. The lower part is mottled red, yellowish red, and strong brown channery silty clay loam. Weathered bedrock extends to a depth of 40 inches and is highly fractured slate. Silt loam is in cracks and seams. Unweathered fractured slate is at at a depth of 40 inches.

This soil will erode where areas are bare and unprotected. In these areas, surface runoff is rapid and the susceptibility to erosion is severe. The permeability and shrink-swell potential of the subsoil are moderate. The available water capacity is low to moderate. Depth to bedrock is 20 to 40 inches.

Urban land consists of areas that are covered with buildings, streets, parking lots, and driveways.

Included in mapping are small areas of Kirksey, Goldston, Misenheimer, and Tatum soils. The Goldston soils are in areas where the topography is most broken, typically on knolls and short side slopes. The Misenheimer and Kirksey soils are in depressional areas and around intermittent drainageways. The Tatum soils have smoother slopes and are near the center of

In woodland areas, the dominant trees are white oak, post oak, blackjack oak, chestnut oak, red oak, hickory, shortleaf pine, and Virginia pine. The main understory plants are cedar, redbud, blackgum, sweetgum, and red maple. Moderately steep slopes and stones are the main limitations for woodland use and management.

Stones, slow permeability, high shrink-swell potential, low strength for roads and streets, the clayey subsoil, and steepness of slope are the major limitations for building site development and recreational uses.

This Enon soil is in capability subclass VIIs. The woodland ordination symbol is 7R.

**GeB—Georgeville silt loam, 2 to 8 percent slopes.** This soil is well drained and gently sloping. It is on broad, smooth upland ridges that are dissected by intermittent drainageways. The underlying bedrock strata are mostly siltstone and sandstone. The larger areas of this soil are in the vicinity of Millingport and Bloomington. The areas are irregular in shape and range from 4 to more than 200 acres.

Typically, this Georgeville soil has a strong brown silt loam surface layer 8 inches thick. The subsoil extends to a depth of 59 inches. It is red silty clay in the upper and middle parts and silty clay loam in the lower part. The underlying material to a depth of 80 inches is weak red and yellowish brown saprolite that crushes to silt loam.

This soil will erode where areas are bare and unprotected. Surface runoff is medium. The surface layer is subject to crusting after hard rains, and clods form if this soil is worked when wet. The permeability of the subsoil is moderate, and the shrink-swell potential is low. The available water capacity is moderate. Depth to bedrock is more than 60 inches.

Included with this soil in mapping are small areas of Tatum, Badin, and Kirksey soils. The Tatum and Badin soils have moderate shrink-swell potential. They are on narrow ridgetops and knolls and have slopes that are slightly more than 8 percent. Kirksey soils are moderately well drained. They are along intermittent drainageways and in small depressions. Also included are some areas of eroded soils that have a silty clay loam surface layer. In places are small areas of similar soils that have a yellowish red or strong brown subsoil. The included soils make up 15 to 20 percent of this map unit.

Most of this Georgeville soil is used as cropland. The rest is used mainly as woodland, although some areas are used for hay or pasture.

The main crops are corn, soybeans, milo, and small grains; however, horticultural crops, such as tomatoes, cucumbers, sweet corn, and green beans, are also grown. Steepness of slope, surface runoff, and the hazard of erosion are the main limitations. Conservation practices are needed to control erosion and improve the content of organic matter.

Where this soil is used for hay or pasture, proper management is needed to maintain a protective plant cover to control runoff and erosion.

In woodland areas, the dominant trees are loblolly pine, shortleaf pine, Virginia pine, yellow poplar, hickory, white oak, red oak, and post oak. The main understory plants are dogwood, sourwood, American holly, cedar, black cherry, red maple, and sassafras. There are no major limitations for woodland use and management.

This soil has no major limitations for building site development and recreational uses. However, the clayey subsoil, moderate permeability, and steepness of slope are limitations that affect some uses. Erosion is a hazard on construction sites, and conservation practices are needed.

This Georgeville soil is in capability subclass IIe. The woodland ordination symbol is 8A.

**GfB2—Georgeville silty clay loam, 2 to 8 percent slopes, eroded.** This soil is well drained and gently sloping. It is on broad, smooth upland ridges that are dissected by intermittent drainageways. The underlying bedrock strata are mostly siltstone and sandstone. The larger areas of this soil are around Norwood. The areas are irregular in shape and range from 4 to more than 80 acres

Typically, this Georgeville soil has a red silty clay loam surface layer 6 inches thick. The subsoil to a depth of 60 inches is red silty clay. The underlying material to a depth of 72 inches is light reddish brown saprolite that crushes to silt loam.

This soil will continue to erode where areas are bare and unprotected. Where this soil is cultivated, a crust will form after hard rains and will limit infiltration. Clods form if the soil is worked when wet. Surface runoff is rapid, and the susceptibility to additional erosion is severe. The permeability of the subsoil is moderate, and the shrink-swell potential is low. The available water capacity is moderate. Depth to bedrock is more than 60 inches.

Included with this soil in mapping are small areas of Badin, Kirksey, and Tatum soils. Badin and Tatum soils have moderate shrink-swell potential. They are on narrow ridgetops and knolls and slopes are slightly pasture because of steepness of slope, droughtiness, and the very slaty surface layer.

Shallow depth to bedrock, steepness of slope, and the large volume of slate fragments are major limitations for building site development and recreational uses.

This Goldston soil is in capability subclass VIIs. The woodland ordination symbol is 7D.

**HeB—Hiwassee gravelly loam, 2 to 8 percent slopes.** This soil is well drained and gently sloping. It is on broad uplands, mainly in the northeastern corner of the county in the vicinity of Isenhour. The larger areas of this soil commonly are oblong and irregular in width and range up to 275 acres. The smaller areas of less than 15 acres are mostly on ridge points and knolls.

Typically, this Hiwassee soil has a dark reddish brown gravelly loam surface layer 6 inches thick. The subsoil extends to a depth of 70 inches. It is dark red clay in the upper part. In the middle part, it is red clay loam that has reddish yellow mottles. In the lower part, it is red loam that has reddish yellow mottles.

The surface layer is 15 to 35 percent gravel, by volume. This soil will erode where areas are bare and unprotected; however, the gravel provides a mulching effect that controls erosion. Surface runoff is medium. The clayey subsoil is moderately permeable and has moderate shrink-swell potential. The available water capacity is moderate. Depth to bedrock is more than 60 inches.

Included in mapping are small areas of Enon, Georgeville, Kirksey, Tatum, and Uwharrie soils. Enon soils are more yellow and less acid. They are in areas that are underlain by less acid rock and commonly are cobbly. Georgeville and Tatum soils do not have a dark red subsoil. Tatum soils have bedrock at a depth of 40 to 60 inches and are in the smaller areas where the ridges are narrow. Kirksey soils are moderately well drained. They are at the head of and along the intermittent drainageways. The Uwharrie soils are in small areas where many stones are on the surface. Also included are some small eroded areas of soils that have a gravelly clay loam surface layer and some areas that are stony. The included soils make up 20 to 30 percent of this map unit.

This Hiwassee soil is used mainly as woodland. The rest is used for crops or pasture.

In woodland areas, the dominant trees are loblolly pine, shortleaf pine, Virginia pine, yellow poplar, hickory, white oak, red oak, and post oak. The main understory plants are dogwood, sourwood, American holly, cedar, black cherry, red maple, and sassafras. There are no major limitations for woodland use and management.

In cultivated areas, corn, soybeans, grain sorghum, and small grains are the main crops. The gravelly surface layer, surface runoff, and hazard of erosion are the main limitations for crop production. Conservation practices are needed to control erosion and surface runoff and to improve the content of organic matter. Limitations for crops also apply to hay and pasture plants.

This soil has no major limitations for building site development and recreational uses. However, the clayey subsoil, moderate permeability, and steepness of slope are limitations that affect some uses. Erosion is a hazard at construction sites, and conservation practices are needed.

This Hiwassee soil is in capability subclass IIe. The woodland ordination symbol is 7A.

**HeD—Hiwassee gravelly loam, 8 to 15 percent slopes.** This soil is well drained and strongly sloping. It is mainly in the northeastern corner of the county in the vicinity of Isenhour, commonly on side slopes adjacent to Hiwassee soil that is gently sloping. Most areas are oblong and range from 10 to more than 50 acres.

Typically, this Hiwassee soil has a dark reddish brown gravelly loam surface layer 6 inches thick. The subsoil extends to a depth of 70 inches. It is dark red clay in the upper part. In the middle part it is red clay loam that has reddish yellow mottles. In the lower part it is red loam that has reddish yellow mottles.

This soil will erode where areas are bare and unprotected. The surface layer is 15 to 35 percent gravel, which provides a mulch effect and reduces the hazard of erosion. Surface runoff is rapid. The clayey subsoil is moderately permeable, and the shrink-swell potential is moderate. The available water capacity is moderate. Depth to bedrock is more than 60 inches.

Included with this soil in mapping are small areas of Enon, Kirksey, and Tatum soils. Enon soils are more yellow and less acid. They are in areas that are underlain by less acid rock and commonly are cobbly. Kirksey soils are moderately well drained. They are along the drainageways. Tatum soils have a channery surface layer and do not have a dark red subsoil. Also included are some small areas of eroded soils that have a gravelly clay loam surface layer and some areas that are stony. The included soils make up 20 to 30 percent of this map unit.

This Hiwassee soil is used mainly as woodland or summer droughtiness are the main limitations for woodland use and management.

Seasonal wetness, the very low available water capacity, and shallow depth to bedrock severely limit the use of this soil for crop production. Some areas can be cropped successfully, however, with a well planned system of soil and water conservation practices.

This soil is suited to hay and pasture plants. Proper pasture management includes controlled grazing and fertilization according to the needs of the soil.

Shallow depth to bedrock, wetness, and slate fragments are major limitations to the use of this soil for building site development and recreational uses.

This Misenheimer soil is in capability subclass IIIw. The woodland ordination symbol is 6D.

**Oa—Oakboro silt loam, frequently flooded.** This soil is nearly level and moderately well drained. It is on long, narrow flood plains typically at the upper headwaters of creeks; however, it is also at the lower reaches of some larger streams where flood plains are narrow and valley walls are steep. The streams commonly flow over bedrock. The areas are long, narrow, and generally less than 300 feet wide and range from 4 to 100 acres or more.

Typically, this Oakboro soil has a yellowish brown silt loam surface layer 4 inches thick. The subsurface layer to a depth of 10 inches is light yellowish brown silt loam. The subsoil extends to a depth of 46 inches. The upper part is brownish yellow silty clay loam that has light yellowish brown mottles. The lower part is mottled brownish yellow, light gray, and light yellowish brown silty clay loam. Hard fractured slate is at a depth of 46 inches.

The permeability is moderate, and the available water capacity is high. Depth to the seasonal high water table is about 1.5 to 2 feet late in winter and early in spring. This soil is subject to frequent flooding for brief periods. Bedrock is at a depth of 40 to 60 inches.

Included in mapping are small areas of well drained Congaree soils that are on the natural levees adjacent to the stream channels. Also included are some small areas of soils that have a gravelly or cobbly surface. In some areas the slate rock is within 20 to 40 inches of the surface and small wet areas are in depressions. Areas of urban land within the city limits of Albemarle are also included. The included soils make up about 20 percent of the map unit.

This soil is mostly in unmanaged hardwood forests. In cleared areas, small acreages are used for crops, such as corn (fig. 10) and soybeans, and for hay or pasture.

In woodland areas, the dominant trees are loblolly pine, yellow poplar, sweetgum, and willow oak. The main understory plants are cottonwood, hornbeam, alder, and red maple. Wetness is the main limitation for woodland use and management.

Wetness and frequent flooding are the main concerns in pasture management. Drainage systems are needed for crops sensitive to wetness, but suitable outlets are not available in most places.

This soil is not used for building sites and recreational uses because of wetness and flooding.

This Oakboro soil is in capability subclass IVw. The woodland ordination symbol is 8A.

**Qu—Quarries.** This map unit consists of areas where the soil has been removed and part of the underlying bedrock has been excavated. Most of the quarrying is for gravel or crushed stone that is used in road building or other paving. In some areas, fine-grained shale-like rock has been quarried for use in the manufacturing of bricks. Most areas are 4 to 25 acres or more.

These quarries are 10 to more than 100 feet deep and side slopes are mostly steep to vertical. Water is at the deepest levels where quarrying is no longer active. These water areas are identified on the maps at the back of this publication.

Included in mapping are areas of spoil embankment and areas that have been graded or filled to facilitate the quarrying operations. Small areas of undisturbed soils can be in a few places.

These areas have little vegetation and low potential for reclamation and development of any kind.

Recommendation for use and management of areas in this map unit require onsite investigation.

**TaF—Tatum gravelly loam, 15 to 35 percent slopes.** This soil is well drained. It is on steep side slopes adjacent to streams mainly in the northeastern corner of the county in the vicinity of Isenhour. The slopes are smooth, slightly convex, long, and variable in width. The areas range from 5 to 60 acres or more.

Typically, this Tatum soil has a brown gravelly loam surface layer 3 inches thick. The subsurface layer to a depth of 6 inches is light yellowish brown silt loam. The subsoil extends to a depth of 42 inches. It is yellowish red silty clay loam in the upper part, red silty clay in the middle part, and red silty clay loam in the lower part. Weathered bedrock is at a depth of 42 to 60 inches. Hard sandstone bedrock is at a depth of 60 inches.

This soil will erode where areas are bare and unprotected. Surface runoff is very rapid, and the susceptibility to erosion is very severe. Permeability and


This soil survey map was compiled by the U.S. Department of Agriculture, Soil Conservation Service, and cooperating agencies. Base maps are from 1976–1977 aerial photography. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

**REFERENCE 25**

# Albemarle

2014



## 1. System Information

### Contact Information

Water System Name: Albemarle
Mailing Address: PO Box 190
Albemarle, NC 28002-0190

PWSID: 01-84-010
Ownership: Municipality

**Complete**

Contact Person: Michael L. Leonas
Phone: 704-984-9608

Title: Director - Public Utilities
Fax: 704-984-9606

### Distribution System

| Line Type | Size Range (Inches) | Estimated % of lines |
|---|---|---|
| Asbestos Cement | 6-16 | 3.00 % |
| Cast Iron | 6-24 | 30.00 % |
| Ductile Iron | 4-30 | 62.00 % |
| Galvanized Iron | 2 | 1.00 % |
| Other | 20-24 | 2.00 % |
| Polyvinyl Chloride | 2-8 | 2.00 % |

What are the estimated total miles of distribution system lines? 157 Miles
How many feet of distribution lines were replaced during 2014? 1,500 Feet
How many feet of new water mains were added during 2014? 0 Feet
How many meters were replaced in 2014? 50
How old are the oldest meters in this system? 40 Year(s)
How many meters for outdoor water use, such as irrigation, are not billed for sewer services? 675
What is this system's finished water storage capacity? 10.400 Million Gallons
Has water pressure been inadequate in any part of the system since last update? No

### Programs

Does this system have a program to work or flush hydrants? Yes, Monthly
Does this system have a valve exercise program? No, Semi-Annually
Does this system have a cross-connection program? Yes
Does this system have a program to replace meters? Yes
Does this system have a plumbing retrofit program? No
Does this system have an active water conservation public education program? Yes
Does this system have a leak detection program? No

### Water Conservation

What type of rate structure is used? Decreasing Block
How much reclaimed water does this system use? 0.000 MGD For how many connections? 0
Does this system have an interconnection with another system capable of providing water in an emergency? No

Albemarle has two (2) water treatment plants. Each plant is capable of providing water to the service area. Each plant has the treatment capacity to meet the needs of the service area in the unlikely event of an one of the treatment plants being disabled.

## 2. Water Use Information

### Service Area

| Sub-Basin(s) | % of Service Population | County(s) | % of Service Population |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Yadkin River (18-1) | 100 % | Stanly | 100 % |

What was the year-round population served in 2014? 16,000

Has this system acquired another system since last report? No

**Water Use by Type**

| Type of Use | Metered Connections | Metered Average Use (MGD) | Non-Metered Connections | Non-Metered Estimated Use (MGD) |
|---|---|---|---|---|
| Residential | 6,224 | 0.843 | 0 | 0.000 |
| Commercial | 1,012 | 0.928 | 0 | 0.000 |
| Industrial | 15 | 1.281 | 0 | 0.000 |
| Institutional | 25 | 0.052 | 0 | 0.000 |

How much water was used for system processes (backwash, line cleaning, flushing, etc.)? 0.030 MGD

System processes water use is estimated at 330,000 gpd.

**Water Sales**

| Purchaser | PWSID | Average Daily Sold (MGD) | Days Used | Contract MGD | Contract Expiration | Recurring | Required to comply with water use restrictions? | Pipe Size(s) (Inches) | Use Type |
|---|---|---|---|---|---|---|---|---|---|
| Pfeiffer-North Stanly Water | 01-84-025 | 0.495 | 365 | 0.750 | 2044 | Yes | Yes | 12 | Regular |
| Stanly County | 01-84-035 | 1.433 | 365 | 3.000 | 2016 | Yes | Yes | 12 | Regular |

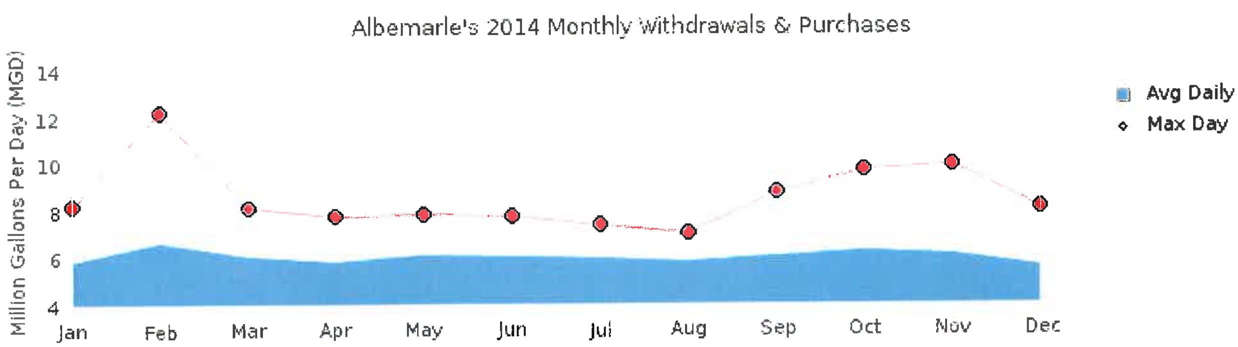
Oakboro System acquired by Stanly County in 2014.

## 3. Water Supply Sources

**Monthly Withdrawals & Purchases**

| | Average Daily Use (MGD) | Max Day Use (MGD) | | Average Daily Use (MGD) | Max Day Use (MGD) | | Average Daily Use (MGD) | Max Day Use (MGD) |
|---|---|---|---|---|---|---|---|---|
| Jan | 5.810 | 8.160 | May | 6.040 | 7.790 | Sep | 6.010 | 8.800 |
| Feb | 6.590 | 12.170 | Jun | 5.980 | 7.720 | Oct | 6.240 | 9.700 |
| Mar | 5.980 | 8.100 | Jul | 5.960 | 7.410 | Nov | 6.090 | 9.960 |
| Apr | 5.790 | 7.760 | Aug | 5.810 | 7.010 | Dec | 5.540 | 8.090 |

The number days usage of each surface water source was changed to 365 to produce an average daily withdrawal that matched the average daily use submitted in the monthly table.




**Surface Water Sources**

| Stream | Reservoir | Average Daily Withdrawal MGD | Average Daily Withdrawal Days Used | Maximum Day Withdrawal (MGD) | Available Raw Water Supply MGD | Available Raw Water Supply * Qualifier | Usable On-Stream Raw Water Supply Storage (MG) |
|---|---|---|---|---|---|---|---|
| Yadkin River | Tuckertown | 2.840 | 365 | 4.800 | 9.000 | C | 0.000 |
| Yadkin River at Narrows | Narrows (Badin Lake) | 3.150 | 365 | 8.250 | 9.000 | C | 0.000 |

* Qualifier: C=Contract Amount, SY20=20-year Safe Yield, SY50=50-year Safe Yield, F=20% of 7Q10 or other instream flow requirement, CUA=Capacity Use Area Permit

### Surface Water Sources (continued)

| Stream | Reservoir | Drainage Area (sq mi) | Metered? | Sub-Basin | County | Year Offline | Use Type |
|---|---|---|---|---|---|---|---|
| Yadkin River | Tuckertown | 4,080 | Yes | Yadkin River (18-1) | Stanly | | Regular |
| Yadkin River at Narrows | Narrows (Badin Lake) | 4,180 | Yes | Yadkin River (18-1) | Stanly | | Regular |

What is this system's off-stream raw water supply storage capacity? 55 Million gallons

Are surface water sources monitored? Yes, Daily

Are you required to maintain minimum flows downstream of its intake or dam? No

Does this system anticipate transferring surface water between river basins? No

The number days usage of each surface water source was changed to 365 to produce an average daily withdrawal that matched the average daily use submitted in the monthly table.

### Water Treatment Plants

| Plant Name | Permitted Capacity (MGD) | Is Raw Water Metered? | Is Finished Water Ouput Metered? | Source |
|---|---|---|---|---|
| Tuckertown Water Treatment Plt | 6.500 | Yes | Yes | Yadkin River - Tuckertown Reservoir |
| US 52 HWY Water Treatment Plan | 10.000 | No | No | Yadkin River - Narrows Reservoir (Badin Lake) |

Did average daily water production exceed 80% of approved plant capacity for five consecutive days during 2014? No

If yes, was any water conservation implemented?

Did average daily water production exceed 90% of approved plant capacity for five consecutive days during 2014? No

If yes, was any water conservation implemented?

Are peak day demands expected to exceed the water treatment plant capacity in the next 10 years? No

## 4. Wastewater Information

### Monthly Discharges

| | Average Daily Discharge (MGD) | | Average Daily Discharge (MGD) | | Average Daily Discharge (MGD) |
|---|---|---|---|---|---|
| Jan | 7.580 | May | 5.470 | Sep | 4.730 |
| Feb | 8.700 | Jun | 4.260 | Oct | 4.010 |
| Mar | 8.830 | Jul | 4.490 | Nov | 4.940 |
| Apr | 9.080 | Aug | 4.930 | Dec | 5.790 |

How many sewer connections does this system have? 6,616

How many water service connections with septic systems does this system have? 618

Are there plans to build or expand wastewater treatment facilities in the next 10 years? No

### Wastewater Permits

| Permit Number | Permitted Capacity (MGD) | Design Capacity (MGD) | Average Annual Daily Discharge (MGD) | Maximum Day Discharge (MGD) | Receiving Stream | Receiving Basin |
|---|---|---|---|---|---|---|
| NC0024244 | 12.000 | 12.000 | 6.070 | 17.300 | Long Creek | Rocky River (18-4) |
| NC0044024 | 0.000 | 0.000 | 0.000 | | Little Long Creek | Rocky River (18-4) |
| NC0075701 | 0.000 | 0.000 | 0.105 | | Tuckertown Reservoir | Yadkin River (18-1) |

### Wastewater Interconnections

| Water System | PWSID | Type | Average Daily Amount | | Contract Maximum (MGD) |
|---|---|---|---|---|---|
| | | | MGD | Days Used | |
| New London | 01-84-025 | Receiving | 0.133 | 365 | 0.000 |
| Stanly County | 01-84-035 | Receiving | 0.153 | 365 | 0.329 |

## 5. Planning

**Projections**

| | 2014 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|
| Year-Round Population | 16,000 | 17,000 | 19,000 | 21,000 | 23,000 | 25,000 |
| Seasonal Population | 0 | 0 | 0 | 0 | 0 | 0 |
| Residential | 0.843 | 0.900 | 1.000 | 1.100 | 1.200 | 1.400 |
| Commercial | 0.928 | 0.990 | 1.100 | 1.200 | 1.400 | 1.500 |
| Industrial | 1.281 | 1.360 | 1.500 | 1.700 | 1.900 | 2.100 |
| Institutional | 0.052 | 0.060 | 0.070 | 0.080 | 0.090 | 0.100 |
| System Process | 0.030 | 0.360 | 0.390 | 0.430 | 0.470 | 0.510 |
| Unaccounted-for | 0.928 | 1.087 | 1.202 | 1.335 | 1.498 | 1.661 |

Projected unaccounted for water values were adjusted based on system calculated values to more realistically represent future conditions.

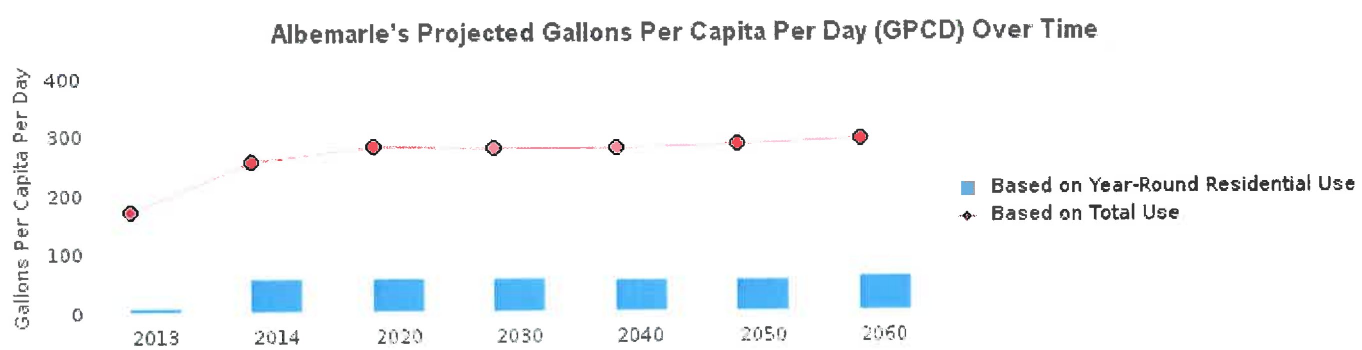
**Future Water Sales**

| Purchaser | PWSID | MGD | Contract Year Begin | Year End | Pipe Size(s) (Inches) | Use Type |
|---|---|---|---|---|---|---|
| City of Concord | 01-13-010 | 5.000 | 2015 | 2035 | 24 | Regular |

The contract that Concord-Kannapolis has with Albemarle reserves up to 10 MGD of supply, and grants a 40% allocation (4 MGD) to Kannapolis through their interconnection with Concord. However, the contract is worded such that this allocation will not become available until Albemarle expands its water treatment capacity and increases its maximum allowable withdrawal. At this time there is no time frame for treatment capacity expansion or increasing the allowable withdrawal. Currently, Albemarle is contracted to sell a maximum of 5 MGD to Concord-Kannapolis of which 40% (2 MGD) is allocated to Kannapolis. This supply is projected to be available around mid-August 2015 when the transmission mains and pump stations between Albemarle and Concord are complete.

Demand v/s Percent of Supply

| | 2014 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|
| Surface Water Supply | 18.000 | 18.000 | 18.000 | 18.000 | 18.000 | 18.000 |
| Ground Water Supply | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Purchases | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Future Supplies | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Total Available Supply (MGD) | 18.000 | 18.000 | 18.000 | 18.000 | 18.000 | 18.000 |
| Service Area Demand | 4.062 | 4.757 | 5.262 | 5.845 | 6.558 | 7.271 |
| Sales | 1.928 | 3.750 | 3.750 | 3.750 | 3.750 | 3.750 |
| Future Sales | | 5.000 | 5.000 | 0.000 | 0.000 | 0.000 |
| Total Demand (MGD) | 5.990 | 13.507 | 14.012 | 9.595 | 10.308 | 11.021 |
| Demand as Percent of Supply | 33% | 75% | 78% | 53% | 57% | 61% |




The purpose of the above chart is to show a general indication of how the long-term per capita water demand changes over time. The per capita water demand may actually be different than indicated due to seasonal populations and the accuracy of data submitted. Water systems that have calculated long-term per capita water demand based on a methodology that produces different results may submit their information in the notes field.

Your long-term water demand is 53 gallons per capita per day. What demand management practices do you plan to implement to reduce the per capita water demand (i.e. conduct regular water audits, implement a plumbing retrofit program, employ practices such as rainwater harvesting or reclaimed water)? If these practices are covered elsewhere in your plan, indicate where the practices are discussed here.

Are there other demand management practices you will implement to reduce your future supply needs?

What supplies other than the ones listed in future supplies are being considered to meet your future supply needs?

How does the water system intend to implement the demand management and supply planning components above?

**Additional Information**

Has this system participated in regional water supply or water use planning? No

What major water supply reports or studies were used for planning?

Please describe any other needs or issues regarding your water supply sources, any water system deficiencies or needed improvements (storage, treatment, etc.) or your ability to meet present and future water needs. Include both quantity and quality considerations, as well as financial, technical, managerial, permitting, and compliance issues:

# Norwood

2014



## 1. System Information

### Contact Information

Complete

| | | | |
|---|---|---|---|
| Water System Name: | Norwood | PWSID: | 01-84-015 |
| Mailing Address: | P.O. Box 697<br>Norwood, NC 28128 | Ownership: | Municipality |
| Contact Person: | Bryan Bowles | Title: | Town Administrator |
| Phone: | 704-474-3416 | Fax: | 704-474-3201 |
| Secondary Contact: | Chris Borre | Phone: | 704-474-3618 |
| Mailing Address: | PO Box 670<br>Bailey, NC 27807 | Fax: | 704-474-0376 |

### Distribution System

| Line Type | Size Range (Inches) | Estimated % of lines |
|---|---|---|
| Asbestos Cement | 2 | 3.00 % |
| Cast Iron | 6-8 | 20.00 % |
| Ductile Iron | 8-16 | 20.00 % |
| Polyvinyl Chloride | 6-12 | 57.00 % |

What are the estimated total miles of distribution system lines? 40 Miles

How many feet of distribution lines were replaced during 2014? 0 Feet

How many feet of new water mains were added during 2014? 4,710 Feet

How many meters were replaced in 2014? 40

How old are the oldest meters in this system? 11 Year(s)

How many meters for outdoor water use, such as irrigation, are not billed for sewer services? 9

What is this system's finished water storage capacity? 1.800 Million Gallons

Has water pressure been inadequate in any part of the system since last update? No

### Programs

Does this system have a program to work or flush hydrants? Yes, Semi-Annually

Does this system have a valve exercise program? Yes, Annually

Does this system have a cross-connection program? Yes

Does this system have a program to replace meters? Yes

Does this system have a plumbing retrofit program? No

Does this system have an active water conservation public education program? No

Does this system have a leak detection program? No

### Water Conservation

What type of rate structure is used? Decreasing Block

How much reclaimed water does this system use? 0.000 MGD For how many connections? 0

Does this system have an interconnection with another system capable of providing water in an emergency? Yes

## 2. Water Use Information

### Service Area

| Sub-Basin(s) | % of Service Population | County(s) | % of Service Population |
|---|---|---|---|
| Yadkin River (18-1) | 50 % | Stanly | 100 % |
| Rocky River (18-4) | 50 % | | |

What was the year-round population served in 2014? 2,675

Has this system acquired another system since last report? No

**Water Use by Type**

| Type of Use | Metered Connections | Metered Average Use (MGD) | Non-Metered Connections | Non-Metered Estimated Use (MGD) |
|---|---|---|---|---|
| Residential | 1,430 | 0.180 | 0 | 0.000 |
| Commercial | 91 | 0.030 | 3 | 0.000 |
| Industrial | 17 | 0.057 | 0 | 0.000 |
| Institutional | 33 | 0.030 | 0 | 0.000 |

How much water was used for system processes (backwash, line cleaning, flushing, etc.)? 0.050 MGD

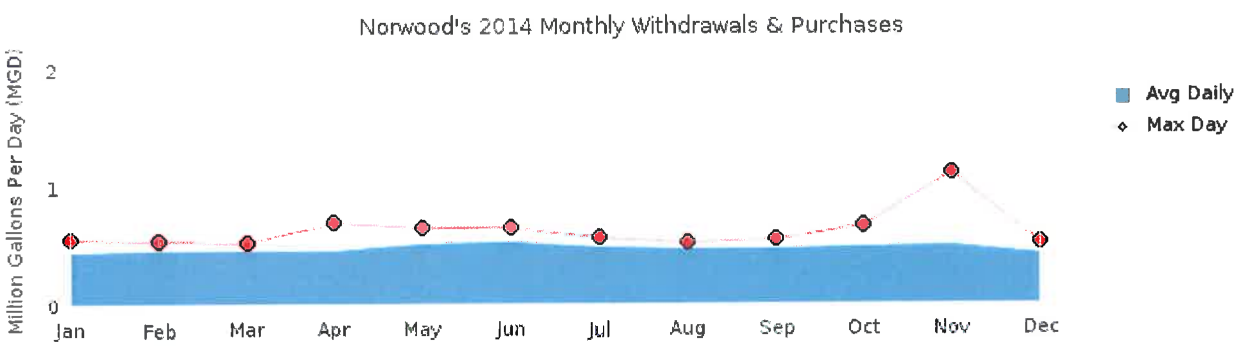
**Water Sales**

| Purchaser | PWSID | Average Daily Sold (MGD) | Days Used | Contract MGD | Contract Expiration | Contract Recurring | Required to comply with water use restrictions? | Pipe Size(s) (Inches) | Use Type |
|---|---|---|---|---|---|---|---|---|---|
| Stanly County Utilities | 01-84-035 | 0.048 | 365 | 0.050 | | Yes | Yes | 12 | Regular |

## 3. Water Supply Sources

**Monthly Withdrawals & Purchases**

| | Average Daily Use (MGD) | Max Day Use (MGD) | | Average Daily Use (MGD) | Max Day Use (MGD) | | Average Daily Use (MGD) | Max Day Use (MGD) |
|---|---|---|---|---|---|---|---|---|
| Jan | 0.428 | 0.541 | May | 0.496 | 0.653 | Sep | 0.458 | 0.550 |
| Feb | 0.448 | 0.528 | Jun | 0.523 | 0.642 | Oct | 0.474 | 0.657 |
| Mar | 0.445 | 0.514 | Jul | 0.475 | 0.554 | Nov | 0.488 | 1.108 |
| Apr | 0.450 | 0.694 | Aug | 0.451 | 0.513 | Dec | 0.420 | 0.518 |




**Surface Water Sources**

| Stream | Reservoir | Average Daily Withdrawal MGD | Average Daily Withdrawal Days Used | Maximum Day Withdrawal (MGD) | Available Raw Water Supply MGD | Available Raw Water Supply * Qualifier | Usable On-Stream Raw Water Supply Storage (MG) |
|---|---|---|---|---|---|---|---|
| Yadkin River | Lake Tillery | 0.463 | 365 | 1.108 | 2.000 | C | 2.000 |

* Qualifier: C=Contract Amount, SY20=20-year Safe Yield, SY50=50-year Safe Yield, F=20% of 7Q10 or other instream flow requirement, CUA=Capacity Use Area Permit

**Surface Water Sources (continued)**

| Stream | Reservoir | Drainage Area (sq mi) | Metered? | Sub-Basin | County | Year Offline | Use Type |
|---|---|---|---|---|---|---|---|
| Yadkin River | Lake Tillery | 4,600 | Yes | Yadkin River (18-1) | Stanly | | Regular |

What is this system's off-stream raw water supply storage capacity? 0 Million gallons

Are surface water sources monitored? Yes, Daily

Are you required to maintain minimum flows downstream of its intake or dam? No

Does this system anticipate transferring surface water between river basins? No

**Water Purchases From Other Systems**

| Seller | PWSID | Average Daily Purchased (MGD) | Days Used | Contract MGD | Contract Expiration | Contract Recurring | Required to comply with water use restrictions? | Pipe Size(s) (Inches) | Use Type |
|---|---|---|---|---|---|---|---|---|---|
| Stanly County Water System | 20-84-009 | 0.000 | 0 | 0.000 | | Yes | No | 12 | Emergency |

**Water Treatment Plants**

| Plant Name | Permitted Capacity (MGD) | Is Raw Water Metered? | Is Finished Water Ouput Metered? | Source |
|---|---|---|---|---|
| Norwood Water Treatment Plant | 2.000 | Yes | Yes | Lake Tillery |

Did average daily water production exceed 80% of approved plant capacity for five consecutive days during 2014? No

If yes, was any water conservation implemented?

Did average daily water production exceed 90% of approved plant capacity for five consecutive days during 2014? No

If yes, was any water conservation implemented?

Are peak day demands expected to exceed the water treatment plant capacity in the next 10 years? No

## 4. Wastewater Information

**Monthly Discharges**

| | Average Daily Discharge (MGD) | | Average Daily Discharge (MGD) | | Average Daily Discharge (MGD) |
|---|---|---|---|---|---|
| Jan | 0.439 | May | 0.332 | Sep | 0.276 |
| Feb | 0.560 | Jun | 0.298 | Oct | 0.206 |
| Mar | 0.609 | Jul | 0.274 | Nov | 0.222 |
| Apr | 0.537 | Aug | 0.343 | Dec | 0.318 |

How many sewer connections does this system have? 2,800

How many water service connections with septic systems does this system have? 1

Are there plans to build or expand wastewater treatment facilities in the next 10 years? No

**Wastewater Permits**

| Permit Number | Permitted Capacity (MGD) | Design Capacity (MGD) | Average Annual Daily Discharge (MGD) | Maximum Day Discharge (MGD) | Receiving Stream | Receiving Basin |
|---|---|---|---|---|---|---|
| NC0021628 | 0.750 | 0.750 | 0.368 | 2.078 | Rocky River | Yadkin River (18-1) |

## 5. Planning

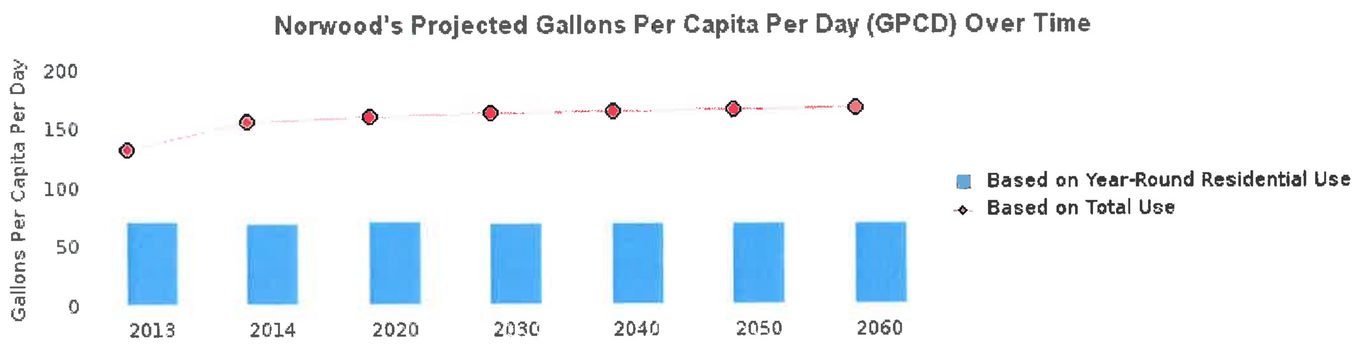
**Projections**

| | 2014 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|
| Year-Round Population | 2,675 | 2,700 | 2,750 | 2,800 | 2,850 | 2,900 |
| Seasonal Population | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | |
| Residential | 0.180 | 0.186 | 0.188 | 0.190 | 0.192 | 0.194 |
| Commercial | 0.030 | 0.035 | 0.037 | 0.039 | 0.041 | 0.043 |
| Industrial | 0.057 | 0.060 | 0.065 | 0.070 | 0.075 | 0.080 |
| Institutional | 0.030 | 0.031 | 0.032 | 0.033 | 0.034 | 0.035 |
| System Process | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| Unaccounted-for | 0.068 | 0.071 | 0.073 | 0.075 | 0.077 | 0.079 |

Demand v/s Percent of Supply

| | 2014 | 2020 | 2030 | 2040 | 2050 | 2060 |
|---|---|---|---|---|---|---|
| Surface Water Supply | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 |
| Ground Water Supply | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Purchases | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Future Supplies | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Total Available Supply (MGD) | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 |
| Service Area Demand | 0.415 | 0.433 | 0.445 | 0.457 | 0.469 | 0.481 |
| Sales | 0.048 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| Future Sales | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Total Demand (MGD) | 0.463 | 0.483 | 0.495 | 0.507 | 0.519 | 0.531 |
| Demand as Percent of Supply | 23% | 24% | 25% | 25% | 26% | 27% |




The purpose of the above chart is to show a general indication of how the long-term per capita water demand changes over time. The per capita water demand may actually be different than indicated due to seasonal populations and the accuracy of data submitted. Water systems that have calculated long-term per capita water demand based on a methodology that produces different results may submit their information in the notes field.

Your long-term water demand is 67 gallons per capita per day. What demand management practices do you plan to implement to reduce the per capita water demand (i.e. conduct regular water audits, implement a plumbing retrofit program, employ practices such as rainwater harvesting or reclaimed water)? If these practices are covered elsewhere in your plan, indicate where the practices are discussed here. Norwood has implemented a meter replacement program that could reduce the per capita water demand.

Are there other demand management practices you will implement to reduce your future supply needs?

What supplies other than the ones listed in future supplies are being considered to meet your future supply needs?

How does the water system intend to implement the demand management and supply planning components above?

**Additional Information**

Has this system participated in regional water supply or water use planning? No

What major water supply reports or studies were used for planning?

Please describe any other needs or issues regarding your water supply sources, any water system deficiencies or needed improvements (storage, treatment, etc.) or your ability to meet present and future water needs. Include both quantity and quality considerations, as well as financial, technical, managerial, permitting, and compliance issues:

**REFERENCE 26**

MEMORANDUM

To: File

From: Stuart F Parker, Hydrogeologist,
NC Superfund Section

Date: September 18, 2015

Subject: Alcoa Badin
GIS-based estimate of Groundwater-using Populations

In August and September, 2015, at SFP's request, Amy Axon, Hydrogeologist, NC Superfund Section completed a GIS analysis of potential groundwater receptors within four miles of the Alcoa Badin Landfill, the Alcoa Badin Ball Field, and Alcoa Badin Spent Pot Liner Disposal Areas 1 and 2.

The analysis was completed by determining the digitized 2010 Census populations existing within >0-1/4 mile, >1/4-1/2 mile, >½-1 mile, >1-2 mile, >2-3 mile, and >3-4 mile distance increments from the property boundaries (or physical edge) of the respective sites. Because urban populations within the study areas have access to non-groundwater-based municipal water supply, census blocks falling within GIS-based Municipal Boundaries were removed.

Several municipal water lines currently extend up to several miles beyond the municipal boundaries, but the number of rural homes along the water line routes that are connected to these extensions was not determined as part of this study. Therefore the GIS analysis errs on the side of overestimating the groundwater populations, as summarized in the attached tables.

EJ Screen Tool

| Ballfield Area Population Calculations Based on 2010 Census | | |
|---|---|---|
| Distance | Population | Pop in Ring |
| 1/4 mile | 354 | 354 |
| 1/2 Mile | 862 | 508 |
| 1 mile | 1229 | 367 |
| 2 Mile | 2740 | 1511 |
| 3 Mile | 3571 | 831 |
| 4 Mile | 5314 | 1743 |
| | Total: | **5314** |

| Landfill Area Population Calculations Based on 2010 Census | | |
|---|---|---|
| Distance | Population | Pop in Ring |
| 1/4 mile | 183 | 183 |
| 1/2 Mile | 529 | 346 |
| 1 mile | 1264 | 735 |
| 2 Mile | 2898 | 1634 |
| 3 Mile | 4116 | 1218 |
| 4 Mile | 7876 | 3760 |
| | Total: | **7876** |

| Spent Potliner Disposal Area 1 Population Calculations Based on 2010 Census | | |
|---|---|---|
| Distance | Population | Pop in Ring |
| 1/4 mile | 128 | 128 |
| 1/2 Mile | 175 | 47 |
| 1 mile | 591 | 416 |
| 2 Mile | 1348 | 757 |
| 3 Mile | 4265 | 2917 |
| 4 Mile | 7564 | 3299 |
| | Total: | **7564** |

| Spent Potliner Disposal Area 2 Population Calculations Based on 2010 Census |
|---|

GIS Based Analysis

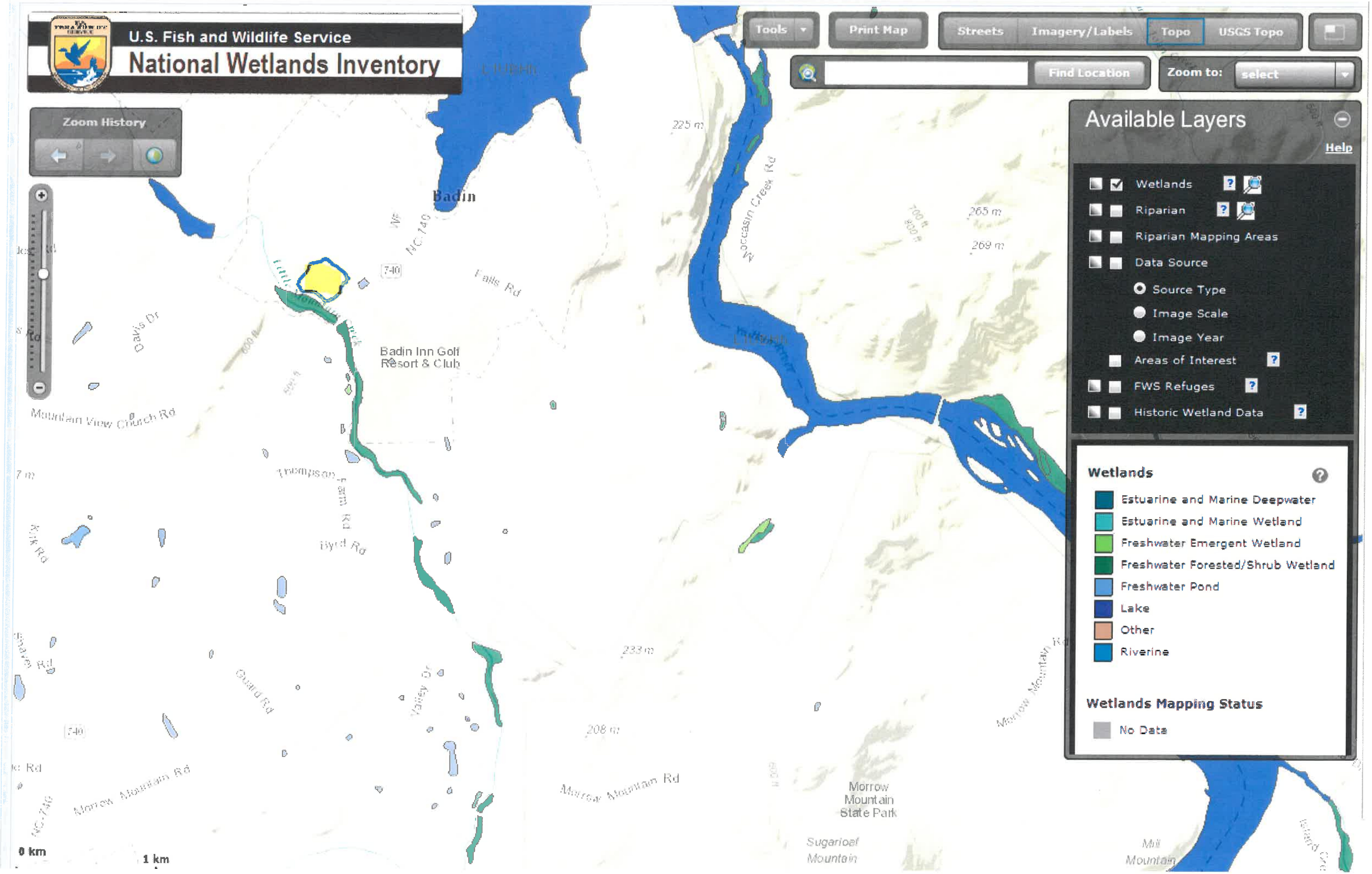
| Ballfield Area Population Calculations Based on 2010 Census | |
|---|---|
| Distance | Pop in Ring |
| 1/4 mile | 0 |
| 1/2 Mile | 2 |
| 1 mile | 101 |
| 2 Mile | 809 |
| 3 Mile | 891 |
| 4 Mile | 1332 |
| | |

| Landfill Area Population Calculations Based on 2010 Census | |
|---|---|
| Distance | Pop in Ring |
| 1/4 mile | 9 |
| 1/2 Mile | 48 |
| 1 mile | 339 |
| 2 Mile | 780 |
| 3 Mile | 1104 |
| 4 Mile | 1177 |
| | |

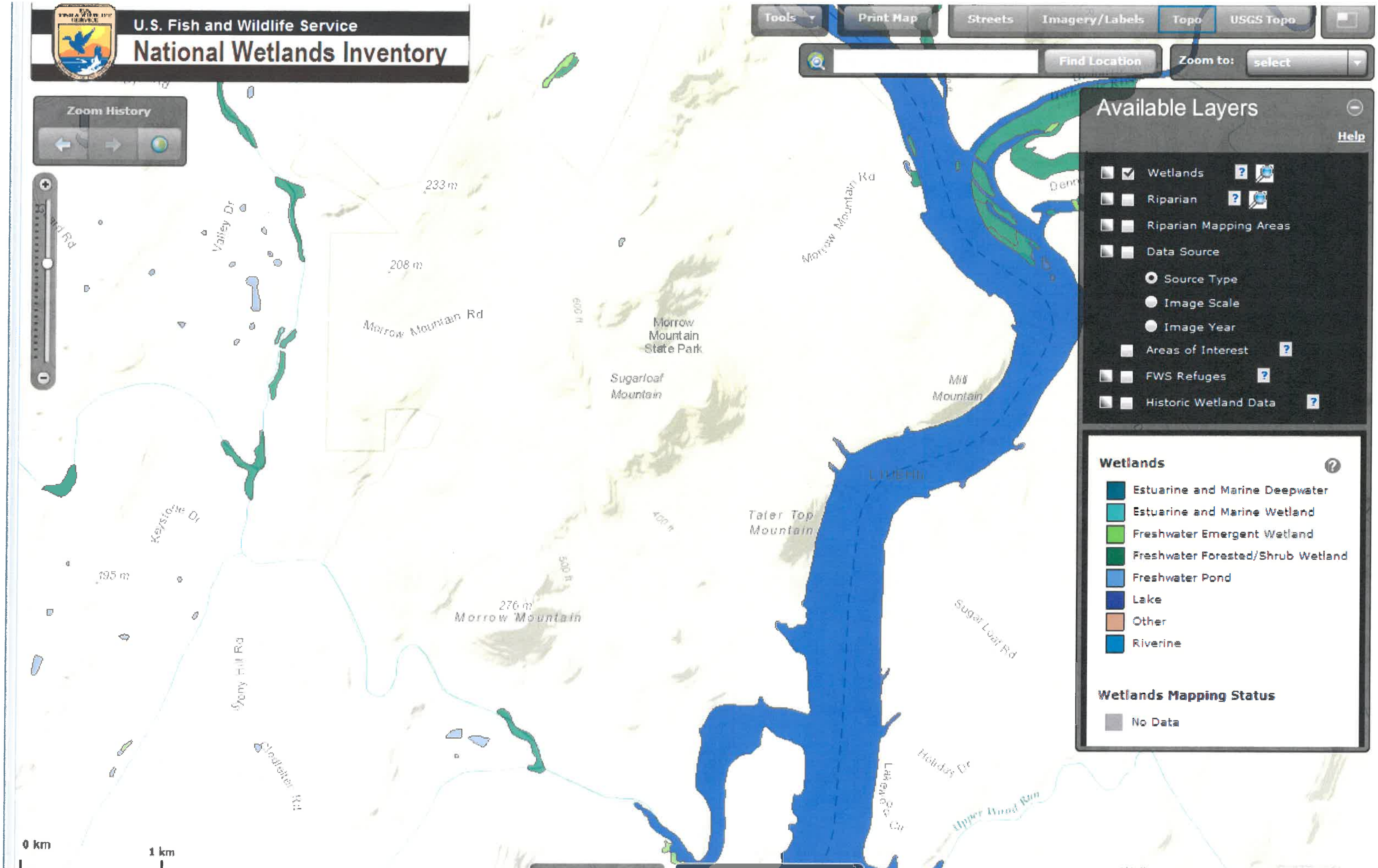
| Spent Potliner Disposal Area 1 Population Calculations Based on 2010 Census | |
|---|---|
| Distance | Pop in Ring |
| 1/4 mile | |
| 1/2 Mile | |
| 1 mile | 348 |
| 2 Mile | 815 |
| 3 Mile | 1817 |
| 4 Mile | 1622 |
| | |

| Spent Potliner Disposal Area 2 Population Calculations Based on 2010 Census |
|---|

**REFERENCE 27**



U.S. Fish and Wildlife Service
National Wetlands Inventory
Tools
Print Map
Streets
Imagery/Labels
Topo
USGS Topo
Find Location
Zoom to:
select
Zoom History
Available Layers
Help
Wetlands
Riparian
Riparian Mapping Areas
Data Source
Source Type
Image Scale
Image Year
Areas of Interest
FWS Refuges
Historic Wetland Data
Wetlands
Estuarine and Marine Deepwater
Estuarine and Marine Wetland
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Other
Riverine
Wetlands Mapping Status
No Data
Badin
Badin Inn Golf Resort & Club
Falls Rd
NC 740
740
Davis Dr
Mountain View Church Rd
Thompson Farm Rd
Byrd Rd
Valley Dr
Morrow Mountain Rd
Moccasin Creek Rd
Morrow Mountain State Park
Sugarloaf Mountain
Mill Mountain
225 m
265 m
269 m
233 m
208 m
0 km
1 km



U.S. Fish and Wildlife Service
National Wetlands Inventory
Tools
Print Map
Streets
Imagery/Labels
Topo
USGS Topo
Find Location
Zoom to:
select
Zoom History
Available Layers
Help
Wetlands
Riparian
Riparian Mapping Areas
Data Source
Source Type
Image Scale
Image Year
Areas of Interest
FWS Refuges
Historic Wetland Data
Wetlands
Estuarine and Marine Deepwater
Estuarine and Marine Wetland
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Other
Riverine
Wetlands Mapping Status
No Data
Morrow Mountain Rd
Morrow Mountain State Park
Sugarloaf Mountain
Mill Mountain
Tater Top Mountain
Morrow Mountain
Morrow Mountain Rd
Valley Dr
Keystone Dr
Sugar Loaf Rd
Holiday Dr
233 m
208 m
195 m
276 m
0 km
1 km

**REFERENCE 28**

MEMORANDUM

To: File

From: Stuart F Parker, Hydrogeologist,
NC Superfund Section

Date: August 13, 2015

Subject: Alcoa Badin Landfill
Site Inspection
Surface Water Pathway and Wetland Definition

SFP used the US Fish and Wildlife Service's on-line Wetland Mapper http://www.fws.gov/wetlands/data/mapper.HTML to delineate the surface water pathway. From the Landfill, Little Mountain Creek flows east and southeast to join Mountain Creek, 3.2 miles downstream. Mountain Creek continues eastward 2.7 miles, then discharges to Lake Tillery Reservoir. The remainder of the 15-mile Surface Water Pathway is within Lake Tillery.

The 15-mile Surface Water Pathway contains a total of 4.0 miles of Palustrine Forested, Scrub Shrub and Emergent wetland frontage.

Using published USGS gaging data, SFP determined mean surface drainage areas for each pathway segment. Multiplying each drainage area by published Mean Annual Runoff (13.5 in) for the Badin area, then dividing by a conversion factor (13.58), SFP calculated mean annual flow at each of the 5 points. They are summarized as follows:

| Station Location | Mean Drainage Area (sq mi) | Mean Annual Flow (cfs) | HRS Dilution Weight |
|---|---|---|---|
| Little Mountain Creek | 7.81 | 7.8 | 1 |
| Mountain Creek | 17.98 | 17.9 | 0.1 |
| Lake Tillery | 4586 | 4559 | 0.001 |

The Hazard Ranking System (Ref. 1) classifies Little Mountain Creek as a minimal stream (<10 cfs), Mountain Creek as a small to moderate stream (10-100 cfs), and the Lake Tillery segment as a large stream/river (1000-10,000 cfs).

**REFERENCE 29**

U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 83-211

# DRAINAGE AREAS OF SELECTED SITES ON STREAMS IN NORTH CAROLINA

Prepared in cooperation with the

North Carolina Department of Natural

Resources and Community Development

| STATION NUMBER | STATION NAME | DRAINAGE AREA (SQ MI) | SITE TYPE | LAT | LONG | QUAD NAME | COUNTY CODE |
|---|---|---|---|---|---|---|---|
| 0212149222 | LEONARD C AT SR 1821 NR BETHESDA | 3.84 | 20 | 355333 | 801244 | MIDWAY | 057 |
| 0212149300 | LEONARD C AT SR 1837 NR BETHESDA | 5.16 | 01 | 355314 | 801230 | MIDWAY | 057 |
| 0212149400 | LEONARD C AB CITY LK D NR LEXINGTON | 6.51 | 02 | 355218 | 801300 | LEXINGTON EAST | 057 |
| 0212149405 | LEONARD C AT DAM NR LEXINGTON | 7.34 | 20 | 355129 | 801255 | LEXINGTON EAST | 057 |
| 0212149420 | TINKERS C AT SR 1464 NR BETHESDA | 1.34 | 20 | 355409 | 801350 | MIDWAY | 057 |
| 0212149430 | TINKERS C AT SR 1836 AT BETHESDA | 2.27 | 20 | 355317 | 801356 | MIDWAY | 057 |
| 0212149440 | EASTER C AT SR 1836 AT BETHESDA | 2.11 | 20 | 355308 | 801412 | MIDWAY | 057 |
| 0212149590 | LEONARD C TRIB NR LEXINGTON | 2.32 | 20 | 355033 | 801334 | LEXINGTON EAST | 057 |
| 0212149620 | LEONARD C AT SR 2001 NR LEXINGTON | 18.6 | 20 | 354953 | 801323 | LEXINGTON EAST | 057 |
| 0212149680 | ABBOTTS C AT SR 2010 AT LEXINGTON | 171. | 20 | 354925 | 801319 | LEXINGTON EAST | 057 |
| 0212150000 | ABBOTTS C AT LEXINGTON | 175. | 01 | 354823 | 801405 | LEXINGTON EAST | 057 |
| 0212151050 | ABBOTTS C NR LEXINGTON | 181. | 20 | 354629 | 801426 | LEXINGTON EAST | 057 |
| 0212152100 | ABBOTTS C NR SANDY GROVE | 183. | 20 | 354520 | 801410 | LEXINGTON EAST | 057 |
| 0212153025 | POUNDER F TRIB AT MTH NR SANDY GROVE | 2.98 | 20 | 354756 | 801158 | LEXINGTON EAST | 057 |
| 0212153050 | POUNDER F NR SANDY GROVE | 6.21 | 20 | 354722 | 801211 | LEXINGTON EAST | 057 |
| 0212153275 | POUNDER F TRIB NR HEDRIC GROVE | 2.62 | 20 | 354618 | 801239 | LEXINGTON EAST | 057 |
| 0212153650 | POUNDER F AT MTH NR HEDRICK GROVE | 14.0 | 20 | 354529 | 801401 | LEXINGTON EAST | 057 |
| 0212153675 | ABBOTTS C TRIB AT MTH AT HIGHROCK LAKE NR SANDY GR | 0.83 | 20 | 354508 | 801423 | LEXINGTON EAST | 057 |
| 0212170350 | ABBOTTS C AT SR 2320 AT SOUTHMONT | 223. | 20 | 353233 | 801518 | SOUTHMONT | 057 |
| 0212175050 | RUDDLE B NR SILVER HILL | 5.39 | 20 | 354119 | 801346 | DENTON | 057 |
| 0212193950 | FLAT SWP C TRIB AT MTH AT GORDONTOWN | 2.21 | 20 | 354535 | 800707 | FAIR GROVE | 057 |
| 0212194000 | FLAT SWP C NR LEXINGTON | 6.42 | 11 | 354359 | 800637 | DENTON | 057 |
| 0212194050 | ROCKY MEADOW B AT SR 2274 NR SILVER VALLEY | 2.18 | 20 | 354245 | 800810 | DENTON | 057 |
| 0212195800 | FLAT SWP C NR SILVER HILL | 15.3 | 02 | 354112 | 800906 | DENTON | 057 |
| 0212195900 | FLAT SWP C AT MTH NR SILVER HILL | 19.6 | 20 | 354020 | 801000 | DENTON | 057 |
| 0212195950 | FOURMILE B AT HEDRICK GROVE | 2.93 | 20 | 354605 | 801026 | LEXINGTON EAST | 057 |
| 0212200000 | FOURMILE B AT SOUTHMONT | 14.2 | 01 | 354051 | 801029 | DENTON | 057 |
| 0212236850 | PANTHER C AT SR 1004 NR LIBERTY | 3.47 | 20 | 353415 | 801812 | GOLD HILL | 159 |
| 0212238200 | PANTHER C NR LIBERTY | 8.04 | 02 | 353530 | 801633 | GOLD HILL | 159 |
| 0212250000 | YADKIN R AT HIGH ROCK | 3973. | 01 | 353546 | 801359 | DENTON | 159 |
| 0212250650 | CEDAR C AT SR 2143 NR POOLETOWN | 1.92 | 20 | 353426 | 801516 | GOLD HILL | 159 |
| 0212251300 | W B LICK C NR SNYDER | 2.88 | 02 | 354135 | 800606 | DENTON | 057 |
| 0212251350 | LICK C AT NC 109 NR SNYDER | 4.87 | 20 | 354046 | 800600 | DENTON | 057 |
| 0212251400 | LICK C NR DENTON | 12.4 | 11 | 353949 | 800716 | DENTON | 057 |
| 0212252600 | LICK C TRIB BL SED NR DENTON | 1.43 | 11 | 353657 | 800825 | DENTON | 057 |
| 0212252615 | LICK C TRIB AT SR 2504 NR HEALING SPRINGS | 4.23 | 20 | 353716 | 800302 | DENTON | 057 |
| 0212253000 | LICK C AT HEALING SPRINGS | 28.0 | 02 | 353659 | 801031 | DENTON | 057 |
| 0212254100 | LICK C AT MTH NR HIGH ROCK | 34.3 | 20 | 353450 | 801230 | DENTON | 057 |
| 0212254300 | YADKIN R AB CABIN C NR JACKSON HILL | 4018. | 20 | 353424 | 801230 | DENTON | 057 |
| 0212255955 | CABIN C AT DIRT ROAD NR HANDY | 8.71 | 20 | 353508 | 800801 | DENTON | 057 |
| 0212256000 | CABIN C NR JACKSON HILL | 13.5 | 03 | 353457 | 800912 | DENTON | 057 |
| 0212258100 | CABIN C AT MTH NR JACKSON HILL | 20.6 | 02 | 353355 | 801225 | DENTON | 057 |
| 0212259500 | FLAT C HEADWATERS NR POOLETOWN | 4.60 | 20 | 353238 | 801516 | GOLD HILL | 159 |
| 0212259800 | FLAT C NR POOLETOWN | 5.23 | 20 | 353228 | 801437 | DENTON | 159 |
| 0212260100 | FLAT C AT MTH NR NEWSOM | 9.48 | 20 | 353250 | 801220 | DENTON | 159 |
| 0212260700 | YADKIN R AB RILES C AT NEWSOM | 4051. | 20 | 353142 | 801142 | DENTON | 057 |
| 0212260845 | RILES C HEADWATERS NR GOLD HILL | 3.39 | 20 | 353125 | 801745 | GOLD HILL | 159 |
| 0212260886 | RILES C AT SR 2356 NR GOLD HILL | 6.12 | 20 | 353046 | 801638 | GOLD HILL | 159 |
| 0212263155 | CURL TAIL C AT MISENHEIMER | 1.55 | 20 | 352908 | 801718 | MOUNT PLEASANT | 167 |
| 0212263161 | CURL TAIL C BL SED AT MESENHEIMER | 1.74 | 20 | 352852 | 801637 | MOUNT PLEASANT | 167 |
| 0212263166 | CURL TAIL C AT SR 1134 AT RICHFIELD | 3.25 | 11 | 352832 | 801516 | MOUNT PLEASANT | 167 |
| 0212263290 | CURL TAIL C AT MTH NR NEW LONDON | 9.91 | 20 | 354919 | 801354 | ALBEMARLE | 167 |
| 0212263300 | RILES C NR GOLD HILL | 26.3 | 02 | 353018 | 801303 | DENTON | 057 |
| 0212264300 | RILES C AT MTH AT NEWSOM | 30.2 | 20 | 353139 | 801150 | DENTON | 159 |
| 0212267100 | ELLIS C NR NEWSOM | 3.23 | 02 | 353208 | 800344 | DENTON | 057 |
| 0212267800 | ELLIS C AT MTH AT NEWSOM | 7.75 | 20 | 353140 | 801120 | DENTON | 057 |
| 0212268800 | YADKIN R NR GOLD HILL | 4091. | 20 | 353022 | 801053 | DENTON | 057 |
| 0212269900 | TUCKERTOWN RES ON YADKIN R NR ELDORADO | 4097. | 20 | 352305 | 801030 | ALBEMARLE | 167 |
| 0212269915 | YADKIN R TRIB AT MTH NR ISENHOUR | 3.00 | 20 | 352815 | 800957 | ALBEMARLE | 167 |
| 0212269945 | GARR C AT MTH NR TUCKERTOWN | 2.70 | 20 | 352932 | 800835 | ALBEMARLE | 123 |
| 0212272000 | BEAVERDAM C TRIB NR DENTON | 2.90 | 11 | 353157 | 800504 | DENTON | 057 |
| 0212272400 | BEAVERDAM C AT MTH NR JACKSON HILL | 8.93 | 02 | 353050 | 800605 | DENTON | 057 |
| 0212272450 | ALLS F AT SR 2550 NR JACKSON HILL | 2.50 | 20 | 353039 | 800636 | DENTON | 057 |
| 0212276600 | GLADY F AT BLAINE | 2.88 | 02 | 352947 | 800347 | ALBEMARLE | 123 |
| 0212276650 | GLADY F AT MTH NR ELDORADO | 4.86 | 20 | 352900 | 800358 | ALBEMARLE | 123 |
| 0212284400 | YADKIN R AT BADIN DAM | 4154. | 20 | 352510 | 800534 | ALBEMARLE | 167 |
| 0212292200 | YADKIN R AT FALLS DAM | 4159. | 20 | 352341 | 800432 | ALBEMARLE | 167 |
| 0212292400 | YADKIN R AB UWHARRIE R NR BADIN | 4164. | 20 | 352250 | 800335 | ALBEMARLE | 167 |
| 0212299505 | UWHARRIE R HEADWATERS AT SR 1610 NR HIGH POINT | 1.70 | 20 | 355353 | 800054 | HIGH POINT WEST | 151 |
| 0212299550 | UWHARRIE R AT NC 62 NR THOMASVILLE | 5.80 | 20 | 355256 | 800008 | HIGH POINT WEST | 151 |
| 0212300000 | UWHARRIE R NR TRINITY | 10.9 | 01 | 355205 | 795931 | GLENOLA | 151 |
| 0212301000 | UWHARRIE R TRIB AT SR 1564 NR TRINITY | 2.71 | 20 | 355044 | 795906 | GLENOLA | 151 |
| 0212301050 | UWHARRIE R TRIB AT SR 1566 NR HILLSVILLE | 3.82 | 20 | 355107 | 795700 | GLENOLA | 151 |
| 0212301075 | UWHARRIE R TRIB AT MTH NR HILLSVILLE | 4.94 | 20 | 355017 | 795752 | GLENOLA | 151 |
| 0212310900 | UWHARRIE R TRIB AB MTH AT SR 1545 NR HILLSVILLE | 1.61 | 20 | 354925 | 795808 | GLENOLA | 151 |
| 0212311159 | UWHARRIE R AT SR 1547 NR HILLSVILLE | 26.0 | 20 | 354918 | 795819 | GLENOLA | 151 |
| 0212311300 | UWHARRIE R NR GLENOLA | 32.1 | 02 | 354825 | 795950 | GLENOLA | 151 |
| 0212312000 | UWHARRIE R NR ASHBORO | 36.6 | 02 | 354720 | 795920 | GLENOLA | 151 |
| 0212313005 | UWHARRIE R TRIB NR FLINT HILL | 1.74 | 20 | 354632 | 795911 | GLENOLA | 151 |
| 0212314300 | UWHARRIE R NR FLINT HILL | 41.3 | 02 | 354555 | 795935 | GLENOLA | 151 |
| 0212316600 | L UWHARRIE R NR TRINITY | 2.52 | 20 | 355045 | 800203 | FAIR GROVE | 151 |
| 0212317130 | L UWHARRIE R AT SR 1404 NR FLINT HILL | 5.46 | 20 | 354848 | 800248 | FAIR GROVE | 151 |
| 0212317200 | L UWHARRIE R NR LIGHT | 8.33 | 02 | 354810 | 800310 | FAIR GROVE | 057 |
| 0212318750 | PLUMMER C AT MTH NR GORDONTOWN | 5.88 | 20 | 354543 | 800401 | FAIR GROVE | 057 |
| 0212318900 | BRIER C NR HOLLY GROVE | 8.86 | 02 | 354620 | 800348 | FAIR GROVE | 057 |

# LOWER YADKIN RIVER - CONTINUED

| STATION NUMBER | STATION NAME | DRAINAGE AREA (SQ MI) | SITE TYPE | LAT | LONG | QUAD NAME | COUNTY CODE |
|---|---|---|---|---|---|---|---|
| 0212345100 | BARNES C NR OPHIR | 20.0 | 02 | 352822 | 795826 | TROY | 123 |
| 0212345600 | BARNES C NR UWHARRIE | 22.4 | 02 | 352606 | 795950 | TROY | 123 |
| 0212347900 | HOGPEN B NR UWHARRIE | 1.02 | 02 | 352558 | 795947 | TROY | 123 |
| 0212350000 | UWHARRIE R NR ELDORADO | 342. | 01 | 352547 | 800105 | ALBEMARLE | 123 |
| 0212353300 | SPENCER C AT UWHARRIE | 7.61 | 02 | 352533 | 800044 | ALBEMARLE | 123 |
| 0212354095 | W B MCLEANS C AT MTH NR UWHARRIE | 4.96 | 20 | 352602 | 800134 | ALBEMARLE | 123 |
| 0212354100 | MCLEANS C NR UWHARRIE | 8.33 | 02 | 352543 | 800117 | ALBEMARLE | 123 |
| 0212356600 | CEDAR C NR UWHARRIE | 5.13 | 02 | 352339 | 800054 | ALBEMARLE | 123 |
| 0212356710 | DUTCHMANS C AT MTH NR BADIN | 3.94 | 20 | 352311 | 800230 | ALBEMARLE | 123 |
| 0212357000 | UWHARRIE R AT MTH NR BADIN | 373. | 20 | 352254 | 800325 | ALBEMARLE | 123 |

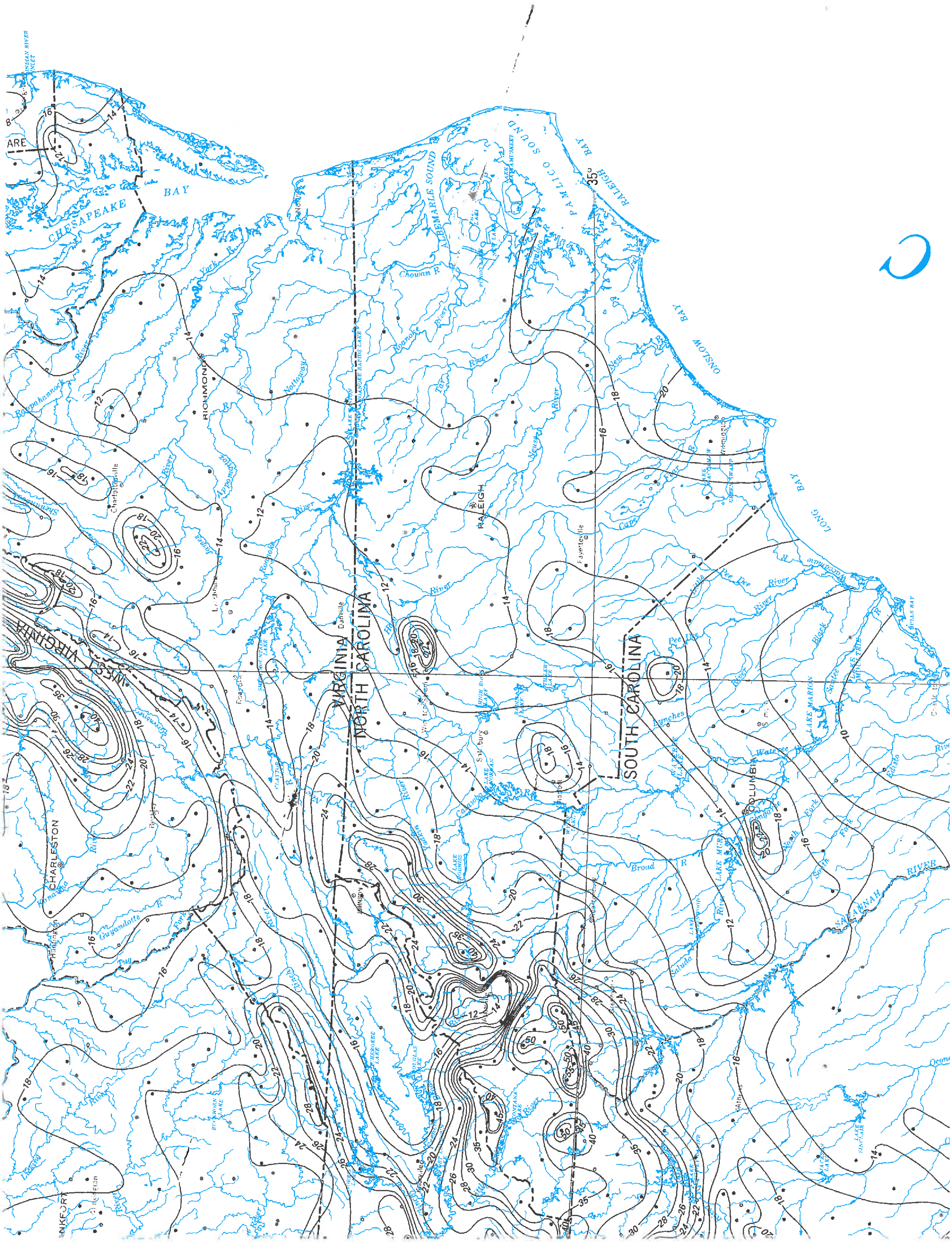
# UPPER PEE DEE RIVER

| STATION NUMBER | STATION NAME | DRAINAGE AREA (SQ MI) | SITE TYPE | LAT | LONG | QUAD NAME | COUNTY CODE |
|---|---|---|---|---|---|---|---|
| 0212357300 | BIG ISLAND C NR UWHARRIE | 3.14 | 02 | 352140 | 800230 | ALBEMARLE | 123 |
| 0212359850 | MOUNTAIN C HEADWATERS NR NEW LONDON | 2.24 | 20 | 352532 | 801052 | ALBEMARLE | 167 |
| 0212359875 | MOUNTAIN C AT NC 740 NR ALBEMARLE | 8.24 | 20 | 352159 | 800850 | ALBEMARLE | 167 |
| 0212359900 | MOUNTAIN C NR ALBEMARLE | 14.0 | 02 | 352148 | 800657 | ALBEMARLE | 167 |
| 0212362880 | L MOUNTAIN C AT BADIN | 5.42 | 20 | 352420 | 800724 | ALBEMARLE | 167 |
| 0212363200 | L MOUNTAIN C NR ALBEMARLE | 10.2 | 02 | 352208 | 800640 | ALBEMARLE | 167 |
| 0212364800 | MOUNTAIN C AT MTH NR ALBEMARLE | 31.7 | 20 | 352025 | 800505 | ALBEMARLE | 167 |
| 0212364865 | UPPER WOOD RUN AT MTH NR UWHARRIE | 1.77 | 20 | 352012 | 800333 | ALBEMARLE | 123 |
| 0212364885 | WOOD RUN AT MTH NR PEE DEE | 2.89 | 20 | 351948 | 800345 | ALBEMARLE | 123 |
| 0212366600 | PEE DEE R AT NC 27 NR ALBEMARLE | 4586. | 20 | 351830 | 800444 | ALBEMARLE | 167 |
| 0212366645 | ROCKY C AT MTH NR PEE DEE | 3.80 | 20 | 351814 | 800415 | ALBEMARLE | 167 |
| 0212367735 | JACOBS C TRIB AT MTH NR PORTER | 4.85 | 20 | 351756 | 800845 | ALBEMARLE | 167 |
| 0212367800 | JACOBS C NR PORTER | 11.6 | 02 | 351730 | 800708 | ALBEMARLE | 167 |
| 0212369550 | CEDAR C AT US 52 AT NORWOOD | 1.93 | 20 | 351347 | 800750 | AQUADALE | 167 |
| 0212371700 | LOWER RICHLAND C AT MTH NR MT GILEAD | 3.18 | 20 | 351405 | 800325 | MOUNT GILEAD WEST | 123 |
| 0212373600 | PEE DEE R AT NORWOOD DAM NR NORWOOD | 4638. | 20 | 351224 | 800357 | MOUNT GILEAD WEST | 167 |
| 0212376325 | CLARKS C HEADWATERS NR PEE DEE | 5.14 | 20 | 351723 | 800058 | ALBEMARLE | 167 |
| 0212376350 | LICK F HEADWATERS NR WADESVILLE | 4.43 | 20 | 353718 | 795902 | TROY | 123 |
| 0212376400 | LICK F AT MTH NR PEE DEE | 11.4 | 20 | 351525 | 800100 | ALBEMARLE | 123 |
| 0212377200 | CLARKS C NR MT GILEAD | 22.0 | 02 | 351408 | 800121 | MOUNT GILEAD WEST | 123 |
| 0212377250 | BIG B AT NC 73 NR MT GILEAD | 1.88 | 20 | 351355 | 800105 | MOUNT GILEAD WEST | 123 |
| 0212377400 | CLARKS C NR MT GILEAD | 26.0 | 02 | 351316 | 800159 | MOUNT GILEAD WEST | 123 |
| 0212377700 | CLARKS C NR TROY | 32.6 | 02 | 351234 | 800230 | MOUNT GILEAD WEST | 123 |
| 0212378400 | CLARKS C AT MTH NR NORWOOD | 35.4 | 02 | 351200 | 800340 | MOUNT GILEAD WEST | 123 |
| 0212378450 | PEE DEE R TRIB AT MTH NR HYDRO | 2.00 | 20 | 351143 | 800347 | MOUNT GILEAD WEST | 167 |

# ROCKY RIVER

| STATION NUMBER | STATION NAME | DRAINAGE AREA (SQ MI) | SITE TYPE | LAT | LONG | QUAD NAME | COUNTY CODE |
|---|---|---|---|---|---|---|---|
| 0212380800 | ROCKY R AT SR 1147 NR MOORESVILLE | 2.66 | 20 | 353241 | 804552 | MOORESVILLE | 097 |
| 0212384400 | DYE C NR MOORESVILLE | 3.96 | 02 | 353214 | 804741 | MOORESVILLE | 097 |
| 0212388100 | ROCKY R AT SR 1608 NR DAVIDSON | 13.4 | 20 | 352829 | 804648 | CORNELIUS | 119 |
| 0212391320 | W B ROCKY R AT SR 1136 NR MOORESVILLE | 3.62 | 20 | 353202 | 804920 | MOORESVILLE | 097 |
| 0212391330 | W B ROCKY R AT SR 1138 NR DAVIDSON | 7.21 | 20 | 353109 | 804858 | MOORESVILLE | 097 |
| 0212391700 | W B ROCKY R NR CORNELIUS | 13.6 | 02 | 352821 | 804733 | CORNELIUS | 119 |
| 0212393200 | S P ROCKY R AT NC 73 NR CORNELIUS | 4.98 | 20 | 352823 | 804902 | CORNELIUS | 119 |
| 0212395300 | ROCKY R NR CALDWELL | 39.0 | 02 | 352718 | 804543 | CORNELIUS | 025 |
| 0212399400 | ROCKY R AT SR 1449 NR DEWEESE | 44.4 | 20 | 352527 | 804428 | KANNAPOLIS | 025 |
| 0212402400 | ROCKY R AT COX MILL NR HARRISBURG | 47.1 | 20 | 352429 | 804349 | KANNAPOLIS | 025 |
| 0212405000 | S P CLARKE CREEK NR HUNTERSVILLE | 5.75 | 11 | 352421 | 804806 | CORNELIUS | 119 |
| 0212406000 | N PRONG CLARKE C NR HUNTERSVILLE | 3.63 | 20 | 352511 | 804753 | CORNELIUS | 119 |
| 0212407650 | RAMAH C AT SR 2427 NR HUNTERSVILLE | 3.09 | 20 | 352631 | 804807 | CORNELIUS | 119 |
| 0212407700 | RAMAH C NR HUNTERSVILLE | 6.19 | 02 | 352526 | 804556 | CORNELIUS | 119 |
| 0212408000 | CLARKE C NR HARRISBURG | 21.9 | 02 | 352450 | 804508 | CORNELIUS | 025 |
| 0212409100 | CLARKE C AT SR 1448 NR PLEASANT GROVE | 28.2 | 20 | 352312 | 804346 | KANNAPOLIS | 025 |
| 0212410100 | ROCKY R NR PLEASANT GROVE | 76.8 | 02 | 352259 | 804318 | KANNAPOLIS | 025 |
| 0212411000 | ROCKY R NR ROBERTA MILL | 87.2 | 20 | 352133 | 804031 | HARRISBURG | 025 |
| 0212411512 | MALLARD C AT SR 2480 NR CROFT | 2.48 | 20 | 351943 | 804806 | DERITA | 119 |
| 0212411725 | CLARKS C TRIB AT SR 2480 NR CROFT | 2.85 | 20 | 352050 | 804745 | DERITA | 119 |
| 0212411812 | CLARKS C AT MTH NR DERITA | 6.40 | 20 | 351936 | 804634 | DERITA | 119 |
| 0212412200 | MALLARD C NR DERITA | 11.9 | 02 | 351934 | 804625 | DERITA | 119 |
| 0212412250 | DOBY C AT SR 2665 NR DERITA | 3.09 | 20 | 351845 | 804537 | DERITA | 119 |
| 0212413000 | MALLARD C NR CHARLOTTE | 20.6 | 20 | 351905 | 804414 | HARRISBURG | 119 |
| 0212414600 | MALLARD C NR NEWELL | 26.1 | 20 | 351912 | 804354 | HARRISBURG | 119 |
| 0212414805 | STONY C NR DERITA | 1.59 | 20 | 352101 | 804431 | HARRISBURG | 119 |
| 0212414960 | STONY C AT US 29 NR HARRISBURG | 6.71 | 20 | 352002 | 804311 | HARRISBURG | 119 |
| 0212415000 | MALLARD C AT HARRISBURG | 41.1 | 20 | 352002 | 804005 | HARRISBURG | 025 |
| 0212417450 | ROCKY R AT PHARRS MILL | 135. | 20 | 351947 | 803705 | CONCORD SE | 025 |
| 0212413700 | CODDLE C AT SR 1153 NR MOORESVILLE | 2.47 | 20 | 353422 | 804559 | MOORESVILLE | 097 |
| 0212419200 | CODDLE C AT SR 1150 NR ENOCHVILLE | 7.05 | 20 | 353251 | 804458 | ENOCHVILLE | 097 |
| 0212419224 | EAST F AT SR 1335 NR ENOCHVILLE | 3.06 | 20 | 353304 | 804315 | ENOCHVILLE | 159 |
| 0212419249 | EAST F AT SR 1353 NR ENOCHVILLE | 6.38 | 20 | 353238 | 804423 | ENOCHVILLE | 159 |
| 0212419274 | CODDLE C AT SR 1612 NR DAVIDSON | 22.7 | 20 | 353014 | 804411 | ENOCHVILLE | 025 |
| 0212419286 | PARK C AT SR 1363 NR KANNAPOLIS | 2.45 | 20 | 353118 | 804202 | ENOCHVILLE | 159 |
| 0212419300 | PARK C NR KANNAPOLIS | 5.27 | 02 | 352923 | 804258 | KANNAPOLIS | 025 |
| 0212419400 | CODDLE C AT SR 1609 NR DEWEESE | 32.2 | 20 | 352851 | 804258 | KANNAPOLIS | 025 |
| 0212419454 | MILL C AT SR 1363 NR KANNAPOLIS | 2.38 | 20 | 353100 | 804120 | ENOCHVILLE | 159 |
| 0212419500 | MILL C AT SR 1609 NR KANNAPOLIS | 5.45 | 20 | 352904 | 804209 | KANNAPOLIS | 025 |
| 0212420445 | MILL C AT SR 1619 NR KANNAPOLIS | 8.06 | 20 | 352702 | 804214 | KANNAPOLIS | 025 |

# REFERENCE 30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Charlottesville
Lynchburg
Danville
VIRGINIA
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WEST VIRGINIA
SOUTH CAROLINA
RALEIGH
Fayetteville
Salisbury
COLUMBIA
CHARLESTON
Huntington
Johnson
Asheville
Knoxville
ALBEMARLE SOUND
PAMLICO SOUND
ONSLOW BAY
LONG BAY
RALEIGH BAY
Chowan R
Roanoke River
Tar River
Neuse River
Cape Fear R
Pee Dee River
Broad R
SAVANNAH RIVER
Wateree
Lynches
Saluda
Kanawha
Guyandotte R
Tug Fork
Rappahannock River
York R
Appomattox
James
Nottoway
New R
Yadkin River
Catawba
LAKE MARION
LAKE MURRAY
LAKE MATTAMUSKEET
Wilmington
35°

**REFERENCE 31**

CONNECTGIS WEB HOSTING

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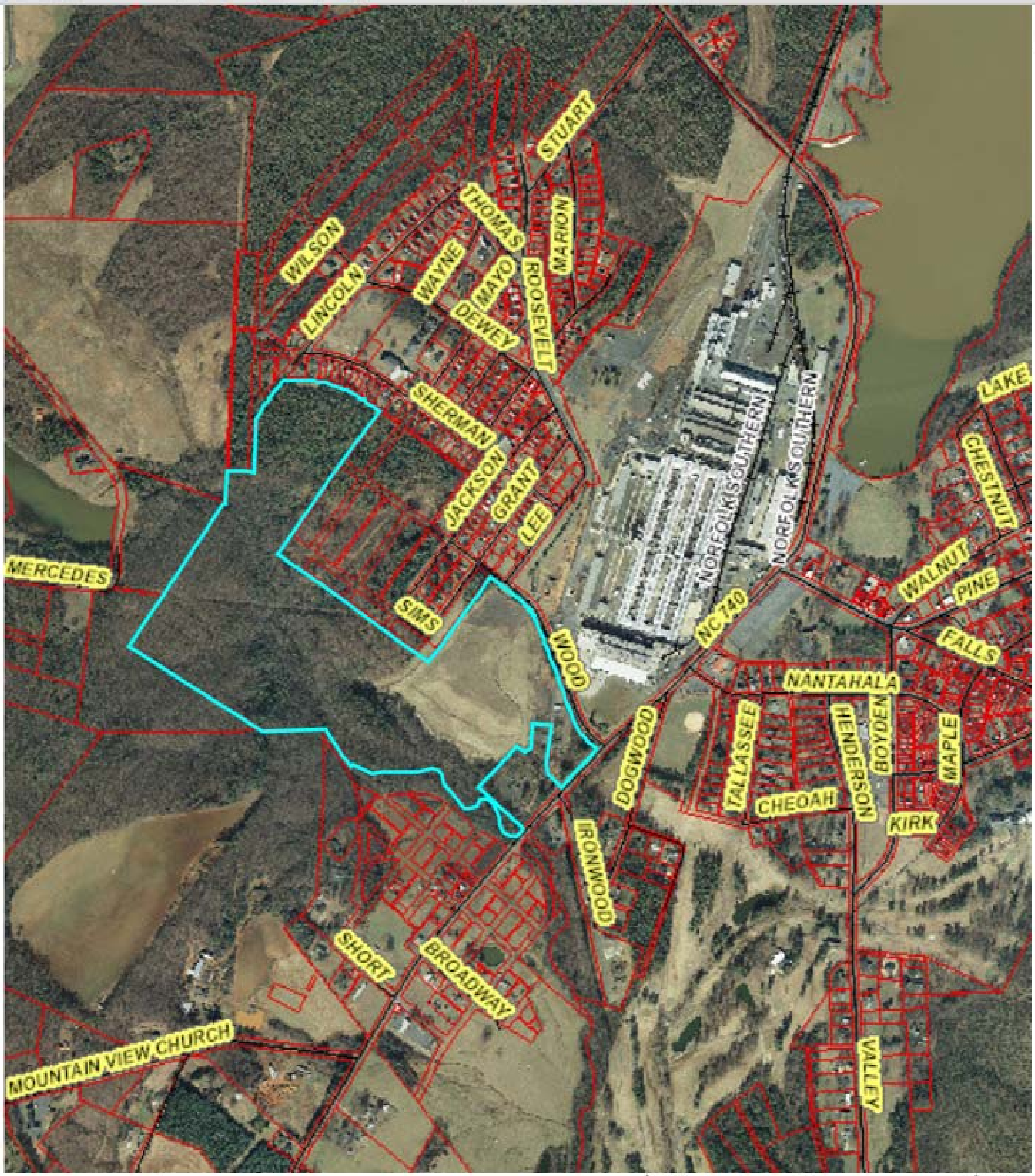


Layers

**Information**

**Parcels**

Property Record Card

Deed

Plat

| | |
|---|---|
| Tax Record: | |
| PIN: | 666003 |
| Owner Name: | ALUMINUM COMPANY OF AM |
| Owner Name 2: | |
| Mailing Address: | 201 ISABE |
| Mailing Address 2: | |
| City: | PITTS |
| State: | |
| Zip: | |
| Physical Address: | NC 74 |

more

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Legend

Excel 2000/2003 | Results | Display Labels - | Display 50

**REFERENCE 32**

A larger map is available at the park office.

# Morrow Mountain State Park

## Legend

- Amphitheater
- Bathhouse
- Boat Ramp
- Boat Rentals
- Bridle Trail
- Dump Station
- Family Camping
- Family Vacation Cabin
- Group Camping
- Hiking Trail
- Horse Trailer Parking
- Hospital - Stanly Regional Medical Center 704-984-4000
- Information
- Museum
- Parking
- Park Boundary
- Park Gate
- Park Office
- Picnic Area
- Point of Interest
- Primitive Camping
- Public Telephone
- Ranger Residence
- Restrooms
- Road - Gravel
- - Paved
- Swimming Pool

## Trails

| Trails | Miles | Blaze | Difficulty |
|---|---|---|---|
| Backpack | 2.0 miles | easy | white circles |
| Bridle: Short Loop* | 3.9 miles | moderate | white circles |
| Bridle: Middle Loop* | 5.5 miles | moderate | blue circles |
| Bridle: Long Loop* | 9.3 miles | moderate | red circles |
| Campground/Pool | 0.8 miles | easy | white triangles |
| Fall Mountain | 4.1 miles | moderate | orange triangles |
| Hattaway Mountain | 2.0 miles | strenuous | orange squares |
| Laurel | 0.6 miles | easy | red hexagons |
| Morrow Mountain** | 2.6 miles | moderate | blue triangles |
| Mountain Loop | 0.8 miles | easy | red squares |
| Quarry | 0.6 miles | easy | blue diamonds |
| Rocks** | 1.3 miles | easy | blue squares |
| Sugarloaf Mountain | 2.8 miles | strenuous | orange diamonds |
| Three Rivers | 0.8 miles | easy | blue hexagons |

* All bridle trails may be used for hiking
** Distance is measured one way, double distance for round trip


**AFTER HOURS EMERGENCY PROCEDURES**

Park gates are locked at specific times which vary with the seasons. Should an emergency arise after the gates are locked, there is a pay phone outside the park office. Emergency procedures are posted beside the phone.

03/15

**REFERENCE 33**

# High Rock, Tuckertown, Badin & Tillery Lakes

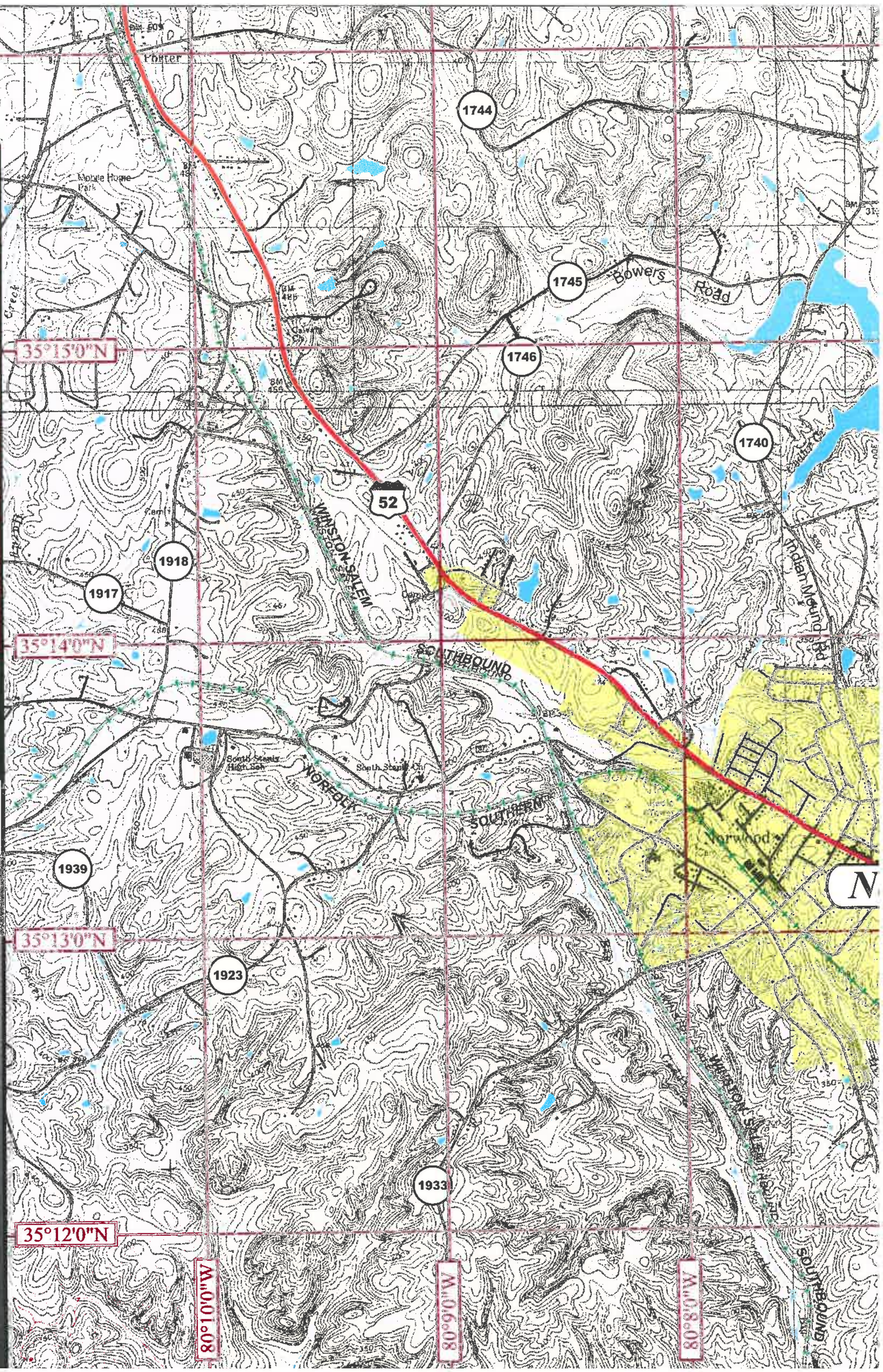
KINGFISHER — QUALITY LAKE MAPS — ESTABLISHED 1970

*Topographic lake map for fishing, boating, and recreation*

## Map # 1200 &1201

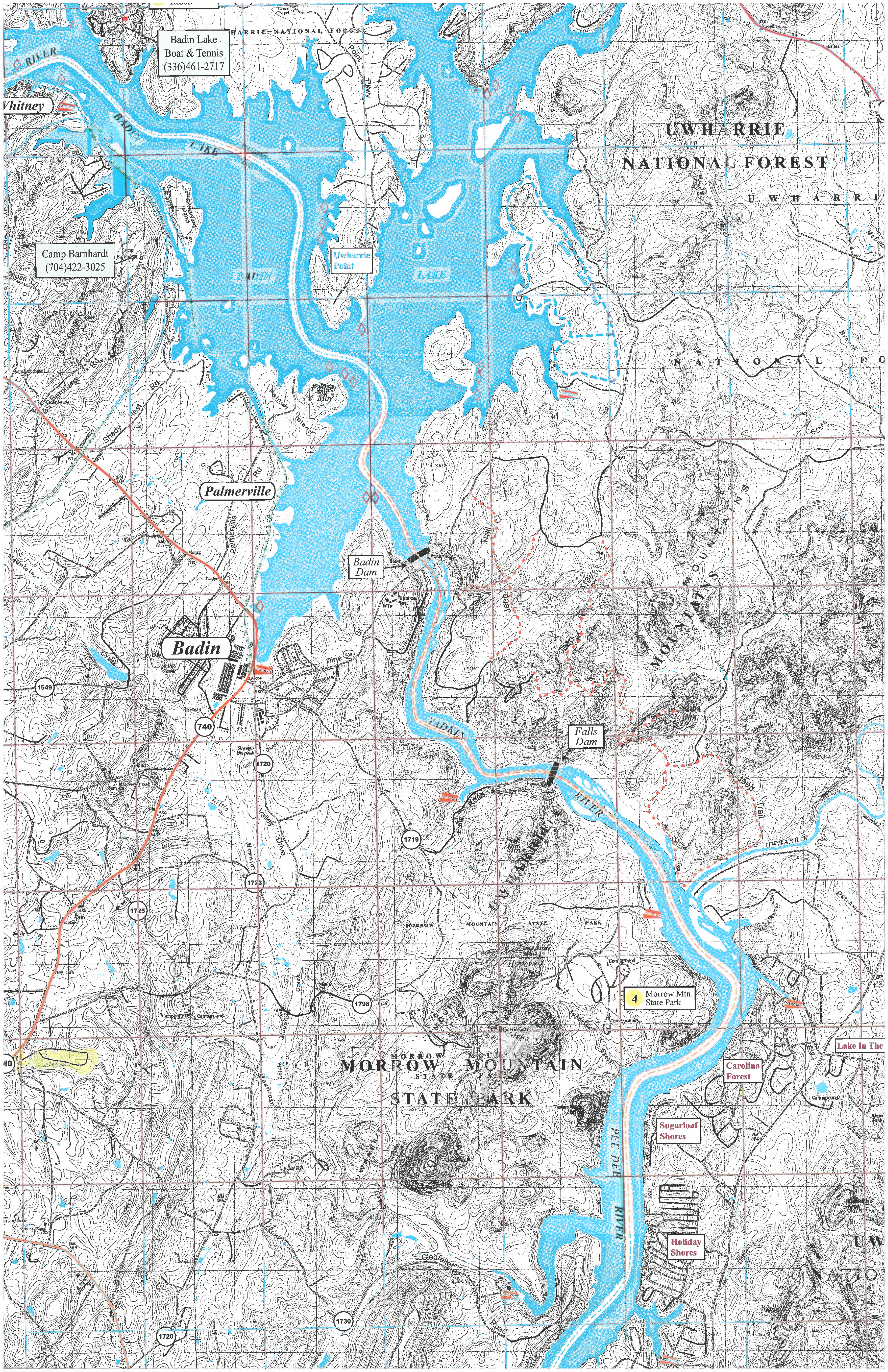
***Waterproof & Tear Resistant***

- GPS Compatible
  - Marina Listings
  - Lake Structure
  - Road Network
  - More






Kingfisher Maps, Inc.
Ph: (800) 326-0257 • FAX: (803) 695-4383
E-mail: info@kfmaps.com
Site: www.kingfishermaps.com



Badin Lake
Boat & Tennis
(336)461-2717
Whitney
UWHARRIE
NATIONAL FOREST
Camp Barnhardt
(704)422-3025
Uwharrie
Point
BADIN
LAKE
Palmerville
Badin
Dam
Badin
Falls
Dam
MOUNTAINS
YADKIN
RIVER
4
Morrow Mtn.
State Park
MORROW MOUNTAIN
STATE PARK
Lake In The
Carolina
Forest
Sugarloaf
Shores
Holiday
Shores
PEE DEE
RIVER
740
1549
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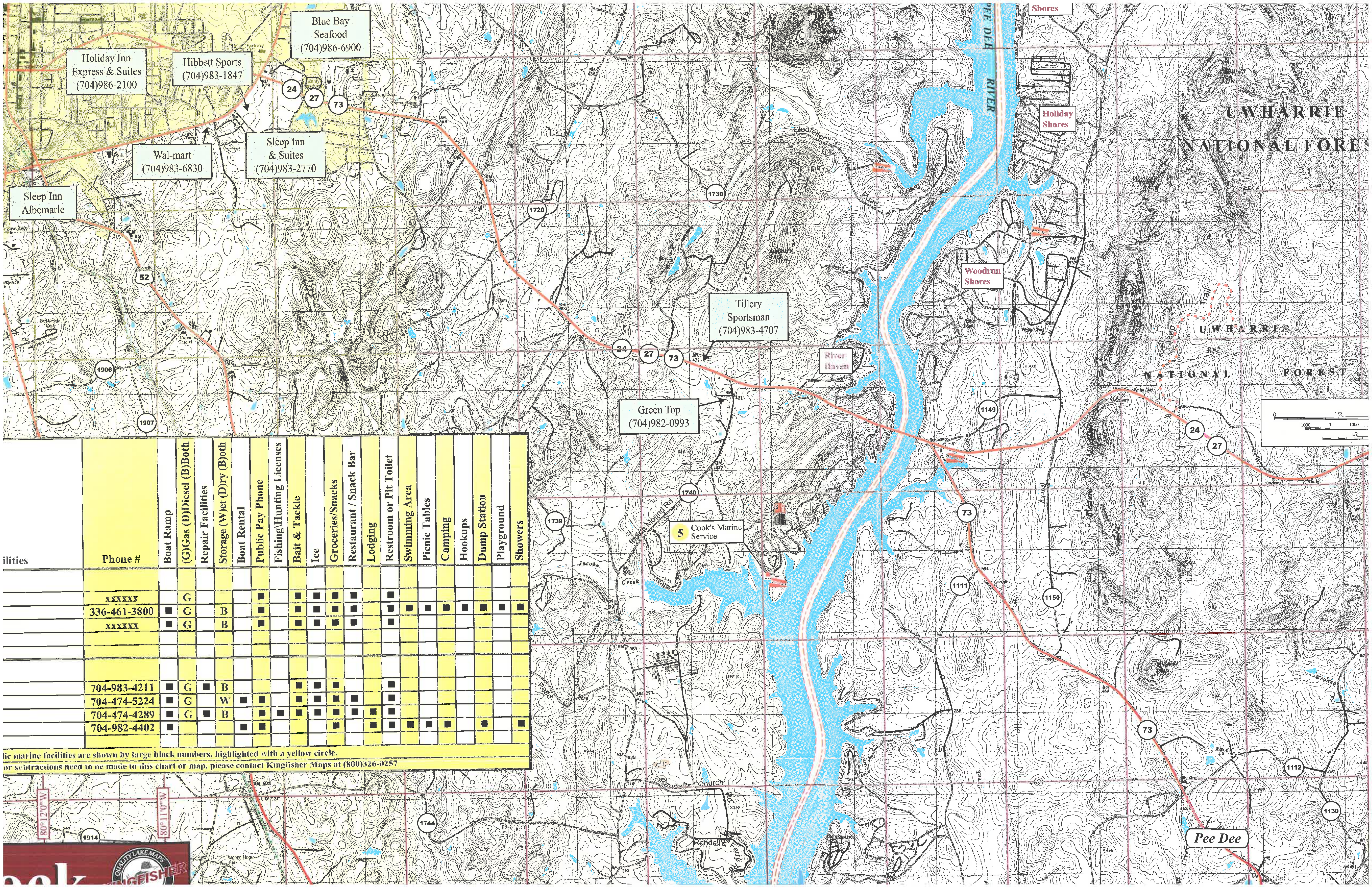
1723
1725
1798
1730




| ...ilities | Phone # | Boat Ramp | (G)Gas (D)Diesel (B)Both | Repair Facilities | Storage (W)et (D)ry (B)oth | Boat Rental | Public Pay Phone | Fishing\Hunting Licenses | Bait & Tackle | Ice | Groceries/Snacks | Restaurant / Snack Bar | Lodging | Restroom or Pit Toilet | Swimming Area | Picnic Tables | Camping | Hookups | Dump Station | Playground | Showers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | xxxxxx | | G | | | | ■ | | ■ | ■ | ■ | ■ | | ■ | | | | | | | |
| | 336-461-3800 | ■ | G | | B | | ■ | | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | xxxxxx | ■ | G | | B | | ■ | | ■ | ■ | ■ | ■ | | ■ | | | | | | | |
| | 704-983-4211 | ■ | G | ■ | B | | | | ■ | ■ | ■ | | | ■ | | | | | | | |
| | 704-474-5224 | ■ | G | | W | ■ | ■ | | ■ | ■ | ■ | ■ | | ■ | | | | | | | |
| | 704-474-4289 | ■ | G | ■ | B | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | | |
| | 704-982-4402 | ■ | | | | ■ | ■ | | | | ■ | | ■ | ■ | ■ | ■ | ■ | | ■ | | ■ |

...lic marine facilities are shown by large black numbers, highlighted with a yellow circle.

...or subtractions need to be made to this chart or map, please contact Kingfisher Maps at (800)326-0257

**REFERENCE 34**

N.C. Department of Health and Human Services

# Fish Consumption Advisories

Current Advisories for N.C.

Fish consumption advisories are issued by the Occupational and Environmental Epidemiology Branch, N.C. Division of Public Health. Learn more about this OEE program. Find current fish advisories for the state of North Carolina and for specific bodies of water in North Carolina. You may also use the Reports by County index to browse all available OEE reports, including fish advisories, hazardous site assessments, and community health studies.

Learn more about lakes and rivers in North Carolina:

- NC Department of Cultural Resources: North Carolina Geography in a Snap: Bodies of Water
- NC Department of Cultural Resources: Rivers

## Statewide Advisories

**Pollutant:** Mercury
**Date Issued/Updated:** April 2, 2008
**Advisory:**
*Women of Childbearing Age (15-44 years), Pregnant Women, Nursing Women, and Children under 15:*
Do not eat fish high in mercury, including largemouth bass caught in the state. Eat up to two meals per week of fish low in mercury. A meal is 6 ounces of uncooked fish for adults, or 2 ounces of uncooked fish for children under 15.
*All Other Individuals:*
Eat no more than one meal per week of fish high in mercury, including

largemouth bass caught in the state. Eat up to four meals per week of fish low in mercury. A meal is 6 ounces of uncooked fish for adults, or 2 ounces of uncooked fish for children under 15.
**Affected Fish:** Fish high in mercury

Learn more about mercury in fish.

## Site-Specific Advisories by Body of Water



### A

- **Albemarle Sound**

  **Affected Counties:** Bertie, Camden, Chowan, Currituck, Pasquotank, Perquimans, Tyrrell, and Washington

  **Site:** Albemarle Sound from Bull Bay to Harvey Point; West to the mouth of the Roanoke River and to the mouth of the Chowan River to the U.S. Highway 17 Bridge

**Pollutant:** Dioxins

**Date Issued:** October 2001

**Advisory:** Catfish and carp from these waters may contain low levels of dioxins. Women of childbearing age and children should not eat any catfish or carp from this area until further notice. All other persons should eat no more than one meal per month of catfish and carp from this area. Swimming, boating, and other recreational activities present no known significant health risks and are not affected by this advisory.

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**B**

- **Badin Lake**

  **Affected Counties:** Montgomery, Stanly

  **Pollutants:** Mercury, Polychlorinated biphenyls (PCBs)

  **Date Issued:** February 11, 2009

  **Advisory:** Elevated levels of chemicals called PCBs, along with mercury, may be found in catfish and largemouth bass in these waters. Pregnant women, women who may become pregnant, and children under 15 should avoid eating catfish and largemouth bass from this lake due to high levels of mercury as well as PCBs. Other people should eat no more than one meal per week of catfish and largemouth bass from this lake.

  See the related public health consultation and fish tissue study.

  Please also see the statewide mercury advisory.

- **Brier Creek**

  **Affected Counties:** Wake

  **Site:** Downstream of Brier Creek Reservoir; See also Lake Crabtree and Little Brier Creek

  **Pollutant:** Polychlorinated biphenyls (PCBs)

  **Date Issued:** May 7, 2004

  **Advisory:** Do not eat any fish from Brier Creek. High levels of PCBs have been found in the fish. Swimming, boating, and other recreational activities present no known significant health risks from PCBs and are not affected by this advisory. PCB-related risks, if any, from these activities have been shown to be negligible. If future testing reveals new information, then new advice will be given and new signs will be issued.

- Brier Creek, Little (See **Little Brier Creek**)

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C

- **Chatuge Lake**

  **Affected Counties:** Clay

  **Pollutant:** Mercury

  **Date Issued:** December 14, 2012

  **Advisory:** Elevated levels of mercury may be found in white bass or largemouth bass caught in Lake Chatuge. Women of childbearing age (15-44 years) and children under 15 should not eat any white bass or largemouth bass caught in Lake Chatuge. All other persons should eat no more than one meal (6 ounces) per week of white bass or largemouth bass caught in the lake. Swimming, boating, other recreational activities, and handling the fish present no known significant health risks and are not affected by this advisory. State health officials are unable to positively identify the original sources of the contamination, but have determined that airborne sources such as wind-blown dust are the most likely source.

Please also see the statewide mercury advisory.

- **Crabtree Creek**

  **Affected Counties:** Wake

  **Site:** Above Lake Crabtree and below Lake Crabtree to where it enters the Neuse River

  **Pollutant:** Polychlorinated biphenyls (PCBs)

  **Date Issued:** March 31, 2006

  **Advisory:** Limit consumption of carp, catfish, and largemouth bass from Crabtree Creek to no more than one meal per month. High levels of PCBs have been found in carp, catfish, and largemouth bass from these waters.

- Crabtree, Lake (See **Lake Crabtree**)

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**D**

- **Dan River**

  **Affected Counties:** Caswell, Rockingham

  **Site:** Dan River in North Carolina downstream of the Duke Energy – Dan River Steam Station spill site

**Pollutant:** Coal ash

**Date Revised:** February 27, 2015

**Fish and Shellfish Consumption:** On February 2, 2014, there was a release of coal ash to the Dan River from a waste ash pond on the Duke Energy - Dan River Steam Station near Eden, North Carolina. As a result, we recommend that people do not eat any fish or shellfish from the Dan River downstream of the spill in North Carolina's Rockingham and Caswell counties. We do not yet have the information needed to determine if eating fish or shellfish presents a health hazard or not. We are working with other agencies to collect fish downstream of the spill. We are evaluating the data from fish sampling as it becomes available to identify when eating the fish is no longer a concern.

**Recreational Water Use:** Contaminant levels related to the coal ash spill should not present a health risk during recreational use of the river. The most recent surface water and sediment data indicate that no health hazards are expected while boating or swimming. As an added precaution, if you come in contact with what appears to be coal ash, wash your skin off with soap and water.

See also Dan River Coal Ash Spill (Duke Energy – Dan River Steam Station Site)

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**F**

- **Falls Reservoir**

  **Affected Counties:** Montgomery, Stanly

  **Site:** See also Yadkin-Pee Dee River System

**Pollutant:** Polychlorinated biphenyls (PCBs)

**Date Issued:** March 13, 2013

**Advisory:** Levels of chemicals called PCBs were found above the state action level (0.05 mg/kg) in **catfish** species larger than 18 inches (450 mm) in Falls Reservoir. Prior studies of **catfish** in the state's lakes and rivers have identified elevated levels of mercury **south and east of U.S. Highway I-85**. The recommended number of meals for catfish as a result of the mercury advisory is also protective of potential health effects associated with eating catfish contaminated with PCBs in this lake. The recommended mercury advisory for catfish in this area is: *Pregnant women, nursing women, women who may become pregnant, and children under age 15 should not eat any catfish from* this lake. *Other people should not eat more than one meal a week. A meal of fish is approximately six (6) ounces of uncooked fish.*

See the related public health risk assessment of fish and sediment.

Please also see the statewide mercury advisory.

- **Fontana Lake**

**Affected Counties:** Graham and Swain

**Site:** See also Santeetlah Lake (Graham County)

**Pollutant:** Mercury

**Date Issued:** September 10, 2008

**Advisory:** Pregnant women, women who may become pregnant, and children under 15 should avoid eating walleye from Santeetlah and Fontana lakes due to high levels of mercury. Other people should limit their consumption of those fish to no more than one meal per week.

Please also see the statewide mercury advisory.

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## G

- Gaston, Lake (See **Lake Gaston**)

- **Glenville Reservoir**

  **Affected Counties:** Jackson

  **Pollutant:** Mercury

  **Date Issued:** December 9, 2014

  **Advisory:** Testing detected elevated levels of mercury in walleye in the Glenville Reservoir exceeding the N.C. Division of Public Health's action level for mercury of 0.4 mg/kg. Previous studies have shown that largemouth bass in all waters of North Carolina have elevated levels of mercury. The N.C. Division of Public Health recommends that pregnant women, nursing women, women who may become pregnant, and children under age 15 should not eat any walleye and largemouth bass from Glenville Reservoir. Other individuals should not eat more than one meal per month of walleye and one meal per week of largemouth bass from Glenville Reservoir. A meal of fish is approximately 6 ounces prior to cooking.

  **Recreational Water Use:** The elevated levels of mercury in walleye and largemouth bass does not present a known health risk for people engaging in recreational activities such as touching the water, wading, swimming, boating, or handling the fish.

  Please also see the statewide mercury advisory.

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## H

- **High Rock Lake**

  **Affected Counties:** Davidson, Rowan

  **Site:** See also Yadkin-Pee Dee River System

  **Pollutant:** Polychlorinated biphenyls (PCBs)

  **Date Issued:** March 13, 2013

  **Advisory:** Levels of chemicals called PCBs were found above the state action level (0.05 mg/kg) in **catfish** species larger than 18 inches (450 mm) in High Rock Lake. Prior studies of **catfish** in the state's lakes and rivers have identified elevated levels of mercury **south and east of U.S. Highway I-85**. The recommended number of meals for catfish as a result of the mercury advisory is also protective of potential health effects associated with eating catfish contaminated with PCBs in this lake. The recommended mercury advisory for catfish in this area is: *Pregnant women, nursing women, women who may become pregnant, and children under age 15 should not eat any catfish from* this lake. *Other people should not eat more than one meal a week. A meal of fish is approximately six (6) ounces of uncooked fish.*

  See the related public health risk assessment of fish and sediment.

  Please also see the statewide mercury advisory.

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## L

- Lake Chatuge (See **Chatuge Lake**)
- **Lake Crabtree**

**Affected Counties:** Wake

**Site:** See also Brier Creek and Little Brier Creek

**Pollutant:** Polychlorinated biphenyls (PCBs)

**Date Issued:** May 7, 2004

**Advisory:** Do not eat carp or catfish from Lake Crabtree. High levels of PCBs have been found in these fish. Limit consumption of all other fish from Lake Crabtree to no more than one meal per month. When in doubt about the fish species, do not eat any of the fish. Swimming, boating, and other recreational activities present no known significant health risks from PCBs and are not affected by this advisory. PCB-related risks, if any, from these activities have been shown to be negligible. If future testing reveals new information, then new advice will be given and new signs will be issued.

- Lake Fontana (See **Fontana Lake**)
- **Lake Gaston**

**Affected Counties:** Halifax, Northampton and Warren

**Pollutant:** Mercury

**Date Issued:** November 18, 2009

**Advisory:** Elevated levels of mercury may be found in walleye and largemouth bass in these waters. Pregnant women, women who may become pregnant, and children under 15 should avoid eating walleye and largemouth bass from this lake due to high levels of mercury. Other people should eat no more than one to two meals per month of walleye or largemouth bass from this lake.

Please also see the statewide mercury advisory.

- Lake Nantahala (See **Nantahala Lake**)
- **Lake Norman**

**Affected Counties:** Catawba, Iredell, Lincoln and Mecklenburg

**Pollutants:** Mercury, Polychlorinated biphenyls (PCBs)

**Date Issued:** April 9, 2013

**Advisory:** Levels of PCBs have been found in striped bass in Lake Norman that exceed the state action level for PCBs of 0.05 mg/kg. Because previous studies have shown that largemouth bass in all waters of North Carolina have elevated levels of mercury, this advisory for Lake Norman includes largemouth bass as well as striped bass. Pregnant women, nursing women, women who may become pregnant, and children under age 15 should not eat any striped bass or largemouth bass from Lake Norman. To guard against mercury exposure and potential PCB exposure, other people should not eat more than two meals a month of largemouth bass and one meal a week of striped bass from Lake Norman. A meal of fish is considered approximately six (6) ounces of uncooked fish.

Please also see the statewide mercury advisory.

- Lake Santeetlah (See **Santeetlah Lake**)
- **Lake Tillery**

**Affected Counties:** Montgomery, Stanly

**Site:** See also Yadkin-Pee Dee River System

**Pollutant:** Polychlorinated biphenyls (PCBs)

**Date Issued:** March 13, 2013

**Advisory:** Levels of chemicals called PCBs were found above the state action level (0.05 mg/kg) in **catfish** species larger than 18 inches (450 mm) in Lake Tillery. Prior studies of **catfish** in the state's lakes and rivers have identified elevated levels of mercury **south and east of U.S. Highway I-85**. The recommended number of meals for catfish as a result of the mercury advisory is also protective of potential health effects associated with eating catfish contaminated with PCBs in this lake. The recommended mercury advisory for catfish in this area is: *Pregnant women, nursing women, women who may become pregnant, and children under age 15 should not eat any catfish from* this lake. *Other people should not eat more than one meal a week. A meal of fish is approximately six (6) ounces of uncooked fish.*

See the related public health risk assessment of fish and sediment.

Please also see the statewide mercury advisory.

- **Lake Wylie**

  **Affected Counties:** Gaston and Mecklenburg

  **Pollutants:** Mercury, Polychlorinated biphenyls (PCBs)

  **Date Issued:** December 23, 2011

  **Advisory:** Elevated levels of PCBs have been found in largemouth bass in Lake Wylie. In addition, previous studies have shown that largemouth bass in all waters of North Carolina have elevated levels of mercury. Pregnant women, nursing women, women who may become pregnant, and children under age 15 should not eat any largemouth bass. To guard against mercury and PCB exposure, other people should not eat more than two meals a month of largemouth bass from this lake.

  Please also see the statewide mercury advisory.

- **Little Brier Creek**

**REFERENCE 35**

**STATE OF NORTH CAROLINA**
**DEPARTMENT OF ENVIRONMENTAL QUALITY**
**DIVISION OF WATER RESOURCES**

# PERMIT

## TO DISCHARGE WASTEWATER AND STORMWATER UNDER THE

## NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of North Carolina General Statute 143-215.1, other lawful standards and regulations promulgated and adopted by the North Carolina Environmental Management Commission, and the Federal Water Pollution Control Act, as amended,

**Alcoa Inc.**

is hereby authorized to discharge wastewater and stormwater from a facility located at the

**Alcoa - Badin Works**
**NC Hwy. 740 & NCSR 1719**
**Stanly County**

to receiving waters designated as UT to Little Mountain Creek and Badin Lake (Yadkin River) in the Yadkin - Pee Dee River Basin

in accordance with effluent limitations, monitoring requirements, and other conditions set forth in Parts I, II, and III of this permit.

This permit shall become effective

This permit and the authorization to discharge shall expire at midnight on May 30, 2020.

Signed this day

S. Jay Zimmerman, P.G.
Director, Division of Water Resources
By Authority of the Environmental Management Commission

## SUPPLEMENT TO PERMIT COVER SHEET

*The authority to operate and discharge from this facility arises exclusively under the terms and conditions of this NPDES Permit. Therefore, upon the effective date of this permit, any and all previous NPDES Permits issued for this facility and bearing this permit number are revoked.*

## Alcoa Inc.

is hereby authorized to:

1. Discharge the following:

- stormwater at Outfalls 002, 004, 017, 018, 020, and 022;
- groundwater, stormwater and fire protection water at Outfalls 005, Outfall 012, Outfall 011 when flows exceed the capacity of the diffuser, and Outfall 013;
- overflow from stormwater retention pond at Outfall 019.

all outfalls being located at or near the Alcoa - Badin Works in Stanly County; and

2. Discharge such groundwater, stormwater and/or fire protection water from locations specified on the attached map into an unnamed tributary to Little Mountain Creek (Outfalls 004, 005, 017, 018, and 022) and into Badin Lake (Yadkin River) (Outfalls 002, 011, 012, 013, 019, 020) which are classified as Class "WS-IV" waters and Class "WS-IV CA & B" waters, respectively, in the Yadkin-Pee Dee River Basin.

All discharges shall be in accordance with the attached schedules as follows:

**Part I:** **Monitoring, Controls, and Limitations for Permitted Discharges**
**A. Effluent Limitations and Monitoring Requirements**
**B. Stormwater Management Requirements**
**C. Special Conditions**
**Part II:** **Standard Conditions for NPDES Permits**
**Part III:** **Other Requirements**

Any other point source discharge to surface waters of the state is prohibited unless covered by another permit, authorization, or approval.

This permit does not relieve the Permittee from responsibility for compliance with any other applicable federal, state, or local law, rule, standard, ordinance, order, judgment, or decree.

# PART I

## SECTION A - EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning on the effective date of the permit and lasting until expiration, the Permittee is authorized to discharge wastewater and stormwater associated with the activities described in its current NPDES permit application. Such discharges shall be monitored, controlled, and limited as specified below.

### A.(1.) EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 005[15A NCAC 02B .0400 et seq., 02B .0500 et seq.]

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the Permittee is authorized to discharge ***groundwater, stormwater, and fire protection water*** at Outfall 005 subject to the following effluent limitations and monitoring requirements:

| PARAMETER | EFFLUENT LIMITATIONS | | | MONITORING REQUIREMENTS | | |
|---|---|---|---|---|---|---|
| | Monthly Average | Weekly Average | Daily Maximum | Measurement Frequency | Sample Type | Sample Location [1] |
| Flow | | | | Monthly | Instantaneous | E |
| Total Suspended Solids | | | | Quarterly | Composite [2] | E |
| pH | Shall remain within the range of 6.0 to 9.0 standard units at all times | | | Monthly | Grab | E |
| Total Aluminum | | | | Quarterly | Composite [2] | E |
| Total Fluoride | 1.8 mg/l | | 24 mg/l | Monthly | Composite [2] | E |
| Total Cyanide [3] | 5 µg/l | | 46.6 µg/l | Monthly | Grab | E |
| Acute Toxicity [4] | | | | Quarterly | Composite [2] | E |

**Footnotes:**

1. Sample locations: E - Effluent.
2. The Permittee may use time-proportionate compositing or other sampling method provided that the alternate method yields samples that are reasonably representative of the discharge during the monitoring period.
3. The Permittee shall report on its Discharge Monitoring Reports the actual laboratory results for each effluent sample tested. However, for the purpose of compliance with this permit, the quantitation limit for Total Cyanide shall be defined as 10 µg/L, and the Division shall treat each reported value less than 10 µg /L as zero.
4. Acute Toxicity P/F Quarterly; see Condition C. (1).

**A.(2.) EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 011** [15A NCAC 02B .0400 et seq., 02B .0500 et seq.]

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the Permittee is authorized to discharge ***fire protection waters, groundwater, and stormwater*** exceeding the Outfall 012 diffuser capacity at Outfall 011 subject to the following effluent limitations and monitoring requirements:

| PARAMETER | EFFLUENT LIMITATIONS | | | MONITORING REQUIREMENTS | | |
|---|---|---|---|---|---|---|
| | Monthly Average | Weekly Average | Daily Maximum | Measurement Frequency | Sample Type | Sample Location [1] |
| Flow | | | | Monthly | Instantaneous | E |
| Total Aluminum | | | | Quarterly | Composite[2] | E |
| Total Fluoride | 1.8 mg/l | | 24 mg/l | Monthly | Composite[2] | E |
| Total Cyanide [3] | 5 µg/l | | 46.6 µg/l | Monthly | Grab | E |
| Total Suspended Solids | | | | Quarterly | Composite[2] | E |
| Trichloroethene (TCE) [4] | 0.6 µg/l | | | Monthly | Grab | E |
| pH | Shall remain within the range of 6.0 to 9.0 standard units at all times | | | Quarterly | Grab | E |
| Acute Toxicity [5] | | | | Quarterly | Composite[2] | E |

**Footnotes:**

1. Sample locations: E - Effluent.
2. The Permittee may use time-proportionate compositing or other sampling method provided that the alternate method yields samples that are reasonably representative of the discharge during the monitoring period.
3. The Permittee shall report on its Discharge Monitoring Reports the actual laboratory results for each effluent sample tested. However, for the purpose of compliance with this permit, the quantitation limit for Total Cyanide shall be defined as 10 µg /L, and the Division shall treat each reported value less than 10 µg /L as zero.
4. The facility may request that the Division review the data after collection of at least 12 data points to determine if there is reasonable potential to exceed the water quality standard or EPA criteria. If no reasonable potential exists, the Division may remove the limit and/or reduce the monitoring frequency.
5. Acute Toxicity Monitoring Quarterly; see Condition C.(2).

## A.(3.) EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 012 [15A NCAC 02B .0400 et seq., 02B .0500 et seq.]

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the Permittee is authorized to discharge ***fire protection waters, groundwater, and stormwater*** at Outfall 012 (diffuser) subject to the following effluent limitations and monitoring requirements:

| PARAMETER | EFFLUENT LIMITATIONS | | | MONITORING REQUIREMENTS | | |
|---|---|---|---|---|---|---|
| | Monthly Average | Weekly Average | Daily Maximum | Measurement Frequency | Sample Type | Sample Location [1] |
| Flow | | | | Monthly | Instantaneous | E |
| Total Suspended Solids | | | | Quarterly | Composite [2] | E |
| pH | Shall remain within the range of 6.0 to 9.0 standard units at all times | | | Monthly | Grab | E |
| Total Cyanide [3] | 130 µg/l | | 434 µg/l | Monthly | Grab | E |
| Total Fluoride | | | | Quarterly | Composite [2] | E |
| Total Aluminum | | | | Quarterly | Composite [2] | E |
| Trichloroethene (TCE) [4] | 15.6 µg/l | | | Monthly | Grab | E |
| Chronic Toxicity [5] | | | | Quarterly | Composite [2] | E |

**Footnotes:**

1. Sample locations: E - Effluent.
2. The Permittee may use time-proportionate compositing or other sampling method provided that the alternate method yields samples that are reasonably representative of the discharge during the monitoring period.
3. The Permittee shall report on its Discharge Monitoring Reports the actual laboratory results for each effluent sample tested. However, for the purpose of compliance with this permit, the quantitation limit for Total Cyanide shall be defined as 10 µg /L, and the Division shall treat each reported value less than 10 µg /L as zero.
4. The facility may request that the Division review the data after collection of at least 12 data points to determine if there is reasonable potential to exceed the water quality standard or EPA criteria. If no reasonable potential exists, the Division may remove the limit and/or reduce the monitoring frequency.
5. Chronic Toxicity Pass/Fail Quarterly; see Condition C.(3).

**A. (4.) EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 013** [15A NCAC 02B .0400 et seq., 02B .0500 et seq.]

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the Permittee is authorized to discharge ***groundwater and stormwater*** at Outfall 013 subject to the following effluent limitations and monitoring requirements:

| PARAMETER | EFFLUENT LIMITATIONS | | | MONITORING REQUIREMENTS | | |
|---|---|---|---|---|---|---|
| | Monthly Average | Weekly Average [1] | Daily Maximum | Measurement Frequency | Sample Type | Sample Location [1] |
| Flow | | | | Monthly | Instantaneous | E |
| Total Suspended Solids | | | | Quarterly | Composite [2] | E |
| Total Aluminum | | | | Quarterly | Composite [2] | E |
| Total Fluoride | | | | Quarterly | Composite [2] | E |
| Total Cyanide [3] | 5 µg/l | | 46.6 µg/l | Monthly | Grab | E |
| pH | Shall remain within the range of 6.0 to 9.0 standard units at all times | | | Monthly | Grab | E |
| Acute Toxicity [4] | | | | Quarterly | Composite [2] | E |

**Footnotes:**

1. Sample locations: E - Effluent.
2. The Permittee may use time-proportionate compositing or other sampling method provided that the alternate method yields samples that are reasonably representative of the discharge during the monitoring period.
3. The Permittee shall report on its Discharge Monitoring Reports the actual laboratory results for each effluent sample tested. However, for the purpose of compliance with this permit, the quantitation limit for Total Cyanide shall be defined as 10 µg /L, and the Division shall treat each reported value less than 10 µg /L as zero.
4. Acute Toxicity Monitoring Quarterly; see Condition C.(2).

**A. (5.) EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - Outfall 019** [15A NCAC 02B .0400 et seq., 02B .0500 et seq.]

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the Permittee is authorized to discharge ***overflow from the retention pond at the Old Brick Landfill*** at Outfall 019 subject to the following effluent limitations and monitoring requirements:

| PARAMETER | EFFLUENT LIMITATIONS | | | MONITORING REQUIREMENTS | | |
|---|---|---|---|---|---|---|
| | Monthly Average | Weekly Average | Daily Maximum | Measurement Frequency | Sample Type | Sample Location [1] |
| Flow | | | | Semi-annual | See Note 2 | E |
| Total Rainfall (inches) [2] | | | | Semi-annual | Rain gauge | --- |
| Total Suspended Solids | | | | Semi-annual | Grab | E |
| Total Aluminum | | | | Semi-annual | Grab | E |
| Total Fluoride | | | | Semi-annual | Grab | E |
| Total Cyanide | | | | Semi-annual | Grab | E |
| pH | Shall remain within the range of 6.0 to 9.0 standard units at all times | | | Semi-annual | Grab | E |
| Acute Toxicity [3] | | | | Annual | Grab | E |

**Footnotes:**

1. Sample locations: E - Effluent.
2. For each sampled representative storm event the total precipitation must be recorded. An on-site rain gauge or local rain gauge reading must be recorded.
3. Acute Toxicity Monitoring Annual; see Condition C.(4).

**A. (6.) INSTREAM MONITORING** [15A NCAC 02B .0500 et seq.]

Instream monitoring is required for the following parameters at the locations specified:

| PARAMETER | MONITORING REQUIREMENTS | | |
|---|---|---|---|
| | Measurement Frequency | Sample Type | Sample Location [1] |
| pH | Monthly | Grab | U1, WC, EC, D1, D2 |
| Total Cyanide | Monthly | Grab | U1, WC, EC, D1, D2 |
| Total Fluoride | Monthly | Grab | U1, WC, EC, D1, D2 |
| Total Lead | Monthly | Grab | U1, WC, EC, D1, D2 |
| Total Arsenic | Monthly | Grab | U1, WC, EC, D1, D2 |

1. U1- Little Mountain Creek Upstream of the landfill, WC – Little Mountain Creek near the drainage from the west toe drain channel, EC – Little Mountain Creek near the drainage from the east toe drain channel, D1 – Little Mountain Creek downstream from EC, D2 - Little Mountain Creek downstream from NC 740.

**A. (7.) PRIORITY POLLUTANT ANALYSIS** [G.S. 143-215.1(b)]

Within one year of the effective date of the permit the permittee shall submit the result of a priority pollutant scan for each of the following outfalls: 005, 011, 012 and 013. The pollutant analysis shall consist of the 126 pollutants included in Appendix A to 40 CFR 423 and listed in the following table:

| | | |
|---|---|---|
| Acenaphthene | Methylene chloride | Vinyl chloride |
| Acrolein | Methyl chloride | Aldrin |
| Acrylonitrile | Methyl bromide | Dieldrin |
| Benzene | Bromoform | Chlordane |
| Benzidine | Dichlorobromomethane | 4,4-DDT |
| Carbon tetrachloride | Chlorodibromomethane | 4,4-DDE |
| Chlorobenzene | Hexachlorobutadiene | 4,4-DDD |
| 1,2,4-trichlorobenzene | Hexachlorocyclopentadiene | Alpha-endosulfan |
| Hexachlorobenzene | Isophorone | Beta-endosulfan |
| 1,2-dichloroethane | Naphthalene | Endosulfan sulfate |
| 1,1,1-trichloreothane | Nitrobenzene | Endrin |
| Hexachloroethane | 2-nitrophenol | Endrin aldehyde |
| 1,1-dichloroethane | 4-nitrophenol | Heptachlor |
| 1,1,2-trichloroethane | 2,4-dinitrophenol | Heptachlor epoxide |
| 1,1,2,2-tetrachloroethane | 4,6-dinitro-o-cresol | Alpha-BHC |
| Chloroethane | N-nitrosodimethylamine | Beta-BHC |
| Bis(2-chloroethyl) ether | N-nitrosodiphenylamine | Gamma-BHC |
| 2-chloroethyl vinyl ethers | N-nitrosodi-n-propylamine | Delta-BHC |
| 2-chloronaphthalene | Pentachlorophenol | PCB–1242 (Arochlor 1242) |
| 2,4,6-trichlorophenol | Phenol | PCB–1254 (Arochlor 1254) |
| Parachlorometa cresol | Bis(2-ethylhexyl) phthalate | PCB–1221 (Arochlor 1221) |
| Chloroform | Butyl benzyl phthalate | PCB–1232 (Arochlor 1232) |
| 2-chlorophenol | Di-N-Butyl Phthalate | PCB–1248 (Arochlor 1248) |
| 1,2-dichlorobenzene | Di-n-octyl phthalate | PCB–1260 (Arochlor 1260) |
| 1,3-dichlorobenzene | Diethyl Phthalate | PCB–1016 (Arochlor 1016) |
| 1,4-dichlorobenzene | Dimethyl phthalate | Toxaphene |
| 3,3-dichlorobenzidine | benzo(a) anthracene | Antimony |
| 1,1-dichloroethylene | Benzo(a)pyrene | Arsenic |
| 1,2-trans-dichloroethylene | Benzo(b) fluoranthene | Asbestos |
| 2,4-dichlorophenol | Benzo(k) fluoranthene | Beryllium |
| 1,2-dichloropropane | Chrysene | Cadmium |
| 1,3-dichloropropylene | Acenaphthylene | Chromium |
| 2,4-dimethylphenol | Anthracene | Copper |
| 2,4-dinitrotoluene | Benzo(ghi) perylene | Cyanide, Total |
| 2,6-dinitrotoluene | Fluorene | Lead |
| 1,2-diphenylhydrazine | Phenanthrene | Mercury |
| Ethylbenzene | Dibenzo(,h) anthracene | Nickel |
| Fluoranthene | Indeno (1,2,3-cd) pyrene | Selenium |
| 4-chlorophenyl phenyl ether | Pyrene | Silver |
| 4-bromophenyl phenyl ether | Tetrachloroethylene | Thallium |
| Bis(2-chloroisopropyl) ether | Toluene | Zinc |
| Bis(2-chloroethoxy) methane | Trichloroethylene | 2,3,7,8-TCDD |

## SECTION B - STORMWATER MANAGEMENT REQUIREMENTS [G.S. 143-215.1(a) et seq., 15A NCAC 02H .0126 et seq.]

### B.(1.) STORMWATER MONITORING REQUIREMENTS - Outfalls 002, 004, 017, 018, 020 & 022

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the Permittee is authorized to discharge ***stormwater*** at Outfalls 002, 004, 017, 018, 020 and 022. Such discharges shall be controlled, limited, and monitored as specified in this permit.

**1. Analytical Monitoring:**

Analytical monitoring of stormwater discharges shall be performed as specified below. All analytical monitoring shall be performed during a **measureable storm event.**

A **measurable storm event** is a storm event that results in **an actual discharge** from the permitted site outfall. The previous measurable storm event must have been at least 72 hours prior. The 72-hour storm interval does not apply if the permittee is able to document that a shorter interval is representative for local storm events during the sampling period, and the permittee obtains approval from the local DEMLR Regional Engineer (*See Definitions).*

**Analytical Monitoring Requirements**

| Discharge Characteristics | Units | Measurement Frequency[1] | Sample Type[2] | Sample Location[3] |
|---|---|---|---|---|
| Total Suspended Solids (TSS) | mg/L | semi-annual | Grab | SDO |
| Chemical Oxygen Demand (COD) | mg/L | semi-annual | Grab | SDO |
| Aluminum, Total Recoverable | mg/L | semi-annual | Grab | SDO |
| Total Cyanide | mg/L | semi-annual | Grab | SDO |
| Total Fluoride | mg/L | semi-annual | Grab | SDO |
| Total Rainfall[4] | inches | semi-annual | Rain Gauge | - |

**Footnotes:**

1. Measurement Frequency: Twice per year (unless other provisions of this permit prompt monthly sampling) during a measureable storm event, until either another permit is issued for this facility or until this permit is revoked or rescinded. If the facility is monitoring monthly because of Tier Two or Three response actions under the previous permit, the facility shall continue a monthly monitoring and reporting schedule in Tier Two or Tier Three status until relieved by the provisions of this permit by DEMLR.
2. Grab samples shall be collected within the first 30 minutes of discharge. When physical separation between outfalls prevents collecting all samples within the first 30 minutes, sampling shall begin within the first 30 minutes, and shall continue until completed.
3. Sample Location: Samples shall be collected at each stormwater discharge outfall (SDO) unless representative outfall status (ROS) has been granted. A copy of DEMLR's letter granting ROS shall be kept on site.
4. For each sampled measureable storm event, the total precipitation must be recorded. An on-site rain gauge is required. Where isolated sites are unmanned for extended periods of time, a local rain gauge reading may be substituted for an on-site reading.

The permittee shall complete the analytical samplings in accordance with the schedule specified below, unless *adverse weather* conditions prevent sample collection. A **minimum of 60 days must separate Period 1 and Period 2 sample dates**, unless monthly monitoring has been instituted under a Tier Two response. Inability to sample because of adverse weather conditions must be documented in the SPPP and recorded on the DMR. The permittee must report the results from each sample taken within the monitoring period (see Part II, Section D). However, for purposes of benchmark comparison and Tiered response actions, the permittee shall use the analytical results from **the first sample with valid results** within the monitoring period.

**Monitoring Schedule**

| Monitoring period[1,2] | Sample Number | Start | End |
|---|---|---|---|
| Year 1 – Period 1 | 1 | January 1, 2016 | June 30, 2016 |
| Year 1 – Period 2 | 2 | July 1, 2016 | December 31, 2016 |
| Year 2 – Period 1 | 3 | January 1, 2017 | June 30, 2017 |
| Year 2 – Period 2 | 4 | July 1, 2017 | December 31, 2017 |
| Year 3 – Period 1 | 5 | January 1, 2018 | June 30, 2018 |
| Year 3 – Period 2 | 6 | July 1, 2018 | December 31, 2018 |
| Year 4 – Period 1 | 7 | January 1, 2019 | June 30, 2019 |
| Year 4 – Period 2 | 8 | July 1, 2019 | December 31, 2019 |
| Year 5 – Period 1 | 9 | January 1, 2020 | June 30, 2020 |
| Year 5 – Period 2 | 10 | July 1, 2020 | December 1, 2020 |

**Footnotes:**

1. Maintain semi-annual monitoring until either another permit is issued for this facility or until this permit is revoked or rescinded. The permittee must submit an application for renewal of coverage before the submittal deadline (180 days before expiration) to be considered for renewed coverage under the permit. The permittee must continue analytical monitoring throughout the permit renewal process, even if a renewal permit is not issued until after expiration of this permit.
2. If no discharge occurs during the sampling period, the permittee must submit a monitoring report indicating "No Flow" or "No Discharge" within 30 days of the end of the sampling period.

Failure to monitor semi-annually per permit terms may result in DEMLR requiring **monthly monitoring** for all parameters for a specified time period. "No discharge" from an outfall during a monitoring period does not constitute failure to monitor, as long as it is properly recorded and reported.

The permittee shall compare monitoring results to the benchmark values below. Exceedances of benchmark values require the permittee to increase monitoring, increase management actions, increase record keeping, and/or install stormwater Best Management Practices (BMPs) in a tiered program. See below the descriptions of **Tier One**, **Tier Two**, and **Tier Three** response actions. In the event that DEMLR releases the permittee from continued monthly monitoring and reporting under Tier Two or Tier Three, DEMLR's release letter may remain in effect through subsequent reissuance of this permit, unless the release letter provides for other conditions or duration.

**Benchmark Values for Analytical Monitoring**

| Discharge Characteristics | Units | Benchmark |
|---|---|---|
| Total Suspended Solids (TSS) | mg/L | 100 |
| Chemical Oxygen Demand | mg/L | 120 |
| Aluminum, Total Recoverable | mg/L | 0.75 |
| Total Cyanide | mg/L | 0.02 |
| Total Fluoride | mg/L | 6 |

The benchmark values above are not permit limits but should be used as guidelines for implementation of the permittee's SPPP. An **exceedance of a stormwater benchmark value is not a permit violation**; however, failure to respond to the exceedance as outlined in this permit is a violation of permit conditions.

| *Tier One* |
|---|
| **If:** The **first valid sampling results** are above a benchmark value for any parameter at any outfall; |
| **Then:** The permittee shall:<br>1. Conduct a stormwater management inspection of the facility **within two weeks of receiving sampling results.**<br>2. Identify and evaluate possible causes of the benchmark value exceedance.<br>3. Identify potential, and select the specific feasible: source controls, operational controls, or physical improvements to reduce concentrations of the parameters of concern.<br>4. Implement the selected feasible actions **within two months of the inspection.**<br>5. Record each instance of a Tier One response in the SPPP. Include the date and value of the benchmark exceedence, the inspection date, the personnel conducting the inspection, the selected actions, and the date the selected actions were implemented.<br>6. Note: Benchmark exceedances for a different parameter separately trigger a tiered response. |

| *Tier Two* |
|---|
| **If:** The **first valid sampling results** from two consecutive monitoring periods are above the benchmark values for any specific parameter at a specific discharge outfall; |
| **Then:** The permittee shall:<br>1. Repeat all the required actions outlined above in Tier One.<br>2. Immediately institute monthly monitoring and reporting for all parameters. The permittee shall conduct monthly monitoring at every outfall where a sampling result exceeded the benchmark value for two consecutive samples. Monthly (analytical and qualitative) monitoring shall continue until three consecutive sample results are below the benchmark values or within benchmark range.<br>3. If no discharge occurs during the sampling period, the permittee is required to submit a monthly monitoring report indicating "No Flow" to comply with reporting requirements.<br>4. *Alternatively,* in lieu of steps 2 and 3, the permittee may, after two consecutive exceedances, exercise the option of contacting the DEMLR Regional Engineer as provided below in Tier Three. The Regional Engineer may direct the response actions on the part of the permittee as provided in Tier Three, including reduced or additional sampling parameters or frequency.<br>5. Maintain a record of the Tier Two response in the SPPP.<br>6. Continue Tier Two response obligations throughout the permit renewal process. |

| *Tier Three* |
|---|
| **If:** The **valid sampling results required for the permit monitoring periods** exceed the benchmark value for any specific parameter at any specific outfall on **four occasions**, the permittee shall notify the DEMLR Regional Engineer in writing **within 30 days of receipt** of the fourth analytical results; |
| **Then:** The Division **may but is not limited to**:<br>• require that the permittee revise, increase, or decrease the monitoring and reporting frequency for some or all of the parameters herein;<br>• require sampling of additional or substitute parameters;<br>• require the permittee to install structural stormwater controls;<br>• require the permittee to implement other stormwater control measures;<br>• require the permittee to perform upstream and downstream monitoring to characterize impacts on receiving waters; or<br>• require the permittee implement site modifications to qualify for a No Exposure Exclusion;<br>• require the permittee to continue Tier Three obligations through the permit renewal process. |

**2. Qualitative Monitoring Requirements**

The purpose of qualitative monitoring is to evaluate the effectiveness of the Stormwater Pollution Prevention Plan (SPPP) and identify new potential sources of stormwater pollution. Qualitative monitoring of stormwater outfalls must be performed during a **measurable storm event.**

Qualitative monitoring requires a visual inspection of each stormwater outfall *regardless of* representative outfall status. Qualitative monitoring shall be performed semi-annually as specified below, and during required analytical monitoring events (unless the permittee is required to perform further qualitative monitoring per the **Qualitative Monitoring Response**, below). Inability to monitor because of adverse weather conditions must be documented in the SPPP and recorded on the Qualitative Monitoring Report form (see *Adverse Weather* in Definitions). Only SDOs discharging *stormwater associated with industrial activity* must be monitored (See Definitions).

In the event an atypical condition is noted at a stormwater discharge outfall, the permittee shall document the suspected cause of the condition and any actions taken in response to the discovery. This documentation will be maintained with the SPPP.

**Qualitative Monitoring Requirements**

| Discharge Characteristics | Frequency[1] | Monitoring Location[2] |
|---|---|---|
| Color | semi-annual | SDO |
| Odor | semi-annual | SDO |
| Clarity | semi-annual | SDO |
| Floating Solids | semi-annual | SDO |
| Suspended Solids | semi-annual | SDO |
| Foam | semi-annual | SDO |
| Oil Sheen | semi-annual | SDO |
| Erosion or deposition at the outfall | semi-annual | SDO |

| Discharge Characteristics | Frequency[1] | Monitoring Location[2] |
|---|---|---|
| Other obvious indicators of stormwater pollution | semi-annual | SDO |

**Footnotes:**

1. Monitoring Frequency: Twice per year during a **measureable storm event** unless other provisions of this permit prompt monthly monitoring. See schedule of monitoring periods through the end of this permitting cycle. The permittee must continue qualitative monitoring throughout the permit renewal process until a new permit is issued.
2. Monitoring Location: Qualitative monitoring shall be performed at each stormwater discharge outfall (SDO) regardless of representative outfall status.

**A minimum of 60 days** must separate monitoring dates, *unless additional sampling has been instituted as part of other analytical monitoring requirements in this permit.*

If the permittee's qualitative monitoring indicates that existing stormwater BMPs are ineffective, or that significant stormwater contamination is present, the permittee shall investigate potential causes, evaluate the feasibility of corrective action, and implement those corrective actions within 60 days, per the **Qualitative Monitoring Response**, below. A written record of the permittee's investigation, evaluation, and response actions shall be kept in the SPPP.

| Qualitative Monitoring Response |
|---|
| Qualitative monitoring is for the purposes of evaluating SPPP effectiveness, identifying new potential sources of stormwater pollution, and prompting the permittee's response to pollution. If the permittee repeatedly fails to respond effectively to correct problems identified by qualitative monitoring, or if the discharge causes or contributes to a water quality standard violation, **DEMLR may but is not limited to:**<br>• require that the permittee revise, increase, or decrease the monitoring frequency for some or all parameters (analytical or qualitative)<br>• require the permittee to install structural stormwater controls;<br>• require the permittee to implement other stormwater control measures;<br>• require the permittee to perform upstream and downstream monitoring to characterize impacts on receiving waters; or<br>• require the permittee implement site modifications to qualify for a No Exposure Exclusion. |

## B.(2.) STORMWATER POLLUTION PREVENTION PLAN

The permittee shall **develop and implement** a Stormwater Pollution Prevention Plan (SPPP). The SPPP shall be maintained on site unless exempted from this requirement by DEMLR. The SPPP is public information in accordance with Part II, Standard Conditions, Section E Paragraph 10 of this permit. The SPPP shall include, at a minimum, the following items:

1. **Site Overview**. The Site Overview shall provide a description of the physical facility and the potential pollutant sources that may be expected to contribute to contamination of stormwater discharges. The Site Overview shall contain the following:

   (a) A general **location map** (USGS quadrangle map or appropriately drafted equivalent map), showing the facility's location in relation to transportation routes and surface waters; the name of the receiving waters to which the stormwater outfalls discharge, or if the discharge is to a municipal separate storm sewer system, the name of the municipality and the ultimate receiving waters; and accurate latitude and longitude of the points of stormwater discharge associated with industrial activity. The general location map (or alternatively the site map) shall identify whether any receiving waters are **impaired** (on the state's 303(d) list of impaired waters) or if the site is located in a **watershed for which a TMDL has been established**, and what the parameters of concern are.

   (b) A **narrative description** of storage practices, loading and unloading activities, outdoor process areas, dust or particulate generating or control processes, and waste disposal practices. A **narrative description** of the potential pollutants that could be expected to be present in the stormwater discharge from each outfall.

   (c) A **site map** drawn at a scale sufficient to clearly depict: the site property boundary; the stormwater discharge outfalls; all on-site and adjacent surface waters and wetlands; industrial activity areas (including storage of materials, disposal areas, process areas, loading and unloading areas, and haul roads); site topography and finished grade; all drainage features and structures; drainage area boundaries and total contributing area for each outfall; direction of flow in each drainage area; industrial activities occurring in each drainage area; buildings; stormwater Best Management Practices (BMPs); and impervious surfaces. The site map must indicate the percentage of each drainage area that is impervious, and the site map must include a graphic scale indication and north arrow.

   (d) A **list of significant spills or leaks** of pollutants during the previous three (3) years and any corrective actions taken to mitigate spill impacts.

   (e) Certification that the stormwater outfalls have been evaluated for the presence of non-stormwater discharges. **The permittee shall re-certify annually that the stormwater outfalls have been evaluated for the presence of non-stormwater discharges**. If non-stormwater discharges are present, the permittee shall identify the source and record whether the discharge is otherwise permitted (by rule or a different permit). The permittee shall evaluate the environmental significance of the non-stormwater discharges and include a summary written record with the certification. The certification statement and summary written record shall be retained with the SPPP, and shall be dated and signed in accordance with the requirements found in Standard Conditions for NPDES Permits, Part II, Section B.11(b).

   (f) If a permanent source of non-stormwater flow is identified in accordance with B. (2) 1. (e) the permittee shall notify DWR and DEMLR. The notification must include a description and frequency of discharge for the identified non-stormwater flow. The notification must be submitted to the following addresses:

DWR/NPDES Complex Permitting Unit
1617 Mail Service Center
Raleigh, NC 27699-1617

DEMLR / Stormwater Permitting Program
1612 Mail Service Center
Raleigh, NC 27699-1612**.**

2. **Stormwater Management Strategy**. The Stormwater Management Strategy shall contain a narrative description of the materials management practices employed which control or minimize the stormwater exposure of significant materials, including structural and nonstructural measures. The Stormwater Management Strategy, at a minimum, shall incorporate the following:

    (a) **Feasibility Study**. A review of the technical and economic feasibility of changing the methods of operations and/or storage practices to eliminate or reduce exposure of materials and processes to rainfall and run-on flows. Wherever practical, the permittee shall prevent exposure of all storage areas, material handling operations, and manufacturing or fueling operations. In areas where elimination of exposure is not practical, this review shall document the feasibility of diverting the stormwater run-on away from areas of potential contamination.

    (b) **Secondary Containment Requirements and Records**. Secondary containment is required for: bulk storage of liquid materials; storage in any amount of Section 313 of Title III of the Superfund Amendments and Reauthorization Act (SARA) water priority chemicals; and storage in any amount of hazardous substances, in order to prevent leaks and spills from contaminating stormwater runoff. A table or summary of all such tanks and stored materials and their associated secondary containment areas shall be maintained. If the secondary containment devices are connected to stormwater conveyance systems, the connection shall be controlled by manually activated valves or other similar devices (which shall be secured closed with a locking mechanism). Any stormwater that accumulates in the containment area shall be at a minimum visually observed for color, foam, outfall staining, visible sheens and dry weather flow, prior to release of the accumulated stormwater. Accumulated stormwater shall be released if found to be uncontaminated by any material. Records documenting the individual making the observation, the description of the accumulated stormwater, and the date and time of the release shall be kept for a period of five (5) years. For facilities subject to a federal oil Spill Prevention, Control, and Countermeasure Plan (SPCC), any portion of the SPCC Plan fully compliant with the requirements of this permit may be used to demonstrate compliance with this permit.

    (c) **BMP Summary**. A listing of site structural and non-structural Best Management Practices (BMPs) shall be provided. The installation and implementation of BMPs shall be based on the assessment of the potential for sources to contribute significant quantities of pollutants to stormwater discharges and on data collected through monitoring of stormwater discharges. The BMP Summary shall include a written record of the specific rationale for installation and implementation of the selected site BMPs. The BMP Summary shall be reviewed and updated annually.

3. **Spill Prevention and Response Procedures**. The Spill Prevention and Response Procedures (SPRP) shall incorporate an assessment of potential pollutant sources based on a materials inventory of the facility. Facility personnel responsible for implementing the SPRP shall be identified in a written list incorporated into the SPRP and signed and dated by each individual acknowledging their responsibilities for the plan. A responsible person shall be on-site at all times during facility operations that have increased potential to contaminate stormwater runoff through spills or exposure of materials associated with the facility operations. The SPRP must be site stormwater specific. Therefore, an oil Spill Prevention Control and Countermeasure plan (SPCC) may be a component of the SPRP, but may

not be sufficient to completely address the stormwater aspects of the SPRP. The common elements of the SPCC with the SPRP may be incorporated by reference into the SPRP.

4. **Preventative Maintenance and Good Housekeeping Program**. A preventative maintenance and good housekeeping program shall be developed and implemented. The program shall address all stormwater control systems (if applicable), stormwater discharge outfalls, all on-site and adjacent surface waters and wetlands, industrial activity areas (including material storage areas, material handling areas, disposal areas, process areas, loading and unloading areas, and haul roads), all drainage features and structures, and existing structural BMPs. The program shall establish schedules of inspections, maintenance, and housekeeping activities of stormwater control systems, as well as facility equipment, facility areas, and facility systems that present a potential for stormwater exposure or stormwater pollution where not already addressed under another element of the SPPP. Inspection of material handling areas and regular cleaning schedules of these areas shall be incorporated into the program. Timely compliance with the established schedules for inspections, maintenance, and housekeeping shall be recorded and maintained in the SPPP.

5. **Facility Inspections**. Inspections of the facility and all stormwater *systems* shall occur as part of the Preventative Maintenance and Good Housekeeping Program at a minimum on a semi-annual schedule, once during the first half of the year (January to June), and once during the second half (July to December), with at least 60 days separating inspection dates (unless performed more frequently than semi-annually). These facility inspections are different from, and in addition to, the stormwater discharge characteristic monitoring *at the outfalls* required in Part I Section B.(1.).

6. **Employee Training**. Training programs shall be developed and training provided at a minimum on an annual basis for facility personnel with responsibilities for: spill response and cleanup, preventative maintenance activities, and for any of the facility's operations that have the potential to contaminate stormwater runoff. The facility personnel responsible for implementing the training shall be identified, and their annual training shall be documented by the signature of each employee trained.

7. **Responsible Party**. The SPPP shall identify a specific position or positions responsible for the overall coordination, development, implementation, and revision of the SPPP. Responsibilities for all components of the SPPP shall be documented and position assignments provided.

8. **SPPP Amendment and Annual Update**. The permittee shall amend the SPPP whenever there is a change in design, construction, operation, site drainage, maintenance, or configuration of the physical features which may have a significant effect on the potential for the discharge of pollutants to surface waters. **All aspects of the SPPP shall be reviewed and updated on an annual basis**. The annual update shall include:

   (a) an *updated list of significant spills or leaks* of pollutants for the previous three (3) years, or the notation that no spills have occurred (element of the **Site Overview**);
   (b) a written *re-certification that the stormwater outfalls have been evaluated for the presence of non-stormwater discharge*s (element of the **Site Overview**);
   (c) a documented re-evaluation of the effectiveness of the on-site stormwater BMPs (*BMP Summary* element of the **Stormwater Management Strategy**).
   (d) a *review and comparison of sample analytical data* to benchmark values (if applicable) over the past year, including a discussion about Tiered Response status. The permittee shall use the Annual Summary Data Monitoring Report (DMR) form, available from the DEMLR Stormwater Permitting Program's website (See 'Monitoring Forms' here: http://portal.ncdenr.org/web/lr/npdes-stormwater).

The Director may notify the permittee when the SPPP does not meet one or more of the minimum requirements of the permit. Within 30 days of such notice, the permittee shall submit a time schedule to the Director for modifying the SPPP to meet minimum requirements. The permittee shall provide certification in writing in accordance with Part II, Standard Conditions, Section B, Paragraph 11 to the Director that the changes have been made.

9. **SPPP Implementation**. The permittee shall implement the Stormwater Pollution Prevention Plan and all appropriate BMPs consistent with the provisions of this permit, in order to control contaminants entering surface waters via stormwater. Implementation of the SPPP shall include documentation of all monitoring, measurements, inspections, maintenance activities, and training provided to employees, including the log of the sampling data and of actions taken to implement BMPs associated with the industrial activities, including vehicle maintenance activities. Such documentation shall be kept on-site for a period of five (5) years and made available to the Director or the Director's authorized representative immediately upon request.

**B.(3.) STORMWATER DEFINITIONS**

1. Adverse Weather
Adverse conditions are those that are dangerous or create inaccessibility for personnel, such as local flooding, high winds, or electrical storms, or situations that otherwise make sampling impractical. When adverse weather conditions prevent the collection of samples during the sample period, the permittee must take a substitute sample or perform a visual assessment during the next qualifying storm event. Documentation of an adverse event (with date, time and written narrative) and the rationale must be included with your SPPP records. Adverse weather does not exempt the permittee from having to file a monitoring report in accordance with the sampling schedule. Adverse events and failures to monitor must also be explained and reported on the relevant DMR.

2. Allowable Non-Stormwater Discharges
Non-stormwater discharges which shall be allowed in the stormwater conveyance system include:
   a. Uncontaminated groundwater, foundation drains, air-conditioner condensate without added chemicals, springs, discharges of uncontaminated potable water, waterline and fire hydrant flushings, water from footing drains, flows from riparian habitats and wetlands.
   b. Discharges resulting from fire-fighting or fire-fighting training, or emergency shower or eye wash as a result of use in the event of an emergency.

3. Best Management Practices (BMPs)
Measures or practices used to reduce the amount of pollution entering surface waters. BMPs may take the form of a process, activity, or physical structure. More information on BMPs can be found at: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm.

4. Bypass (stormwater)
A bypass is the known diversion of stormwater from any portion of a stormwater control facility including the collection system, which is not a designed or established operating mode for the facility.

5. Bulk Storage of Liquid Products
Liquid raw materials, intermediate products, manufactured products, waste materials, or by-products with a single above ground storage container having a capacity of greater than 660 gallons or with multiple above ground storage containers located in close proximity to each other having a total combined storage capacity of greater than 1,320 gallons.

6. <u>DEMLR</u>
The Division of Energy, Mineral, and Land Resources.

7. <u>Landfill</u>
A disposal facility or part of a disposal facility where waste is placed in or on land and which is not a land treatment facility, a surface impoundment, an injection well, a hazardous waste long-term storage facility or a surface storage facility.

8. <u>Measureable Storm Event</u>
A storm event that results in an actual discharge from the permitted site outfall. The previous measurable storm event must have been at least 72 hours prior. The 72-hour storm interval may not apply if the permittee is able to document that a shorter interval is representative for local storm events during the sampling period, and obtains approval from the local DEMLR Regional Office. Two copies of this information and a written request letter shall be sent to the local DEMLR Regional Office. After authorization by the DEMLR Regional Office, a written approval letter must be kept on site in the permittee's SPPP.

9. <u>No Exposure</u>
A condition of no exposure means that all industrial materials and activities are protected by a storm resistant shelter or acceptable storage containers to prevent exposure to rain, snow, snowmelt, or runoff. Industrial materials or activities include, but are not limited to, material handling equipment or activities, industrial machinery, raw materials, intermediate products, by-products, final products, or waste products [40 CFR 122.26 (b)(14)]. DEMLR may grant a No Exposure Exclusion from NPDES Stormwater Permitting requirements only if a facility complies with the terms and conditions described in 40 CFR §122.26(g).

10. <u>Point Source Discharge of Stormwater</u>
Any discernible, confined and discrete conveyance including, but not specifically limited to, any pipe, ditch, channel, tunnel, conduit, well, or discrete fissure from which stormwater is or may be discharged to waters of the state.

11. <u>Representative Outfall Status</u>
When it is established that the discharge of stormwater runoff from a single outfall is representative of the discharges at multiple outfalls, the Division may grant representative outfall status. Representative outfall status allows the permittee to perform analytical monitoring at a reduced number of outfalls.

12. <u>Secondary Containment</u>
Spill containment for the contents of the single largest tank within the containment structure plus sufficient freeboard to contain the 25-year, 24-hour storm event.

13. <u>Section 313 Water Priority Chemical</u>
A chemical or chemical category which:
   a. Is listed in 40 CFR 372.65 pursuant to Section 313 of Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986, also titled the Emergency Planning and Community Right-to-Know Act of 1986;
   b. Is present at or above threshold levels at a facility subject to SARA title III, Section 313 reporting requirements; and
   c. Meets at least one of the following criteria:
      i. Is listed in appendix D of 40 CFR part 122 on Table II (organic priority pollutants), Table III (certain metals, cyanides, and phenols) or Table IV (certain toxic pollutants and hazardous substances);
      ii. Is listed as a hazardous substance pursuant to section 311(b)(2)(A) of the CWA at 40 CFR 116.4; or

iii. Is a pollutant for which EPA has published acute or chronic water quality criteria.

14. Significant Materials
Includes, but is not limited to: raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under section 101(14) of CERCLA; any chemical the facility is required to report pursuant to section 313 of Title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag and sludge that have the potential to be released with stormwater discharges.

15. Significant Spills
Includes, but is not limited to: releases of oil or hazardous substances in excess of reportable quantities under section 311 of the Clean Water Act (Ref: 40 CFR 110.3and 40 CFR 117.3) or section 102 of CERCLA (Ref: 40 CFR 302.4).

16. Stormwater Discharge Outfall (SDO)
The point of departure of stormwater from a discernible, confined, or discrete conveyance, including but not limited to, storm sewer pipes, drainage ditches, channels, spillways, or channelized collection areas, from which stormwater flows directly or indirectly into waters of the State of North Carolina.

17. Stormwater Runoff
The flow of water which results from precipitation and which occurs immediately following rainfall or as a result of snowmelt.

18. Stormwater Associated with Industrial Activity
The discharge from any point source which is used for collecting and conveying stormwater and which is directly related to manufacturing, processing or raw material storage areas at an industrial site. Facilities considered to be engaged in "industrial activities" include those activities defined in 40 CFR 122.26(b)(14). The term does not include discharges from facilities or activities excluded from the NPDES program.

19. Stormwater Pollution Prevention Plan
A comprehensive site-specific plan which details measures and practices to reduce stormwater pollution and is based on an evaluation of the pollution potential of the site.

20. Total Maximum Daily Load (TMDL)
TMDLs are written plans for attaining and maintaining water quality standards, in all seasons, for a specific water body and pollutant. A list of approved TMDLs for the state of North Carolina can be found at **http://portal.ncdenr.org/web/wq/ps/mtu/tmdl**.

21. Vehicle Maintenance Activity
Vehicle rehabilitation, mechanical repairs, painting, fueling, lubrication, vehicle cleaning operations, or airport deicing operations.

22. Visible Sedimentation
Solid particulate matter, both mineral and organic, that has been or is being transported by water, air, gravity, or ice from its site of origin which can be seen with the unaided eye.

23. 25-year, 24 hour Storm Event
The maximum 24-hour precipitation event expected to be equaled or exceeded, on the average, once in 25 years.

## SECTION C - SPECIAL CONDITIONS

### C. (1.) ACUTE TOXICITY PASS/FAIL PERMIT LIMIT (Quarterly; Outfall 005) [15A NCAC 02B .0200 et seq.]

The permittee shall conduct acute toxicity tests on a **quarterly** basis using protocols defined in the North Carolina Procedure Document entitled "Pass/Fail Methodology For Determining Acute Toxicity In A Single Effluent Concentration" (Revised December 2010 or subsequent versions). The monitoring shall be performed as a Fathead Minnow (*Pimephales promelas*) 24 hour static test. The effluent concentration at which there may be at no time significant acute mortality is **90%** (defined as treatment two in the procedure document). The tests will be performed **once during each calendar quarter (January-March, April-June, July-September and October-December).** Effluent sampling for this testing must be obtained during representative effluent discharge and shall be performed at the NPDES permitted final effluent discharge below all treatment processes.

Should any single quarterly monitoring indicate a failure to meet specified limits, then monthly monitoring will begin immediately until such time that a single test is passed. Upon passing, this monthly test requirement will revert to quarterly in the months specified above.

All toxicity testing results required as part of this permit condition will be entered on the Effluent Discharge Monitoring Form (MR-1) for the month in which it was performed, using the parameter code TGE6C. Additionally, DWR Form AT-2 (original) is to be sent to the following address:

Attention: North Carolina Division of Water Resources
Aquatic Toxicology Branch, Water Sciences Section
1623 Mail Service Center
Raleigh, North Carolina 27699-1623

Completed Aquatic Toxicity Test Forms shall be filed with the Aquatic Toxicology Branch no later than 30 days after the end of the reporting period for which the report is made.

Test data shall be complete and accurate and include all supporting chemical/physical measurements performed in association with the toxicity tests, as well as all dose/response data. Total residual chlorine of the effluent toxicity sample must be measured and reported if chlorine is employed for disinfection of the waste stream.

Should there be no discharge of flow from the facility during a month in which toxicity monitoring is required, the permittee will complete the information located at the top of the aquatic toxicity (AT) test form indicating the facility name, permit number, pipe number, county, and the month/year of the report with the notation of "No Flow" in the comment area of the form. The report shall be submitted to the Environmental Sciences Section at the address cited above.

Should the permittee fail to monitor during a month in which toxicity monitoring is required, then monthly monitoring will begin immediately until such time that a single test is passed. Upon passing, this monthly test requirement will revert to quarterly in the months specified above. Assessment of toxicity compliance is based on the toxicity testing quarter, which is the three month time interval that begins on the first day of the month in which toxicity testing is required by this permit and continues until the final day of the third month.

Should any test data from either these monitoring requirements or tests performed by the North Carolina Division of Water Resources indicate potential impacts to the receiving stream, this permit may be re-opened and modified to include alternate monitoring requirements or limits.

If the Permittee monitors any pollutant more frequently than required by this permit, the results of such monitoring shall be included in the calculation & reporting of the data submitted on the DMR & all AT Form submitted.

**NOTE: Failure to achieve test conditions as specified in the cited document, such as minimum control organism survival and appropriate environmental controls, shall constitute an invalid test and will require immediate follow-up testing to be completed no later than the last day of the month following the month of the initial monitoring.**

**C. (2.) ACUTE TOXICITY MONITORING (Quarterly; Outfalls 011 and 013)** [15A NCAC 02B .0200 et seq.]

The permittee shall conduct acute toxicity tests on a **quarterly** basis using protocols defined as definitive in E.P.A. Document EPA/600/4-90/027 entitled "Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms." The monitoring shall be performed as a **Fathead Minnow (*Pimephales promelas*) 24-hour static test**. Effluent samples for self-monitoring purposes must be obtained during representative effluent discharge below all waste treatment. The tests will be performed **on a discharge event during each calendar quarter (January-March, April-June, July-September and October-December)**.

The parameter code for this test is **TAE6C**. All toxicity testing results required as part of this permit condition will be entered on the Effluent Discharge Form (MR-1) for the month in which it was performed, using the appropriate parameter code. Additionally, DWR Form AT-1 (original) is to be sent to the following address:

Attention: North Carolina Division of Water Resources
Aquatic Toxicology Branch, Water Sciences Section
1623 Mail Service Center
Raleigh, North Carolina 27699-1623

Completed Aquatic Toxicity Test Forms shall be filed with the Aquatic Toxicology Branch no later than 30 days after the end of the reporting period for which the report is made

Test data shall be complete and accurate and include all supporting chemical/physical measurements performed in association with the toxicity tests, as well as all dose/response data. Total residual chlorine of the effluent toxicity sample must be measured and reported if chlorine is employed for disinfection of the waste stream.

Should there be no discharge of flow from the facility during a quarter in which toxicity monitoring is required, the permittee will complete the information located at the top of the aquatic toxicity (AT) test form indicating the facility name, permit number, pipe number, county, and the month/year of the report with the notation of "No Flow" in the comment area of the form. The report shall be submitted to the Environmental Sciences Branch at the address cited above.

Should any test data from this monitoring requirement or tests performed by the North Carolina Division of Water Resources indicate potential impacts to the receiving stream, this permit may be re-opened and modified to include alternate monitoring requirements or limits.

**NOTE: Failure to achieve test conditions as specified in the cited document, such as minimum control organism survival and appropriate environmental controls, shall constitute an invalid test and will require immediate follow-up testing to be completed no later than the last day of the month following the month of the initial monitoring.**

**C. (3.) CHRONIC TOXICITY PASS/FAIL PERMIT LIMIT (Quarterly; Outfall 012)** [15A NCAC 02B .0200 et seq.]

The effluent discharge shall at no time exhibit observable inhibition of reproduction or significant mortality to ***Ceriodaphnia dubia*** at an effluent concentration of **16% at Outfall 012**.

The permit holder shall perform at a minimum, **quarterly** monitoring using test procedures outlined in the "North Carolina Ceriodaphnia Chronic Effluent Bioassay Procedure," Revised February 1998, or subsequent versions or "North Carolina Phase II Chronic Whole Effluent Toxicity Test Procedure" (Revised-February 1998) or subsequent versions. Effluent samples for self-monitoring purposes must be obtained during representative effluent discharge below all waste treatment. The tests will be performed **once during each calendar quarter (January-March, April-June, July-September and October-December)**.

If the test procedure performed as the first test of any single quarter results in a failure or ChV below the permit limit, then multiple-concentration testing shall be performed at a minimum, in each of the two following months as described in "North Carolina Phase II Chronic Whole Effluent Toxicity Test Procedure" (Revised-February 1998) or subsequent versions.

The chronic value for multiple concentration tests will be determined using the geometric mean of the highest concentration having no detectable impairment of reproduction or survival and the lowest concentration that does have a detectable impairment of reproduction or survival. The definition of "detectable impairment," collection methods, exposure regimes, and further statistical methods are specified in the "North Carolina Phase II Chronic Whole Effluent Toxicity Test Procedure" (Revised-February 1998) or subsequent versions.

All toxicity testing results required as part of this permit condition will be entered on the Effluent Discharge Monitoring Form (MR-1) for the months in which tests were performed, using the parameter code **TGP3B** for the pass/fail results and **THP3B** for the Chronic Value. Additionally, DWR Form AT-3 (original) is to be sent to the following address:

Attention: North Carolina Division of Water Resources
Aquatic Toxicology Branch, Water Sciences Section
1623 Mail Service Center
Raleigh, North Carolina 27699-1623

Completed Aquatic Toxicity Test Forms shall be filed with the Aquatic Toxicology Branch no later than 30 days after the end of the reporting period for which the report is made.
Test data shall be complete, accurate, include all supporting chemical/physical measurements and all concentration/response data, and be certified by laboratory supervisor and ORC or approved designate signature. Total residual chlorine of the effluent toxicity sample must be measured and reported if chlorine is employed for disinfection of the waste stream.

Should there be no discharge of flow from the facility during a quarter in which toxicity monitoring is required, the Permittee will complete the information located at the top of the aquatic toxicity (AT) test form indicating the facility name, permit number, pipe number, county, and the month/year of the report with the notation of "No Flow" in the comment area of the form. The report shall be submitted to the Environmental Sciences Branch at the address cited above.

Should the Permittee fail to monitor during a month in which toxicity monitoring is required, monitoring will be required during the following month.

Should any test data from this monitoring requirement or tests performed by the North Carolina Division of Water Resources indicate potential impacts to the receiving stream, this permit may be re-opened and modified to include alternate monitoring requirements or limits.

**NOTE: Failure to achieve test conditions as specified in the cited document, such as minimum control organism survival, minimum control organism reproduction, and appropriate environmental controls, shall constitute an invalid test and will require immediate follow-up testing to be completed no later than the last day of the month following the month of the initial monitoring.**

**C. (4.) ACUTE TOXICITY MONITORING (Annual; Outfall 019)** [15A NCAC 02B .0200 et seq.]

The permittee shall conduct annual toxicity tests using protocols defined as definitive in E.P.A. Document EPA/600/4–90/027 entitled "Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms." The monitoring shall be performed as a Fathead Minnow (*Pimephales promelas)* 24-hour static test. Effluent samples for self-monitoring purposes must be obtained below all waste treatment. The permittee will conduct **one test annually**, with the annual period beginning in January of the calendar year of the effective date of the permit.

**The annual toxicity test must be performed by June 30**. Should there be no discharge of flow from the facility during the six month period January 1-June 30, the permittee will complete the information located at the top of the aquatic toxicity (AT) test form indicating the facility name, permit number, pipe number, county and in the comments section indicate "No Flow for January 1-June 30, {*calendar year*}." The report must be signed and submitted to the Environmental Sciences Section at the address noted below.

**If no discharge event occurs from January 1-June 30, yet a discharge event occurs from July 1-December 31, then the facility must perform toxicity monitoring and report the data as noted below.**

The parameter code for this test is **TAE6C**. All toxicity testing results required as part of this permit condition will be entered on the Effluent Discharge Form (MR-1) for the month in which it was performed, using the appropriate parameter code. Additionally, DWR Form AT-1 (original) is to be sent to the following address:

Attention: North Carolina Division of Water Resources
Aquatic Toxicology Branch, Water Sciences Section
1623 Mail Service Center
Raleigh, North Carolina 27699-1623

Completed Aquatic Toxicity Test Forms shall be filed with the Aquatic Toxicology Branch no later than 30 days after the end of the reporting period for which the report is made.

Test data shall be complete and accurate and include all supporting chemical/physical measurements performed in association with the toxicity tests, as well as all dose/response data. Total residual chlorine of the effluent toxicity sample must be measured and reported if chlorine is employed for disinfection of the waste stream.

Should any test data from either these monitoring requirements or tests performed by the North Carolina Division of Water Resources indicate potential impacts to the receiving stream, this permit may be re-opened and modified to include alternate monitoring requirements or limits.

**NOTE: Failure to achieve test conditions as specified in the cited document, such as minimum control organism survival and appropriate environmental controls, shall constitute an invalid test and will require immediate follow-up testing to be completed no later than the last day of the month following the month of the initial monitoring.**

**C. (5.) PERMIT REOPENER** [G.S. 143-215.1(b)]

The permitttee shall notify the Division if any industrial activity is proposed to take place at the facility which changes the characteristics of the wastewaters as authorized in this permit or adds additional sources of wastewater. A notification shall be submitted to the Division describing the new activities and expected wastewater characteristics 90 days prior to proposed start of operations.

**C. (6.) ELECTRONIC REPORTING OF DISCHARGE MONITORING REPORTS** [G.S. 143-215.1(b)]

Proposed federal regulations require electronic submittal of all discharge monitoring reports (DMRs) and specify that, if a state does not establish a system to receive such submittals, then permittees must submit DMRs electronically to the Environmental Protection Agency (EPA). The Division anticipates that these regulations will be adopted and is beginning implementation in late 2013.

NOTE: This special condition supplements or supersedes the following sections within Part II of this permit (*Standard Conditions for NPDES Permits*):

- Section B. (11.) Signatory Requirements
- Section D. (2.) Reporting
- Section D. (6.) Records Retention
- Section E. (5.) Monitoring Reports

1. **<u>Reporting [Supersedes Part II Section D. (2.) and Section E. (5.) (a)]</u>**

Beginning no later than 270 days from the effective date of this permit, the permittee shall begin reporting discharge monitoring data electronically using the NC DWR's Electronic Discharge Monitoring Report (eDMR) internet application.

Monitoring results obtained during the previous month(s) shall be summarized for each month and submitted electronically using eDMR. The eDMR system allows permitted facilities to enter monitoring data and submit DMRs electronically using the internet. Until such time that the state's eDMR application is compliant with EPA's Cross-Media Electronic Reporting Regulation (CROMERR), permittees will be required to submit all discharge monitoring data to the state electronically using eDMR and will be required to complete the eDMR submission by printing, signing, and submitting one signed original and a copy of the computer printed eDMR to the following address:

DWR / Information Processing Unit
ATTENTION: Central Files / eDMR
1617 Mail Service Center
Raleigh, North Carolina 27699-1617

If a permittee is unable to use the eDMR system due to a demonstrated hardship or due to the facility being physically located in an area where less than 10 percent of the households have broadband access, then a temporary waiver from the NPDES electronic reporting requirements may be granted and discharge monitoring data may be submitted on paper DMR forms (MR 1, 1.1, 2, 3) or alternative forms approved by the Director. Duplicate signed copies shall be submitted to the mailing address above.

Requests for temporary waivers from the NPDES electronic reporting requirements must be submitted in writing to the Division for written approval at least sixty (60) days prior to the date the facility would be required under this permit to begin using eDMR. Temporary waivers shall be valid for twelve (12) months and shall thereupon expire. At such time, DMRs shall be submitted electronically to the Division unless the permittee re-applies for and is granted a new temporary waiver by the Division.

Information on eDMR and application for a temporary waiver from the NPDES electronic reporting requirements is found on the following web page:

http://portal.ncdenr.org/web/wq/admin/bog/ipu/edmr

Regardless of the submission method, the first DMR is due on the last day of the month following the issuance of the permit or in the case of a new facility, on the last day of the month following the commencement of discharge.

**2. Signatory Requirements [Supplements Part II Section B. (11.) (b) and supersedes Section B. (11.) (d)]**

All eDMRs submitted to the permit issuing authority shall be signed by a person described in Part II, Section B. (11.)(a) or by a duly authorized representative of that person as described in Part II, Section B. (11.)(b). A person, and not a position, must be delegated signatory authority for eDMR reporting purposes.

For eDMR submissions, the person signing and submitting the DMR must obtain an eDMR user account and login credentials to access the eDMR system. For more information on North Carolina's eDMR system, registering for eDMR and obtaining an eDMR user account, please visit the following web page:

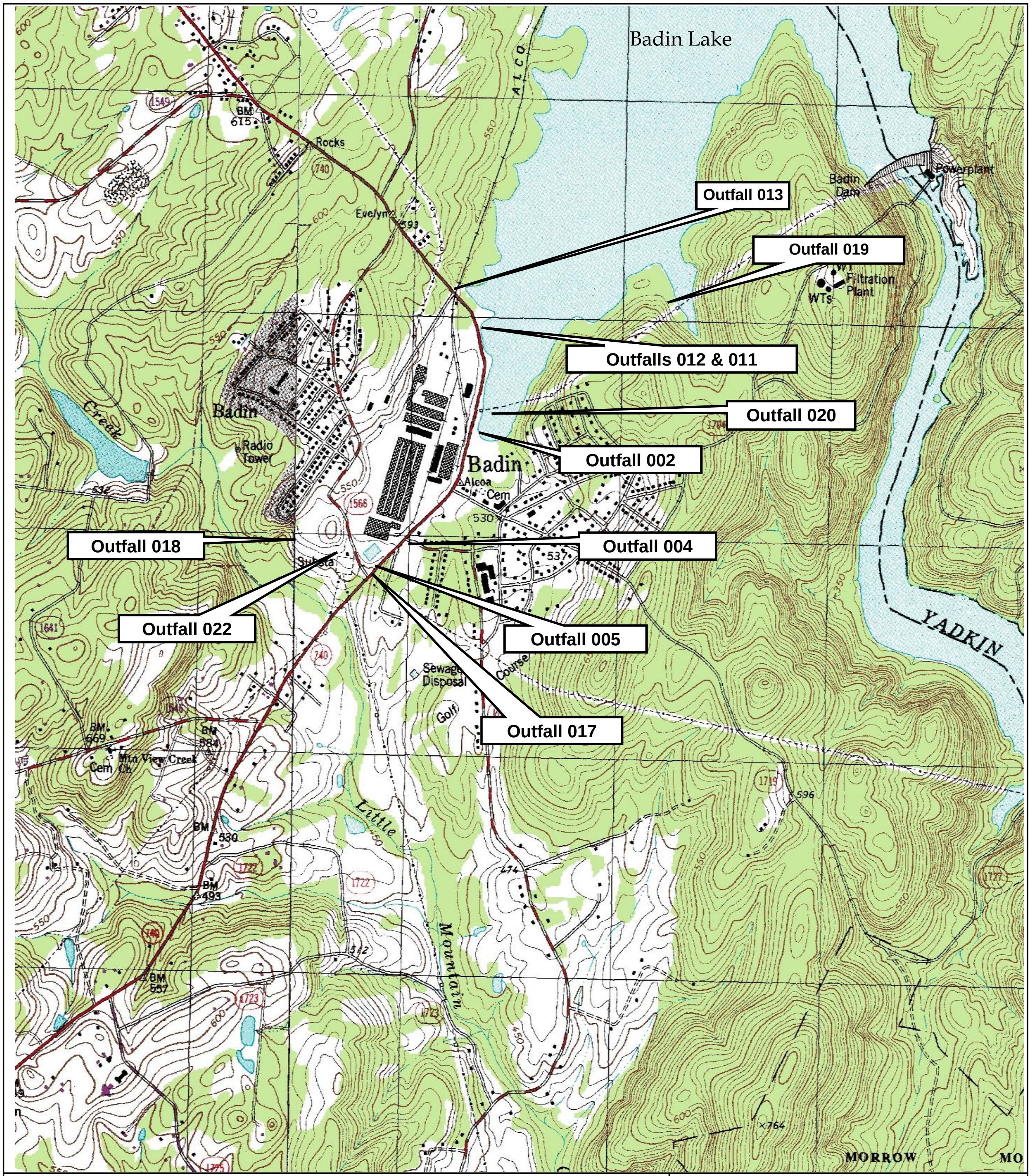
http://portal.ncdenr.org/web/wq/admin/bog/ipu/edmr

Certification. Any person submitting an electronic DMR using the state's eDMR system shall make the following certification [40 CFR 122.22]. NO OTHER STATEMENTS OF CERTIFICATION WILL BE ACCEPTED:

*"I certify, under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations."*

**3. Records Retention [Supplements Part II Section D. (6.)]**

The permittee shall retain records of all Discharge Monitoring Reports, including eDMR submissions. These records or copies shall be maintained for a period of at least 3 years from the date of the report. This period may be extended by request of the Director at any time [40 CFR 122.41].




**Alcoa, Inc. Badin Works – Stanly County**

| | |
|---|---|
| Receiving Stream: | Badin Lake (Yadkin River) and UT to Little Mountain Creek |
| Stream Classification: | WS-IV CA & B and WS-IV |
| River Basin: | Yadkin/Pee Dee |
| Sub-Basin #: | 03-07-08 |
| USGS Quad #: | F18NE, F18NW Badin & New London, NC |

**Location Map**

N ↑

**NC0004308**