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Site Name (Subject):	SPRAGUE ELECTRIC COMPANY
Site ID (Document ID):	NCD003167780
Document Name (DocType):	Expanded SI (ESI)
Report Segment:	2
Description:	References
Date of Document:	3/28/2002
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Access Level:	PUBLIC
Division:	WASTE MANAGEMENT
Section:	SUPERFUND
Program (Document Group):	SERB (SERB)
Document Category:	FACILITY

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STATE OF NORTH CAROLINA

Department of Environment
and Natural Resources
Division of Waste Management
Superfund Section

EXPANDED SITE INSPECTION
REFERENCES:

Sprague Aluminum Co.
NCD 003 167 780
Lansing, Ashe County, NC
Reference No. 02619

March 2002

Stuart F. Parker, Jr.
Hydrogeologist
Division of Waste Management
Superfund Section

Expanded Site Inspection
Sprague Aluminum Co.
NCD 003 167 780
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Ref. 1

See Figure 1 of this Report

Ref. 2

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

27 November 1985

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

SUBJECT: Preliminary Assessment Report
Sprague Electric Co. NC D003167780
Highway 194
Lansing, NC 28643

Dear Ms. Bland:

Enclosed please find the Preliminary Assessment report for the subject site. This priority is based on review of available data.

Sprague Electric Company is about a 60 acre site located off NC 194 south of Lansing, NC. The plant has manufactured aluminum electrolytic capacitors since 1953. No other business has ever occupied the site.

The company uses aluminum foil, nitric acid, tartaric acid, sodium hydroxide, calcium hydroxide, sodium chloride, and dimethylformamide (DMF) in the production process. Aluminum oxides are formed when the aluminum foil is etched in an electrochemical bath. Aluminum oxides are recovered from the waste water, by filtering and settling in a lagoon, and sold. Effluent pH was reported between 3 and 4. Waste DMF is shipped off site in drums.

Several wells were reported to be on the site; however, only one is presently in use. The well water is tested periodically for bacteria and iron content. Soil, well, and impoundment sampling is recommended to confirm that no hazardous constituents are present. Based on the available information, a low priority is recommended for inspection of this site.

On 27 November 1985, this Preliminary Assessment was reviewed by CERCLA Unit personnel and by the following representatives from the North Carolina Department of Natural Resources and Community Development, Division of Environmental Management: 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,

Stan Atwood

Stan Atwood, Toxicologist
Solid and Hazardous Waste Management Branch
Environmental Health Section

SA/tb/0221b

EPA

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

I. IDENTIFICATION
01 STATE: NC
02 SITE NUMBER: D003167780

II. SITE NAME AND LOCATION

01 SITE NAME (Legal, common, or descriptive name of site): Sprague Electric Co.	02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER: Highway 194
03 CITY: Lansing	04 STATE: NC; 05 ZIP CODE: 28643; 06 COUNTY: Ashe; 07 COUNTY CODE: 005; 08 CONG. DIST.: 5
09 COORDINATES LATITUDE: 36 28 48 .N; LONGITUDE: 08 1 30 10 .W	

10 DIRECTIONS TO SITE (Starting from nearest public road):
Take highway 194 South of Lansing about 1½ to 2 miles. Plant is located on the left across the river.

III. RESPONSIBLE PARTIES

01 OWNER (if known): General Cable Corp.	02 STREET (Business, mailing, residential):
03 CITY: Greenwich	04 STATE: CT; 05 ZIP CODE: ; 06 TELEPHONE NUMBER: ( )
07 OPERATOR (if known and different from owner): Sprague Electric Co.	08 STREET (Business, mailing, residential): 87 Marshall Street
09 CITY: North Adams	10 STATE: MA; 11 ZIP CODE: 01247; 12 TELEPHONE NUMBER: (413 664-4411

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 3001 DATE RECEIVED: __/__/__ (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
1953 (BEGINNING YEAR) | _____ (ENDING YEAR) ☐ UNKNOWN

04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED
Sprague Electric manufactures Aluminum electrolytic capacitors. Nitric acid and sodiu hydroxide are used and consumed in the process. Waste water (pH 3 to 4) containing aluminum oxides is held in a surface impoundment. The aluminum oxides settle and are mined and sold. Nitric acid is stored in above ground tanks. Dimethylformamide (DMF)

05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION
is also used. DMF wastes are stored in drums and transported off site. Several wells were reported on site; only one is currently used. Potential hazards exist for spills of nitric acid. No hazardous constituents were reported for their waste stream.

V. PRIORITY ASSESSMENT

01 PRIORITY FOR INSPECTION (Check one. If high or medium is checked, complete Part 3 - Waste Information and Part 5 - 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
Ron Watson, Plant Engineer	Sprague Electric Co.	(919) 384-2551

04 PERSON RESPONSIBLE FOR ASSESSMENT	05 AGENCY	06 ORGANIZATION	07 TELEPHONE NUMBER	08 DATE
Stan Atwood/Pat DeRosa	NC DHR/DHS	SHW Mgmt. Br.	(919) 733-2178	11 / 20 / 85 (MONTH DAY YEAR)

EPA FORM 2070-12 (7-81)

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER
NC	D003167780

II. HAZARDOUS CONDITIONS AND INCIDENTS

01 [X] A. GROUNDWATER CONTAMINATION — 02 ☐ OBSERVED (DATE: _____) — [X] POTENTIAL — ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: _____ — 04 NARRATIVE DESCRIPTION

Large surface impoundment.

01 [X] B. SURFACE WATER CONTAMINATION — 02 ☐ OBSERVED (DATE: _____) — [X] POTENTIAL — ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: _____ — 04 NARRATIVE DESCRIPTION

North Fork of the New River traverses the site.

01 ☐ C. CONTAMINATION OF AIR — 02 ☐ OBSERVED (DATE: _____) — ☐ POTENTIAL — ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: _____ — 04 NARRATIVE DESCRIPTION

01 ☐ D. FIRE/EXPLOSIVE CONDITIONS — 02 ☐ OBSERVED (DATE: _____) — [X] POTENTIAL — ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: _____ — 04 NARRATIVE DESCRIPTION

01 ☐ E. DIRECT CONTACT — 02 ☐ OBSERVED (DATE: _____) — ☐ POTENTIAL — ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: _____ — 04 NARRATIVE DESCRIPTION

01 [X] F. CONTAMINATION OF SOIL — 02 ☐ OBSERVED (DATE: _____) — ☐ POTENTIAL — ☐ ALLEGED
03 AREA POTENTIALLY AFFECTED: _____ — 04 NARRATIVE DESCRIPTION

Surface impoundment or spills.

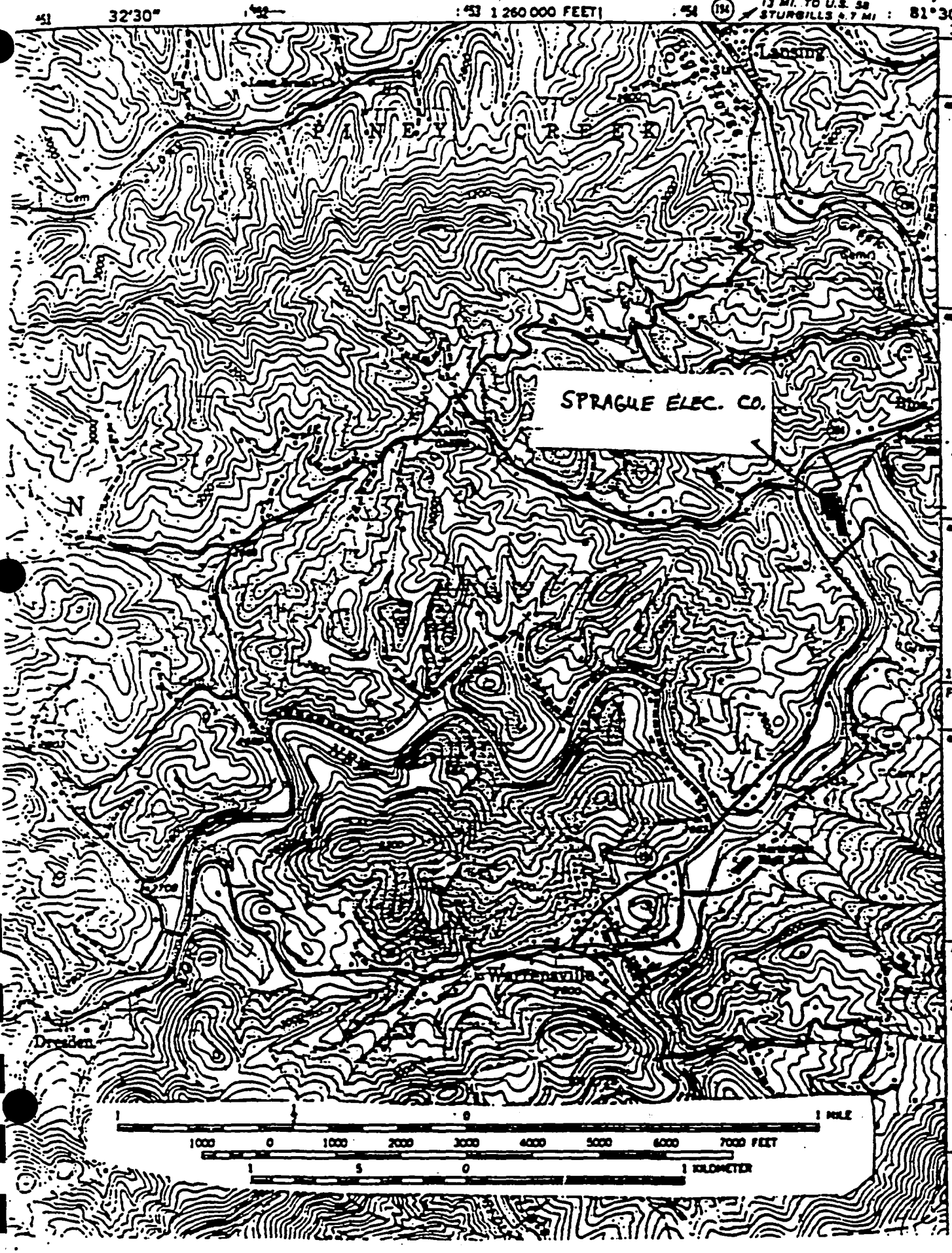
01 ☐ G. DRINKING WATER CONTAMINATION — 02 ☐ OBSERVED (DATE: _____) — ☐ POTENTIAL — ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: _____ — 04 NARRATIVE DESCRIPTION

01 [X] H. WORKER EXPOSURE/INJURY — 02 ☐ OBSERVED (DATE: _____) — [X] POTENTIAL — ☐ ALLEGED
03 WORKERS POTENTIALLY AFFECTED: _____ — 04 NARRATIVE DESCRIPTION

Handling and use of nitric acid.

01 ☐ I. POPULATION EXPOSURE/INJURY — 02 ☐ OBSERVED (DATE: _____) — ☐ POTENTIAL — ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: _____ — 04 NARRATIVE DESCRIPTION

WARREN_ /ILLE QUADRANGLE
NORTH CAROLINA—ASHE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



NCDENR

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES

DIVISION OF WASTE MANAGEMENT

JAMES B. HUNT JR.
GOVERNOR

BILL HOLMAN
SECRETARY

WILLIAM L. MEYER
DIRECTOR

May 31, 2000

Ms. Jennifer Wendel, RPM
US EPA Region IV Waste Division
Atlanta Federal Building
61 Forsyth St., 11th Floor
Atlanta, GA 30303-3104

Subject: Site Re-Assessment Report (SRR)
Sprague Aluminum (aka Sprague Electric Co.)
NCD 003 167 780
Lansing, Ashe Co., NC

Dear Ms. Wendel:

As part of this Site Re-Assessment Report, the April 19, 1990 FIT Report, the September 6, 1991 Site Inspection (SI) Report (Ref. 7), and the October 21, 1992 Site Inspection Prioritization (SIP) Report (Ref. 6) were reviewed. All of these reports recommended further action under CERCLA. These reports referred to the site as Sprague Electric Co., but CERCLIS now lists the site as "Sprague Aluminum". The site is located in Ashe County, in the mountainous northwestern corner of North Carolina. Site coordinates are latitude 36° 28' 48" N and longitude 81° 30' 10" W (Ref. 4).

The Sprague Aluminum site lies on a bend of the North Fork of the New River, and three sides of the facility are on the banks of this "Outstanding Resource" river. Past leachate problems with the wastewater treatment lagoons caused pH problems and high aluminum in the river (Ref. 5). The Wetland Inventory Map shows an HRS-qualified wetlands along the river downgradient from the lagoons (Figure 1). The river is a healthy fishery (Ref. 4). An onsite, 900'-deep well (Figure 2) serving 450 workers has not shown contamination (Refs. 3, 5). Shallow groundwater under the site has shown a pH as low as 3.63 and contamination with aluminum, cadmium, and chromium (Ref. 3).

The active site has been used for the manufacture of aluminum-based capacitors since 1954 (Refs. 6, 7). The facility was operated under the name of Sprague Electric from 1954 until around 1991. Sprague Electric's manufacturing process included acid etching of aluminum. United Chemi-con purchased the facility (but not the lagoons) sometime around 1991 and currently operates the facility (Refs. 6, 7). United Chemi-con discontinued the aluminum etching process; etched aluminum is now purchased (Ref 5). The approximately 12.5-acre parcel holding the former lagoons will be discussed below.

FIRST IN AMERICA 2010

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United Chemi-con and the American Annuity Group, successor-in-interest to Sprague Electric, submitted a Comprehensive Site Assessment to the NC DENR Winston Salem Regional Office (WSRO) in April 1999. At least 14 monitoring wells have been installed on the United Chemi-con property (Figure 3). Sources on the United Chemi-con property include soil in the old etching area containing high levels of aluminum; soil in the tank area containing cyanide and manganese; soil in the drum storage area containing cadmium, DDE, manganese, nickel and zinc, a contaminant dike area showing chlorinated solvents and a metal debris and ash fill area. A Remediation Action has not yet been approved (Ref. 1).

United Chemi-con did not purchase or ever use part of the original Sprague Electric property -- the 12.5-acre "evaporation/wastewater treatment" lagoon property, now owned by American Annuity Group, successor-in-interest to Sprague Electric. The evaporation lagoon property borders the North Fork of the New River and is the most eastern and downstream source area on the site (Figures 2 & 3). Access to the pond property is limited by a 6'- high chain link fence (Ref. 4) . The lagoons were never operated under a permit (Ref. 3).

During the operation of the lagoons, aluminum oxide waste was placed in these settling lagoons. This aluminum oxide waste was periodically mined and resold (Refs. 6, 7). Water from the lagoons was not directly discharged into the river, but either "evaporated" or "percolated" to groundwater (Ref. 4). Because the area has an average annual precipitation of 49 inches and a mean annual lake evaporation rate of 33 inches (Refs. 6, 7), yielding a net annual precipitation of 16 inches, discharge to groundwater from the lagoons is likely to have occurred.

Under the supervision of WSRO, the lagoons were closed around 1995. WSRO did not require a formal closure plan. Approximately 2.2 million gallons of pond water were discharged through one of United Chemi-con's NPDES-permitted outfalls to the river, under a special one-time NPDES permit. Pond sediments were tested and found to contain levels of contaminants below hazardous waste levels and were left in place. The ponds were then backfilled (Refs. 2, 3, 4). Groundwater downgradient from the lagoons has not been sampled. The April 1999 Comprehensive Site Assessment did not include the lagoon property, and no additional actions or studies are planned for the lagoon property.

A review of the pond sludge data and background data, and a comparison of these levels with the Inactive Hazardous Sites Soil Remediation Goals (Ref. 2) indicates that sludge may remain that threatens groundwater and surface water. In some instances, background samples were not analyzed for contaminants detected in the pond sludge samples. Dimethylformamide (DMF), a chemical used by the facility for many years, does not appear on SCDM or the typical target compound lists for organic analyses.

Based on a review of the SI and subsequent SIP, as well as interviews with WSRO officials and a review of maps and data obtained on this site subsequent to these reports, NC Superfund Section concurs with the recommendations for further action under CERCLA. The site poses a potential threat to the food chain and the environment and is recommended for an Expanded Site Inspection (ESI).

Because the United Chemi-con property is being addressed by the current owners, the ESI should be conducted on the lagoon property in order to characterize the source, to determine if groundwater under the former lagoons is contaminated, and to determine if this source is releasing or has a potential to release contaminants to the surface water fishery and/or wetlands, either via the overland route or the groundwater-to-surface water pathway. Due to the topography of the region, background soil, surface water and sediment sample locations should be carefully chosen so that they are well upgradient of the site access road and drainage ditches as well as upgradient from the most upstream point where groundwater-to-surface water discharge could occur. The Comprehensive Site Assessment should be reviewed prior to completion of the study plan.

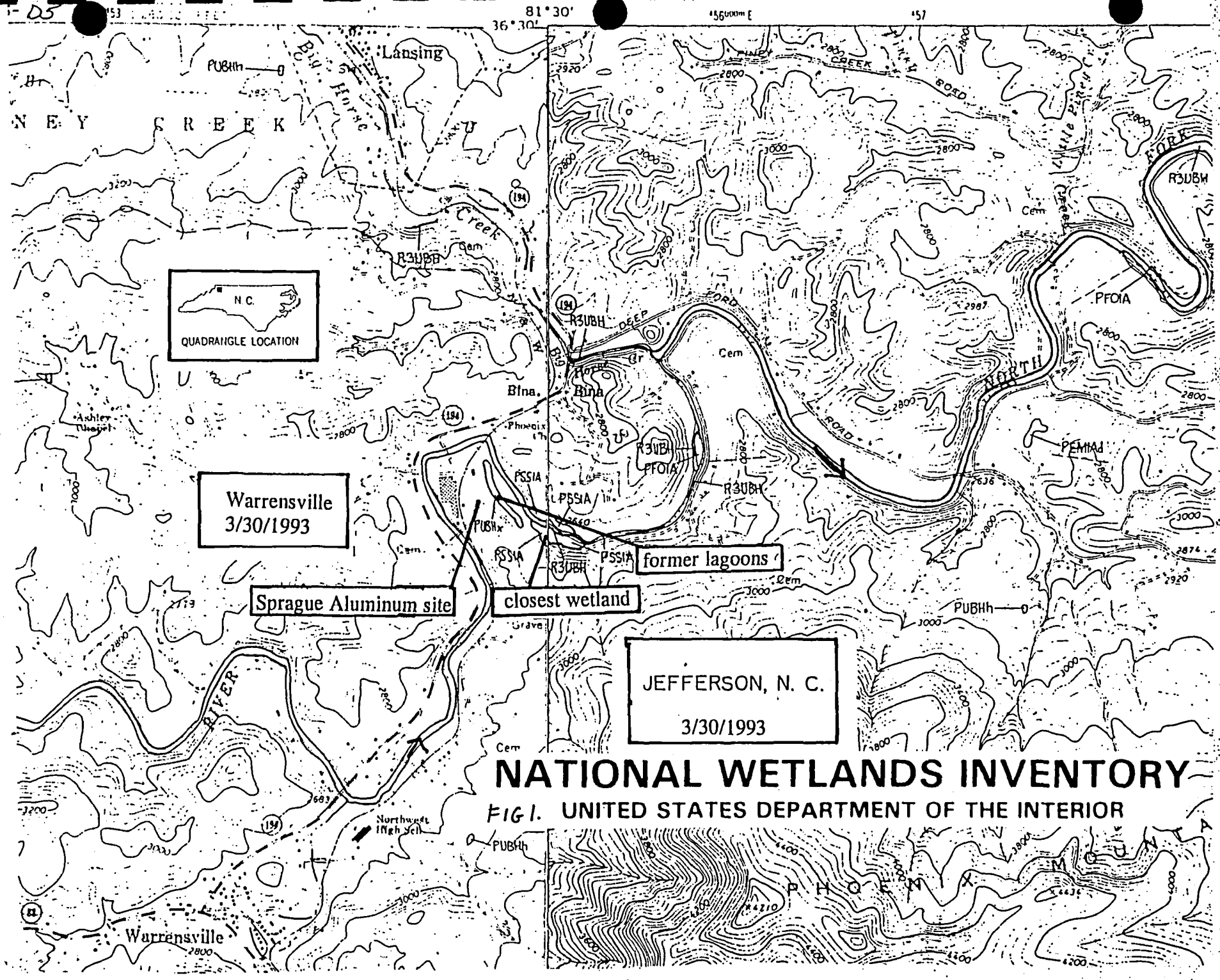
If you have any questions, please contact me at (919) 733-2801 ext. 318.

Sincerely,

Jeanette Stanley
Environmental Chemist
NC Superfund Section

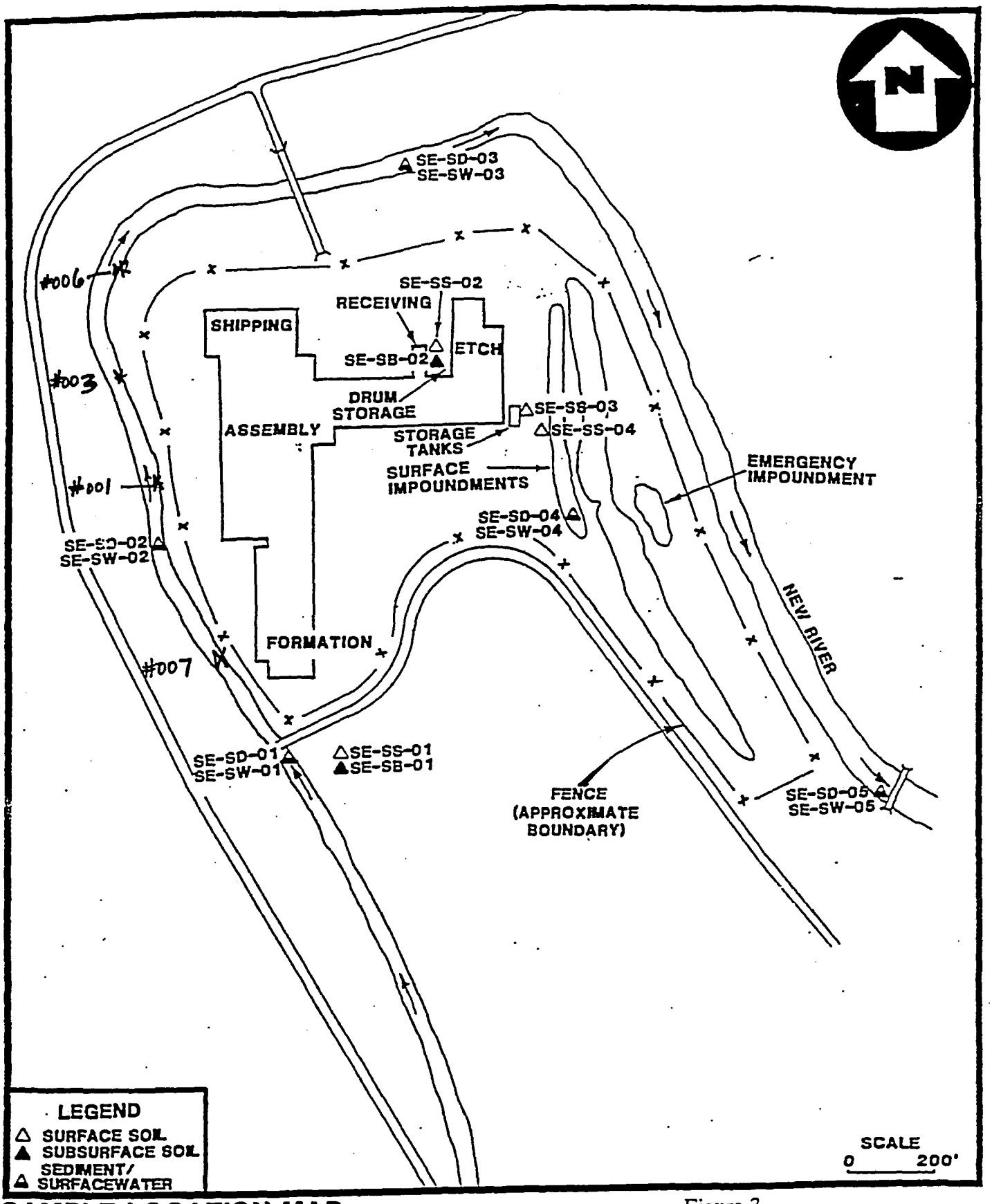
Dan LaMontagne, Head
Site Evaluation & Removal Branch
NC Superfund Section

Enclosures



NATIONAL WETLANDS INVENTORY

FIG I. UNITED STATES DEPARTMENT OF THE INTERIOR



SAMPLE LOCATION MAP
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

Figure 3.
Site Inspection Sample Location and NPDES Outfall Locations

NUS CORPORATION

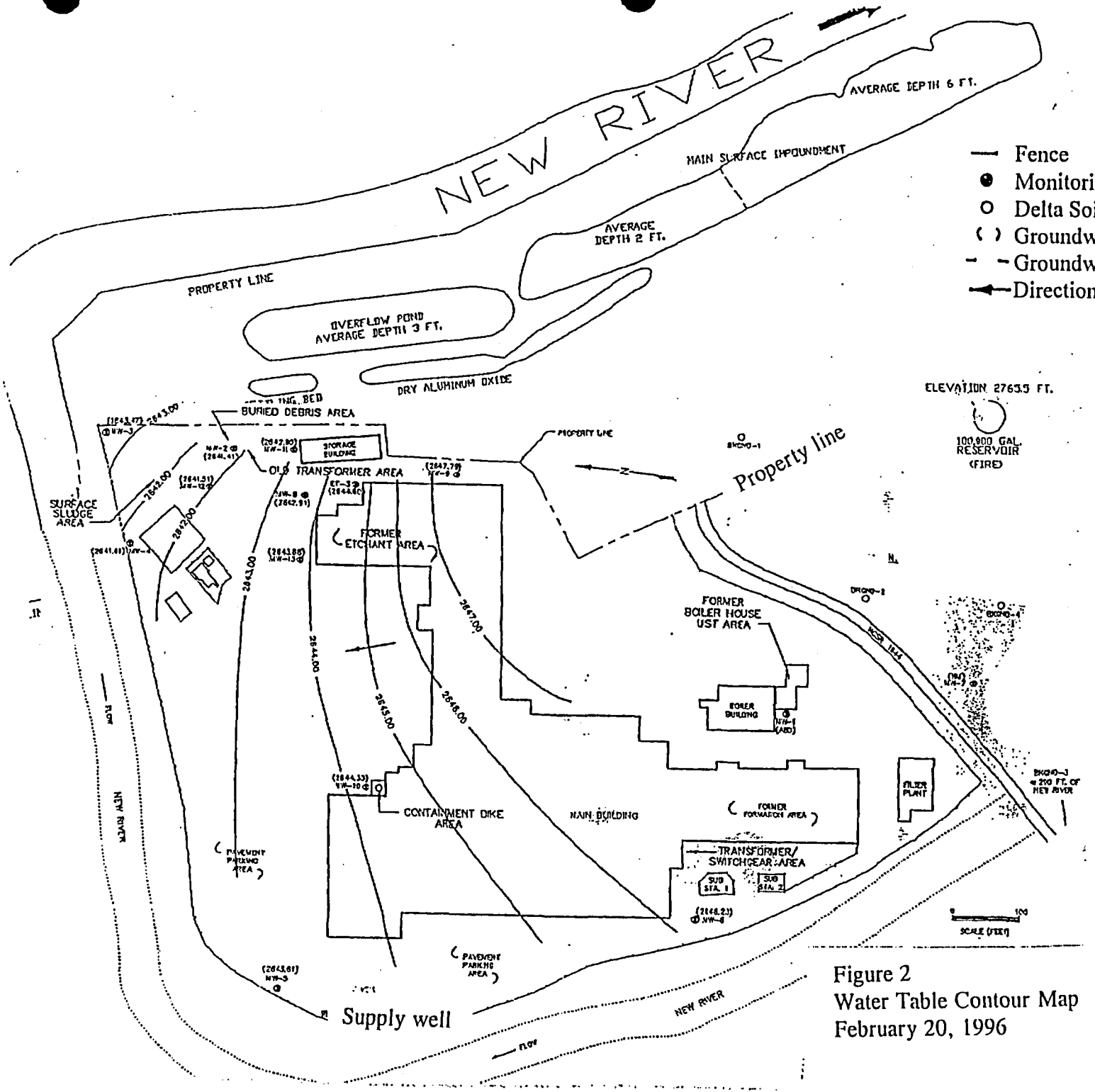


Figure 2
Water Table Contour Map
February 20, 1996

List of References

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2. Stanley, Jeanette, Environmental Chemist, NC Superfund Section, Memo, Dec. 27, 1996.
3. Stanley, Jeanette, Environmental Chemist, NC Superfund Section, Memo, Dec. 5, 1996.
4. Stanley, Jeanette, Environmental Chemist, NC Superfund Section, Memo, Dec. 27, 1995.
5. Stanley, Jeanette, Environmental Chemist, NC Superfund Section, Memo, July 7, 1995.
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7. Halliburton NUS Environmental Corporation, Site Inspection, Sept. 6, 1991.

Ref. 1

MEMO

DATE: May 24, 2000
TO: File
FROM: Jeanette Stanley
Environmental Chemist
NC Superfund Section
SITE: Sprague Aluminum (aka Sprague Electric Co.)
NCD 003 167 780
Lansing, Ashe County, NC

Today, I talked with Donald Geddes, Winston-Salem Regional Office (WSRO) (336) 771-4600. He reported that the consultant to United Chemi-con and American Annuity had submitted the Comprehensive Site Assessment (CSA) to WSRO in April 1999. Mr. Geddes reported that this is similar to a Remedial Investigation conducted under Superfund. A Remedial Action Plan has not yet been approved for the site. This CSA was conducted on the portion of the site purchased by United Chemi-con. United Chemi-con continues to operate the facility.

No additional studies have been conducted on the former lagoon property. Mr. Geddes reported that the former lagoon ownership and status has remained unchanged since the lagoons were closed.

Ref. 2

MEMO

DATE: December 27, 1996

TO: File

FROM: Jeanette Stanley, Environmental Chemist, NC Superfund Section

SITE: Sprague Aluminum Company
NCD 003 167 780
Lansing, Ashe County, NC

I have again reviewed the Sprague Aluminum Company data from previous reports. The United Chemi-con facility is in operation and is being regulated by the NC Division of Water Quality. The adjacent old pond property is still owned by the Sprague company and is the only portion of the property that would be a CERCLA concern.

The old ponds have been drained. The sludges were tested, determined to not be hazardous waste and left in place. The ponds were then backfilled. I have reviewed the data from the pond sludges to determine if there are any remaining CERCLA concerns on the drained pond property.

The attached table shows the level of metals found in the sludges and these numbers are compared to the soil remediation goals for these metals found in the March 1996 "Inactive Hazardous Sites Program Guidelines for Responsible Party Voluntary Site Remedial Action". These soil remediation goals shown in the table are required clean up levels for both scenarios -- when groundwater has been contaminated and when it has not. Since these ponds have been backfilled, there is no longer a soil exposure risk.

There is no groundwater data for the groundwater under the ponds. However, since the operating facility previously conducted the activities that resulted in the deposition of the wastes into the ponds, it is appropriate to assume that if contaminants are found in the groundwater under the ponds, they are likely to be the same contaminants found under the operating facility. Chromium, cadmium, and barium were detected in the groundwater under the operating facility. The levels of these contaminants in the pond sludge are above the Soil Remediation Goal (20 x groundwater quality standard), but none of these contaminants were found in the pond sludge at levels three times background. Background samples taken during the Site Inspection Prioritization (SIP) also show levels of chromium and barium at or above the levels of the background taken during the sludge investigation. The SIP background samples did not show any cadmium.

Other metals found in the pond sludge slightly above the soil remediation goal if groundwater contamination is found (copper, nickel, and silver) were not tested for in the background sample. Manganese was significantly higher than the soil remediation goal if groundwater contamination is found, but the background sample was also not tested for manganese. Background samples taken during the Site Inspection Prioritization (SIP) show levels of manganese, copper, and nickel at or above the levels of these metals found in the background taken for the sludge investigation. The SIP background samples were not tested for silver. None of the metals detected in the pond sludges are above Soil Remediation Goals if the groundwater is not contaminated.

Sprague Aluminum: Pond Sludge Samples and Comparison with Soil Remediation Goals

	Highest level found in six samples	Average of six samples (mg/kg)	BKG level (mg/kg)	20 x GW Quality Standard (SRG if GW is contaminated) (ppm)	SRG if no GW contamination (mg/kg)	Is average greater than 3 x BKG and greater than 20 x GW Quality Standard?	Is average above SRG if no GW contamination?
Antimony	0.82	0.37	NA	---	6.2	No	No
Arsenic	1.82	0.41	<1.3	1	4.6	No	No
Barium	87.56	31	NA	40	none	No	No
Boron	602	229	NA	---	none	No GW Quality Standard	No
Cadmium	1.34	0.29	2.2	0.1	7.8	Not 3 x BKG*	No
Chromium	33.42	10.7	80	1	15,600 (Cr III) 78 (Cr VI)	Not 3 x BKG*	No
Copper	52	29.2	NA	20	620	BKG not tested for copper*	No
Lead	4.68	1.5	7.5	0.3	400	Not 3 x BKG*	No
Manganese	82.82	35.44	NA	1	none	BKG not tested for manganese*	No
Mercury	0.07	0.02	<0.065	0.022	4.6	No	No
Nickel	34.8	7.7	NA	2	320	BKG not tested for nickel*	No
Selenium	2.36	0.8	<1.3	1	78	No	No
Silver	1.54	0.54	<2.6	0.36	78	Yes	No
Vanadium	31.2	12.7	NA	---	140	No GW Quality Standard	No
Zinc	13.5	9.16	NA	40.2	4600	No	No

NA = Not analyzed; SRG = Soil Remediation Goal; GW = Groundwater; BKG = Background

* These contaminants are above the 20 x GW Quality Standard (SRG if there is GW contamination); however, either background levels were above the level detected in the sludge or the background sample was not analyzed for the metal. None of the metals in the average of the sludge sample were above the SRG if there is not groundwater contamination.

Ref. 3

MEMO

DATE: December 5, 1996

TO: File

FROM: Jeanette Stanley
Environmental Chemist
NC Superfund Section

SITE: Sprague Aluminum Company
NCD 003 167 780
Lansing, Ashe County, NC

I have reviewed recent information on the Sprague Aluminum site. I have communicated with Donald Geddes of the Winston-Salem Regional Office (WSRO). He has provided maps and additional information. I have combined these in order to show the operating United Chemi-con facility and the old lagoons on the same map. This map and a map showing the approximate outfall locations are attached.

GROUNDWATER

The attached map shows the 14 monitoring wells on the United Chemi-con facility. There are no monitoring wells between the old lagoons and the river. There is groundwater contamination on the United Chemi-con site.

- In 1995, wells ET-3 and MW-8 (in the vicinity of the old etching area) contained aluminum at levels ranging from 6,200 ug/L to 51,000 ug/L and had a pH around 3.

- In 1993, these wells also contained levels of barium, cadmium and chromium above the NC DEM's action levels. No volatile or semivolatile compounds above groundwater standards have been detected in the groundwater. I have not reviewed all of the data to determine if all groundwater samples have been non-detect for all organic compounds.

- United Chemi-con is still in the assessment phase of the groundwater contamination. WSRO will be requiring remediation of this contaminated groundwater on the United Chemi-con site.

- There is a water supply well on the northwest corner of the property, near the New River. It serves 450 people and is 900' deep. It is tested per NC Public Water Supply requirements. No contaminants above drinking water standards have been detected.

- The WSRO has requested that United Chemi-con conduct a survey of other drinking water wells within 1/4 mile of the facility but this survey has not yet been received. WSRO will be investigating the liklihood of contamination of these wells and/or proof from United Chemi-con that these wells will not be contaminated.

SURFACE WATER

- In May 1996, the Winston-Salem Regional Office requested sampling in the New River to determine if any contaminants are discharging to the River. This sampling has not yet been conducted.

- There are four NPDES-permitted outfalls from the facility into the New River. The approximate locations are marked on the attached map. One permitted outfall has no limits for copper although monitoring for copper was required monthly for one year. Copper in the outfall was 37 ug/L in the first sample. A surface water sample (taken during the SIP in the vicinity of this outfall) was 29 ug/L.

LAGOONS

- The lagoons have not been used since 1992. They were pumped out and backfilled in within the past year. Prior to backfilling, sludges were tested and found to not be a hazardous waste. Lagoon sludges contained arsenic (0 - 1.82 ppm), mercury (0.005 - 0.07 ppm), and selenium (2.36 ppm) at levels more than three times background. Lead, cadmium, and chromium levels were all lower than the background sample. Sludges were also tested for antimony (0 - 0.82 ppm), boron (0 - 602 ppm), copper (12 - 52 ppm), nickel (1.7 - 34.8 ppm), silver (0.01 - 1.54 ppm), vanadium (4.3 - 17.7 ppm), and zinc (5.4 - 13.5 ppm), but the background sample was not tested for these inorganics. The lagoons also contain aluminum. These sludge samples did not contain volatile or semivolatile organic compounds.

- The lagoons were neither built nor operated under a NC permit. A RCRA permit was not required for their operation.

- Neither groundwater under the lagoons nor between the lagoons and the river has been tested for contamination. There are no monitoring wells in these areas. There are monitoring wells between the facility and the lagoons.

OTHER SOURCES

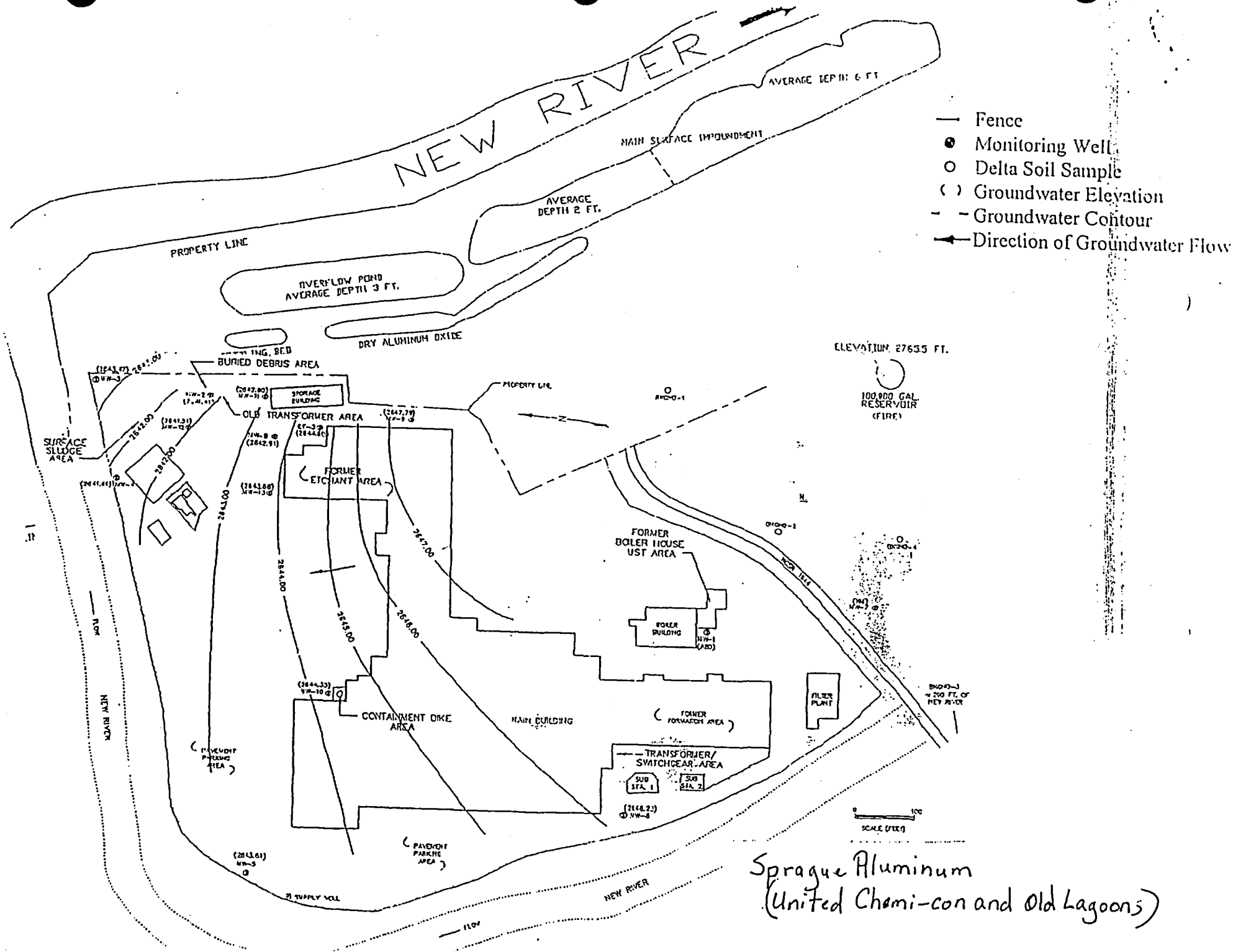
Other sources consist of contaminated soil. About 800 square feet of surface soil is in the tank area and it contains cyanaide and manganese. About 2,200 square feet of contaminated surface soil in the drum storage area contains cadmium, DDE, manganese, nickel and zinc.

VIOLATIONS

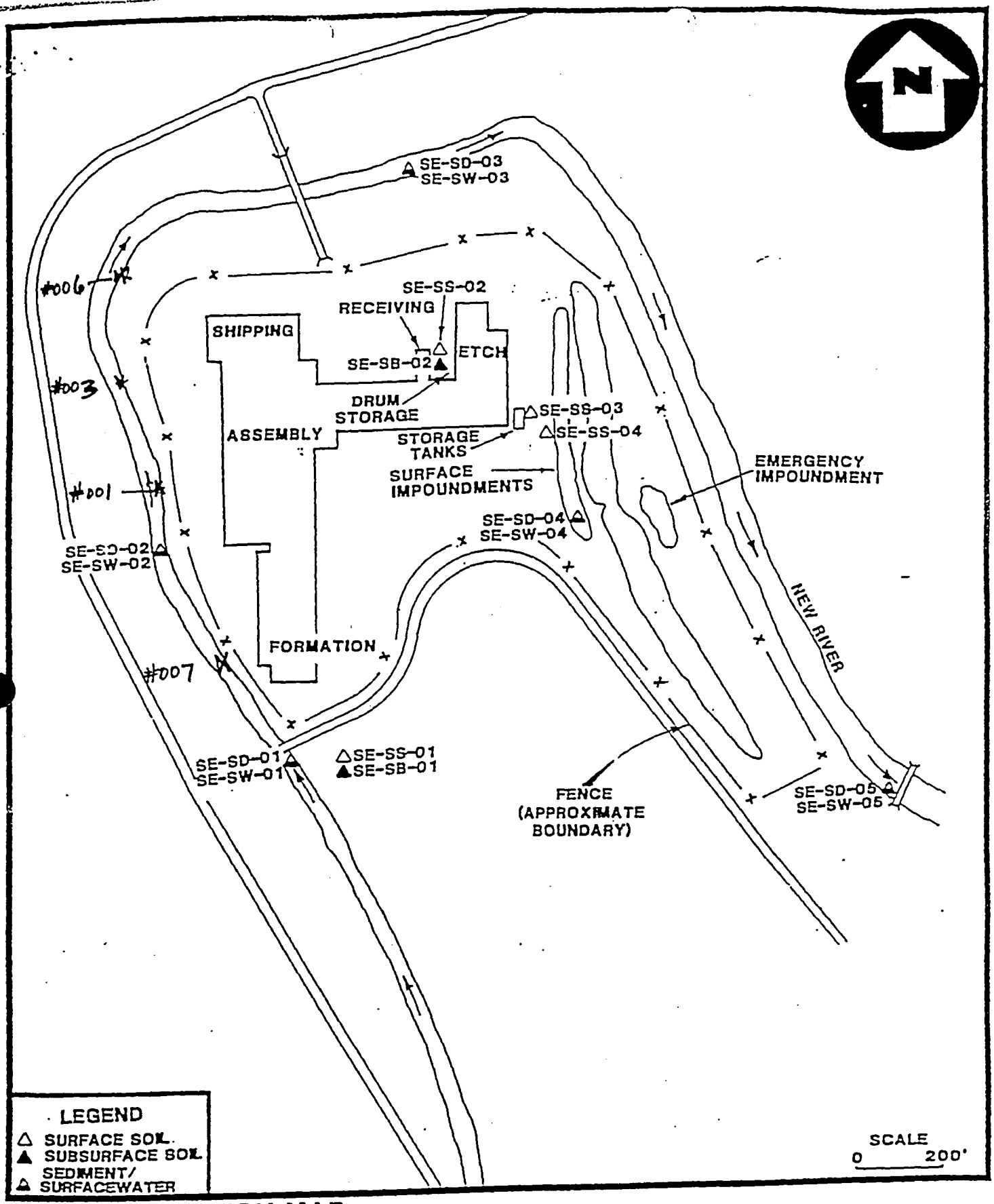
- A March 16, 1994 NOV issued by the NC DEM Water Quality Section stated that the facility was spreading residuals from the drying beds on the grounds or stored. The facility was ordered to take residuals to a landfill. Sampling of outfall #001 was in violation because the facility was doing grab samples instead of composite samples. Outfall #001 (non-contact, boiler, A/C, and assembled product rinse discharge) was required to be monitored for cadmium, chromium, copper, lead, nickel, silver, and zinc monthly for one year. Some copper (29 ug/L) and zinc (44 ug/L) were detected in one sample. Seven semivolatile and volatile organics plus seven unidentified peaks were detected in outfall #001, including 290 ug/L dimethylformamide and 6.9 ug/L tetrachloroethylene. Outfall #006 showed 16 unidentified volatile and semivolatile peaks and 1.9 ug/L 1,2-dichlorobenzene.

WSRO employees have stated that United Chemi-con is a little behind schedule but is generally cooperative and willing to clean up the site. WSRO is currently regulating the groundwater contamination and plans to order groundwater remediation. This groundwater contamination is the primary threat to human health. Even though 450 people use the onsite drinking water well, it is not contaminated.

Threats to the environment have been reduced by closing down the lagoons and backfilling these to prevent soil exposure and further migration of the contaminants to the river. While aluminum has been detected in the river, sampling conducted thus far in the river has not shown levels of highly bioaccumulative or ecotoxic contaminants that are more than three times background.



Sprague Aluminum
(United Chemi-con and Old Lagoons)



SAMPLE LOCATION MAP
[illegible]RAGUE ELECTRIC COMPANY
[illegible]LANSING, ASHE COUNTY, NORTH CAROLINA

FIGURE 3

NUS CORPORATION

Ref. 4

MEMO

DATE: December 27, 1995

TO: File

FROM: Jeanette Stanley
Environmental Chemist
NC Superfund Section

SITE: Sprague Aluminum Company
NCD 003 167 780
Lansing, Ashe County, NC

On December 16, I spoke with George Smith, NC Division of Water Quality, Water Quality Section (910) 771-4600 about the pond property associated with the Sprague site. Since he is familiar with the property, I asked his professional opinion regarding any remaining environmental concerns about the ponds had not been addressed by draining the ponds, sampling the sediment and backfilling them. He said that he felt fairly confident about the cleanup. Mr. Smith said that the ponds did not discharge to the river, they were "evaporation" ponds and that the ponds did have an aerator at one time. He has some remaining concerns about the dimethylformamide (DMF) that was used by the facility, discharged by the facility to the river at one time and probably discharged to the ponds at an earlier date. Mr. Smith said that DMF is a toxic chemical.

I looked up the properties of DMF. It is toxic by skin absorption and is a strong irritant to skin and tissue. It is a moderate fire risk. It is miscible with water but not with chlorinated solvents. It is less dense than water. DMF is not listed in the Superfund Chemical Data Matrix. There is no groundwater or drinking water standard for DMF. Due to these properties and facts, it is my opinion that even if DMF was indeed discharged to the ponds, some was lost during aeration. Due to the properties of the chemical, it would not sink below the pond water and concentrate in the groundwater but would remain in solution.

Mr. Smith said that there is a small area on the pond property that appears to be wetlands, but he is not sure. He said he has been on the river down to a mile below the facility and he has not noted any areas that appear to be wetlands. The river banks are either cow pastures or steep slopes. He has conducted a macroinvertebrate study along the river and he said that the river is very healthy. He did not know of there ever being a fish kill along the river. He also said that the pond property is surrounded by a 6' high chain link fence. He is not sure if it is totally inaccessible, but it is overgrown and unattractive for any recreational use.

I asked him about who owns the property and if there were any funds available to pay for additional clean up if any was required. He said that the Sprague company has sold most of its assets and had paid for draining and backfilling the ponds but he did not believe there were additional funds available.

Ref. 5

MEMO

DATE: July 7, 1995

TO: File

FROM: Jeanette Stanley
Environmental Chemist
NC Superfund Section

Jeanette Stanley

SITE: Sprague ~~Electric~~ aluminum Company
NCD 003 167 780
Lansing, Ashe County, NC

I spoke with several people in the Winston-Salem regional office of NC DEM (910) 771-4600. In the Water Quality Section, I spoke with Steve Mauney, supervisor of Water Quality Section and Jim Johnston, Environmental Chemist. Mr. Johnston has worked with the regional office for about 10 years and provided the following information on the Sprague facility:

- The lagoons are no longer in use and are waiting to be closed down. Past leachate problems with the lagoons caused pH problems and high aluminum in the river. The lagoons were drained several years ago. Rainwater may have filled the lagoons again . The current status of the lagoons is not known. Mr. Johnston has not visited the property for about two years.

- There were a number of computer-generated Notices of Violations for NPDES violations served to the facility in the past. These violations were a permitting error on the part of NC DEM as limits were too low and unattainable. Violations were for Total Suspended Solids and Oil and Grease. Once permit limits were raised to attainable levels, there were no more violations.

- A Japanese firm has purchased the plant and is now operating it. They did not purchase the lagoon portion of the property. The facility quit etching operations three to five years ago. They now purchase etched material.

I spoke with Mr. Lee Spencer, Regional Engineer in the Public Water Supply Section. He said that the company name is now United Chemi-con. The contact point is Mr. Lesley D. Hovermale, 185 McNeil Rd., Lansing, NC 28643. Mr. Spencer said that the onsite well is 900' deep and is used for drinking water for the workers. The system ID # is 01-05-441. There are 450 workers using this well. All tests have been in compliance with drinking water standards. One recent test was elevated in fecal coliform, but four subsequent tests have passed. A recent application was submitted by the plant for a waiver for PCBs and pesticides and testing results allowed the facility to go to a less frequent testing schedule.

My call was then transferred to Ms. Sherri Knight, the Regional Groundwater Supervisor. I asked her if there were any on-site monitoring wells. She indicated that there were several and that there had definitely been a release of contamination to groundwater. Aluminum was very elevated in at least one monitoring well. Barium and chromium were above the 2L standards, but close to background levels. The filtered/unfiltered issue was being discussed in connection with this round of testing and she was unsure at this time if there was indeed an observed release of chromium to the groundwater. She said that there were several underground storage tanks (she thinks four) recently pulled on the site. She should have more information on the results in the near future. She said that the facility is cooperating and seems willing to clean up the site. The contact with the tank pulls has been Martha Waller with Parker, Poe, the legal counsel for the facility.

I called Mr. Paul Clark at Public Water Supply (919) 715-3217 and he FAXed the results of the most recent inorganic test results on the onsite drinking water well. These are attached.

âââââââââââââââââââââââââââââââââââMacSoft VT #1âââââââââââââââââââââââââââââââââââ

PROGRAM-W30RET01 INORGANIC CHEMICAL ANALYSIS FILE-W30HF001

PUBLIC WATER SYSTEM

Water System ID Number 0105441 LAB ID 37733 HYRDO ANALYTICAL LABORATORIES
Name of System UNITED CHEMI-CON
Type of Sample E (Regular=D; Check=C; Special=S)
Collected on: Date: 122194 Time: 0950 AM (AM/PM) Location Code: 375

CONTAM	NAME	METHOD	RESULTS		CONTAM	NAME	METHOD	RESULTS
1005	ARSENIC	000	0.0000	**	1045	SELENIUM	000	
1010	BARIUM	000	0.0000	**	1050	SILVER	000	
1015	CADMIUM	000	0.0000	**	1052	SODIUM	000	
1020	CHROMIUM	000	0.0000	**	1055	SULFATE	000	
1024	CYANIDE	000	0.0000	**	1074	ANTIMONY	000	
1025	FLUORIDE	000	0.0000	**	1075	BERYLLIUM	000	
1028	IRON	000	0.0000	**	1085	THALLIUM	000	
1030	LEAD	000	0.0000	**	1925	PH	000	
1032	MANGANESE	000	0.0000	**	0000		000	
1035	MERCURY	000	0.0000	**	0000		000	
1036	NICKEL	000	0.0000	**	0000		000	
1040	NITRATE	109	0.1300	**	0000		000	
1041	NITRITE	109 <	0.0100	**	0000		000	

Date Received 010695 Date Reported 122994 Date Analyzed 122894
Laboratory Number 021837 Reported By W30 Comment FORMATION/L.D.A.
PRESS ENTER FOR NEXT RECORD; PF13 FOR UNSAT REASON 2;
PF14 FOR UNSAT REASON3; OR PRESS PF16 TO EXIT

Jeanette Stanley, 7/7/95

There is no record of inorganic monitoring for this system. This is a non-transient non-community water. They have until the end of 1995 to conduct inorganic monitoring.

Paul

PS: Nitrate monitoring is separate from inorganic

TO: J. Stanley
FAX: 733-4811
FROM: P. CLARK
FAX: 715-2.2047

Ref. 1

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

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

RECEIVED
MAY 17 1993
SUPERFUND SECTION

4WD-WPB

MAY 13 1993

Ms. Pat DeRosa
CERCLA Branch
North Carolina Department of Environment,
Health and Natural Resources
P.O. Box 27687
Raleigh, North Carolina 27611-7687

Dear Ms. DeRosa:

Enclosed please find a copy of the Final Site Inspection Prioritization (SIP) Report for the Sprague Electric Company site in Lansing, Ashe County, North Carolina (NCD003167780). This report was prepared for EPA Region IV by Black & Veatch Waste Science and Technology Corp.

Based on a review of the report, it has been determined that the site warrants further action under federal authority. An observed release of heavy metals has been documented in the North Fork of the New River, which is classified as a fishery. Therefore, an Expanded Site Inspection (ESI) has been recommended on a low priority basis to assess the threat to the human food chain population.

If you should have any questions, please feel free to contact me at (404) 347-5065.

Sincerely yours,

Craig A. Benedikt

Craig A. Benedikt
EPA NC CERCLA Project Officer

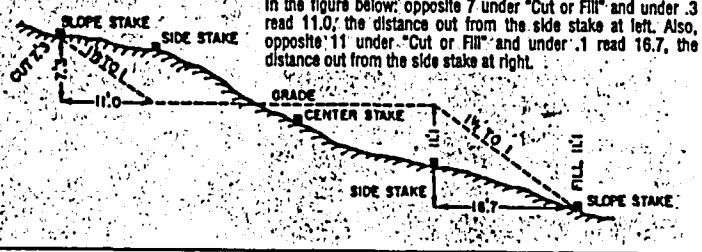
Enclosure

Printed on Recycled Paper

DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING

Roadway of any Width. Side Slopes 1½ to 1.

In the figure below: opposite 7 under "Cut or Fill" and under .3 read 11.0, the distance out from the side stake at left. Also, opposite 11 under "Cut or Fill" and under .1 read 16.7, the distance out from the side stake at right.



Cut or Fill	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	Cut or Fill
	Distance out from Side or Shoulder Stake										
0	0.0	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	0
1	1.5	1.7	1.8	2.0	2.1	2.3	2.4	2.6	2.7	2.9	1
2	3.0	3.2	3.3	3.5	3.6	3.8	3.9	4.1	4.2	4.4	2
3	4.5	4.7	4.8	5.0	5.1	5.3	5.4	5.6	5.7	5.9	3
4	6.0	6.2	6.3	6.5	6.6	6.8	6.9	7.1	7.2	7.4	4
5	7.5	7.7	7.8	8.0	8.1	8.3	8.4	8.6	8.7	8.9	5
6	9.0	9.2	9.3	9.5	9.6	9.8	9.9	10.1	10.2	10.4	6
7	10.5	10.7	10.8	11.0	11.1	11.3	11.4	11.6	11.7	11.9	7
8	12.0	12.2	12.3	12.5	12.6	12.8	12.9	13.1	13.2	13.4	8
9	13.5	13.7	13.8	14.0	14.1	14.3	14.4	14.6	14.7	14.9	9
10	15.0	15.2	15.3	15.5	15.6	15.8	15.9	16.1	16.2	16.4	10
11	16.5	16.7	16.8	17.0	17.1	17.3	17.4	17.6	17.7	17.9	11
12	18.0	18.2	18.3	18.5	18.6	18.8	18.9	19.1	19.2	19.4	12
13	19.5	19.7	19.8	20.0	20.1	20.3	20.4	20.6	20.7	20.9	13
14	21.0	21.2	21.3	21.5	21.6	21.8	21.9	22.1	22.2	22.4	14
15	22.5	22.7	22.8	23.0	23.1	23.3	23.4	23.6	23.7	23.9	15
16	24.0	24.2	24.3	24.5	24.6	24.8	24.9	25.1	25.2	25.4	16
17	25.5	25.7	25.8	26.0	26.1	26.3	26.4	26.6	26.7	26.9	17
18	27.0	27.2	27.3	27.5	27.6	27.8	27.9	28.1	28.2	28.4	18
19	28.5	28.7	28.8	29.0	29.1	29.3	29.4	29.6	29.7	29.9	19
20	30.0	30.2	30.3	30.5	30.6	30.8	30.9	31.1	31.2	31.4	20
21	31.5	31.7	31.8	32.0	32.1	32.3	32.4	32.6	32.7	32.9	21
22	33.0	33.2	33.3	33.5	33.6	33.8	33.9	34.1	34.2	34.4	22
23	34.5	34.7	34.8	35.0	35.1	35.3	35.4	35.6	35.7	35.9	23
24	36.0	36.2	36.3	36.5	36.6	36.8	36.9	37.1	37.2	37.4	24
25	37.5	37.7	37.8	38.0	38.1	38.3	38.4	38.6	38.7	38.9	25
26	39.0	39.2	39.3	39.5	39.6	39.8	39.9	40.1	40.2	40.4	26
27	40.5	40.7	40.8	41.0	41.1	41.3	41.4	41.6	41.7	41.9	27
28	42.0	42.2	42.3	42.5	42.6	42.8	42.9	43.1	43.2	43.4	28
29	43.5	43.7	43.8	44.0	44.1	44.3	44.4	44.6	44.7	44.9	29
30	45.0	45.2	45.3	45.5	45.6	45.8	45.9	46.1	46.2	46.4	30
31	46.5	46.7	46.8	47.0	47.1	47.3	47.4	47.6	47.7	47.9	31
32	48.0	48.2	48.3	48.5	48.6	48.8	48.9	49.1	49.2	49.4	32
33	49.5	49.7	49.8	50.0	50.1	50.3	50.4	50.6	50.7	50.9	33
34	51.0	51.2	51.3	51.5	51.6	51.8	51.9	52.1	52.2	52.4	34
35	52.5	52.7	52.8	53.0	53.1	53.3	53.4	53.6	53.7	53.9	35
36	54.0	54.2	54.3	54.5	54.6	54.8	54.9	55.1	55.2	55.4	36
37	55.5	55.7	55.8	56.0	56.1	56.3	56.4	56.6	56.7	56.9	37
38	57.0	57.2	57.3	57.5	57.6	57.8	57.9	58.1	58.2	58.4	38
39	58.5	58.7	58.8	59.0	59.1	59.3	59.4	59.6	59.7	59.9	39
40	60.0	60.2	60.3	60.5	60.6	60.8	60.9	61.1	61.2	61.4	40

STUART F PARKER
NCDENR, DIV WASTE MGT
SUPERFUND SECTION
401 Oberlin Rd Suite 150
Raleigh NC 27605

7/30/98 →

The paper in this book is made of 50% high grade rag stock with a WATER RESISTING surface sizing.

Ref. 4

SPRAGUE ALUMINUM EST RECON.

NCD 003 167 780 9/25/01 p. 1

ASHE COUNTY NC

SFP & HDNN LEFT AND DROVE TO FORMER SPRAGUE ALUMINUM (NOW UNITED CHEMICON). MET WITH RICHARD POWELL OF DELTA ENVIRONMENTAL CONSULTANTS, CONS. FOR ~~AMERICAN~~ GREAT AMERICAN FINANCIAL RESOURCES, ~~THE~~ (AKA AMERICAN ANNUITIES) THE CURRENT OWNER OF THE SITE'S FORMER EVAPORATION/SETTLING POND PROPERTY.

OBJECTIVES OF RECON.

① CLEAR UTILITIES AT POND PROP AND BACKGROUND SAMPLE POINTS. (OK)

② EXAMINE/ESTABLISH ACCESS FOR SFC H2O PATHWAY SAMPLES. ~~[illegible]~~ (N/A) (CAN) OF SITE.

③ TEST AUGER TO EVALUATE NEED FOR LITTLE BEAVER TO INSTALL TEMP MWS DURING EST.

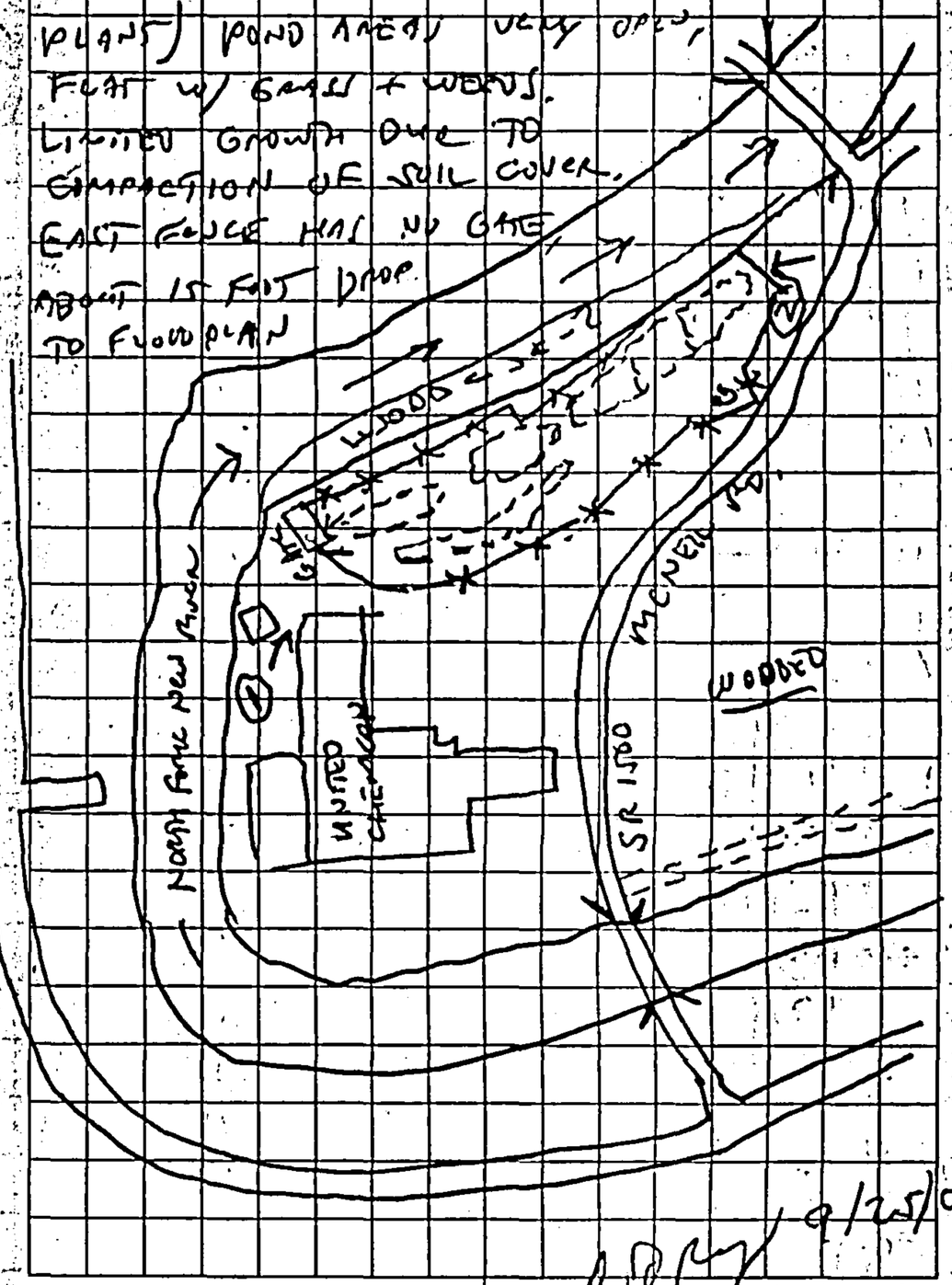
④ GET PLOT OF PROPERTIES, ALSO OTHER ITEMS REQUESTED OF GAFR

⑤ ID BACKGROUND WELL LOCATION AND TEST AUGER DONE - SITE HAS MWS

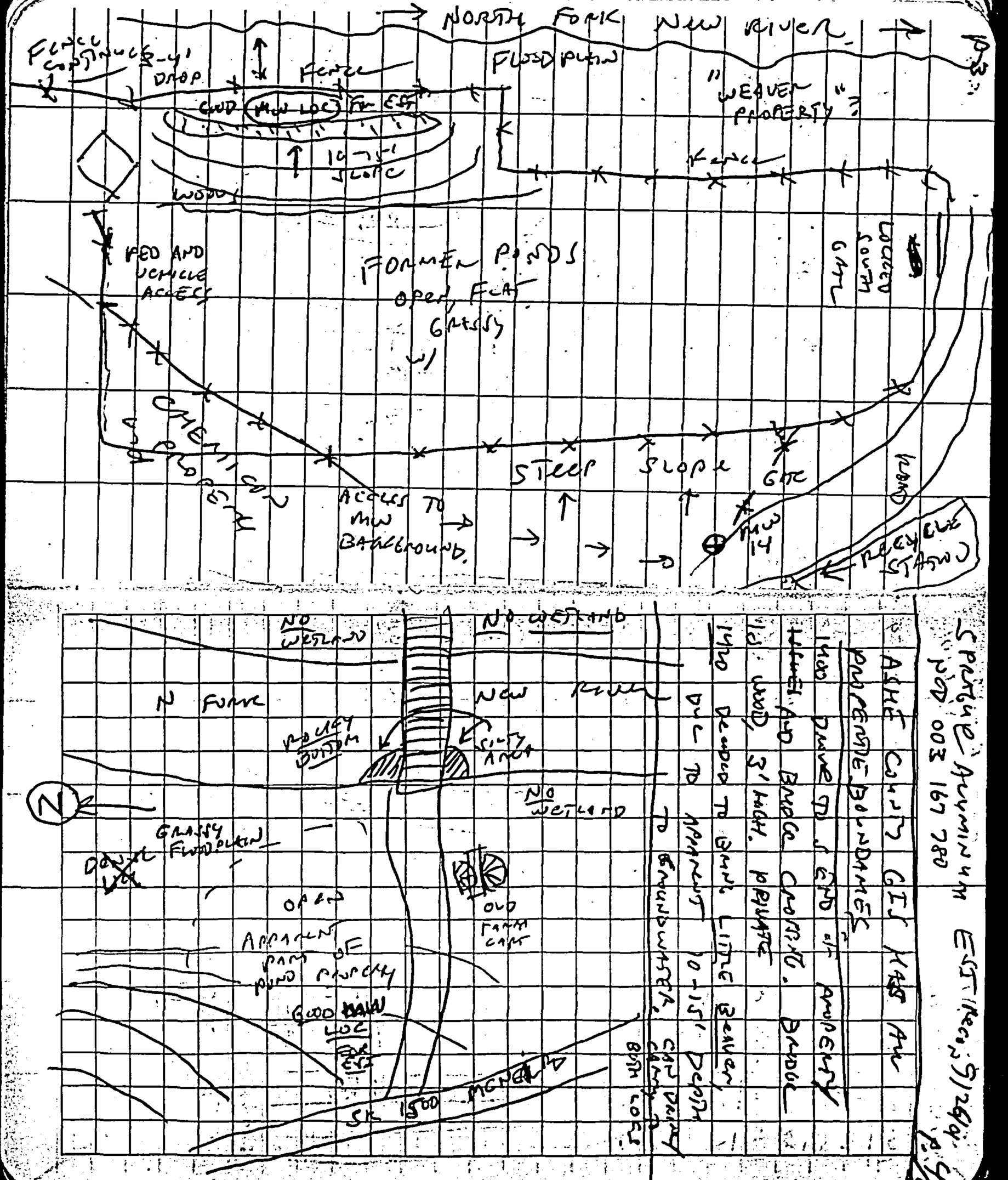
LEFT OFFICE 0900 ONSITE 1300 (N/A 64) MET NICK POWELL/ROBERT GOSS LOOKED AT SURVEY PLAT.

SITE HAS MWS WE CAN USE AS BACKGROUND.

1322 EXAMINED POND AREA (ACCESS THRU PLANT) POND AREA VERY OPEN, FLAT W/ GRASS & WEEDS. LIMITED GROWTH DUE TO COMPACTION OF SOIL COVER. EAST FENCE HAS NO GATE, ABOUT 15 FOOT DROP TO FLOODPLAIN



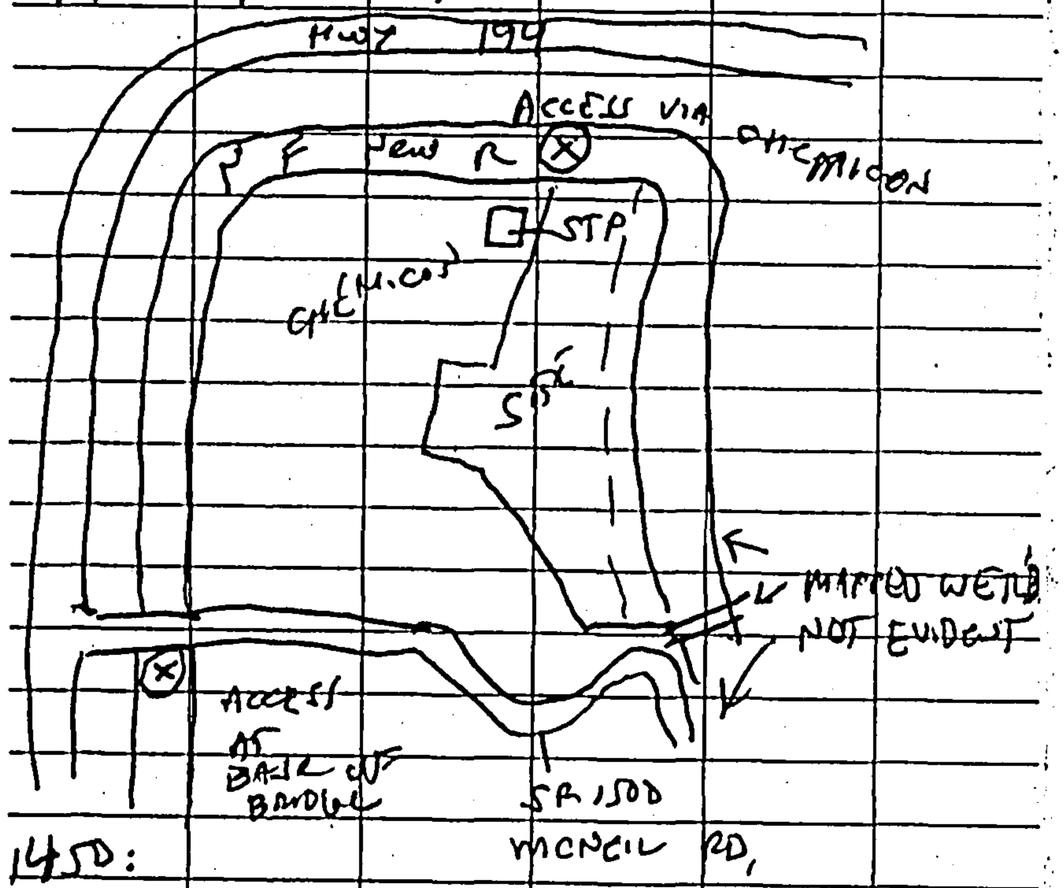
9/25/01


NORTH FORK NEW RIVER
FLOODPLAIN
"WEAVER PROPERTY"
FENCE
FENCE CONTINUES 4' DROP
GOOD MW LOC FOR EST
10-15' SLOPE
WOODS
FORMER PONDS
OPEN, FLAT GRASSY W/
CREEK
STEEP SLOPE
GATE
ACCESS TO MW BACKGROUND.
MW 14
RECYCLING STATION
LOCKED GATE
ASHE COUNTY GIS MAP
PROPERTY BOUNDARIES
1400 DRIVE TO END OF PROPERTY
WEAVER AND BRIDGE CROSSING. BRIDGE
15' WIDE, 3' HIGH. PRIVATE
1420 DECIDED TO BANK LITTLE BEAVER
DUE TO APPARENT 10-15' DEPTH
TO BACKGROUND, CAN DRAW
BOTH LOCS.
5 PARCEL ADMINISTRATION
NO 003 167 780
EST. RECEIVED 5/26/94
NO WETLAND
NO WETLAND
N FORK
NEW RIVER
ROCKY BOTTOM
SILTY AREA
NO WETLAND
N
GRASSY FLOODPLAIN
DOUBLE LOC
OPEN
OLD FARM CAR
APPARENT PAN OF POND PROPERTY
GOOD MW LOC FOR EST
SR 1500 MCNEILL

SPRAGUE ALUMINUM EST RECON.
NOD 003 167 780 9/26/01

1425 EXAMINED MAPPED WETLAND AREA AND DETERMINED THAT AREAS ARE ON ELEVATED FLOOD PLAIN, (Δ) UNLIKELY TO BE HYDRIC — (Δ) NO WETLAND SAMPLE.

1430-1450 CHECKED ACCESS TO NF NEW RIVER FOR UPSTREAM SAMPLES



1450:
LEFT SITE
OFFICE: 19:30

9/26/01

"Rite in the Rain"®
ALL-WEATHER WRITING PAPER

Name: STUART PARKER
NC SUPERFUND SECTION

Address: 401 OBERLIN RD
RALEIGH NC 27605

Phone: 919 733 2801

Project:

Clear Vinyl Protective Slipcovers (Item No. 30) are available for this style of notebook. Helps protect your notebook from wear & tear. Contact your dealer or the J. L. Darling Corporation.

(1)

CONTENTS

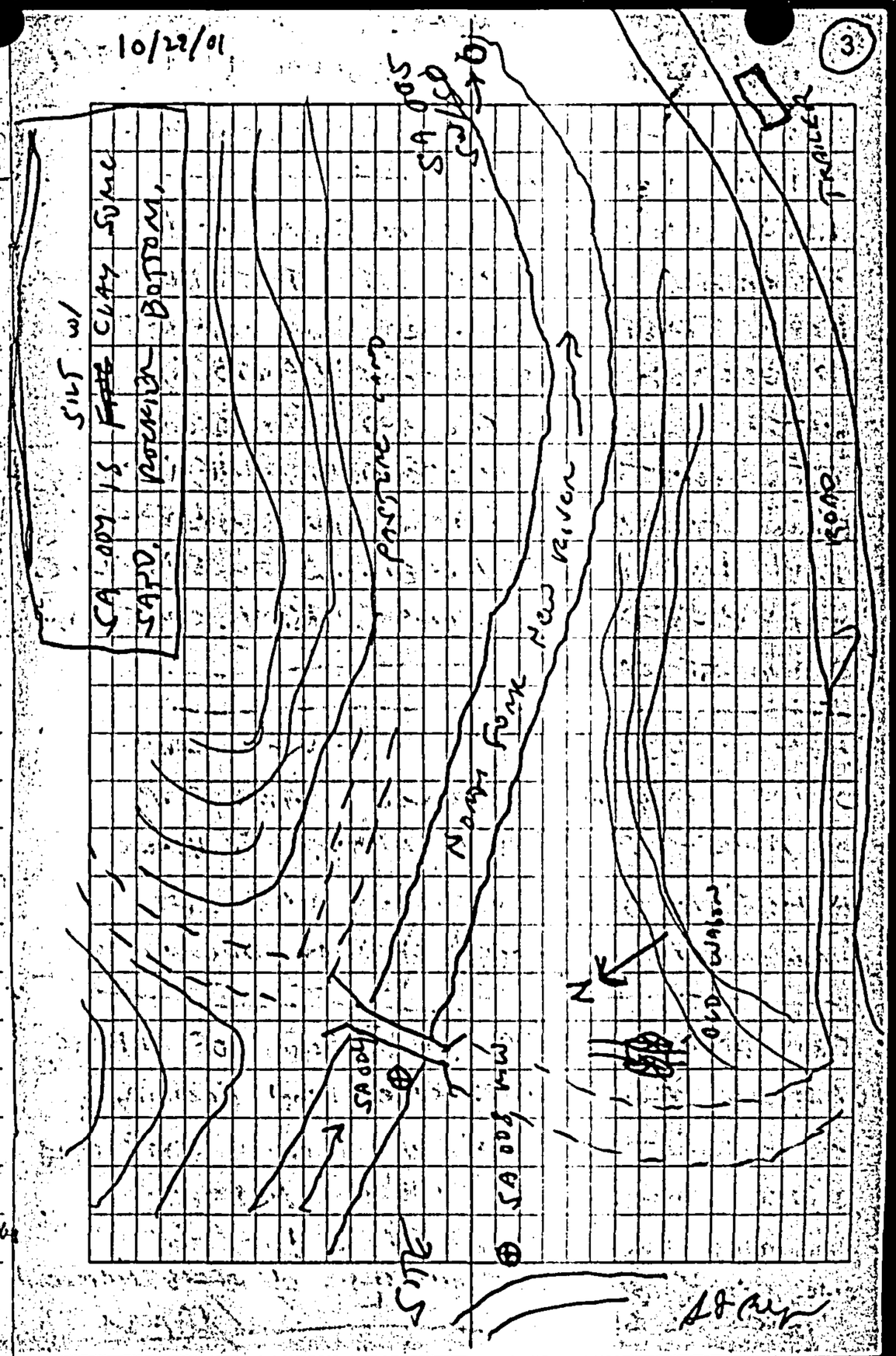
PAGE	REFERENCE	DATE
	EXPANDED SITE INSPECTION SAMPLING 10/24-30/01	
	SF PARKER, H ZINN, M BRYSON, J BARRON, M DEATON, K HAGEN — NC SUPERFUND SECTION	
	NCDENR DIVISION OF WASTE MANAGEMENT	
	SPRAGUE ALUMINUM CO LANSING, ASHE COUNTY NC NCD 003 167 780	
	NOTES BY: STUART PARKER	
	BOOKLET 1 OF 1	

(2) SPRAGUE ALUMINUM CO 10/29/01
LANSING ASHE COUNTY NC
NCD 003 167 780 EST SAMPLING

10/29/01 LEFT OFFC 0800, ONSITE 13:
WEATHER CLEAR, DRY 56 °F

ONSITE 1320 MET W/ SAM WATSON,
DELTA ENV. CONSULTANTS INC AT MW 14
H. ZINN, K HAGEN & MIKE DEASON SET UP
LITTLE BEAVER TO DRILL AT SA 008 MW
1400 M BRYSON MOBILIZED TO COLLECT SA 005 SD
AND SA 005 SD ON N FORK NEW RIVER, APPROX
1200 FT DOWNSTREAM OF SITE.
1412 COLLECTED SEDIMENT SAMPLE, BROWN
SILT W/ CLAY, SOME SAND, ORGANIC RICH (LEAVES)
1402 COLLECTED SFC WATER SA 005 SW
SPLIT BOTH SAMPLES W/ DELTA ENVIRON.
(PHOTOS 1-3)
1420: H. ZINN REPORTED POWER AUGER REFUSAL
AT ~8-FT. ROTARY REFUSAL FOLLOWED BY
FLAT BOTTOM REFUSAL.
1428 M BRYSON COLLECTED SA 004 SW
UPSTREAM OF BRIDGE JUST DOWN STREAM
FROM SITE. 1437 - COLLECTED SA 004 SD
PHOTO 4: LOOKING DOWNSTREAM FROM BRIDGE
TOWARD TRAILER UPSTREAM FROM SA 005.
MBry

10/22/01 (3)



 SPRAGUE ALUMINUM
NCD 003 167 780 ESI SAMPLING 10/29/01

1440 H ZINN STARTED NEW DRILL HOLE FOR SA-008-MW.

1455 DROVE ALONG RIVER FLOODPLAIN TO COLLECT SA 003 SW/SD, JUST DOWNSTREAM FROM TRESTLE (DEMOLISHED) AND ADJACENT TO VERTICAL ROCK OUTCROP (PHOTO 6)

NOTE: C+D/ROCKY FILL AND EARTH MOVING EQUIPMENT ON OPPOSITE (NORTH) BANK, UPSTREAM FROM SAMPLE AND TRESTLE, AND OPPOSITE FROM IMPOUNDMENT/CHEMICON PROPERTY LINE

1501 COLLECTED H_2O SAMPLE. 1504 COLLECTED SEDIMENT SAMPLE.

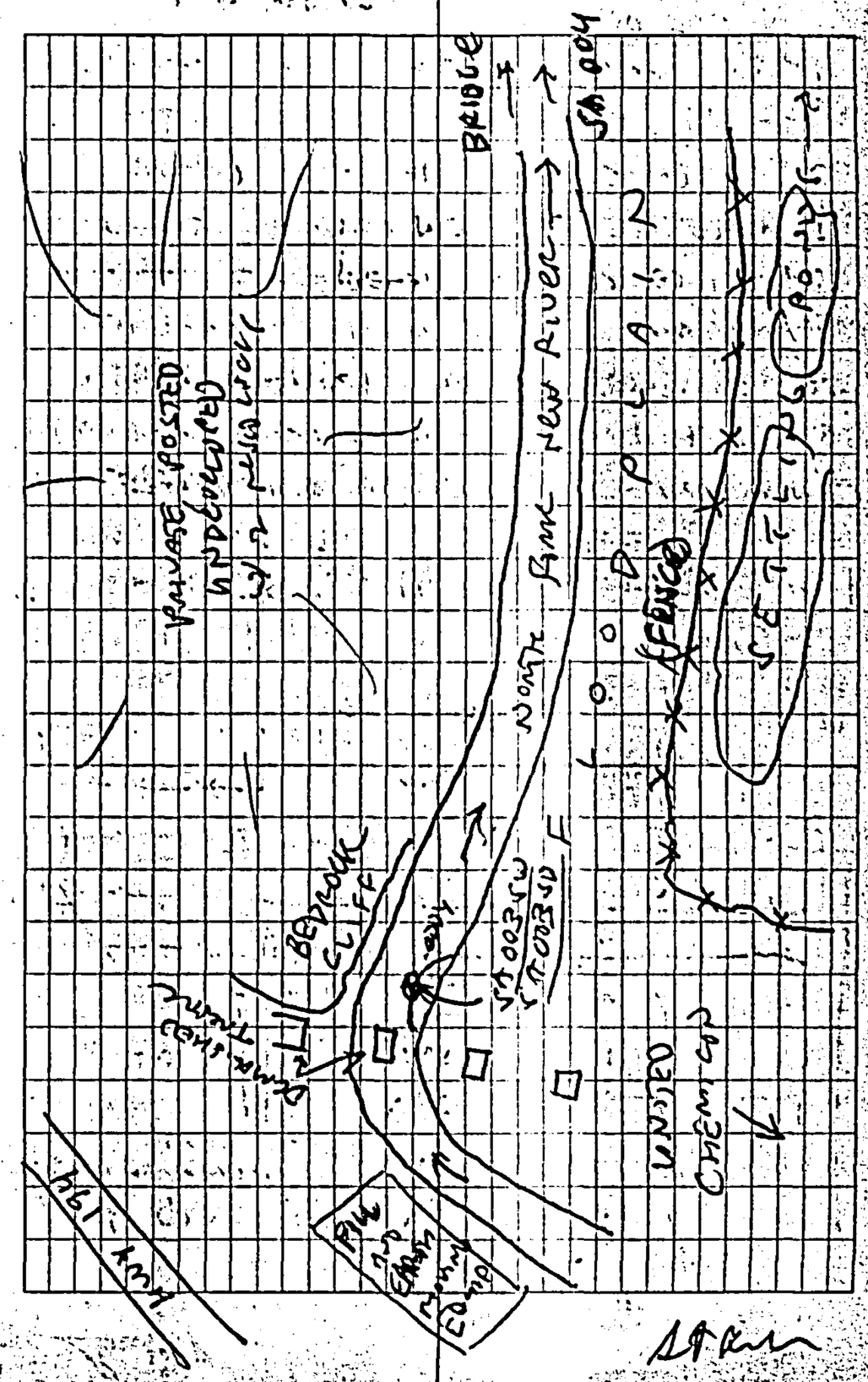
1510 H ZINN REPORTED REFUSAL ON COBBLE BED AT ~9 FT. REPLACED CUTTING TIP OF AUGER TO TRY TO PENETRATE. NO WATER IN HOLE AT 9 FT, JUST SOME WET SEAMS (CREMATED/FINE LOAMS) ON WAY-DOWN.

1530 DROVE TO SR 1500 ROAD CROSSING OF N FORK, UPSTREAM FROM UNITED CHEMICON FACILITY

2 SEDIMENT LOCATIONS, w/ 1 DUPLICATE SED SAMPLE

1 WATER LOCATION w/ MS/MSD METALS.

COLLECTED FROM ONE UPSTREAM LOC. AND ONE BELOW ABOVE BUT UPSTREAM OF ~~[illegible]~~ CHEMICON (SEE PHOTO 6)

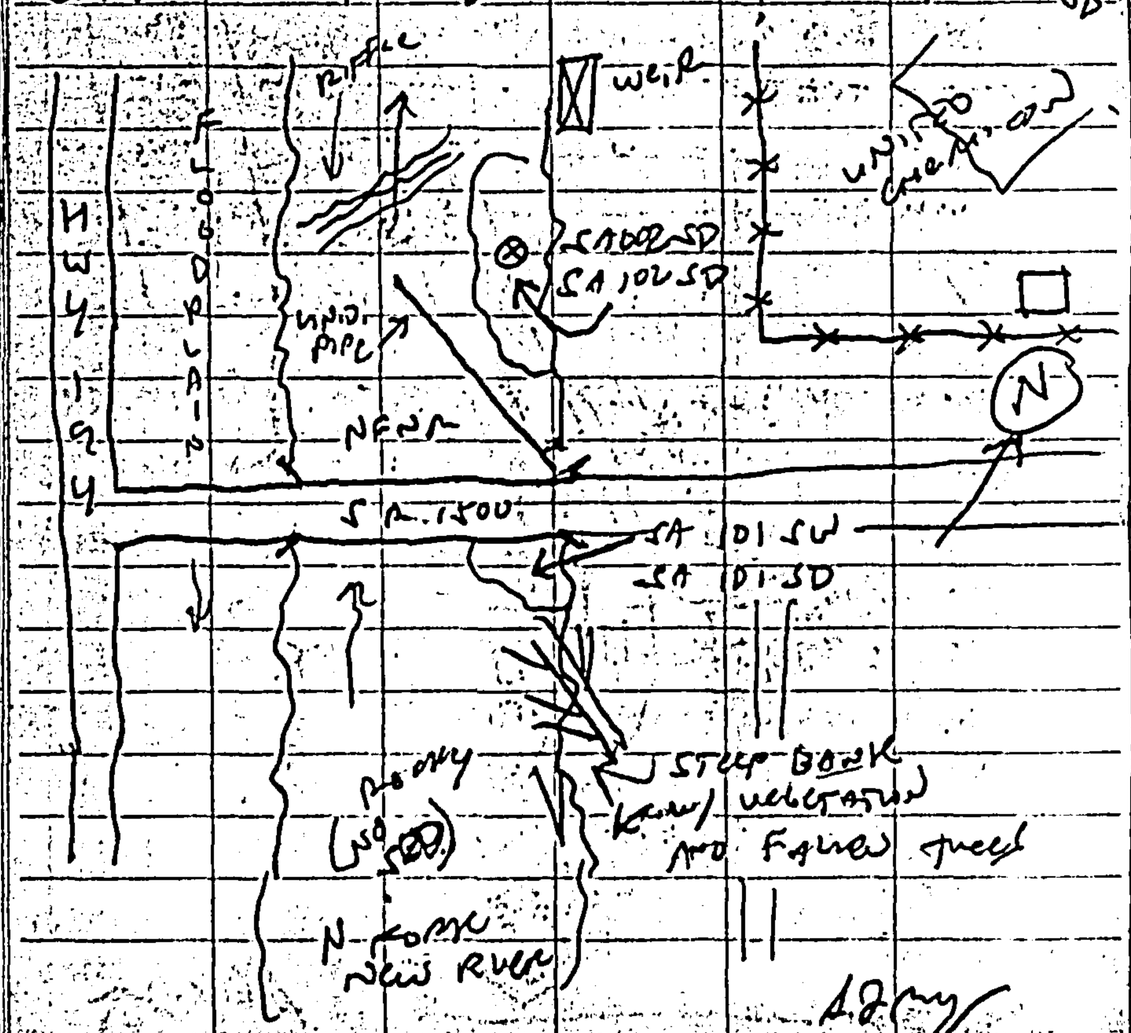


SPRAGUE ALUMINUM 10/29/01
NCD 003 167 780 EST SAMPLING

15 SD UNABLE TO GET FINES AT 2nd UPSTREAM LOCATION. SAMPLED ADJACENT TO UPPER CULVERT ABUTMENT (PHOTO 4)

1540 SAMPLE # SA 001 SW COLLECTED. SAMPLE SA 001 SD COLLECTED 1550 (VSD)

POOR/NO ACCESS ON SEDIMENT FUNNION UPSTREAM, SO COLLECTED SA 002 SD (30') DOWNSTREAM FROM BRIDGE @ 1612 (JAMES BATESON COLLECTED). CONTAINERS FOR DUPLICATE SUBMITTED, SA 102 SD

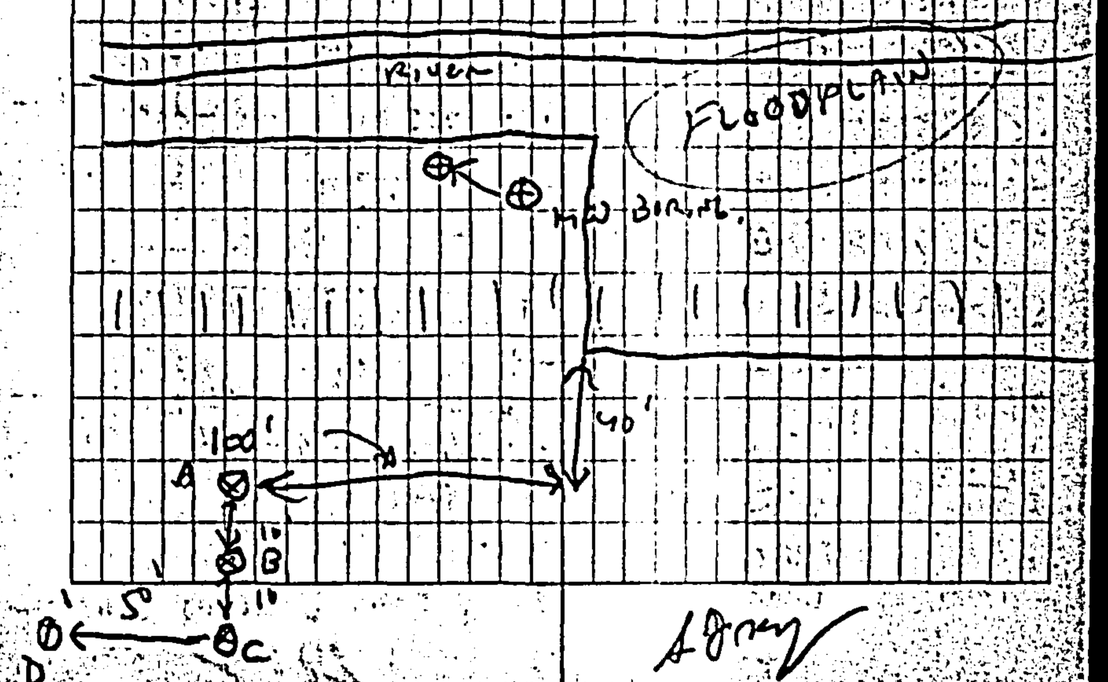


AJ Gray

HAND ATTEMPTING TO DRILL SECOND MONITORING WELL INSIDE FENCE OF IMPOUNDMENT AREA. LEFT OTHER MW TO SEE IF FILLS OVERNIGHT

REFUSAL AT 9' AT BOREHOLE 1644 APPARENT FILL SURFACE, NO MOISTURE ~~MW 00~~ (SA 007 MW). RELOCATED FOR NEW HOLE

1648 J BATESON HAND AUGERING AT SA 010 SD NO SIGN OF SLUDGE AT ↓ 4 FT. D FROM LIGHT BROWN SILTY FILL TO DARKER WEATHERED MICACEOUS MATERIAL AT 4 FT. REFUSAL ON GRAVEL. RELOCATED 10' TOWARD CHEMICAL. SAME MATERIAL, REFUSAL. SAME AGAIN ANOTHER 10 FEET. MOVED 10' ALONG POND AXIS



AJ Gray

SPECIFIC ALUMINUM 10/29-30/01
NCD 003 167 080 EST SAMPLING

1700 HEINN INSTALLED TEMP MON
SA 007 MW. BACKED UP LITTLE BEAVER

1740 M BRYSON HIT GRAY SLUDGE AT
8' DEPTH IN HAND AUGERING "D".
17:50 COLLECTED SAMPLE SA-010-SL
GRAY, CREAM-TEXTURED SEMI SOLID
W/ SULFURIC ODOR, NO VOLATILE ORGANIC
EMISSIONS.

LEFT SITE 1815 ARRIVED AT HOTEL 1845 (BEST WESTERN)

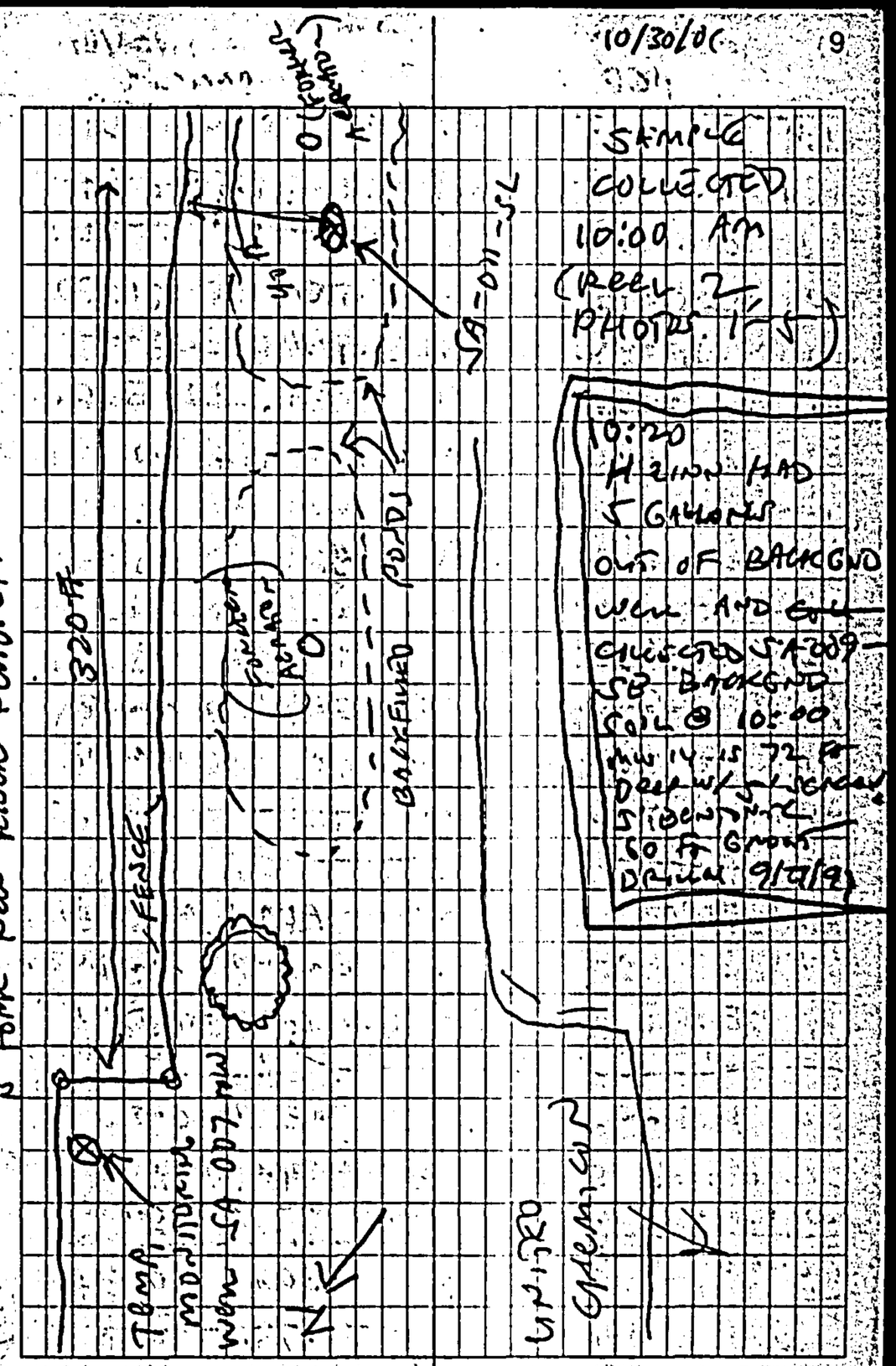
10/30/01 ON SITE 0820 SUNNY, 32→50°F

HZ, MD, KH TO START ON BACKGROUND WELL
SA 006 MW / SA 106 MW. JB AND
AND SOIL SA 009 SB
WELL
DEPTH 74.4 ft DTW 60.4. 14.0 ft H_2O
COLUMN 7 GALLONS TOTAL VOLUME.

JB AND MB TO COLLECT SLUDGE
SAMPLE SA 011 SL.

MINIRAE # 102236
CAL READING 49.8.

0945 JB → MB HIT
BLACK SLUDGE IN BOREHOLE SA-011 AT
APPROX 12 ft. UNLIKE SA010, THIS IS
BLACK VITREOUS. LIMITED THICKNESS, SO
SAMPLED BOREHOLE SPOIL FROM DESCENT AUGER



SAMPLE COLLECTED 10:00 AM (REEL 2 PHOTOS 1-5)

10:20 HEINN HAD 5 GALLONS OUT OF BACKGND WELL AND COLL COLLECTED SA-009-SB BACKGND COIL @ 10:00
MW IS 72 ft DEEP W/ 5 screen
SIDENOTE
50 ft GROUT
DRILLER 9/19/01

NED 003 167 780 EST SAMPLING

10:40 PROCEEDED TO SA 008 MW LOCATION

TOTAL DEPTH (TOC) 9.23'; DTW TOC 7.98'

STICKUP = 1.65'

NO RESPONSE FROM BATTERY SO USED AUTO BATTERY FROM SUBURBAN.

1105 STARTED INITIAL PURGE. 1.25 ft STANDING IN WELL, DRAWN DOWN TO BOTTOM IN 5 MIN. WATER IS CHOCOLATE BROWN, MUDDY.

1130 PUMPED WELL DRY IN 5 SECONDS.

HZ USING GENERATOR INSTEAD OF POWER VENTURE AND BATTERIES, BECAUSE P.V. KEEPS BLOWING FUSES. GENERATOR NOT STARTING.

1147 STARTED PERISTALTIC ALARM AT SA 008 MW. DRIED UP IMMEDIATELY. WELL NOT PRODUCING.

SFP DECIDED TO ABANDON GW SAMPLING THIS LOC. SFP REMOVED CASING AND BACKFILLED MW.

1210 H ZINN REPORTED UNABLE TO GET BACKGROUND SAMPLE. GENERATOR FLOW TOO HIGH. LOW FLOW BLOWS OUT FUSES ON BATT CONVERTER

WELL SA 007 MW
12.45 DEPTH; 10.55 DTW BELOW T.O. CASING
1.6 ft STANDING H_2O.

1225 ABANDONED BACKGROUND SAMPLING @ SA 006 MW

1234 H BRYSON STARTED PURGE OF SA 007 MW

1238 WELL DRY AFTER 0.25 GAL / 1 VOLUME PUMPED

1253 START PUMPING. DRY AT 1254.

SFP DECIDED TO ABANDON WELL AND SAMPLING OF GROUNDWATER. BEGAN PULLING CASING.

NOTE, WATER TABLE LOW DUE TO 3 YEAR DROUGHT

(1) MULTIPLE ATTEMPTS AT DRILLING USING AVAILABLE METHOD ("LITTLE BEAVER") FAILED TO PENETRATE BEYOND SOIL OVERBURDEN TO AQUIFER. WELLS DID NOT PRODUCE GROUNDWATER

(2) AVAILABLE "GRAVITY" EQUIPMENT UNABLE TO EXTRACT BACKGROUND SAMPLE FROM 60 ± FOOT DEEP MW 14.

GROUNDWATER SAMPLING AT THIS SITE WILL REQUIRE (A) USE OF GEOPROBE OR OTHER POWER DRILL, OR (B) INSTALLATION OF PERMANENT MONITORING WELLS DUE TO NATURE OF SUBSURFACE MATERIAL

1320 EXCHANGED SAMPLE CUSTODY W/ DELTA ENVIRONMENTAL. 15 gal LABELED PURGE WATER IN 6 GAL CONTAINER LEFT BY MW 14. LEFT SITE OFFC 1330. AT 1328.

SPRAGUE ALUMINUM ESI SAMPLING
NCD 003 167 780 ~~9/30/01~~ 11/1/01

NOTE: CAMERA MALFUNCTIONED
DUE TO IMPROPER REPAIR:
PHOTOS NOT SUITABLE FOR USE
DUE TO LIGHT LEAKAGE:

END OF ESF NOTES
BOOK

"Rite in the Rain"®
ALL-WEATHER WRITING PAPER

Name STUART PARKER
NC SUPERFUND SECTION

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RALEIGH NC 27605

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CONTENTS

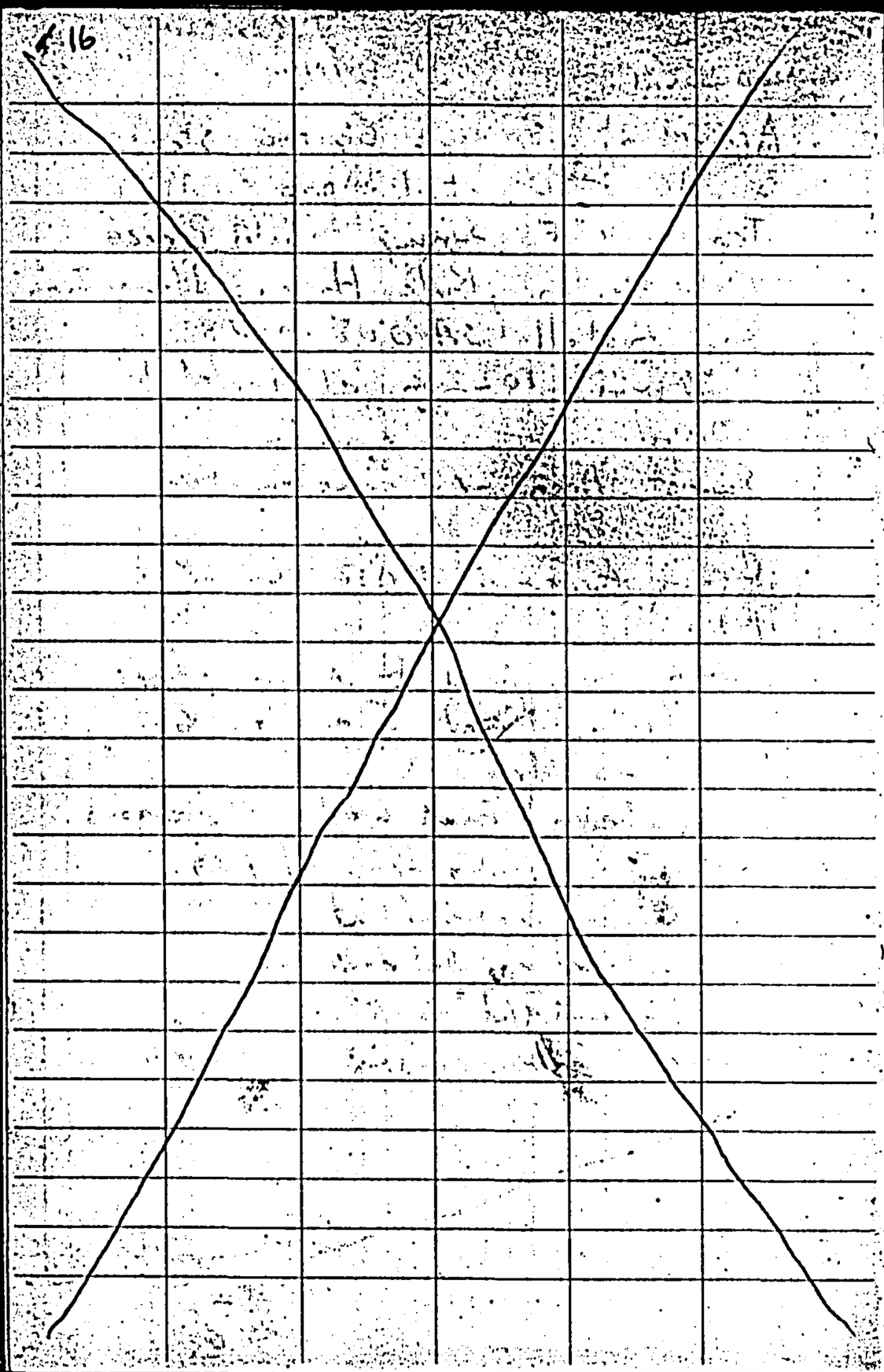
PAGE	REFERENCE	DATE
	SPRAGUE ALUMINUM CO LANSING ASHE COUNTY NC NCD 003 167 789	
	ESI SAMPLING 10/29-30/01	
	BOOKLET 2 OF 2	
	SF PARKER (PROJECT MANAGER)	
	NOTES BY HARRY ZINN	

SPRAGUE ALUMINUM EST SAMPLING
NOD 003 167 780 10/29/01 15

Arrived at Sprague Electric Site
on 10-29-01 at 1:30 pm
Temp 54° F Sunny slight Breeze
Mike Decton, Kyle Higgins, Harry Zinn
will install SA-008 MW
Hnu unit 102236 calibrated to
50.0.
Swept Area w/ Magnetometer

Begin Auger at SA 008 MW at
14:10
Brown Clayey Sand to Auger refusal
at 8'-0". Waited 5 minutes but
hole was dry.
Relocated 3 Feet West of previous
spot. Began augering at 14:40
Next auger refusal at 9'-0"
encountered rounded rock at
2" dia and flat to 4" dia round.
Set well screen + casing at 15:40

10-29-01



Arrived at SA-002-MW Location
Set up on location in Log and
fence below middle pond location
Scan w/magnetometer no signals
0' to 8' Same brown clayey
sand as SA 002-MW Location
at 8' material appeared to change
to a dark grey clay slightly
moist
Encountered auger refusal at
9.04. When augers were
removed they were not damp.

Relocated 15 feet upstream and
began again at 16:55
0-8' same as previous spot
at 8' changed again to
dark grey sticky clay.
Same material till auger
refused at 14'-6". When
augers were removed last
3 feet were wet. Set aside
to 11 depth. Time ~~15:10~~ 17:50 HS

10-22-01

SPMABUC	ALUMINUM	ESF	SAMPLED
NCD 003 167 780	10/30/01		Bogan

SA-006-MW purged dry after 6 gal. try to wait but little to no recharge. After 12:30 tried one more time. No luck abandoned sampling attempts at 12:30

Arrived at SA-006-MW Location
Sunny Temp upper 30's
Harry Zinn, Kyle Hagen, Mike Oestin.
Sam Watson of Delta Enviro is splitting samples. pH meter 22858
Calibrate pH to 4.0 and 10.0
Calibrate Cond to 1413
Well sounded
Total depth 74.4
Depth to Water 60.4
Water column 14.0
3 Volumes for 2" well 7 gal
Turbidity 4.96 on 5 Std
meter 46.8 on 50 Std
941000006268 577 on 0-1000 Std

Begin Purge at 10:40

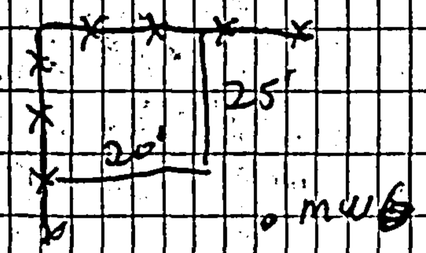
gal	Time	pH	Cond	Temp	Turb
0	~~0940~~ 10:40 KEH	6.4	235µS	12.5°C	278 NTU
2	0956	6.5	224	16.5	63
4	1012	6.55	228	16.5	38
6	1026	6.49	225	17.8	67

See notes on LOG

8:20

SPRAGUE ALUMINUM SITE EST SAMPLING
NCD 003 167 780 10/30/02 (BOOK 2) #21

SA-007-SB Background Soil
Collected above SA-006-MW



0-1'6" light tan sandy soil
1'6"-2'9" grey tan sand
slight gravel layer encountered at 2'0-2'9"
Sample collected from 2'6 to 2'9"
Sample collected at 10:00 END

LATITUDE AND LONGITUDE CALCULATION WORKSHEET #2

LI USING ENGINEER'S SCALE (1/60)

SITE NAME: Sprague Aluminum CERCLIS #: NCD 003 167 780

AKA: Sprague Electric SSID: 402619

ADDRESS: NA

CITY: Lansing STATE: NC ZIP CODE: 28643

SITE REFERENCE POINT: Center

USGS QUAD MAP NAME: Warrensville, NC TOWNSHIP: - N/S RANGE: - E/W

SCALE: 1 : 24,000 MAP DATE: 1966 SECTION: - 1/4 - 1/4 - 1/4

MAP DATUM [1927] [1983] (CIRCLE ONE) MERIDIAN: -

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

LONGITUDE: 81 ° 30 ' 0.00 " LATITUDE: 36 ° 22 ' 30.00 "

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

LONGITUDE: 81 ° 30 ' 0.00 " LATITUDE: 36 ° 27 ' 30.00 "

CALCULATIONS: LATITUDE (7.5' QUADRANGLE MAP)

A) NUMBER OF RULER GRADUATIONS FROM LATITUDE GRID LINE TO SITE REF POINT: 229

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

A X 0.3304 = 75.66 "

C) EXPRESS IN MINUTES AND SECONDS (1' = 60") : 1 ' 15.66 "

D) ADD TO STARTING LATITUDE: 36 ° 27 ' 30.00 " + 1 ' 15.66 "

SITE LATITUDE: 36 ° 28 ' 45.66 "

CALCULATIONS: LONGITUDE (7.5' QUADRANGLE MAP)

A) NUMBER OF RULER GRADUATIONS FROM RIGHT LONGITUDE LINE TO SITE REF POINT: 28

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

A X 0.3304 = 9.25 "

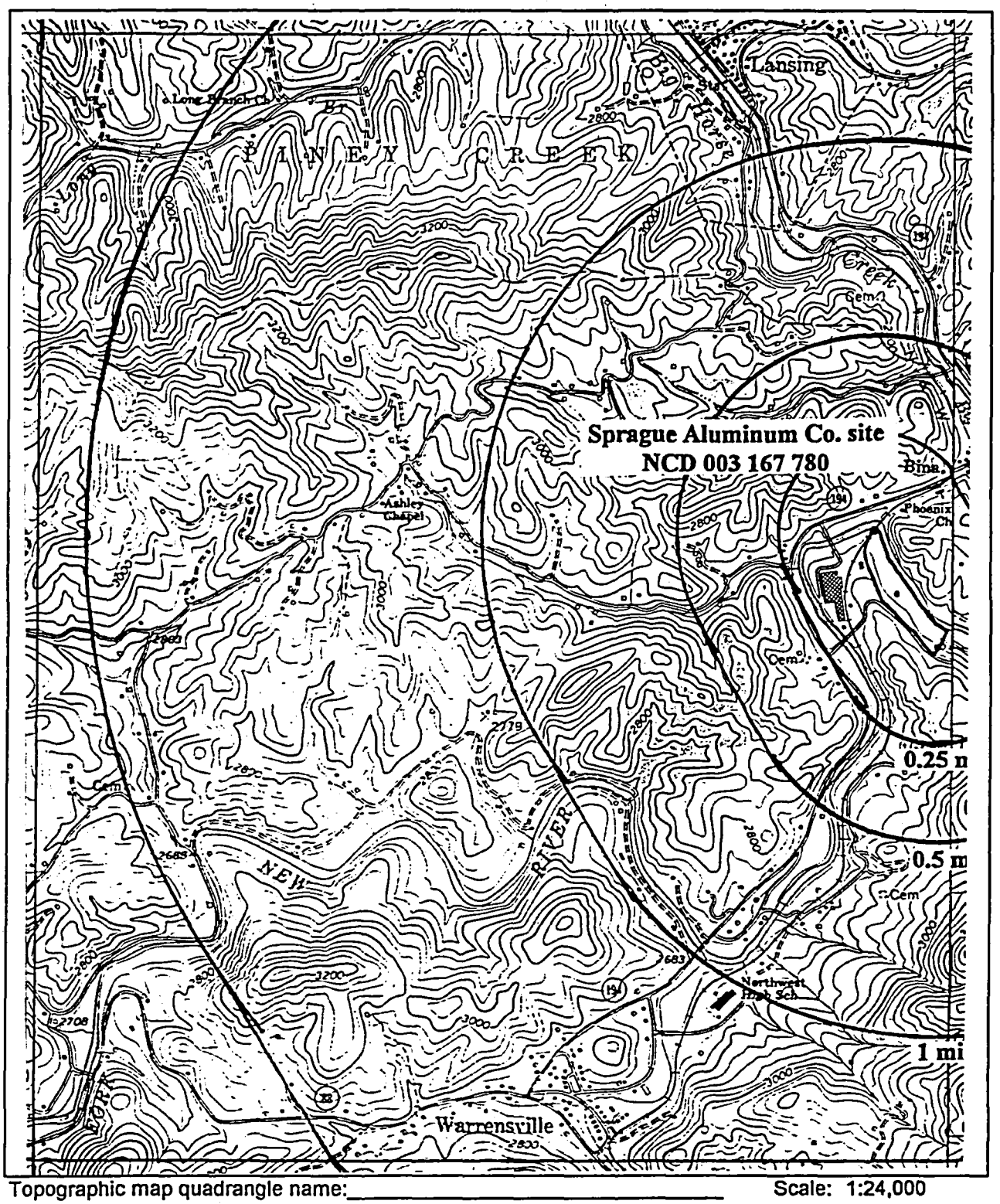
C) EXPRESS IN MINUTES AND SECONDS (1' = 60") : 0 ' 9.25 "

D) ADD TO STARTING LATITUDE: 81 ° 30 ' 0.00 " + 0 ' 9.25 "

SITE LONGITUDE: 81 ° 30 ' 9.25 "

INVESTIGATOR: [signature] DATE: 2/18/02

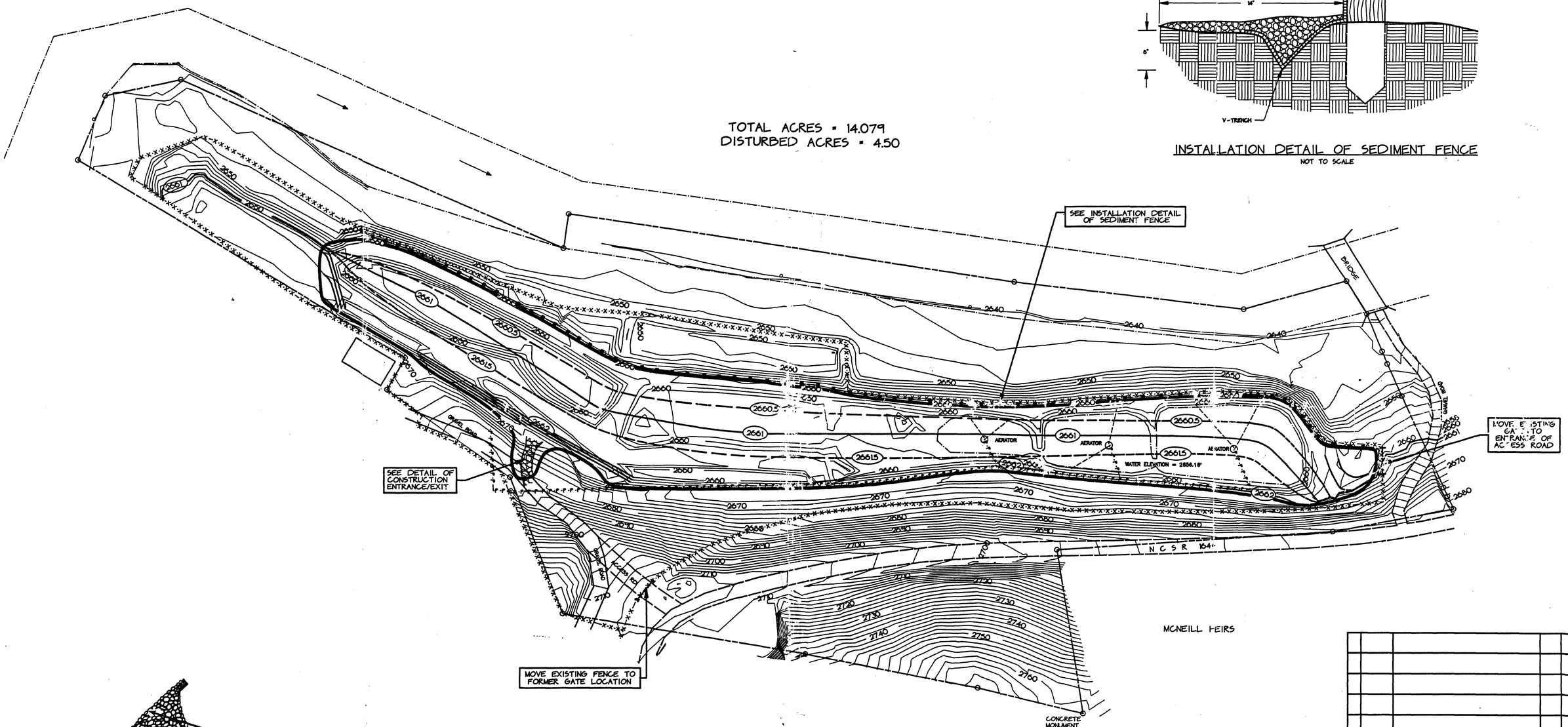
Site Name: SPRAGUE ALUMINUM CO. Number: NCD 003 167 780

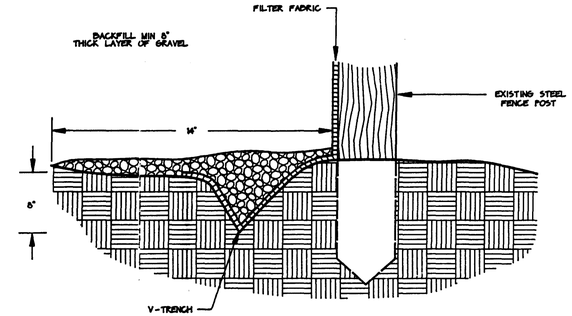


Topographic map quadrangle name: _____ Scale: 1:24,000

Coordinates of lower right corner of 2.5' topographic grid:

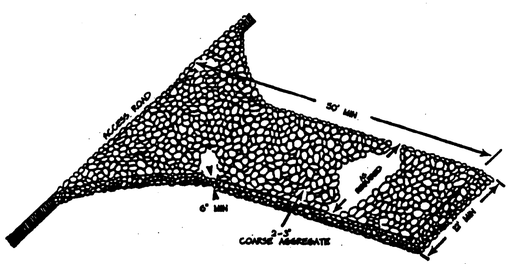
Latitude: 36° 27' 30" Longitude: 81° 30' 00"





INSTALLATION DETAIL OF SEDIMENT FENCE

NOT TO SCALE



DETAIL OF CONSTRUCTION ENTRANCE/EXIT

NOT TO SCALE

LEGEND

- F-F-F OVERHEAD POWER LINE
- X-X-X FENCE
- EXISTING CONTOUR LINES
- NEW CONTOUR LINES
- SEDIMENT FENCE

N

0 60'

NO.	DATE	DESCRIPTION	DRAWN	REVIEW

Delta
Environmental Consultants, Inc.
6701 Carmel Road, Suite 200
Charlotte, North Carolina 28226

SEAL

NORTH CAROLINA PROFESSIONAL SEAL 16983 ENGINEER

7/11/95

DELTA PROJECT NO. E194-001	CLIENT/LOCATION AMERICAN ANNUITY GROUP CINCINNATI, OHIO
PROJECT MANAGER S. ZBUR	
DESIGNED BY J. HO/K. SKORE	DRAWING DESCRIPTION PROPOSED LAGOON CLOSURE CONTOURS
DRAWN BY C. HAITHCOX	
REVIEWED BY	DATE 7-5-95 · SCALE 1" = 60' · CAD NO. 001-CONT · SHEET 2 OF 2

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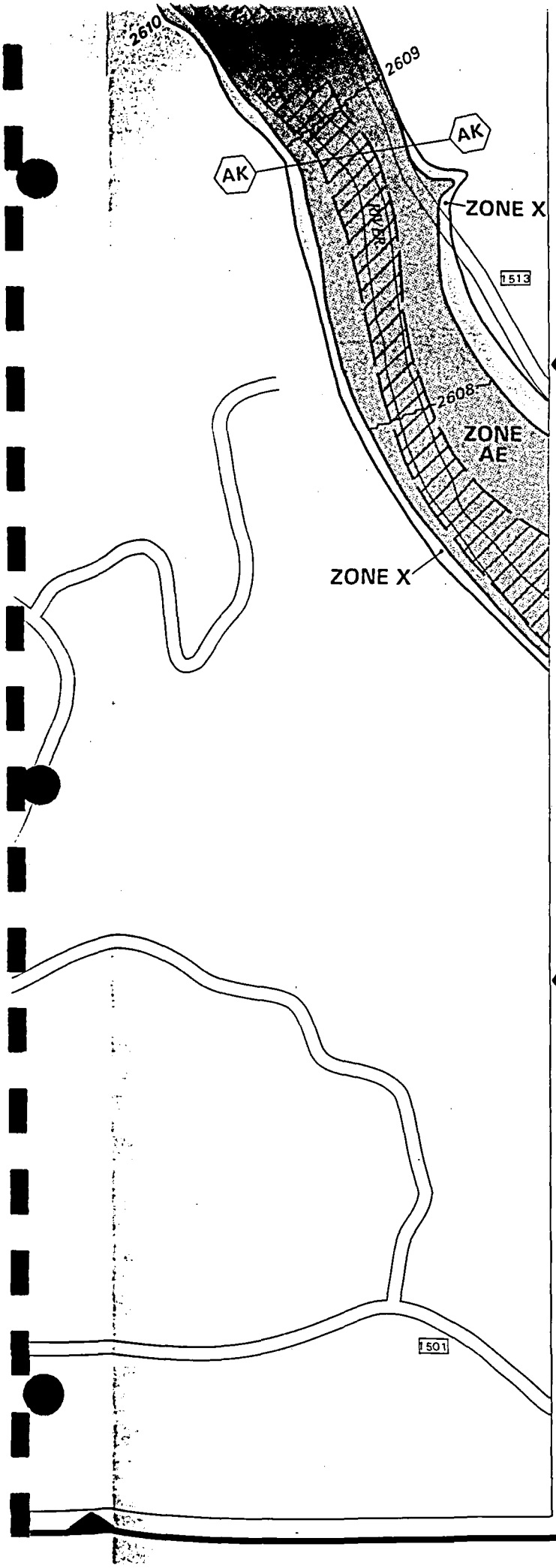


Ref. 7

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

N

APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

ASHE COUNTY,
NORTH CAROLINA AND
INCORPORATED AREAS

PANEL 38 OF 175

CONTAINS:

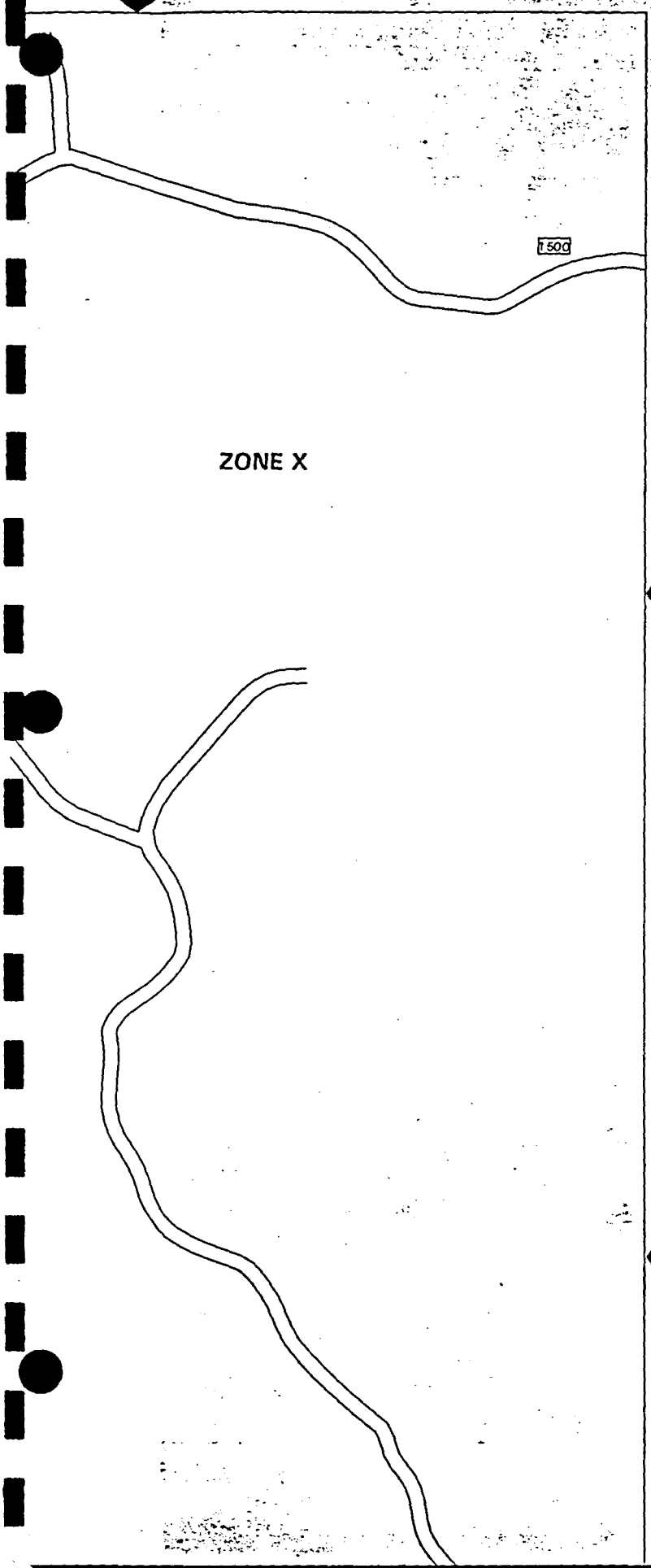
COMMUNITY	NUMBER	PANEL	SUFFIX
LANSING, TOWN OF	370374	0038	E
UNINCORPORATED AREAS	370007	0038	E

PANEL LOCATION

MAP NUMBER:
37009C0038 E

EFFECTIVE DATE:
AUGUST 16, 1988

Federal Emergency Management Agency



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A	No base flood elevations determined.
ZONE AE	Base flood elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE A99	To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.
ZONE V	Coastal flood with velocity hazard (wave action); no base flood elevations determined.
ZONE VE	Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X	Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X	Areas determined to be outside 500-year flood plain.
ZONE D	Areas in which flood hazards are undetermined.

	Flood Boundary
	Floodway Boundary
	Zone D Boundary
	Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
513	Base Flood Elevation Line; Elevation in Feet*
D — D	Cross Section Line
(EL 987)	Base Flood Elevation in Feet Where Uniform Within Zone*
RM7X	Elevation Reference Mark
•MI.5	River Mile

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas.

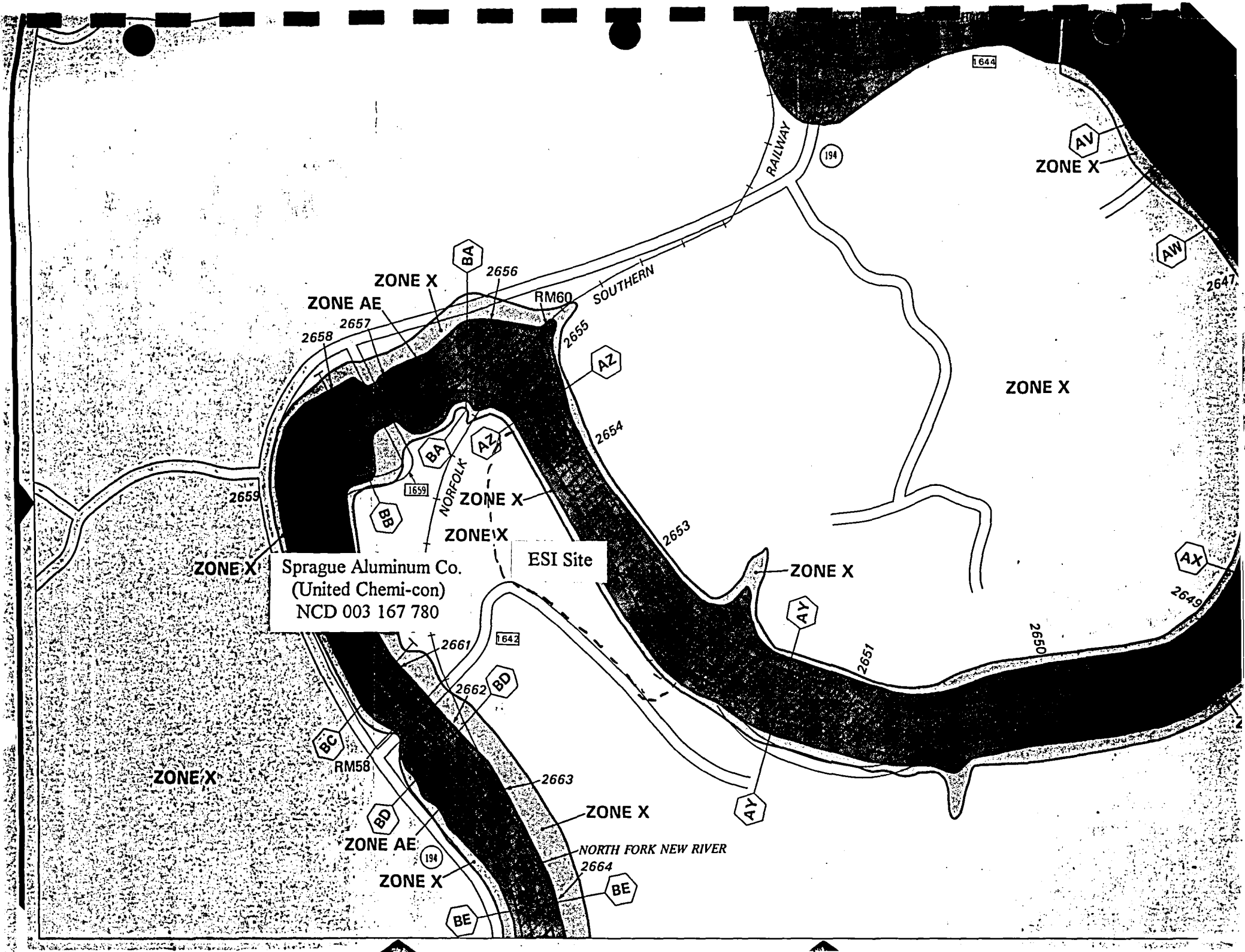
Certain areas not in Special Flood Hazard Areas may be protected by flood control structures

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 1/20 inch.

Coastal base flood elevations apply only landward of the shoreline.

Elevation reference marks are described in the Flood Insurance Study Report.


ZONE X
ZONE AE
2658
2657
2656
BA
RM60
SOUTHERN
RAILWAY
194
1644
AV
AW
2647
2655
AZ
2654
ZONE X
BA
AZ
1659
NORFOLK
BB
ZONE X
ZONE X
2659
ZONE X
Sprague Aluminum Co.
(United Chemi-con)
NCD 003 167 780
ESI Site
2653
ZONE X
AX
2649
AY
2651
2650
2661
1642
2662
BD
BC
RM58
ZONE X
2663
ZONE X
BD
ZONE AE
194
ZONE X
NORTH FORK NEW RIVER
2664
BE
BE
AY

NORTH CAROLINA ATLAS

PORTRAIT OF A CHANGING SOUTHERN STATE

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Foreword by JAMES E. HOLSHOUSER, JR.

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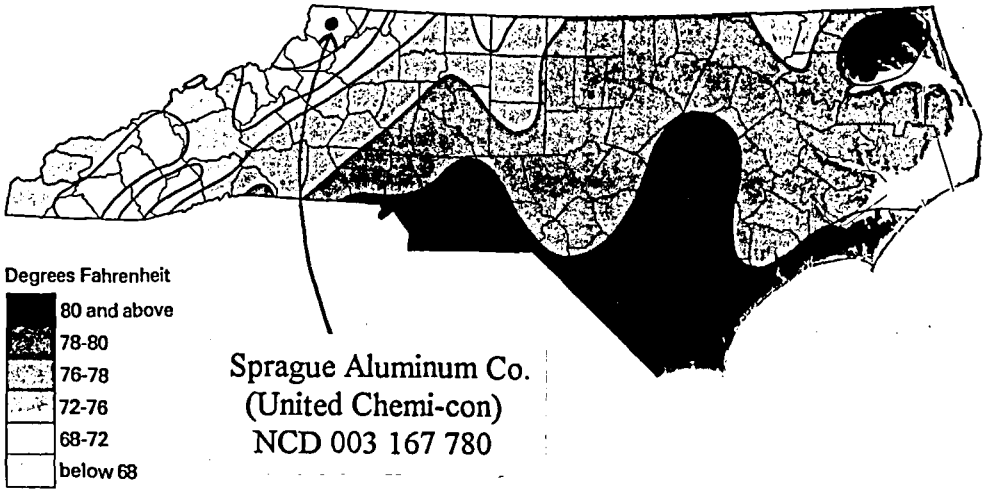
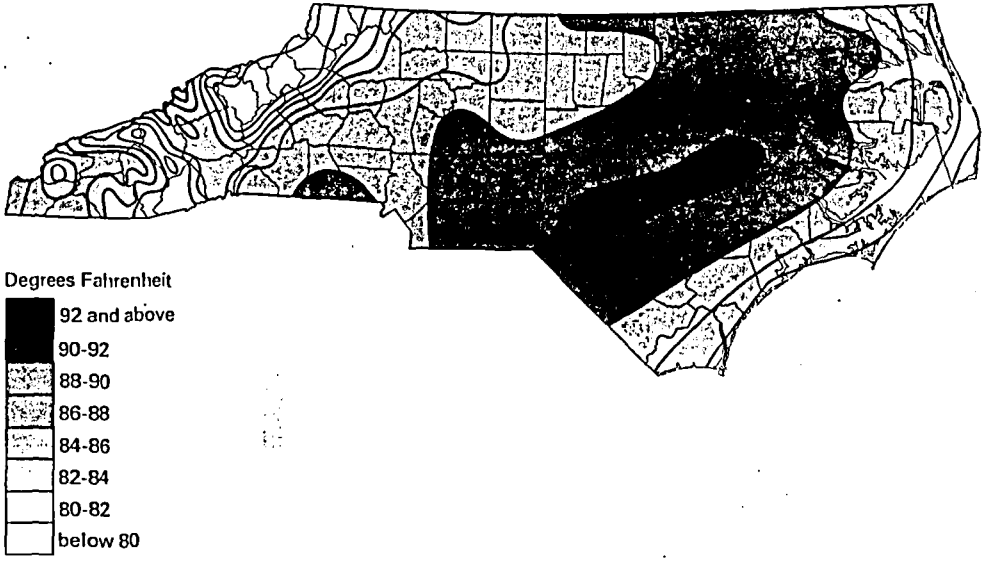
R/S 1300/NC/1975

Figure Average July Temperature in N.C.



Source: U.S. Department of Commerce, *Weather and Climate in North Carolina,* 1972.

Figure 5.10. Mean Maximum July Temperature in N.C.



Source: U.S. Department of Commerce, *Weather and Climate in North Carolina,* 1972.

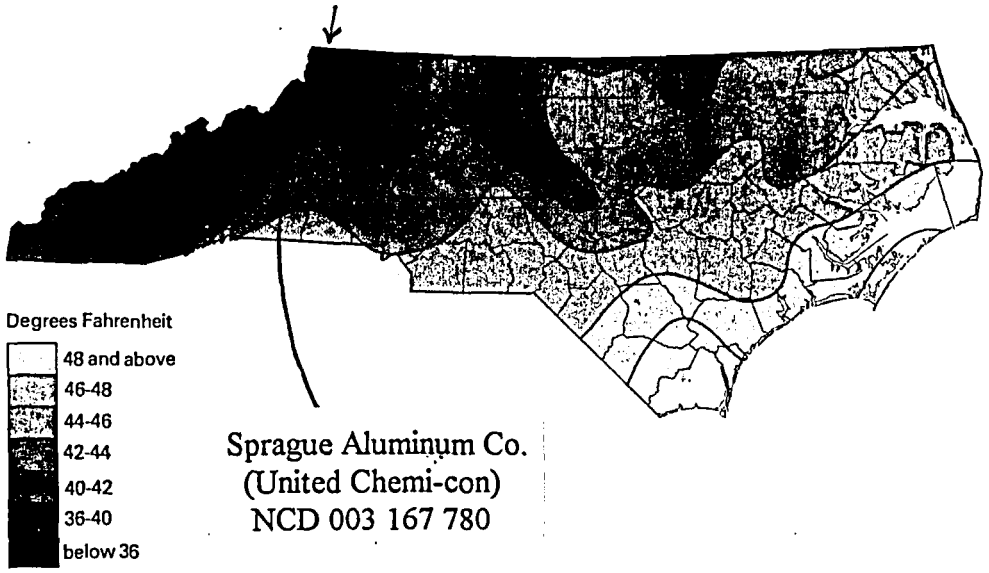
These strip-like regions have longer freeze-free s ns and thereby show earlier dates for the end of the f e period than their surroundings. They support frost-susceptible vegetation long after the greenery has disappeared in nearby areas. Often in early winter or even in midwinter a contrasting belt of green flanked above and below by brown may be seen. These green belts are characteristically located along slopes that face the winter sun, are protected from cold northern winds, and have cold air drainage to lower valleys. The blossoming of dogwood and redbud moves across the state in a pattern similar to that of the end of the freeze season to blanket North Carolina with color and beauty.

Summer Summer is characterized by its high temperatures, high humidities, high amounts of rainfall, and high physiological stress. Except for the amelioration of these climatic elements in the Mountains, and the relief afforded by sea breezes along the coast, elsewhere in the state summer is a season of extremes. Mean monthly minimum temperatures for July and August are in the upper seventies and eighties and mean maximum temperatures reach into the nineties.

However, to quote a popular adage, "it's not the heat but the humidity," and North Carolina's temperatures in combination with the high water vapor amounts prevalent during the summer months are definitely uncomfortable. In addition, high sunshine percentages and a predominance of southerly winds tend to aggravate an already unpleasant climatic condition. Only the periodic passage of cool, dry air masses from the north and sea breezes in the coastal areas alleviate the discomfort of summer weather for North Carolina's low-lying counties.

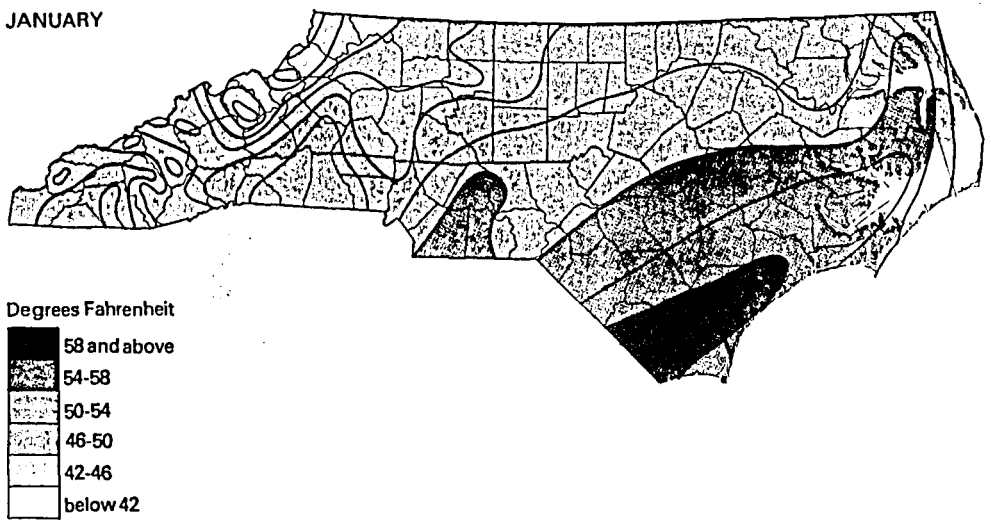
July Average Temperatures The pattern of mean temperatures in July is similar to the pattern in January (Figure 5.9). However, in the Piedmont and Coastal Plain, isotherms are fewer in number and farther apart. In the Mountains, the reverse is true. The widespread isotherms east of the Mountains indicate that temperature averages across central and eastern North Carolina exhibit little contrast. From the western Piedmont to the coast, the difference in mean temperatures is only 4° F. Although the influence of the ocean is not evident in the arrangement of isotherms, the high temperatures of the Coastal Plain are made less severe by the cooling power of the sea breeze. Hatteras, on the Outer Banks, records a temperature of 90° F. on the average of only one day each year, while Wilmington, a short distance from the coast, has an occurrence of 90° F. temperatures about twenty-four days annually. In contrast with these locations, Raleigh and Winston-Salem mean temperatures for July are slightly lower, but the average number of days on which a temperature of 90° F. or above is experienced increases to more than forty.

Figure 5.2. Average January Temperatures in N.C.



Source: U.S. Department of Commerce, *Weather and Climate in North Carolina,* 1972.

Figure 5.3. Mean Maximum Temperature in N.C.



Source: U.S. Department of Commerce, *Weather and Climate in North Carolina,* 1972.

Seasonal Changes in Climate

Winter The alternate passage of low- and high-pressure systems over the state during winter months results in changing weather conditions. Moisture and warmer temperatures are characteristically associated with frequently passing low-pressure cells. Lows are followed by polar highs, which bring lower temperatures and clear skies. However, even when under the influence of these polar highs, temperatures seldom fall below 10° F., and midday temperatures reach into the forties, making the winter season very tolerable by northern standards.

January average temperatures shown in Figure 5.2 illustrate the mildness of winters. Only at the highest elevations do temperatures average below freezing. The mean temperature for January at Mount Mitchell is 28.7° F., the lowest in the state. Yet, at Asheville, located on the lee side of the mountains, temperatures for January average 39.4° F.

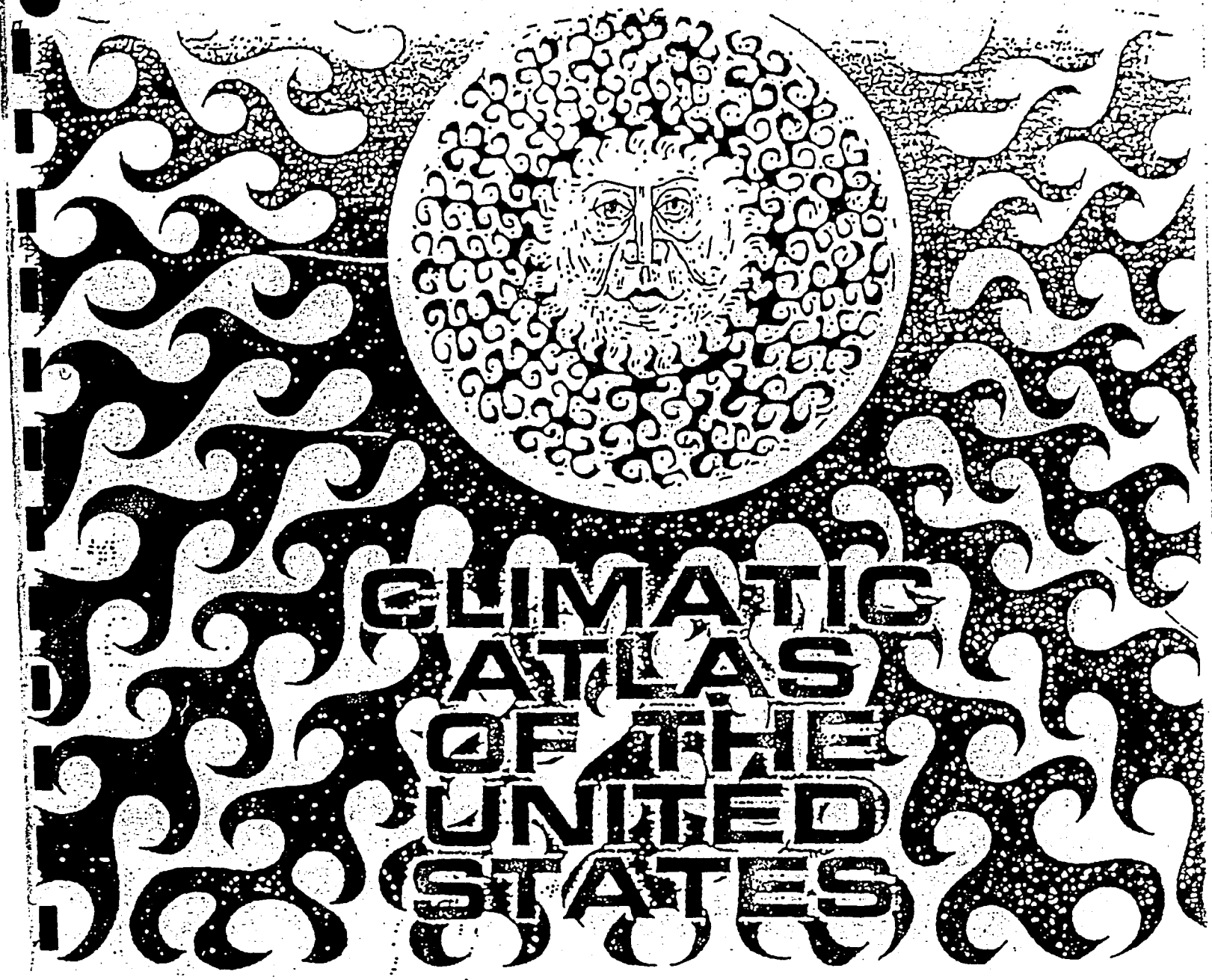
Nowhere else in North Carolina is the local contrast in temperatures as great as in the western counties. Temperature contrasts are least where the climate is mildest. Hatteras, on the Outer Banks, has a January mean of 48.0° F., and only thirteen days each year when temperatures of 32° F. and below are recorded.

The tendency for January isotherms to parallel the coast shows the influence of the Atlantic Ocean. Wilmington, in southeastern North Carolina, the most subtropical area in the state, exemplifies the maritime effect. This coastal city has a January mean temperature of 47.8° F.; and an average of only eight days during January when temperatures dip to 32° F. or less, as compared with eighteen days at Raleigh and nineteen at Asheville.

In the Piedmont, latitude is the primary control on temperature, and the isotherms maintain a zonal pattern. As might be expected, temperature averages lie between those exhibited by the surrounding regions. Charlotte has a mean January temperature of 42.3° F., Greensboro, 39.0° F., and Raleigh, 42.7° F.

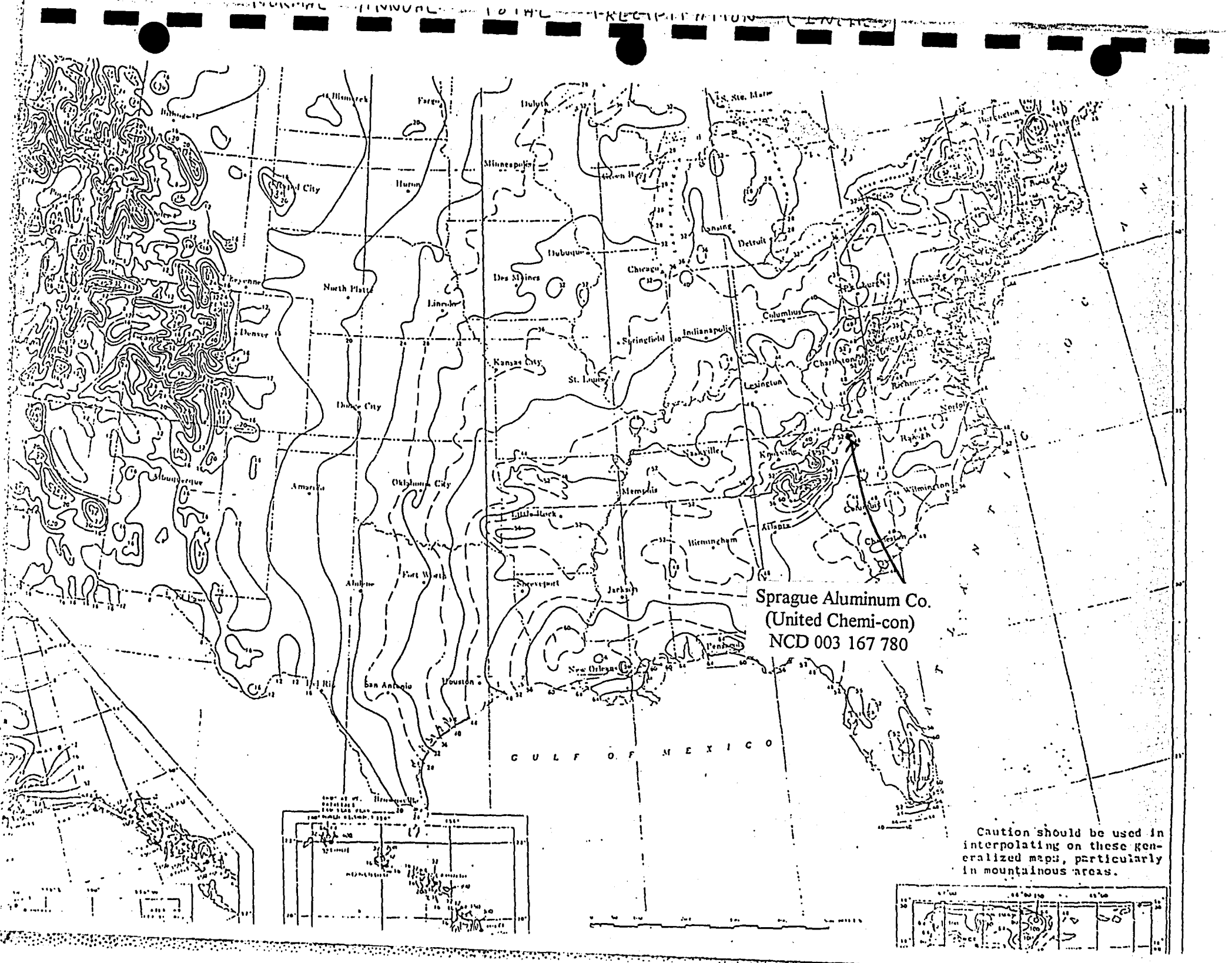
However, whereas Asheville averages eighty-three days each year when temperatures drop below freezing, Winston-Salem has freezing temperatures eighty-eight days annually, and Greensboro has eighty-four days with freezing temperatures.

Ref. 9



ce . Environmental Science Services Administration . Environmental Data Service

ited States Department of Commerce, 1979, Climatic Atlas of the United States,
ational Climatic Center, Asheville, NC.


Sprague Aluminum Co.
(United Chemi-con)
NCD 003 167 780
GULF OF MEXICO
Caution should be used in interpolating on these generalized maps, particularly in mountainous areas.
Bismarck
Fargo
Duluth
Sault Ste. Marie
Minneapolis
Green Bay
Rapid City
Huron
Lansing
Detroit
Dubuque
Chicago
Des Moines
Cheyenne
North Platte
Lincoln
Columbus
Springfield
Indianapolis
Denver
Kansas City
St. Louis
Charleston
Lexington
Dodge City
Knoxville
Raleigh
Albuquerque
Amarillo
Oklahoma City
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Little Rock
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Birmingham
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Jackson
Pensacola
New Orleans
San Antonio
Houston

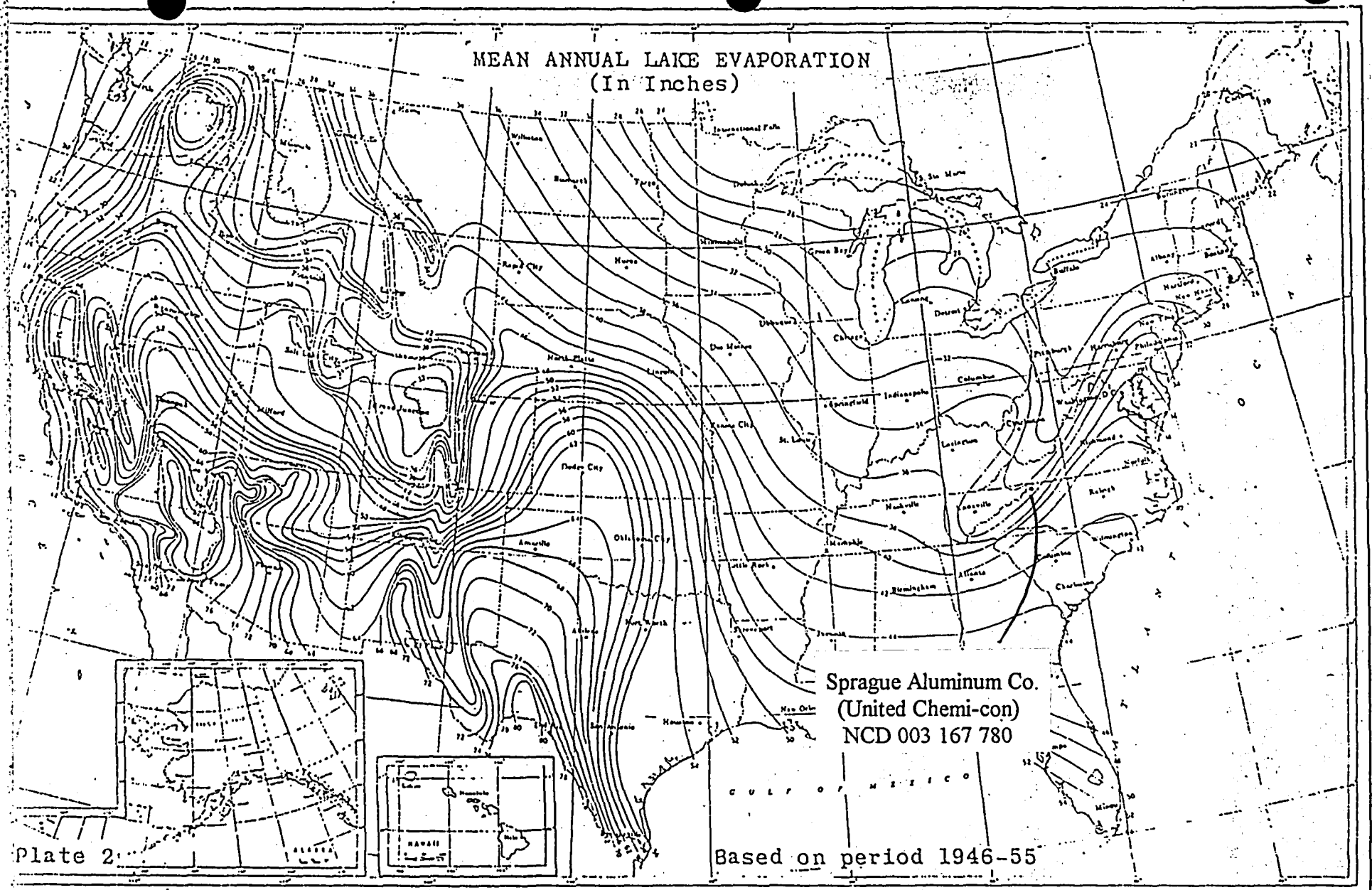
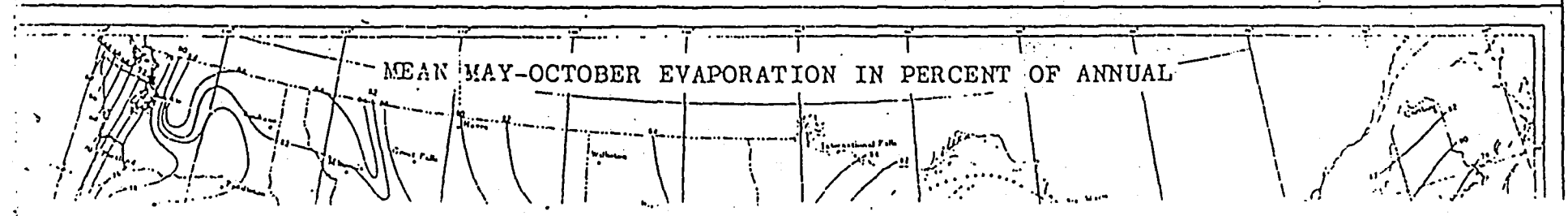

MEAN ANNUAL LAKE EVAPORATION
(In Inches)
Sprague Aluminum Co.
(United Chemi-con)
NCD 003 167 780
GULF OF MEXICO
Based on period 1946-55

Plate 2


MEAN MAY-OCTOBER EVAPORATION IN PERCENT OF ANNUAL

DEPARTMENT OF COMMERCE
S. Houston, Secretary

WEATHER BUREAU
F.W. Reichelderfer, Chief

TECHNICAL PAPER NO. 40

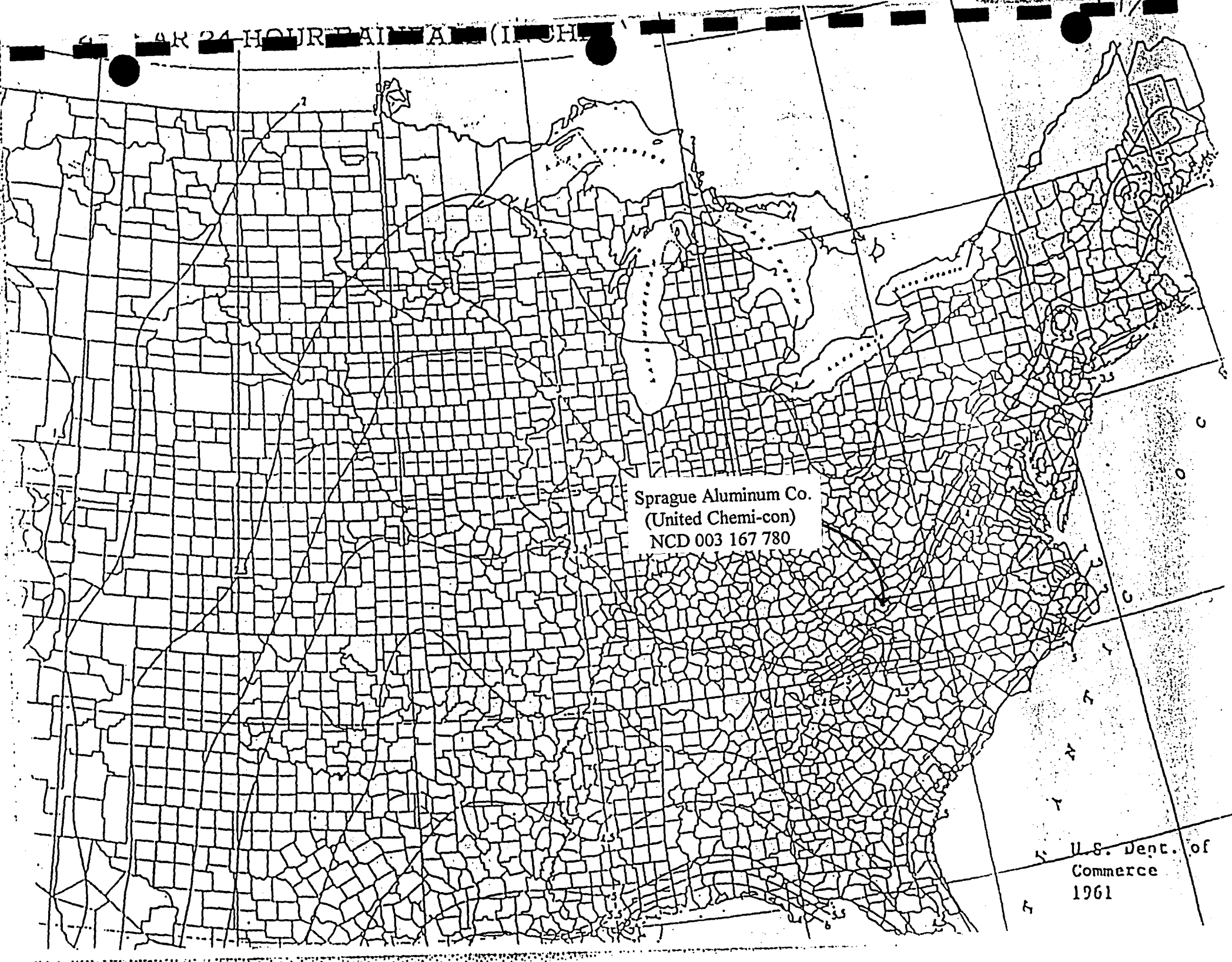
RAINFALL FREQUENCY ATLAS OF THE UNITED STATES

for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years

Prepared by
DAVID M. HERSHFIELD
Climatic Studies Section, Hydrologic Services Division
for
Engineering Division, Soil Conservation Service
U.S. Department of Agriculture

PROPERTY OF EPA
FIT IV

Ref. 10


Sprague Aluminum Co.
(United Chemi-con)
NCD 003 167 780
U.S. Dept. of
Commerce
1961

Ref. 11

R-586-9-1-3

FINAL REPORT

SITE INSPECTION
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA
EPA ID NO.: NCD003167780

Prepared Under
TDD No. F4-9010-25
Contract No. 68-01-7346

Revision 0

FOR THE

WASTE MANAGEMENT DIVISION
U.S. ENVIRONMENTAL PROTECTION AGENCY

SEPTEMBER 6, 1991

CERCLA

HALLIBURTON NUS ENVIRONMENTAL CORPORATION
SUPERFUND DIVISION

Prepared By	Reviewed By	Approved By
Eric Corbin Project Manager		Phil Blackwell Regional Project Manager

TABLE OF CONTENTS

Section No.		Page
EXECUTIVE SUMMARY		ES-1
1.0	INTRODUCTION	1
1.1	Objectives	1
1.2	Scope of Work	1
2.0	SITE CHARACTERIZATION	3
2.1	Site History	3
2.2	Site Description	6
	2.2.1 Site Features	6
	2.2.2 Waste Characteristics	6
3.0	REGIONAL POPULATIONS AND ENVIRONMENTS	7
3.1	Population and Land Use	7
	3.1.1 Demography	7
	3.1.2 Land Use	7
3.2	Surface Water	8
	3.2.1 Climatology	8
	3.2.2 Overland Drainage	8
	3.2.3 Potentially Affected Water Bodies	8
3.3	Groundwater	8
	3.3.1 Hydrogeology	8
	3.3.2 Aquifer Use	9
4.0	FIELD INVESTIGATION	10
4.1	Sample Collection	10
	4.1.1 Sample Collection Methodology	10
	4.1.2 Duplicate Samples	10
	4.1.3 Description of Samples and Sample Locations	10
	4.1.4 Field Measurements	14
4.2	Sample Analysis	14
	4.2.1 Analytical Support and Methodology	14
	4.2.2 Analytical Data Quality and Data Qualifiers	14
	4.2.3 Presentation of Analytical Results	16
5.0	SUMMARY	27
REFERENCES		28
APPENDIX A	Topographic Map	
APPENDIX B	Analytical Data	
APPENDIX C	Site Inspection Report	

TABLES

Number		Page
Table 1	Sample Codes, Descriptions, Locations, and Rationale	11
Table 2	Field Measurements	15
Table 3	Summary of Inorganic Analytical Results - Surface Soil Samples	17
Table 4	Summary of Inorganic Analytical Results - Subsurface Soil Samples	19
Table 5	Summary of Inorganic Analytical Results - Sediment Samples	20
Table 6	Summary of Inorganic Analytical Results - Surface Water Samples	21
Table 7	Summary of Organic Analytical Results - Surface Soil Samples	23
Table 8	Summary of Organic Analytical Reseults - Subsurface Soil Samples	25
Table 9	Summary of Organic Analytical Results - Sediment Samples	26

FIGURES

Figure 1	Site Location Map	4
Figure 2	Site Layout Map	5
Figure 3	Sample Location Map	13

EXECUTIVE SUMMARY

The Sprague Electric Company facility is situated on a tract of land located off of Highway 194 approximately 1.25 miles south of Lansing, Ashe County, North Carolina. The facility began operations at this location in 1953 and has been actively engaged in the manufacturing of aluminum electrolytic capacitors.

The manufacturing process utilized involved the etching of aluminum foil in an electrochemical bath resulting in the formation of aluminum oxide wastes which were recovered from a wastewater treatment system and then sold. Raw materials utilized in the production process include aluminum foil, nitric acid, tartaric acid, sodium hydroxide, calcium hydroxide, sodium chloride, sulfuric acid, and dimethylformamide.

The facility is located in the Blue Ridge physiographic province and Piedmont Blue Ridge groundwater region. The region is characterized by a thick layer of residual soil and weathered rock overlying fractured crystalline and metamorphosed sedimentary rocks. Geologically, the area of the electric company is underlain by residual soils ranging from 25 to 36 feet thick with the residuum being underlain by blue and white metamorphosed granite rocks of the Late Proterozoic era. The aquifer used in the area is the unconfined crystalline rock aquifer system. Water levels in the immediate area of the facility are less than 25 feet below land surface because of its proximity to the New River.

The surface water pathway was determined to be of concern for this facility. Because the facility is surrounded by the New River on three sides, surface water runoff leaving the facility via various onsite drainage routes enters the river directly. Additionally, wastewater from the sewage treatment plant and non-contact boiler water are discharged into the New River. Water from the aluminum oxide treatment lagoon system was never discharged to the river, but rather either percolated into the ground or evaporated. Due to the lagoons' proximity to the river, percolation into the river may have occurred. This process has now been discontinued. The river is utilized for recreational swimming, fishing, and boating. The groundwater pathway is also of concern. All totaled, 600 municipal customers and 800 private residences (2.89 x 1,400 = 4,046 people) utilize groundwater for potable purposes within a 4-mile site radius and would be at potential risk if contamination to groundwater occurs. Due to restricted site access, the air pathway is of least concern; however, onsite employees could be potentially exposed to organic and inorganic contaminants detected in onsite surface soil samples.

Sixteen environmental samples were collected during the field investigation associated with this study. No site-related organic contaminants were detected in the onsite samples. Surface and subsurface soil samples collected from near the drum storage area and storage tank area contained a total of five metals at elevated levels. A sediment sample collected from a surface impoundment contained elevated levels of three different metals. Results from the analysis of surface water samples collected downstream of the facility and from one of the facility's surface impoundments revealed the presence of six inorganic substances at elevated levels.

The predominant heavy metals detected throughout the samples were mercury and zinc. Metals such as aluminum, beryllium, copper, iron, lead, nickel, and manganese were also reported at many times the background level. These and other impurities can be removed from aluminum in the etching bath process. Sample results also indicated the presence of mercury. Mercury is utilized in electrical applications.

Based on the analysis of possible migration pathways, the results of the sampling investigation, and the information obtained from the references, FIT 4 recommends that this site be evaluated using the HRS (effective March 14, 1991).

1.0 INTRODUCTION

The HALLIBURTON NUS Environmental Corporation Region 4 Field Investigation Team (FIT) was tasked by the U.S. Environmental Protection Agency (EPA), Waste Management Division to conduct a Site Inspection (SI) at the Sprague Electric Company facility in Lansing, Ashe County, North Carolina. The investigation was performed under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA). The task was performed to satisfy the requirements stated in Technical Directive Document (TDD) number F4-9010-25. The field investigation was conducted December 11-12, 1990.

1.1 OBJECTIVES

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

1.2 SCOPE OF WORK

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

- Obtain and review relevant background materials.
- Obtain information on local water systems.
- Determine location of and distance to nearest potable well.
- Evaluate potentially affected populations and environments associated with the groundwater, surface water, air, and soil exposure pathways.

- Develop a site sketch.
- Collect environmental samples.

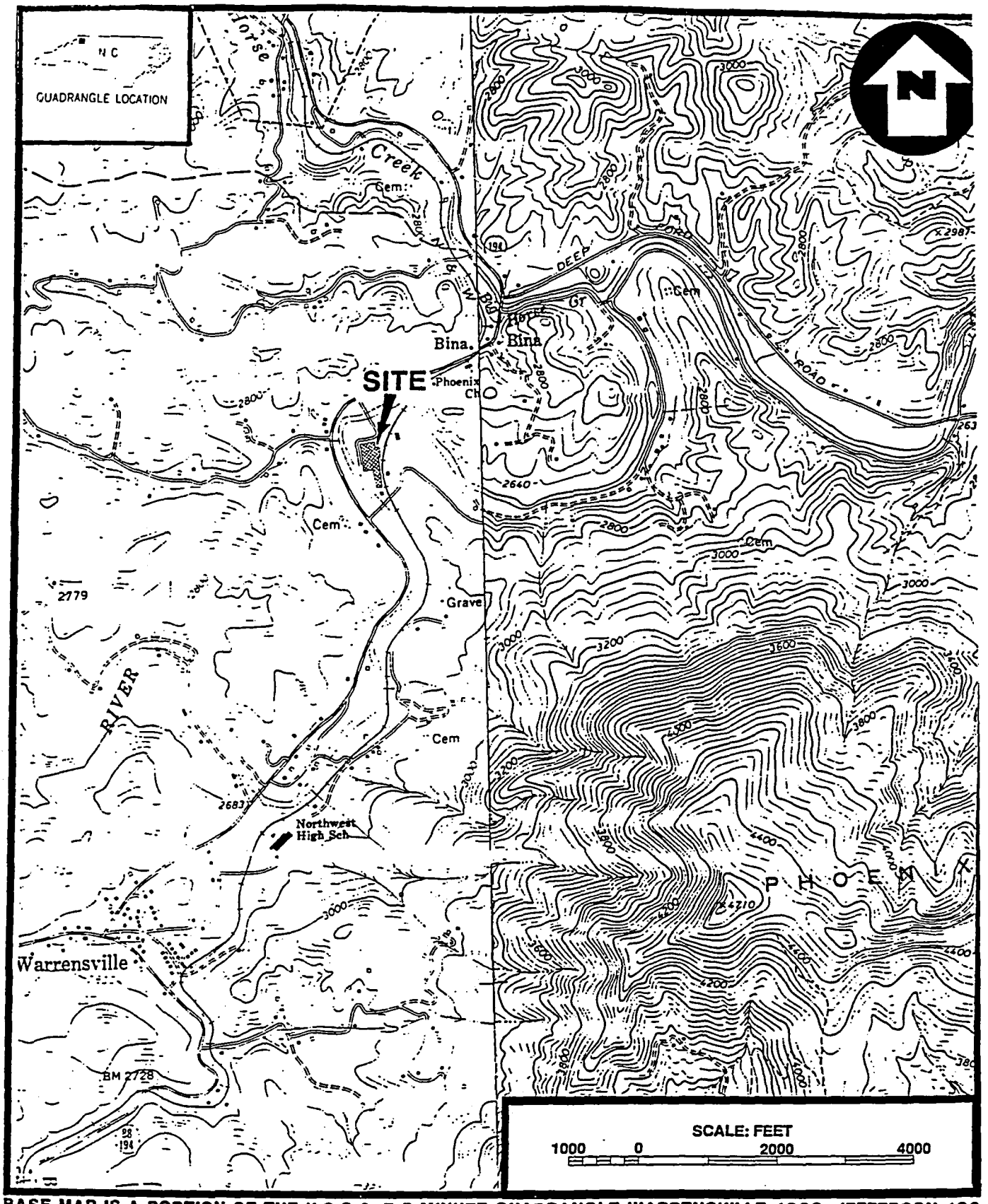
2.0 SITE CHARACTERIZATION

2.1 SITE HISTORY

The Sprague Electric Company facility is situated on a tract of land located off of Highway 194 approximately 1.25 miles south of Lansing, Ashe County, North Carolina (Ref. 1, Appendix A). The facility location is shown in Figure 1, and the facility layout is shown in Figure 2. The facility has been actively engaged in the manufacturing of aluminum electrolytic capacitors since 1953 and is the only known industry that has ever occupied the facility area (Refs. 1, 2).

The manufacturing process involves the etching of aluminum foil in an electrochemical bath. Aluminum oxides formed in the process are recovered from a wastewater treatment system. Waste dimethylformamide (DMF) was also used in the process (Refs. 1, 2). Available information indicates that wastes were handled in essentially the same manner since operations commenced (Ref. 2).

On November 17, 1980, Sprague Electric Company filed a RCRA Part A hazardous waste permit application for treatment of wastes. They reported that their facility conducted operations that resulted in a discharge to U.S. waters and that 250,000,000 pounds of corrosive waste (D002) were treated per year (Ref. 3). At the time of filing, Sprague Electric Company officials advised the U.S. Environmental Protection Agency that they were in doubt as to whether or not the Lansing plant was a waste treatment, storage, or disposal facility under the Resource Conservation and Recovery Act, and that the application was submitted as a precaution in case this location was such a facility (Ref. 4). On December 16, 1981, the USEPA advised Sprague Electric Company that they acknowledged receipt of Sprague's request for withdrawal of their permit application under RCRA (Ref. 5). On March 4, 1982, the North Carolina Solid and Hazardous Waste Management Branch (NCHWMB) granted Sprague's request for deletion as a treater, storer, or disposer of hazardous waste under RCRA (Ref. 6). On July 1, 1983, Sprague was also deleted as a large quantity generator of hazardous waste under RCRA (Ref. 7). On November 14, 1983, Sprague advised the NCHWBM that a Part B application for the facility would not be filed. On March 13, 1984, the NCHWMB advised Sprague that their interim status was formally terminated (Ref. 8). The facility is currently listed as a small-quantity generator (Ref. 9).

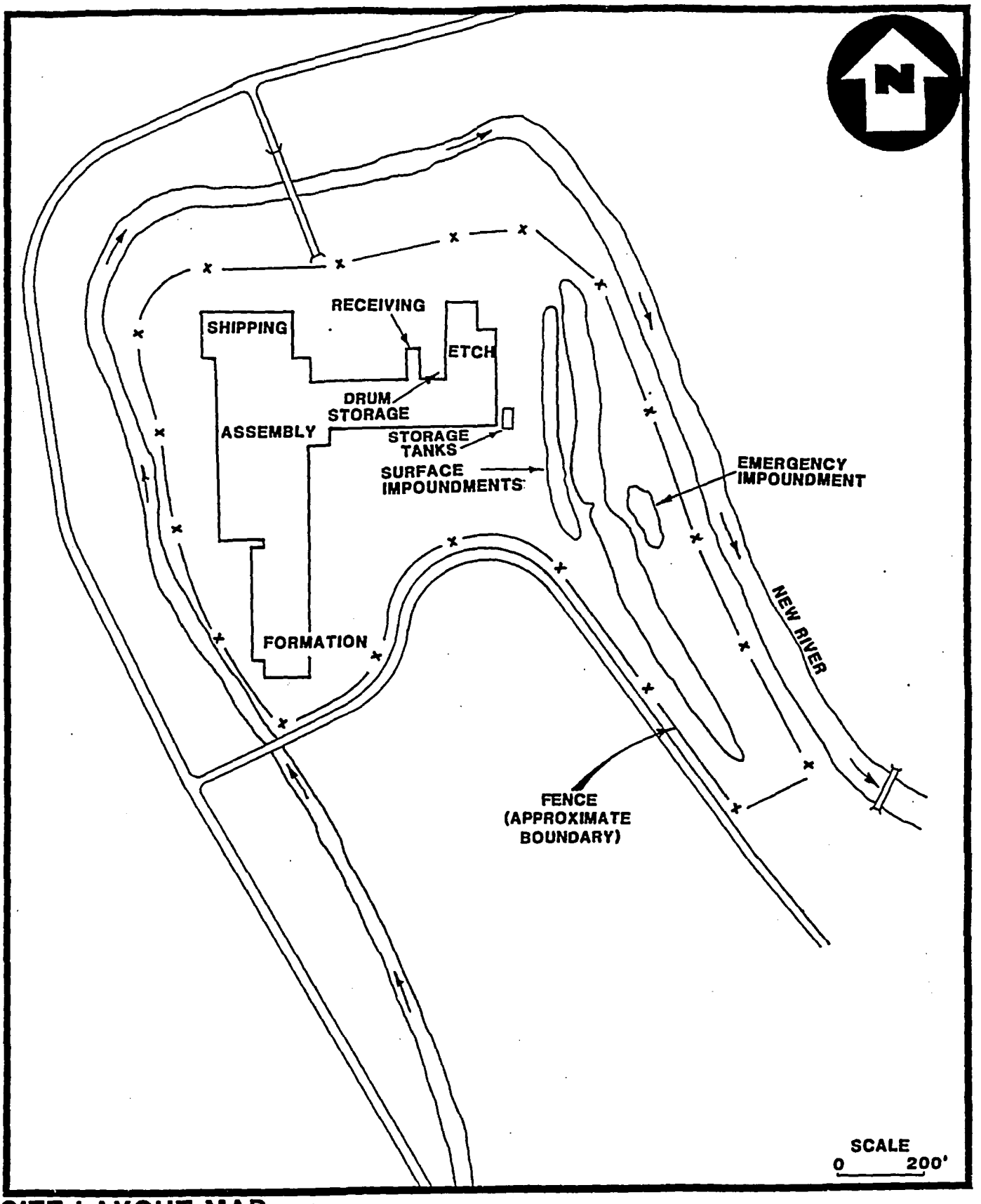


BASE MAP IS A PORTION OF THE U.S.G.S. 7.5 MINUTE QUADRANGLE WARRENSVILLE 1966, JEFFERSON 196 NORTH CAROLINA.

SITE LOCATION MAP
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

FIGURE 1

NUS CORPORATION



SITE LAYOUT MAP
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

FIGURE 2

NUS CORPORATION

2.2 SITE DESCRIPTION

2.2.1 Site Features

The currently active facility is situated on a 60-acre tract of property located adjacent to Highway 195 approximately 1.25 miles south of Lansing, North Carolina, in a rural section of Ashe County (Ref. 1, Appendix A). The facility is enclosed within a 6-foot-high chain-link fence, and access to the property is restricted to a main entrance gate located along the facility's south side (Ref. 10). The operation is comprised of the main facility building housing office and warehouse space, assembly and etching operations, as well as shipping and receiving areas (Ref. 10, Figure 2). Areas adjacent to the facility are paved access roads and parking areas, while areas further away from the facility are comprised of grassy areas (Ref. 10, Figure 2). Additionally, a wastewater treatment lagoon system located east of the facility and adjacent to the New River was constructed to allow for the settling of aluminum oxides (Refs. 1, 2, Figure 2). This system is no longer in operation (Ref. 10). A drum storage area, a tank storage area, and a sewage treatment plant also exist on site (Ref. 10, Figure 2). The tank storage area contains two sulfuric acid and two nitric acid storage tanks (Ref. 10). Three industrial wells also exist on site, however, only one of them is currently in use (Ref. 10).

2.2.2 Waste Characteristics

The facility, since inception, has been actively engaged in the manufacturing of aluminum electrolytic capacitors (Refs. 1, 2). Raw materials utilized in the production process include aluminum foil, nitric acid, tartaric acid, sodium hydroxide, calcium hydroxide, sodium chloride, sulfuric acid, and dimethylformamide (DMF) (Refs. 1, 2). A wastewater treatment lagoon system was formerly operated on site to allow for the settling and treatment of aluminum oxide wastewater (Refs. 1, 2, Figure 2). Aluminum oxides formed from a manufacturing process involving the etching of aluminum foil in an electrochemical bath were recovered from the wastewater treatment system by filtering and settling in the lagoon, then were mined and sold (Refs. 1, 2). Wastewater from this system was not allowed to be discharged to the New River but rather was allowed to percolate into the ground or evaporate (Ref. 11). These lagoons are therefore believed to be unlined and this treatment process has been discontinued. Wastewater from the sewage treatment plant and non-contact boiler water are discharged into the New River and are NPDES permitted (Ref. 11). Waste dimethylformamide (DMF) used in the process is stored in drums and shipped off site (Refs. 1, 2). A drum storage area also exists adjacent to the former etching building (Ref. 10). Available information indicates that wastes have been handled in essentially the same manner since operations commenced (Ref. 2).

3.0 REGIONAL POPULATIONS AND ENVIRONMENTS

3.1 POPULATION AND LAND USE

3.1.1 Demography

The Sprague Electric Company facility is located in a rural portion of Ashe County approximately 1.25 miles south of Lansing, North Carolina (Appendix A). Most of the population in the area consists of full-time residents. Population density increases most sharply near Lansing (Appendix A). The population within a 1-mile radius is approximately 258; within a 4-mile radius, the population is estimated to be 2,300 (Ref. 12, Appendix A). The nearest residence is located approximately 400 feet west of the facility. No day-care centers are located adjacent to the facility. The nearest school identified is located approximately 1.1 miles south of the facility (Appendix A). Direct access to the facility is limited by a chain-link fence which restricts unauthorized entry (Figure 2).

3.1.2 Land Use

The majority of the land area within a 1-mile radius of the facility is rural (Appendix A). Cattle production is the primary type of agricultural activity practiced in the county. The county has about 34,500 head of cattle and ranks second in the state in cattle production. Permanent pastureland accounts for a large portion of the local land use, with the remainder in forestland (Ref. 13, Appendix A). Forest products, hay, tobacco, corn, and truck crops account for the remaining agriculture (Ref. 13). Only small towns exist in the study area which include Lansing, Smithport, and Warrensville (Appendix A). The area is best characterized as hilly and mountainous and has many relatively high mountain peaks (Ref. 13, Appendix A).

Phoenix Mountain, located approximately 1 mile southeast of the facility, is a sensitive environment which supports 11 peripherally rare plant species plus several endangered species (Ref. 14). The Cooper's hawk (Occipiter cooperii), bog rose (Arethusa bulbosa), robin runaway (Dalibarda repens), fringed gentian (Gentianopsis crinita), spreading avens (Geum radiatum), virginia spiraea (Spiraea virginiana), and the roseroot (Sedum rosea) are state endangered species in Ashe County. In addition, several state listed threatened species also exist in Ashe County (Ref. 15).

3.2 SURFACE WATER

3.2.1 Climatology

The average annual rainfall in the Ashe County region is approximately 50 inches per year. Mean annual evaporation is approximately 33 inches per year. Net rainfall is, therefore, 17 inches per year. In the month of July, the site area receives most of its normal precipitation (approximately 6 inches) (Ref. 16). The site area receives the least precipitation during the month of October (approximately 3 inches) (Ref. 16). The 2-year, 24-hour rainfall is approximately 3 inches (Ref. 17). In winter, the average temperature is 34°F, and in summer the average temperature is 67°F (Ref. 13).

3.2.2 Overland Drainage

Surface water run-off from the facility has the potential to migrate north, east, and west into the North Fork of the New River located adjacent to the facility. The North Fork of the New River follows a meandering path to the northeast, beyond 15 miles downstream from the facility (Appendix A). Since the facility property is located adjacent to the river, run-off has the potential to enter the river directly.

3.2.3 Potentially Affected Water Bodies

There are no known surface water intakes utilized for potable purposes located along the drainage pathway; however, fishing, boating, and swimming are recreational uses of the river (Refs. 18, 19). The New River is utilized for irrigational purposes (Ref. 18).

3.3 GROUNDWATER

3.3.1 Hydrogeology

The Sprague Electric Company is located in the Blue Ridge physiographic province and Piedmont-Blue Ridge groundwater region. This region is characterized by a thick layer of residual soil and weathered rock overlying fractured crystalline and metamorphosed sedimentary rocks (Refs. 20, plate 28; 21, pp. 251, 252). The immediate area around the facility consists of high hills and steeply sloped, narrow valleys (Appendix A).

Geologically, the area of the electric company is underlain by residual soils ranging from 25 to 36 feet thick. The residuum is underlain by blue and white metamorphosed granite rocks of the Late

Proterozoic era (Ref. 22). The aquifer used in the area is the crystalline rock aquifer system (Ref. 23, p. 331). Two wells drilled in the city of Warrensville, 1.5 miles south of the facility, were 80 and 130 feet deep. The 80-foot deep well reached water at 70 and 75 feet below land surface (bls). The 130-foot deep well reached water at 50 feet bls (Ref. 22). Water levels in the immediate area of the facility are less than 25 feet bls because of its proximity to the New River. The direction of groundwater flow is in the local area downgradient toward the North Fork of the New River (Appendix A).

Groundwater flows along the fractures in the bedrock and in the intergranular pore spaces of the residual soils. The porosity and the hydraulic conductivity of the soil decreases as depth increases (Ref. 24, pp. 12-14). Some igneous dikes are found in the Piedmont region, but these have few fractures and contain little water (Ref. 24, p. 10). The residual soils and bedrock are hydrologically interconnected (Ref. 21, pp. 252, 253). The unsaturated zone of the residual soils represents the layer of lowest hydraulic conductivity. Soils of this type have been shown to have hydraulic conductivities that range between 1×10^{-3} cm/sec and 1×10^{-5} cm/sec (Ref. 25, p. 29).

3.3.2 Aquifer Use

Two municipal water systems exist within a 4-mile radius of the facility. The nearby town of Lansing obtains its water from two wells located approximately 1.5 miles north of the facility and within the Lansing corporate boundary (Ref. 26, Appendix A). This system currently provides service to 65 customers (2.89 x 65 = 187 people) within the corporate boundary (Ref. 26). The Jefferson Water Department provides service to a very small segment of the study area located approximately 3.8 miles southeast of the facility (Appendix A). This system obtains its water from seven wells located in and near Jefferson, North Carolina (Ref. 26, Appendix A). Only one of these wells, however, is situated within the 4-mile radius and is located approximately 3.9 miles southeast of the facility. The water from these wells is mixed prior to distribution (Ref. 26, Appendix A). This system currently provides service to 535 customers (2.89 x 535 = 1,546 people) (Ref. 26). Residences not served by these municipal systems rely on wells and springs to supply their potable water needs. Information derived from a house count on USGS 7.5 minute series topographic quadrangle maps was used to approximate the number of private wells and springs being utilized. Within a 4-mile radius of the facility, approximately 800 residences and 600 municipal customers (2.89 x 1,400 = 4,046 people) utilize groundwater from private wells or springs for potable purposes. The nearest well is located approximately 500 feet west of the facility (Appendix A).

4.0 FIELD INVESTIGATION

4.1 SAMPLE COLLECTION

During the field investigation, conducted the week of December 11, 1991, FIT 4 attempted to identify and characterize contaminants which may be present in the environment as a result of activities that were conducted at Sprague Electric Company. To accomplish this, FIT 4 collected environmental surface soil, subsurface soil, sediment, and surface water samples from a number of strategic locations. These locations were selected based on historical information, hydrogeological data for the region and site area, and direct observation at the site.

4.1.1 Sample Collection Methodology

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

4.1.2 Duplicate Samples

Duplicate samples were offered to and declined by Thomas Miller, a designated representative of Sprague Electric Company. Receipt for sample forms are on file at FIT 4.

4.1.3 Description of Samples and Sample Locations

During the sampling investigation, a total of 16 environmental samples were collected. Surface and subsurface soil samples were collected from near the aboveground storage tank area and from the drum storage area. Background samples for these media were collected south of the facility adjacent to the New River. Surface water and sediment samples were collected from locations upstream and downstream of the facility on the New River. An additional surface water sample and a sediment sample were also collected from an onsite surface impoundment. No groundwater samples were collected due to the depth to groundwater and the presence of rock at shallow depths (Ref. 10). Sample codes, descriptions, locations, and rationale are presented in Table 1. All sample locations are shown in Figure 3.

TABLE 1

SAMPLE CODES, DESCRIPTIONS, LOCATIONS, AND RATIONALE
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

Sample Code	Description	Location	Rationale
SE-SS-01	Surface Soil	From an area south of the facility adjacent to the New River	To assess background conditions
SE-SS-02	Surface Soil	From the northern side of the main facility adjacent to a drum storage area	To determine presence or absence of contaminants
SE-SS-03	Surface Soil	From the eastern side of the main facility adjacent to the nitric and sulfuric acid storage tanks	To determine presence or absence of contaminants
SE-SS-04	Surface Soil	From an area located approximately 20 feet east of the nitric and sulfuric acid storage tanks	To determine presence or absence of contaminants
SE-SB-01	Subsurface Soil	From an area south of the facility adjacent to the New River at 3 to 4 feet bls	To assess background conditions
SE-SB-02	Subsurface Soil	From the northern side of the main facility adjacent to a drum storage area at 4 feet bls	To determine presence or absence of contaminants
SE-SW-01	Surface Water	From an upstream location on the New River south of the facility	To assess upstream (background) surface water conditions
SE-SW-02	Surface Water	From a downstream location west of the facility on the New River from a facility discharge pipe	To determine presence or absence of contaminants
SE-SW-03	Surface Water	From a location north and downstream of the facility on the New River	To assess downstream surface water conditions
SE-SW-04	Surface Water	From a surface impoundment located east of the facility	To determine presence or absence of contaminants
SE-SW-05	Surface Water	From a location southeast and downstream of the facility on the New River	To assess downstream surface water conditions
SE-SD-01	Sediment	From an upstream location on the New River south of the facility	To assess upstream sediment conditions

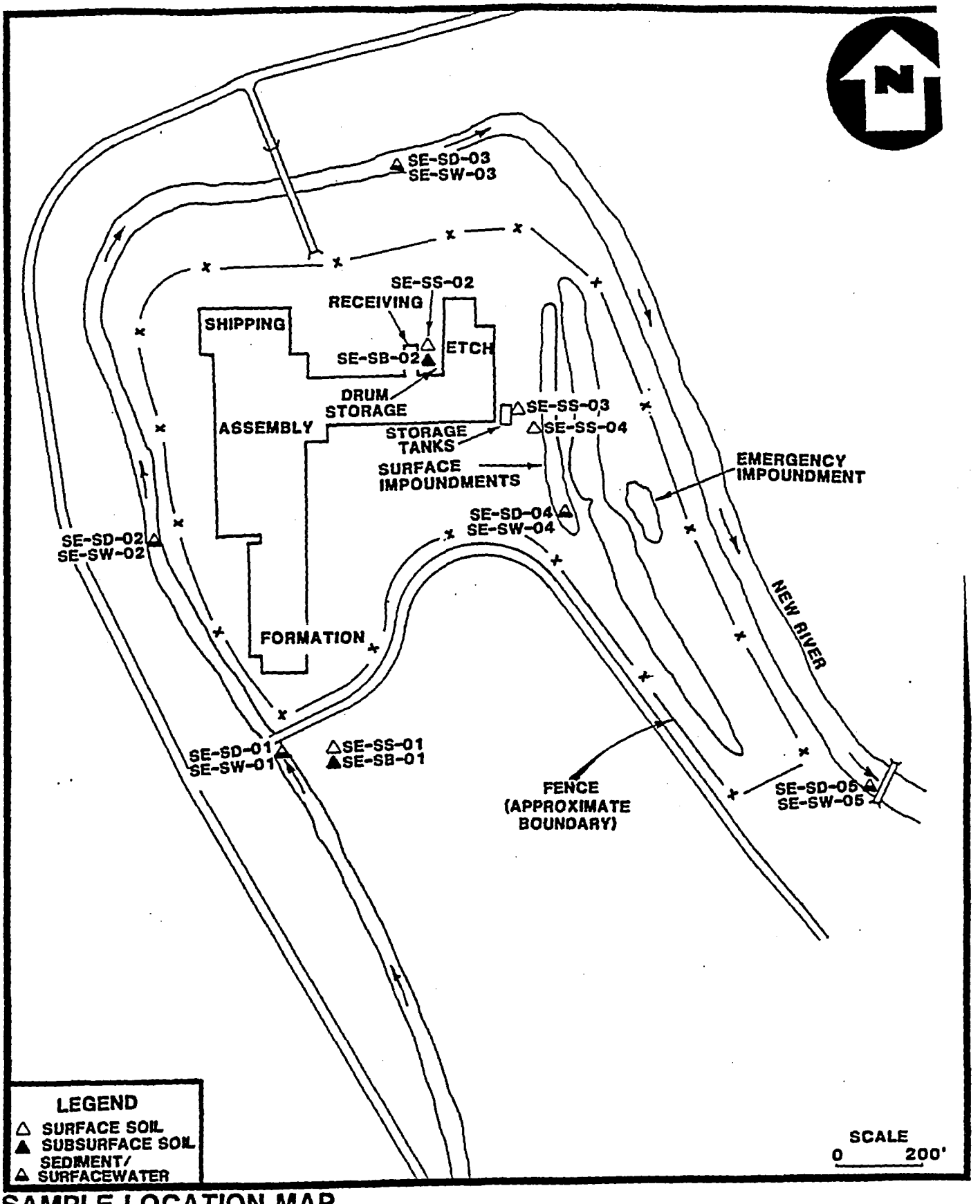
SE - Sprague Electric Company
SS - Surface Soil
SB - Subsurface Soil
SD - Sediment
SW - Surface Water
bls - Below Land Surface

TABLE 1

SAMPLE CODES, DESCRIPTIONS, LOCATIONS, AND RATIONALE
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

Sample Code	Description	Location	Rationale
SE-SD-02	Sediment	From a downstream location west of the facility on the New River, near a facility discharge pipe	To determine presence or absence of contaminants
SE-SD-03	Sediment	From a location north and downstream of the facility on the New River	To assess downstream sediment conditions
SE-SD-04	Sediment	From a surface impoundment located east of the facility	To determine presence or absence of contaminants
SE-SD-05	Sediment	From a location southeast and downstream of the facility on the New River	To assess downstream sediment conditions

SE - Sprague Electric Company
SS - Surface Soil
SB - Subsurface Soil
SD - Sediment
SW - Surface Water
bls - Below Land Surface



SAMPLE LOCATION MAP
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

FIGURE 3

NUS CORPORATION

4.1.4 Field Measurements

Field measurements were performed on all water samples (Table 2). Parameters measured included temperature, pH, and conductivity of the sample at time of collection. No field measurements were performed on the soil samples during this investigation.

4.2 SAMPLE ANALYSIS

4.2.1 Analytical Support and Methodology

All samples collected were analyzed under the Contract Laboratory Program (CLP) and analyzed for all organic and inorganic parameters listed in the Target Compound List (TCL). Organic analysis of soil and water samples was performed by Compuchem of Research Triangle Park, North Carolina. Inorganic analysis of soil and water samples was performed by S-Cubed of San Diego, California.

All laboratory analyses and laboratory quality assurance procedures used during this investigation were in accordance with standard procedures and protocols as specified in the Laboratory Operations and Quality Control Manual, United States Environmental Protection Agency, Region IV, Environmental Services Division, issued October 24, 1990; or as specified by the existing United States Environmental Protection Agency standard procedures and protocols for the Contract Laboratory Program (CLP) Statement of Work (SOW), as applicable.

4.2.2 Analytical Data Quality and Data Qualifiers

All analytical data were subjected to a quality assurance review as described in the EPA Environmental Services Division laboratory data evaluation guidelines. In the tables, some of the concentrations of the organic and inorganic parameters have been flagged with a "J". This indicates that the qualitative analysis was acceptable, but the quantitative value has been estimated. A few other compounds are flagged with an "N", indicating that they were detected based on the presumptive evidence of their presence. This means that the compound was tentatively identified, and its detection cannot be used as positive identification of its presence. Results for some background samples are reported with a "U" flag. This flag means that the material was analyzed for but not detected. The reported number is the laboratory-derived minimum quantitation limit (MQL) for the compound or element in that sample. At times, miscellaneous organic compounds that do not appear on the target compound list are reported with a data set. These compounds are labeled as "JN", indicating that they are tentatively identified at estimated quantities. Because these

TABLE 2

FIELD MEASUREMENTS
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

Sample Code	pH	Conductivity (umhos/cm)	Temp. (°F)
SE-SW-01	7.65	54	53.1
SE-SW-02	8.94	990	72.9
SE-SW-03	7.57	578	57.4
SE-SW-04	5.03	328	47.2
SE-SW-05	7.05	91	43.5

SE - Sprague Electric
SW - Surface Water

compounds are not routinely analyzed for or reported, background levels or MQL values are not generally available for comparison. The complete analytical data sheets and analytical data qualifier reports are presented in Appendix B.

4.2.3 Presentation of Analytical Results

This section presents a discussion and interpretation of the analytical results from the environmental samples collected during the investigation at Sprague Electric Company. Results of surface soil, subsurface soil, sediment, and surface water samples are presented in Tables 3, 4, 5, 6, 7, 8, and 9. Background samples have been designated for all media. Values for background sample results are presented as either a measured value or as the minimum quantitation limit (MQL). Samples containing concentrations of contaminants greater than three times the background level or MQL of these contaminants are considered to be elevated. These samples are noted in the text.

Summaries of inorganic analytical results can be found in Tables 3, 4, 5, and 6. There were four surface soil samples collected during the investigation. Sample SE-SS-02 was collected from the north side of the main facility adjacent to a drum storage area. This sample contained elevated levels of mercury (0.40J mg/kg; 3 times MQL), nickel (190 mg/kg; 5 times background), and zinc (260 mg/kg; 3 times background). Another surface soil sample containing elevated levels of metals was SE-SS-04, collected 20 feet east of the nitric and sulfuric acid storage tanks. This sample contained lead at an estimated level 3 times background (40J mg/kg). The remaining two surface soil samples contained no elevated levels of metals.

There were two subsurface soil samples collected. The onsite sample SE-SB-02 was taken from the same location as the corresponding surface soil sample (north of the main building adjacent to the drum storage area). It was determined that this sample contained beryllium at a level 3 times MQL (1.6 mg/kg).

There were five locations at which a sediment and a surface water sample were collected. Of the five sediment samples, only one, SE-SD-04, contained inorganics at elevated concentrations. This sediment sample was collected from a surface impoundment located east of the facility building. SE-SD-04 contained aluminum (290,000 mg/kg; 8 times background), mercury (0.8J mg/kg; 4 times MQL), and sodium (9100 mg/kg; 25 times MQL).

TABLE 3

SUMMARY OF INORGANIC ANALYTICAL RESULTS
SURFACE SOIL SAMPLES
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

PARAMETERS (mg/kg)	Background SE-SS-01	North of Main Building, Adjacent to Drum Storage Area SE-SS-02	West of Main Building, Adjacent to the Nitric and Sulfuric Acid Storage Tanks SE-SS-03	20 feet West of Nitric and Sulfuric Acid Storage Tanks SE-SS-04
ALUMINUM	43,000	25,000	69,000	41,000
ARSENIC	3.5	-	2.7	-
BARIUM	270	380	210	640
CADMIUM	1.1U	2.4	-	-
CALCIUM	2700	5400	5500	2600
CHROMIUM	88	45	93	92
COBALT	24	22	52	25
COPPER	42	100	42	37
IRON	48,000	36,000	58,000	54,000
LEAD	13J	33J	14J	40J
MAGNESIUM	7600	7700	5600	13,000
MANGANESE	590U	650	1300	700
MERCURY	0.13U	0.40J	-	-
NICKEL	35	190	35	38
POTASSIUM	3700	4900	1600	9900

- Material analyzed for but not detected above minimum quantitation limit (MQL).
J Estimated value.
U Material was analyzed for but not detected. The number given is the MQL.

TABLE 3

SUMMARY OF INORGANIC ANALYTICAL RESULTS
SURFACE SOIL SAMPLES
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

PARAMETERS (mg/kg)	Background SE-SS-01	North of Main Building, Adjacent to Drum Storage Area SE-SS-02	West of Main Building, Adjacent to the Nitric and Sulfuric Acid Storage Tanks SE-SS-03	20 feet West of Nitric and Sulfuric Acid Storage Tanks SE-SS-04
SODIUM	3600	-	-	-
VANADIUM	120	110	170	130
ZINC	76	260	68	86
CYANIDE	0.66U	-	0.86	0.89

- Material analyzed for but not detected above minimum quantitation limit (MQL).
J Estimated value.
U Material was analyzed for but not detected. The number given is the MQL.

TABLE 4

SUMMARY OF INORGANIC ANALYTICAL RESULTS
SUBSURFACE SOIL SAMPLES
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

PARAMETERS (mg/kg)	Background SE-SB-01	North of Main Building, Adjacent to Drum Storage Area SE-SB-02
ALUMINUM	22,000	26,000
BARIUM	170	360
BERYLLIUM	0.53U	1.6
CADMIUM	0.96U	-
CALCIUM	2900	6600
CHROMIUM	68	37
COBALT	23	23
COPPER	36	37
IRON	30,000	39,000
LEAD	5.6J	3.2J
MAGNESIUM	6300	9000
MANGANESE	560	620
NICKEL	24	18
POTASSIUM	2700	6300
VANADIUM	81	120
ZINC	47	39

- Material analyzed for but not detected above minimum quantitation limit (MQL).

J Estimated value.

U Material was analyzed for but not detected. The number given is the MQL.

TABLE 5

SUMMARY OF INORGANIC ANALYTICAL RESULTS
SEDIMENT SAMPLES
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

PARAMETERS (mg/kg)	Background SS-SD-01	Downstream, West of Facility on the New River SE-SD-02	Downstream, North of Facility on the New River SE-SD-03	Surface Impoundment East of Facility SE-SD-04	Downstream, Southeast of Facility on the New River SE-SD-05
ALUMINUM	37,000	6000	17,000	290,000	12,000
BARIUM	290	51	120	55	98
CALCIUM	2400	1500	3400	750	1500
CHROMIUM	48	17	36	23	26
COBALT	28	6.8	17	5.7	12
COPPER	32	35	53	46	22
IRON	49,000	12,000	25,000	13,000	18,000
LEAD	31J	17J	27J	7.3J	9.2J
MAGNESIUM	7800	1800	4400	1200	3600
MANGANESE	920	210	480	110	360
MERCURY	0.18U	-	-	0.80J	-
NICKEL	28	28	21	15	14
POTASSIUM	4500	-	2500	1600	2100
SODIUM	U	-	-	9100	-
VANADIUM	100	32	67	43	45
ZINC	99	39	100	48	49
CYANIDE	0.91U	-	-	1.7	-

- Material analyzed for but not detected above minimum quantitation limit (MQL).
J Estimated value.
U Material was analyzed for but not detected. The number given is the MQL.

Elevated inorganic concentrations were detected in three of the surface water samples. Sample SE-SW-02, collected downstream on the New River west of the site, contained copper (29 ug/l; 7 times MQL), sodium (13,000 ug/l; 5 times MQL), and zinc (43 ug/l; times MQL). The surface water collected from a surface impoundment (SE-SW-04) contained calcium (11,000 ug/l; 3 times background), manganese (120 ug/l; 6 times MQL), and sodium (47,000 ug/l; 19 times MQL). SE-SW-05 was collected downstream on the New River southeast of the site. This sample contained elevated concentrations of iron (800 ug/l; 4 times MQL) and manganese (100 ug/l; 5 times MQL).

Most of the metals detected can be attributed to operations at the facility. The plant manufactures aluminum electrolytic capacitors. Many metals are commonly found in a binary system with aluminum, including beryllium, copper, iron, manganese, nickel, lead, and zinc (Ref. 27). These and other impurities can be removed from aluminum in the etching bath process. This could explain their presence in samples collected during the investigation. The source of the mercury (identified in estimated values in two of the samples) is uncertain. The major use of mercury is in electrical applications such as batteries, electric lamps, wiring and switching devices (Ref. 28).

Summaries of organic results can be found in Tables 7, 8, and 9. There were no organic compounds detected at elevated levels in any of the samples collected. There were, however, several polynuclear aromatic hydrocarbons detected in estimated concentrations in a few of the onsite soil samples. These contaminants were not, however, at concentrations above the MQLs for those compounds.

TABLE 7

SUMMARY OF ORGANIC ANALYTICAL RESULTS
SURFACE SOIL SAMPLES
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

PARAMETERS (ug/kg)	Trip Blank SE-TB-01S	Background SE-SS-01	North of Main Building, Adjacent to Drum Storage Area SE-SS-02	West of Main Building, Adjacent to the Nitric and Sulfuric Acid Storage Tanks SE-SS-03	20 feet West of Nitric and Sulfuric Acid Storage Tanks SE-SS-04
EXTRACTABLE COMPOUNDS					
ACENAPHTHENE	-	890U	81J	-	-
FLUORENE	-	890U	86J	-	-
PHENANTHRENE	-	890U	780J	130J	-
ANTHRACENE	-	890U	190J	-	-
FLUORANTHENE	-	890U	-	160J	-
PYRENE	-	890U	480J	-	-
CHRYSENE	-	890U	310J	-	-
BENZO(B AND/OR K)FLUORANTHENE	-	890U	420J	-	-
BENZO-A-PYRENE	-	890U	430J	-	-
INDENO (1,2,3-CD) PYRENE	-	890U	210J	-	-
BENZO(GHI)PERYLENE	-	890U	230J	-	-
UNIDENTIFIED COMPOUNDS	-	7000J/5	800J	3000J/3	-
BENZACEPHENANTHRYLENE(1)			500JN		

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

TABLE 8

SUMMARY OF ORGANIC ANALYTICAL RESULTS
SUBSURFACE SOIL SAMPLES
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

PARAMETERS (ug/kg)	Background SE-SB-01	North of Main Building, Adjacent to Drum Storage Area SE-SB-02
EXTRACTABLE COMPOUNDS		
PHENANTHRENE	810U	110J
FLUORANTHENE	810U	91J

J Estimated value.
U Material was analyzed for but not detected. The number given is the MQL.

TABLE 9

SUMMARY OF ORGANIC ANALYTICAL RESULTS
SEDIMENT SAMPLES
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

PARAMETERS (ug/kg)	Background SE-SD-01	Downstream, West of Facility on the New River SE-SD-02	Downstream, North of Facility on the New River SE-SD-03	Surface Impoundment West of Facility SE-SD-04	Downstream, Southeast of Facility on the New River SE-SD-05
PURGEABLE COMPOUNDS					
CHLOROFORM	10U	-	6J	-	-
EXTRACTABLE COMPOUNDS					
PHENANTHRENE	1300U	-	170J	-	-
DI-N-BUTYLPHTHALATE	1300U	-	170J	-	-
FLUORANTHENE	1300U	-	220J	-	-
PYRENE	1300U	-	120J	-	-
BENZO-A-PYRENE	380J	-	-	-	-
UNIDENTIFIED COMPOUNDS	10,000J/5	-	3000J/2	30,000J/14	5000J/5
PHOSPHORIC ACID, DIOCTADECYLESTER(1)	2000JN				1000JN
PETROLEUM PRODUCT(1)				N	
HYDROXYPHENYLMETHYLPHENOL(1)					700JN

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

5.0 SUMMARY

The surface water pathway is of concern from operations conducted at Sprague Electric Company. Contaminants can enter the river directly via surface water run-off, or indirectly by downward leakage through surface and subsurface soils, through percolation from the lagoon system, or by rainfall, until they reach the water table which eventually discharges into the New River. The New River is utilized for recreational fishing, boating and swimming. The groundwater pathway is also of concern due to the use of the unconfined crystalline rock aquifer in the area. Within a 4-mile site radius, approximately 600 municipal customers and 800 private residences utilize groundwater to supply their potable water needs. The air migration and onsite exposure pathways are of least concern at the facility due to restricted site access, however, onsite employees could be potentially exposed to organic and inorganic contaminants detected in onsite surface soil samples.

The sampling investigation consisted of the collection of 16 environmental samples: four surface soil, two subsurface soil, five sediment, and five surface water samples. No organic compounds were detected at concentrations above the MQLs for those compounds. Several polynuclear aromatic compounds were detected at estimated concentrations in a few of the onsite soil samples, but they are not believed to be site related. Surface and subsurface soil samples collected near the drum storage area and near the storage tank area were found to be contaminated with five different inorganic contaminants. Inorganic contaminants of greatest concern include lead and zinc, which are potential impurities removed from aluminum in the etching bath process. Mercury, which is utilized in electrical applications, was detected in a subsurface soil sample collected near the drum storage area. A sediment sample collected from a surface impoundment contained several metals including aluminum and mercury which are potentially site related. Analysis of surface water samples collected downstream of the facility and from one of the facility's surface impoundments revealed the presence of six inorganic substances. Most notably, copper, iron, manganese, and zinc were detected, and all are potential constituents of the aluminum etching bath process. It appears that these inorganic contaminants have the potential to enter the New River.

Based on the analysis of possible migration pathways, the results of the sampling investigation, and the information obtained from the references, FIT 4 recommends that this site be evaluated using the HRS (effective March 14, 1991).

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Ref. 12

United States Environmental Protection Agency
Superfund

Office of Emergency and Remedial Response
Washington, DC 20460

Publication
September 1995

EPA

Superfund Chemical Data Matrix

RECEIVED
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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OFFICE OF
SOLID WASTE AND EMERGENCY
RESPONSE

MEMORANDUM

SUBJECT: PREscore Version 4.0 and the Updated Superfund Chemical Data Matrix

FROM: Dave Evans, Director /S/
State/Tribal/Site Identification Center

TO: All Regional Site Assessment Chiefs

PREscore Version 4.0, a software tool used to help site assessment investigators screen and score NPL candidate sites using the Hazard Ranking System (HRS) and the Superfund Chemical Data Matrix (SCDM) database which interfaces with PREscore providing chemical factor values and health benchmark values were updated recently enabling the site investigator to assess an NPL candidate site with greater accuracy in evaluating risks to human health and environment. Thus far, only PREscore Version 4.0, equipped with a SCDM Chemical Data File, has been released to all users. The updated SCDM database was not released concurrent with PREscore due to prioritized funding capabilities during the Continuing Resolution period as well as the need to conduct further testing to ensure chemical value accuracy.

Many of the PREscore users are very satisfied with the new software in regard to its efficiency, accuracy and the ability to manage and document data. The new software contains the following new capabilities.

- Contaminants and concentrations that are re-selected automatically when updating site files created by previous versions of PREscore

- A larger Superfund Chemical Data Matrix (SCDM) file that contains updated toxicity and benchmark values for all 397 contaminants, including more than 50 additional chemicals.

- Access to WordPerfect for documentation and reference list editing

- Site file output that is generated as a WordPerfect document

Of course, as with any new software tool, combined with the successes there are initial system failures encountered as well. Because PREscore and SCDM have far greater system improvements and updated chemical data elements than the sum of all previous version improvements, system implementation and programmed data element problems are likely to be encountered. Unfortunately, our rigorous system testing methods cannot detect every problem. To date, thanks to regional assistance in the implementation and trouble shooting effort, several contaminant-specific values in SCDM affecting site scores developed using PREscore Version 4.0 have been identified (see table below) and are being corrected.

Specific issues encountered include:

Contaminant Parameter Issue
Asbestos
Lead Toxicity Default toxicity value assigned according to the Federal Register is not properly implemented.

Endosulfan I/II Air Gas Migration Migration potential value is incorrect and is less than the previous release of SCDM.

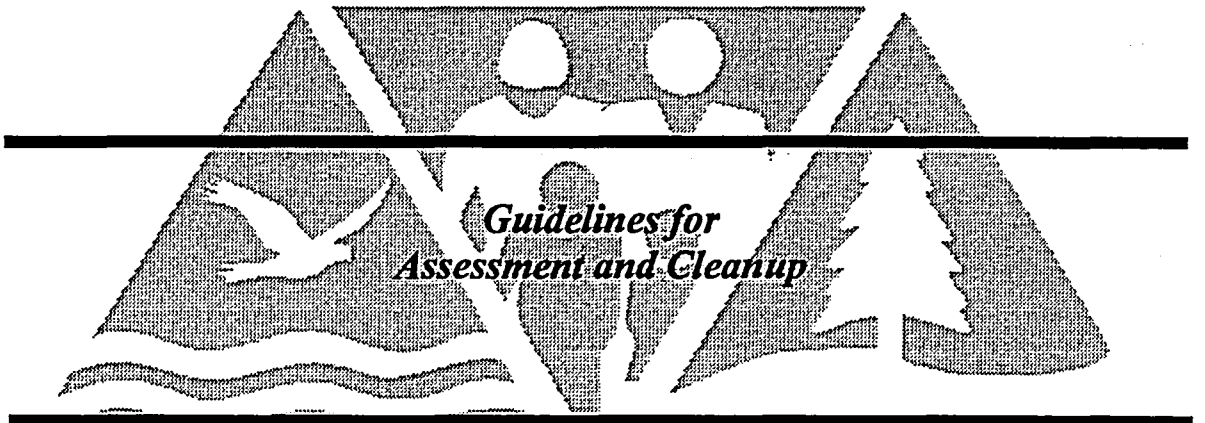
PCBs Air Gas Mobility Mobility value is incorrect and is substantially greater than the previous release of SCDM, which can result in an marked change in the site score.

Carbon Tetrachloride

TABLE OF CONTENTS

Section		Page
TABLE OF CONTENTS		iii
SECTION 1	INTRODUCTION	1
	1.1 DEFINITIONS	1
SECTION 2	SUPERFUND CHEMICAL DATA MATRIX DATA SELECTION RULES	3
	2.1 HAZARDOUS SUBSTANCE IDENTITIES	3
	2.2 DATA SELECTION METHODOLOGY	5
	2.2.1 Toxicity Information	5
	2.2.2 Carcinogenicity Information	7
	2.2.3 Mobility Information	9
	2.2.4 Persistence Information	13
	2.2.5 Bioaccumulation Potential Information	14
	2.2.6 Ecotoxicity Parameters	16
	2.2.7 Benchmarks	16
SECTION 3	CHEMICAL DATA, FACTOR VALUES, AND BENCHMARKS FOR HAZARDOUS SUBSTANCES	30
APPENDIX A	CHEMICAL DATA, FACTOR VALUES, AND BENCHMARKS FOR CHEMICAL SUBSTANCES	A-1
APPENDIX B-1	TABLES FOR NON-RADIOACTIVE HAZARDOUS SUBSTANCES	B-1
APPENDIX B-2	TABLES FOR RADIONUCLIDES	B-77
APPENDIX C	SYNONYM LIST	C-1

Inactive Hazardous Sites Program



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NCDENR

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES

North Carolina Department of Environment and Natural Resources
Division of Waste Management
Superfund Section
Inactive Hazardous Sites Branch

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Purpose and Intended Use of the Guidelines

These guidelines outline the ***minimum*** technical and administrative requirements for all site assessments and site cleanups conducted pursuant to the Inactive Hazardous Sites Response Act of 1987 (N.C.G.S. 130A-310 *et.seq.*) except for those cleanups conducted under the Inactive Hazardous Sites Registered Environmental Consultant (REC) Program. For additional information on the REC program, please refer to the *REC Program Rules and Implementation Guidance, June 2001.*

These guidelines should be used by remediating parties at priority action sites when responding to *Site Assessment Request Letters, Site Assessment Orders, Site Cleanup Request Letters, Remedial Action Orders,* and *Administrative Orders on Consent* for voluntary remedial actions **not** conducted under the REC program. Due to the wide range of conditions encountered at hazardous substance disposal sites, the guidelines will not address every conceivable situation. At most sites, the consultant will need to prescribe additional sample collection and analysis based on site-specific conditions. The importance of retaining a qualified and experienced environmental consultant cannot be overemphasized.

Note: **In order to receive branch approval, all voluntary site cleanups, whether managed under the REC program or managed directly by the branch, must be conducted pursuant to a consent order with the division. "Independent cleanups" conducted outside consent orders are no longer an option, and will not be acknowledged by the branch.**

Table of Contents

1.0. Introduction

2.0. Remedial Investigation Work Plans

3.0. Remedial Investigation Reports

4.0. Remediation Goals

5.0. Remedial Action

Appendix A: Minimum Sampling and Analytical Requirements for the Remedial Investigation

A.1. Introduction
A.2. Minimum Soil Sample Collection
A.3. Minimum Groundwater Sample Collection
A.4. Minimum Surface Water and Sediment Sample Collection
A.5. Other Sample Collection
A.6. Standard Field Protocols
A.7. Minimum Sample Analyses
A.8. Data Reporting Requirements

Appendix B: Minimum Requirements for Confirmation Sampling and Analysis

B.1. Introduction
B.2. Soil Sampling
B.3. Groundwater Sampling
B.4. Surface Water/Sediment Sampling
B.5. Minimum Sample Analyses

Appendix C: Sensitive Environment Contacts

Appendix D: Land Use Restrictions

D.1. Approval Process for Use of Land Use Restrictions as the Remedy
D.2. Land Use Restrictions Consent Form
D.3. Cancellation of Land Use Restrictions

Note 1: The soil remediation goal for PCBs was established in accordance with USEPA policy for cleanup of PCBs at Superfund sites. The unrestricted use remediation goal for PCBs is 1 ppm. This number may not be adjusted. It represents a 1×10^{-6} cancer risk. However, higher levels can remain in subsurface soils if (1) restrictive covenants, which prevent exposure, are applied and (2) the remaining concentrations of PCBs in soil are shown not to pose a threat to groundwater (i.e. soils meet protection of groundwater remediation criteria). Application of restrictive covenants requires branch approval (see 4.2).

Note 2: Some of the remediation goals shown in Table 4-1 may be more stringent than natural background concentrations or method detection limits. Cleanup to below site-specific natural background concentrations (metals only) or method detection limits (using the analytical methods specified in section A.7.1.2) is not required.

4.1.1.2 "Protection of groundwater" soil remediation goals

Procedure

In addition to meeting health-based remediation goals, soils must meet a protection of groundwater remediation goal. The remediating party may use a laboratory leachate analysis model to determine the potential for soils to leach residual contamination to groundwater. The branch recommends the use of TCLP analysis to determine the leachability of contaminants. If another laboratory model is used, the remediating party must demonstrate its scientific validity, and that its precision and accuracy are commensurate with its stated use. Soils which leach organic contaminants in excess of the groundwater remediation goals will require further remediation. Soils which leach metals in excess of the groundwater remediation goals (or natural leachable background concentrations, whichever are less stringent) will also require further remediation.

Alternatively the remediating party can use simple scientifically-valid mathematical equations, employing site-specific field data for all parameters, to calculate protection of groundwater remediation goals. The use of generic values for these parameters is not allowed.

Exceptions

At sites that meet any of the following three conditions, the "protection of groundwater" soil remediation goals do not apply :

1. Residual soil contaminant concentrations (mg/kg) for metals only, do not exceed the site-specific natural background concentrations;

2. Residual soil contaminant concentrations (in mg/kg) for both metals and organics, do not exceed values of twenty times the corresponding groundwater remediation goals (in mg/l);

3. Residual soil contaminant concentrations (in mg/kg) for metals and organics, do not exceed the health-based soil remediation goals (in mg/kg) described in section 4.1.1.1, and either (a) or (b) applies:

   (a) the remediating party has determined that all on-site disposal and releases of hazardous substances occurred prior to 1980, and sampling demonstrates that groundwater is free of hazardous substances;

   (b) the branch-approved remedial action plan for the site includes active groundwater remediation and demonstrates that the final remedy for groundwater will address any future leaching of contaminants from soil to groundwater.

4.1.2 Remediation goals for groundwater

The branch's remediation goals for groundwater consist of the *least stringent* of: (i) the health-based remediation goals shown in Table 4-2; (ii) the method detection limits (using the analytical methods specified in section A.7.1.2); or (iii) natural background concentrations (metals only).

The health-based remediation goals shown in Table 4-2 are based on the lower of: (i) state groundwater standards (15A NCAC 2L .0202); (ii) federal Maximum Contaminant Levels (MCL's); or (iii) non-zero Maximum Contaminant Level Goals (MCLG's). For contaminants that are not listed contact the branch.

4.1.3 Remediation goals for sediments

Remediation goals for sediment are based on the *most stringent* of: (i) the health-based soil remediation goals listed in Table 4-1 (or the upstream "background" concentrations if less stringent); and (ii) remediation goals sufficient to ensure that contaminated sediment will not cause exceedances of the remediation goals for groundwater and surface water.

Remediation goals may be adjusted by the branch at the time of remedy selection if warranted. If the preferred remedy (selection governed by the feasibility study included in the Remedial Action Plan) can not achieve the remediation goals provided, the branch will re-establish levels based on the lowest concentration that can be achieved at the site given that those levels must correspond to less than the maximum cumulative excess cancer risk of 1×10^{-4} and a hazard index of 1.

Note 1: If contaminated sediments are located in a wetland or other sensitive environment, the branch will weigh the benefit of active remediation with the need for protecting and preserving sensitive environments and instead using passive remedies or institutional controls.

Note 2: At sites with surface water contamination, remediating parties may need to plan the remedial action to address continuing source areas first. For example, surface water contamination may result from continuing releases from soils. In this case, soils must be remediated to whatever levels will ensure attainment of the surface water remediation goals.

4.1.4 Remediation goals for surface water

Preliminary remediation goals for surface water are established by the Division of Water Quality (DWQ) using State or Federal surface water standards for the protection of human health and/or aquatic life. Final remediation goals will be set at the DWQ standards or upstream "background" concentrations, whichever are less stringent, with the exception of the following two conditions: (1) if surface water contamination is causing sediments to exceed cleanup criteria, remediation of surface water will be necessary to eliminate this effect; (2) if remediation of surface water is determined to cause unreasonable harm to a wetland (or other protected environment) alternate goals will be determined by the branch.

4.2 Remediation Goals for Restricted Land Use

Under certain site conditions, it may not be appropriate or feasible to meet the soil or sediment remediation goals described in sections 4.1.1 and 4.1.2. The remediating party may propose (for branch review and approval) alternate soil or sediment remediation goals based on a restricted land-use exposure scenario. The process and requirements for proposing restricted land use as a remedy are described in detail in Appendix D of these guidelines.

4.3 Additional Provisions

The branch considers "monitored natural attenuation" to be a potential remedial alternative for attaining the remediation goals *not* a waiver of the remediation goals. If natural attenuation of any contaminated medium is proposed, the remediating party must demonstrate that it is supported by the results of the feasibility study and that it is the preferred remedy.

Table 4-1: Soil Remediation Goals[1]

** Hazardous substances identified with an asterisk exhibit both carcinogenic and non-carcinogenic effects. The carcinogenic remediation goal is listed because it is more stringent at the 1 x 10^{-6} risk concentration than the remediation goal for non-carcinogenic effects. Cleanup below method detection limits, using analytical methods prescribed in the guidelines, is not required.*

Chemical	CASRN	RG (ppm)	
Acetone	67641	320	N
Acetone cyanohydrin	75865	9.8	N
Acetophenone	98862	0.098	N
Acrolein	107028	0.02	N
Acrylamide *	79061	0.11	C
Acrylic acid	79107	5800	N
Acrylonitrile *	107131	0.21	C
Aldicarb	116063	12.2	N
Aldrin *	309002	0.029	C
Allyl alcohol	107186	62	N
Allyl chloride	107051	600	N
4-Aminopyridine	504245	0.24	N
Ammonium sulfamate	7773060	2400	N
Aniline*	62533	85	C
Antimony and compounds (not listed below)	7440360	6.2	N
Antimony pentoxide	1314609	7.8	N
Antimony potassium tartrate	304610	14	N
Antimony tetroxide	1332316	6.2	N
Antimony trioxide	1309644	6.2	N
Arsenic	7440382	4.4	N
Benzene*	71432	0.65	C
Benzidine *	92875	0.021	C
Benzoic acid	65850	48000	N
Benzotrichloride	98077	0.037	C
Benzyl chloride	100447	0.89	C
Beryllium and compounds	7440417	30	N
alpha BHC	319846	0.092	C
beta BHC	319857	0.32	C
gamma BHC (Lindane)*	58899	0.44	C
technical BHC (hexachlorocyclohexane, all isomers)	608731	0.32	C
Bis(2-chloroethyl)ether	111444	0.21	C
Bis(2-ethylhexyl)phthalate (DEHP)*	117817	35	C
Bis(chloromethyl)ether	542881	0.00019	C
Bromodichloromethane *	75274	1	C
Bromoform (tribromomethane)*	75252	62	C
Bromomethane	74839	0.78	N

See Footnotes page 4-13.

Table 4-1: Soil Remediation Goals[1] - (Cont.)

** Hazardous substances identified with an asterisk exhibit both carcinogenic and non-carcinogenic effects. The carcinogenic remediation goal is listed because it is more stringent at the 1 x 10^{-6} risk concentration than the remediation goal for non-carcinogenic effects. Cleanup below method detection limits, using analytical methods prescribed in the guidelines, is not required.*

Chemical	CASRN	RG (ppm)	
1-Butanol	71363	1220	N
Butyl benzyl phthalate	85687	2400	N
Cacodylic acid	75605	36	N
Cadmium and compounds	7440439	7.4	N
Captan*	133062	140	C
Carbaryl	63252	1220	N
Carbon disulfide	75150	72	N
Carbon tetrachloride *	56235	0.24	C
Chlordane *	57749	1.6	C
2-Chloro-1,3-butadiene	126998	0.72	N
4-Chloro-2,2-methylaniline hydrochloride	3165933	1.1	C
4-Chloro-2-methylaniline	95692	0.84	C
4-Chloroaniline	106478	48	N
Chlorobenzene	108907	30	N
Chlorobenzilate *	510156	1.8	C
4-Chlorobenzotrifluoride	98566	240	N
1-Chlorobutane	109693	142	N
Chloroethane*	75003	3	C
Chloroform *	67663	0.24	C
Chloromethane	74873	1.2	C
beta-Chloronaphthalene	91587	780	N
o-Chloronitrobenzene	88733	81	C
p-Chloronitrobenzene	100005	11	C
2-Chlorophenol	95578	12.6	N
o-Chlorotoluene	95498	32	N
Chlorpyrifos	2921882	36	N
Chromium III and compounds	16065831	24000	N
Chromium VI and compounds*	18540299	30	C
Copper and compounds	7440508	580	N
Crotonaldehyde *	123739	0.0053	C
Cumene	98828	32	N
Cyanide	57125	2.2	N
Cyclohexanone	108941	62000	N
Dalapon	75990	360	N
DDD	72548	2.4	C
DDE	72559	1.7	C

See Footnotes page 4-13.

Table 4-1: Soil Remediation Goals[1] - (Cont.)

** Hazardous substances identified with an asterisk exhibit both carcinogenic and non-carcinogenic effects. The carcinogenic remediation goal is listed because it is more stringent at the 1 x 10^{-6} risk concentration than the remediation goal for non-carcinogenic effects. Cleanup below method detection limits, using analytical methods prescribed in the guidelines, is not required.*

Chemical	CASRN	RG (ppm)	
DDT*	50293	1.7	C
Diallate	2303164	8	C
Diazinon	333415	11	N
Dibenzofuran	132649	58	N
1,2-Dibromo-3-chloropropane*	96128	0.45	C
1,2-Dibromoethane	106934	0069	C
Di-n-butyl phthalate	84742	1220	N
1,2-Dichlorobenzene	95501	1400	N
1,3-Dichlorobenzene	541731	2.6	N
1,4-Dichlorobenzene*	106467	3.4	C
3,3'-Dichlorobenzidine	91941	1.1	C
Dichlorodifluoromethane	75718	18.8	N
1,1-Dichloroethane	75343	118	N
1,2-Dichloroethane (EDC)*	107062	0.35	C
1,1-Dichloroethylene*	75354	0.054	C
1,2-Dichloroethylene (cis)	156592	8.6	N
1,2-Dichloroethylene (mixture)	540590	8.6	N
1,2-Dichloroethylene (trans)	156605	12.6	N
2,4-Dichlorophenol	120832	36	N
2,4-Dichlorophenoxyacetic acid (2,4-D)	94757	138	N
1,2-Dichloropropane*	78875	0.35	C
2,3-Dichloropropanol	616239	36	N
1,3-Dichloropropene *	542756	0.7	C
Dichlorvos *	62737	1.7	C
Dicofol	115322	1.1	C
Dieldrin *	60571	0.03	C
Diethyl phthalate	84662	9800	N
Diethylstilbestrol	56531	0.00014	C
Dimethoate	60515	2.4	N
3,3'-Dimethoxybenzidine	119904	35	C
3,3'-Dimethylbenzidine	119937	0.053	C
1,1-Dimethylhydrazine	57147	0.19	C
1,2-Dimethylhydrazine	540738	0.013	C
2,4-Dimethylphenol	105679	2400	N
Dimethyl phthalate	131113	122000	N

See Footnotes page 4-13.

Table 4-1: Soil Remediation Goals[1] - (Cont.)

* *Hazardous substances identified with an asterisk exhibit both carcinogenic and non-carcinogenic effects. The carcinogenic remediation goal is listed because it is more stringent at the 1 x 10^{-4} risk concentration than the remediation goal for non-carcinogenic effects. Cleanup below method detection limits, using analytical methods prescribed in the guidelines, is not required.*

Chemical	*CASRN*	*RG (ppm)*	
1,2-Dinitrobenzene (o-Dinitrobenzene)	528290	4.8	N
1,3-Dinitrobenzene (m-Dinitrobenzene)	99650	12.2	N
1,4-Dinitrobenzene (p-Dinitrobenzene)	100254	4.8	N
2,4-Dinitrophenol	51285	24	N
2,4-Dinitrotoluene	121142	24	N
2,6-Dinitrotoluene	606202	12.2	N
Dinitrotoluene mixture	NA	0.72	C
Dinoseb	88857	12.2	N
Dioxins and Furans			
2,3,7,8-Heptachlorodibenzo-p-dioxin (2,3,7,8-HPeCDD)	NA	0.0004	C
2,3,7,8-Hexachlorodibenzo-p-dioxin (2,3,7,8-HxCDD)	NA	0.00004	C
Octachlorodibenzo-p-dioxin (OCDD)	NA	0.004	C
2,3,7,8-Pentachlorodibenzo-p-dioxin (2,3,7,8-PeCDD)	NA	0.000008	C
2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)	1746016	0.000004	C
2,3,7,8-Heptachlorodibenzofuran (2,3,7,8-HPCDF)	NA	0.0004	C
2,3,7,8-Hexachlorodibenzofuran (2,3,7,8-HxCDF)	NA	0.00004	C
Octochlorodibenzofuran (OCDF)	NA	0.004	C
1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-PeCDF)	NA	0.00008	C
2,3,7,8-Pentachlorodibenzofuran (2,3,7,8-PeCDF)	NA	0.000008	C
2,3,7,8-Tetrachlorodibenzofuran (2,3,7,8-TCDF)	NA	0.00004	C
Diphenylamine	122394	300	N
1,2-Diphenylhydrazine	122667	0.61	C
Diquat	85007	26	N
Disulfoton	298044	0.48	N
Diuron	330541	24	N
Endosulfan	115297	74	N
Endothall	145733	240	N
Endrin	72208	3.6	N
Epichlorohydrin	106898	1.52	N
Ethion	563122	6.2	N
2-Ethoxyethanol	110805	4800	N
Ethyl acetate	141786	3800	N
Ethyl acrylate	140885	0.21	C
Ethyl ether	60297	3200	N
Ethyl methacrylate	97632	42	N

See Footnotes page 4-13.

Table 4-1: Soil Remediation Goals[1] - (Cont.)

** Hazardous substances identified with an asterisk exhibit both carcinogenic and non-carcinogenic effects. The carcinogenic remediation goal is listed because it is more stringent at the 1 x 10^{-6} risk concentration than the remediation goal for non-carcinogenic effects. Cleanup below method detection limits, using analytical methods prescribed in the guidelines, is not required.*

Chemical	CASRN	RG (ppm)	
Ethylbenzene	100414	300	N
Ethylene diamine	107153	240	N
Ethylene oxide	75218	0.14	C
Ethylenethiourea (ETU)*	96457	4.4	C
Formaldehyde	50000	1856	N
Formic acid	64186	24000	N
Furfural	98011	36	N
Glycidaldehyde	765344	4.8	N
Heptachlor *	76448	0.11	C
Heptachlor epoxide *	1024573	0.053	C
Hexachlorobenzene*	118741	0.3	C
Hexachlorobutadiene *	87683	6.2	C
Hexachlorocyclopentadiene	77474	84	N
Hexachloroethane *	67721	35	C
Hexachlorophene	70304	3.6	N
Hydrazine	302012	0.16	C
Isophorone *	78591	510	C
Kepone	143500	0.027	C
Lead	7439921	400	2
Malathion	121755	240	N
Maleic anhydride	108316	1220	N
Maleic hydrazide	123331	340	N
Malononitrile	109773	0.24	N
Mercury (inorganic)	7439976	4.6	N
Methacrylonitrile	126987	0.42	N
Methanol	67561	6200	N
Methomyl	16752775	8.8	N
Methoxychlor	72435	62	N
2-Methyl benzenamine (2-methylaniline)	95534	2	C
2-Methyl benzenamine hydrochloride (2-methylaniline hydrochloride)	636215	2.7	C
Methyl chlorocarbonate	79221	12200	N
4,4'-Methylene bis(2 chloroaniline)*	101144	3.7	C
Methylene bromide	74953	13.4	N
Methylene chloride *	75092	8.9	C
Methyl ethyl ketone (MEK)	78933	1460	N

See Footnotes page 4-13.

Table 4-1: Soil Remediation Goals[1] - (Cont.)

** Hazardous substances identified with an asterisk exhibit both carcinogenic and non-carcinogenic effects. The carcinogenic remediation goal is listed because it is more stringent at the 1 x 10^{-6} risk concentration than the remediation goal for non-carcinogenic effects. Cleanup below method detection limits, using analytical methods prescribed in the guidelines, is not required.*

Chemical	CASRN	RG (ppm)	
Methyl hydrazine	60344	0.44	C
Methyl isobutyl ketone (4-methyl-2-pentanone)	108101	158	N
Methyl methacrylate	80626	440	N
Methyl parathion	298000	3	N
2-Methylphenol (o-cresol)	95487	620	N
3-Methylphenol (m-cresol)	108394	620	N
4-Methylphenol (p-cresol)	106445	62	N
Naled	300765	24	N
Nickel and compounds	7440020	320	N
Nitric oxide	10102439	1560	N
2-Nitroaniline	88744	0.7	N
Nitrobenzene	98953	4	N
4-Nitrophenol	100027	98	N
N-Nitrosodiethanolamine	1116547	0.17	C
N-Nitrosodiethylamine	55185	0.0095	C
N-Nitrosodimethylamine	62759	0.013	C
N-Nitrosodi-n-butylamine	924163	0.024	C
N-Nitroso di-n-propylamine	621647	0.0069	C
N-Nitrosodiphenylamine	86306	99	C
N-Nitrosopyrrolidine	930552	0.23	C
m-Nitrotoluene	99081	74	N
o-Nitrotoluene	88722	74	N
p-Nitrotoluene	99990	74	N
Octamethylpyrophosphoramide	152169	24	N
Paraquat	1910425	54	N
Parathion	56382	74	N
Pentachlorobenzene	608935	9.8	N
Pentachloronitrobenzene *	82688	1.9	C
Pentachlorophenol *	87865	3	C
Phenol	108952	7400	N
p-Phenylenediamine	106503	74	N
Phenylmercuric acetate	62384	0.98	N
Phorate	298022	2.4	N
Phosphine	7803512	3.6	N
Phosphorus (white)	7723140	0.32	N

See Footnotes page 4-13.

Table 4-1: Soil Remediation Goals[1] - (Cont.)

** Hazardous substances identified with an asterisk exhibit both carcinogenic and non-carcinogenic effects. The carcinogenic remediation goal is listed because it is more stringent at the 1 x 10^{-6} risk concentration than the remediation goal for non-carcinogenic effects. Cleanup below method detection limits, using analytical methods prescribed in the guidelines, is not required.*

Chemical	*CASRN*	*RG (ppm)*	
Phthalic anhydride	85449	24000	N
Polychlorinated biphenyls (PCBs)[3]	1336363	1	3
Polynuclear aromatic hydrocarbons			
Acenaphthene	83329	740	N
Anthracene	120127	4400	N
Benzo[a]pyrene	50328	0.062	C
Benzo[b]fluoranthene	205992	0.62	C
Benzo[k]fluoranthene	207089	6.2	C
Benz[a]anthracene	56553	0.62	C
Carbofuran	1563662	62	N
Chrysene	218019	62	C
Dibenz[a,h]anthracene	53703	0.062	C
Fluoranthene	206440	460	N
Fluorene	86737	520	N
Indeno(1,2,3-cd)pyrene	193395	0.62	C
Naphthalene	91203	11.2	N
2-methyl Naphthalene	91576	11.2	N
Pyrene	129000	460	N
Pronamide	23950585	920	N
Propargite	2312358	240	N
Propargyl alcohol	107197	24	N
Propazine	139402	240	N
Propylene oxide	75569	1.9	C
Pyridine	110861	12.2	N
Quinoline	91225	0.041	C
Selenious acid	7783008	62	N
Selenium	7782492	78	N
Selenourea	630104	62	N
Silver and compounds	7440224	78	N
Sodium fluoroacetate	62748	0.24	N
Strychnine	57249	3.6	N
Styrene	100425	3200	N
1,2,4,5-Tetrachlorobenzene	95943	3.6	N
1,1,1,2-Tetrachloroethane *	630206	3	C
1,1,2,2-Tetrachloroethane*	79345	0.38	C

See Footnotes page 4-13.

Table 4-1: Soil Remediation Goals[1] - (Cont.)

** Hazardous substances identified with an asterisk exhibit both carcinogenic and non-carcinogenic effects. The carcinogenic remediation goal is listed because it is more stringent at the 1 x 10^{-6} risk concentration than the remediation goal for non-carcinogenic effects. Cleanup below method detection limits, using analytical methods prescribed in the guidelines, is not required.*

Chemical	*CASRN*	*RG (ppm)*	
Tetrachloroethylene (PCE)*	127184	5.7	C
2,3,4,6-Tetrachlorophenol	58902	360	N
p,a,a,a-Tetrachlorotoluene	5216251	0.024	C
Tetraethyldithiopyrophosphate	3689245	6.2	N
Thallium and compounds	N/A	1.04	N
Thiofanox	39196184	3.6	N
Thiram	137268	62	N
Toluene	108883	3200	N
Toluene-2,4-diamine	95807	0.15	C
Toluene-2,6-diamine	823405	2400	N
p-Toluidine	106490	2.6	C
Toxaphene	8001352	0.44	C
1,1,2-Trichloro-1,2,2-trifluoroethane	76131	460000	N
1,2,4-Trichlorobenzene	120821	130	N
1,1,1-Trichloroethane	71556	126	N
1,1,2-Trichloroethane *	79005	0.84	C
Trichloroethylene (TCE)*	79016	2.8	C
Trichlorofluoromethane	75694	78	N
2,4,5-Trichlorophenol	95954	1220	N
2,4,6-Trichlorophenol	88062	44	C
2-(2,4,5-Trichlorophenoxy)propionic acid	93721	98	N
2,4,5-Trichlorophenoxyacetic acid	93765	122	N
1,1,2-Trichloropropane	598776	3	N
1,2,3-Trichloropropane *	96184	0.0014	C
1,3,5-Trinitrobenzene	99354	4.2	N
Vanadium	7440622	110	N
Vinyl acetate	108054	86	N
Vinyl chloride	75014	0.15	C
Xylene (mixed)	1330207	280	N
Zinc	7440666	4600	N
Zinc phosphide	1314847	4.6	N

1 - Adapted from USEPA Region IX, 2000 Preliminary Remediation Goal Table, except as noted.
2 - The RG is based on USEPA guidance on lead cleanup levels.
3 - The RG is based on USEPA policy for cleanup of PCBs at Superfund Sites. The Branch is currently reviewing the PCB remediation goal policy and may issue further guidance at a later date.
C - The RG is based on the carcinogenic endpoint and corresponds to an excess lifetime cancer risk of 1 in 1,000,000.
N - The RG is based on the non-carcinogenic endpoint and corresponds to a hazard quotient of 0.2.
NA - Not Available.

Table 4-2: Groundwater Remediation Goals

For each contaminant the lower of the 15A NCAC 2L standard or interim standard, the USEPA non-zero MCLG, or the USEPA MCL was retained as the remediation goal. All RG's unless otherwise specified by footnotes are the 15A NCAC 2L standard or interim standard. Cleanup below method detection limits, using analytical methods prescribed in these guidelines, is not required.

Chemical	*CASRN*	*RG (ppb)*
Acenaphthene	83329	80
Acenaphthylene	208968	210
Acetone	67641	700
Acrylamide	79061	0.01
Anthracene	120127	2100
Antimony[1]	7440360	6
Arsenic	7440382	50
Barium	7440393	2000
Benzene	71432	1
Benzoic acid	65850	28000
Benzo(a)anthracene	56553	0.05
Benzo(b)fluoranthene	205992	0.047
Benzo(k)fluoranthene	207089	0.47
Benzo(g,h,i)perylene	191242	210
Benzo(a)pyrene	50328	0.0047
Beryllium[1]	7440417	4
Bis(2-chloroethyl)ether	111444	0.031
Bis(2-ethylhexyl)phthalate	117817	3
Bromodichloromethane	75274	0.6
Bromoform	75252	0.19
n-Butylbenzene	104518	70
sec-Butylbenzene	135988	70
tert-Butylbenzene	980606	70
Butyl benzyl phthalate	85687	100
Cadmium	7440439	5
Caprolactam	105602	3500
Carbon disulfide	75150	700
Carbofuran	1563662	36
Carbon tetrachloride	56235	0.3
Chlordane	57749	0.027
Chlorobenzene	108907	50
Chloroethane	75003	2800
Chloroform	67663	0.19

Table 4-2: Groundwater Remediation Goals - (Cont.)

For each contaminant the lower of the 15A NCAC 2L standard or interim standard, the USEPA non-zero MCLG, or the USEPA MCL was retained as the remediation goal. All RG's unless otherwise specified by footnotes are the 15A NCAC 2L standard or interim standard. Cleanup below method detection limits, using analytical methods prescribed in these guidelines, is not required.

Chemical	CASRN	RG (ppb)
Chloromethane	74873	2.6
2-Chlorophenol	95578	0.1
2-Chlorotoluene	95498	140
Chromium	744073	50
Chrysene	218019	5
Copper	7440508	1000
Cyanide	57125	154
Dibenz(a,h)anthracene	537030	0.0047
Dibenzofuran	132649	28
1,2-Dibromo-3-chloropropane	96128	0.025
Dibromochloromethane	124481	0.41
ortho-Dichlorobenzene (1,2-Dichlorobenzene)[1]	95501	620
meta-Dichlorobenzene (1,3-Dichlorobenzene)	541731	620
para-Dichlorobenzene (1,4-Dichlorobenzene)	106467	75
p,p'-Dichlorodiphenyl Dichloroethane (DDD)	73548	0.14
p,p"-Dichlorodiphenyltrchloroethane (DDT)	500293	0.1
Dichlorodifluoromethane (Freon-12)	75718	1400
1,1-Dichloroethane	75343	700
1,2-Dichloroethane	107062	0.38
1,1-Dichloroethylene	75354	7
cis-1,2-Dichloroethylene	156902	70
trans-1,2-Dichloroethylene	156605	70
2,4-Dichlorophenoxy-acetic-acid (2,4-D)	94757	70
1,2-Dichloropropane	78875	0.56
1,3-Dichloropropene	542756	0.2
Dieldrin	60571	0.0022
2,4-Dimethylphenol	105679	140
Disulfoton	298044	0.28
Diethyl phthalate	84662	5000
Di-n-butyl phthalate	84742	700
Diquat[1]	85007	. 20
para-Dioxane	123911	7
2,3,7,8-tetrachlorodibenzo-p-Dioxin (2,3,7,8-TCDD)	1746016	2.2×10^{-7}

Table 4-2: Groundwater Remediation Goals - (Cont.)

For each contaminant the lower of the 15A NCAC 2L standard or interim standard, the USEPA non-zero MCLG, or the USEPA MCL was retained as the remediation goal. All RG's unless otherwise specified by footnotes are the 15A NCAC 2L standard or interim standard. Cleanup below method detection limits, using analytical methods prescribed in these guidelines, is not required.

Chemical	CASRN	RG (ppb)
Diphenyl	92524	350
Endosulfan II (beta-endosulfan)	115297	42
Endrin	72208	2
Ethyl acetate	141786	2600
Ethlylbenzene	100414	29
Ethylene dibromide	106934	0.0004
Ethylene glycol	N/A	7000
Fluoranthene	206440	280
Fluorene	86737	280
Heptachlor	76448	0.008
Heptachlor epoxide	1024573	0.004
Hexachlorobenzene	118741	0.02
Hexachlorobutadiene	87683	0.44
Hexachlorocyclohexane Isomers (total Hexachlorohexane: includes alpha, beta, delta, gamma, and epsilon isomer)	608731	0.019
Hexachlorocyclopentadiene[1]	608731	50
2-Hexanone	591786	280
Indeno(1,2,3-cd)pyrene	193395	0.047
Isophorone	78591	36.8
Isopropyl benzene	98828	70
Isopropyl ether	108203	70
Lead	7439921	15
Lindane	58899	0.2
Mercury	7439976	1.1
Methanol	67561	3500
Methoxychlor	72435	35
Methyl ethyl ketone	78933	170
Methylene chloride	75092	5
2-Methylnaphthalene	91576	28
3-Methylphenol (m-cresol)	108394	35
4-Methylphenol (p-cresol)	106445	3.5
Napthalene	91203	21
Nickel	7440020	100

Table 4-2: Groundwater Remediation Goals - (Cont.)

For each contaminant the lower of the 15A NCAC 2L standard or interim standard, the USEPA non -zero MCLG, or the USEPA MCL was retained as the remediation goal. All RG's unless otherwise specified by footnotes are the 15A NCAC 2L standard or interim standard. Cleanup below method detection limits, using analytical methods prescribed in these guidelines, is not required.

Chemical	CASRN	RG (ppb)
N-Nitrosodimethylamine	62759	0.0007
Pentachlorophenol	87865	0.3
Phenanthrene	85018	210
Phenol	108952	300
Phorate	298022	1.4
PCBs[1]	1336363	0.5
N-Propylbenzene	103651	70
Pyrene	129000	210
Selenium	7782492	50
Silver	7440224	18
Simazine[1]	122349	3.5
Styrene	100425	100
2,4,5-TP[1]	93765	50
1,1,2,2-Tetrachloroethane	79345	0.17
Tetrachloroethylene	127184	0.7
2,3,4,6-Tetrachlorophenol	58902	210
Thallium	7440280	2
Toluene	108883	1000
Toxaphene	8001352	0.031
1,2,4-Trichlorobenzene	120821	70
1,1,1-Trichloroethane	71556	200
1,1,2-Trichloroethane[1]	79005	5
Trichloroethylene	79016	2.8
1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113)	76131	210
Trichlorofluoromethane	75694	2100
1,2,3-Trichloropropane	96184	0.005
1,2,4-Trimethylbenzene	95636	350
1,3,5-Trimethylbenzene	108678	350
Vinyl chloride	75014	0.015
Xylenes	1320000	530
Zinc	1310000	2100

1 - USEPA MCL

Ref. 14

AUG 25 1993

Brown & Root Environmental

800 Oak Ridge Turnpike, A-400
Oak Ridge, TN 37830

93-A648

August 18, 1993

Mr. Steve Zbur
Senior Project Manager
Delta Environmental Consultants, Inc.
6701 Carmel Road
Suite 200
Charlotte, North Carolina 28226-3801

Subject: Final Report
Delta Project No. 50-92-105.15
Brown & Root Project No. NG60
Preliminary Environmental Sampling
Speico Facility
Lansing, North Carolina

Dear Steve:

Brown & Root Environmental appreciates the opportunity to work with Delta Environmental Consultants on the above referenced project.

This report contains a description of the activities and the methods used to complete the scope of work. In addition, the results of the sludge soundings and water depth measurements are included. We have forwarded this part of the final report before the lab results are available so that Delta can proceed with the volume calculations and closure plans. The lab report will be provided as soon as possible.

Brown & Root Environmental looks forward to working with Delta Environmental Consultants on the closure of the lagoons located at the Lansing, NC facility. If you have any questions about this report or any of the information it contains, please feel free to call either myself or Dan Bowser at our Oak Ridge, Tennessee office at (615) 483-9900.

Sincerely,

Daniel A Bowser for:

Swaine Skean
Project Manager

SS:ymh

cc: Mr. Daniel A. Bowser
File NG60/db

On August 11, 1993, Brown & Root Environmental (B&RE) entered into a subcontract with Delta Environmental Consultants, Inc. (Delta). This contract detailed the collection of water samples and depth soundings of bottom sediments (sludge) contained in a lagoon located at the United Chemi-Con Manufacturing facility in Lansing, North Carolina. This lagoon had been used by Sprague Electric Company for approximately forty years as a settling pond to store and reclaim aluminum oxide sludge generated by their plant processes.

The scope of work contained in the above referenced contract included the following:

- Mobilization of a two man crew and equipment;
- Collection of grab samples from each lagoon and submit them to an approved lab for analysis as detailed in Delta's RFP;
- Perform sludge soundings and water level measurements;
- Prepare and submit to Delta a final report including the results of the lab analysis and the sludge soundings.

B&RE representatives mobilized on August 12, 1993. Upon arrival at the site, it was discovered that only three of the lagoons (nos. 2, 6 & 7) contained water. These lagoons were sampled based on methods contained in the EPA's Compendium of Superfund Field Operations Methods. The water samples were collected from a boat at sample points designated by Delta . The samples were packaged as per lab and B&RE protocol, preserved at approximately 4°C. and forwarded to the lab for analysis. The water contained in lagoons 2 and 6 was observed to be a bright green color while water from number 7 was dark brown. The water depth measurements are shown in Table I. Please note that the entries for lagoon number 2 indicate an absence of water. While there was a small volume of water present in the lagoon, none of the designated sample points fell within the pool. The water in this lagoon measured <= six inches and covered an area of approximately 10' x 25'.

The sludge soundings and water depth measurements were performed by using clear pvc pipe to collect an undisturbed sample of the bottom sludge. The clear pvc tube was advanced into the clay liner of the lagoons to a depth of approximately six inches. This formed a clay plug in the tube, trapping the sludge sample above it and allowing retrieval of the sample. The sludge depth was then determined by direct measurement of the sample. The water level was measured by marking the top of the water surface level and measuring down to the top of the sludge sample. At the same time, the samples were visually examined for stratification. It was noted that in several locations in the upper lagoons (#'s 1,2,3,4&5) there appeared to exist a 3"-5" layer of silty clay. The sludge contained in the lower two lagoons, no. 6 and no. 7, was distinctly different in texture and color than the sludge in the other lagoons. The sludge was observed to be black in color and of less consistency. The sludge sounding values are also recorded in Table I.

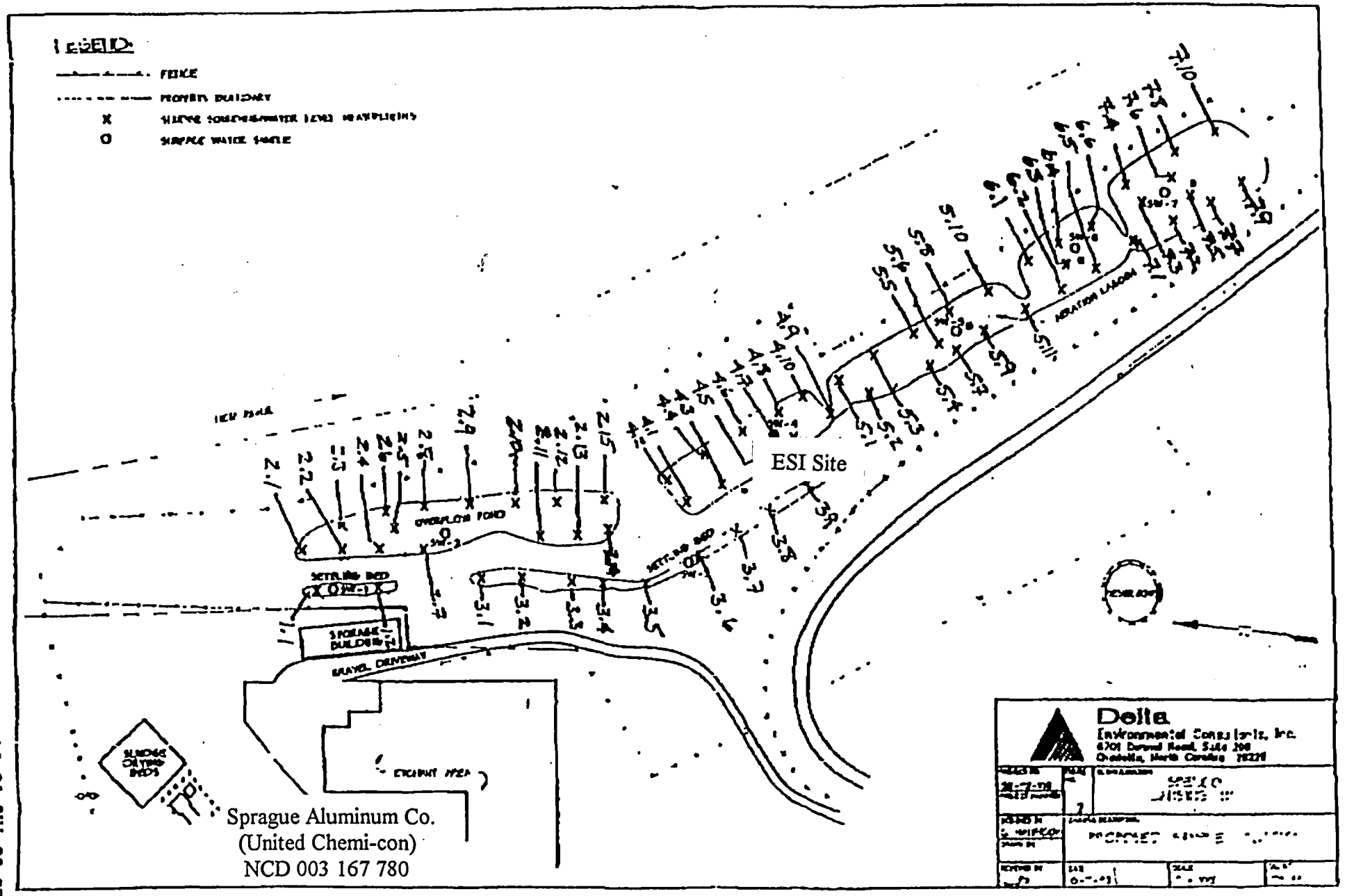

LEGEND
FENCE
PROPERTY BOUNDARY
SURFACE WATER SAMPLE
ESI Site
OVERFLOW POND
SETTLING BED
STORAGE BUILDING
GRAVEL DRIVEWAY
ENTRANCE AREA
Sprague Aluminum Co.
(United Chemi-con)
NCD 003 167 780
Delta
Environmental Consultants, Inc.

TABLE I

LOCATION	SLUDGE DEPTH	WATER DEPTH
1.1	48	0
1.2	31	0
2.1	43	0
2.2	54	0
2.3	14	0
2.4	45	0
2.5	27	0
2.6	22	0
2.7	18	0
2.8	27	0
2.9	12	0
2.10	6	0
2.11	12	0
2.12	16	0
2.13	19	0
2.14	13	0
2.15	20	0
3.1	30	0
3.2	27	0
3.3	18	0
3.4	24	0
3.5	46	0
3.6	32	0
3.7	23	0
3.8	18	0
3.9	38	0

LOCATION	SLUDGE DEPTH	WATER DEPTH
4.1	40	0
4.2	57	0
4.3	48	0
4.4	70	0
4.5	45	0
4.6	48	0
4.7	87	0
4.8	68	0
4.9	93	0
4.10	63	0
5.1	106	0
5.2	91	0
5.3	27	0
5.4	103	0
5.5	91	0
5.6	90	0
5.7	45	0
5.8	91	0
5.9	83	0
5.10	77	0
5.11	41	0
6.1	16	42
6.2	12	49
6.3	11	52
6.4	11	54
6.5	13	52
6.6	8	47
7.1	10	72
7.2	10	77
7.3	12	84
7.4	13	96
7.5	12	90
7.6	13	95
7.7	12	97
7.8	13	91
7.9	12	94
7.10	12	88

All depth measurements are recorded in inches

Brown & Root Environmental

[illegible] Oak Ridge Turnpike, A-[illegible]
Oak Ridge, TN 37830

93-A682

September 17, 1993

Delta Environmental Consultants, Inc.
6701 Carmel Road
Suite 200
Charlotte, North Carolina 28226-3901

Attention: Mr. Steve Zbor, P.G.
Senior Project Manager

Subject: Final Deliverable
Delta Project No. 50-92-105.15
Brown & Root Project No. NG60
Preliminary Environmental Sampling
Spelco Facility
Lansing, North Carolina

Dear Steve:

Please find enclosed the hard copy analytical results of the samples collected during the sampling event conducted at Spelco's Lansing, North Carolina facility on August 12, 1993.

This constitutes the final deliverable associated with the above referenced statement of work. The invoice for this project will be processed at this time and forwarded to you during the next billing cycle.

Brown & Root Environmental looks forward to working with Delta Environmental Consultants on this and any other future projects. If you have any questions about this report or any of the information it contains, please feel free to call either myself or Dan Bowser at our Oak Ridge, Tennessee office at (615) 483-9900.

Sincerely,

Swaine Skeen
Project Manager

SS:yma

Enclosure

cc: Mr. Daniel A. Bowser, Halliburton NUS
Ms. Chris Savin, Halliburton NUS
File NG60/Cat 2.4/db

ENVIRONMENTAL TESTING & CONSULTING, INC.
2924 Walnut Grove Road • Memphis, TN 38111 • (901) 327-2750 • FAX (901) 327-6334
Founded 1972

August 30, 1993

Mr. Swaine Skeen
Brown & Root Environmental
800 Oak Ridge Turnpike
Jackson Plaza A-600
Oak Ridge, TN 37830

REF: ANALYTICAL TESTING
SAMPLE DATE: 08/12/93
SITE ID: DELTA/SPELCO - LANSING, NC
SAMPLE ID: #2, 6, 7 POND/SURFACE SAMPLES (AQUEOUS)

Dear Mr. Skeen:

The above referenced site has been analyzed per your instructions. The tests were performed in our laboratory (#02027) in accordance with Standard Methods, 17th Edition and the Solid Waste Manual, SW-846. The results are shown below and on the attached Organic Analysis Data Sheets

Test	Composite of 2,6,7 Results (ppm)	Method Number	Date Analyzed	By
pH	6.6	4500-B	08/13/93	SH
Biochemical Oxygen Demand$_5$	21	5210-B	08/13/93	LM
Total Suspended Solids	36	2540-D	08/18/93	TG
Chemical Oxygen Demand	114	5220-B	08/23/93	LM
Dissolved Oxygen	10.5	4500-G	08/13/93	LM
Aluminum	2.41	3111-D	08/26/93	BB
Arsenic	<0.002	3114-B	08/17/93	JF
Barium	<0.03	3111-D	08/26/93	BB
Cadmium	<0.002	3111-B	08/25/93	BB
Chromium	<0.02	3111-B	08/25/93	BB
Lead	<0.05	3111-B	08/25/93	BB
Mercury	<0.001	3112-B	08/17/93	SH
Selenium	<0.002	3114-B	08/17/93	JF
Silver	<0.01	3111-B	08/26/93	BB

Please call our office if you have any questions.

Sincerely,

Randall H. Thomas
Vice President

jw

13-005

ENVIRONMENTAL TESTING & CONSULTING, INC.
2924 Walnut Grove Road • Memphis, TN 38111 • (901) 327-2750 • FAX (901) 327-6334
Founded 1972

September 8, 1993

Mr. Swaine Skeen
Brown & Root Environmental
800 Oak Ridge Turnpike
Jackson Plaza A-600
Oak Ridge, TN 37830

REF: ANALYTICAL TESTING
SAMPLE DATE: 08/12/93
SITE ID: DELTA/SPELCO - LANSING, NC
SAMPLE ID: #2, 6, 7 POND/SURFACE SAMPLES (AQUEOUS)

Dear Mr. Skeen:

Due to instrumentation problems the above referenced site was screened by Method 8010/8020 and quantitated by Method 8240.

Please call our office if you have any questions.

Sincerely,

Michael Kauffman
Laboratory Manager

lb

0813-005

ENVIRONMENTAL TESTING AND CONSULTING, INC.
MEMPHIS, TN
GC/MS FRACTION - VOLATILE COMPOUNDS

CLIENT NAME : BROWN & ROOT ENVIRONMENTAL PROJECT # : _____ DATE ANALYZED : 08/26/93
ANALYST : LS

SITE ID : DELTA/SPELCO-LANSING, N.C.
SAMPLE ID : #2 GRAB
SAMPLE DATE : 08/12/93 FILE NAME : 0813-005.DOC
DATE ARRIVED : 08/13/93 SAMPLE # : 0813-005-4 METHOD (SW-846) : 8240
MATRIX : AQUEOUS

COMPOUND	SAMPLE RESULTS UNITS:(ppb)	PQL :(ppb)
Benzene	ND	5
Bromodichloromethane	ND	5
Bromoform	ND	5
Bromomethane	ND	5
Carbon Tetrachloride	ND	5
Chlorobenzene	ND	5
Chlorodibromomethane	ND	5
Chloroethane	ND	5
2-Chloroethyl vinyl ether	ND	50
Chloroform	ND	5
Chloromethane	ND	5
1,2-Dichlorobenzene	ND	5
1,3-Dichlorobenzene	ND	5
1,4-Dichlorobenzene	ND	5
Dichlorodifluoromethane	ND	5
1,1-Dichloroethane	ND	5
1,2-Dichloroethane	ND	5
1,1-Dichloroethene	ND	5
trans-1,2-Dichloroethene	ND	5
1,2-Dichloropropane	ND	5
cis-1,3-Dichloropropene	ND	5
trans-1,3-Dichloropropene	ND	5
Ethylbenzene	ND	5
Methylene Chloride	ND	15
1,1,2,2-Tetrachloroethane	ND	5
Tetrachloroethene	ND	5
Toluene	ND	5
1,1,1-Trichloroethane	ND	5
1,1,2-Trichloroethane	ND	5
Trichloroethene	ND	5
Trichlorofluoromethane	ND	5
Vinyl Chloride	ND	5
Xylenes	ND	5

SURROGATE	RESULT	EXP (ppb)	% REC	QC LIMITS
1,2-Dichloroethane-d4	55.3	50.0	111	76-114
Toluene-d8	54.2	50.0	108	88-110
4-Bromofluorobenzene	56.5	50.0	113	86-115

ND - NOT DETECTED
PQL - PRACTICAL QUANTITATION LIMIT

LABORATORY MANAGER

ENVIRONMENTAL TESTING AND CONSULTING, INC.
MEMPHIS, TN
GC/MS FRACTION - VOLATILE COMPOUNDS

CLIENT NAME : BROWN & ROOT ENVIRONMENTAL
PROJECT # : _____
DATE ANALYZED : 08/26/93
ANALYST : LS

SITE ID : DELTA/SPELCO-LANSING, N.C.
SAMPLE ID : #6 GRAB
SAMPLE DATE : 08/12/93
DATE ARRIVED : 08/13/93
MATRIX : AQUEOUS
FILE NAME : 0813-005.DOC
SAMPLE # : 0813-005-3
METHOD (SW-846) : 8240

COMPOUND	SAMPLE RESULTS UNITS:(ppb)	PQL :(ppb)
Benzene	ND	5
Bromodichloromethane	ND	5
Bromoform	ND	5
Bromomethane	ND	5
Carbon Tetrachloride	ND	5
Chlorobenzene	ND	5
Chlorodibromomethane	ND	5
Chloroethane	ND	5
2-Chloroethyl vinyl ether	ND	50
Chloroform	ND	5
Chloromethane	ND	5
1,2-Dichlorobenzene	ND	5
1,3-Dichlorobenzene	ND	5
1,4-Dichlorobenzene	ND	5
Dichlorodifluoromethane	ND	5
1,1-Dichloroethane	ND	5
1,2-Dichloroethane	ND	5
1,1-Dichloroethene	ND	5
trans-1,2-Dichloroethene	ND	5
1,2-Dichloropropane	ND	5
cis-1,3-Dichloropropene	ND	5
trans-1,3-Dichloropropene	ND	5
Ethylbenzene	ND	5
Methylene Chloride	ND	15
1,1,2,2-Tetrachloroethane	ND	5
Tetrachloroethene	ND	5
Toluene	ND	5
1,1,1-Trichloroethane	ND	5
1,1,2-Trichloroethane	ND	5
Trichloroethene	ND	5
Trichlorofluoromethane	ND	5
Vinyl Chloride	ND	5
Xylenes	ND	5

SURROGATE	RESULT	EXP (ppb)	% REC	QC LIMITS
1,2-Dichloroethane-d4	54.2	50.0	108	76-114
Toluene-d8	54.0	50.0	108	88-110
4-Bromofluorobenzene	56.6	50.0	113	86-115

ND - NOT DETECTED
PQL - PRACTICAL QUANTITATION LIMIT

LABORATORY MANAGER

ENVIRONMENTAL TESTING AND CONSULTING, INC.
MEMPHIS, TN
GC/MS FRACTION - VOLATILE COMPOUNDS

CLIENT NAME : BROWN & ROOT ENVIRONMENTAL
PROJECT # : _____
DATE ANALYZED : 08/26/93
ANALYST : JS

SITE ID : DELTA/SPELCO-LANSING, N.C.
SAMPLE ID : #7 GRAB
SAMPLE DATE : 08/12/93
DATE ARRIVED : 08/13/93
MATRIX : AQUEOUS
FILE NAME : 0813-005.DOC
SAMPLE # : 0813-005-7
METHOD (SW-846) : 8240

COMPOUND	SAMPLE RESULTS UNITS:(ppb)	PQL :(ppb)
Benzene	ND	5
Bromodichloromethane	ND	5
Bromoform	ND	5
Bromomethane	ND	5
Carbon Tetrachloride	ND	5
Chlorobenzene	ND	5
Chlorodibromomethane	ND	5
Chloroethane	ND	5
2-Chloroethyl vinyl ether	ND	50
Chloroform	ND	5
Chloromethane	ND	5
1,2-Dichlorobenzene	ND	5
1,3-Dichlorobenzene	ND	5
1,4-Dichlorobenzene	ND	5
Dichlorodifluoromethane	ND	5
1,1-Dichloroethane	ND	5
1,2-Dichloroethane	ND	5
1,1-Dichloroethane	ND	5
trans-1,2-Dichloroethene	ND	5
1,2-Dichloropropane	ND	5
cis-1,3-Dichloropropene	ND	5
trans-1,3-Dichloropropene	ND	5
Ethylbenzene	ND	5
Methylene Chloride	ND	15
1,1,2,2-Tetrachloroethane	ND	5
Tetrachloroethene	ND	5
Toluene	ND	5
1,1,1-Trichloroethane	ND	5
1,1,2-Trichloroethane	ND	5
Trichloroethene	ND	5
Trichlorofluoromethane	ND	5
Vinyl Chloride	ND	5
Xylenes	ND	5

SURROGATE	RESULT	EXP (ppb)	% REC	QC LIMITS
1,2-Dichloroethane-d4	53.3	50.0	107	76-114
Toluene-d8	53.8	50.0	108	88-110
4-Bromofluorobenzene	55.7	50.0	111	86-115

ND - NOT DETECTED
PQL - PRACTICAL QUANTITATION LIMIT

LABORATORY MANAGER

ENVIRONMENTAL TESTING AND CONSULTING, INC.
MEMPHIS, TN
GC/MS FRACTION - VOLATILE COMPOUNDS

CLIENT NAME : BROWN & ROOT ENVIRONMENTAL
PROJECT # : _____
DATE ANALYZED : 08/26/93
ANALYST : LS

SITE ID : DELTA/SPELCO-LANSING, N.C.
SAMPLE ID : COMPOSITE OF #7, #6, & #2
SAMPLE DATE : 08/12/93
DATE ARRIVED : 08/13/93
MATRIX : AQUEOUS
FILE NAME : 0813-005.DOC
SAMPLE # : 0813-005-1
METHOD (SW-846) : 8240

COMPOUND	SAMPLE RESULTS UNITS:(ppb)	PQL :(ppb)
Benzene	ND	5
Bromodichloromethane	ND	5
Bromoform	ND	5
Bromomethane	ND	5
Carbon Tetrachloride	ND	5
Chlorobenzene	ND	5
Chlorodibromomethane	ND	5
Chloroethane	ND	5
2-Chloroethyl vinyl ether	ND	50
Chloroform	ND	5
Chloromethane	ND	5
1,2-Dichlorobenzene	ND	5
1,3-Dichlorobenzene	ND	5
1,4-Dichlorobenzene	ND	5
Dichlorodifluoromethane	ND	5
1,1-Dichloroethane	ND	5
1,2-Dichloroethane	ND	5
1,1-Dichloroethene	ND	5
trans-1,2-Dichloroethene	ND	5
1,2-Dichloropropane	ND	5
cis-1,3-Dichloropropene	ND	5
trans-1,3-Dichloropropene	ND	5
Ethylbenzene	ND	5
Methylene Chloride	ND	15
1,1,2,2-Tetrachloroethane	ND	5
Tetrachloroethene	ND	5
Toluene	ND	5
1,1,1-Trichloroethane	ND	5
1,1,2-Trichloroethane	ND	5
Trichloroethene	ND	5
Trichlorofluoromethane	ND	5
Vinyl Chloride	ND	5
Xylenes	ND	5

SURROGATE	RESULT	EXP (ppb)	% REC	QC LIMITS
1,2-Dichloroethane-d4	54.4	50.0	109	76-114
Toluene-d8	52.8	50.0	106	88-110
4-Bromofluorobenzene	55.8	50.0	112	86-115

ND - NOT DETECTED
PQL - PRACTICAL QUANTITATION LIMIT

[signature]
SR. MANAGER

DATE REPORT ACCEPTED 12/9/92
DISPOSITION ESI - 1 Ref. 15 rity
SAM SIGNATURE Craig A. Benedict

FINAL
SITE INSPECTION PRIORITIZATION

RECEIVED
MAY 17 1993
SUPERFUND SECTION
NOV 06 1992

Sprague Electric Company
Lansing, Ashe County, North Carolina

EPA ID Nº NCD003167780
WasteLAN Nº 02619

Prepared under
EPA Contract Nº 68-W9-0055

CERCLA

Prepared for
WASTE MANAGEMENT DIVISION
U.S. Environmental Protection Agency

Prepared by
B&V Waste Science and Technology Corp
BVWST Project Nº 52012.070

October 21, 1992

Prepared by:	Reviewed by:	Approved by:
Victor Blix	Tancie Hatcher for	
Victor Blix	Bryan Williams	Hubert Wieland
Site Manager	Technical Reviewer	Project Manager

FINAL
SITE INSPECTION PRIORITIZATION
Sprague Electric Company
Lansing, Ashe County, North Carolina
NCD003167780
WasteLAN № 02619

TABLE OF CONTENTS

Page №

1.0 Introduction 1

2.0 Site Description and History 1

3.0 Groundwater Pathway 4

3.1 Hydrogeologic Setting 4

3.2 Groundwater Targets 5

4.0 Surface Water Pathway 6

5.0 Air and Soil Exposure Pathway 6

6.0 Conclusion 7

TABLES — Following Page №

Table 1 Surface Soil Samples 4
Table 2 Subsurface Soil Samples 4
Table 3 Surface Soil Samples 4
Table 4 Sediment Samples 4

FIGURES — Following Page №

Figure 1 Site Location Map 1
Figure 2 Site Layout Map 3
Figure 3 Sample Location Map 4

SITE ASSESSMENT

Final Site Inspection Prioritization

Sprague Electric Company

Lansing, Ashe County, North Carolina

NCD003167780

WasteLAN № 02619

1.0 Introduction

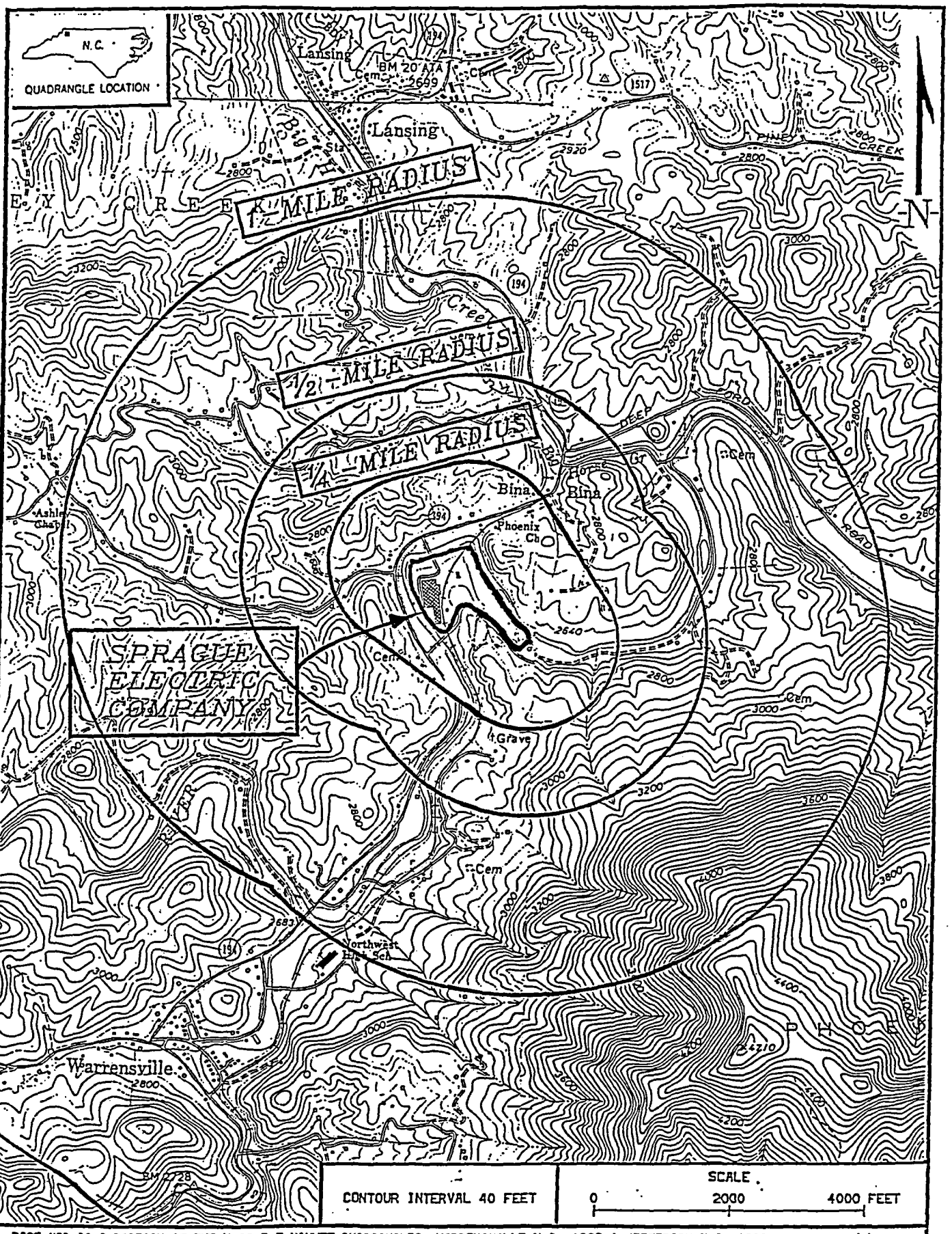
B&V Waste Science and Technology was tasked to conduct a Site Investigation Prioritization (SIP) for the Sprague Electric Company in Lansing, Ashe County, North Carolina. This study was performed under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA).

The SIP will update the Site Inspection conducted by the Halliburton NUS Environmental Corporation on September 6, 1991, which was performed prior to the implementation of the revised Hazard Ranking System. Sources of information used in this evaluation include EPA CERCLA file material, as well as documentation generated during a target survey. The SIP will quantify the threats posed by the site and provide sufficient documentation in order to decide on the appropriate future course of action.

2.0 Site Description and History

The Sprague Electric Company, located in Lansing, Ashe County, North Carolina, occupies approximately 60 acres of land located off of Highway 194 approximately 1.25 miles south of Lansing (Figure 1). The facility has been in operation since 1953 and is the only known industry that has ever occupied the site (Refs. 1, p. 3; 2, 3).

The only known operation conducted at the facility involved the manufacture of aluminum electrolytic capacitors. The manufacturing process used involves the etching of aluminum foil in an electrochemical bath. Aluminum oxides formed in the process are recovered from a wastewater treatment system. Waste dimethylformamide (DMF) was also used in the process (Refs. 2, 3). Available information



BASE MAP IS A PORTION OF THE USGS 7.5 MINUTE QUADRANGLES, WARRENSVILLE N.C. 1966 & JEFFERSON N.C. 1968.

SITE LOCATION MAP
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

FIGURE 1

indicates that wastes were handled in essentially the same manner since operations commenced (Ref. 3).

On November 17, 1980, Sprague Electric Company filed a RCRA Part A Hazardous Waste Permit Application for treatment of wastes. According to the application, the facilities operations resulted in a discharge to U.S. waters. In addition, 250,000,000 pounds of corrosive waste (D002) were treated per year at the facility (Ref. 4). According to a letter to the U.S. Environmental Protection Agency (USEPA) at the time of filing, Sprague Electric Company officials were in doubt as to whether or not the Lansing plant was a waste treatment, storage, or disposal facility under the Resource Conservation and Recovery Act, and that the application was submitted as a precaution in case this location was such a facility (Ref. 5). Sprague Electric Company was advised by the USEPA on December 16, 1981 that they acknowledged receipt of Sprague's request for withdrawal of their application under RCRA (Ref. 6). On March 4, 1982, the North Carolina Solid and Hazardous Waste Management Branch (NCHWMB) accepted Sprague's request for deletion as a treatment, storage, or disposal facility of hazardous waste under RCRA (Ref. 7). On July 1, 1983, Sprague was also deleted as a large quantity generator of hazardous waste under RCRA (Ref. 8). According to a March 13, 1984 letter, Sprague was advised by NCHWMB that their interim status was formally terminated. This was in response to a November 14, 1983, letter in which Sprague advised the NCHWBM that a Part B application for the facility would not be filed (Ref. 9). The facility is currently listed by RCRA as a small-quantity generator (Ref. 10).

The facility has been actively engaged in the manufacturing of aluminum electrolytic capacitors (Refs. 2, 3). Raw materials used in the production process include aluminum foil, nitric acid, tartaric acid, sodium hydroxide, calcium hydroxide, sodium chloride, sulfuric acid, and dimethylformamide (DMF) (Refs. 2, 3). A wastewater treatment lagoon system was formerly operated on site to allow for the settling and treatment of aluminum oxide wastewaters (Ref. 1, p. 6). Aluminum oxides were formed from a manufacturing process involving the etching of aluminum foil in an electrochemical bath. They were then recovered from the wastewater treatment system by filtering and settling in the lagoon, and then mined and sold (Refs. 2, 3).

Wastewater from this system was not allowed to be discharged to the New River but rather depended upon evaporation and percolation to remove the wastewater (Ref. 11). These lagoons are therefore believed to be unlined and the treatment process has been discontinued (Ref. 1). Non-contact boiler water and wastewater from the sewage treatment plant was discharged into the New River. Both discharges were NPDES permitted (Ref. 11). Waste dimethylformamide (DMF) used in the process is shipped off-site in drums (Ref. 2). Available information indicates that wastes have been handled in essentially the same manner since operations commenced (Ref. 1, p. 6; 3).

The facilities at the Sprague Electric site consist of the main facility building, housing office and warehouse space, assembly and etching operations, and shipping and receiving areas. Adjacent to the facility are paved access roads and parking areas. Areas further away from the facility are grassed and/or landscaped (Ref. 1, p. 6). A wastewater treatment lagoon system, located east of the facility and adjacent to the New River, is no longer in operation (Refs. 1, p. 6; 2, 3; Figure 2). A drum storage area, a tank storage area, and a sewage treatment plant also exist on site (Refs. 1, p. 6; 12, Figure 2). The tank storage area contains two sulfuric acid and two nitric acid storage tanks (Refs. 1, p. 6; 12). Three industrial wells also exist onsite; however, only one of them is currently in use (Refs. 1, p. 6; 12). The facility is enclosed within a 6-foot-high chain-link fence, and access to the property is restricted to a main entrance gate located along the facility's south side (Ref. 12). The site layout is detailed in Figure 2. The surrounding area is primarily a sparsely populated residential and agricultural district. The geographical coordinates are 36°28'48" North Latitude and 81°30'10" West Longitude (Ref. 13). The site is at 2760 feet above mean sea level (amsl)(Ref. 13).

The average annual precipitation for Lansing is 49 inches, and the mean annual lake pan evaporation is 33 inches, yielding a net annual precipitation of 16 inches (Ref. 14, pp. 13, 63). The 2-year, 24-hour rainfall for the area is 2.9 inches (Ref. 15).

The Site Inspection (SI) being updated was completed by the Halliburton NUS Environmental Corporation, on September 6, 1991. During the SI, sixteen surface

soil, subsurface soil, sediment, and surface water samples were collected to determine if contamination was present onsite (Figure 3). Cyanide, calcium, manganese, sodium, and zinc are a few contaminants of concern that can be attributed to the site. Sample results are presented in Tables 1, 2, 3, and 4 (Ref. 1).

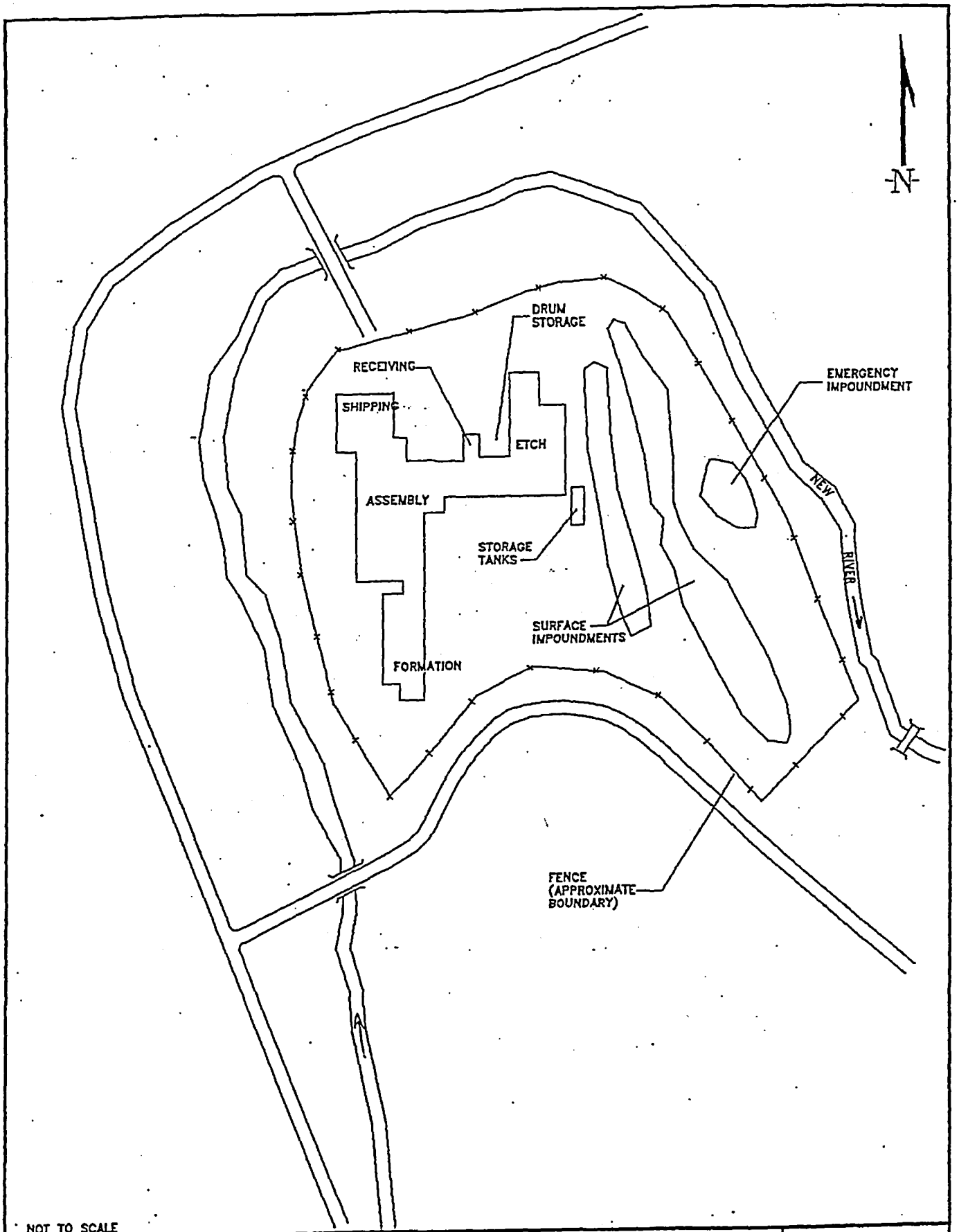
3.0 Groundwater Pathway

3.1 Hydrogeologic Setting

The Sprague Electric Company is located in the Blue Ridge Physiographic Province. This region is characterized by a thick layer of residual soil and weathered rock overlying fractured crystalline and metamorphosed sedimentary and metamorphosed granitic rocks (Refs. 16, 17). Locally, the area of the site is underlain by residual soils ranging from 25 to 36 feet thick. The residuum is underlain by blue and white metamorphosed granite rocks of the Late Proterozoic Era (Ref. 18).

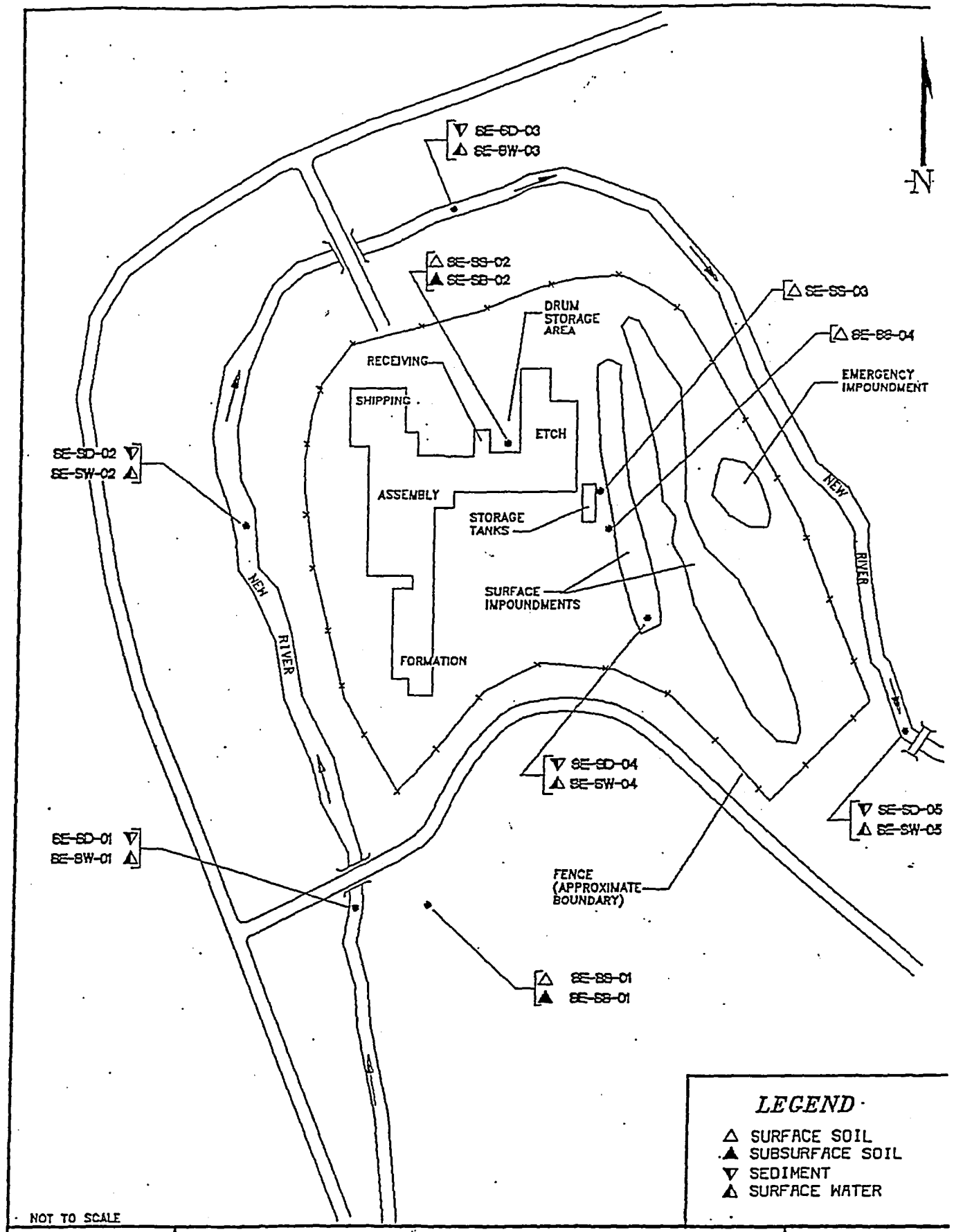
The Sprague Electric Company is located in the Piedmont Blue Ridge groundwater region. The aquifer used in the area is the metamorphosed granite aquifer system (Ref. 18). Two wells drilled in the city of Warrensville, 1.5 miles south of the facility, were 80 and 130 feet deep. The 80-foot deep well reached water at 70 and 75 feet below land surface (bls). The 130-foot deep well reached water at 50 feet bls (Ref. 18). Water levels in the immediate area of the facility are less than 25 feet bls because of its proximity to the New River. The direction of groundwater flow in the local area is north toward the North Fork of the New River (Ref. 13).

Groundwater flows along the fractures in the bedrock and in the intergranular pore spaces of the residual soils. Some igneous dikes are found in the Piedmont region, but these have few fractures and contain little water (Ref. 19). Fractured granite typically has a hydraulic conductivity 1.0×10^{-2} to 1.0×10^{-6} cm/s (Ref. 20). The residual soils and bedrock are hydraulically interconnected (Ref. 17). The porosity and the hydraulic conductivity of the soil decreases as depth increases (Ref. 19). The unsaturated zone of the residual soils represents the layer of lowest hydraulic



SITE LAYOUT MAP
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

FIGURE 2



SAMPLE LOCATION MAP
SPRAGUE ELECTRIC COMPANY
LANSING, ASHE COUNTY, NORTH CAROLINA

FIGURE 3

Table 1
Surface Soil Samples
Quantified Analytical Data
Sprague Electric Company
Lansing, Ashe County, North Carolina

Parameters	SE–SS–01 (mg/kg)	SE–SS–02 (mg/kg)	SE–SS–03 (mg/kg)	SE–SS–04 (mg/kg)
Inorganic Compounds and/or Elements	Background	Drum Storage Area	Storage Tank Area	Near Surface Impoundments
Cadmium	1.1U	2.4	–	–
Lead	13J	33J	14J	40J
Manganese	590U	650	1,300	700
Mercury	0.13U	0.40J	–	–
Nickel	35	190	35	38
Zinc	76	260	68	86
Cyanide	0.66U	–	0.86	0.89
Pesticide/PCB Compounds	**(ug/kg)**	**(ug/kg)**	**(ug/kg)**	**(ug/kg)**
4,4'–DDE (P,P'–DDE)	22U	51	–	–

– Material analyzed for but not detected above minimum quantitation limit (MQL).
J Estimated Value
U Material was analyzed for but not detected. The number given is the MQL.
▒ 3 times background or greater than or equal to MQL, CRDL, or CRQL.

Table 2
Subsurface Soil Samples
Quantified Analytical Data
Sprague Electric Company
Lansing, Ashe County, North Carolina

Inorganic Elements	SE-SB-01 (mg/kg)	SE-SB-02 (mg/kg)
	Background	Drum Storage Area
Beryllium	0.53U	1.6

U Material was analyzed for but not detected. The number given is the MQL.
3 times background or greater than or equal to MQL, CRDL, or CRQL.

Table 3
Surface Water Samples
Quantified Analytical Data
Sprague Electric Company
Lansing, Ashe County, North Carolina

Inorganic Elements	SE–SW–01 (ug/l)	SE–SW–02 (ug/l)	SE–SW–03 (ug/l)	SE–SW–04 (ug/l)	SE–SW–05 (ug/l)
	Background	New River West of Site	New River North of Site	Surface Impoundment	Downstream of Site
Barium	20U	–	18	–	28
Calcium	3,500	3,300	4,500	11,000	4,500
Copper	4U	29	–	–	–
Iron	190U	–	–	–	800
Manganese	20U	–	–	120	100
Potassium	1,100U	–	1,300	–	1,600
Sodium	2,500U	13,000	–	47,000	3,400
Zinc	6U	43	–	–	–

– Material analyzed for but not detected above minimum quantitation limit (MQL).
U Material was analyzed for but not detected. The number given is the MQL.
▒ 3 times background or greater than or equal to MQL, CRDL, or CRQL.

Table 4
Sediment Samples
Quantified Analytical Data
Sprague Electric Company
Lansing, Ashe County, North Carolina

Inorganic Compounds and/or Elements	SS-SD-01 (mg/kg)	SS-SD-04 (mg/kg)
	Background	Surface Impoundment
Aluminum	37,000	290,000
Mercury	0.18U	0.80J
Sodium	360U	9,100
Cyanide	0.91U	1.7

– Material analyzed for but not detected above minimum quantitation limit (MQL).
J Estimated Value
U Material was analyzed for but not detected. The number given is the MQL.
▒ 3 times background or greater than or equal to MQL, CRDL, or CRQL.

conductivity. Soils of this type have been shown to have hydraulic conductivities that range between 1 x 10^{-3} cm/sec and 1 x 10^{-5} cm/sec (Ref. 20).

3.2 Groundwater Targets

Residents in the 4-mile radius of the Sprague Electric site obtain potable water from two municipal systems and from private wells. The Lansing Water System serves 65 connections from two wells located approximately 1.5 miles north of the facility (Ref. 21, p. 5, 6). These wells serve approximately 161 people within the Lansing corporate boundary (Refs. 21, p. 5, 6; 23). There are no known private wells in the Lansing city limits (Refs. 13, 21, p. 5, 6).

The Jefferson Water Department well system serves 535 connections in the Jefferson area. There are seven wells in this system. Only one of these wells, however, is situated within the 4-mile radius and is located 3.9 miles southeast of the facility. The portion of the Jefferson wellfield within 4 miles of the site provides potable water to approximately 190 people (Refs. 13, 21, p. 6-8; 23). Wells in the Jefferson Water System may potentially serve more than the listed number of persons because the entire system is blended. Although it is probable that there are some private wells located within the Jefferson Water Department service area, all residences have access to municipal water (Ref. 21, p. 6-8).

Residences not served by municipal systems are assumed to obtain their potable water from private wells. Based on estimates made from available topographic maps in conjunction with municipal water service data, approximately 2,617 persons within 4 miles of the facility are served by private wells. The closest of these lies approximately 500 feet west of the facility (Refs. 13, 21, p. 5-8).

4.0 Surface Water Pathway

Surface water run-off from the site migrates north, east, and west into the North Fork of the New River located adjacent to the facility. The 15-mile surface water pathway expires in the New River. The average flow for the North Fork of the New River is 259 cfs (Ref. 23). There are no surface water intakes used for potable purposes along the surface water migration pathway (Ref. 13, 24).

Sensitive environments found within a 4-mile radius of the site include the ranges of several federally endangered and threatened species, or species whose status is under review. These are the Bog turtle and the Riffle beetle (Ref. 25). Recreational fishing occurs in the North Fork of the New River (Ref. 26). In addition, no wetlands were identified along the surface water pathway, nor within a 0.5 mile radius of the site (Ref. 13).

5.0 Air and Soil Exposure Pathways

The Sprague Electric Company is comprised of the main facility building, housing office and warehouse space, assembly and etching operations, as well as shipping and receiving areas. Areas adjacent to the facility are paved access roads and parking areas, while areas further away from the facility are comprised of grassy areas. Additionally, a wastewater treatment lagoon system located east of the facility and adjacent to the New River was constructed to allow for the settling of aluminum oxides. This system is no longer in operation. A drum storage area, a tank storage area, and a sewage treatment plant also exist on site (Refs. 1, 2, 3, 12).

The population within the 4 mile radius of the site is 3,985. The populations within 0-0.25, 0.25-0.5, 0.5-1, 1-2, 2-3, and 3-4 mile radii of the site are 35, 40, 129, 194, 2,106, and 1,481, respectively (Refs. 12, 22, 27). The nearest residence is 300 feet west of the property (Ref. 13). The closest school is 1 mile south-southwest of the site (Ref. 13). Presently, the closest individuals are 525 onsite workers (Ref. 28).

The facility is enclosed within a 6-foot-high chain-link fence, and access to the property is restricted to a main entrance gate located along the facility's south side (Ref. 12).

As mentioned previously, the federally listed endangered and threatened species that are known to inhabit Ashe County include the Bog turtle, Bewick's wren, Regal fritillary, Riffle beetle, Glade spurge, Spreading avens, Mountain bluet, Heller's blazing star, Gray's lily, Carolina saxifrage, and the Virginia spiraea. Additionally, the state listed endangered and threatened species include the Cooper's hawk, Warbling vireo, Rock gnome lichen, Bob rose, Cone-shaped sedge, Robin runaway, Fringed gentian, and the Roseroot (Ref. 25).

6.0 Conclusion

The Sprague Electric Company site was evaluated to assess the threat posed to human health and the environment and to determine the need for additional investigation. From the information gathered in the study of the Sprague Electric Company, further action is recommended. The surface water pathway is the primary concern due to actual contamination of the North Fork of the New River. The North Fork of the New River is documented as a fishery. The groundwater pathway is also a concern at the site due to the number of groundwater users in the area. In addition, the soil exposure pathway is of concern due to the presence of contaminants at or near surface level, and because the ranges of several federally endangered species are found within 4 miles of the site.

8. O.W. Strickland, Head, North Carolina Soild and Hazardous Waste Management Branch, letter to Edward A. Stone, Sprague Electric Company, July 1, 1983. Subject: Notification of facility status change.

9. O.W. Strickland, Head, North Carolina Soild and Hazardous Waste Management Branch, letter to Edward A. Stone, Sprague Electric Company, March 13, 1984. Subject: Sprague Electric Company.

10. North Carolina Department of Human Resources, Solid and Hazardous Waste Management, Alphabetical List of Hazardous Waste Facilities, August 10, 1989. Subject: Sprague Electric Company.

11. Jack Hardin, Sprague Electric Company, Lansing, North Carolina, telephone conversation with Eric Corbin, Halliburton NUS Environmental Corporation, March 14, 1991. Subject: Wastewater discharges.

12. NUS Corporation Field Logbook No. F4-2661 for Sprague Electric Company, TDD No. F4-9010-25. Documentation of Phase II Screening Site Inspection, December 11-12, 1990.

13. U.S. Geological Survey (USGS), 7.5 minute series Topographic Quadrangle Maps of North Carolina: Warrensville 1966, Jefferson 1968, Park 1959 (Photorevised 1978), Grassy Creek 1966 (Photorevised 1978), Scale 1:24,000.

14. U.S. Department of Commerce, Climatic Atlas of the United States, June 1968 (Reprinted 1983).

15. U.S. Department of Commerce, Rainfall Frequency Atlas of the United States, Technical Paper Number 40 (Washington, D.C.: GPO, 1961).

16. Oscar E. Meinzer, The Occurrence of Groundwater in the United States. U. S. Geological Survey Water Supply Paper Nº 489, (Washington, D. C.: GPO, 1023).

17. Linda Aller, et al., DRASTIC: A Standardized System for Evaluating Ground-Water Pollution Using Hydrogeologic Settings. EPA-600/2-87-035 (Ada, Oklahoma: EPA, April 1987), pp. 251, 252.

18. Mrs. Ray Taylor, Taylor Well Drilling, telephone conversation with Brant McCanless, NUS Corporation, March 12, 1990. Subject: Geology and groundwater levels in the Warrensville, North Carolina area.

19. Charles C. Daniel, III and N. Bonar Sharpless, Groundwater Supply Potential and Procedures for Well-Site Selection Upper Cape Fear River Basin, (North Carolina Department of Natural Resources and Community Development, Raleigh, North Carolina, October 1983), pp. 10, 12-15.

20. R. Allen Freeze and John A. Cherry, Groundwater (Englewood Cliffs, N. J.: Prentice-Hall, Inc. 1979), p. 29.

21. NUS Corporation Field Logbook Nº F4-9998 for Sprague Electric Company, TDD Nº F4-9001-132. Documentation of facility reconnaissance, February 12, 1990.

22. U.S. Department of Commerce, Proof Copy of table generated for 1990, Table 6, CPH-1: Summary Population and Housing Characteristics, issued by Bureau of Census, (April 1991).

23. Mike Scoville, North Carolina Environmental Resources, telephone conversation with Victor Blix, B&V Waste Science and Technology Corp., July 20, 1992. Subject: Stream gauge information.

24. Halliburton NUS Enviromental Corporation Project Note, North Carolina Surface Water Intakes, July 11, 1990. Subject: Ashe County, North Carolina.

25. North Carolina Natural Heritage Program Element List for Ashe County, June 30, 1989, p. 2.

26. Sonny Williams, Game Warden, Ashe County, North Carolina, telephone conversation with Eric Corbin, NUS Corporation, March 14, 1990. Subject: Recreational uses of the New River.

27. U.S. Environmental Protection Agency, Graphical Exposure Modeling System (GEMS) Data Base. Compiled from U.S. Bureau of the Census data (1983).

28. Sandy Gambill, Ashe County Chamber of Commerce, telephone conversation with Victor Blix, B&V Waste Science and Technology Corp., July 9, 1992. Subject: Number of employees working onsite.

RECEIVED
N.C. Dept. of EHNR
APR - 7 1999
Winston-Salem
Regional Office

Ref. 16

COMPREHENSIVE SITE ASSESSMENT
FORMER ETCHANT AREA
UNITED CHEMI-CON MANUFACTURING, INC.
Formerly SPRAGUE ELECTRIC COMPANY
LANSING, NORTH CAROLINA
DELTA PROJECT NO. S094-001-1.0046

Delta
Environmental
Consultants, Inc.

4068 Mt. Royal Boulevard
Suite 225-Gamma
Allison Park, Pennsylvania 1510
USA
412/487-7700
FAX: 412/487-9785

April 6, 1999

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N.C. Dept. of EHNR
APR - 7 1999
Winston-Salem
Regional Office

North Carolina Department of the Environment
and Natural Resources
Division of Water Quality
Winston-Salem Regional Office
585 Waughtown Street
Winston-Salem, NC 27107

Attention: Mr. Don Geddes

Subject: **Submittal of Comprehensive Site Assessment Reports**
United Chemi-Con Manufacturing
Former Sprague Electric Company
Lansing, North Carolina
Delta Project No. S094-001-1.0046

Dear Don:

Enclosed are Comprehensive Site Assessments (CSAs) for two separate areas at the referenced site (the Former Etchant Area and Containment Dike Area). The CSAs were voluntarily performed by American Annuity Group, Inc. (AAG) in order to sufficiently characterize the cause, significance and extent of ground water and soil impacts at the facility.

Attached to each report is the completed Certification for Submittal of a Comprehensive Site Assessment, along with explanations regarding specific items for each submittal.

Please contact me or John Gruber with AAG if you have any questions or comments regarding the contents of these reports.

Sincerely,

DELTA ENVIRONMENTAL CONSULTANTS, INC.

Stephen A. Zbur, P.G.
Project Manager
North Carolina Licensed Geologist # 1090

cc: John Gruber, AAG, Inc.
Ed Stone, AAG, Inc.
Craig Bromby, Hunton & Williams
Tom Griffin, Parker, Poe, Adams & Bernstein

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 Purpose 1
1.2 Scope of Work 1

2.0 SITE HISTORY AND SOURCE CHARACTERIZATION 1

2.1 Property Ownership and Use 1
2.2 Release Incidents and Environmental Investigations 2
2.3 Corrective Actions to Date 3

3.0 POTENTIAL RECEPTORS AND MIGRATION PATHWAYS 3

3.1 Water Supply Wells 3
3.2 Surface Water 4
3.3 Utilities 4

4.0 PHYSICAL SETTING 4

4.1 Regional Geology and Hydrogeology 4
4.2 Site Geology and Soils 5

5.0 FIELD ACTIVITIES 5

5.1 Soil Investigation 5
5.2 Ground Water Investigation 6
5.2.1 Monitoring Well Construction 6
5.2.2 Monitoring Well Location and Rationale 6
5.2.3 Ground Water Flow 7
5.3 Ground Water Analytical Results 8
5.3.1 Background Ground Water Quality 8
5.3.2 Constituent Plume Characteristics 8
5.4 Surface Water 9

6.0 CONCLUSIONS 9

7.0 RECOMMENDATIONS 10

8.0 REFERENCES 10

9.0 REMARKS 11

TABLES

Table 1	Sampling Summary
Table 2	Background Soil and Surface Water Analytical Results
Table 3	Soil Analytical Results
Table 4	Monitoring Well Construction Characteristics
Table 5	Summary of Ground Water Field Indicator Parameters
Table 6	Ground Water Analytical Results - Dissolved/Total Aluminum
Table 7	Ground Water Analytical Results - Volatile Organic Compounds & Metals
Table 8	Natural Attenuation and Geotechnical Parameters, Former Etchant Area

FIGURES

Figure 1	Topographic Map
Figure 2	Site Map
Figure 3	Potential Receptor Survey Map
Figure 4	Soil Sample Location Map
Figure 5	Soil Isoconcentration Cross Section Location Map
Figure 6	Soil pH Isoconcentration Contour Map - Cross Section A-A' (October 1997)
Figure 7	Soil pH Isoconcentration Contour Map - Cross Section B-B' (October 1997)
Figure 8	Soil pH Isoconcentration Contour Map (October 1997)
Figure 9	Ground Water Sample Location Map
Figure 10	Ground Water Elevation Contour Map (October 1997)
Figure 11	Ground Water pH Isoconcentration Contour Map (October 1997)
Figure 12	Ground Water Isoconcentration Contour Cross Section Location Map
Figure 13	Ground Water pH Isoconcentration Contour Cross Section A-A' (October 1997)
Figure 14	Ground Water pH Isoconcentration Contour Cross Section B-B' (October 1997)

APPENDICES

Appendix A	Laboratory Analytical Data
Appendix B	Geotechnical Analytical Data
Appendix C	Soil Boring Logs/Monitoring Well Construction Details
Appendix D	Vertical Gradient Calculations

COMPREHENSIVE SITE ASSESSMENT
FORMER ETCHANT AREA
UNITED CHEMI-CON MANUFACTURING, INC.
Formerly SPRAGUE ELECTRIC COMPANY
LANSING, NORTH CAROLINA
DELTA PROJECT NO. S094-001-1.0046

1.0 INTRODUCTION

1.1 Purpose

The purpose of this report is to provide a comprehensive discussion of the various phases of site assessment activities performed in the former etchant area at the referenced site. Delta Environmental Consultants, Inc. (Delta) was retained by American Annuity Group, Inc. (AAG), successor in interest to Sprague Electric Company (Sprague), to perform this comprehensive site assessment (CSA).

This CSA was prepared in order to better determine the nature and extent of aluminum and low pH present in the subsurface within a portion of the site. The purposes of performing the CSA were to:

- delineate the nature and extent of previous releases of aluminum and low pH process material to the soil and ground water;
- characterize the subsurface geology and hydrogeology;
- provide sufficient data in order to prepare a Corrective Action Plan; and,
- determine if remediation is necessary.

1.2 Scope of Work

The CSA included performing the following tasks:

- obtaining and analyzing 23 soil samples;
- installing eleven water table monitoring wells and one telescoped deep monitoring well;
- advancing eight soil borings within the former etchant area;
- obtaining ground water samples from three Geoprobe borings and each monitoring well on one to three occasions;
- obtaining three surface water samples on two occasions in order to evaluate water quality of North Fork of the New River;
- performing laboratory analyses of the soil, ground water and surface water samples to determine chemical quality;
- determining potential receptors by performing a visual survey of the area within a 1,500-foot radius of the site;
- performing geotechnical analysis on select samples in order to determine hydraulic properties of the surficial aquifer; and,
- preparing this report.

2.0 SITE HISTORY AND SOURCE CHARACTERIZATION

2.1 Property Ownership and Use

The site is located in Ashe County, North Carolina, approximately one and one-quarter miles south of Lansing (Figures 1 and 2). The 60 acre site is bordered on the north and west by the North Fork of the New River.

The facility was owned and operated from 1953 through August 1992 by Sprague. United Chemi-Con Manufacturing, Inc. (UCCM) purchased the facility from Sprague on August 31, 1992.

The facility was constructed in 1953 and operations were initiated by Sprague in 1954. Historically, the processes employed at the facility include winding, impregnation, assembly, aging, testing, and packing of aluminum based capacitors. Previous activities also included the etching and formation of aluminum oxide from approximately 1961 through 1990.

The etching process, which was performed in the northeast portion of the building, consisted of a high alkaline cleaning followed by a dip into the etching solution (which consisted of a nitric or sulfuric acid solution) followed by a final rinse with water. Nitric and sulfuric acid used in the etching process were stored in above ground tanks that were formerly located on the southeast side of the former etchant area building at the location illustrated in Figure 2. The acids were pumped through stainless steel pipes into mixing tanks that were located within concrete lined basins within the former etchant area building. The acids were combined with deionized water in the mixing tanks and heated. The mixing tanks were located on hydraulic lifts located underneath aluminum rollers. After cleansing in caustic solution, the mixing tanks were raised and lowered and the aluminum was submerged into the etching solution. After being removed from the mixing tank, the aluminum was sprayed with deionized water. The etching solution was used over several times until it became too diluted for use. Wastewaters from the etching process were discharged into floor drains and directed through underground pipes to the former retention ponds located immediately east of the former etchant area, on property that is still owned by AAG.

All of the former process equipment associated with the etchant process was removed from the facility in 1992. In 1993, the former etchant basins within the building were filled and capped with concrete. UCCM has since renovated this portion of the area for use in the assembly process.

UCCM continues to produce aluminum based capacitors. The capacitors are impregnated with an electrolytic solution that consists of a mixture of dimethylformamide (DMF) and ethylene glycol.

2.2 Release Incidents and Environmental Investigations

Data from previous investigations performed by AAG at various locations throughout the site have been submitted to the NCDENR Division of Environmental Management (DEM) and Division of Solid Waste Management. On October 1, 1992, a notification of a suspected release of heating oil from underground storage tank(s) was made by Hunton & Williams (counsel for AAG) to the Groundwater Section of the Winston-Salem Regional Office (WSRO). On November 20, 1992, Hunton & Williams submitted a report of ground water test results under monitoring well permit #04-0119-WM-0037 to the Groundwater Section of the DEM in Raleigh, North Carolina.

The initial soil and ground water analytical data obtained from the former etchant and formation areas were presented in the Status Report, Etchant and Formation Basin Data prepared by Delta in March 1993 (this report was submitted to the Groundwater Section of the WSRO by UCCM in March 1993). This status report presented the background information, site history and analytical results of three soil, two ground water and three concrete samples. Laboratory analysis of these samples revealed aluminum concentrations in shallow soil (ET-1 and ET-2A) above the average background concentration (as discussed in Section 5.1), but within the same order of magnitude. Monitoring wells ET-2 and ET-3 were advanced within the former etchant area basin. The results of the filtered ground water analyses indicated that dissolved aluminum was present in the ground water beneath the etchant area at concentrations of 230 micrograms per liter (ug/l) at ET-2 and 39,000 ug/l at ET-3. Review of the pH for these samples indicated that the ground water occurs under acidic conditions (4.7 and 5.9). The results of the laboratory analysis of the three concrete samples did not indicate the presence of extractable quantities of targeted TCLP analytes including volatiles, semi-volatiles and metals. The results of the ignitability, reactivity and corrosivity analysis performed on the concrete confirms the TCLP data in characterizing the concrete samples in the basins as a non-hazardous media.

On December 16, 1994, a copy of Delta's Report of Phase II Sampling was submitted to the Groundwater Section of the WSRO by Parker, Poe, Adams and Bernstein (counsel for UCCM). As part of the Phase II sampling, two additional water table monitoring wells (MW-08 and MW-09) were installed in September 1993. The results of the ground water samples obtained from these monitoring wells did not indicate the presence of volatile organic compounds (VOCs) above the method detection limits. The analytical results of the filtered ground water samples indicated dissolved aluminum concentrations in the ground water at monitoring wells ET-03 (56,000 ug/l) and monitoring well MW-08 (5,600 ug/l). The analytical results of the ground water sample obtained from monitoring well MW-09 revealed an aluminum concentration of less than 100 ug/l in the filtered ground water sample. Monitoring well ET-02 was not sampled for this investigation since this well was abandoned in March 1993 due to renovations in the former etchant area. The pH values obtained from ground water monitoring wells ET-03 and MW-09 ranged from 3.7 to 6.3. Based on this data, a recommendation was made to obtain additional ground water samples downgradient of monitoring wells MW-08 and ET-03 to better determine the extent of the dissolved aluminum and low pH plume. Based on the absence of detectable levels of dissolved aluminum and higher pH levels at monitoring well MW-09 (relative to the values obtained from ground water at monitoring wells ET-02, ET-03 and MW-08), the former acid storage tanks located on the south side of the former etchant area building, do not appear to have been a source for the dissolved aluminum plume.

A Site Assessment Report, which presented soil and ground water data collected by Delta from numerous investigations conducted from July 1992 to February 1996, was submitted to the Groundwater Section of the WSRO on May 20, 1996. The tasks performed in the former etchant area included collecting three water samples from Geoprobe borings GP-104, GP-106 and GP-107. In addition, three water table monitoring wells (MW-11 through MW-13) were installed to provide reproducible ground water analytical data downgradient of the low pH/dissolved aluminum plume. The analytical results from the three Geoprobe samples did not indicate the presence of aluminum in the filtered samples. The associated pH values of the ground water obtained from the Geoprobe samples ranged from 6.03 to 6.50. The analytical results of the ground water samples obtained from monitoring wells MW-11 through MW-13 indicated unfiltered aluminum concentrations at two orders of magnitude less than the unfiltered concentrations reported in the ground water at monitoring wells ET-02, ET-03 and MW-08. The pH values obtained from ground water at monitoring wells MW-11 through MW-13 ranged from 5.71 to 6.36.

A follow-up meeting was held with representatives of WSRO on May 29, 1996. Based on the results of this meeting, additional activities were performed at the site and summarized in the Project Status Update, which was submitted to the Groundwater Section of the WSRO in May 1997. Activities performed at part of this update for the etchant area included obtaining three surface water samples, as discussed in Section 5.4.

2.3 Corrective Actions to Date

Other than the removal of the former process equipment associated with the etchant process, corrective actions have not been performed at the former etchant area.

3.0 POTENTIAL RECEPTORS AND MIGRATION PATHWAYS

3.1 Water Supply Wells

According to Gerald Elliott of the Ashe County Health Department, the area within a 1,500-foot radius of the center of the site is not serviced by municipal water. The closest municipal water supply is provided by the Town of Lansing.

According to Donna Cochran, the Town Clerk of Lansing, the water supply for the Town of Lansing is derived from a supply well located within the town limits. The well yield is approximately 18 gallons per minute and services approximately 100 households. The town is currently evaluating the need for an additional well. Ms. Cochran also indicated that municipal water lines do not extend past the town limits, which are approximately two to three miles from the site.

Based on this information, Delta performed a visual survey of the area within a 1,500 feet radius of the center of the site to identify water supply wells. Accessible streets and roadways were traversed by car and properties were observed to identify well heads or well houses that are commonly associated with domestic water supply wells. Our survey did not reveal the presence of these structures.

A tax map with the names and addresses of property owners (within the specified radius of the site) was obtained from the Ashe County Tax Assessors Office in Jefferson, North Carolina. The visual survey indicated the presence of structures on 13 of the 34 parcels (including the UCCM facility) within a 1,500-foot radius of the facility. Each of the 13 parcels that contain structures are assumed to have domestic supply wells, as illustrated in Figure 3.

The location of the supply well that provides water to the facility is shown on Figure 2. The well is used for potable and process purposes. According to the driller, Newman Brothers, the well has a total depth of 805 feet. Six-inch galvanized casing extends from ground surface to a depth of 50 feet. Water bearing fractures were reported at depths of 60, 80, 180, 310, 500, and between 540 and 570 feet. According to Newman Brothers, each fracture produced water at a rate of approximately five gallons per minute for a combined yield of 30 gallons per minute.

3.2 Surface Water

The North Fork of the New River borders the UCCM property to the north and west. This surface water feature serves as a local discharge point for ground water in the surficial aquifer during periods when the river is a gaining surface water body. The overall volume of ground water that discharges to the New River via baseflow is negligible compared to the overall flow of the river. The location of the New River with respect to the facility is illustrated in Figures 1 and 2.

The North Carolina Division of Water Quality (DWQ) has assigned the North Fork a primary classification of C. Class C waters are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, and agriculture. The North Fork has also been given supplemental classifications of Outstanding Resource Waters (ORW) and Trout Waters (Tr).

3.3 Utilities

Underground utilities such as water lines, sewers and drain lines are present at the facility, but are located primarily west of the former etchant area. However, due to the depth of ground water in the this area (approximately 30 feet below ground surface), utilities should not provide a conduit for enhanced ground water migration. The former wastewater discharge lines used for the etchant process are shown in Figure 4.

4.0 PHYSICAL SETTING

4.1 Regional Geology and Hydrogeology

The site is situated in the Blue Ridge Belt of North Carolina. The Blue Ridge Belt consists of a series of thrust sheets stacked on one another. Locally, the thrust faults bounding the sheets can be mapped at the surface. Where mapped, distinct lithologic differences are found from one side of the fault to the other. Other major structural features include large folds. Broad upwarps produce large anticlines and major anticlinoriums, while broad downwarps produce large synclines and synclinoriums. Where erosion breeches these large upwarps, windows are created exposing younger rocks in the thrust sheet below (NCGS, 1988).

Bedrock at the site consists of massive to well foliated biotite granitic gneiss with locally intrusive metamorphosed granitic intrusive rock. The bedrock is of Middle to Late Proterozoic age (Rhodes, 1985). The land surface is underlain by clay-rich unconsolidated material derived from the in-situ weathering of the underlying bedrock. This material, which averages from about 90 to 200 feet in thickness and may be as much as 300 feet thick in some valleys, is referred to as saprolite. In many valleys, especially those of larger streams, flood plains are underlain by

thin, moderately well-sorted alluvium deposited by the streams. When the distinction between saprolite and alluvium is not important, the term regolith is used to refer to the layer of unconsolidated sediments (Heath, 1983).

The regolith contains water in pore spaces between sediment particles. Conversely, the bedrock typically does not display intergranular porosity. Ground water in bedrock is transported via features such as fractures, foliation, and former bedding planes. Recharge of the ground water systems occurs in the areas above the floodplains of the streams, and natural discharge occurs in low lying areas as seepage springs that are common near the base of slopes and baseflow discharge into streams and rivers (Heath, 1983).

4.2 Site Geology and Soils

Drilling investigations performed as part of this assessment indicate that subsurface soils are saprolite and alluvium consisting of micaceous clays and silts. The unconsolidated material ranges in thickness from 20 to 60 feet and grades into weathered granitic gneiss bedrock. Alluvial sands and silts were encountered in boreholes advanced along the floodplain of the New River.

The Soil Survey of Ashe County, North Carolina indicates that the site soils are classified as Braddock-Urban Land Complex soils. These soils are predominantly acidic with a pH range of 3.6 to 5.5 and an organic matter content of one-half to one per cent (USDA, 1985).

5.0 FIELD ACTIVITIES

The CSA field activities were conducted using a phased approach. Subsequent phases of investigation were based upon the results obtained from the previous phase. The purposes of performing the field activities were to:

- further investigate the nature and extent of elevated aluminum and low pH identified in the ground water;
- better characterize the site geology and hydrogeology; and,
- obtain data in order to determine the potential for the low pH plume to naturally attenuate and dilute.

5.1 Soil Investigation

A total of 23 soil samples were obtained from 18 locations between January 1993 and September 1997. Table 1 summarizes specific information regarding the sample date, depth and analytical protocol.

In January 1993, four background soil samples (Bkgnd-1 through Bkgnd-4) were collected from the locations shown in Figure 2 to document the presence and magnitude of naturally occurring metals in the soils that underlay the site. Aluminum was the predominant metal detected in the background soil samples. Aluminum concentrations ranged from 13,000 milligrams per kilogram (mg/kg) to 23,000 mg/kg for an average of 18,000 mg/kg. Historical soil analytical data are summarized in Table 2. The laboratory report from this data and all additional soil data are presented in Appendix A.

In January 1993, three soil samples (ET-01, ET-02, and ET-02A) were collected in the former etchant area at the locations shown in Figure 4. The soil samples were analyzed for the presence RCRA metals, total and extractable aluminum, VOCs and tentatively identified compounds. The analytical results are summarized in Table 3.

In September 1997, a Geoprobe investigation was conducted in order to delineate the lateral and vertical extent of impacted soil. Ten boreholes (GP-300 through GP-309) were advanced at the locations shown in Figure 4. Refusal was encountered at six and one-half feet below grade at GP-300 and at seven and one-half feet below grade at GP-305. Thus, soil samples from these boreholes were not submitted for analyses. A soil sample was also obtained from the borehole advanced for the installation of monitoring well MW-14 at a depth of 10 feet below grade.

Soil samples were collected at two to four foot intervals during Geoprobe borehole advancement. Field pH readings were collected by creating a slurry consisting of four ounces of soil and four ounces of deionized water. The pH of the slurry was recorded using a precalibrated Accumet pH meter. Based upon the field measurements, a maximum of two soil samples were selected from each borehole and submitted to IEA, Inc. (IEA) for analysis of pH and total aluminum. Soil analytical data is summarized in Table 3.

In addition, saturated soil samples were collected from boreholes (SB-001 and SB-002) and submitted to MVTL Laboratories, Inc. in Bismarck, North Dakota for analysis of the Determination of Calcium Carbonate Equivalence and Neutralization Potential using method C15105. An undisturbed soil (UD) sample was collected from soil boring SB-002 at a depth of 8.5 to 10.5 feet below ground surface in accordance with ASTM Method D 1587-83, "Practice for Thin-Walled Tube Sampling of Soils." Several attempts were made to collect the UD sample below the water table surface, but the soil was too dense. The soil sample was submitted to Law Engineering and Environmental Services, Inc. for geotechnical analyses including, grain size distribution, hydraulic conductivity, density, and specific gravity. LAW described the soil as a orange-yellow, micaceous, silty fine to medium grained sand with partially weathered rock fragments. The laboratory report is presented as Appendix B.

Based on a review of Table 3, an area of low pH (less than 6.0) was identified at the locations of Geoprobe borings GP-301, GP-304, GP-306 and GP-309. Two soil isoconcentration cross-sections were constructed through the impacted area. The locations of the cross sections are shown on Figure 5. Soil pH isoconcentration cross sections A-A' and B-B' are presented as Figures 6 and 7, respectively. Figure 8 presents an isoconcentration contour map for pH for the etchant area soils. All aluminum values are below the NCDENR guidance clean-up level of 200,000 mg/kg and within the same order of magnitude as the average aluminum background concentration.

5.2 Ground Water Investigation

5.2.1 Monitoring Well Construction

Eleven shallow (water table) monitoring wells and one deep monitoring well were installed in order to characterize the subsurface geology and delineate the lateral and vertical extent of impacted ground water. The locations of the monitoring wells are shown in Figure 9. Monitoring well construction details are summarized in Table 4. Soil boring logs and monitoring well construction details are presented in Appendix C.

The shallow monitoring wells were completed at depths ranging from 13 to 72 feet below ground surface. The shallow monitoring wells were installed using continuous flight hollow stem augers and were completed with 10 to 15 feet of two-inch diameter, flush threaded, 0.010 inch factory slotted PVC screen and two-inch diameter PVC riser. A gravel filter pack was added to an approximate height of two feet above the top of the well screen. A minimum two foot thick bentonite seal was added above the filter pack. The remaining annulus was grouted to the surface. With the exception of monitoring well MW-14, the shallow monitoring wells were completed in saprolite.

Monitoring well DW-01 was completed at a depth of 71 feet below ground surface using air rotary methods. A ten inch borehole was advanced to approximately 61 feet below ground surface. Six-inch diameter galvanized steel surface casing was inserted into the borehole and the annulus was grouted to the surface using the tremie method. The casing was allowed to set overnight to allow the cement to harden. A six-inch diameter borehole was advanced through the surface casing to a depth of 71 feet below ground surface. The monitoring well was completed with five feet of two-inch diameter, flush threaded, 0.010 inch factory slotted PVC screen and two-inch diameter PVC riser. A gravel filter pack was added to an approximate depth of two feet above the top of the well screen. A minimum two foot thick bentonite seal was added above the filter pack. The remaining annulus was grouted to the surface.

5.2.2 Monitoring Well Location and Rationale

Monitoring wells MW-02, MW-03 and MW-04 were installed by UCCM as part of their due diligence activities. Monitoring wells ET-02 and ET-03 were installed by Delta in January 1993 (monitoring well ET-02 was abandoned

in March 1993 due to renovations in the former etchant area). Monitoring wells MW-08 and MW-09 were installed by Delta in September 1993 in order to better define the upgradient and downgradient extent of impacted ground water.

A Geoprobe investigation was conducted at the site in October 1995. Five sampling points (GP-103 through GP-107) were advanced at an approximate depth of 30 to 35 feet below ground surface at the locations shown in Figure 9. Representative ground water samples were collected from points GP-104, GP-106, and GP-107 and submitted for laboratory analysis. Subsurface conditions did not allow the Geoprobe to penetrate the water table at points GP-103 and GP-105.

Monitoring wells MW-11, MW-12, and MW-13 were installed in November 1995. The monitoring well locations were selected based upon information collected during the Geoprobe investigation and installed to provide reproducible ground water analytical data down gradient and cross-gradient of the former etchant area plume.

Monitoring wells MW-14 and DW-01 were installed in September 1997. Monitoring well MW-14 was installed in order to define the upgradient extent of the former etchant area plume, and monitoring well DW-01 was installed in order to define the vertical extent of the former etchant area plume.

5.2.3 Ground Water Flow

Depth to ground water measurements have been collected between two and six occasions since 1993. Ground water elevation data from October 13, 1997 are presented in Table 4. Ground water elevation data collected during the October 1997 sampling event were used to construct a ground water elevation contour map, as illustrated in Figure 10. Review of Figure 10 indicates that the direction of ground water flow is north/northeast at an average horizontal gradient of 0.02. Monitoring wells MW-03 and MW-04 are located approximately 50 feet from the New River. The ground water elevation at these wells, with respect to the elevations observed at monitoring wells MW-2 and MW-12, indicate that the New River was a losing stream (i.e. discharging surface water to the ground water), thus the river was receiving negligible amounts of ground water during this interval.

Based on the above information, the average linear ground water flow velocity (seepage velocity) parallel to ground water flow was calculated using the following equation:

$$V_x = \frac{-K}{ne} \frac{dH}{dL}$$

where: V_x = average linear ground water velocity parallel to ground water flow direction (seepage velocity) [L/T]
K = hydraulic conductivity
ne = effective porosity
dH/dL = hydraulic gradient

from piezometer data

Assuming a hydraulic conductivity of 0.79 feet per day (2.8 x 10 -4 cm/sec), an effective porosity of 0.2 (20% for sandy silt) and a hydraulic gradient of 0.02, the average linear ground water flow velocity is estimated at 0.079 feet per day, or approximately 29 feet per year.

Using the calculated ground water flow velocity, the amount of time for the constituent plume to travel from monitoring well ET-03 to the New River located approximately 420 feet north of monitoring well ET-03 is approximately 15 years. This conservative calculated travel time does not take into consideration factors (intervals when the New River is a losing stream, dilution, dispersion of attenuation) that will retard the movement of plume constituents.

The vertical gradient for monitoring well pair ET-03/DW-01 was calculated using ground water elevation data collected on October 13, 1997. The data suggest a gradient of 0.27 downward at this location. Vertical gradient calculations are presented as Appendix D.

5.3 Ground Water Analytical Results

5.3.1 Background Ground Water Quality

Forty-eight ground water samples were obtained from 15 locations and analyzed for the constituents identified in Table 1. The pH results are presented in Table 5. Historical and recent pH values from ground water samples collected from the monitoring wells in the former etchant area are below the range of 6.5 to 8.5 established as the standard by 15A NCAC 2L .0202 (g). The pH of ground water in upgradient monitoring well MW-14 during the October 1997 sampling event was 6.01. Based upon this value and the acidity of the site soils, the pH of the ground water in the area naturally occurs at a value of less than 6.5.

5.3.2 Constituent Plume Characteristics

Representative ground water samples have been collected on one to six occasions from the monitoring wells in the former etchant area since 1993. All of the ground water samples were analyzed for field-filtered and unfiltered aluminum and pH. Bailing techniques were used to collect ground water samples prior to November 1995. Low-flow purging and sampling techniques have been used to collect ground water samples during and since the 1995 sampling event. A summary of ground water analytical data are summarized in Tables 5 through 8.

The most recent round of ground water sampling was performed on October 14 and 15, 1997. Ground water samples were collected from monitoring wells MW-08, MW-11, MW-12, MW-13, MW-14, ET-03, and DW-01 using QED Well Wizard bladder pump. Water quality measurements such as pH, temperature, dissolved oxygen, specific conductance, turbidity, and oxidation-reduction potential recorded using a QED model FC 4000 MicroPurge Flow Cell. The ground water samples were submitted to IEA for analyses of field-filtered and dissolved aluminum (Method 3030C), iron, hardness, alkalinity, sulfate, sulfite, phosphate, nitrate, and nitrite.

The October 1997 ground water analytical data are consistent with analytical data collected during previous sampling events. The analytical data suggest that the constituent plume originates in the immediate vicinity of monitoring well ET-03 (pH value of 3.86) and extends approximately 360 feet north (based on inferred isoconcentration of 6.0). Ground water in the former etchant area has been impacted to a depth of 65 feet as determined by a pH value of 5.14 recorded from monitoring well DW-01. An isoconcentration contour map for pH was developed from the October 1997 data and is presented as Figure 11. Isoconcentration cross-sections for pH were developed through the areas identified in Figure 12. Ground water pH isoconcentration contour cross-sections are presented as Figures 13 and 14.

Filtered and unfiltered (dissolved and total) aluminum samples have been analyzed on the ground water. Table 6 presents the aluminum ground water analytical results. Elevated total and dissolved aluminum are present in the ground water at monitoring wells ET-03, MW-08 and DW-1. Dissolved aluminum is present in ground water that has pH values below 5. Review of Table 6 indicates that unfiltered aluminum concentrations have reduced significantly since the implementation of low-flow sampling techniques.

The NCDENR has not established a standard for aluminum. The dissolved aluminum concentration reported in the ground water sample collected from upgradient (background) monitoring well MW-14 was 144 ug/l. The USEPA Region III Risk Based Concentration (RBC) value for aluminum in tap water is 37,000 ug/l. None of the ground water samples collected during the October 1997 sampling event contained aluminum in excess of the RBC.

Targeted VOCs and dissolved metals have been reported below the NCDENR ground water standards, as illustrated in Table 7.

The ground water analytical data indicate the presence of iron, nitrate, and sulfate above the ground water standards specified in NCAC 2L .0202. The presence of nitrate and sulfate may be attributed to releases and breakdown of nitric and sulfuric acids from the etching process. The highest concentrations of sulfate and nitrate are present in the ground water samples collected from monitoring wells MW-08, ET-03, and DW-01 which are located in the source

area. The presence of iron can be explained by the low pH and moderate redox potential (ORP), as presented in Table 8. Ferrous iron is soluble within these ORP conditions reported at ET-03, MW-06, MW-11 and MW-14 (Hem, 1992). At a lower ORP (as evidenced in the ground water sample collected from DW-01), iron is not soluble.

The presence of nitrate and sulfate parallel the presence of low pH and dissolved aluminum. Based on dissolved oxygen levels (consistently greater than 1.0 milligrams per liter-mg/l) it is unlikely that bioattenuation of nitrate and sulfate is occurring since microorganisms actively use nitrate and sulfate to consume organic matter only when dissolved oxygen levels are less than 1.0 mg/l.

The neutralization capacity of the soil is minimal since one of four soil samples contained calcium carbonate greater than 1% by weight detection limit.

5.4 Surface Water

Surface water samples were collected from the New River at three locations (identified as "upstream", "downstream", and "midstream") on October 21, 1996 and analyzed for field pH, total aluminum and volatile organic compounds. The locations of the surface water samples are shown on Figure 2. Field pH measurements were collected at the same locations on October 14, 1997. The field pH measurements were between 6.5 and 8.0. The analytical results are summarized in Table 2.

6.0 CONCLUSIONS

Based on the results of the CSA, previous activities at the facility have impacted the soil and ground water. A summary of the conclusions obtained from this assessment is presented below:

- The facility has manufactured aluminum-based capacitors since 1954. Previous activities included the etching and formation of aluminum oxide from approximately 1961 through 1990.
- The etching process utilized nitric and sulfuric acid solutions.
- The North Fork of the New River borders the UCCM property to the north and west. This surface water feature serves as a local discharge point for ground water in the surficial aquifer during periods when the river is a gaining surface water body.
- The ground water data obtained in October 1997 indicates that the New River was a losing stream, thus the river was receiving negligible amount of ground water during this interval.
- Depth to ground water in the vicinity of the former etchant area ranges from 30.10 feet bgs to 33.58 feet bgs.
- Laterally, ground water flow direction at the water table is north/northeast at a horizontal gradient of 0.02.
- Vertically, water level readings obtained from the nested wells (ET-03 and DW-01) indicate a downward vertical gradient.
- Based on the calculated ground water flow velocity of approximately 29 feet per year, the amount of time for the low pH plume to travel from monitoring well ET-03 to the New River is approximately 15 years. The etching process was initiated at the facility approximately 38 years ago. The higher pH values reported in the ground water at monitoring well MW-02 and MW-12 (as compared to the pH values present in the ground water at ET-03 and MW-08) indicate that the low pH plume is diluting through diffusion and dispersion in the subsurface.
- The low pH, nitrate and sulfate are attributed to historical etchant activities associated with the nitric and sulfuric acid.
- The presence of dissolved aluminum is restricted to areas that display pH concentrations less than approximately 5.0 and is attributed to this relative low pH.

- VOCs and dissolved metals are not present in the soil or ground water at levels in excess of NCDENR guidelines or standards.
- The NCDENR has not established a clean-up level for pH. Soil samples collected in the former etchant area exhibit pH values ranging from 3.9 to over 7.0. The Ashe County Soil Survey indicates that the soils located at the site are strongly acidic with values ranging from 3.6 to 5.5.
- The NCDENR also has not established a clean-up level for aluminum. The USEPA Region III RBC has established a value of 200,000 mg/kg for an industrial/commercial scenario. None of the soil samples collected and analyzed in the former etchant area has contained an aluminum concentration in excess of the RBC.
- Based upon the information presented above, impacted soils in the former etchant area do not pose a threat to site workers (due to the lack of an exposure route).
- The low pH plume in the former etchant area has not impacted the New River as evidence by surface water field pH measurements.
- The low pH plume should continue to decrease in size due to dilution and the fact that the source area currently represents minimal concentrations of acid (based on the low levels of nitrate and sulfate as compared to the levels that would be present in the acidic solutions at the time they were used in the etchant process).
- Based upon the information presented above, the constituent plume in the former etchant area does not appear to be a threat to surface water or ground water receptors. Thus, additional investigation and active remediation is neither appropriate nor proposed.
- Based on the results of the CSA, the process of dilution is restoring the pH of the ground water to background levels.
- Continued monitoring to monitor the natural dilution is the preferred remedial alternative.

7.0 RECOMMENDATIONS

Based upon the conclusions above, a Corrective Action Plan should be prepared to propose a ground water monitoring plan for the former etchant area. This plan will include a proposal to monitor ground water and surface water, initially, on a semi-annual basis for a period of five years. This monitoring will allow further definition of the plume geometry and the on-going dilution process.

An annual letter report would be prepared and submitted to the NCDENR for review. This report will include the analytical results and our conclusions and recommendations regarding plume geometry and the on-going dilution process.

8.0 REFERENCES

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9.0 REMARKS

The recommendations contained in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted and hydrogeologic and engineering practices at this time and location. Other than this, no warranty is implied or intended.

This report was prepared by:

DELTA ENVIRONMENTAL CONSULTANTS, INC.

Richard E. Powell
Project Geologist

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North Carolina Licensed Geologist No. 1090

NORTH CAROLINA LICENSED SEAL 1090 GEOLOGIST STEPHEN A. ZBUR

Delta Environmental Consultants, Inc.	Project Number: S094-001	Site Id: MW-07
	Project Name: LANSING	Location: LANSING,NORTH CAROLINA
	Contractor: GEOLOGIC EXPLORATION	Elevation: 2673.55'
Consulting Firm: DELTA ENVIRONMENTAL		Datum: Mean Sea Level
Logged By: RICK POWELL		Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'
Date(s): 01/19/93 - 01/20/93		
Purpose: Monitoring Well, Shallow		Blank Casing: type: PVC dia: 2.00in fm: 0.0' to: 18.40'
Drilling Method: Hollow Stem Auger		
Annular Fill: type: NEAT CEMENT fm: 0.00' to: 12.40'; type: Bentonite Pellets fm: 12.40' to: 14.40'; type: SAND PACK #2 fm: 14.40' to: 28.40'		Screens: type: Slotted size: 0.010in dia: 2.00in fm: 18.40' to: 28.40'
		Remarks:

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	PID	Graphic Log	USCS Code	Material Description
							ML	CLAYEY SILT,ORANGE,TAN,WHITE,MICACEOUS SILT
2670			1	4 8 8	7.0 ppm			
	10		2	4 4 6	1.2 ppm			AS ABOVE WITH FINE SAND
2660			3		1.0 ppm			BECOMES MOIST
	20		4	14 16 36	1.0 ppm		SM	SILTY FINE TO MEDIUM SAND,YELLOW,WHITE,TAN,MINERAL BANDING AT 45-60 DEGREES FROM HORIZONTAL
2650								ENCOUNTERED WELL ROUNDED RIVER GRAVEL
								AUGER REFUSAL, BORING TERMINATED AT 28 FEET
	30							
2640								

Well Construction

MP. EL. 2673.93

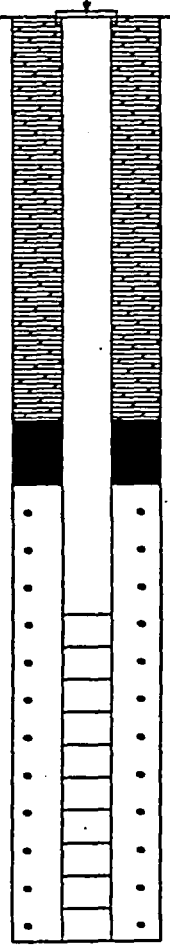

TABLE 1

SAMPLING SUMMARY
FORMER ETCHANT AREA

LOCATION	SAMPLE TYPE	SAMPLE ID	DATE COLLECTED	DEPTH	ANALYTICAL PROTOCOL											
					A	B	C	D	E	F	G	H	I	J	K	L
BACKGROUND	SOIL	Bkgnd-1, Bkgnd-2, Bkgnd -3	Jan-93	0-2'			X									
	SOIL	Bkgnd -4	Feb-94	1-2'			X									
	SURFACE WATER	Up, Mid & Downstream,	Oct-96	WATER SURFACE	X				X			X				
	SURFACE WATER	Up, Mid & Downstream,	Sep-97	WATER SURFACE								X				
					A	B	C	D	E	F	G	H	I	J	K	L
FORMER	SOIL	ET-01, ET-02A	Jan-93	1-1.5'	X	X	X			X			X			X
ETCHANT	SOIL	ET-02	Jan-93	20-21.5'	X	X	X			X						X
AREA	SOIL	GP-301	Sep-97	28-30'					X			X				
	SOIL	GP-302	Sep-97	22-24'					X			X				
	SOIL	GP-304	Sep-97	4-6'					X			X				
	SOIL	GP-304	Sep-97	22-24'					X			X				
	SOIL	GP-306	Sep-97	10-12'					X			X				
	SOIL	GP-306	Sep-97	22-24'					X			X				
	SOIL	GP-307	Sep-97	4-6'					X			X				
	SOIL	GP-308	Sep-97	4-6'					X			X				
	SOIL	GP-308	Sep-97	22-24'					X			X				
	SOIL	GP-309	Sep-97	4-6'					X			X				
	SOIL	GP-309	Sep-97	16-18'					X			X				
	SOIL	SB-001	Sep-97	28-30'											X	
	SOIL	SB-002	Sep-97	8.5-10.5', 28.5-30.5'											X	
	SOIL	MW-14	Sep-97	10'								X				
	SOIL	MW-14	Sep-97	60'											X	
	SOIL	DW-01	Sep-97	30-32'											X	
	GROUND WATER	MW-02,MW-03, MW-04	Aug-92	WATER TABLE		X			X	X						
	GROUND WATER	MW-02,MW-03, MW-04	Jan-93	WATER TABLE					X	X	X					
	GROUND WATER	ET-02, ET-03	Jan-93	WATER TABLE		X		X			X					
	GROUND WATER	MW-02,MW-03, MW-04	Sep-93	WATER TABLE					X	X						
	GROUND WATER	ET-03	Sep-93	WATER TABLE	X			X			X					
	GROUND WATER	MW-08, MW-09	Sep-93	WATER TABLE	X			X			X					
	GROUND WATER	ET-03, MW-08, MW-09	Nov-95	WATER TABLE					X	X	X					
	GROUND WATER	MW-11,MW-12, MW-13	Nov-95	WATER TABLE					X	X	X					
	GROUND WATER	GP-104, GP-106, GP-107	Nov-95	WATER TABLE					X	X	X					
	GROUND WATER	ET-03, MW-08, MW-09	May-96	WATER TABLE							X					
	GROUND WATER	MW-11, MW-12, MW-13	May-96	WATER TABLE							X					
	GROUND WATER	ET-03, MW-08, MW-09	May-97	WATER TABLE					X		X					
	GROUND WATER	MW-11, MW-12, MW-13	May-97	WATER TABLE					X		X					
	GROUND WATER	MW-02,MW-03, MW-04	Oct-97	WATER TABLE							X					
	GROUND WATER	ET-03, MW-08	Oct-97	WATER TABLE					X	X				X		
	GROUND WATER	MW-11 through MW-14	Oct-97	WATER TABLE					X	X				X		
	GROUND WATER	DW-01	Oct-97	BEDROCK, 65-71'					X	X				X		
	GROUND WATER	ET-03, MW-08, DW-01	Jan-98	WATER TABLE							X					

ANALYTICAL PROTOCOL KEY:

A: VOCs (8240)
B: VOCs (8240) with library search
C: Total RCRA metals including aluminum
D: Total/ dissolved metals including aluminum
E: Total aluminum
F: Dissolved or extractable aluminum
G: Field indicator parameters (pH, conductivity, temperature)
H: Laboratory or field pH
I: Leachable aluminum
J: Natural attenuation parameters (hardness, alkalinity, sulfate, sulfite, iron, phosphate, nitrate, nitrite)
K: Calcium carbonate
L: VOC Tentatively Identified Compound Scan

TABLE 2

BACKGROUND SOIL AND SURFACE WATER
ANALYTICAL RESULTS
FORMER ETCHANT AREA

SOIL						
SAMPLE DESIGNATION:	Bkgnd -1	Bkgnd -2	Bkgnd -3	Bkgnd -4	Bkgnd -4	Average Background
DEPTH:	(0 - 2')	(0 - 1')	(1 - 2')	(1 - 2')	(1 - 2')	
DATE SAMPLED:	Jan-93	Jan-93	Jan-93	Feb-94	Feb-94	
SAMPLED BY:	Delta	Delta	Delta	Delta	AWARE	
METALS (mg/kg)						
Aluminum	13000	23000	13000	22000	19000	18000
Arsenic	<1.2	<1.3	<1.3	NA	2.3	1.45
Barium	300	440	170	200	160	254
Cadmium	<1.2	2.2	<1.3	NA	NA	1.5
Chromium	70	80	30	47	44	54.2
Lead	2.3	7.5	4.5	6.5	7.6	5.68
Mercury	<0.058	<0.065	<0.063	NA	0.1	0.07
Selenium	<1.2	<1.3	<1.3	NA	NA	<1.3
Silver	<2.3	<2.6	<2.5	NA	NA	<2.5

SURFACE WATER							
SAMPLE DESIGNATION:	Upstream	Upstream	Midstream	Midstream	Downstream	Downstream	Surface Water Standard
DATE SAMPLED:	Oct-96	Sep-97	Oct-96	Sep-97	Oct-96	Sep-97	
SAMPLED BY:	Delta	Delta	Delta	Delta	Delta	Delta	
METALS (mg/l)							
Aluminum	<100	NA	460	NA	<100	NA	NS
VOLATILES (ug/l)							
All targeted VOCs	BQL	NA	BQL	NA	BQL	NA	NS
FIELD INDICATOR PARAMETERS							
pH	6.49	7.8	6.73	7.0	7.25	7.7	6.0-9.0

NA = Not Analyzed
mg/l = milligrams per liter
ug/l = micrograms per liter
BQL = Below the quantitation limit

TABLE 3

SOIL ANALYTICAL RESULTS
FORMER ETCHANT AREA

SAMPLE DESIGNATION:	ET-01	ET-02A	ET-02	GP-301	GP-302	GP-304	GP-304	GP-306	GP-306	GP-307	GP-308	GP-308	GP-309	GP-309	MW-14	Average Bkgnd	Clean-up Level
DEPTH:	(1-1.5')	(1-1.5')	(20-21.5')	(28-30')	(22-24')	(4-6')	(22-24')	(10-12')	(22-24')	(4-6')	(4-6')	(22-24')	(4-6')	(16-18')	(10')		
DATE SAMPLED:	Jan-93	Jan-93	Jan-93	Sep-97	Sep-97	Sep-97	Sep-97	Sep-97	Sep-97	Sep-97	Sep-97	Sep-97	Sep-97	Sep-97	Oct-97		
SAMPLED BY:	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	
METALS (mg/kg)																	
Aluminum	32000	17000	13000	11100	12500	28100	16200	19800	12400	16100	22600	10900	16400	14800	NA	18000	200000
Aluminum, leachable (mg/l)	0.15	0.97	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NS
Arsenic	<1.2	1.3	<1.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.45	3.8
Barium	550	180	520	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	254	28000
Cadmium	2.2	2.4	<1.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.5	200
Chromium	72	23	85	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	54.2	2000
Lead	23	8.9	4.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.68	400
Mercury	<0.062	<0.064	<0.062	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.07	40
Selenium	<1.2	<1.2	<1.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<1.3	2000
Silver	<2.5	<2.6	<2.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<2.5	2000
VOLATILES (mg/kg)																	
Acetone	<0.012	<0.013	<0.012	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	40000
TICs Found - 1 Unknown	0.003, RT=24.1	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NS
FIELD INDICATOR PARAMETERS																	
pH	NA	NA	NA	5.9	6.3	4.7	7.7	3.9	4.3	6.6	6.8	6.3	5.3	5.6	6.5	NA	NS

mg/kg = Milligrams per kilogram.
mg/l = Milligrams per liter.
NS = No regulatory limit.
NA = Not analyzed.
TICS = Tentatively identified compounds.
RT = Retention time.
• = Concentration exceeds the clean-up level or average background concentration.
Clean-up levels are from the North Carolina risk analysis framework for industrial/commercial exposure scenarios.

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TABLE 4

MONITORING WELL CONSTRUCTION CHARACTERISTICS
FORMER ETCHANT AREA

MONITORING WELL NO.	TOTAL DEPTH (fbg)	SCREEN INTERVAL (fbg)	DEPTH TO GROUND WATER (10/13/97) (fbg)	TOP OF CASING ELEVATION (msl)	WATER TABLE ELEVATION (10/13/97) (msl)
MW-02	38	28 - 38	NM	2669.61	NM
MW-03	13	3-13	NM	2645.27	NM
MW-04	13	3-13	NM	2647.49	NM
MW-08	37	22 - 37	30.85	2671.91	2641.06
MW-09	35	20 - 35	33.58	2677.59	2644.01
MW-11	40	25 - 40	30.42	2661.73	2640.76
MW-12	45	30 - 45	30.60	2671.18	2640.58
MW-13	40	25 - 40	30.77	2670.51	2639.74
MW-14	72	62 - 72	57.05	2712.62	2655.57
ET-02	40	25 - 40	NM	-	-
ET-03	35	20 - 35	30.10	2672.27	2642.17
DW-01	71	66 - 71	39.77	2672.05	2632.28

NM = not measured
fbg = feet below ground elevation
msl = feet above mean sea level

TABLE 5

SUMMARY OF GROUND WATER FIELD INDICATOR PARAMETERS
FORMER ETCHANT AREA

	MONITORING WELLS																	
	MW-02			MW-03			MW-04			ET-02			ET-03			MW-08		
	pH (Std. Units)	Conductivity (uS)	Temp. (C)	pH (Std. Units)	Conductivity (uS)	Temp. (C)	pH (Std. Units)	Conductivity (uS)	Temp. (C)	pH (Std. Units)	Conductivity (uS)	Temp. (C)	pH (Std. Units)	Conductivity (uS)	Temp. (C)	pH (Std. Units)	Conductivity (uS)	Temp. (C)
Jan-93	6.9	700	15	7.3	245	10	6.4	360	11.5	5.9	460	17	4.77	1150	10.5	NI	NI	NI
Sep-93	5.9	NA	13.7	6.4	NA	15.5	6.2	NA	16	NS	NS	NS	3.70	NS	13.9	4.70	NS	13.8
Nov-95	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3.63	2584	17.6	4.04	2368	22.2
Nov-96	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3.73	NA	NA	4.41	NA	NA
May-97	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3.68	1380	17.2	4.37	1176	19.9
Oct-97	5.6	NA	NA	7.6	NA	NA	6.0	NA	NA	NS	NS	NS	3.86	1354	14.27	4.24	1679	15.66

	MONITORING WELLS																	
	MW-09			MW-11			MW-12			MW-13			MW-14			DW-01		
	pH (Std. Units)	Conductivity (uS)	Temp. (C)	pH (Std. Units)	Conductivity (uS)	Temp. (C)	pH (Std. Units)	Conductivity (uS)	Temp. (C)	pH (Std. Units)	Conductivity (uS)	Temp. (C)	pH (Std. Units)	Conductivity (uS)	Temp. (C)	pH (Std. Units)	Conductivity (uS)	Temp. (C)
Jan-93	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NS	NS	NS	NS	NS	NS
Sep-93	6.30	NS	15.6	NI	NI	NI	NI	NI	NI	NI	NI	NI	NS	NS	NS	NS	NS	NS
Nov-95	5.76	711	NS	6.36	180.9	17.2	5.71	138.3	15.4	6.01	252.7	18.5	NS	NS	NS	NS	NS	NS
Nov-96	5.59	NA	NA	6.38	NA	NA	5.48	NA	NA	5.80	NA	NA	NS	NS	NS	NS	NS	NS
May-97	5.18	482	12.9	6.32	150	17.2	5.51	182	15.5	5.86	376	16	NS	NS	NS	NS	NS	NS
Oct-97	NS	NS	NS	6.54	79	12.77	5.70	154	12.44	5.89	396	16.39	6.01	120	11.61	5.14	731	16.25

	GEOPROBE SAMPLES								
	GP-104			GP-106			GP-107		
	pH (Std. Units)	Conductivity (uS)	Temp. (C)	pH (Std. Units)	Conductivity (uS)	Temp. (C)	pH (Std. Units)	Conductivity (uS)	Temp. (C)
Nov-95	6.50	1.75	NS	6.09	1.1	NS	6.45	4.4	NS

SPECIFIC CONDUCTIVITY VALUES ARE REPORTED AS MICROMHOS/CM
TEMPERATURES REPORTED AS DEGREES CENTIGRADE
NI = MONITORING WELL HAD NOT BEEN INSTALLED AT TIME OF SAMPLING
NA = NOT ANALYZED
NS = SAMPLE NOT OBTAINED

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	MW-02 FILTERED	MW-02 UNFILTERED
Aug-92	NS	170000
Jan-93	<100	99000
Sep-93	<100	41000
Sep-93	NS	NS
Nov-95	NS	NS
Nov-95	NS	NS
May-97	NS	NS
Oct-97	NS	NS

	MW-09 FILTERED	MW-09 UNFILTERED
Aug-92	NI	NI
Jan-93	NI	NI
Sep-93	<100	7000
Sep-93	<200	2600*
Nov-95	<100	570*
Nov-95	NS	NS
May-97	NS	910*
Oct-97	NS	NS

	GP-104 FILTERED	GP-104 UNFILTERED
Nov-95	<100	17000*

ALL VALUES ARE REPORTED AS PARTS PER
NS = MONITORING WELL NOT SAMPLED.
NI = MONITORING WELL HAD NOT BEEN INS
* = UNFILTERED ALUMINUM ANALYZED IN
THESE GROUND WATER SAMPLES WERE

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GROUNDWATER ANALYTICAL RESULTS
DISSOLVED / TOTAL ALUMINUM
FORMER ETCHANT AREA

	MONITORING WELLS											
	MW-02 FILTERED	MW-02 UNFILTERED	MW-03 FILTERED	MW-03 UNFILTERED	MW-04 FILTERED	MW-04 UNFILTERED	ET-02 FILTERED	ET-02 UNFILTERED	ET-03 FILTERED	ET-03 UNFILTERED	MW-08 FILTERED	MW-08 UNFILTERED
Aug-92	NS	170000	NS	100000	NS	240000	NI	NI	NI	NI	NI	NI
Jan-93	<100	99000	<100	54000	<100	71000	230	64000	39000	74000	NI	NI
Sep-93	<100	41000	<100	42000	<100	35000	NS	NS	56000	56000	5600	81000
Sep-93	NS	NS	<100	NS	NS	NS	NS	NS	NS	NS	5000	59000
Nov-95	NS	NS	NS	NS	NS	NS	NS	NS	51000	48000*	6200	6800*
Nov-95	NS	NS	NS	NS	NS	NS	NS	NS	NS	46900*	NS	11100*
May-97	NS	NS	NS	NS	NS	NS	NS	NS	NS	20000*	NS	2200*
Oct-97	NS	NS	NS	NS	NS	NS	NS	NS	20600	19678*	2460	3955*

	MONITORING WELLS											
	MW-09 FILTERED	MW-09 UNFILTERED	MW-11 FILTERED	MW-11 UNFILTERED	MW-12 FILTERED	MW-12 UNFILTERED	MW-13 FILTERED	MW-13 UNFILTERED	MW-14 FILTERED	MW-14 UNFILTERED	DW-01 FILTERED	DW-01 UNFILTERED
Aug-92	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Jan-93	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Sep-93	<100	7000	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Sep-93	<200	2600*	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Nov-95	<100	570*	<100	570*	<100	170*	<100	330*	NI	NI	NI	NI
Nov-95	NS	NS	NS	704*	NS	NS	NS	218*	NI	NI	NI	NI
May-97	NS	910*	NS	440*	NS	170*	NS	320*	NI	NI	NI	NI
Oct-97	NS	NS	84.5	1921*	<50.0	948*	<50.0	248*	144	2579*	2390	3371*

	GEOPROBE SAMPLES					
	GP-104 FILTERED	GP-104 UNFILTERED	GP-106 FILTERED	GP-106 UNFILTERED	GP-107 FILTERED	GP-107 UNFILTERED
Nov-95	<100	17000*	<100	8800*	<100	45000*

ALL VALUES ARE REPORTED AS PARTS PER BILLION (UG/L).
NS = MONITORING WELL NOT SAMPLED.
NI = MONITORING WELL HAD NOT BEEN INSTALLED AT TIME OF SAMPLING.
* = UNFILTERED ALUMINUM ANALYZED IN ACCORDANCE WITH STANDARD METHOD 3030C (DENR GUIDELINES).
THESE GROUND WATER SAMPLES WERE OBTAINED USING LOW FLOW (MICROPURGING TECHNIQUES).

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TABLE 7

GROUND WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS AND METALS
FORMER ETCHANT AREA

SAMPLE DESIGNATION:	MW-02	MW-03	MW-04	ET-02	ET-02	ET-03	MW-02	MW-02	MW-03	MW-03	MW-04	MW-04	ET-03	2L STANDARD
FILTERED/ UNFILTERED:	UNFILTERED	UNFILTERED	UNFILTERED	UNFILTERED	FILTERED	UNFILTERED	UNFILTERED	FILTERED	UNFILTERED	FILTERED	UNFILTERED	FILTERED	FILTERED	
DATE SAMPLED:	Aug-92	Aug-92	Aug-92	Jan-93	Jan-93	Jan-93	Jan-93	Jan-93	Jan-93	Jan-93	Jan-93	Jan-93	Jan-93	
SAMPLED BY:	AWARE	AWARE	AWARE	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	ug/l
METALS														
Arsenic	<0.5	<0.5	<0.5	< 5.0	< 5.0	< 25	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	< 10	50
Barium	1800	1800	6600 *	1500	< 100	940	830	<100	980	<100	1300	260	< 100	2000
Cadmium	<5.0	<5.0	<5.0	< 5.0	< 5.0	< 5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	< 5.0	5
Chromium	240 *	190 *	450 *	280 *	< 10	43	120 *	<10	92 *	<10	130 *	<10	< 10	50
Lead	24 *	40	67 *	< 5.0	< 5.0	< 5.0	21 *	<5.0	20	<5.0	19	<5.0	< 5.0	15
Mercury	<0.5	<0.5	0.6	< 0.10	< 0.10	< 0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	< 0.10	1.1
Selenium	<5.0	<5.0	<5.0	< 5.0	< 5.0	< 10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	< 5.0	50
Silver	<10	<10	<10	< 10	< 10	< 10	<10	<10	<10	<10	<10	<10	< 10	15
VOLATILES														
Tetrachloroethene	NA	<1.0	<1.0	<5.0	NA	<5.0	NA	NA	3 *	NA	<1.0	NA	NA	0.7
Acetone	NA	NA	NA	< 10	NA	< 10	NA	NA	NA	NA	NA	NA	NA	700
Trichloroethene	10 *	12 *	<1.0	<5.0	NA	<5.0	12 *	NA	8 *	NA	<1.0	NA	NA	2.8
LIBRARY SEARCH														
Number TICs Found	NA	NA	NA	0	NA	0	NA	NA	NA	NA	NA	NA	NA	NS

SAMPLE DESIGNATION:	ET-03	ET-03	MW-02	MW-02	MW-03	MW-03	MW-04	MW-04	MW-08	MW-08	MW-08	MW-08	MW-09	MW-09	MW-09	MW-09	2L STANDARD
FILTERED/ UNFILTERED:	UNFILTERED	FILTERED	UNFILTERED	FILTERED	UNFILTERED	FILTERED	UNFILTERED	FILTERED	UNFILTERED	UNFILTERED	FILTERED	FILTERED	UNFILTERED	UNFILTERED	FILTERED	FILTERED	
DATE SAMPLED:	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	
SAMPLED BY:	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	AWARE	DELTA	AWARE	DELTA	AWARE	DELTA	AWARE	ug/l
METALS																	
Arsenic	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	50
Barium	<100	<100	390	<100	570	<100	730	290	990	620	<100	<200	130	<200	<100	<200	2000
Cadmium	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.8 *	NA	<5.0	NA	<5.0	NA	<5.0	NA	5
Chromium	12	12	50	<10	67 *	<10	50	<10	140 *	90 *	<10	<10	<10	20	<10	<10	50
Lead	<5.0	<5.0	6.9	<5.0	9	<5.0	7.6	<5.0	14	15	<5.0	12	<5.0	5	<5.0	6	15
Mercury	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.1
Selenium	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	50
Silver	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	15
VOLATILES																	
Tetrachloroethene	<5.0	NA	NA	NA	<5.0	NA	<5.0	NA	<5.0	NA	NA	NA	<5.0	NA	NA	NA	0.7
Acetone	<10	NA	<10	NA	<10	NA	<10	NA	<10	NA	NA	NA	<10	NA	NA	NA	700
Trichloroethene	<5.0	NA	<5.0	NA	<5.0	NA	<5.0	NA	<5.0	NA	NA	NA	<5.0	NA	NA	NA	2.8
LIBRARY SEARCH																	
Number TICs Found	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NS

All values reported in micrograms per liter (ug/l).
NA = Not analyzed.
NS = North Carolina 2L standard not established.
TICs = Tentatively identified compounds.
* = Concentration exceeds ground water standard.

9400\ftsamples.xls

SAMPLE DES
FILTERED/ UN
DATE
SA
GROUND WAT
Iron
Alkalinity
Hardness
Nitrite
Nitrate
Total Phosphoru
Sulfite
Sulfate
DO (field)
ORP (field)
SOIL
SAMPLE DESI
DATE
SA
Calcium Carbona
Wet Density (pcf)
Moisture Content
Specific Gravity
Permeability (cm/

mg/l = Milligrams
NS = North Carol
NA = Not analyz
DO = Dissolved
ORP = Oxidation
pcf = Pounds per
cm/sec = Centimet
* = Concentrati

9400\tcs\tcha.xls

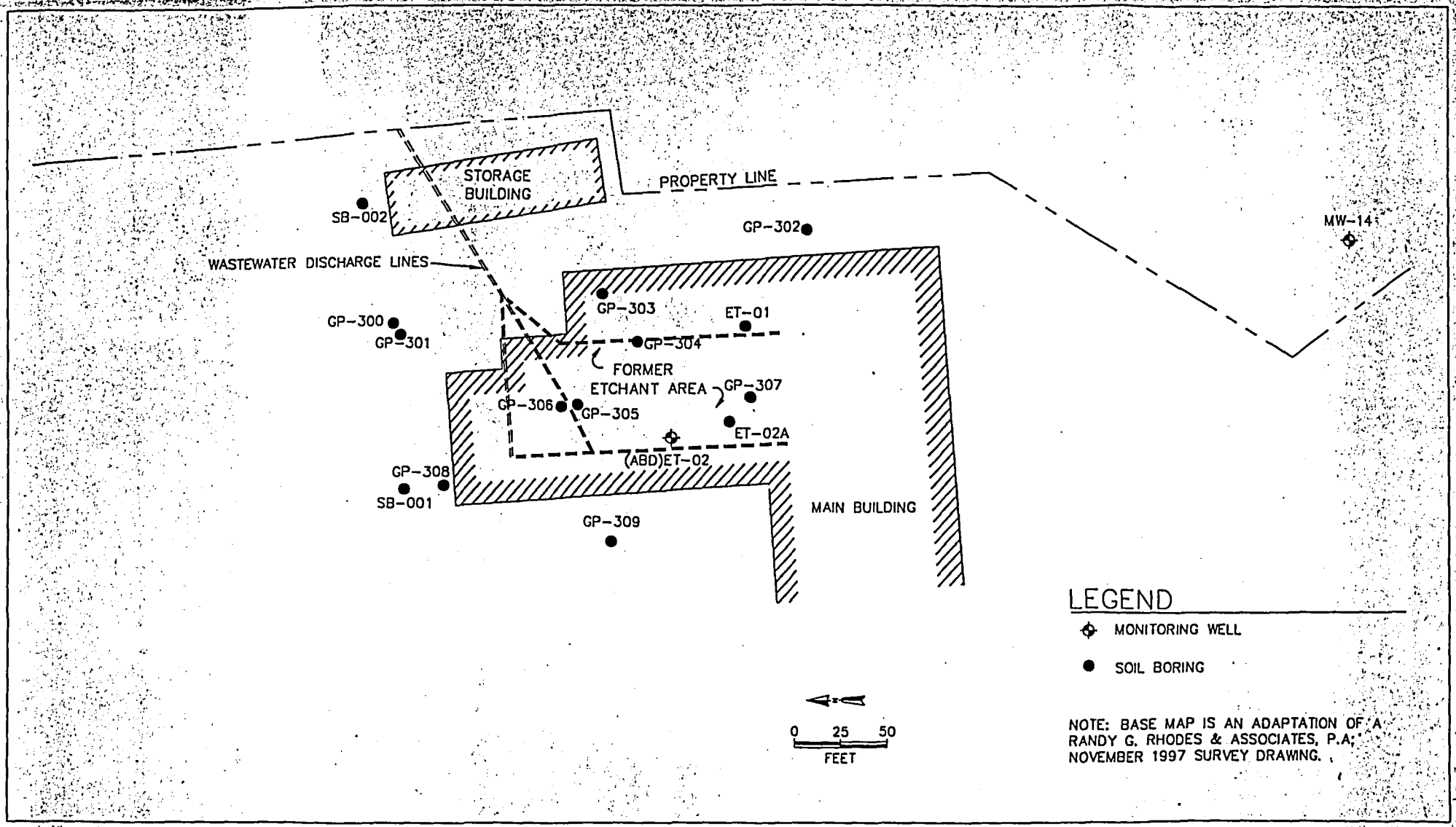
TABLE 8

NATURAL ATTENUATION AND GEOTECHNICAL PARAMETERS
FORMER ETCHANT AREA

SAMPLE DESIGNATION:	ET-03	MW-08	MW-11	MW-12	MW-13	MW-14	DW-01	2L STANDARD (mg/L)
FILTERED/ UNFILTERED:	FILTERED	FILTERED	FILTERED	FILTERED	FILTERED	FILTERED	FILTERED	
DATE SAMPLED:	Oct-97	Oct-97	Oct-97	Oct-97	Oct-97	Oct-97	Oct-97	
SAMPLED BY:	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	
GROUND WATER (mg/l)								
Iron	0.975*	1.970*	0.626*	0.138	<0.100	0.702*	<0.100	0.3
Alkalinity	<1.0	<1.0	49.7	21.8	37.2	47.6	<1.0	NS
Hardness	213	58.9	6.4	54.1	155	53.6	172	NS
Nitrite	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.068	1
Nitrate	20.1*	13.0*	0.383	10.8*	6.10	0.957	19.6*	10
Total Phosphorous	0.168	<0.02	0.02	<0.02	0.026	0.038	<0.02	NS
Sulfite	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	NS
Sulfate	342*	268*	17.3	5.35	114	16.3	212	250
DO (field)	10.67	5.93	7.16	8.13	7.31	4.66	8.76	NS
ORP (field)	307.5	247.5	337.8	350	142.9	345.8	-90.0	NS

SOIL					
SAMPLE DESIGNATION:	SB-001	SB-002	SB-002	MW-14	DW-01
DEPTH:	(28-30')	(8.5 - 10.5')	(28.5- 30.5')	(60')	(30 - 32')
DATE SAMPLED:	Sep-97	Sep-97	Sep-97	Sep-97	Sep-97
SAMPLED BY:	DELTA	DELTA	DELTA	DELTA	DELTA
Calcium Carbonate (%)	<1	NA	2.48	<1	<1
Wet Density (pcf)	NA	95.3	NA	NA	NA
Moisture Content (%)	NA	12.2	NA	NA	NA
Specific Gravity	NA	2.72	NA	NA	NA
Permeability (cm/sec)	NA	2.8×10^{-4}	NA	NA	NA

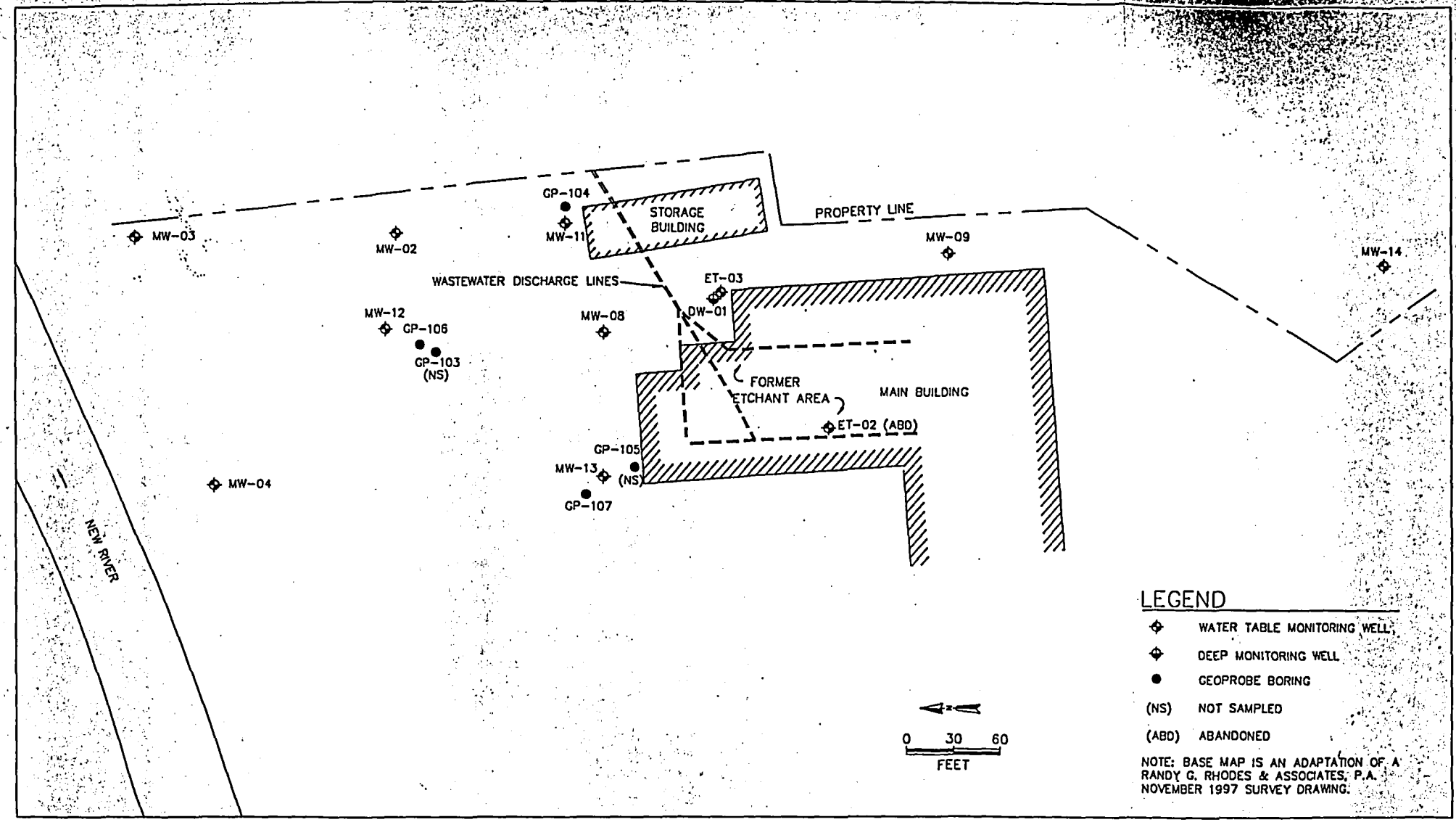
mg/l = Milligrams per liter.
NS = North Carolina 2L standard not established.
NA = Not analyzed.
DO = Dissolved Oxygen
ORP = Oxidation Reduction Potential, reported in millivolts
pcf = Pounds per cubic feet.
cm/sec = Centimeters per second.
* = Concentration exceeds 2L standard



Delta Environmental Consultants, Inc.

TITLE:
SOIL SAMPLE LOCATION MAP
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

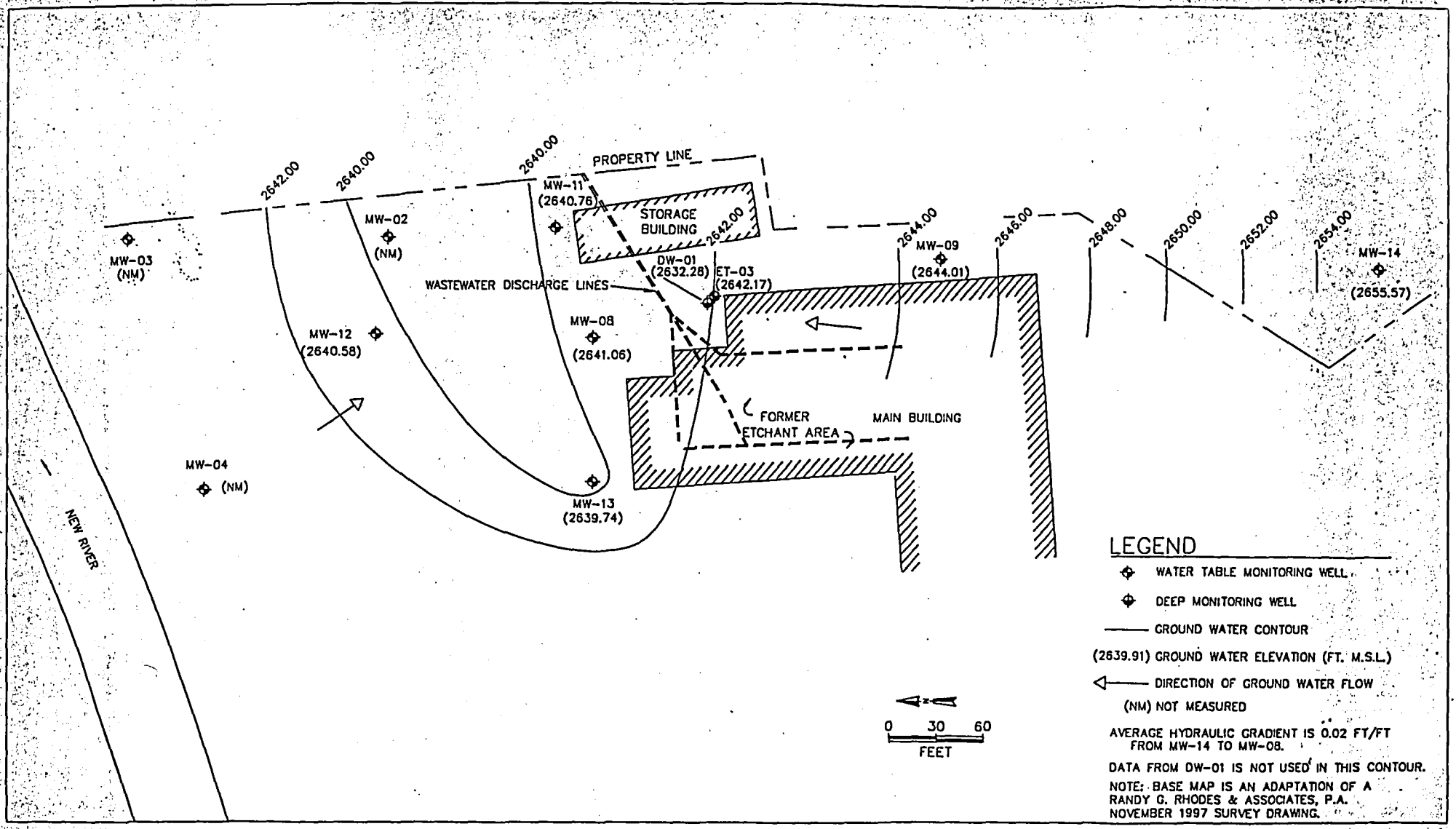
DWN: AWH	DES.:	PROJECT NO.: S094-001
CHKD:	APPD:	FIGURE NO.: 4
DATE: 1/28/99	REV.:	



Delta Environmental Consultants, Inc.

TITLE:
GROUND WATER SAMPLE LOCATION MAP
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

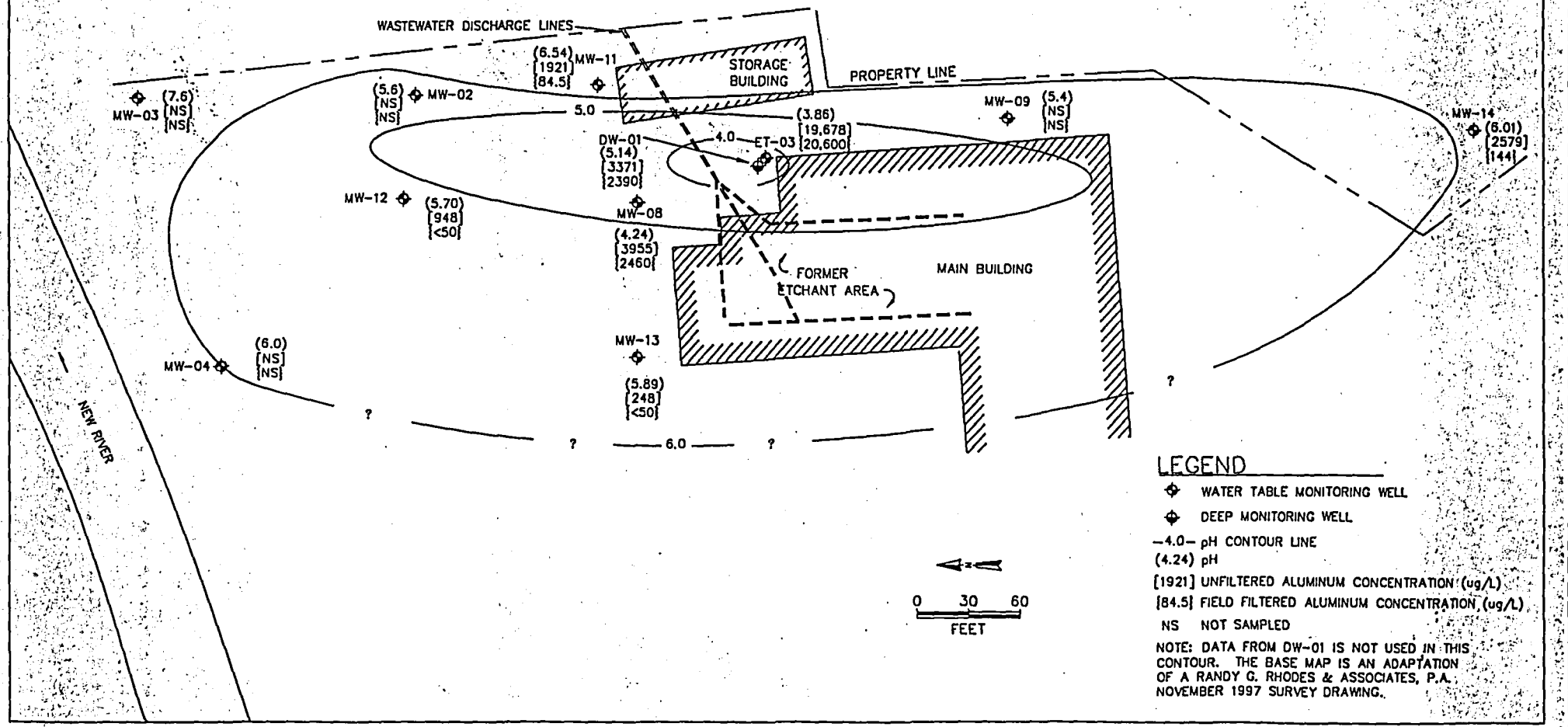
DWN: AWH	DES.: REP.	PROJECT NO.: S094-001	
CHKD:	APPD:	FIGURE NO.: 9	
DATE: 01/26/98	REV.:		



Delta Environmental Consultants, Inc.

TITLE:
GROUND WATER ELEVATION CONTOUR MAP (OCTOBER 1997)
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

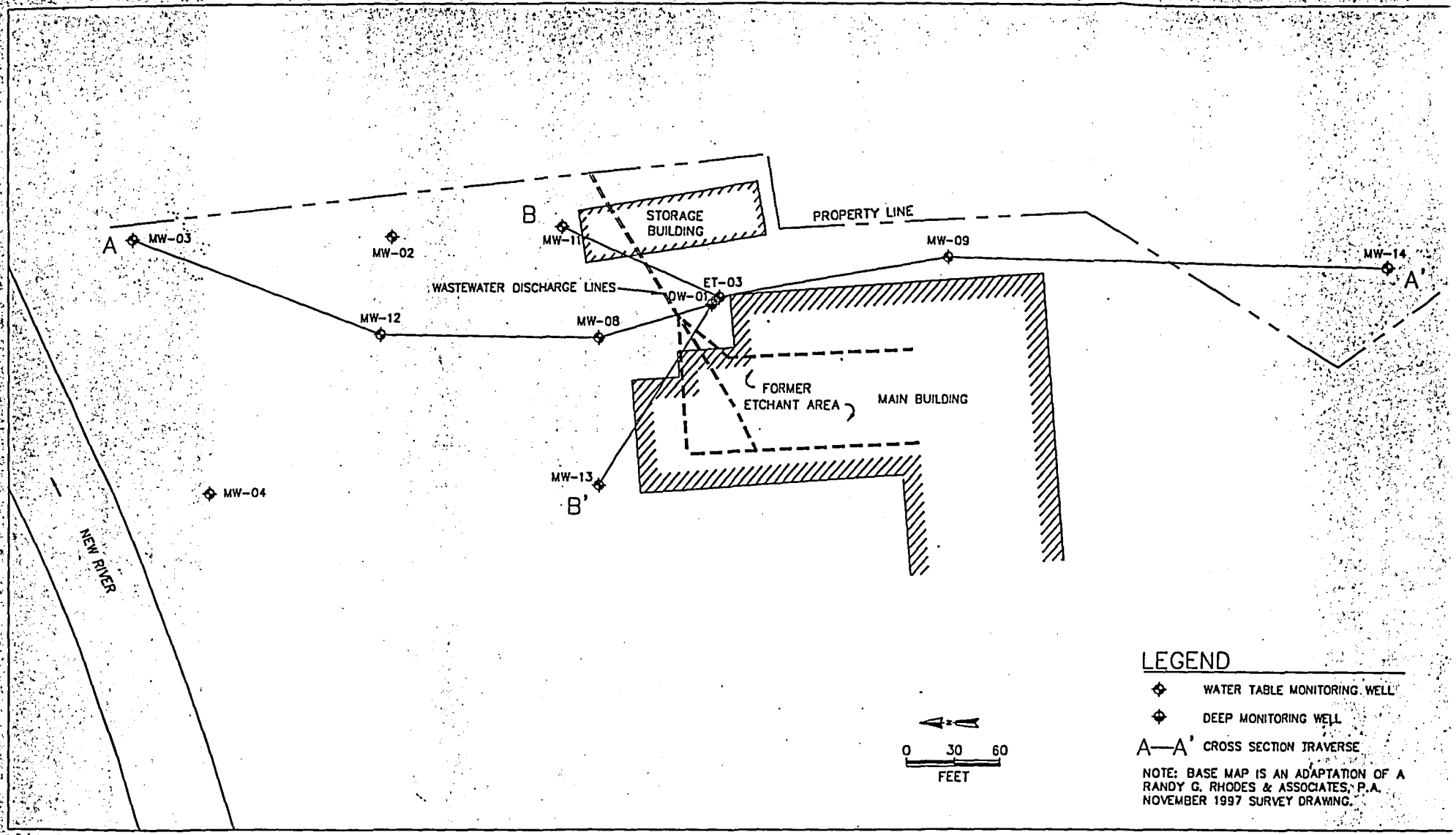
DWN: AWH	DES.: REP	PROJECT NO.: S094-00
CHKD:	APPD:	FIGURE NO.: 10
DATE: 01/26/98	REV.:	



Delta Environmental Consultants, Inc.

TITLE:
GROUND WATER pH ISOCONCENTRATION CONTOUR MAP (OCTOBER 1997)
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

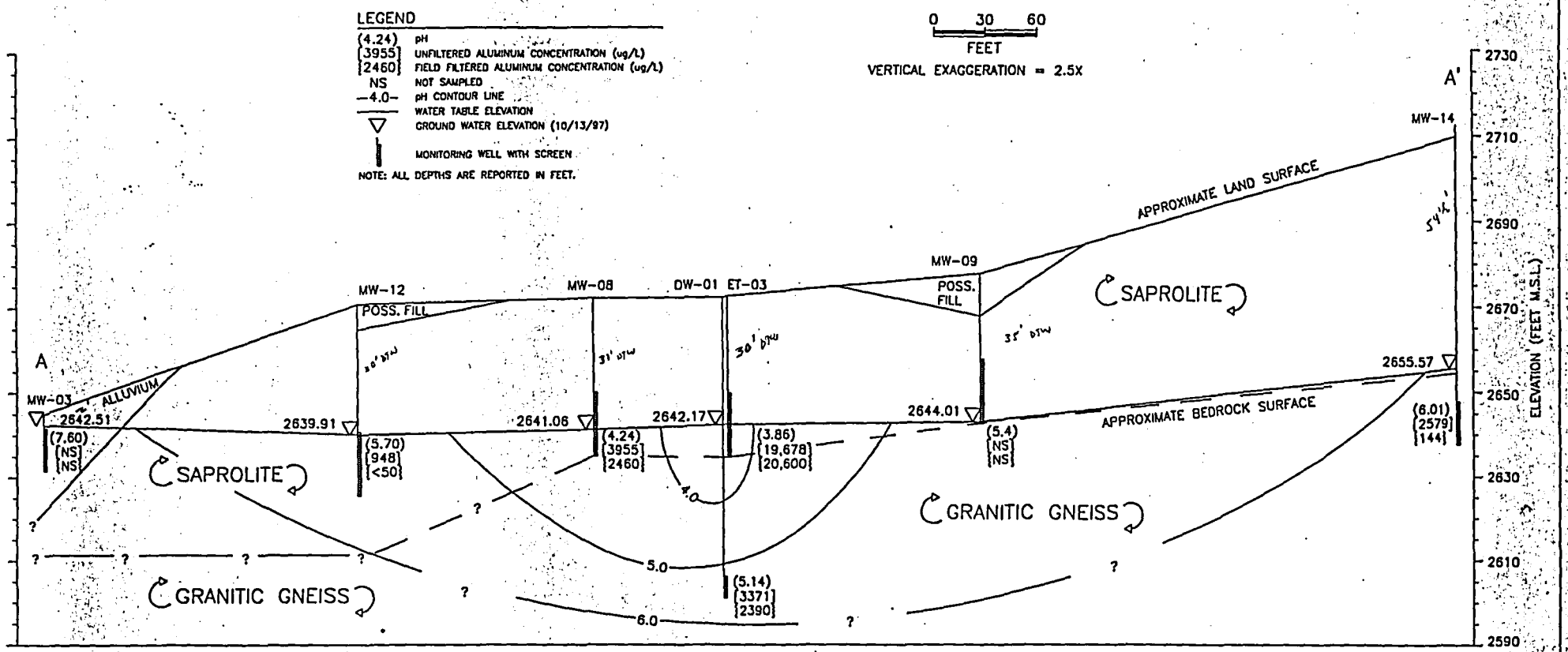
DWN: AWH	DES.: REP	PROJECT NO.: S094-001
CHKD:	APPD:	FIGURE NO.: 1.1
DATE: 01/26/98	REV.:	



Delta Environmental Consultants, Inc.

TITLE:
GROUND WATER ISOCONCENTRATION CROSS SECTION LOCATION MAP
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

DWN: AWH	DES.: REP	PROJECT NO.: S094-00	
CHKD:	APPD:	FIGURE NO.: 12	
DATE: 01/26/98	REV.:		



Delta Environmental Consultants, Inc.

TITLE:
GROUND WATER pH ISOCONCENTRATION CONTOUR CROSS SECTION A – A' (OCTOBER 1997)
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

DWN: AWH	DES.: REP	PROJECT NO.: S094-001	
CHKD:	APPD:		
DATE: 01/27/98	REV.:	FIGURE NO.: 13	

Ref. 17

COMPREHENSIVE SITE ASSESSMENT
CONTAINMENT DIKE AREA
UNITED CHEMI-CON MANUFACTURING, INC.
Formerly SPRAGUE ELECTRIC COMPANY
LANSING, NORTH CAROLINA
DELTA PROJECT NO. S094-001-1.0046

This report was prepared by:

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April 1999

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 Purpose 1
1.2 Scope of Work 1

2.0 SITE HISTORY AND SOURCE CHARACTERIZATION 1

2.1 Property Ownership and Use 1
2.2 Release Incidents and Environmental Investigations 2
2.3 Corrective Actions to Date 3

3.0 POTENTIAL RECEPTORS AND MIGRATION PATHWAYS 3

3.1 Water Supply Wells 3
3.2 Surface Water 3
3.3 Utilities 4

4.0 PHYSICAL SETTING 4

4.1 Regional Geology and Hydrogeology 4
4.2 Site Geology and Soils 4

5.0 FIELD ACTIVITIES 4

5.1 Soil Investigation 5
5.2 Ground Water Investigation 6
5.2.1 Monitoring Well Construction 6
5.2.2 Monitoring Well Location and Rationale 6
5.2.3 Ground Water Flow 7
5.3 Ground Water Analytical Results 8
5.4 Surface Water 9
5.5 Preliminary Natural Attenuation Data 9

6.0 CONCLUSIONS 9

7.0 RECOMMENDATIONS 10

8.0 REFERENCES 11

9.0 REMARKS 11

TABLES

Table 1	Sampling Summary
Table 2	Historical Soil Analytical Data
Table 3	Soil Geotechnical Analytical Data
Table 4	Monitoring Well Construction Characteristics
Table 5	Historical Ground Water Elevations
Table 6A	Ground Water Analytical Data - VOCs
Table 6B	Ground Water Analytical Data - SVOCs & Metals
Table 7	Surface Water Analytical Results
Table 8	Preliminary Natural Attenuation Data
Table 9	Preliminary Natural Attenuation Screening

FIGURES

Figure 1	Topographic Location Map
Figure 2	Site Map
Figure 3	Potential Receptor Survey Map
Figure 4	Cross-Section Location Map
Figure 5	Cross-Section A-A'
Figure 6	Cross Section B-B'
Figure 7	Containment Area Soil Sample Map
Figure 8	Water Table Elevation Contour Map (Aug-98)
Figure 9	Potentiometric Surface Map (Aug -98)
Figure 10	TCE Isoconcentration Contour Map, Water Table (Aug-98)
Figure 11	Naphthalene Isoconcentration Map, Water Table (Aug-98)
Figure 12	2-Methylnaphthalene Isoconcentration Map, Water Table (Aug-98)
Figure 13	TCE Isoconcentration Map, Bedrock Wells (Aug-98)

APPENDICES

Appendix A	Laboratory Analytical Data
Appendix B	Transport Model
Appendix C	Geotechnical Laboratory Data
Appendix D	Soil Boring Logs / Monitoring Well Construction Details
Appendix E	Vertical Gradient Calculations
Appendix F	Supply Well Analytical Results
Appendix G	Analytical Parameters & Weighing for Preliminary Screening

COMPREHENSIVE SITE ASSESSMENT
CONTAINMENT DIKE AREA
UNITED CHEMI-CON MANUFACTURING, INC.
Formerly SPRAGUE ELECTRIC COMPANY
LANSING, NORTH CAROLINA
DELTA PROJECT NO. S094-001-1.0046

1.0 INTRODUCTION

1.1 Purpose

The purpose of this report is to provide a comprehensive discussion of the various phases of site assessment activities performed in the containment dike area at the referenced site. Delta Environmental Consultants, Inc. (Delta) was retained by American Annuity Group, Inc. (AAG), successor in interest to Sprague Electric Company (Sprague), to perform this comprehensive site assessment (CSA).

This CSA was prepared in order to better determine the nature and extent of volatile organic compounds (VOCs) present in the subsurface within a portion of the site. The purposes of performing the CSA were to:

- delineate the nature and extent of previous releases of VOCs to the soil and ground water;
- characterize the subsurface geology and hydrogeology;
- provide sufficient data in order to prepare a Corrective Action Plan; and,
- determine if remediation is necessary.

1.2 Scope of Work

The CSA included performing the following tasks:

- obtaining and analyzing 25 soil samples;
- installing ten water table monitoring wells and three telescoped deep monitoring wells;
- obtaining ground water samples from two Geoprobe borings and each monitoring well on two to seven occasions;
- reviewing analytical results provided by United Chemi-Con Manufacturing, Inc. (UCCM) for the water supply well;
- obtaining three surface water samples in order to evaluate water quality of North Fork of the New River;
- performing laboratory analyses of the soil, ground water and surface water samples to determine chemical quality;
- determining potential receptors by performing a visual survey of the area within a 1,500-foot radius of the site;
- performing geotechnical analysis on select samples in order to determine hydraulic properties of the surficial aquifer;
- determining the potential for the VOCs to naturally attenuate; and,
- preparing this report.

2.0 SITE HISTORY AND SOURCE CHARACTERIZATION

2.1 Property Ownership and Use

The site is located in Ashe County, North Carolina, approximately one and one-quarter miles south of Lansing (Figures 1 and 2). The 60 acre site is bordered on the north and west by the North Fork of the New River.

Immediately east of the UCCM facility is property currently owned by AAG. Immediately south of the UCCM facility is undeveloped and wooded area.

The facility was owned and operated from 1953 through August 1992 by Sprague. UCCM purchased the facility from Sprague on August 31, 1992.

The facility was constructed in 1953 and operations were initiated by Sprague in 1954. Historically, the processes employed at the facility include winding, impregnation, assembly, aging, testing, and packing of aluminum based capacitors. Previous activities also included the etching and formation of aluminum oxide from approximately 1961 through 1990.

UCCM continues to produce aluminum based capacitors. The capacitors are impregnated with an electrolytic solution that consists of a mixture of dimethylformamide (DMF) and ethylene glycol. A 10,000-gallon above ground storage tank (AST) is present within the containment dike area. This AST contains DMF and was installed in the early 1980's. Rainwater that collects within the dike area is periodically discharged through a drain along the north side of the dike. The dike is constructed of concrete blocks and contains a concrete floor.

Formerly, trichloroethene (TCE) and possibly tetrachloroethene (PCE) and methylene chloride were used to remove residue from manufactured capacitors from approximately 1972 through 1977. The chemicals were used in a vapor degreaser located near the center of the manufacturing building (Figure 2). According to interviews with former Sprague employees, the solvents were stored in 55-gallon drums and transported to the vapor degreaser as needed.

2.2 Release Incidents and Environmental Investigations

Data from previous investigations performed by AAG at various locations throughout the site have been submitted to the NCDENR Division of Environmental Management (DEM) and Division of Solid Waste Management. On October 1, 1992, a notification of a suspected release of heating oil from underground storage tank(s) was made by Hunton & Williams (counsel for AAG) to the Groundwater Section of the Winston-Salem Regional Office (WSRO). On November 20, 1992, Hunton & Williams submitted a report of ground water test results under monitoring well permit #04-0119-WM-0037 to the Groundwater Section of the DEM in Raleigh, North Carolina.

On December 16, 1994, a copy of Delta's Report of Phase II Sampling was submitted to the Groundwater Section of the WSRO by Parker, Poe, Adams and Bernstein (counsel for UCCM). As part of this investigation, eleven soil samples were obtained from the containment dike area between January and September 1993. Ground water monitoring well MW-10 was installed in September 1993 immediately adjacent to the drain located along the north side of the dike. The soil analytical results indicated the presence of PCE, acetone and methyl ethyl ketone (MEK). The ground water analytical results indicated detectable levels of toluene, ethylbenzene and xylenes. All of these reported concentrations, as well as the remaining targeted VOCs, were below the North Carolina ground water quality standard.

A Site Assessment Report, which presented soil and ground water data collected by Delta from numerous investigations conducted from July 1992 to February 1996, was submitted to the Groundwater Section of the WSRO on May 20, 1996. The additional activities performed as part of this report included obtaining seven additional soil samples and two ground water samples (from within the building) using a Geoprobe. In addition, ground water samples were obtained from monitoring well MW-10 on four occasions between February 1994 and 1996. The soil analytical results continued to indicate the presence of acetone and MEK. Based on the results obtained from this phase of investigation, the lateral and vertical extent of impacted soil has been defined. No further action was recommended for the soil since the reported concentrations were below DEM's proposed clean-up levels, and since neither acetone, MEK or chlorinated VOCs had been detected in the ground water at monitoring well MW-10. The ground water analytical data indicated the presence of benzene, toluene, ethylbenzene and xylene (BTEX) in samples collected from monitoring well MW-10. Based on the Geoprobe sampling, the downgradient extent of BTEX had been defined. The source of the BTEX was unknown and not attributed to the only other identified potential source, an abandoned UST located 190 feet northeast of the containment dike.

A follow-up meeting was held with representatives of WSRO on May 29, 1996. Based on the results of this meeting, additional activities were performed at the site and summarized in the Project Status Update, which was submitted to the Groundwater Section of the WSRO in May 1997. Activities performed at part of this update for the containment dike area included obtaining three surface water samples, as discussed in Section 5.4.

2.3 Corrective Actions to Date

Corrective actions have not been performed at the containment dike area.

3.0 POTENTIAL RECEPTORS AND MIGRATION PATHWAYS

3.1 Water Supply Wells

According to Gerald Elliott of the Ashe County Health Department, the area within a 1,500-foot radius of the center of the site is not serviced by municipal water. The closest municipal water supply is provided by the Town of Lansing.

According to Donna Cochran, the Town Clerk of Lansing, the water supply for the Town of Lansing is derived from a supply well located within the town limits. The well yield is approximately 18 gallons per minute and services approximately 100 households. The town is currently evaluating the need for an additional well. Ms. Cochran also indicated that municipal water lines do not extend past the town limits, which are approximately two to three miles from the site.

Based on this information, Delta performed a visual survey of the area within a 1,500 feet radius of the center of the site to identify water supply wells. Accessible streets and roadways were traversed by car and properties were observed to identify well heads or well houses that are commonly associated with domestic water supply wells. Our survey did not reveal the presence of these structures.

A tax map with the names and addresses of property owners (within the specified radius of the site) was obtained from the Ashe County Tax Assessors Office in Jefferson, North Carolina. The visual survey indicated the presence of structures on 13 of the 34 parcels (including the UCCM facility) within a 1,500-foot radius of the facility. Each of the 13 parcels that contain structures are assumed to have domestic supply wells, as illustrated in Figure 3.

The location of the supply well that provides water to the facility is shown on Figure 2. The well is used for potable and process purposes. According to the driller, Newman Brothers, the well has a total depth of 805 feet. Six-inch galvanized casing extends from ground surface to a depth of 50 feet. Water bearing fractures were reported at depths of 60, 80, 180, 310, 500, and between 540 and 570 feet. According to Newman Brothers, each fracture produced water at a rate of approximately five gallons per minute for a combined yield of 30 gallons per minute.

3.2 Surface Water

The North Fork of the New River borders the UCCM property to the north and west. This surface water feature serves as a local discharge point for ground water in the surficial aquifer during periods when the river is a gaining surface water body. The overall volume of ground water that discharges to the New River via baseflow is negligible compared to the overall flow of the river. The location of the New River with respect to the facility is illustrated in Figures 1 and 2.

The North Carolina Division of Water Quality (DWQ) has assigned the North Fork a primary classification of C. Class C waters are protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival and agriculture. The North Fork has also been given supplemental classifications of Outstanding Resource Waters and Trout Waters.

3.3 Utilities

Underground utilities such as water lines, sewers and drain lines are present at the facility. However, due to the depth of ground water in the this area (10-25 feet below ground surface-bgs), utilities should not provide a conduit for enhanced ground water migration.

4.0 PHYSICAL SETTING

4.1 Regional Geology and Hydrogeology

The site is situated in the Blue Ridge Belt of North Carolina. The Blue Ridge Belt consists of a series of thrust sheets stacked on one another. Locally, the thrust faults bounding the sheets can be mapped at the surface. Where mapped, distinct lithologic differences are found from one side of the fault to the other. Other major structural features include large folds. Broad upwarps produce large anticlines and major anticlinoriums, while broad downwarps produce large synclines and synclinoriums. Where erosion breeches these large upwarps, windows are created exposing younger rocks in the thrust sheet below (NCGS, 1988).

Bedrock at the site consists of massive to well foliated biotite granitic gneiss with locally intrusive metamorphosed granitic intrusive rock. The bedrock is of Middle to Late Proterozoic age (Rhodes, 1985). The land surface is underlain by clay-rich unconsolidated material derived from the in-situ weathering of the underlying bedrock. This material, which averages from about 90 to 200 feet in thickness and may be as much as 300 feet thick in some valleys, is referred to as saprolite. In many valleys, especially those of larger streams, flood plains are underlain by thin, moderately well-sorted alluvium deposited by the streams. When the distinction between saprolite and alluvium is not important, the term regolith is used to refer to the layer of unconsolidated sediments (Heath, 1983).

The regolith contains water in pore spaces between sediment particles. Conversely, the bedrock typically does not display intergranular porosity. Ground water in bedrock is transported via features such as fractures, foliation, and former bedding planes. Recharge of the ground water systems occurs in the areas above the floodplains of the streams, and natural discharge occurs in low lying areas as seepage springs that are common near the base of slopes and baseflow discharge into streams and rivers (Heath, 1983).

4.2 Site Geology and Soils

Drilling investigations performed as part of this assessment indicate that subsurface soils are saprolite and alluvium consisting of micaceous clays and silts. The unconsolidated material ranges in thickness from 20 to 60 feet and grades into weathered granitic gneiss bedrock. Alluvial sands and silts were encountered in boreholes advanced along the floodplain of the New River.

Two geologic cross-sections were constructed through the impacted area. The locations of the cross sections are shown on Figure 4. Cross Sections A-A' and B-B' are presented as Figures 5 and 6, respectively.

The Soil Survey of Ashe County, North Carolina indicates that the site soils are classified as Braddock-Urban Land Complex soils. These soils are predominantly acidic with a pH range of 3.6 to 5.5 and an organic matter content of one-half to one per cent (USDA, 1985).

5.0 FIELD ACTIVITIES

The CSA field activities were conducted using a phased approach. Subsequent phases of investigation were based upon the results obtained from the previous phase. The purposes of performing the field activities were to:

- further investigate the nature and extent of VOCs identified in the soil and ground water;
- better characterize the site geology and hydrogeology; and,
- obtain data in order to determine the potential for the VOCs to naturally attenuate.

5.1 Soil Investigation

A total of 25 soil samples were obtained from 14 locations between January 1993 and September 1997. Table 1 summarizes specific information regarding the sample date, depth and analytical protocol.

Five soil investigations have been conducted in the containment dike area to better determine the extent and magnitude of the VOCs. The source(s) of the VOCs have not been determined. However, analytical data suggest that the release was in the vicinity of soil sample locations CD-2 through CD-4. Soil boring/sample locations are shown in Figure 7. Historical soil analytical data are presented in Table 2 and the laboratory reports are presented as Appendix A.

In January 1993, three soil samples (CD-2 through CD-4) were collected in the containment dike area and analyzed for the presence of VOCs. This sampling was initiated based on the presence of elevated levels of TCE and PCE in a sample obtained by UCCM (adjacent to the drain located along the north side of the dike) in August 1992 as part of their due diligence activities. The analytical results indicate the presence of PCE in soil samples CD-2, CD-3, and CD-4 at concentrations of 3.40 milligrams per kilogram (mg/kg), 0.033 mg/kg, and 0.02 mg/kg, respectively. Acetone and MEK were present in CD-3 at concentrations of 0.029 mg/kg and 0.024 mg/kg, respectively. TCE was not reported in any of the soil samples above the analytical detection limits.

In September 1993, nine soil samples (CD-5 through CD-10 and MW-10) were collected and analyzed for the presence of VOCs. The analytical results indicate the presence of acetone at concentrations ranging from 28.8 mg/kg at CD-10 to 0.04 mg/kg at MW-10 (collected at 15 to 15.5 feet bgs). PCE and TCE were not reported in any of the soil samples above the analytical detection limits.

In November 1994, four soil samples (CDA-CD2, CDA-CD2A, CDA-CD3, and CDA-CD10) were collected and analyzed for the presence of VOCs. Samples CDA-CD2, CDA-CD3 and CDA-CD10 were obtained from the same locations and depths of previous soil samples CD-2, CD-3 and CD-10 (obtained in January and September 1993). The analytical results indicate the presence of acetone at concentrations ranging from 0.52 at CDA-CD2A to 0.086 mg/kg at CDA-CD3. PCE and TCE were not reported in any of the soil samples above the analytical detection limits.

In February 1996, two soil borings (GP-208 and GP-209) were advanced and four soil samples were collected at selected intervals and analyzed for the presence of VOCs. The analytical results indicate the presence of acetone at concentrations ranging from 0.43 mg/kg at GP-208 (collected 3.0 to 4.0 feet bgs) to 0.013 mg/kg at GP-208 (collected 0.5 to 2.0 feet bgs). MEK was also present at GP-209 (2.0 to 3.0 feet bgs) at a concentration of 0.044 mg/kg. PCE and TCE were not reported in any of the soil samples above the analytical detection limits.

In September 1997, three soil samples were collected during the installation of monitoring wells MW-15 and DW-2. Targeted VOCs were not reported above the analytical detection limits. Soil-to-ground water maximum contaminant concentrations were calculated for TCE, acetone and MEK using the methodology recommended by NCDENR. Calculations for each VOC are presented as Appendix B and the resulting permissible maximum concentrations for each of these three VOCs are presented on Table 2. Review of Table 2 indicates that all of the historical reported concentration of acetone and MEK are below the soil-to-ground water maximum concentration. PCE concentrations have been below the maximum concentration since January 1993.

In addition, saturated soil samples were collected from monitoring wells MW-15 through MW-17 and submitted to IEA for analysis of total organic carbon in order to assist in determining the potential for the soil to attenuate the VOCs. An undisturbed soil (UD) sample was collected from soil boring SB-002 (identified in the Comprehensive Site Assessment for the etchant area) at a depth of 8.5 to 10.5 feet bgs in accordance with ASTM Method D 1587-"Practice for Thin-Walled Tube Sampling of Soils." Several attempts were made to collect the UD sample below the water table surface, but the soil was too dense. The soil samples was submitted to Law Engineering and Environmental Services, Inc. for geotechnical analyses including, grain size distribution, hydraulic conductivity,

density, and specific gravity. LAW described the soil as a orange-yellow, micaceous, silty fine to medium grained sand with partially weathered rock fragments. The data is summarized in Table 3 and the geotechnical laboratory report is presented as Appendix C.

5.2 Ground Water Investigation

5.2.1 Monitoring Well Construction

Ten shallow (water table) monitoring wells monitoring wells (MW-05, 15, 16, 17, 18, 19, 20, 21, 22 and 23) and three bedrock monitoring wells (DW-02, 03, and 04) have been installed in order to delineate the lateral and vertical extent of impacted ground water. In addition, ground water samples were obtained from the water table at Geoprobe borings GP-201 and GP-202. The locations of the monitoring wells and Geoprobe ground water samples are shown in Figure 4. Monitoring well construction details are summarized in Table 4. Soil boring logs and monitoring well construction details are presented in Appendix D.

The shallow monitoring wells were completed at depths ranging from 18 to 35 feet bgs. With the exception of monitoring well MW-19, the shallow monitoring wells were installed using continuous flight hollow stem augers. Monitoring well MW-19 was installed using air rotary techniques. The wells were completed with 10 to 15 feet of two-inch diameter, flush threaded, 0.010 inch factory slotted PVC screen and two-inch diameter PVC riser. A gravel filter pack was added to an approximate height of two feet above the top of the well screen. A minimum two foot thick bentonite seal was added above the filter pack. The remaining annulus was grouted to the surface.

Bedrock monitoring wells DW-02, 03, and 04 were completed at a depths of 61, 59, and 52 feet bgs, respectively. The wells were advanced using air rotary methods. In general, an eight to ten inch borehole was advanced to 45 to 50 feet below ground surface. Five to six-inch diameter galvanized steel surface casing was inserted into the borehole and the annulus was grouted to the surface using the tremie method. The casings were allowed to set overnight to allow the cement to harden. A five to six-inch diameter borehole was advanced approximately 10 feet below the bottom of the surface casing until the first water bearing zone was encountered. The monitoring wells were completed with five feet of two-inch diameter, flush threaded, 0.010 inch factory slotted PVC screen and two-inch diameter PVC riser. Gravel filter packs were added to an approximate depth of two feet above the top of the well screen. Minimum two foot thick bentonite seals were added above the filter pack. The remaining annulus were grouted to the surface.

5.2.2 Monitoring Well Location and Rationale

Four ground water investigations have been conducted in the containment dike area. Monitoring well MW-10 was installed in September 1993 to determine if the VOCs previously identified in the soil were also present in ground water.

In February 1996, Geoprobe borings (GP-201 through GP-205) were advanced to attempt to better define the lateral extent of impacted ground water. Ground water samples were collected from GP-201 and GP-202 and analyzed for the presence of benzene, toluene, ethylbenzene and total xylenes. Probe refusal was encountered at borings GP-203 through GP-205 prior to encountering ground water. Thus, ground water samples were not collected from these locations.

Based upon the February 1996 Geoprobe investigation, monitoring wells MW-15, MW-16, MW-17, MW-18, and DW-02 were installed in September 1997 to attempt to define the lateral and vertical extent of impacted ground water.

In October 1997 and January 1998, ground water samples were collected from monitoring wells MW-05 (which installed by UCCM as part of their due diligence activities), MW-10, MW-15, MW-16, MW-17, MW-18, and -02 and analyzed for the presence of VOCs and semi-volatile organic compounds (SVOCs).

Monitoring wells MW-19 through MW-23, DW-03, and DW-04 were installed in July and August 1998. Monitoring well MW-19 was installed in order to provide an upgradient monitoring point. Monitoring wells MW-20 and MW-23 were installed in order to provide a cross-gradient monitoring point. Monitoring wells MW-21 and MW-22 were installed to provide a downgradient monitoring point. Bedrock monitoring wells DW-03 and DW-04 were installed to evaluate ground water quality in the shallow portion of the bedrock.

5.2.3 Ground Water Flow

Depth to ground water measurements have been collected between two and six occasions since 1993. Ground water elevation data from January and August 1998 are presented in Table 5. Water table elevation data collected during the August 1998 sampling event was used to construct a ground water elevation contour map, as illustrated in Figure 8. Review of Figure 8 indicates that the direction of ground water flow is north/northwest, towards the New River, at an average horizontal gradient of 0.007.

Based on the above information, the average linear ground water flow velocity (seepage velocity parallel to ground water flow) of the unconsolidated material was calculated using the following equation:

$$V_x = \frac{-K}{ne} \frac{dH}{dL}$$

where: V_x = average linear ground water velocity parallel to ground water flow direction (seepage velocity) [L/T]
K = hydraulic conductivity
ne = effective porosity
dH/dL = hydraulic gradient

FROM PERMEABILITY TEST? (ON SAMPLE)

Assuming a hydraulic conductivity of 0.79 feet per day (2.8 x 10 -4 cm/sec), an effective porosity of 0.2 (20% for sandy silt) and a hydraulic gradient of 0.007, the average linear ground water flow velocity through the unconsolidated material is estimated at 0.028 feet per day, or approximately 10 feet per year.

Using the calculated ground water flow velocity, the amount of time for the constituent plume to travel from monitoring well MW-10 to the New River (located approximately 350 feet north of monitoring well MW-10) is approximately 35 years. This conservative calculated travel time does not take into consideration factors (intervals when the New River is a losing stream, dilution, biodegradation, dispersion or attenuation) that will retard the movement of plume constituents.

The ground water elevations from the three telescoping monitoring wells (DW-02 through DW-04) obtained during the August 1998 sampling event were used to prepare a potentiometric map of the shallow bedrock zone, as illustrated in Figure 9. This data indicates the direction of ground water flow is north/northwest towards the New River at an average hydraulic gradient of 0.007 (consistent with the flow direction and gradient observed at the water table).

Static water level readings were obtained from the three nested wells (DW-02/MW-10, DW-03/MW-20 and DW-04/MW-21). Review of this data, as presented in Appendix E, indicates an upward (negative) vertical gradient of ground water from well cluster DW-02/MW-10 in January 1998 and a downward (positive) vertical gradient for each of the three well clusters in August 1998. The average gradient for each cluster is presented below:

Well ID	Date	Gradient
DW-02 / MW-10	January 28, 1998	- 0.004
DW-02 / MW-10	August 12, 1998	0.006
DW-03 / MW-20	August 12, 1998	0.004
DW-04 / MW-21	August 12, 1998	0.005

The August 1998 data indicates that an average downward vertical gradient (0.005) is within the same order of magnitude of the horizontal hydraulic gradient (0.007) that was also calculated from the August 1998 data.

5.3 Ground Water Analytical Results

Representative ground water samples have been collected on two to seven occasions from the monitoring wells in the containment dike area since 1993. Ground water analyses have included VOCs, metals and SVOCs. Natural attenuation analyses consisting of selected inorganics, dissolved gases, and field measurements were performed on select wells in October 1997. A summary of the VOCs, metals and SVOC results is presented in Tables 6A and 6B.

The analyses of ground water collected from MW-10 in 1993, 1994, and 1995 indicated the presence of benzene above the ground water quality standards specified in 15A NCAC 2L .0202 (2L standards). None of the targeted VOCs were present above method detection limits in the ground water samples obtained from Geoprobe borings GP-201 and GP-202 in February 1996. The ground water analytical results from October 1997 and January 1998 indicated the presence of VOCs and SVOCs above 2L standards in all of the monitoring wells except monitoring well MW-5.

The most recent round of ground water sampling was performed on August 12, 1998. Ground water samples were collected from monitoring wells MW-10, MW-15 through MW-23, DW-02, DW-03, and DW-04 using disposable bailers. The ground water samples were submitted to Paradigm Analytical Laboratories, Inc. (Paradigm) for analyses of VOCs and SVOCs using EPA Methods 8260 and 8270. Tetrachloroethene, TCE, naphthalene, and 2-methylnaphthalene were present at concentrations exceeding their respective 2L standards at all of the monitoring wells except MW-5.

As part of routine monitoring at the facility, the supply well is sampled on an annual basis by UCCM for various constituents including VOCs. Chemistry data from the 1994 and 1995 sampling were provided by UCCM and are presented as Appendix F. The analytical results did not indicate the presence of any VOCs above the method detection limit, with the exception of chloroform (attributed to the chlorination system associated with the supply well). A water sample was obtained from the supply well by Delta in August 1998, concurrent with the final round of ground water sampling. The results from this analysis did not indicate the presence of targeted VOCs or SVOCs above the method detection limits, as summarized in Tables 6A and 6B.

Filtered and unfiltered (dissolved and total) ground water samples have been obtained and analyzed for RCRA metals and aluminum. Table 6B presents the ground water analytical results for the respective metals. Elevated total and dissolved aluminum was present in the ground water at monitoring well MW-5 in September 1993.

The NCDENR has not established a standard for aluminum. The USEPA Region III Risk-Based Concentration (RBC) value for aluminum in tap water is 37,000 ug/l. None of the filtered ground water samples contained aluminum in excess of the RBC value. In addition, metals from all of the other filtered samples did not display readings in excess of the NCDENR Ground Water Standards, specified in NCAC 2L.0202.

Isoconcentration contour maps for TCE, naphthalene and 2-methylnaphthalene, based on the water table monitoring wells, are presented as Figures 10 through 12, respectively. Figure 13 illustrates isoconcentrations of TCE at the bedrock monitoring wells and the supply well, based on data obtained in August 1998.

Analytical data are consistent with analytical data collected during previous sampling events. The analytical data suggest that the constituent plume originates in the vicinity of monitoring wells MW-8 and MW-10 and extends approximately 350 feet north.

5.4 Surface Water

Surface water samples were collected from the New River at three locations (identified as "upstream", "downstream", and "midstream") on October 21, 1996 and analyzed for field pH and VOCs. The locations of the surface water samples are shown on Figure 2. Field pH measurements were collected at the same locations on October 14, 1997. The field pH measurements were between 6.5 and 8.0 and all targeted VOCs (chlorinated and non-chlorinated) were reported below the analytical detection limits of 1 ug/l or 4/ug/l. The analytical results are summarized in Table 7.

5.5 Preliminary Natural Attenuation Data

In recent years, natural attenuation (NA) has become increasingly accepted as a remedial alternative for VOCs dissolved in the ground water. The United States Air Force Center for Environmental Excellence and the EPA have developed a technical protocol for the evaluation of the NA of chlorinated VOCs in ground water. An overview of the protocol has been presented in the technical paper *Overview of the Technical Protocol for Natural Attenuation of Chlorinated VOCs in Ground Water Under Development* for the US Air Force Center for Environmental Excellence (Wiedemier at el, 1996).

This initial site screening was performed to determine if NA may be appropriate as site remedial option. The screening process consists of assigning score values based upon the collection of geochemical and ground water analytical data. A copy of the Analytical Parameters and Weighing for Preliminary Screening table from the Weidemier article is presented as Appendix G. The process relies on the fact that biodegradation will cause predictable changes in ground water chemistry.

Preliminary NA analytical data and field parameters were collected in conjunction with the October 1997 ground water sampling event. The analyses included iron, manganese, alkalinity, hardness, nitrate, nitrite, total phosphorous, sulfite, sulfate, dissolved carbon dioxide, dissolved oxygen, dissolved nitrogen, dissolved methane, pH, and oxidation-reduction potential (ORP). Preliminary natural attenuation data are summarized in Table 8.

According to the guidance document, a score of 15 points or more is suggestive that biodegradation is occurring. A preliminary score of 14 was calculated using the referenced protocol. However, analyses such as chloride, hydrogen, total organic carbon, volatile fatty acids and ethene were not performed. Therefore, the score should be higher than the preliminary score of 14. The results of the preliminary screening are presented in Table 9.

6.0 CONCLUSIONS

Based on the results of the CSA, previous activities at the facility have impacted the soil and ground water. A summary of the conclusions obtained from this assessment is presented below:

- The facility has manufactured aluminum-based capacitors since 1954. Historically TCE and possibly PCE and methylene chloride were used to remove residue from manufactured capacitors through the late 1970's.
- The North Fork of the New River borders the UCCM property to the north and west. This surface water feature serves as a local discharge point for ground water in the surficial aquifer during periods when the river is a gaining surface water body.
- Depth to ground water in the vicinity of the former containment dike area ranges from 10.61 feet bgs to 25.94 feet bgs.
- Laterally, ground water flow direction at the water table is north/northeast at a horizontal gradient of 0.007.
- Vertically, water level readings obtained from the nested wells in January 1998 indicate an upward vertical gradient and the data obtained in August 1998 indicates a downward vertical gradient (0.005). The fluctuations in the vertical gradient are attributed to responses of water levels in the New River.

- Based on the calculated ground water flow velocity of approximately 10 feet per year, the amount of time for ground water to travel from monitoring well MW-10 to the New River is approximately 35 years.
- The source of the chlorinated VOCs is attributed to former degreasing and handling activities associated with the capacitor cleaning process.
- The source of the VOCs associated with petroleum hydrocarbons (BTEX, naphthalene and 2-methylnaphthalene) is unknown. UCCM personnel have indicated that underground storage tanks historically have not been present in the north portion of the main building.
- VOCs and total metals are not present in the soil at levels in excess of NCDENR guidelines.
- Based on the low levels of residual phase VOCs beneath the site, the soil does not contain a large mass of VOCs
- The VOCs that were previously reported in the soil have biodegraded or evaporated to levels below detection limits.
- Dissolved metals are not present in the ground water at levels in excess of NCDENR's ground water standards or EPA's RBC.
- The lateral and vertical extent of dissolved phase TCE and PCE have not been determined. Based on the low levels of chlorinated VOCs, dense non-aqueous phase liquids are not present in the subsurface.
- VOCs are not present in the supply well or the New River at levels above the analytical detection limits, as evidenced by the supply well and surface water analytical results. Dissolved phase chlorinated VOC concentrations reported in the ground water at monitoring well cluster DW-03/MW-20 (which is located approximately 100 feet from the UCCM supply well) approach the ground water standards for these respective constituents. In addition, the dissolved phase chlorinated VOCs obtained from the three bedrock monitoring wells (DW-02 through DW-04) are lower in the ground water at monitoring well DW-03 (the shallow bedrock well located closest to the supply well) than those reported at monitoring wells DW-02 and DW-04.
- The preliminary NA data suggests that the ground water constituent plume is attenuating to applicable clean-up standards prior to reaching receptors.
- Continued monitoring to evaluate the plume geometry and to better predict the amount of NA is the preferred remedial alternative, based on the low levels of dissolved phase VOCs in the ground water and the absence of detectable levels of VOCs in the supply well and New River.

7.0 RECOMMENDATIONS

MAY BE UNAPPROVABLE IF THERE IS OR WILL BE A 2B VIOLATION.

Based upon the conclusions above, active remediation is not recommended. A Corrective Action Plan should be prepared to propose a ground water monitoring plan for this area. This plan will include a proposal to monitor ground water and surface water, initially, on a semi-annual basis for at least five years. This monitoring will allow further definition of the plume geometry and the on-going NA process.

An annual letter report would be prepared and submitted to the NCDENR for review. This report will include the analytical results and our conclusions and recommendations regarding plume geometry and the on-going dilution process.

In addition, a complete NA analysis should be performed on ground water samples obtained from all of the monitoring wells. After obtaining the NA data, the ground water solute transport parameters, calculation of biodegradation rates and the apparent attenuation rates should be determined in order to evaluate if all screening criteria are met.

Additional assessment and remediation of the soil is not warranted since all of the reported values are below the soil-to-ground water criteria.

8.0 REFERENCES

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9.0 REMARKS

The recommendations contained in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted and hydrogeologic and engineering practices at this time and location. Other than this, no warranty is implied or intended.

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TABLE 1

SAMPLING SUMMARY
CONTAINMENT DIKE AREA

SAMPLE TYPE	SAMPLE ID	DATE COLLECTED	DEPTH	ANALYTICAL PROTOCOL							
				A	B	C	D	E	F	G	H
SOIL	CD-2, CD-3, CD-4	Jan-93	1.0'	X							
SOIL	CD-5 thru CD-10	Sep-93	0.5-1.5'	X							
SOIL	MW-10	Sep-93	4.5-5.0', 15-15.5'	X							
SOIL	CD-CD2, CDA-CD3, CDA-CD10	Nov-94	0.5-1.0'	X							
SOIL	CD-CD2A	Nov-94	2.0-2.5'	X							
SOIL	GP-208	Feb-96	0.5-2.0'	X							
SOIL	GP-208	Feb-96	3.0-4'	X			X				
SOIL	GP-209	Feb-96	0.5-1.0', 2.0-3.0'	X							
SOIL	DW-2	Sep-97	5-7'	X		X					
SOIL	DW-2	Sep-97	15-17'	X		X					
SOIL	MW-15	Sep-97	14-16'	X		X					
SOIL	MW-15	Sep-97	19-21'								X
SOIL	MW-16	Sep-97	19-20'								X
SOIL	MW-17	Sep-97	19-21'								X
				A	B	C	D	E	F	G	H
GROUND WATER	MW-05	Jan-93	WATER TABLE	X	X				X		
GROUND WATER	MW-05, MW-10	Sep-93	WATER TABLE	X	X				X		
GROUND WATER	MW-10	Feb-94, Mar-94	WATER TABLE					X			
GROUND WATER	MW-10	Oct-95, Feb-96	WATER TABLE					X			
GROUND WATER	GP-201, 202	Feb-96	WATER TABLE					X			
GROUND WATER	MW-10, MW-15 thru MW-18, DW-2	Oct-97	WATER TABLE	X		X				X	
GROUNDWATER	MW-05, MW-10, MW-15 thru MW-18	Jan-98	WATERTABLE	X		X			X		
GROUNDWATER	DW-2	Jan-98	BEDROCK	X		X			X		
GROUNDWATER	MW-10, MW-15 thru MW-23	Aug-98	WATER TABLE	X		X			X		
GROUNDWATER	DW-2, DW-3, DW-4	Aug-98	BEDROCK	X		X			X		
SURFACE WATER	Upstream, Mid-Stream, Downstream	Oct-96	WATER SURFAC	X					X		

ANALYTICAL PROTOCOL KEY:
A: VOCs (8240 or 8260)
B: Total/ dissolved metals including aluminum
C: SVOCs (8270)
D: Total Petroleum Hydrocarbons (GRO, DRO)
E: VOAs (8020)
F: Field indicator parameters (pH, conductivity, temperature)
G: Natural attenuation parameters (hardness, alkalinity, manganese, sulfate, sulfite, iron, phosphate, nitrate, nitrite, carbon dioxide, oxygen, nitrogen, methane)
H: Total Organic Carbon

TABLE

HISTORICAL SOIL ANALYTICAL DATA
CONTAINMENT DIKE AREA

SAMPLE DESIGNATION:	CD-2	CD-3	CD-4	CD-5	CD-6	CD-7	CD-8	CD-9	CD-10	MW-10	MW-10	Soil-to-
DEPTH:	(1.0')	(1.0')	(1.0')	(1.0-1.5')	(0.5-1.0')	(0.5-1.0')	(0.5-1.0')	(0.5-1.0')	(0.5-1.0')	(4.5-5.0')	(15-15.5')	Groundwater
DATE SAMPLED:	Jan-93	Jan-93	Jan-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Sep-93	Maximum
VOLATILES (mg/kg)												Concentration
Tetrachloroethene	3.4*	0.033*	0.02*	<0.005	<0.006	<0.006	<0.006	<0.005	<1.4	<0.006	<0.006	0.007
Acetone	<0.57	0.029	<0.012	0.09	0.1	<0.01	<0.01	<0.01	28.8 *	0.03	0.04	22.7
MEK	<0.57	0.024	<0.012	<0.01	<0.01	<0.01	<0.01	<0.01	<2.8	<0.01	<0.01	1.48

SAMPLE DESIGNATION:	CDA-CD2	CDA-CD2A	CDA-CD3	CDA-CD10	GP-208	GP-208	GP-209	GP-209	MW-15	DW-2	DW-2	Soil-to-
DEPTH:	(0.5-1.0')	(2.0-2.5')	(0.5-1.0')	(0.5-1.0')	(0.5-2.0')	(3.0-4')	(0.5-1.0')	(2.0-3.0')	(14-16')	(5-7')	(15-17')	Groundwater
DATE SAMPLED:	Nov-94	Nov-94	Nov-94	Nov-94	Feb-96	Feb-96	Feb-96	Feb-96	Sep-97	Sep-97	Sep-97	Maximum
VOLATILES (mg/kg)												Concentration
Tetrachloroethene	<0.006	<0.006	<0.006	<0.005	<0.006	<0.006	<0.030	<0.007	<0.006	<0.006	<0.006	0.007
Acetone	<0.011	0.52	0.086	<0.010	0.013	0.430	0.059	0.140	<0.013	<0.013	<0.013	22.7
MEK	<0.011	<0.013	<0.012	<0.010	<0.013	<0.012	<0.059	0.044	<0.013	<0.013	<0.013	1.48

All values are reported as milligrams per kilogram (mg/kg)
* = Values are above Soil-to-Grounwater Maximum Concentration
(1) Transport Model for Calculation of Soil-to-Ground Water Maximum Contaminant Concentrations
Volume I, Groundwater Guidelines Document, NCDENR

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TABLE 4
MONITORING WELL CONSTRUCTION CHARACTERISTICS
CONTAINMENT DIKE AREA
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

SITE	WELL DEPTH (feet bgs)	TOTAL DEPTH (feet bgs)	GROUND SURFACE ELEVATION (feet)	MP ELEVATION (feet)	CASING DIAMETER (inches)	SCREENS (feet bgs) INTERVAL	SCREENS (feet bgs) DESCRIPTION	ANNULAR FILLS (feet bgs) INTERVAL	ANNULAR FILLS (feet bgs) TYPE
DW-02	61.00	61.00	2661.60	2661.44	2.00	56.0-61.0	Slotted PVC	0.0-51.0	Backfill
								51.0-54.0	Seal
								54.0-61.0	Filter
DW-03	59.00	59.00	2660.76	2660.28	2.00	54.0-59.0	Slotted PVC	0.0-50.0	Backfill
								50.0-52.0	Seal
								52.0-59.0	Filter
DW-04	52.00	52.00	2653.58	2653.19	2.00	47.0-52.0	Slotted PVC	0.0-44.0	Backfill
								44.0-46.0	Seal
								46.0-52.0	Filter
MW-05	18.00	18.00	2656.07	2665.85	2.00	7.0-17.0	Slotted PVC	0.0-4.0	Backfill
								4.0-6.0	Seal
								6.0-18.0	Filter
MW-10	25.00	25.00	2661.40	2661.73	2.00	10.0-25.0	Slotted PVC	0.0-6.0	Backfill
								6.0-8.0	Seal
								8.0-25.0	Filter
MW-15	25.00	25.00	2660.92	2660.49	2.00	13.0-25.0	Slotted PVC	0.0-8.0	Backfill
								8.0-10.0	Seal
								10.0-25.0	Filter
MW-16	27.00	27.00	2663.63	2663.36	2.00	15.0-27.0	Slotted PVC	0.0-8.0	Backfill
								8.0-10.0	Seal
								10.0-27.0	Filter

TABLE 5

HISTORICAL GROUND WATER ELEVATIONS
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

SITE	DATE	MP ELEVATION (2) (feet)	TIME	DEPTH TO WATER (feet)	△ WATER ELEV. (1) (feet)	WATER ELEV. (2) (feet)
DW-02	01/28/98	2661.440	13:56	17.76	NA	2643.68
MW-05	01/28/98	2655.850	13:45	12.69	NA	2643.16
MW-10	01/28/98	2661.730	14:00	18.21	NA	2643.52
MW-15	01/28/98	2660.490	13:42	17.43	NA	2643.06
MW-16	01/28/98	2663.360	13:40	20.39	NA	2642.97
MW-16	01/28/98	2663.360	13:45	12.69	7.70	2650.67
MW-17	01/28/98	2661.840	13:53	18.36	NA	2643.48
MW-18	01/28/98	2665.580	13:51	21.78	NA	2643.80
DW-02	08/12/98	2661.440	08:32	18.20	-0.44	2643.24
DW-03	08/12/98	2660.280	08:54	17.57	NA	2642.71
DW-04	08/12/98	2653.190	08:37	11.69	NA	2641.50
MW-05	08/12/98	2655.850	09:00	13.19	-0.50	2642.66
MW-10	08/12/98	2661.730	08:30	18.27	-0.06	2643.46
MW-15	08/12/98	2660.490	08:52	17.83	-0.40	2642.66
16	08/12/98	2663.360	08:25	20.41	-7.72	2642.95
MW-17	08/12/98	2661.840	08:27	18.32	0.04	2643.52
W-18	08/12/98	2665.580	09:07	22.13	-0.35	2643.45
W-19	08/12/98	2669.980	09:14	18.10	NA	2651.88
MW-20	08/12/98	2660.780	08:57	17.93	NA	2642.85
W-21	08/12/98	2653.240	08:42	11.58	NA	2641.66
W-22	08/12/98	2651.840	08:47	10.61	NA	2641.23
MW-23	08/12/98	2669.840	08:20	25.94	NA	2643.90

) hange in Water Elevation since last reported measurement

) easurements Based on Mean Sea Level

D = Dry NA = Not Available

TABLE 6A

GROUND WATER ANALYTICAL DATA
CONTAINMENT DIKE AREA

VOLATILE ORGANIC COMPOUNDS (ug/l)

SAMPLE DESIGNATION: DATE SAMPLED:	MW-05 Jan-93	MW-05 Sep-93	MW-05 Jan-98	MW-10 Sep-93	MW-10 Feb-94	MW-10 Mar-94	MW-10 Oct-95	MW-10 Feb-96	MW-10 Oct-97	MW-10 Jan-98	MW-10 Aug-98	MW-15 Oct-97	MW-15 Jan-98	MW-15 Aug-98	MW-16 Oct-97	MW-16 Jan-98	MW-16 Aug-98	Supply Well Aug-98	2L Standard
1,2-Dicholorethene	NA	NA	NA	<5	NA	NA	NA	NA	<25	NA	<200	NA	NA	<2	NA	NA	<2	<1	70
Tetrachloroethene	NA	NA	<1	<5	NA	NA	NA	NA	<25	<500	<200	<4	<1	<2	2 *	2 *	3*	<1	0.7
Trichloroethene	<1.0	<5.0	<1	<5	NA	NA	NA	NA	8*	<500	<200	57 *	13 *	25*	18 *	22 *	22*	<1	2.8
Acetone	NA	NA	<5	<10	NA	NA	NA	NA	<120	<2,500	<5000	<20	<5	<50	<5	<5	<50	<25	700
MEK	NA	NA	<5	<10	NA	NA	NA	NA	<120	<2,500	<5000	<20	<5	<50	<5	<5	<50	<25	170
Toluene	NA	NA	<1	14	12	NR	11.2	7.1	14	<500	<200	<4	<1	<2	<1	<1	<2	<1	1000
Ethylbenzene	NA	NA	<1	16	17	NR	18.2	16	11	<500	<200	<4	<1	<2	<1	<1	<2	<1	29
Xylenes	NA	NA	<5	54	35	NR	24.7	24	46	<2,500	<200	<20	<5	<2	<5	<5	<2	<1	400
Benzene	NA	NA	<1	<5	<5	3*	3.8*	<1	4*	<500	<200	<4	<1	<2	<1	<1	<2	<1	1
1,2,4-Trimethylbenzene	NA	NA	<1	NA	NA	NA	NA	NA	<25	<500	<200	<4	<1	<2	<1	<1	<2	<1	350 **
1,3,5-Trimethylbenzene	NA	NA	<1	NA	NA	NA	NA	NA	<25	<500	<200	<4	<1	<2	<1	<1	<2	<1	350 **
MTBE	NA	NA	<1	NA	NA	NA	NA	NA	<25	<500	<200	<4	<1	<2	<1	<1	<2	<1	200
Naphthalene	NA	NA	<1	NA	NA	NA	NA	NA	4400*	5000 *	2600*	<4	<1	<2	<1	<1	<2	<1	21

SAMPLE DESIGNATION DATE SAMPLED	MW-17 Oct-97	MW-17 Jan-98	MW-17 Aug-98	MW-18 Oct-97	MW-18 Jan-98	MW-18 Aug-98	MW-19 Aug-98	MW-20 Aug-98	MW-21 Aug-98	MW-22 Aug-98	MW-23 Aug-98	GP-201 Feb-96	GP-202 Feb-96	DW-2 Oct-97	DW-2 Jan-98	DW-2 Aug-98	DW-3 Aug-98	DW-4 Aug-98	2L Standard
1,2-Dicholorethene	NA	NA	<2.5	NA	NA	<4	<1	<1	<1	<1	<1	NA	NA	NA	NA	<1	<1	<2	70
Tetrachloroethene	31 *	14 *	34*	<2	<10	<4	<1	1*	<1	<1	<1	NA	NA	<2	<5	<5	1*	2*	0.7
Trichloroethene	16 *	150 *	<2.5	8 *	29 *	62*	<1	10*	12*	4*	<1	NA	NA	51 *	86 *	66*	3*	28*	2.8
Acetone	<12	<50	<62	150	<50	<100	<25	<25	<25	<25	<25	NA	NA	<12	<25	<120	<25	<50	700
MEK	<12	<50	<62	<12	<50	<100	<25	<25	<25	<25	<25	NA	NA	<12	<25	<62	<25	<50	170
Toluene	<2	<10	<2.5	<2	<10	<4	<1	<1	<1	<1	<1	<1	<1	<2	<5	<5	<1	<2	1000
Ethylbenzene	<2	<10	<2.5	<2	<10	<4	<1	<1	<1	<1	<1	<1	<1	<2	<5	<5	<1	<2	29
Xylenes	<12	<50	<2.5	<12	<50	<4	<1	<1	<1	<1	<1	<5	<5	<12	<25	<5	<1	<2	400
Benzene	<2	<10	<2.5	<2	<10	<4	<1	<1	<1	<1	<1	<1	<1	<2	<5	<5	<1	<2	1
1,2,4-Trimethylbenzene	<2	<10	<2.5	<2	<10	<4	<1	<1	<1	<1	<1	NA	NA	<2	<5	<5	<1	<2	350 **
1,3,5-Trimethylbenzene	<2	<10	<2.5	<2	<10	<4	<1	<1	<1	<1	<1	NA	NA	<2	<5	<5	<1	<2	350 **
MTBE	<2	<10	<2.5	<2	<10	<4	<1	<1	<1	<1	<1	NA	NA	<2	<5	<5	<1	<2	200
Naphthalene	27 *	31 *	<2.5	13	160 *	7	<1	<1	<1	<1	<1	NA	NA	<2	<5	<5	<1	<2	21

NA = Not analyzed
* = Concentration exceeds the 2L standard or interim maximum allowable concentration.
** = Division of Water Quality Interim Maximum Allowable Concentration

\ssa\cdgw2all VOCs

TABLE 6B

GROUND WATER ANALYTICAL DATA
CONTAINMENT DIKE AREA

SEMI-VOLATILE ORGANIC COMPOUNDS (ug/l)																						
SAMPLE DESIGNATION:	MW-10	MW-10	MW-15	MW-15	MW-16	MW-17	MW-17	MW-18	MW-18	MW-19	MW-20	MW-19	MW-20	MW-21	MW-22	MW-23	DW-02	DW-02	DW-03	DW-04	Supply Well	2L
DATE SAMPLED:	Oct-97	Aug-98	Oct-97	Aug-98	Aug-98	Oct-97	Aug-98	Oct-97	Aug-98	Aug-98	Aug-98	Aug-98	Aug-98	Aug-98	Aug-98	Aug-98	Oct-97	Aug-98	Aug-98	Aug-98	Aug-98	Standard
4-Methylphenol	240*	<100	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<20	<10	<10	3.5 **
2,4-Dichlorophenol	<200	<100	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<20	<10	<10	NS
Di-N-Butylphthalate	<200	<100	<10	<10	<10	14	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<20	<10	<10	NS
Phenol	<200	<100	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	26	300	<10	<10	300
4-Chloroaniline	NA	500*	<20	<10	<10	<20	<10	<20	<10	<10	<10	<10	<10	<10	<10	<10	<20	<10	<20	<10	<10	NS
Dibenzofuran	<200	150	<10	72	<10	<10	<10	<10	56	<10	<10	<10	<10	<10	<10	<10	<10	<10	<20	<10	<10	NS
Anthracene	<200	100	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<20	<10	<10	2100
2,4-Dimythelphenol	210	110	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<20	<10	<10	NS
Fluorene	<200	120	<10	<10	<10	<10	<10	<10	18	<10	<10	<10	<10	<10	<10	<10	<10	<10	<20	<10	<10	280
2-Mythelnaphthalene	<200	800*	<10	16	<10	<10	<10	<10	70*	<10	<10	<10	<10	<10	<10	<10	<10	<10	<20	<10	<10	28
Naphthalene	NA	1400*	<10	<10	<10	NA	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	NA	<10	<20	<10	<10	21
Bis(2-ethylthexyl)phthalate	<200	<100	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	24	<10	<10	<20	<10	<10	NS
Acenaphthene	<200	<100	<10	52	<10	<10	<10	<10	59	<10	<10	<10	<10	<10	<10	<10	<10	<10	<20	<10	<10	80
Acenaphthylene	<200	220*	<10	15	<10	<10	<10	<10	17	<10	<10	<10	<10	<10	<10	<10	<10	<10	<20	<10	<10	210
Phenanthrene	<200	<100	<10	39	<10	<10	<10	<10	28	<10	<10	<10	<10	<10	<10	<10	<10	<10	<20	<10	<10	210

METALS (ug/l)										
SAMPLE DESIGNATION:	MW-5	MW-5	MW-5	MW-5	MW-5	MW-5	MW-5	MW-10	MW-10	
FILTERED/ UNFILTERED	UNFILTERED	FILTERED	UNFILTERED	FILTERED	UNFILTERED	UNFILTERED	UNFILTERED	UNFILTERED	FILTERED	2L
DATE SAMPLED:	Jan-93	Jan-93	Sep-93	Sep-93	Nov-96	May-97	Jan-98	Sep-93	Sep-93	Standard
Aluminum	78000	<100	65000	1700	NA	<100	NA	4400	<100	NS
Arsenic	<5.0	<5.0	NA	NA	NA	NA	NA	NA	NA	50
Barium	970	<100	620	<100	NA	NA	NA	370	280	2000
Cadmium	<5.0	<5.0	<5.0	<5.0	NA	NA	NA	<5.0	<5.0	5
Chromium	190 *	<10	190 *	<10	NA	NA	NA	13	<10	50
Lead	19 *	<5.0	9.2	<5.0	NA	NA	NA	<5.0	<5.0	15
Mercury	<0.10	<0.10	NA	NA	NA	NA	NA	NA	NA	1.1
Selenium	<5.0	<5.0	NA	NA	NA	NA	NA	NA	NA	50
Silver	<10	<10	NA	NA	NA	NA	NA	NA	NA	18

NA = Not analyzed
NS = North Carolina 2L standard not established
(Where a standard is not specified in the NCAC 2L standard, the method detection limit becomes the standard.)
* = Concentration exceeds the 2L standard or interim maximum allowable concentration.
** = Division of Water Quality Interim Maximum Allowable Concentration
SVOCs not analyzed before Oct-97
Metals not analyzed after May-97

\ea\SVOCs_metals

TABLE 7

SURFACE WATER ANALYTICAL RESULTS
CONTAINMENT DIKE AREA

SAMPLE DESIGNATION: DATE SAMPLED:	Upstream Oct-96	Midstream Oct-96	Downstream Oct-96	Surface Water
VOLATILES (ug/l)				
All targeted VOCs	BQL	BQL	BQL	NS
FIELD INDICATOR PARAMETERS				
pH	6.49	6.73	7.25	6.0-9.0

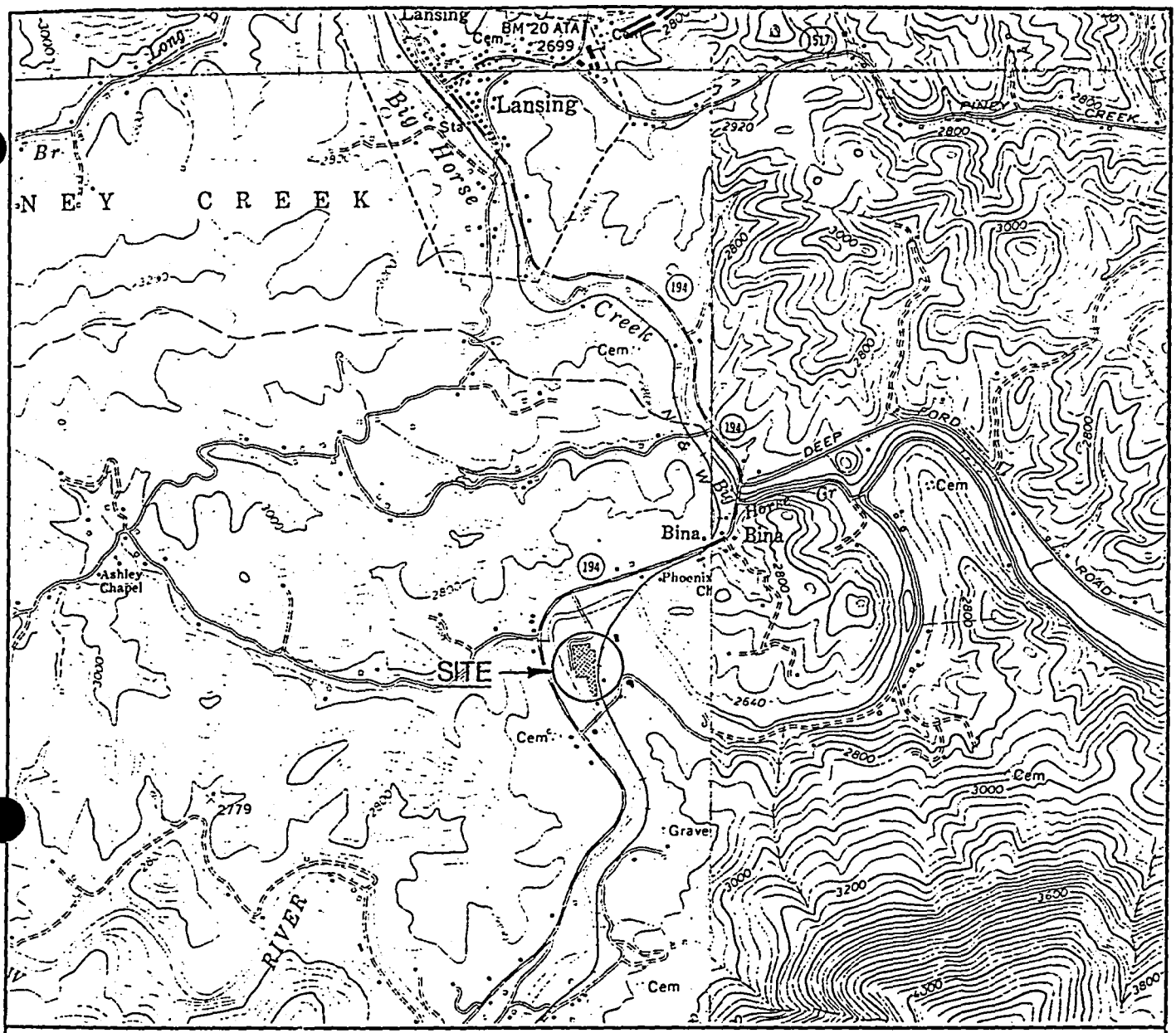
ug/l = micrograms per liter
BQL = Below the quantitation limit

TABLE 8

PRELIMINARY NATURAL ATTENUATION DATA
CONTAINMENT DIKE AREA

SAMPLE DESIGNATION:	MW-10	MW-15	MW-16	MW-17	MW-18	DW-2	2L Standard (mg/l)
DATE SAMPLED:	Oct-97	Oct-97	Oct-97	Oct-97	Oct-97	Oct-97	
SAMPLED BY:	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	
GROUND WATER (mg/l)							
Iron	0.100	0.100	0.358	0.111	0.885	BQL	0.3
Manganese	0.015	0.015	0.538	0.764	8.01	0.0346	0.05
Alkalinity	1,310	154	137	81.0	210	149	NS
Hardness	700	166	199	156	213	144	NS
Nitrite	< 0.02	< 0.02	0.089	0.671	< 0.02	< 0.02	1
Nitrate	0.04	0.092	9.45	10.6	0.138	0.668	10
Total Phosphorous	0.756	BQL	0.065	0.033	0.033	0.211	NS
Sulfide	< 2	< 2	< 2	< 2	< 2	< 2	NS
Sulfate	< 2	15.6	6.99	13.3	13.2	11.6	250
Carbon Dioxide	325.4	169.3	340.5	152.4	76.4	108.5	NS
Oxygen (lab)	0.32	1.47	1.19	1.86	4.27	2.34	NS
Nitrogen(lab)	4.6	13.0	10.1	13.5	13.9	15.7	NS
Methane(lab)	9.06	0.07	0.32	ND	ND	ND	NS
DO (field)	6.73	1.92	1.08	0.93	0.52	2.62	NS
ORP (field)	95.1	-104.5	174.6	157.6	177	-85	NS

NS = North Carolina 2L standard not established.
ND = Not detected above the method detection limit.
DO = Dissolved Oxygen
ORP = Oxidation Reduction Potential, reported in volts
BQL = Below quantitation limit.



SCALE 1:24000

1 0 1 MILE

0 1000 2000 3000 4000 5000 6000 7000

CONTOUR INTERVAL 40 FEET

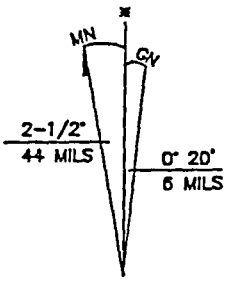
WARRENSVILLE, NC

N3622.5 – W8130/7.5

1966

AMS 4656 I NE-SERIES V842

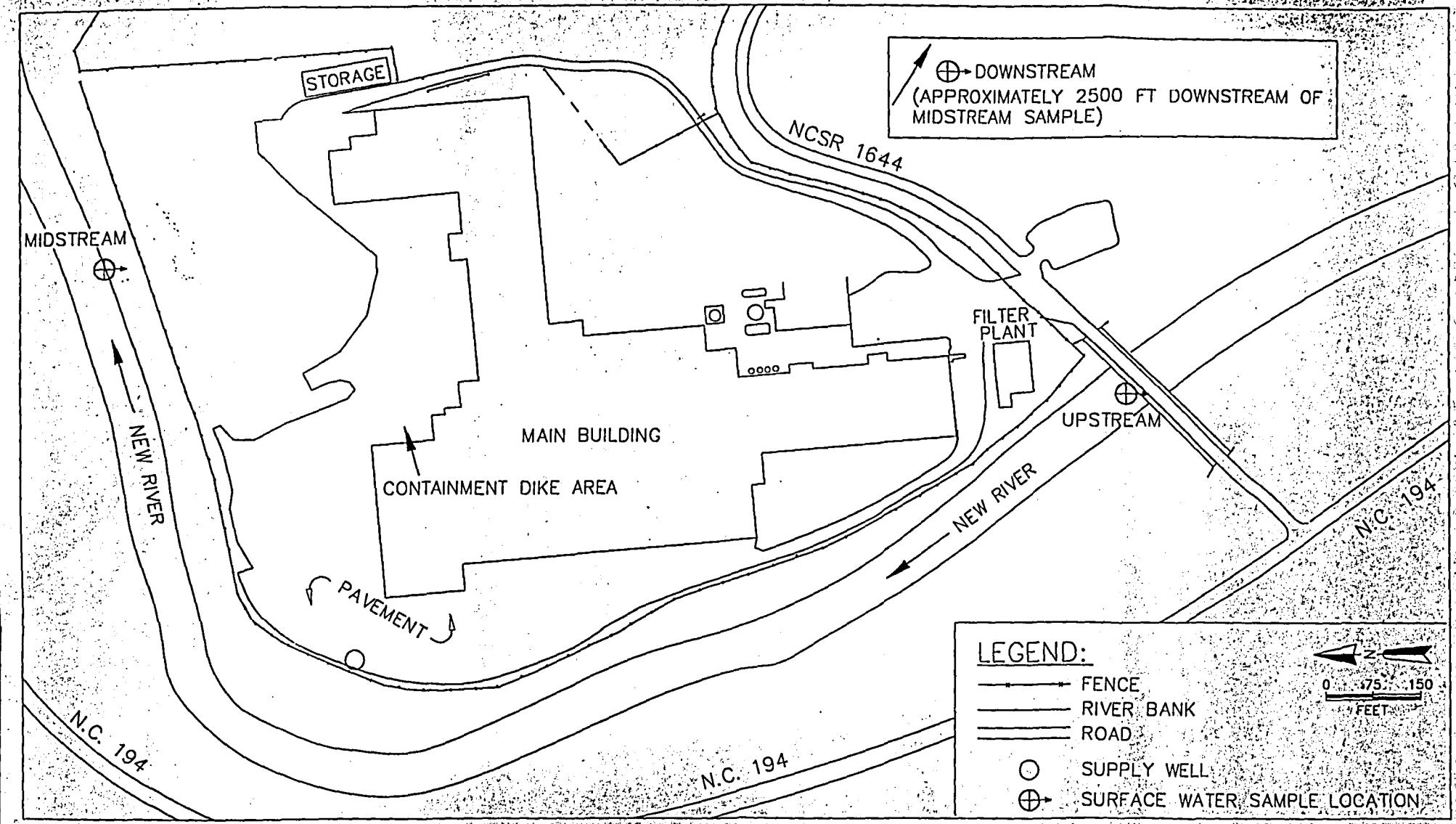
ADDITIONAL QUADS USED IN MAP:
GRASSY CREEK, JEFFERSON & PARK



Delta
Environmental Consultants, Inc.
Charlotte, North Carolina 28226

FIGURE NO.	CLIENT/LOCATION
1	AMERICAN ANNUITY GROUP LANSING, NC

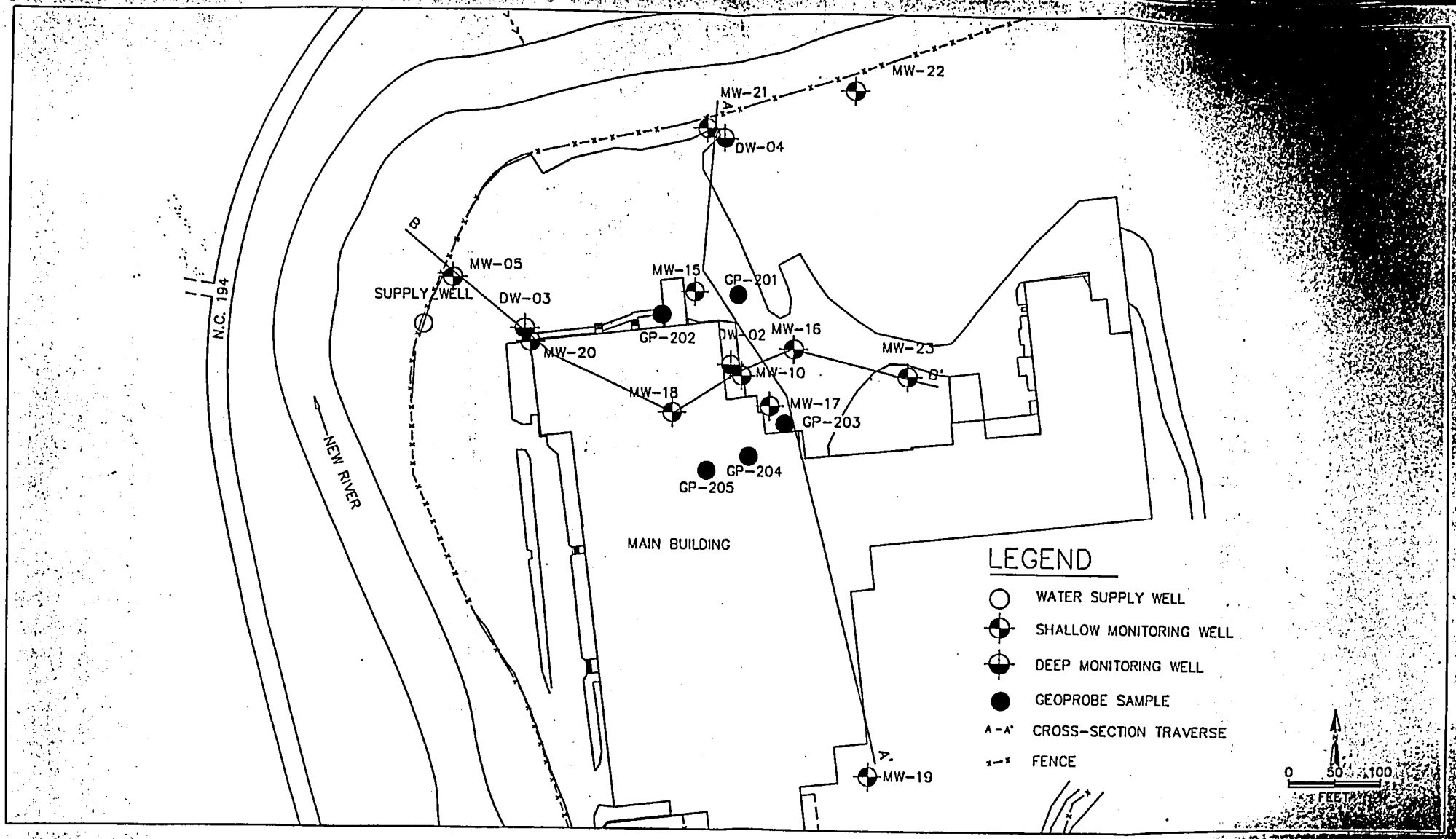
DELTA PROJECT NO.	DESCRIPTION		
E194-001	TOPOGRAPHIC MAP		
DRAWN BY C. GREENE			
REVIEWED BY	DATE 3-15-96	SCALE AS SHOWN	CAD NO. 001-TOPO



Delta Environmental Consultants, Inc.

TITLE:
SITE MAP
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

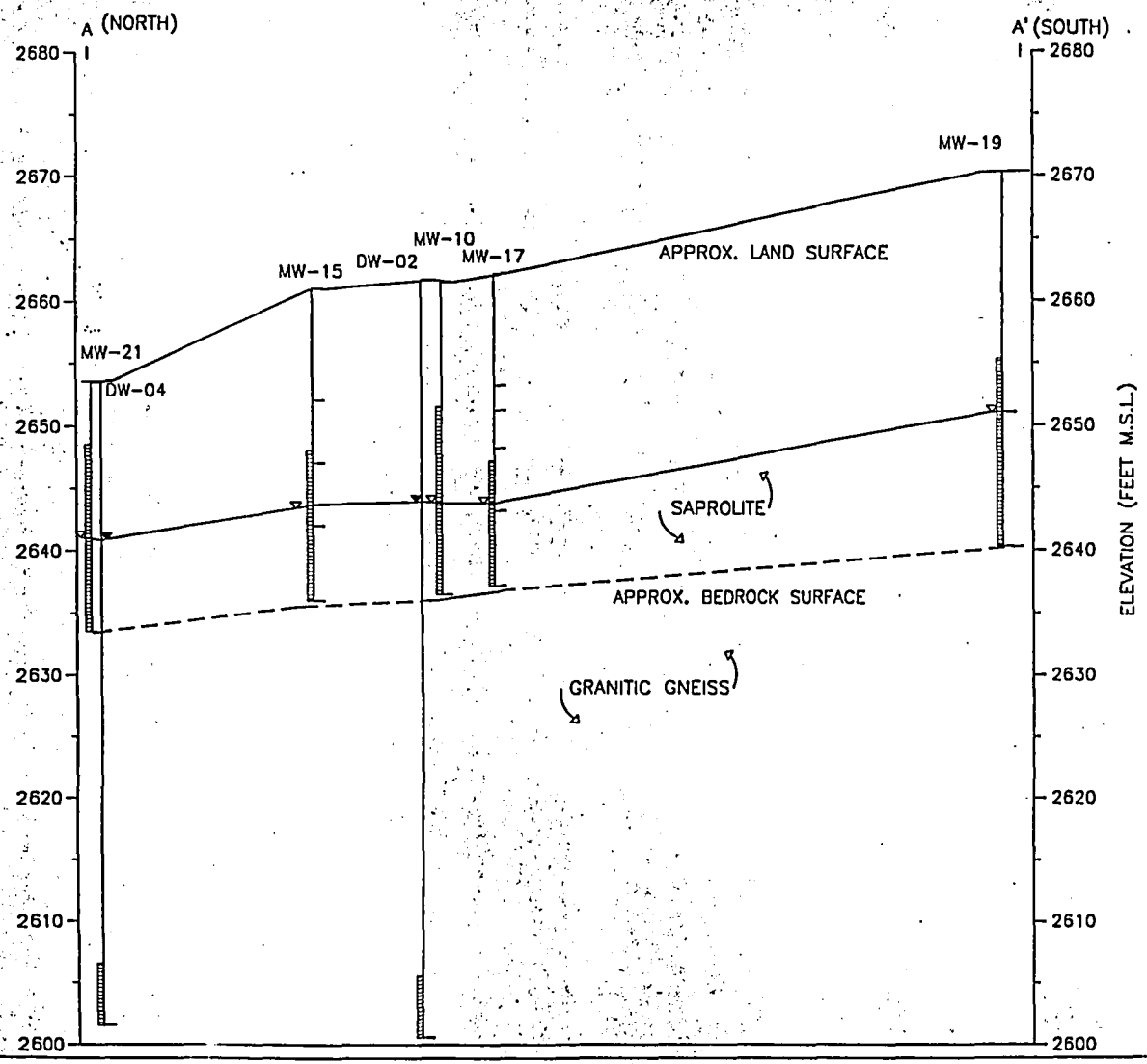
DWN: AWH	DES.: REP	PROJECT NO.: S094-001	
CHKD:	APPD:	FIGURE NO.: 2	
DATE: 1/26/98	REV.:		



Delta Environmental Consultants, Inc.

TITLE:
CROSS-SECTION LOCATION MAP
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

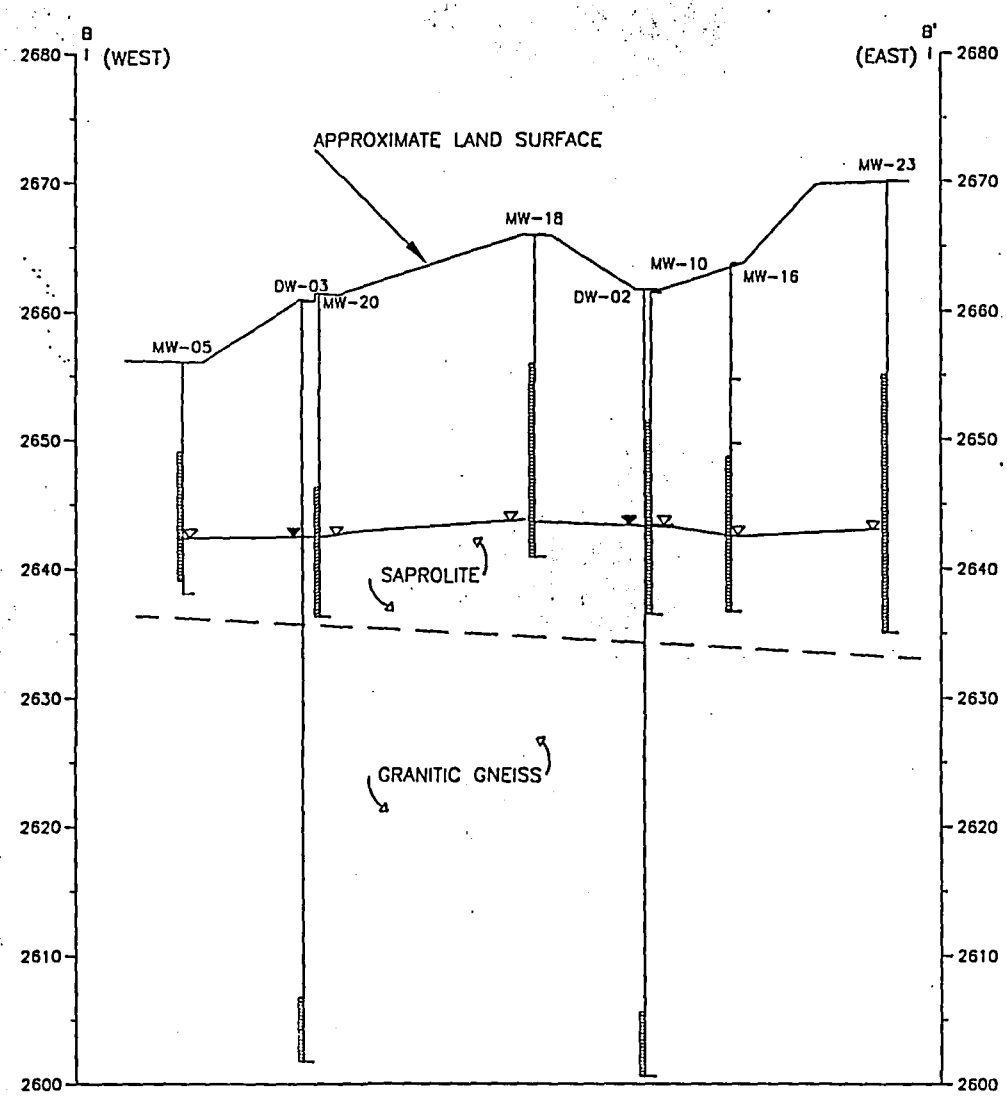
DWN: HLW
CHKD:
DATE:
DES:
APPD:
PROJECT NO.:



Delta Environmental Consultants, Inc.

TITLE:
CROSS-SECTION A – A'
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

DWN: HLW	DES.:	PROJECT NO.: S094-001
CHKD:	APPD:	FIGURE NO.: 5
DATE: 1/29/99	REV.:	



0 50 100
FEET

VERTICAL EXAGGERATION = 10X

LEGEND

▽ WATER TABLE ELEVATION (August 12, 1998)

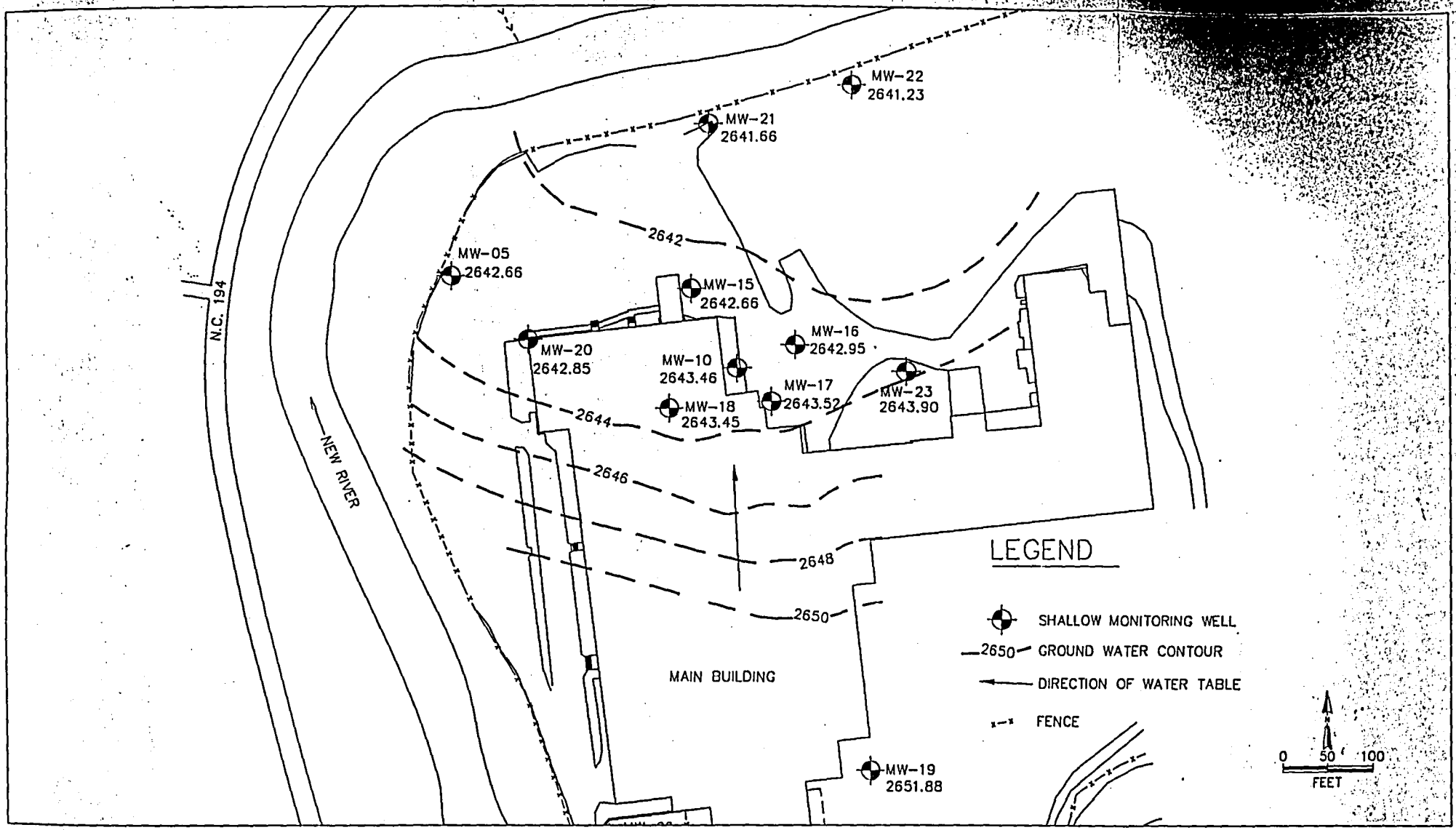
▼ SHALLOW BEDROCK WATER LEVEL (August 12, 1998)

MONITORING WELL WITH SCREEN

Delta Environmental Consultants, Inc.

TITLE:
CROSS-SECTION B – B'
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

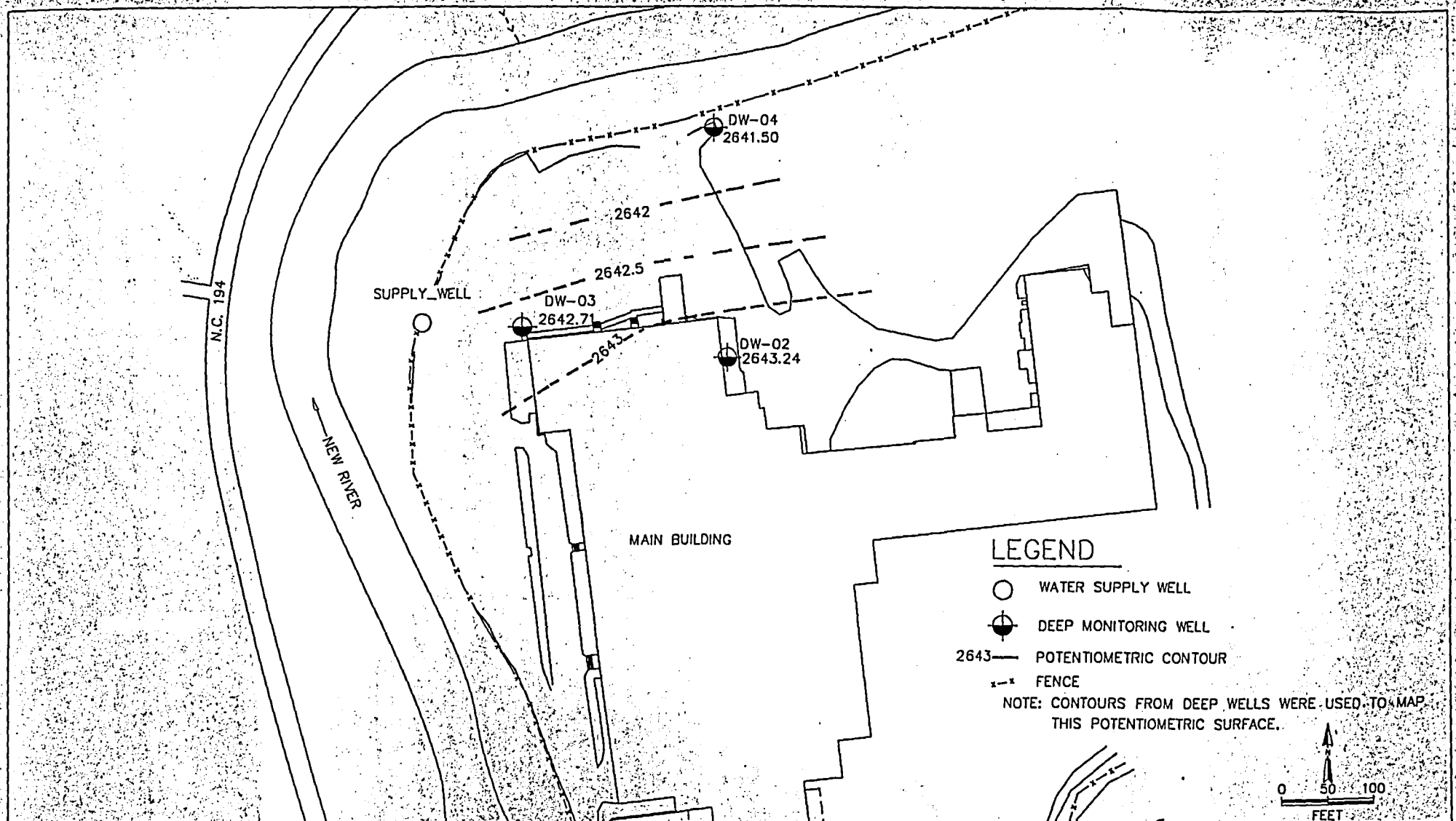
DWN: HLW	DES.:	PROJECT NO.: S094-001
CHKD:	APPD:	FIGURE NO.: 6
DATE: 1/29/99	REV.:	



Delta Environmental Consultants, Inc.

TITLE:
WATER TABLE ELEVATION CONTOUR MAP (Aug-98)
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

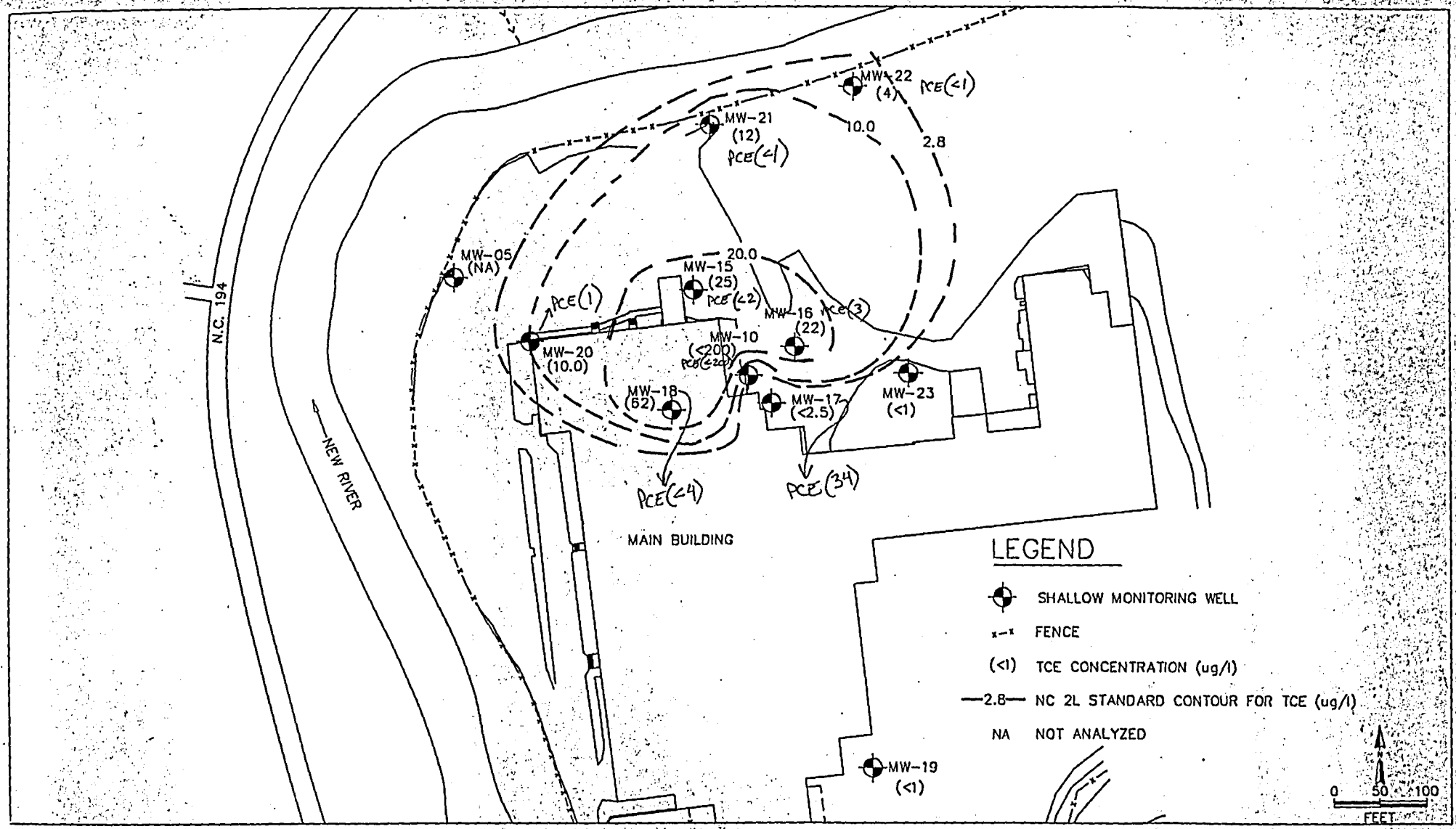
DWN: HLW	DES.:	PROJECT NO.: S094-001
CHKD:	APPD:	FIGURE NO.: 8
DATE: 02/16/99	REV.:	



Delta Environmental Consultants, Inc.

TITLE:
POTENTIOMETRIC SURFACE MAP (Aug-98)
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

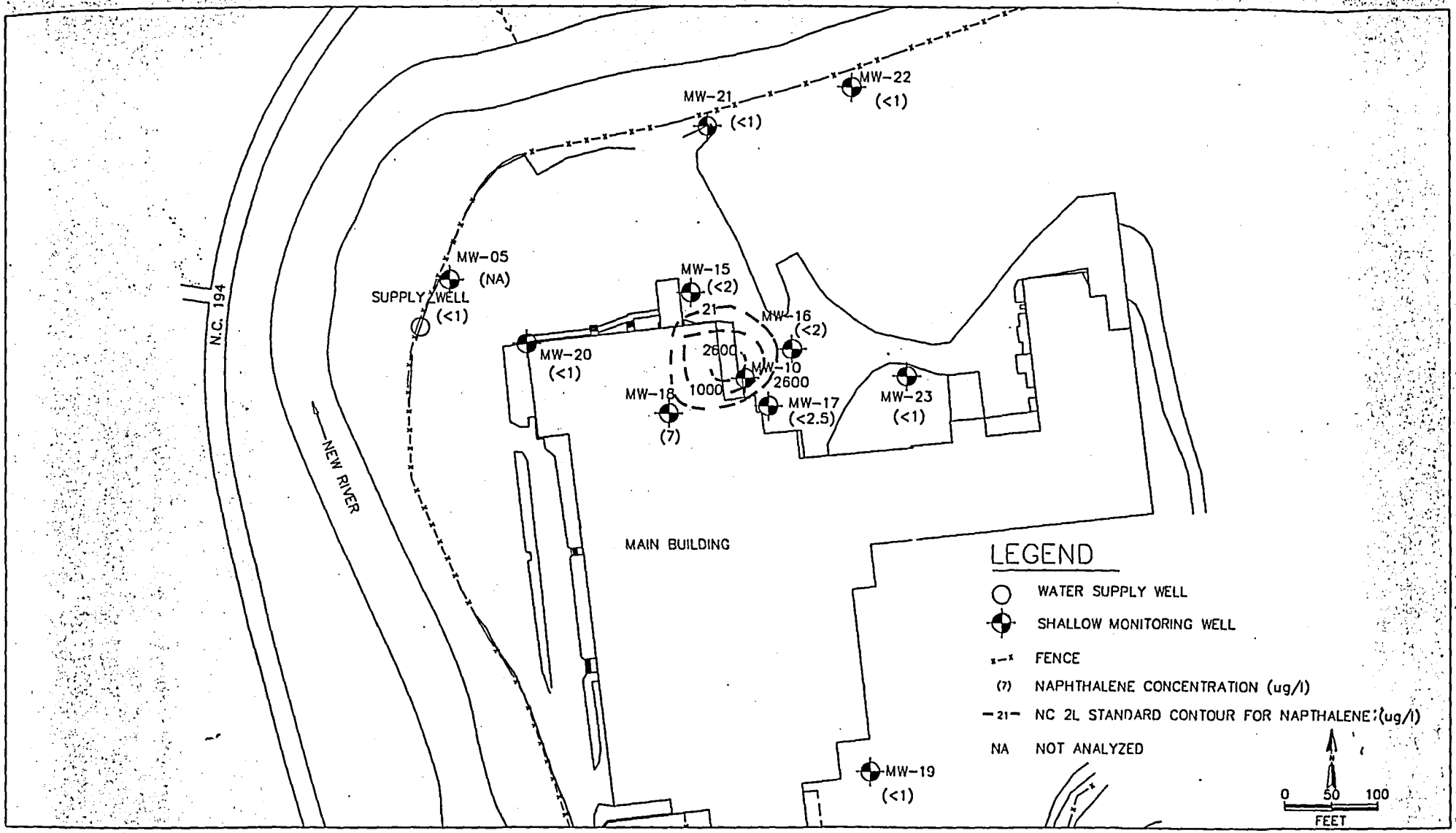
DWN: HLW	DES.:	PROJECT NO.: S094-001
CHKD:	APPD:	FIGURE NO.: 9
DATE: 1/29/99	REV.:	



Delta Environmental Consultants, Inc.

TITLE:
TCE ISOCONCENTRATION CONTOUR MAP, WATER TABLE (Aug-98)
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

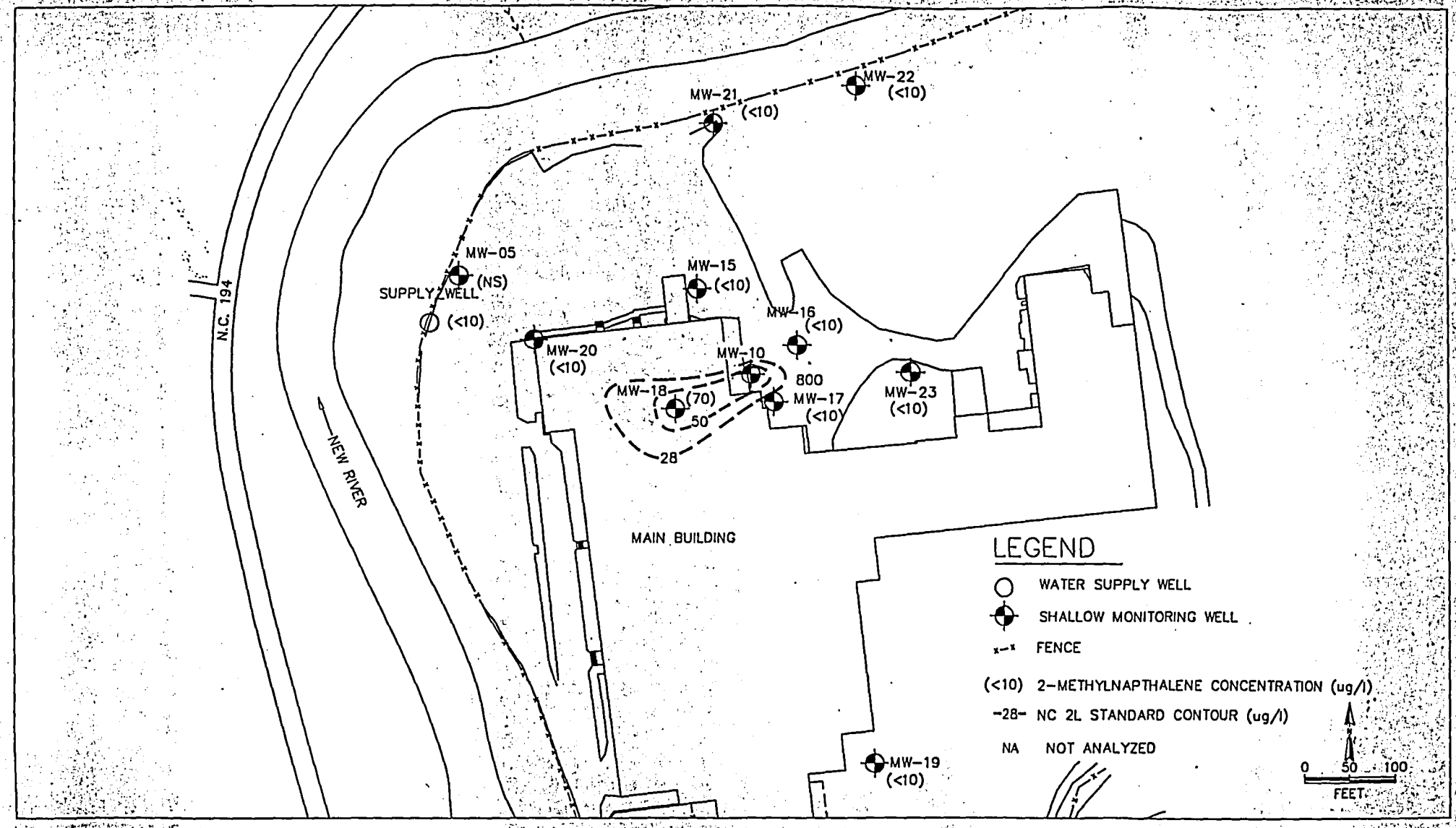
DWN: HLW	DES.:	PROJECT NO.: S094-001
CHKD:	APPD:	FIGURE NO.:
DATE:	REV.:	



Delta Environmental Consultants, Inc.

TITLE:
NAPHTHALENE ISOCONCENTRATION MAP, WATER TABLE (Aug-98)
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

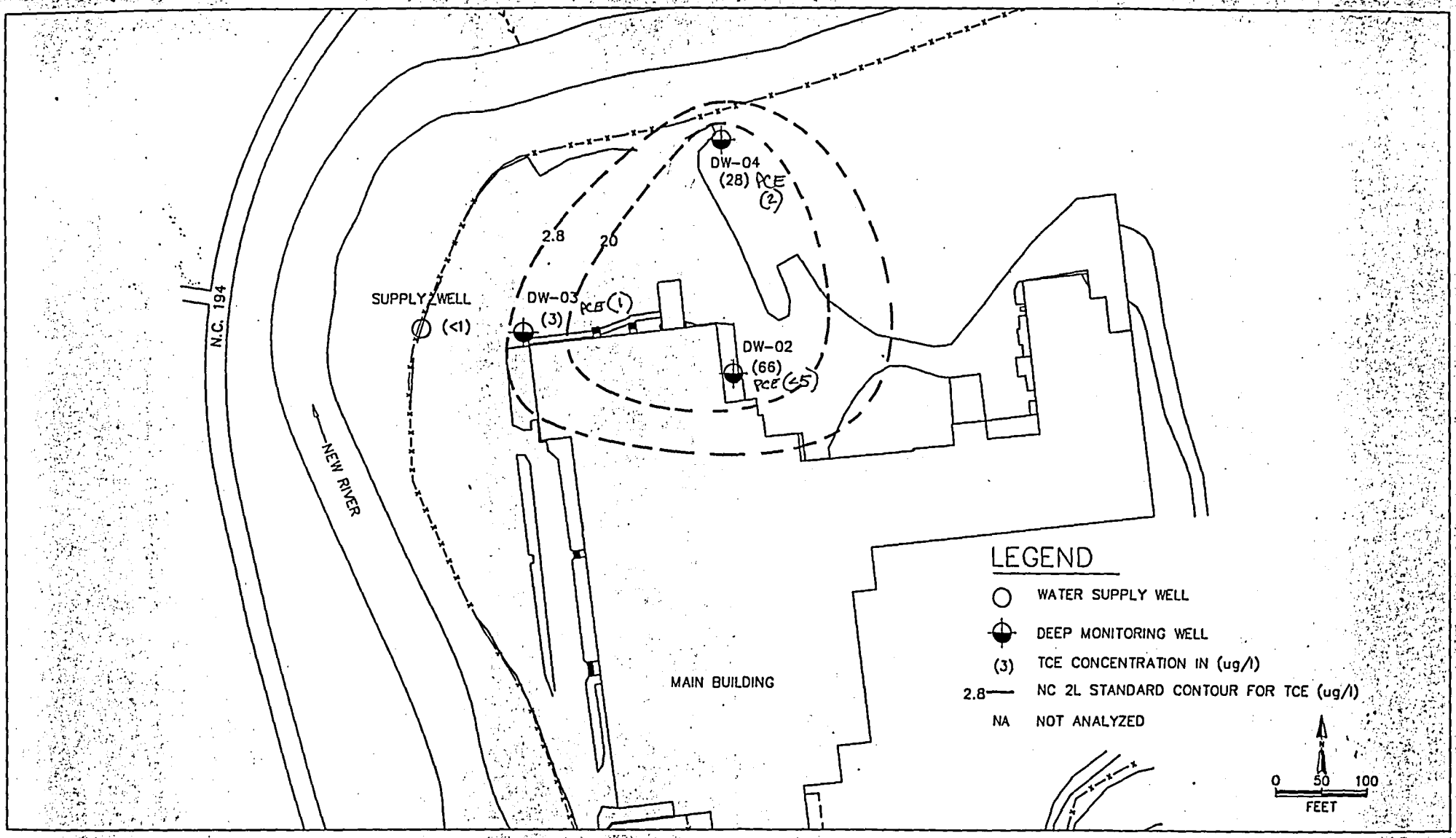
DWN: HLW	DES.:	PROJECT NO.: S094-001
CHKD:	APPD:	FIGURE NO.: 1.1
DATE: 1/29/99	REV.:	



Delta Environmental Consultants, Inc.

TITLE:
2-METHYLNAPHTHALENE ISOCONCENTRATION MAP, WATER TABLE (Aug-98)
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

DWN: HLW	DES.:	PROJECT NO.: S094-001
CHKD:	APPD:	FIGURE NO.: 12
DATE: 1/29/99	REV.:	



Delta Environmental Consultants, Inc.

TITLE:
TCE ISOCONCENTRATION MAP, BEDROCK WELLS (Aug-98)
AMERICAN ANNUITY GROUP
LANSING, NORTH CAROLINA

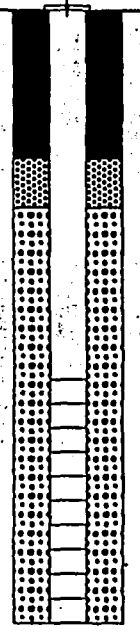
DWN: HLW	DES.:	PROJECT NO.: S094-001
CHKD:	APPD:	FIGURE NO.: 13
DATE: 02/17/99	REV.:	

Delta Environmental Consultants, Inc.	Project Number: S094-001	Site Id: MW-17
	Project Name: LANSING	Location: LANSING, NORTH CAROLINA
	Contractor: GEI	Elevation: 2662.10'
Consulting Firm: DELTA ENVIRONMENTAL		Datum: Mean Sea Level
Logged By: RICK POWELL		Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'
Date(s): 09/26/97 - 09/26/97		
Purpose: Monitoring Well, Shallow		Blank Casing: type: PVC dia: 2.00in fm: 0.0' to: 15.00'
Drilling Method: Hollow Stem Auger		
Annular Fill: type: Bentonite Grout fm: 0.00' to: 6.00'; type: Bentonite Chips fm: 6.00' to: 8.00'; type: SAND PACK #4 fm: 8.00' to: 25.00'		Screens: type: Slotted size: 0.010in dia: 2.00in fm: 15.00' to: 25.00'
		Remarks:

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	PID	Graphic Log	USCS Code	Material Description
							ML	BROWN, CLAYEY SILT WITH ROCK FRAGMENTS
2660								
					0.0 ppm			
	10				0.0 ppm		ML	BROWN SLIGHTLY MICACEAUS SILT, MOIST
					0.0 ppm		ML	
2650								
							ML	RED-BROWN/GRAY MICACEAUS CLAYEY SILT FOLIATION PRESENT
	20							
2640								WEATHERED GNEISS FRAGMENTS
								BORING TERIMINATED AT 25 FEET
	30							
2630								

Well Construction

MP. EL. 2661.84



Ref. 18

NORTH CAROLINA DEPARTMENT OF
ENVIRONMENT AND NATURAL RESOURCES

WINSTON-SALEM REGIONAL OFFICE

DIVISION OF WATER QUALITY
GROUNDWATER SECTION

NCDENR

JAMES B. HUNT JR.
GOVERNOR

BILL HOLMAN
SECRETARY

January 5, 2001

CERTIFIED MAIL NUMBER: 7099 3220 0006 8506 1989
RETURN RECEIPT REQUESTED

Mr. John Gruber
American Annuity Group, Inc.
P.O. Box 120
Cincinnati, OH 45201

SUBJECT: Review of CSA Reports; United Chemi-Con Manufacturing; 185 McNeil Road, Lansing, Ashe County; Groundwater Incident No. 15208; Incident Ranking 110/B

Dear Mr. Gruber:

The Groundwater Section at the Winston-Salem Regional Office has reviewed the comprehensive site assessment reports (CSA's) for the Containment Dike and Former Etchant areas of the subject site. These reports were prepared by Delta Environmental Consultants, Inc., and were received by our office on April 7, 1999.

The most recent groundwater samples reported in the Containment Dike CSA included concentrations of trichloroethene up to 150 ug/L, tetrachloroethene up to 34 ug/L and naphthalene up to 5,000 ug/L. These concentrations are above 15A NCAC 2L .0202 groundwater quality standards. Other compounds were also detected, but at levels below the 2L standards. The Etchant Area CSA reported pH readings that are outside the acceptable pH range listed in 15A NCAC 2L .0202, as well as concentrations of nitrate and sulfate that are above the 2L standards.

Based on the information submitted, the horizontal and vertical extent of contamination has been adequately defined. The CSA's are therefore approved and development of a corrective action plan (CAP) may proceed. If natural attenuation is chosen, please ensure the CAP includes an adequate monitoring schedule to track contaminant degradation in groundwater and contaminant discharge to surface water.

If you have any questions, please feel free to contact Don Geddes at the letterhead address or telephone number.

Sincerely,

Sherri V. Knight

Sherri V. Knight
Regional Groundwater Supervisor

585 WAUGHTOWN STREET, WINSTON-SALEM, NORTH CAROLINA 27107
PHONE 336-771-4600 FAX 336-771-4632
DENR CUSTOMER SERVICE CENTER 1-877-623-6748
AN EQUAL OPPORTUNITY / AFFIRMATIVE EMPLOYER - 50% RECYCLED/10% POST-CONSUMER PAPER

Notes on United Chemi-Con CSA's
January 5, 2001

Both CSA's (Containment Dike and Etchant Area) were approved based on adequate delineation of plumes and low concentrations of contaminants.

RP will propose natural attenuation in CAP, but I was originally concerned over surface water discharge of plume (per Arthur's meeting with Water Quality Section and their decision not to approve any L-CAP's with existing or potential 2B violations).

North Fork New River at that point is a C classification, so 2B standards are:
TCE=92.4 ppb and PCE= 8.85 ppb (only 2 compounds of concern near river).

Highest concentrations detected at 3 wells nearest river (MW-21, MW-22 and DW-4) are:
TCE=28 ppb and PCE=2 ppb (both in DW-4.

DW-4 is approximately 90 feet upgradient of riverbank), so present plume configuration is not causing (and should not cause in the near future) any 2B violation.

So, if everything else looks good (i.e., public notice, geochemistry, empirical data, etc.), CAP should be approvable with a monitoring schedule that includes semi-annual sampling of river *at a new sampling point closest to and immediately downgradient of* DW-4. Supply well should also be sampled in schedule, along with select monitoring wells.

Ref. 19

MEMO

To: John Gruber

From: Steve Zbur
Johnnie Ho

Date: February 23, 1995

Subject: Results of Preliminary Sampling and Closure Recommendations
Off-Site Ponds
Lansing, North Carolina

Delta No: E194-001-1.0015

The purpose of this memo is to summarize the results of the preliminary sampling performed by Laidlaw Environmental Services (Laidlaw) and Brown & Root (B&R) Environmental. Recommendations regarding the pond backfilling, surface water disposal, regulatory interactions and a preliminary closure schedule are also discussed.

ANALYTICAL RESULTS

AAG (formerly SPELCO) retained Laidlaw to perform surface water, soil and sludge sampling and subsequent analysis of material present in the settling ponds. The sampling was performed in June and July 1992. Figure 1 illustrates the sample locations with respect to each pond.

Eleven samples were initially obtained by Laidlaw in June 1992. Six of the eleven samples were collected from sludge present on the bottom of each pond identified as samples SEC-2 through SEC-7 (Table 1). Six soil samples were collected from the bank of each pond above the water line identified as samples SEC-2A through SEC-6A (Table 1). Each sample was analyzed for the priority pollutants to include metals, volatiles and base neutrals (semi-volatiles).

Three surface water samples (SEC-20-23) were obtained by Laidlaw from the ponds in July 1992. The location of the surface water samples as illustrated in Figure 1 is based on information obtained during a telephone conversation with Mr. Swaine Skeen (former Laidlaw employee that performed the sampling). The surface water samples were also analyzed for the priority pollutants as summarized in Table 2.

Two additional samples were obtained by Laidlaw in July 1992 and analyzed to determine if liquids and/or sludge and soil within the ponds display the characteristics of hazardous waste (ignitable, corrosive, reactive, toxic). The analytical results are summarized in Table 3. Mr. Swaine Skeen was not able to recall the location of each sample.

Review of Tables 1 through 3 indicates that no volatile organic compounds were reported at levels greater than the method detection limit (toluene was reported at the detection limit of 5 micrograms per liter or parts per billion in sample SEC-21). All of the base neutrals (semi-volatiles) were reported below the method detection limit in all samples.

Numerous metals were reported above the detection limit and/or the average background concentrations of the soil samples that were collected by Delta for the preliminary site assessment in January 1993. Review of Table 1 indicates low levels of mercury in all of the sludge and soil samples. Mercury was not reported in the background samples. The remaining RCRA metals (arsenic, barium, cadmium, chromium, lead, selenium and silver) were not reported above the average background concentrations. Several other metals such as boron, copper, nickel, and vanadium were present in each of the sludge and soil samples. It is unknown if these concentrations can be attributed to background conditions.

Review of the surface water samples (Table 2) indicates the presence of numerous metals, none of which exceeded the TC regulatory level as described in Table 3. The pH values ranged between 3.52 and 7.21. All of these values are within the TC regulatory level of >2.1 or <12.4. Based on the data provided by Laidlaw, none of the material displays characteristics of hazardous waste.

POND BACKFILLING

Based on the analytical data provided by Laidlaw, the sludge does not display characteristics of a hazardous waste; therefore, the removal or in-place treatment of sludge does not appear to be required by applicable regulations. Delta recommends that the ponds be backfilled. This option would include removing the residual surface water (dewatering) and backfilling the ponds with native soil.

SURFACE WATER DISPOSAL TREATMENT OPTION

A grab sample from each lagoon was collected by B&R in August 1993 and composited for analysis by Environmental Testing and Consulting, Inc. Review of the composite water sample (Table 5) results indicate very low biological activity and total suspended solids in the wastewater. The chemical oxygen demand level indicates the presence of inorganics. None of the metal levels exceeded the TC regulatory level. The pH value is also within the TC regulatory level.

The report from Mr. Swaine Skeen indicates that most of the lagoons were dry in July 1993. Assuming that the surface water disposal is carried out during the same season in 1995 and an average water depth of 3 ft. in each pond, we estimate a surface water volume of 2.2 million gallons (96,300 $ft.^2$ × 3 ft. = 288,900 $ft.^3$ × 7.48 $gal/ft.^3$). Delta recommends the surface water be discharged to the New River through transfer of UCCMs permitted outfall No. 005.

REGULATORY INTERACTION

Discussions have occurred with the staff of the North Carolina Division of Environmental Management (DEM) regarding the drainage and closure of the ponds. The NPDES Permit staff has indicated that the ponds will be able to be drained using an outfall from the NPDES permit formerly held by SPELCO. The Non-discharge Permit staff has indicated that following drainage, the ponds can be closed with no further approval or permits. The sludge material in the ponds has been appropriately tested and shown not to be a hazardous waste. Indications received from DEM staff are that no formal closure plan will be required for the drained ponds.

Notwithstanding the indications and discussions above, AAG could elect to prepare a formal closure plan for submittal to DEM Groundwater Section and request a response to the plan. Alternatively, AAG could proceed with closure and notify DEM upon completion of project milestones and completion of closure.

CLOSURE SCHEDULE

The proposed closure schedule is summarized below:

Task	Completed By
Reconfirm Contractors' Bid	April 14, 1995
Bid Evaluation, Recommendation to AAG	April 28, 1995
Stormwater Permit Submittal	May 1, 1995
Preconstruction Meeting	June 1, 1995
Pond Water Removal	June 15, 1995
Construction (Backfilling/Landscaping)	July 31, 1995

TABLE 1
SLUDGE & SOIL SAMPLES
TOTAL ANALYSES
OFF-SITE PONDS
JUNE 1992
LAIDLAW ENVIRONMENTAL SERVICES, INC.
DELTA PROJECT NO. 50-91-105.15

	SLUDGE SAMPLES						SOIL SAMPLES					
ANALYSIS	SEC-2	SEC-3	SEC-4	SEC-5	SEC-6	SEC-7	SEC-2A	SEC-3A	SEC-4A	SEC-5A	SEC-6A	BACKGROUND
pH	4.68	6.41	7.83	7.21	5.53	3.97	4.51	4.94	5.47	5.48	4.91	NA
PRIORITY POLLUTANTS (mg/kg)												
METALS												
ANTIMONY	<0.01	0.66	0.82	0.26	0.48	<0.01	0.56	4.78	<0.01	<0.01	0.35	NA
ARSENIC	0.06	<0.01	<0.01	0.14	1.82	0.46	<0.01	1.20	<0.01	<0.01	<0.01	<1.3
BERYLLIUM	0.10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	NA
BARIUM	2.10	18.18	55.38	87.56	19.18	13.40	16.34	103.16	102.00	24.64	101.32	210
BORON	602.36	462.18	<0.01	37.88	201.94	69.24	441.50	123.64	19.10	32.56	105.42	NA
CADMIUM	<0.005	<0.005	0.42	1.34	<0.005	<0.005	0.22	0.64	1.52	0.90	0.96	2.2
CHROMIUM	5.82	6.16	9.00	33.42	3.46	6.56	11.66	20.56	25.80	29.10	23.02	80
COPPER	22.18	47.26	12.76	30.32	52.02	10.78	17.34	73.06	27.12	27.00	50.44	NA
LEAD	0.36	<0.01	4.68	3.94	<0.01	<0.01	<0.01	<0.01	4.42	3.74	3.42	7.5
MANGANESE	11.46	29.84	36.88	82.82	7.22	44.46	83.60	73.94	217.78	191.70	120.96	NA
MERCURY	0.008	0.01	0.04	0.07	0.008	0.006	0.01	0.005	0.02	0.008	0.009	<0.045
NICKEL	2.22	1.86	1.80	3.80	34.80	1.70	4.10	6.32	6.56	5.48	6.76	NA
SELENIUM	2.36	0.14	1.32	<0.01	0.98	<0.01	0.90	0.48	<0.01	<0.01	<0.01	<1.3
SILVER	0.01	0.46	0.52	1.54	0.40	0.30	0.28	0.72	0.48	0.14	0.42	<2.6
THALLIUM	2.18	2.82	2.64	2.44	1.58	2.54	4.74	0.32	2.18	0.74	<0.05	NA
VANADIUM	6.48	10.04	17.76	31.28	4.34	6.34	12.36	24.98	37.14	26.18	33.40	NA
ZINC	12.28	5.80	5.44	13.46	7.36	10.62	14.88	27.44	21.30	20.78	24.28	NA

VOLATILES
ALL VOLATILE CONSTITUENTS WERE REPORTED BELOW THE METHOD DETECTION LIMIT.

BASE NEUTRALS (SEMI-VOLATILES)
ALL BASE NEUTRAL CONSTITUENTS WERE REPORTED BELOW THE METHOD DETECTION LIMIT.

NA = NOT ANALYZED
SLUDGE SAMPLES SEC-2 THROUGH SEC- 7 WERE OBTAINED FROM THE LAGOONS THAT CORRESPOND WITH SOIL SAMPLES SEC- 2A THROUGH SEC- 6A.

TABLE 2
SURFACE WATER SAMPLES
TOTAL ANALYSES
OFF-SITE PONDS
JULY 1992
LAIDLAW ENVIRONMENTAL SERVICES, INC.
DELTA PROJECT NO. 50-92-105.15

ANALYTE	SEC-20	SEC-21	SEC-22
pH	5.64	4.43	7.13
PRIORITY POLLUTANTS (mg/l)			
METALS			
ANTIMONY	0.04	<0.01	<0.01
ARSENIC	0.03	0.07	0.03
BERYLLIUM	<0.01	<0.01	<0.01
BARIUM	0.02	0.04	0.01
BORON	98.60	7.30	22.24
CADMIUM	<0.005	<0.005	<0.005
CHROMIUM	0.03	0.02	0.01
COPPER	0.02	0.02	0.03
LEAD	<0.01	<0.01	<0.01
MANGANESE	0.15	0.81	0.06
MERCURY	0.007	<0.002	0.00
NICKEL	0.04	0.01	0.03
SELENIUM	0.08	<0.01	<0.01
SILVER	0.01	<0.01	<0.01
THALLIUM	<0.01	<0.01	<0.01
VANADIUM	<0.01	<0.01	<0.01
ZINC	0.37	0.08	0.03
VOLATILES			
TOLUENE	<0.005	0.005	<0.005

ALL OTHER VOLATILE CONSTITUENTS WERE REPORTED BELOW THE METHOD DETECTION LIMIT.

BASE NEUTRALS (SEMI-VOLATILES)
ALL BASE NEUTRAL CONSTITUENTS WERE REPORTED BELOW THE METHOD DETECTION LIMIT.

TABLE 3
OFF-SITE PONDS
TCLP
JULY 1992
LAIDLAW ENVIRONMENTAL SERVICES, INC.
DELTA PROJECT NO. 50-92-105.15

	LIQUID F-5393 thru F-5395	SLUDGE/SOIL F-4421 thru F-4432	TC REGULATORY LEVEL
pH	6.04	3.52	< 2.1 OR > 12.4
METALS (mg/L)			
ALUMINUM	0.17	26.87	NL
ARSENIC	0.02	< 0.01	5.0
BARIUM	< 0.01	< 0.01	100.0
CADMIUM	< 0.005	0.006	1.0
CHROMIUM	< 0.01	< 0.01	5.0
COPPER	< 0.01	< 0.01	NL
LEAD	< 0.01	< 0.01	5.0
MERCURY	0.003	0.005	0.2
NICKEL	< 0.01	< 0.01	NL
SELENIUM	0.01	0.03	1.0
SILVER	< 0.01	< 0.01	5.0
THALLIUM	< 0.06	< 0.06	NL
ZINC	0.01	0.05	NL

VOLATILES

ALL VOLATILE COMPOUNDS WERE REPORTED BELOW THE METHOD DETECTION LIMIT AND THE TC REGULATORY LEVEL.

BASE NEUTRALS (SEMI-VOLATILES)

ALL BNA COMPOUNDS WERE REPORTED BELOW THE METHOD DETECTION LIMIT AND THE TC REGULATORY LEVEL.

ADDITIONAL COMPOUNDS

CORROSIVITY, REACTIVITY AND FLASH POINT VALUES ARE WITHIN THE ACCEPTABLE TC REGULATORY LEVEL.

NL = NO REGULATORY LIMIT PER 40 CFR, PART 261.

TABLE 4
ESTIMATED SLUDGE VOLUMES
OFF-SITE PONDS
DELTA PROJECT NO. 50-92-105.15
AUGUST 1993

POND	APPROXIMATE AREA (FT^2)	AVERAGE SLUDGE THICKNESS (FT.)	APPROXIMATE SLUDGE VOLUME (YDS^3)
1	2,200	3.3	269
2	26,600	1.9	1,872
3	7,200	2.3	613
4	13,200	5.3	2,591
5	19,600	6.8	3,929
6	13,500	1.0	500
7	18,000	1.0	667
TOTALS:	96,300 (FT^2) OR 2.2 ACRES		10,441 (YDS.^3) OR 15,661 TONS

NOTES:

DATA BASED ON INFORMATION PROVIDED BY BROWN & ROOT ENVIRONMENTAL
A CONVERSION FACTOR OF 1.5 WAS USED TO OBTAIN APPROXIMATE TONNAGE

TABLE 5
SURFACE WATER SAMPLE
TOTAL ANALYSES
OFF-SITE PONDS
AUGUST 1993
BROWN & ROOT
DELTA PROJECT NO. 50-92-105.15

ANALYTE	RESULT
METALS (MG/L)	
ALUMINUM	2.41
ARSENIC	<0.002
BARIUM	<0.03
CADMIUM	<0.002
CHROMIUM	<0.02
LEAD	<0.05
MERCURY	<0.001
SELENIUM	<0.002
SILVER	<0.01
INDICATOR PARAMETERS	
pH	6.6
BIOCHEMICAL OXYGEN DEMAND	21
TOTAL SUSPENDED SOLIDS	36
CHEMICAL OXYGEN DEMAND	114
DISSOLVED OXYGEN	10.5

VOLATILES

ALL VOLATILE CONSTITUENTS WERE REPORTED BELOW THE METHOD DETECTION LIMIT.

CHAIN OF CUSTODY RECORD

Environmental Testing & Consulting, Inc.
2924 Walnut Grove Rd.
Memphis, TN 38111
(901)327-2750 fax (901)327-6334

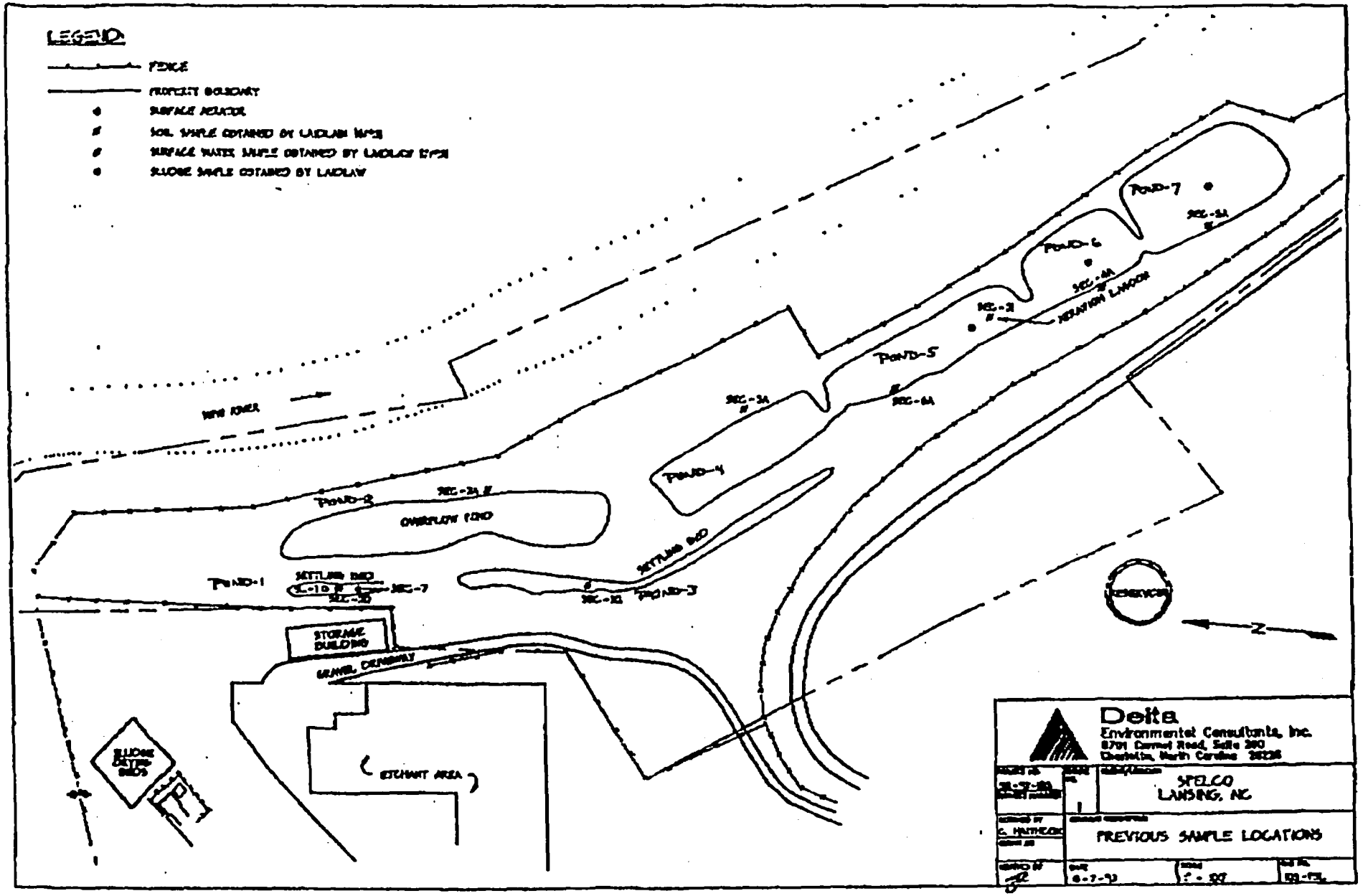
CLIENT NAME	BROWN & ROOT ENVIRONMENTAL
SITE	DELTA/SPECO CARLYLE, NC.
PROJECT #	
SAMPLED (sign)	Robert L. Knight
PHONE #:	615/483-9900
FAX #:	615/483-2014
FID#	
PO #	WILL CALL
FAX RESULTS	
RUSH	
REG. TURN.	
ICE	
REMARKS	Composite 2 VOA containers from each location + analyse for VOC's. Run VOC's on each location from remaining containers (2 each location)

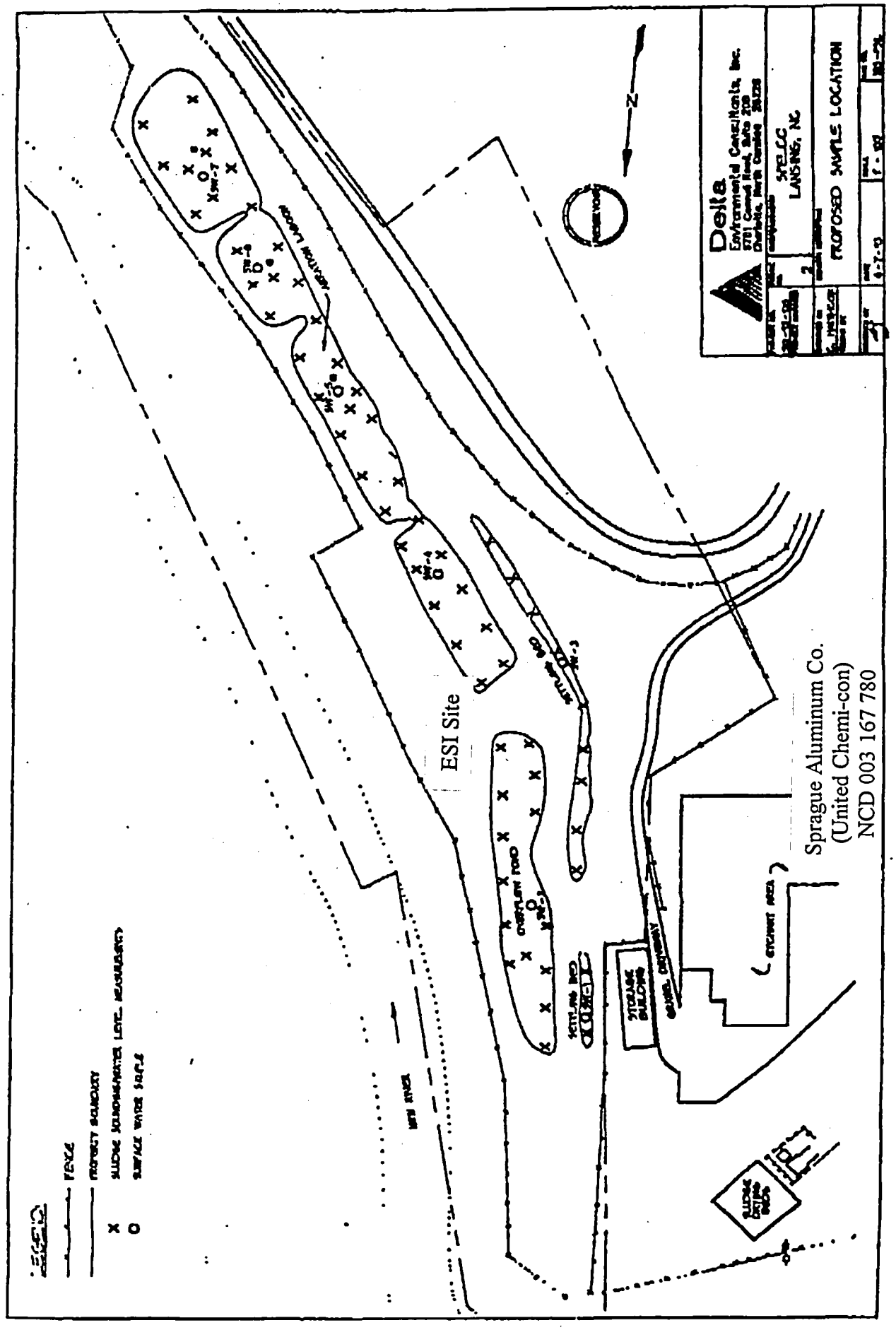
ANALYSES (LIST BELOW)

# of cont.	SAMPLE ID NUMBER	LOCATION/ DEPTH	SAMPLE DATE	SAMPLE TIME	SAMPLE TYPE COMP	SAMPLE TYPE GRAB	MATRIX WATER	MATRIX SOIL	MATRIX OTHER	VOC (Solid Bed)	TPCRA+A	BOD/TSS/pH	COD	DO			
8	#7	POND #7/SURFACE	12Aug93	1142		X	X			X	X	X	X	X			
8	#6	POND #6/SURFACE	12Aug93	1157		X	X			X	X	X	X	X			
8	#2	POND #2/SURFACE	12Aug93	1300		X	X			X	X	X	X	X			

Dan Davison
Dan Brown 8/13/93 left to
1. run VOC's separately and on composite
2. contact lab of sampler into one vial and run analysis
Glen Kane 8/17/93

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY (sign)	12Aug93	1400	RECEIVED BY (sign) Fed ex Airbill # 9936597535		
2. RELINQUISHED BY (sign)			RECEIVED BY (sign)		
3. RELINQUISHED BY (print)			RECEIVED BY LAB (print) S. Hermann	8/13/93	0954
(sign)			(sign) S. Hermann		


LEGEND
FENCE
PROPERTY BOUNDARY
SURFACE AERATOR
SOIL SAMPLE OBTAINED BY LAIDLAW
SURFACE WATER SAMPLE OBTAINED BY LAIDLAW
SLUDGE SAMPLE OBTAINED BY LAIDLAW
NEW RIVER
POND-1
POND-2
POND-3
POND-4
POND-5
POND-6
POND-7
OVERFLOW POND
SETTLING POND
SEC-7
SEC-34
SEC-44
SEC-3
SEC-10
SEC-30
SEC-31
AERATION LAGOON
STORAGE BUILDING
MAIN DRIVEWAY
SLUDGE DRYING BEDS
EXHAUST AREA
RESERVOIR
N
Delta
Environmental Consultants, Inc.
8701 Dorsey Road, Suite 200
Charlotte, North Carolina 28208
SPELCO
LANSING, NC
PREVIOUS SAMPLE LOCATIONS
C. HATHCOCK
6-7-93


Delta
Environmental Consultants, Inc.
PROPOSED SAMPLE LOCATION
SPELCC
LANSING, NC
ESI Site
Sprague Aluminum Co.
(United Chemi-con)
NCD 003 167 780
OVERFLOW POND
SETTLING POND
STORAGE BUILDING
EXCHANGE AREA
PROPERTY BOUNDARY
SURFACE WATER STATE

Sources: I = IRIS H = HEAST A = HEAST Alternate W = Withdrawn from IRIS or HEAST
E = EPA NCEA provisional value O = other

Basis: C = Carcinogenic effects N = Noncarcinogenic effects I = RBC at HI of 0.1 < RBC c

Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Risk-based concentrations: Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Soil Residential mg/kg	Region III SSLs: Soil, for groundwater migration DAF 1 mg/kg	DAF 20 mg/kg
ACETALDEHYDE	75070			2.57E-003 I	7.7E-003 I	y	1.6E+000 C	8.1E-001 C				3.8E-004	7.7E-003 C
ACETOCHLOR	34256821	2E-002 I					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N		
ACETONE	67641	1.00E-001 I				y	6.1E+002 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	1.2E-001	2.5E+000 N
ACETONITRILE	75058			1.7E-002 I		y	1.2E+002 N	6.2E+001 N				2.9E-002	5.8E-001 N
ACETOPHENONE	98862	1.00E-001 I		5.70E-006 W		y	4.2E-002 N	2.1E-002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	1.1E-005	2.2E-004 N
ACROLEIN	107028	2.00E-002 H		5.70E-006 I		y	4.2E-002 N	2.1E-002 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	1.0E-005	2.0E-004 N
ACRYLAMIDE	79061	2.00E-004 I	4.50E+000 I		4.50E+000 I		1.5E-002 C	1.4E-003 C	7.0E-004 C	1.3E+000 C	1.4E-001 C	3.7E-006	7.4E-005 C
ACRYLONITRILE	107131	1.00E-003 H	5.40E-001 I	5.70E-004 I	2.40E-001 I	y	3.7E-002 C	2.6E-002 C	5.8E-003 C	1.1E+001 C	1.2E+000 C	7.4E-006	1.5E-004 C
ALACHLOR	15972608	1.00E-002 I	8.00E-002 H				8.4E-001 C	7.8E-002 C	3.9E-002 C	7.2E+001 C	8.0E+000 C	3.5E-004	7.0E-003 C
ALAR	1596845	1.50E-001 I					5.5E+003 N	5.5E+002 N	2.0E+002 N	3.1E+005 N	1.2E+004 N		
ALDICARB	116063	1.00E-003 I					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N	1.0E-002	2.1E-001 N
ALDICARB SULFONE	1646884	1.00E-003 I					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N	7.5E-003	1.5E-001 N
ALDRIN	309002	3.00E-005 I	1.70E+001 I		1.70E+001 I		3.9E-003 C	3.7E-004 C	1.9E-004 C	3.4E-001 C	3.8E-002 C	3.8E-004	7.7E-003 C
ALUMINUM	7429905	1.00E+000 E		1.00E-003 E			3.7E+004 N	3.7E+000 N	1.4E+003 N	2.0E+006 N	7.8E+004 N		
AMINODINITROTOLUENES		6.00E-005 E					2.2E+000 N	2.2E-001 N	8.1E-002 N	1.2E+002 N	4.7E+000 N		
4-AMINOPYRIDINE	504245	2.00E-005 H					7.3E-001 N	7.3E-002 N	2.7E-002 N	4.1E+001 N	1.6E+000 N		
AMMONIA	7664417			2.86E-002 I		y	2.1E+002 N	1.0E+002 N					
ANILINE	62533	7.00E-003 E	5.70E-003 I	2.90E-004 I			1.2E+001 C	1.1E+000 N	5.5E-001 C	1.0E+003 C	1.1E+002 C I	8.8E-003	1.4E-001 C
ANTIMONY	7440360	4.00E-004 I					1.5E+001 N	1.5E+000 N	5.4E-001 N	8.2E+002 N	3.1E+001 N	6.6E-001	1.3E+001 N
ANTIMONY PENTOXIDE	1314609	5.00E-004 H					1.8E+001 N	1.8E+000 N	6.8E-001 N	1.0E+003 N	3.9E+001 N		
ANTIMONY TETROXIDE	1332816	4.00E-004 H					1.5E+001 N	1.5E+000 N	5.4E-001 N	8.2E+002 N	3.1E+001 N		
ANTIMONY TRIOXIDE	1309644	4.00E-004 H		5.70E-005 I			1.5E+001 N	2.1E-001 N	5.4E-001 N	8.2E+002 N	3.1E+001 N		
ARSENIC	7440382	3.00E-004 I	1.50E+000 I		1.51E+001 I		4.5E-002 C	4.1E-004 C	2.1E-003 C	3.8E+000 C	4.3E-001 C	1.3E-003	2.6E-002 C
ARSINE	7784421			1.40E-005 I		y	1.0E-001 N	5.1E-002 N					
ASSURE	76578148	9.00E-003 I					3.3E+002 N	3.3E+001 N	1.2E+001 N	1.8E+004 N	7.0E+002 N		
ATRAZINE	1912249	3.50E-002 I	2.20E-001 H				3.0E-001 C	2.8E-002 C	1.4E-002 C	2.6E+001 C	2.9E+000 C	4.4E-004	8.8E-003 C
AZOBENZENE	103333		1.10E-001 I		1.10E-001 I		6.1E-001 C	5.7E-002 C	2.9E-002 C	5.2E+001 C	5.8E+000 C	1.8E-003	3.5E-002 C
BARIUM	7440393	7.00E-002 I		1.40E-004 A			2.6E+003 N	5.1E-001 N	9.5E+001 N	1.4E+005 N	5.5E+003 N	1.1E+002	2.1E+003 N
BAYGON	114261	4.00E-003 I					1.5E+002 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N		
BAYTHROID	68359375	2.50E-002 I					9.1E+002 N	9.1E+001 N	3.4E+001 N	5.1E+004 N	2.0E+003 N		
BENTAZON	25057890	3.00E-002 I					1.1E+003 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N		
BENZALDEHYDE	100527	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
BENZENE	71432	3.00E-003 E	5.5E-002 I	1.70E-003 E	2.90E-002 I	y	3.2E-001 C	2.2E-001 C	5.7E-002 C	1.0E+002 C	1.2E+001 C	9.0E-005	1.8E-003 C
BENZENETHIOL	108985	1.00E-005 H				y	6.1E-002 N	3.7E-002 N	1.4E-002 N	2.0E+001 N	7.8E-001 N		
BENZIDINE	92875	3.00E-003 I	2.30E+002 I		2.30E+002 I		2.9E-004 C	2.7E-005 C	1.4E-005 C	2.5E-002 C	2.8E-003 C		
BENZOIC ACID	65850	4.00E+000 I					1.5E+005 N	1.5E+004 N	5.4E+003 N	8.2E+006 N	3.1E+005 N		
BENZYL ALCOHOL	100516	3.00E-001 H					1.1E+004 N	1.1E+003 N	4.1E+002 N	6.1E+005 N	2.3E+004 N	4.4E+000	8.8E+001 N
BENZYL CHLORIDE	100447		0.17 I			y	6.2E-002 C	3.7E-002 C	1.9E-002 C	3.4E+001 C	3.8E+000 C	1.9E-005	3.7E-004 C
BERYLLIUM	7440417	2.00E-003 I		5.7E-006 I	8.40E+000 I		7.3E+001 N	7.5E-004 C	2.7E+000 N	4.1E+003 N	1.6E+002 N	5.8E+001	1.2E+003 N
BIPHENYL	92524	5.00E-002 I				y	3.0E+002 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N	4.8E+000	9.6E+001 N
BIS(2-CHLOROETHYL)ETHER	111444		1.10E+000 I		1.10E+000 I	y	9.6E-003 C	5.7E-003 C	2.9E-003 C	5.2E+000 C	5.8E-001 C	2.2E-006	4.4E-005 C
BIS(2-CHLOROISOPROPYL)ETHER	108601	4.00E-002 I	7.00E-002 H		3.50E-002 H	y	2.6E-001 C	1.8E-001 C	4.5E-002 C	8.2E+001 C	9.1E+000 C	8.4E-005	1.7E-003 C
BIS(CHLOROMETHYL)ETHER	542881		2.20E+002 I		2.20E+002 I	y	4.8E-005 C	2.8E-005 C	1.4E-005 C	2.6E-002 C	2.9E-003 C	9.7E-009	1.9E-007 C
BIS(2-ETHYLHEXYL)PHTHALATE	117817	2.00E-002 I	1.40E-002 I		1.40E-002 E		4.8E+000 C	4.5E-001 C	2.3E-001 C	4.1E+002 C	4.6E+001 C	1.4E+002	2.9E+003 C
BORON	7440428	9.00E-002 I		5.70E-003 H			3.3E+003 N	2.1E+001 N	1.2E+002 N	1.8E+005 N	7.0E+003 N		

Ref. 20

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Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Risk-based concentrations: Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Soil Residential mg/kg	Region III SSLs, Soil, for groundwater migration: DAF 1 mg/kg	DAF 20 mg/kg
BROMODICHLOROMETHANE	75274	2.00E-002 I	6.20E-002 I			y	1.7E-001 C	1.0E-001 C	5.1E-002 C	9.2E+001 C	1.0E+001 C	5.4E-005	1.1E-003 C
BROMOETHENE	593602			8.6E-004 I	1.10E-001 H	y	1.1E-001 C	5.7E-002 C				5.4E-005	1.1E-003 C
BROMOFORM	75252	2.00E-002 I	7.90E-003 I		3.90E-003 I		8.5E+000 C	1.6E+000 C	4.0E-001 C	7.2E+002 C	8.1E+001 C	3.3E-003	6.7E-002 C
BROMOMETHANE	74839	1.40E-003 I		1.40E-003 I		y	8.5E+000 N	5.1E+000 N	1.9E+000 N	2.9E+003 N	1.1E+002 N	2.1E-003	4.1E-002 N
BROMOPHOS	2104963	5.00E-003 H					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
1,3-BUTADIENE	106990				1.80E+000 H	y	7.0E-003 C	3.5E-003 C				3.9E-006	7.8E-005 C
1-BUTANOL	71363	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	7.8E-001	1.6E+001 N
BUTYLBENZYLPHTHALATE	85687	2.00E-001 I					7.3E+003 N	7.3E+002 N	2.7E+002 N	4.1E+005 N	1.6E+004 N	8.4E+002	1.7E+004 N
BUTYLATE	2008415	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
N-BUTYLBENZENE	104518	4.00E-002 E				y	2.4E+002 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
SEC-BUTYLBENZENE	135988	4.00E-002 E				y	2.4E+002 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
TERT-BUTYLBENZENE	98066	4.00E-002 E				y	2.4E+002 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
CADMIUM-WATER	7440439	5.00E-004 I		5.7E-005 E	6.30E+000 I		1.8E+001 N	9.9E-004 C	6.8E-001 N	1.0E+003 N	3.9E+001 N	1.4E+000	2.7E+001 N
CADMIUM-FOOD	7440439	1.00E-003 I		5.7E-005 E	6.30E+000 I		3.7E+001 N	9.9E-004 C	1.4E+000 N	2.0E+003 N	7.8E+001 N	2.7E+000	5.5E+001 N
CAPROLACTAM	105602	5.00E-001 I					1.8E+004 N	1.8E+003 N	6.8E+002 N	1.0E+006 N	3.9E+004 N		
CARBARYL	63252	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	1.5E+000	3.0E+001 N
CARBON DISULFIDE	75150	1.00E-001 I		2.00E-001 I		y	1.0E+003 N	7.3E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	9.5E-001	1.9E+001 N
CARBON TETRACHLORIDE	56235	7.00E-004 I	1.30E-001 I	5.71E-004 E	5.30E-002 I	y	1.6E-001 C	1.2E-001 C	2.4E-002 C	4.4E+001 C	4.9E+000 C	1.1E-004	2.1E-003 C
CARBOSULFAN	55285148	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
CHLORAL HYDRATE	302170	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
CHLORANIL	118752		4.00E-001 H				1.7E-001 C	1.6E-002 C	7.9E-003 C	1.4E+001 C	1.6E+000 C		
CHLORDANE	57749	5.00E-004 I	3.5E-001 I	2.00E-004 I	3.5E-001 I		1.9E-001 C	1.8E-002 C	9.0E-003 C	1.6E+001 C	1.8E+000 C	4.6E-002	9.2E-001 C
CHLORINE	7782505	1.00E-001 I		5.7E-005 E		y	4.2E-001 N	2.1E-001 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
CHLORINE DIOXIDE	10049044	3.00E-002 I		5.70E-005 I		y	4.2E-001 N	2.1E-001 N	4.1E+001 N	6.1E+004 N	2.3E+003 N		
CHLOROACETIC ACID	79118	2.00E-003 H					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N		
4-CHLOROANILINE	106478	4.00E-003 I					1.5E+002 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N	4.8E-002	9.7E-001 N
CHLOROBENZENE	108907	2.00E-002 I		1.7E-002 E		y	1.1E+002 N	6.2E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	4.0E-002	8.0E-001 N
CHLOROBENZILATE	510156	2.00E-002 I	2.70E-001 H		2.70E-001 H		2.5E-001 C	2.3E-002 C	1.2E-002 C	2.1E+001 C	2.4E+000 C	1.3E-003	2.7E-002 C
P-CHLOROBENZOIC ACID	74113	2.00E-001 H					7.3E+003 N	7.3E+002 N	2.7E+002 N	4.1E+005 N	1.6E+004 N		
2-CHLORO-1,3 BUTADIENE	126998	2.00E-002 A		2.00E-003 H		y	1.4E+001 N	7.3E+000 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	8.0E-003	1.2E-001 N
1-CHLOROBUTANE	109693	4.00E-001 H				y	2.4E+003 N	1.5E+003 N	5.4E+002 N	8.2E+005 N	3.1E+004 N	1.0E+000	2.0E+001 N
1-CHLORO-1,1-DIFLUOROETHANE	75683			1.40E+001 I		y	1.0E+005 N	5.1E+004 N				7.0E+001	1.4E+003 N
CHLORODIFLUOROMETHANE	75456			1.40E+001 I		y	1.0E+005 N	5.1E+004 N				7.0E+001	1.4E+003 N
CHLOROETHANE	75003	4.00E-001 E	2.90E-003 E	2.90E+000 I		y	3.6E+000 C	2.2E+000 C	1.1E+000 C	2.0E+003 C	2.2E+002 C	9.6E-004	1.9E-002 C
CHLOROFORM	67663	1.00E-002 I	6.10E-003 I	8.6E-005 E	8.10E-002 I	y	1.5E-001 C I	7.7E-002 C I	5.2E-001 C	9.4E+002 C	1.0E+002 C I	4.5E-005	8.9E-004 C
**CHLOROMETHANE	74873		1.30E-002 H	2.6E-002 I	3.5E-003 E	y	2.1E+000 C	1.8E+000 C	2.4E-001 C	4.4E+002 C	4.9E+001 C	5.2E-004	1.0E-002 C
4-CHLORO-2-METHYLANILINE	95692		5.80E-001 H				1.2E-001 C	1.1E-002 C	5.4E-003 C	9.9E+000 C	1.1E+000 C		
BETA-CHLORONAPHTHALENE	91587	8.00E-002 I				y	4.9E+002 N	2.9E+002 N	1.1E+002 N	1.6E+005 N	6.3E+003 N	1.6E+000	3.2E+001 N
O-CHLORONITROBENZENE	88733		2.50E-002 H			y	4.2E-001 C	2.5E-001 C	1.3E-001 C	2.3E+002 C	2.6E+001 C		
P-CHLORONITROBENZENE	100005		1.80E-002 H			y	5.9E-001 C	3.5E-001 C	1.8E-001 C	3.2E+002 C	3.5E+001 C		
2-CHLOROPHENOL	95578	5.00E-003 I				y	3.0E+001 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
2-CHLOROPROPANE	75296			2.90E-002 H		y	2.1E+002 N	1.1E+002 N				6.6E-002	1.3E+000 N
O-CHLOROTOLUENE	95498	2.00E-002 I				y	1.2E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	6.5E-002	1.3E+000 N
CHLORPYRIFOS	2921882	3.00E-003 I					1.1E+002 N	1.1E+001 N	4.1E+000 N	6.1E+003 N	2.3E+002 N	3.2E+000	6.3E+001 N
CHLORPYRIFOS-METHYL	5598130	1.00E-002 H					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		

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Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Risk-based concentrations: Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Residential mg/kg	Region III SSLs, Soil, for groundwater migration: DAF 1 mg/kg	DAF 20 mg/kg
CHROMIUM III	16065831	1.50E+000 I					5.5E+004 N	5.5E+003 N	2.0E+003 N	3.1E+006 N	1.2E+005 N	9.9E+007	2.0E+009 N
CHROMIUM VI	18540299	3.00E-003 I		3.00E-005 I	4.10E+001 H		1.1E+002 N	1.5E-004 C	4.1E+000 N	6.1E+003 N	2.3E+002 N	2.1E+000	4.2E+001 N
COBALT	7440484	2.00E-002 E		5.00E-006 E			7.3E+002 N	1.8E-002 N	2.7E+001 N	4.1E+004 N	1.6E+003 N		
COKE OVEN EMISSIONS (COAL TAR)	8007452				2.2 I			2.8E-003 C					
COPPER	7440508	4.00E-002 H					1.5E+003 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N	5.3E+002	1.1E+004 N
CROTONALDEHYDE	123739		1.90E+000 H			y	5.6E-003 C	3.3E-003 C	1.7E-003 C	3.0E+000 C	3.4E-001 C	1.5E-005	3.1E-004 C
CUMENE	98828	1.00E-001 I		1.10E-001 I		y	6.6E+002 N	4.0E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	3.2E+000	6.4E+001 N
CYANIDE (FREE)	57125	2.00E-002 I					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	7.4E+000	1.5E+002 N
CALCIUM CYANIDE	592018	4E-002 I					1.5E+003 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
COPPER CYANIDE	544923	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
CYANAZINE	21725462	2.00E-003 H	8.40E-001 H				8.0E-002 C	7.5E-003 C	3.8E-003 C	6.8E+000 C	7.6E-001 C	2.6E-005	5.3E-004 C
CYANOGEN	460195	4.00E-002 I				y	2.4E+002 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
CYANOGEN BROMIDE	506683	9.00E-002 I					3.3E+003 N	3.3E+002 N	1.2E+002 N	1.8E+005 N	7.0E+003 N		
CYANOGEN CHLORIDE	506774	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
HYDROGEN CYANIDE	74908	2.00E-002 I		8.60E-004 I		y	6.2E+000 N	3.1E+000 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	1.1E-001	2.2E+000 N
POTASSIUM CYANIDE	151508	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
POTASSIUM SILVER CYANIDE	506616	2.00E-001 I					7.3E+003 N	7.3E+002 N	2.7E+002 N	4.1E+005 N	1.6E+004 N		
SILVER CYANIDE	506649	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	3.1E+001	6.2E+002 N
SODIUM CYANIDE	143339	4.00E-002 I					1.5E+003 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
THIOCYANATE		5.00E-002 E					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
ZINC CYANIDE	557211	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N	1.1E+002	2.3E+003 N
CYCLOHEXANONE	108941	5.00E+000 I					1.8E+005 N	1.8E+004 N	6.8E+003 N	1.0E+007 N	3.9E+005 N	6.1E+001	1.2E+003 N
CYHALOTHRIN/KARATE	68085858	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
CYPERMETHRIN	52315078	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
DACTHAL	1861321	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
DALAPON	75990	3.00E-002 I					1.1E+003 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N	3.5E-001	7.1E+000 N
DDD	72548		2.40E-001 I				2.8E-001 C	2.6E-002 C	1.3E-002 C	2.4E+001 C	2.7E+000 C	5.6E-001	1.1E+001 C
DDE	72559		3.40E-001 I				2.0E-001 C	1.8E-002 C	9.3E-003 C	1.7E+001 C	1.9E+000 C	1.6E+000	3.5E+001 C
DDT	50293	5.00E-004 I	3.40E-001 I		3.40E-001 I		2.0E-001 C	1.8E-002 C	9.3E-003 C	1.7E+001 C	1.9E+000 C	5.8E-002	1.2E+000 C
DIAZINON	333415	9.00E-004 H					3.3E+001 N	3.3E+000 N	1.2E+000 N	1.8E+003 N	7.0E+001 N	2.1E-002	4.3E-001 N
DIBENZOFURAN	132649	4.00E-003 E				y	2.4E+001 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N	3.8E-001	7.7E+000 N
1,4-DIBROMOBENZENE	106376	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
DIBROMOCHLOROMETHANE	124481	2.00E-002 I	8.40E-002 I			y	1.3E-001 C	7.5E-002 C	3.8E-002 C	6.8E+001 C	7.6E+000 C	4.1E-005	8.3E-004 C
1,2-DIBROMO-3-CHLOROPROPANE	96128		1.40E+000 H	5.70E-005 I	2.40E-003 H	y	4.7E-002 C I	2.1E-001 N	2.3E-003 C	4.1E+000 C	4.6E-001 C	4.4E-005	8.7E-004 C
1,2-DIBROMOETHANE	106934		8.50E+001 I	5.70E-005 H	7.60E-001 I	y	7.5E-004 C	8.2E-003 C	3.7E-005 C	6.7E-002 C	7.5E-003 C	4.3E-007	8.5E-006 C
DIBUTYLPHTHALATE	84742	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	2.5E+002	5.0E+003 N
DICAMBA	1918009	3.00E-002 I					1.1E+003 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N	2.2E-001	4.5E+000 N
**1,2-DICHLOROBENZENE	95501	9.00E-002 I		4.00E-002 H		y	2.7E+002 N	1.5E+002 N	1.2E+002 N	1.8E+005 N	7.0E+003 N	2.3E-001	4.6E+000 N
1,3-DICHLOROBENZENE	541731	3.00E-002 E				y	1.8E+002 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N	1.5E-001	2.9E+000 N
1,4-DICHLOROBENZENE	106467	3.00E-002 E	2.40E-002 H	2.29E-001 I	2.2E-002 E	y	4.7E-001 C	2.8E-001 C	1.3E-001 C	2.4E+002 C	2.7E+001 C	3.6E-004	7.1E-003 C
3,3'-DICHLOROBENZIDINE	91941		4.50E-001 I				1.5E-001 C	1.4E-002 C	7.0E-003 C	1.3E+001 C	1.4E+000 C	2.5E-004	4.9E-003 C
1,4-DICHLORO-2-BUTENE	764410				9.30E+000 H	y	1.3E-003 C	6.7E-004 C				4.0E-007	8.0E-006 C
DICHLORODIFLUOROMETHANE	75718	2.00E-001 I		5.00E-002 A		y	3.5E+002 N	1.8E+002 N	2.7E+002 N	4.1E+005 N	1.6E+004 N	5.5E-001	1.1E+001 N
1,1-DICHLOROETHANE	75343	1.00E-001 H		1.40E-001 A		y	8.0E+002 N	5.1E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	2.3E-001	4.5E+000 N
1,2-DICHLOROETHANE	107062	3.00E-002 E	9.10E-002 I	1.40E-003 E	9.10E-002 I	y	1.2E-001 C	6.9E-002 C	3.5E-002 C	6.3E+001 C	7.0E+000 C	5.2E-005	1.0E-003 C

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Basis: C = Carcinogenic effects N = Noncarcinogenic effects I = RBC at HI of 0.1 < RBC<

Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Risk-based concentrations: Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Soil Residential mg/kg	Region III SSLs: Soil, for groundwater migration DAF 1 mg/kg	DAF 20 mg/kg
1,1-DICHLOROETHENE	75354	9.00E-003 I	6.00E-001 I		1.75E-001 I	y	4.4E-002 C	3.6E-002 C	5.3E-003 C	9.5E+000 C	1.1E+000 C	1.8E-005	3.6E-004 C
CIS-1,2-DICHLOROETHENE	156592	1.00E-002 H				y	6.1E+001 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N	1.7E-002	3.5E-001 N
TRANS-1,2-DICHLOROETHENE	156605	2.00E-002 I				y	1.2E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	4.1E-002	8.2E-001 N
TOTAL 1,2-DICHLOROETHENE	540590	9.00E-003 H				y	5.5E+001 N	3.3E+001 N	1.2E+001 N	1.8E+004 N	7.0E+002 N	1.9E-002	3.7E-001 N
2,4-DICHLOROPHENOL	120832	3.00E-003 I					1.1E+002 N	1.1E+001 N	4.1E+000 N	6.1E+003 N	2.3E+002 N	6.0E-002	1.2E+000 N
2,4-D	94757	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N	4.5E-001	9.0E+000 N
4-(2,4-DICHLOROPHENOXY)BUTYRIC ACID	94826	8E-003 I					2.9E+002 N	2.9E+001 N	1.1E+001 N	1.6E+004 N	6.3E+002 N		
1,2-DICHLOROPROPANE	78875		6.80E-002 H	1.14E-003 I		y	1.6E-001 C	9.2E-002 C	4.6E-002 C	8.4E+001 C	9.4E+000 C	1.0E-004	2.1E-003 C
2,3-DICHLOROPROPANOL	616239	3.00E-003 I					1.1E+002 N	1.1E+001 N	4.1E+000 N	6.1E+003 N	2.3E+002 N		
1,3-DICHLOROPROPENE	542756	3.00E-002 I	1.00E-001 I	5.71E-003 I	1.00E-002 I	y	4.4E-001 C	6.3E-001 C	3.2E-002 C	5.7E+001 C	6.4E+000 C	1.6E-004	3.1E-003 C
DICHLORVOS	62737	5E-004 I	0.29 I	1.43E-004 I			2.3E-001 C	2.2E-002 C	1.1E-002 C	2.0E+001 C	2.2E+000 C	5.5E-005	1.1E-003 C
DICOFOL	115322		4.4E-001 W				1.5E-001 C	1.4E-002 C	7.2E-003 C	1.3E+001 C	1.5E+000 C	9.3E-004	1.9E-002 C
DICYCLOPENTADIENE	77736	3E-002 H		6.00E-005 A		y	4.4E-001 N	2.2E-001 N	4.1E+001 N	6.1E+004 N	2.3E+003 N		
DIELDRIN	60571	5.00E-005 I	1.60E+001 I		1.60E+001 I		4.2E-003 C	3.9E-004 C	2.0E-004 C	3.6E-001 C	4.0E-002 C	1.1E-004	2.2E-003 C
DIESEL EMISSIONS				1.40E-003 I				5.1E+000 N					
DIETHYLPHTHALATE	84662	8.00E-001 I					2.9E+004 N	2.9E+003 N	1.1E+003 N	1.6E+006 N	6.3E+004 N	2.3E+001	4.5E+002 N
DIETHYLENE GLYCOL, MONOBUTYL ETHER	112345			5.70E-003 H				2.1E+001 N					
DIETHYLENE GLYCOL, MONOETHYL ETHER	111900	2.00E+000 H					7.3E+004 N	7.3E+003 N	2.7E+003 N	4.1E+006 N	1.6E+005 N		
DI(2-ETHYLHEXYL)ADIPATE	103231	6.00E-001 I	1.20E-003 I				5.6E+001 C	5.2E+000 C	2.6E+000 C	4.8E+003 C	5.3E+002 C		
DIETHYLSTILBESTROL	56531		4.70E+003 H				1.4E-005 C	1.3E-006 C	6.7E-007 C	1.2E-003 C	1.4E-004 C		
DIFENZOQUAT (AVENGE)	43222486	8.00E-002 I					2.9E+003 N	2.9E+002 N	1.1E+002 N	1.6E+005 N	6.3E+003 N		
1,1-DIFLUOROETHANE	75376			1.10E+001 I		y	8.0E+004 N	4.0E+004 N					
DIISOPROPYL METHYLPHOSPHONATE (DIMP)	1445756	8.00E-002 I					2.9E+003 N	2.9E+002 N	1.1E+002 N	1.6E+005 N	6.3E+003 N		
3,3'-DIMETHOXYBENZIDINE	119904		1.40E-002 H				4.8E+000 C	4.5E-001 C	2.3E-001 C	4.1E+002 C	4.6E+001 C		
DIMETHYLAMINE	124403			5.70E-006 W		y	4.2E-002 N	2.1E-002 N				8.5E-006	1.7E-004 N
2,4-DIMETHYLANILINE HYDROCHLORIDE	21436964		5.80E-001 H				1.2E-001 C	1.1E-002 C	5.4E-003 C	9.9E+000 C	1.1E+000 C		
2,4-DIMETHYLANILINE	95681		7.50E-001 H				8.9E-002 C	8.3E-003 C	4.2E-003 C	7.6E+000 C	8.5E-001 C		
N,N-DIMETHYLANILINE	121697	2.00E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N		
3,3'-DIMETHYLBENZIDINE	119937		9.20E+000 H				7.3E-003 C	6.8E-004 C	3.4E-004 C	6.2E-001 C	6.9E-002 C		
1,1-DIMETHYLHYDRAZINE	57147		2.60E+000 W		3.50E+000 W		2.6E-002 C	1.8E-003 C	1.2E-003 C	2.2E+000 C	2.5E-001 C		
1,2-DIMETHYLHYDRAZINE	540738		3.70E+001 W		3.70E+001 W		1.8E-003 C	1.7E-004 C	8.5E-005 C	1.5E-001 C	1.7E-002 C		
2,4-DIMETHYLPHENOL	105679	2.00E-002 I					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	3.4E-001	6.7E+000 N
2,6-DIMETHYLPHENOL	576261	6.00E-004 I					2.2E+001 N	2.2E+000 N	8.1E-001 N	1.2E+003 N	4.7E+001 N		
3,4-DIMETHYLPHENOL	95658	1.00E-003 I					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N		
DIMETHYLPHTHALATE	131113	1.00E+001 W					3.7E+005 N	3.7E+004 N	1.4E+004 N	2.0E+007 N	7.8E+005 N		
1,2-DINITROBENZENE	528290	4.00E-004 H					1.5E+001 N	1.5E+000 N	5.4E-001 N	8.2E+002 N	3.1E+001 N		
1,3-DINITROBENZENE	99650	1.00E-004 I					3.7E+000 N	3.7E-001 N	1.4E-001 N	2.0E+002 N	7.8E+000 N	1.8E-003	3.7E-002 N
1,4-DINITROBENZENE	100254	4.00E-004 H					1.5E+001 N	1.5E+000 N	5.4E-001 N	8.2E+002 N	3.1E+001 N		
4,6-DINITRO-O-CYCLOHEXYL PHENOL	131895	2.00E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N		
**4,6-DINITRO-2-METHYLPHENOL	534521	1.00E-003 E					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N		
2,4-DINITROPHENOL	51285	2.00E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N		
DINITROTOLUENE MIX			6.80E-001 I				9.8E-002 C	9.2E-003 C	4.6E-003 C	8.4E+000 C	9.4E-001 C		
2,4-DINITROTOLUENE	121142	2.00E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N	2.9E-002	5.7E-001 N
2,6-DINITROTOLUENE	606202	1.00E-003 H					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N	1.2E-002	2.5E-001 N
DINOSEB	88857	1.00E-003 I					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N	8.7E-003	1.7E-001 N

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Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Risk-based concentrations: Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Residential mg/kg	Region III SSLs: Soil, for groundwater migration DAF 1 mg/kg	DAF 20 mg/kg
DIOCTYLPHTHALATE	117840	2.00E-002 H					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	1.2E+005	2.4E+006 N
1,4-DIOXANE	123911		1.10E-002 I				6.1E+000 C	5.7E-001 C	2.9E-001 C	5.2E+002 C	5.8E+001 C	1.3E-003	2.6E-002 C
DIPHENYLAMINE	122394	2.50E-002 I					9.1E+002 N	9.1E+001 N	3.4E+001 N	5.1E+004 N	2.0E+003 N	1.3E+000	2.5E+001 N
1,2-DIPHENYLHYDRAZINE	122667		8.00E-001 I		8.00E-001 I		8.4E-002 C	7.8E-003 C	3.9E-003 C	7.2E+000 C	8.0E-001 C	1.3E-004	2.5E-003 C
DIQUAT	85007	2.20E-003 I					8.0E+001 N	8.0E+000 N	3.0E+000 N	4.5E+003 N	1.7E+002 N	1.7E-002	3.3E-001 N
DISULFOTON	298044	4.00E-005 I					1.5E+000 N	1.5E-001 N	5.4E-002 N	8.2E+001 N	3.1E+000 N	3.2E-003	6.4E-002 N
1,4-DITHIANE	505293	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
DIURON	330541	2.00E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N	5.8E-002	1.2E+000 N
ENDOSULFAN	115297	6.00E-003 I					2.2E+002 N	2.2E+001 N	8.1E+000 N	1.2E+004 N	4.7E+002 N	9.8E-001	2.0E+001 N
ENDRIN	72208	3.00E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N	2.7E-001	5.4E+000 N
EPICHLOROHYDRIN	106898	2.00E-003 H	9.90E-003 I	2.86E-004 I	4.20E-003 I	y	2.0E+000 N	1.0E+000 N	3.2E-001 C I	5.8E+002 C I	6.5E+001 C I	4.2E-004	8.4E-003 N
ETHION	563122	5.00E-004 I					1.8E+001 N	1.8E+000 N	6.8E-001 N	1.0E+003 N	3.9E+001 N	3.2E-001	6.4E+000 N
2-ETHOXYETHANOL	110805	4.00E-001 H		5.70E-002 I			1.5E+004 N	2.1E+002 N	5.4E+002 N	8.2E+005 N	3.1E+004 N	3.3E+000	6.5E+001 N
ETHYL ACETATE	141786	9.00E-001 I				y	5.5E+003 N	3.3E+003 N	1.2E+003 N	1.8E+006 N	7.0E+004 N	1.7E+000	3.5E+001 N
ETHYLBENZENE	100414	1.00E-001 I		2.90E-001 I		y	1.3E+003 N	1.1E+003 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	7.5E-001	1.5E+001 N
ETHYLENE DIAMINE	107153	2.00E-002 H					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N		
ETHYLENE GLYCOL	107211	2.00E+000 I					7.3E+004 N	7.3E+003 N	2.7E+003 N	4.1E+006 N	1.6E+005 N	1.5E+001	3.0E+002 N
ETHYLENE GLYCOL, MONOBUTYL ETHER	111762	5.00E-001 I		3.70E+000 I			1.8E+004 N	1.4E+004 N	6.8E+002 N	1.0E+006 N	3.9E+004 N		
ETHYLENE OXIDE	75218		1.00E+000 H		3.50E-001 H	y	2.3E-002 C	1.8E-002 C	3.2E-003 C	5.7E+000 C	6.4E-001 C	4.8E-006	9.5E-005 C
ETHYLENE THIOUREA	96457	8.00E-005 I	1.1E-001 H				6.1E-001 C I	5.7E-002 C I	2.9E-002 C I	5.2E+001 C I	5.8E+000 C I		
ETHYL ETHER	60297	2.00E-001 I				y	1.2E+003 N	7.3E+002 N	2.7E+002 N	4.1E+005 N	1.6E+004 N	4.2E-001	8.5E+000 N
ETHYL METHACRYLATE	97632	9.00E-002 H				y	5.5E+002 N	3.3E+002 N	1.2E+002 N	1.8E+005 N	7.0E+003 N	1.0E+000	2.1E+001 N
FENAMIPHOS	22224926	2.50E-004 I					9.1E+000 N	9.1E-001 N	3.4E-001 N	5.1E+002 N	2.0E+001 N	7.8E-003	1.6E-001 N
FLUOMETURON	2164172	1.30E-002 I					4.7E+002 N	4.7E+001 N	1.8E+001 N	2.7E+004 N	1.0E+003 N		
FLUORINE	7782414	6.00E-002 I					2.2E+003 N	2.2E+002 N	8.1E+001 N	1.2E+005 N	4.7E+003 N		
FOMESAFEN	72178020		1.90E-001 I				3.5E-001 C	3.3E-002 C	1.7E-002 C	3.0E+001 C	3.4E+000 C		
FONOFOS	944229	2.00E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N	1.8E-001	3.5E+000 N
FORMALDEHYDE	50000	2.00E-001 I			4.50E-002 I		7.3E+003 N	1.4E-001 C	2.7E+002 N	4.1E+005 N	1.6E+004 N	1.5E+000	3.0E+001 N
FORMIC ACID	64186	2.00E+000 H					7.3E+004 N	7.3E+003 N	2.7E+003 N	4.1E+006 N	1.6E+005 N		
FURAN	110009	1.00E-003 I				y	6.1E+000 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N	1.5E-003	3.0E-002 N
FURAZOLIDONE	67458		3.80E+000 H				1.8E-002 C	1.6E-003 C	8.3E-004 C	1.5E+000 C	1.7E-001 C		
FURFURAL	98011	3.00E-003 I		1.00E-002 A			1.1E+002 N	3.7E+001 N	4.1E+000 N	6.1E+003 N	2.3E+002 N	2.3E-002	4.6E-001 N
GLYCIDALDEHYDE	765344	4.00E-004 I		2.90E-004 H			1.5E+001 N	1.1E+000 N	5.4E-001 N	8.2E+002 N	3.1E+001 N		
GLYPHOSATE	1071836	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N	2.6E+001	5.3E+002 N
HEPTACHLOR	76448	5.00E-004 I	4.50E+000 I		4.50E+000 I		1.5E-002 C	1.4E-003 C	7.0E-004 C	1.3E+000 C	1.4E-001 C	4.2E-002	8.4E-001 C
HEPTACHLOR EPOXIDE	1024573	1.30E-005 I	9.10E+000 I		9.10E+000 I		7.4E-003 C	6.9E-004 C	3.5E-004 C	6.3E-001 C	7.0E-002 C	1.2E-003	2.5E-002 C
HEXABROMOBENZENE	87821	2.00E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N		
HEXACHLOROBENZENE	118741	8.00E-004 I	1.60E+000 I		1.60E+000 I		4.2E-002 C	3.9E-003 C	2.0E-003 C	3.6E+000 C	4.0E-001 C	2.8E-003	5.2E-002 C
HEXACHLOROBUTADIENE	87683	2.00E-004 H	7.80E-002 I		7.80E-002 I		8.6E-001 C I	8.0E-002 C I	4.0E-002 C I	7.3E+001 C I	8.2E+000 C I	9.2E-002	1.8E+000 C
ALPHA-HCH	319846		6.30E+000 I		6.30E+000 I		1.1E-002 C	9.9E-004 C	5.0E-004 C	9.1E-001 C	1.0E-001 C	4.5E-005	8.9E-004 C
BETA-HCH	319857		1.80E+000 I		1.80E+000 I		3.7E-002 C	3.5E-003 C	1.8E-003 C	3.2E+000 C	3.5E-001 C	1.6E-004	3.1E-003 C
GAMMA-HCH (LINDANE)	58899	3.00E-004 I	1.30E+000 H				5.2E-002 C	4.8E-003 C	2.4E-003 C	4.4E+000 C	4.9E-001 C	2.2E-004	4.3E-003 C
TECHNICAL HCH	608731		1.80E+000 I		1.80E+000 I		3.7E-002 C	3.5E-003 C	1.8E-003 C	3.2E+000 C	3.5E-001 C		
**HEXACHLOROCYCLOPENTADIENE	77474	8.00E-003 I		5.7E-005 I			2.2E+002 N	2.1E-001 N	8.1E+000 N	1.2E+004 N	4.7E+002 N	8.8E+001	1.8E+003 N
HEXACHLORODIBENZODIOXIN MIX	19408743		6.20E+003 I		4.55E+003 I		1.1E-005 C	1.4E-006 C	5.1E-007 C	9.2E-004 C	1.0E-004 C		

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Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Risk-based concentrations: Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Residential mg/kg	Region III SSLs, Soil, for groundwater migration: DAF 1 mg/kg	DAF 20 mg/kg
HEXACHLOROETHANE	67721	1.00E-003 I	1.40E-002 I		1.40E-002 I		4.8E+000 C I	4.5E-001 C I	2.3E-001 C I	4.1E+002 C I	4.6E+001 C I	1.8E-002	3.6E-001 C
HEXACHLOROPHENE	70304	3.00E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N	1.0E+002	2.0E+003 N
1,6-HEXAMETHYLENE DIISOCYANATE	822060			2.90E-006 I				1.1E-002 N					
HEXANE	110543	6.00E-002 H		5.71E-002 I		y	3.5E+002 N	2.1E+002 N	8.1E+001 N	1.2E+005 N	4.7E+003 N	6.9E-001	1.4E+001 N
2-HEXANONE	591786	4.00E-002 E		1.4E-003 E			1.5E+003 N	5.1E+000 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
HEXAZINONE	51235042	3.30E-002 I					1.2E+003 N	1.2E+002 N	4.5E+001 N	6.7E+004 N	2.6E+003 N		
HMX	2691410	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
HYDRAZINE	302012		3.00E+000 I		1.70E+001 I		2.2E-002 C	3.7E-004 C	1.1E-003 C	1.9E+000 C	2.1E-001 C		
HYDROGEN CHLORIDE	7647010			5.70E-003 I				2.1E+001 N					
HYDROGEN SULFIDE	7783064	3.00E-003 I		2.85E-004 I			1.1E+002 N	1.0E+000 N	4.1E+000 N	6.1E+003 N	2.3E+002 N		
HYDROQUINONE	123319	4.00E-002 H					1.5E+003 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N		
**IRON	7439896	6.00E-001 E					2.2E+004 N	2.2E+003 N	8.1E+002 N	1.2E+006 N	4.7E+004 N		
ISOBUTANOL	78831	3.00E-001 I				y	1.8E+003 N	1.1E+003 N	4.1E+002 N	6.1E+005 N	2.3E+004 N	5.9E-001	1.2E+001 N
ISOPHORONE	78591	2.00E-001 I	9.50E-004 I				7.0E+001 C	6.6E+000 C	3.3E+000 C	6.0E+003 C	6.7E+002 C	2.1E-002	4.1E-001 C
ISOPROPALIN	33820530	1.50E-002 I					5.5E+002 N	5.5E+001 N	2.0E+001 N	3.1E+004 N	1.2E+003 N		
ISOPROPYL METHYL PHOSPHONIC ACID	1832548	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
TETRAETHYLLEAD	78002	1.00E-007 I					3.7E-003 N	3.7E-004 N	1.4E-004 N	2.0E-001 N	7.8E-003 N	4.6E-005	9.2E-004 N
LITHIUM	7439932	2.00E-002 E					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N		
MALATHION	121755	2.00E-002 I					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	4.0E-001	8.1E+000 N
MALEIC ANHYDRIDE	108316	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
MANGANESE-NONFOOD	7439965	2.00E-002 I		1.43E-005 I			7.3E+002 N	5.2E-002 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	4.8E+001	9.5E+002 N
MANGANESE-FOOD	7439965	1.40E-001 I		1.43E-005 I			5.1E+003 N	5.2E-002 N	1.9E+002 N	2.9E+005 N	1.1E+004 N	3.3E+002	6.7E+003 N
MEPHOSFOLAN	950107	9.00E-005 H					3.3E+000 N	3.3E-001 N	1.2E-001 N	1.8E+002 N	7.0E+000 N		
MEPIQUAT CHLORIDE	24307264	3.00E-002 I					1.1E+003 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N		
MERCURIC CHLORIDE	7487947	3.00E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N		
MERCURY (INORGANIC)	7439976			8.60E-005 I				3.1E-001 N					
METHYLMERCURY	22967926	1.00E-004 I					3.7E+000 N	3.7E-001 N	1.4E-001 N	2.0E+002 N	7.8E+000 N		
METHACRYLONITRILE	126987	1.00E-004 I		2.00E-004 A		y	1.0E+000 N	7.3E-001 N	1.4E-001 N	2.0E+002 N	7.8E+000 N	2.1E-004	4.2E-003 N
METHANOL	67561	5.00E-001 I					1.8E+004 N	1.8E+003 N	6.8E+002 N	1.0E+006 N	3.9E+004 N	3.8E+000	7.5E+001 N
METHIDATHION	950378	1.00E-003 I					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N		
METHOXYCHLOR	72435	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N	1.5E+001	3.1E+002 N
METHYL ACETATE	79209	1.00E+000 H				y	6.1E+003 N	3.7E+003 N	1.4E+003 N	2.0E+006 N	7.8E+004 N	1.2E+000	2.5E+001 N
METHYL ACRYLATE	96333	3.00E-002 A				y	1.8E+002 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N	5.0E-001	1.0E+001 N
2-METHYLANILINE	95534		2.40E-001 H				2.8E-001 C	2.6E-002 C	1.3E-002 C	2.4E+001 C	2.7E+000 C	2.8E-004	5.7E-003 C
4-(2-METHYL-4-CHLOROPHENOXY) BUTYRIC ACID	94815	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
2-METHYL-4-CHLOROPHENOXYACETIC ACID (MCPA)	94746	5.00E-004 I					1.8E+001 N	1.8E+000 N	6.8E-001 N	1.0E+003 N	3.9E+001 N		
2-(2-METHYL-4-CHLOROPHENOXY)PROPIONIC ACID (MCP	93652	1.00E-003 I					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N		
METHYLCYCLOHEXANE	108872			8.60E-001 H		y	6.3E+003 N	3.1E+003 N					
METHYLENE BROMIDE	74953	1.00E-002 A				y	6.1E+001 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N	1.5E-002	3.0E-001 N
METHYLENE CHLORIDE	75092	6.00E-002 I	7.50E-003 I	8.60E-001 H	1.65E-003 I	y	4.1E+000 C	3.8E+000 C	4.2E-001 C	7.6E+002 C	8.5E+001 C	9.5E-004	1.9E-002 C
4,4'-METHYLENE BIS(2-CHLOROANILINE)	101144	7.00E-004 H	1.30E-001 H		1.30E-001 H		5.2E-001 C	4.8E-002 C	2.4E-002 C	4.4E+001 C	4.9E+000 C		
4,4'-METHYLENE BIS(N,N'-DIMETHYL)ANILINE	101611		4.60E-002 I				1.5E+000 C	1.4E-001 C	6.9E-002 C	1.2E+002 C	1.4E+001 C		
4,4'-METHYLENEDIPHENYL ISOCYANATE	101688			1.7E-004 I				6.2E-001 N					
METHYL ETHYL KETONE (2-BUTANONE)	78933	6.00E-001 I		2.86E-001 I		y	1.9E+003 N	1.0E+003 N	8.1E+002 N	1.2E+006 N	4.7E+004 N	4.0E-001	7.9E+000 N
METHYL HYDRAZINE	60344		1.10E+000 W				6.1E-002 C	5.7E-003 C	2.9E-003 C	5.2E+000 C	5.8E-001 C		

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Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Risk-based concentrations: Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Soil Residential mg/kg	Region III SSLs: Soil, for groundwater migration DAF 1 mg/kg	DAF 20 mg/kg
METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	108101	8.00E-002 H		2.00E-002 A		y	1.4E+002 N	7.3E+001 N	1.1E+002 N	1.6E+005 N	6.3E+003 N	6.5E-002	1.3E+000 N
METHYL METHACRYLATE	80626	1.40E+000 I		2.00E-001 I		y	1.4E+003 N	7.3E+002 N	1.9E+003 N	2.9E+006 N	1.1E+005 N	3.2E-001	6.5E+000 N
2-METHYL-5-NITROANILINE	99558		3.30E-002 H				2.0E+000 C	1.9E-001 C	9.6E-002 C	1.7E+002 C	1.9E+001 C		
METHYL PARATHION	298000	2.50E-004 I					9.1E+000 N	9.1E-001 N	3.4E-001 N	5.1E+002 N	2.0E+001 N	4.3E-003	8.5E-002 N
2-METHYLPHENOL	95487	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
3-METHYLPHENOL	108394	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
4-METHYLPHENOL	106445	5.00E-003 H					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
METHYLSTYRENE MIX	25013154	6.00E-003 A		1.00E-002 A		y	5.5E+001 N	3.7E+001 N	8.1E+000 N	1.2E+004 N	4.7E+002 N	5.1E-002	1.0E+000 N
ALPHA-METHYLSTYRENE	98839	7.00E-002 A				y	4.3E+002 N	2.6E+002 N	9.5E+001 N	1.4E+005 N	5.5E+003 N	4.0E-001	7.9E+000 N
METHYL TERT-BUTYL ETHER	1634044			8.57E-001 I		y	6.3E+003 N	3.1E+003 N				1.4E+000	2.8E+001 N
METOLACHLOR (DUAL)	51218452	1.50E-001 I					5.5E+003 N	5.5E+002 N	2.0E+002 N	3.1E+005 N	1.2E+004 N		
MIREX	2385855	2.00E-004 I					7.3E+000 N	7.3E-001 N	2.7E-001 N	4.1E+002 N	1.6E+001 N		
MOLYBDENUM	7439987	5E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
MONOCHLORAMINE	10599903	1E-001 I		1.00E-001 H			3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
NALED	300765	2E-003 I					7.3E+001 N	7.3E+000 N	2.7E+000 N	4.1E+003 N	1.6E+002 N		
NICKEL REFINERY DUST					8.4E-001 I			7.5E-003 C					
NICKEL	7440020	2.00E-002 I					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N		
NITRATE	14797558	1.60E+000 I					5.8E+004 N	5.8E+003 N	2.2E+003 N	3.3E+006 N	1.3E+005 N		
NITRIC OXIDE	10102439	1.00E-001 W				y	6.1E+002 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
NITRITE	14797650	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
2-NITROANILINE	88744			5.70E-005 H				2.1E-001 N					
NITROBENZENE	98953	5.00E-004 I		6.00E-004 A		y	3.5E+000 N	2.2E+000 N	6.8E-001 N	1.0E+003 N	3.9E+001 N	1.2E-003	2.3E-002 N
NITROFURANTOIN	67209	7.00E-002 H					2.6E+003 N	2.6E+002 N	9.5E+001 N	1.4E+005 N	5.5E+003 N		
NITROFURAZONE	59870		1.50E+000 H				4.5E-002 C	4.2E-003 C	2.1E-003 C	3.8E+000 C	4.3E-001 C		
NITROGEN DIOXIDE	10102440	1.00E+000 W				y	6.1E+003 N	3.7E+003 N	1.4E+003 N	2.0E+006 N	7.8E+004 N		
NITROGLYCERIN	55630		1.4E-002 E				4.8E+000 C	4.5E-001 C	2.3E-001 C	4.1E+002 C	4.6E+001 C		
4-NITROPHENOL	100027	8.00E-003 E					2.9E+002 N	2.9E+001 N	1.1E+001 N	1.6E+004 N	6.3E+002 N	8.7E-002	1.7E+000 N
2-NITROPROPANE	79469			5.70E-003 I	9.40E+000 H	y	1.3E-003 C	6.7E-004 C				3.2E-007	6.4E-006 C
N-NITROSO-DI-N-BUTYLAMINE	924163		5.40E+000 I		5.60E+000 I	y	1.9E-003 C	1.1E-003 C	5.8E-004 C	1.1E+000 C	1.2E-001 C	1.4E-006	2.7E-005 C
N-NITROSODIETHANOLAMINE	1116547		2.80E+000 I				2.4E-002 C	2.2E-003 C	1.1E-003 C	2.0E+000 C	2.3E-001 C		
N-NITROSODIETHYLAMINE	55185		1.50E+002 I		1.50E+002 I		4.5E-004 C	4.2E-005 C	2.1E-005 C	3.8E-002 C	4.3E-003 C	1.1E-007	2.3E-006 C
N-NITROSODIMETHYLAMINE	62759		5.10E+001 I		5.10E+001 I		1.3E-003 C	1.2E-004 C	6.2E-005 C	1.1E-001 C	1.3E-002 C	2.8E-007	5.7E-006 C
N-NITROSODIPHENYLAMINE	86306		4.90E-003 I				1.4E+001 C	1.3E+000 C	6.4E-001 C	1.2E+003 C	1.3E+002 C	3.8E-002	7.6E-001 C
N-NITROSODIPROPYLAMINE	621647		7.00E+000 I				9.6E-003 C	8.9E-004 C	4.5E-004 C	8.2E-001 C	9.1E-002 C	2.4E-006	4.7E-005 C
N-NITROSO-N-ETHYLUREA	759739		1.40E+002 H				4.8E-004 C	4.5E-005 C	2.3E-005 C	4.1E-002 C	4.6E-003 C		
N-NITROSO-N-METHYLETHYLAMINE	10595956		2.20E+001 I				3.0E-003 C	2.8E-004 C	1.4E-004 C	2.6E-001 C	2.9E-002 C		
N-NITROSOPYRROLIDINE	930552		2.10E+000 I		2.10E+000 I		3.2E-002 C	3.0E-003 C	1.5E-003 C	2.7E+000 C	3.0E-001 C		
M-NITROTOLUENE	99081	2.00E-002 E				y	1.2E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N		
O-NITROTOLUENE	88722	1.00E-002 H				y	6.1E+001 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
P-NITROTOLUENE	99990	1.00E-002 H				y	6.1E+001 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
NUSTAR	85509199	7.00E-004 I					2.6E+001 N	2.6E+000 N	9.5E-001 N	1.4E+003 N	5.5E+001 N		
ORYZALIN	19044883	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
OXADIAZON	19666309	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
OXAMYL	23135220	2.50E-002 I					9.1E+002 N	9.1E+001 N	3.4E+001 N	5.1E+004 N	2.0E+003 N	1.9E-001	3.8E+000 N
OXYFLUORFEN	42874033	3.00E-003 I					1.1E+002 N	1.1E+001 N	4.1E+000 N	6.1E+003 N	2.3E+002 N		

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PARAQUAT DICHLORIDE	1910425	4.50E-003 I					1.6E+002 N	1.6E+001 N	6.1E+000 N	9.2E+003 N	3.5E+002 N		
PARATHION	56382	6.00E-003 H					2.2E+002 N	2.2E+001 N	8.1E+000 N	1.2E+004 N	4.7E+002 N	5.0E-001	1.0E+001 N
PENTACHLOROBENZENE	608935	8.00E-004 I					2.9E+001 N	2.9E+000 N	1.1E+000 N	1.6E+003 N	6.3E+001 N	1.0E+000	2.0E+001 N
PENTACHLORONITROBENZENE	82688	3.00E-003 I	2.60E-001 H				2.6E-001 C	2.4E-002 C	1.2E-002 C	2.2E+001 C	2.5E+000 C	4.1E-003	8.2E-002 C
PENTACHLOROPHENOL	87865	3.00E-002 I	1.20E-001 I				5.6E-001 C	5.2E-002 C	2.6E-002 C	4.8E+001 C	5.3E+000 C		
PERMETHRIN	52645531	5.00E-002 I					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N	1.2E+002	2.4E+003 N
PHENOL	108952	6.00E-001 I					2.2E+004 N	2.2E+003 N	8.1E+002 N	1.2E+006 N	4.7E+004 N	6.7E+000	1.3E+002 N
M-PHENYLENEDIAMINE	108452	6.00E-003 I					2.2E+002 N	2.2E+001 N	8.1E+000 N	1.2E+004 N	4.7E+002 N	4.9E-002	9.8E-001 N
O-PHENYLENEDIAMINE	95545		4.70E-002 H				1.4E+000 C	1.3E-001 C	6.7E-002 C	1.2E+002 C	1.4E+001 C		
P-PHENYLENEDIAMINE	106503	1.90E-001 H					6.9E+003 N	6.9E+002 N	2.6E+002 N	3.9E+005 N	1.5E+004 N		
2-PHENYLPHENOL	90437		1.90E-003 H				3.5E+001 C	3.3E+000 C	1.7E+000 C	3.0E+003 C	3.4E+002 C		
PHOSPHINE	7803512	3.00E-004 I		8.60E-005 I			1.1E+001 N	3.1E-001 N	4.1E-001 N	6.1E+002 N	2.3E+001 N		
PHOSPHORIC ACID	7664382			2.90E-003 I				1.1E+001 N					
PHOSPHORUS (WHITE)	7723140	2.00E-005 I					7.3E-001 N	7.3E-002 N	2.7E-002 N	4.1E+001 N	1.6E+000 N		
P-PHTHALIC ACID	100210	1.00E+000 H					3.7E+004 N	3.7E+003 N	1.4E+003 N	2.0E+006 N	7.6E+004 N		
PHTHALIC ANHYDRIDE	85449	2.00E+000 I		3.43E-002 H			7.3E+004 N	1.3E+002 N	2.7E+003 N	4.1E+006 N	1.6E+005 N	2.6E+001	5.2E+002 N
POLYBROMINATED BIPHENYLS		7.00E-006 H	8.90E+000 H				7.5E-003 C	7.0E-004 C	3.5E-004 C	6.4E-001 C	7.2E-002 C I		
POLYCHLORINATED BIPHENYLS	1336363		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C	2.1E-002	4.1E-001 C
AROCLOR-1016	12674112	7.00E-005 I	7.00E-002 I		7.00E-002 I		9.6E-001 C I	8.9E-002 C I	4.5E-002 C I	8.2E+001 C I	5.5E+000 N	2.1E-001	4.2E+000 C
AROCLOR-1221	11104282		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C		
AROCLOR-1232	11141165		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C		
AROCLOR-1242	53469219		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C		
AROCLOR-1248	12672296		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C		
AROCLOR-1254	11097691	2.00E-005 I	2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C I	5.4E-002	1.1E+000 C
AROCLOR-1260	11096825		2.00E+000 I		2.00E+000 I		3.3E-002 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C		
POLYCHLORINATED TERPHENYLS	61788338		4.50E+000 E				1.5E-002 C	1.4E-003 C	7.0E-004 C	1.3E+000 C	1.4E-001 C		
POLYNUCLEAR AROMATIC HYDROCARBONS:													
ACENAPHTHENE	83329	6.00E-002 I				y	3.7E+002 N	2.2E+002 N	8.1E+001 N	1.2E+005 N	4.7E+003 N	5.2E+000	1.0E+002 N
ANTHRACENE	120127	3.00E-001 I				y	1.8E+003 N	1.1E+003 N	4.1E+002 N	6.1E+005 N	2.3E+004 N	2.3E+001	4.7E+002 N
BENZ[A]ANTHRACENE	56553		7.30E-001 E				9.2E-002 C	8.6E-003 C	4.3E-003 C	7.8E+000 C	8.7E-001 C	7.3E-002	1.5E+000 C
BENZO[B]FLUORANTHENE	205992		7.30E-001 E				9.2E-002 C	8.6E-003 C	4.3E-003 C	7.8E+000 C	8.7E-001 C	2.3E-001	4.5E+000 C
BENZO[K]FLUORANTHENE	207089		7.30E-002 E				9.2E-001 C	8.6E-002 C	4.3E-002 C	7.8E+001 C	8.7E+000 C	2.3E+000	4.5E+001 C
BENZO[A]PYRENE	50328		7.30E+000 I		3.10E+000 E		9.2E-003 C	2.0E-003 C	4.3E-004 C	7.8E-001 C	8.7E-002 C	1.9E-002	3.7E-001 C
CARBAZOLE	86748		2.00E-002 H				3.3E+000 C	3.1E-001 C	1.6E-001 C	2.9E+002 C	3.2E+001 C	2.3E-002	4.7E-001 C
CHRYSENE	218019		7.30E-003 E				9.2E+000 C	8.6E-001 C	4.3E-001 C	7.8E+002 C	8.7E+001 C	7.3E+000	1.5E+002 C
DIBENZ[A,H]ANTHRACENE	53703		7.30E+000 E				9.2E-003 C	8.6E-004 C	4.3E-004 C	7.8E-001 C	8.7E-002 C	7.0E-002	1.4E+000 C
DIBENZOFURAN	132649	4.00E-003 E				y	2.4E+001 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N	3.8E-001	7.7E+000 N
FLUORANTHENE	206440	4.00E-002 I					1.5E+003 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N	3.1E+002	6.3E+003 N
FLUORENE	86737	4.00E-002 I				y	2.4E+002 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N	8.8E+000	1.4E+002 N
INDENO[1,2,3-C,D]PYRENE	193395		7.30E-001 E				9.2E-002 C	8.6E-003 C	4.3E-003 C	7.8E+000 C	8.7E-001 C	6.4E-001	1.3E+001 C
2-METHYLNAPHTHALENE	91576	2.00E-002 E				y	1.2E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	1.1E+000	2.2E+001 N
NAPHTHALENE	91203	2.00E-002 I		9.00E-004 I		y	6.5E+000 N	3.3E+000 N	2.7E+001 N	4.1E+004 N	1.6E+003 N	7.7E-003	1.5E-001 N
PYRENE	129000	3.00E-002 I				y	1.8E+002 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N	3.4E+001	6.8E+002 N
PROMETON	1610180	1.50E-002 I					5.5E+002 N	5.5E+001 N	2.0E+001 N	3.1E+004 N	1.2E+003 N		
PROMETRYN	7287196	4.00E-003 I					1.5E+002 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N		

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Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Risk-based concentrations: Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Residential mg/kg	Region III SSLs: Soil, for groundwater migration DAF 1 mg/kg	DAF 20 mg/kg
PROPACHLOR	1918167	1.30E-002 I					4.7E+002 N	4.7E+001 N	1.8E+001 N	2.7E+004 N	1.0E+003 N		
PROPANIL	709988	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
PROPARGITE	2312358	2.00E-002 I					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N		
N-PROPYLBENZENE	103651	4.00E-002 E				y	2.4E+002 N	1.5E+002 N	5.4E+001 N	8.2E+004 N	3.1E+003 N	1.4E+000	2.8E+001 N
PROPYLENE GLYCOL	57556	2.00E+001 H					7.3E+005 N	7.3E+004 N	2.7E+004 N	4.1E+007 N	1.6E+006 N		
PROPYLENE GLYCOL, MONOETHYL ETHER	52125538	7.00E-001 H					2.6E+004 N	2.6E+003 N	9.5E+002 N	1.4E+006 N	5.5E+004 N		
PROPYLENE GLYCOL, MONOMETHYL ETHER	107982	7.00E-001 H		5.70E-001 I			2.6E+004 N	2.1E+003 N	9.5E+002 N	1.4E+006 N	5.5E+004 N		
PURSUIT	81335775	2.50E-001 I					9.1E+003 N	9.1E+002 N	3.4E+002 N	5.1E+005 N	2.0E+004 N		
PYRIDINE	110861	1.00E-003 I					3.7E+001 N	3.7E+000 N	1.4E+000 N	2.0E+003 N	7.8E+001 N		
QUINOLINE	91225		1.20E+001 H				5.6E-003 C	5.2E-004 C	2.6E-004 C	4.8E-001 C	5.3E-002 C		
RDX	121824	3.00E-003 I	1.10E-001 I				6.1E-001 C	5.7E-002 C	2.9E-002 C	5.2E+001 C	5.8E+000 C		
RESMETHRIN	10453868	3.00E-002 I					1.1E+003 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N		
RONNEL	299843	5.00E-002 H					1.8E+003 N	1.8E+002 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
ROTENONE	83794	4.00E-003 I					1.5E+002 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N		
SELENIOUS ACID	7783008	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
SELENIUM	7782492	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N	9.5E-001	1.9E+001 N
SILVER	7440224	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N	1.6E+000	3.1E+001 N
SIMAZINE	122349	5.00E-003 I	1.20E-001 H				5.6E-001 C	5.2E-002 C	2.6E-002 C	4.8E+001 C	5.3E+000 C	1.7E-004	3.3E-003 C
SODIUM AZIDE	26628228	4.00E-003 I					1.5E+002 N	1.5E+001 N	5.4E+000 N	8.2E+003 N	3.1E+002 N		
SODIUM DIETHYLDITHIOCARBAMATE	148185	3.00E-002 I	2.70E-001 H				2.5E-001 C	2.3E-002 C	1.2E-002 C	2.1E+001 C	2.4E+000 C		
STRONTIUM, STABLE	7440246	6.00E-001 I					2.2E+004 N	2.2E+003 N	8.1E+002 N	1.2E+006 N	4.7E+004 N	7.7E+002	1.5E+004 N
STRYCHNINE	57249	3.00E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N	8.3E-003	1.7E-001 N
STYRENE	100425	2.00E-001 I		2.86E-001 I		y	1.6E+003 N	1.0E+003 N	2.7E+002 N	4.1E+005 N	1.6E+004 N	2.9E+000	5.7E+001 N
2,3,7,8-TETRACHLORODIBENZODIOXIN	1746016		1.50E+005 H		1.50E+005 H		4.5E-007 C	4.2E-008 C	2.1E-008 C	3.8E-005 C	4.3E-008 C	4.3E-007	8.6E-008 C
1,2,4,5-TETRACHLOROBENZENE	95943	3.00E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N	3.3E-002	6.6E-001 N
1,1,1,2-TETRACHLOROETHANE	630206	3.00E-002 I	2.60E-002 I		2.60E-002 I	y	4.1E-001 C	2.4E-001 C	1.2E-001 C	2.2E+002 C	2.5E+001 C	2.0E-004	4.0E-003 C
1,1,2,2-TETRACHLOROETHANE	79345	6.00E-002 E	2.00E-001 I		2.00E-001 I	y	5.3E-002 C	3.1E-002 C	1.6E-002 C	2.9E+001 C	3.2E+000 C	3.4E-005	6.8E-004 C
TETRACHLOROETHENE	127184	1.00E-002 I	5.20E-002 E	1.4E-001 E	2.00E-003 E	y	1.1E+000 C	3.1E+000 C	6.1E-002 C	1.1E+002 C	1.2E+001 C	2.4E-003	4.8E-002 C
2,3,4,6-TETRACHLOROPHENOL	58902	3.00E-002 I					1.1E+003 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N		
P,A,A,A-TETRACHLOROTOLUENE	5216251		2.00E+001 H				3.3E-003 C	3.1E-004 C	1.6E-004 C	2.9E-001 C	3.2E-002 C		
1,1,1,2-TETRAFLUOROETHANE	811972			2.29E+001 I		y	1.7E+005 N	8.4E+004 N					
TETRAHYDROFURAN	109999	2.00E-001 E	7.6E-003 E	8.6E-002 E	8.8E-003 E		8.8E+000 C	9.2E-001 C	4.2E-001 C	7.5E+002 C	8.4E+001 C		
TETRYL	479458	1.00E-002 H					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
THALLIC OXIDE	1314325	7.00E-005 W					2.6E+000 N	2.6E-001 N	9.5E-002 N	1.4E+002 N	5.5E+000 N		
THALLIUM	7440280	7.00E-005 O					2.6E+000 N	2.6E-001 N	9.5E-002 N	1.4E+002 N	5.5E+000 N	1.8E-001	3.6E+000 N
THALLIUM ACETATE	563688	9.00E-005 I					3.3E+000 N	3.3E-001 N	1.2E-001 N	1.8E+002 N	7.0E+000 N		
THALLIUM CARBONATE	6533739	8.00E-005 I					2.9E+000 N	2.9E-001 N	1.1E-001 N	1.6E+002 N	6.3E+000 N		
THALLIUM CHLORIDE	7791120	8.00E-005 I					2.9E+000 N	2.9E-001 N	1.1E-001 N	1.6E+002 N	6.3E+000 N		
THALLIUM NITRATE	10102451	9.00E-005 I					3.3E+000 N	3.3E-001 N	1.2E-001 N	1.8E+002 N	7.0E+000 N		
THALLIUM SULFATE (2:1)	7446186	8.00E-005 I					2.9E+000 N	2.9E-001 N	1.1E-001 N	1.6E+002 N	6.3E+000 N		
THIOBENCARB	28249776	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N		
TIN	7440315	6.00E-001 H					2.2E+004 N	2.2E+003 N	8.1E+002 N	1.2E+006 N	4.7E+004 N		

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Chemical	CAS	RfDo mg/kg/d	CSFo 1/mg/kg/d	RfDi mg/kg/d	CSFi 1/mg/kg/d	VOC	Risk-based concentrations: Tap water ug/l	Ambient air ug/m3	Fish mg/kg	Soil Industrial mg/kg	Soil Residential mg/kg	Region III SSLs, Soil, for groundwater migration: DAF 1 mg/kg	DAF 20 mg/kg
TITANIUM	7440326	4.00E+000 E		8.60E-003 E			1.5E+005 N	3.1E+001 N	5.4E+003 N	8.2E+006 N	3.1E+005 N		
TITANIUM DIOXIDE	13463677	4.00E+000 E		8.60E-003 E			1.5E+005 N	3.1E+001 N	5.4E+003 N	8.2E+006 N	3.1E+005 N		
TOLUENE	108883	2.00E-001 I		1.14E-001 I		y	7.5E+002 N	4.2E+002 N	2.7E+002 N	4.1E+005 N	1.6E+004 N	4.4E-001	8.8E+000 N
TOLUENE-2,4-DIAMINE	95807		3.20E+000 H				2.1E-002 C	2.0E-003 C	9.9E-004 C	1.8E+000 C	2.0E-001 C		
TOLUENE-2,5-DIAMINE	95705	6.00E-001 H					2.2E+004 N	2.2E+003 N	8.1E+002 N	1.2E+006 N	4.7E+004 N		
TOLUENE-2,6-DIAMINE	823405	2.00E-001 H					7.3E+003 N	7.3E+002 N	2.7E+002 N	4.1E+005 N	1.6E+004 N		
P-TOLUIDINE	106490		1.90E-001 H				3.5E-001 C	3.3E-002 C	1.7E-002 C	3.0E+001 C	3.4E+000 C	3.0E-004	5.9E-003 C
TOXAPHENE	8001352		1.10E+000 I		1.10E+000 I		6.1E-002 C	5.7E-003 C	2.9E-003 C	5.2E+000 C	5.8E-001 C	3.1E-002	6.3E-001 C
1,2,4-TRIBROMOBENZENE	615543	5.00E-003 I					1.8E+002 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N		
TRIBUTYLTIN OXIDE	56359	3.00E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N		
2,4,6-TRICHLOROANILINE	634935		3.40E-002 H				2.0E+000 C	1.8E-001 C	9.3E-002 C	1.7E+002 C	1.9E+001 C		
1,2,4-TRICHLOROBENZENE	120821	1.00E-002 I		5.70E-002 H		y	1.9E+002 N	2.1E+002 N	1.4E+001 N	2.0E+004 N	7.8E+002 N	3.8E-001	7.5E+000 N
1,1,1-TRICHLOROETHANE	71556	2.80E-001 E		6.30E-001 E		y	3.2E+003 N	2.3E+003 N	3.8E+002 N	5.7E+005 N	2.2E+004 N	3.0E+000	6.0E+001 N
1,1,2-TRICHLOROETHANE	79005	4.00E-003 I	5.70E-002 I		5.60E-002 I	y	1.9E-001 C	1.1E-001 C	5.5E-002 C	1.0E+002 C	1.1E+001 C	3.9E-005	7.8E-004 C
TRICHLOROETHENE	79016	6.00E-003 E	1.10E-002 E		6.00E-003 E	y	1.6E+000 C	1.0E+000 C	2.9E-001 C	5.2E+002 C	5.8E+001 C I	7.7E-004	1.5E-002 C
TRICHLOROFLUOROMETHANE	75694	3.00E-001 I		2.00E-001 A		y	1.3E+003 N	7.3E+002 N	4.1E+002 N	6.1E+005 N	2.3E+004 N	1.1E+000	2.3E+001 N
2,4,5-TRICHLOROPHENOL	95954	1.00E-001 I					3.7E+003 N	3.7E+002 N	1.4E+002 N	2.0E+005 N	7.8E+003 N		
2,4,6-TRICHLOROPHENOL	88062		1.10E-002 I		1.00E-002 I		6.1E+000 C	6.3E-001 C	2.9E-001 C	5.2E+002 C	5.8E+001 C		
2,4,5-T	93765	1.00E-002 I					3.7E+002 N	3.7E+001 N	1.4E+001 N	2.0E+004 N	7.8E+002 N	9.8E-002	2.0E+000 N
2-(2,4,5-TRICHLOROPHENOXY)PROPIONIC ACID	93721	8.00E-003 I					2.9E+002 N	2.9E+001 N	1.1E+001 N	1.6E+004 N	6.3E+002 N	1.1E+000	2.1E+001 N
1,1,2-TRICHLOROPROPANE	598776	5.00E-003 I				y	3.0E+001 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N	1.2E-002	2.5E-001 N
1,2,3-TRICHLOROPROPANE	96184	6.00E-003 I	2.00E+000 E	1.4E-003 E		y	5.3E-003 C	3.1E-003 C	1.6E-003 C	2.9E+000 C	3.2E-001 C	1.8E-006	3.6E-005 C
1,2,3-TRICHLOROPROPENE	96195	5.00E-003 H				y	3.0E+001 N	1.8E+001 N	6.8E+000 N	1.0E+004 N	3.9E+002 N	1.2E-002	2.5E-001 N
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76131	3.00E+001 I		8.60E+000 H		y	5.9E+004 N	3.1E+004 N	4.1E+004 N	6.1E+007 N	2.3E+006 N	1.2E+002	2.3E+003 N
1,2,4-TRIMETHYLBENZENE	95636	5.00E-002 E		1.70E-003 E		y	1.2E+001 N	6.2E+000 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
1,3,5-TRIMETHYLBENZENE	108678	5.00E-002 E		1.70E-003 E		y	1.2E+001 N	6.2E+000 N	6.8E+001 N	1.0E+005 N	3.9E+003 N		
TRIMETHYL PHOSPHATE	512561		3.70E-002 H				1.8E+000 C	1.7E-001 C	8.5E-002 C	1.5E+002 C	1.7E+001 C		
1,3,5-TRINITROBENZENE	99354	3.00E-002 I					1.1E+003 N	1.1E+002 N	4.1E+001 N	6.1E+004 N	2.3E+003 N		
2,4,6-TRINITROTOLUENE	118967	5.00E-004 I	3.00E-002 I				2.2E+000 C I	2.1E-001 C I	1.1E-001 C I	1.9E+002 C I	2.1E+001 C I		
URANIUM (SOLUBLE SALTS; from IRIS)	7440611	3.00E-003 I					1.1E+002 N	1.1E+001 N	4.1E+000 N	6.1E+003 N	2.3E+002 N		
URANIUM (SOLUBLE SALTS; provisional)	7440611	2.00E-004 E					7.3E+000 N	7.3E-001 N	2.7E-001 N	4.1E+002 N	1.6E+001 N		
VANADIUM	7440622	7.00E-003 H					2.6E+002 N	2.6E+001 N	9.5E+000 N	1.4E+004 N	5.5E+002 N	2.6E+002	5.1E+003 N
VANADIUM PENTOXIDE	1314621	9.00E-003 I					3.3E+002 N	3.3E+001 N	1.2E+001 N	1.8E+004 N	7.0E+002 N		
VANADIUM SULFATE	16785612	2.00E-002 H					7.3E+002 N	7.3E+001 N	2.7E+001 N	4.1E+004 N	1.6E+003 N		
VINCLOZOLIN	50471448	2.50E-002 I					9.1E+002 N	9.1E+001 N	3.4E+001 N	5.1E+004 N	2.0E+003 N		
VINYL ACETATE	108054	1.00E+000 H		5.71E-002 I		y	4.1E+002 N	2.1E+002 N	1.4E+003 N	2.0E+006 N	7.8E+004 N	8.7E-002	1.7E+000 N
**VINYL CHLORIDE inc earlylife(see cover memos)	75014	3.00E-003 I	1.40E+000 I	2.8E-002 I	3.00E-002 I	y	1.5E-002 C	7.2E-002 C			9.0E-002 C	1.7E-005	3.3E-004 C
**VINYL CHLORIDE: adult (see cover memos)	75014	3.00E-003 I	7.20E-001 I	2.8E-002 I	1.5E-002 I	y			4.4E-003 C	7.9E+000 C			
WARFARIN	81812	3.00E-004 I					1.1E+001 N	1.1E+000 N	4.1E-001 N	6.1E+002 N	2.3E+001 N	2.2E-002	4.4E-001 N
M-XYLENE	108383	2.00E+000 H				y	1.2E+004 N	7.3E+003 N	2.7E+003 N	4.1E+006 N	1.6E+005 N	1.3E+001	2.5E+002 N
O-XYLENE	95476	2.00E+000 H				y	1.2E+004 N	7.3E+003 N	2.7E+003 N	4.1E+006 N	1.6E+005 N	1.1E+001	2.3E+002 N
P-XYLENE	106423					y							

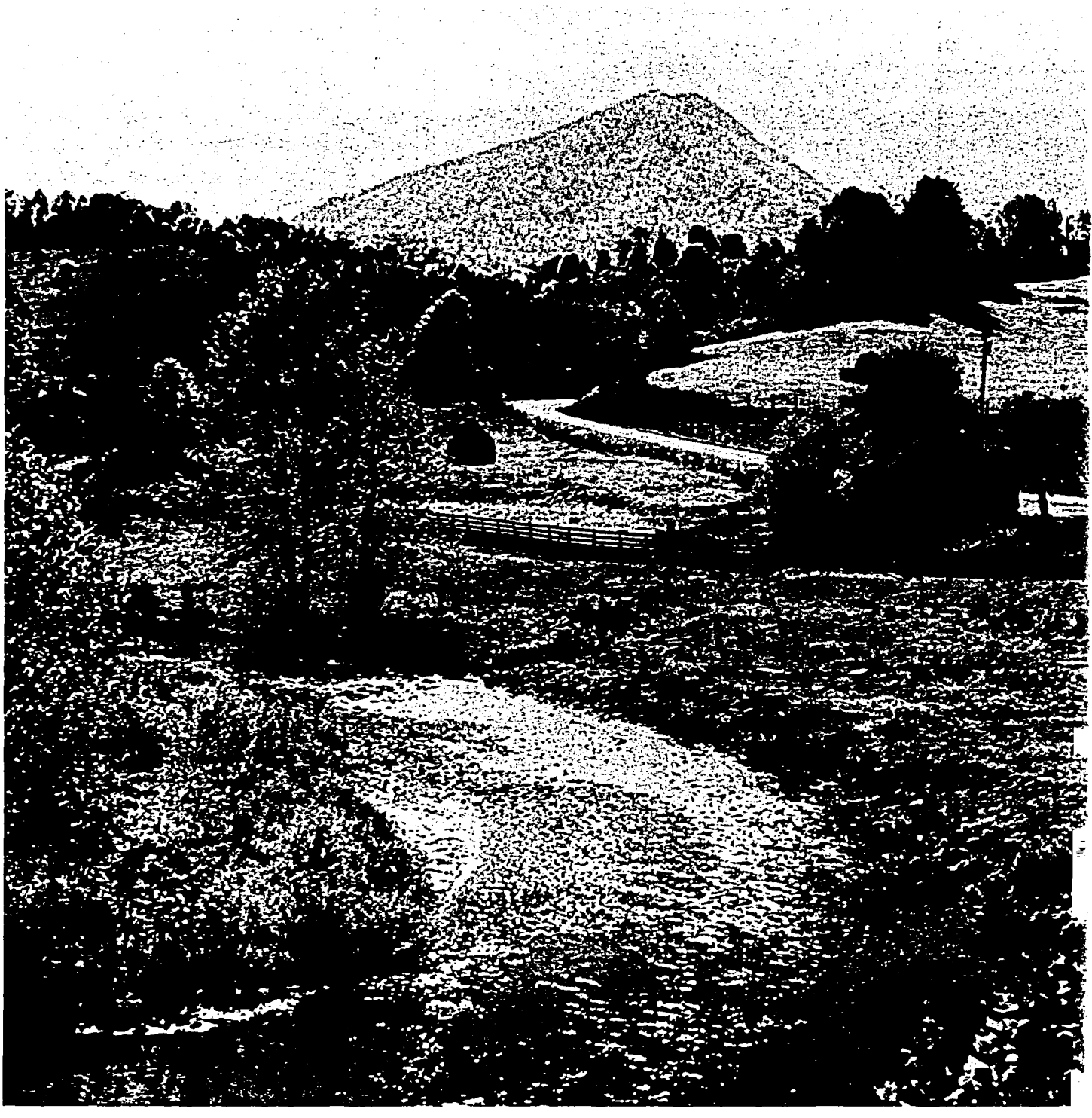
Ref. 21

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 Ashe County Board of Commissioners

Soil Survey of Ashe County, North Carolina



Also included are a few areas of a soil that has less clay in the subsoil than is typical for the Braddock soil. The Clifton, Fannin, and Watauga soils are on the upper slopes of the mapped areas. The Tusquitee soils are in small depressions. The included soils make up about 15 percent of this unit.

Most of the acreage of this Braddock soil is cleared and used for row crops, pasture, or urban uses. This soil is suited to most locally grown row crops and is well suited to pasture. The erosion hazard and slope are the main limitations. Additions of plant nutrients, minimum tillage, and the use of cover crops and crop residue help to reduce erosion and maintain yields.

A few areas of this soil are used as woodland. The dominant trees are yellow-poplar, northern red oak, hickory, and white pine. The understory includes red maple, mountain-laurel, rhododendron, dogwood, sourwood, and American holly.

This soil is suited to most urban uses. Slope is the main limitation. The clayey subsoil and low strength may limit some uses. The soil is suited to most recreation uses. Slope is the main limitation to recreation uses.

This Braddock soil is in capability subclass IVe and woodland group 2c.

BuC—Braddock-Urban land complex, 2 to 15 percent slopes. This map unit consists of areas of Braddock soils and areas of Urban land that are so small and so intricately mixed that they could not be separated at the scale used in mapping. About 40 percent of the acreage is Braddock soils, and 35 percent is Urban land. Areas are irregular in shape and range from 5 to 20 acres.

Typically, the Braddock soils have a dark brown gravelly loam surface layer 8 inches thick. The subsoil, which is 46 inches thick, is yellowish red clay loam in the upper part, clay in the middle part, and gravelly loam in the lower part. The underlying material to a depth of 80 inches is yellowish red and strong brown saprolite that crushes to sandy loam.

In these Braddock soils, permeability is moderate, and available water capacity is moderate. Surface runoff is medium, and the hazard of erosion is severe on bare and exposed areas. The soil is very strongly acid or strongly acid, except where the surface has been limed. Pebbles or cobblestones cover 10 to 25 percent of the surface area of these soils. The depth to bedrock is more than 60 inches.

Urban land consists of buildings, parking lots, streets, or other structures that so obscure or alter the soil that identification of the soil is not feasible. Water movement into and through the soil is very restricted, causing rapid surface runoff and the hazard of flooding in low-lying areas.

Included in mapping are small areas of poorly drained soils near drainageways. In most areas these soils have been covered by urban development. Some small areas are cut or filled with soil material and not covered with pavement, buildings, or other structures. Also included are a few areas of Clifton soils and Evard soils. The included soils make up about 25 percent of this unit.

The Braddock soils are suited to urban and recreation uses. Slope and erosion are the main limitations.

Neither a capability subclass nor a woodland group has been assigned to this unit.

CaF—Chandler loam, 25 to 65 percent slopes. This somewhat excessively drained, micaceous soil is on side slopes. Elevation is 2,600 to 3,500 feet. Mapped areas are generally long and irregular in width. They border drainageways and range from 20 to 200 acres.

Typically, the surface layer, which is 8 inches thick, consists of loam that is dark brown in the upper part and brown in the lower part. The subsoil is strong brown sandy loam 22 inches thick. The underlying material to a depth of 80 inches is strong brown and brown saprolite (fig. 3) that crushes to fine sandy loam.

In this Chandler soil, permeability is moderately rapid, and available water capacity is moderate. Surface runoff is rapid, and the hazard of erosion is very severe on bare and exposed areas. This soil is very strongly acid or strongly acid throughout, except where the surface layer has been limed. Because of the high mica content, this soil is subject to slides or caving where areas are left bare. The depth to bedrock is more than 60 inches and commonly is 10 feet or more.

Included in mapping are small areas of Watauga, Ashe, and Porters soils. A few small areas of soils that are intermingled throughout this map unit are stony or have rock outcrop. In a few areas, slope is less than 25 percent. The well drained Porters soils are at the higher elevations. The well drained Watauga soils are in the less sloping areas, and the somewhat excessively drained Ashe soils are intermingled throughout the unit. The included soils make up about 20 percent of this unit.

Most of the acreage of this Chandler soil is in woodland. The dominant trees are white pine, chestnut oak, and scarlet oak. The understory includes black locust, red maple, mountain-laurel, rhododendron, dogwood, and sourwood. This soil is not a choice site for commercial forests but will probably remain in woodland. Slope and erosion are the main limitations to woodland use.

This soil is poorly suited to row crops, pasture, or urban and recreation use. Slope and erosion are the main limitations to those uses.

This Chandler soil is in capability subclass VIIe and woodland group 3r.

CfB—Clifton loam, 2 to 8 percent slopes. This well drained soil (fig. 4) is on broad ridgetops where elevations range from 2,800 to 3,200 feet. Mapped areas are irregular in shape and range from 5 to 50 acres.

stony loam in the lower part. The underlying material to a depth of 90 inches is strong brown stony sandy loam.

In this Evard soil, permeability is moderate, and available water capacity is medium. Surface runoff is very rapid, and the hazard of erosion is very severe on bare and exposed areas. This soil is very strongly acid or strongly acid throughout, except where the surface layer has been limed. Rock fragments of gneiss or schist make up about 15 to 25 percent of the volume of the surface layer and about 10 percent of the subsoil. The depth to bedrock is more than 60 inches.

Included in mapping are intermingled areas of somewhat excessively drained Ashe, well drained Edneyville, and well drained Watauga soils. A few areas of well drained Porters soils are on north-facing slopes at higher elevations. Also included are a few areas of similar soils that have slope of less than 25 percent or are nonstony. The included soils make up about 20 percent of this map unit.

Most of the acreage of this Evard soil is in woodland. Some areas are in pasture.

The dominant trees are white pine, chestnut oak, and scarlet oak. In some areas along drainageways, the major trees that provide the canopy are yellow-poplar, northern red oak, and eastern hemlock. The understory includes dogwood, black locust, red maple, mountain-laurel, rhododendron, and sourwood. The soil is not a choice site for commercial forests, but it will probably remain in woodland. Stoniness and slope are the main limitations.

This soil is poorly suited to crops, pasture, or urban and recreation uses. Stoniness and slope are the main limitations.

This Evard soil is in capability subclass VIIe and woodland group 2r.

EvE—Evard loam, 15 to 25 percent slopes. This well drained soil is on the upper side slopes and ridgetops. Elevation is 2,700 to 3,200 feet. Most areas are long and narrow and are 5 to 100 acres.

Typically, the surface layer is brown loam 7 inches thick. The subsoil, which is 29 inches thick, is strong brown clay loam in the upper part, yellowish red clay loam in the middle part, and yellowish red sandy loam in the lower part. The underlying material to a depth of 90 inches is yellowish red and strong brown saprolite that crushes to sandy loam.

In this Evard soil, permeability is moderate, and the available water capacity is moderate. Surface runoff is rapid, and the hazard of erosion is severe on bare and exposed areas. This soil is very strongly acid or strongly acid throughout, except where the surface layer has been limed. The depth to bedrock is more than 60 inches.

Included in mapping are small intermingled areas of Fannin, Edneyville, and Clifton soils. A few areas of well drained Porters soils are at the higher elevations. Also included are a few small areas of eroded soils, where the surface layer is sandy clay loam, and a few areas of soils that have a gravelly surface layer. The included soils make up about 20 percent of this unit.

Most of the acreage of this Evard soil is in woodland. The dominant trees are white pine, scarlet oak, white oak, and yellow-poplar. The understory includes dogwood, black locust, mountain-laurel, rhododendron, and sourwood. Slope and erosion are the main limitations.

This soil is poorly suited to row crops. Slope and erosion are the main limitations. This soil is well suited to pasture.

This soil is poorly suited to most urban and recreation uses. Slope limits the use of this soil for septic tank absorption fields, sanitary landfills, roads and streets, and small commercial buildings. Slope is the main limitation for most recreation uses.

This Evard soil is in capability subclass VIe and woodland group 2r.

EvF—Evard loam, 25 to 45 percent slopes. This well drained soil is on side slopes bordering the drainageways. Elevation ranges from 2,700 to 3,200 feet. Areas are long and narrow, and they range from 20 to 200 acres.

Typically, the surface layer is brown loam 7 inches thick. The subsoil, which is 29 inches thick, is strong brown clay loam in the upper part, yellowish red clay loam in the middle part, and yellowish red sandy loam in the lower part. The underlying material to a depth of 90 inches is yellowish red and strong brown fine sandy loam.

In this Evard soil, permeability is moderate, and available water capacity is moderate. Surface runoff is very rapid, and the hazard of erosion is very severe on bare and exposed areas. The soil is very strongly acid or strongly acid throughout, except where the surface layer has been limed. The depth to bedrock is more than 60 inches.

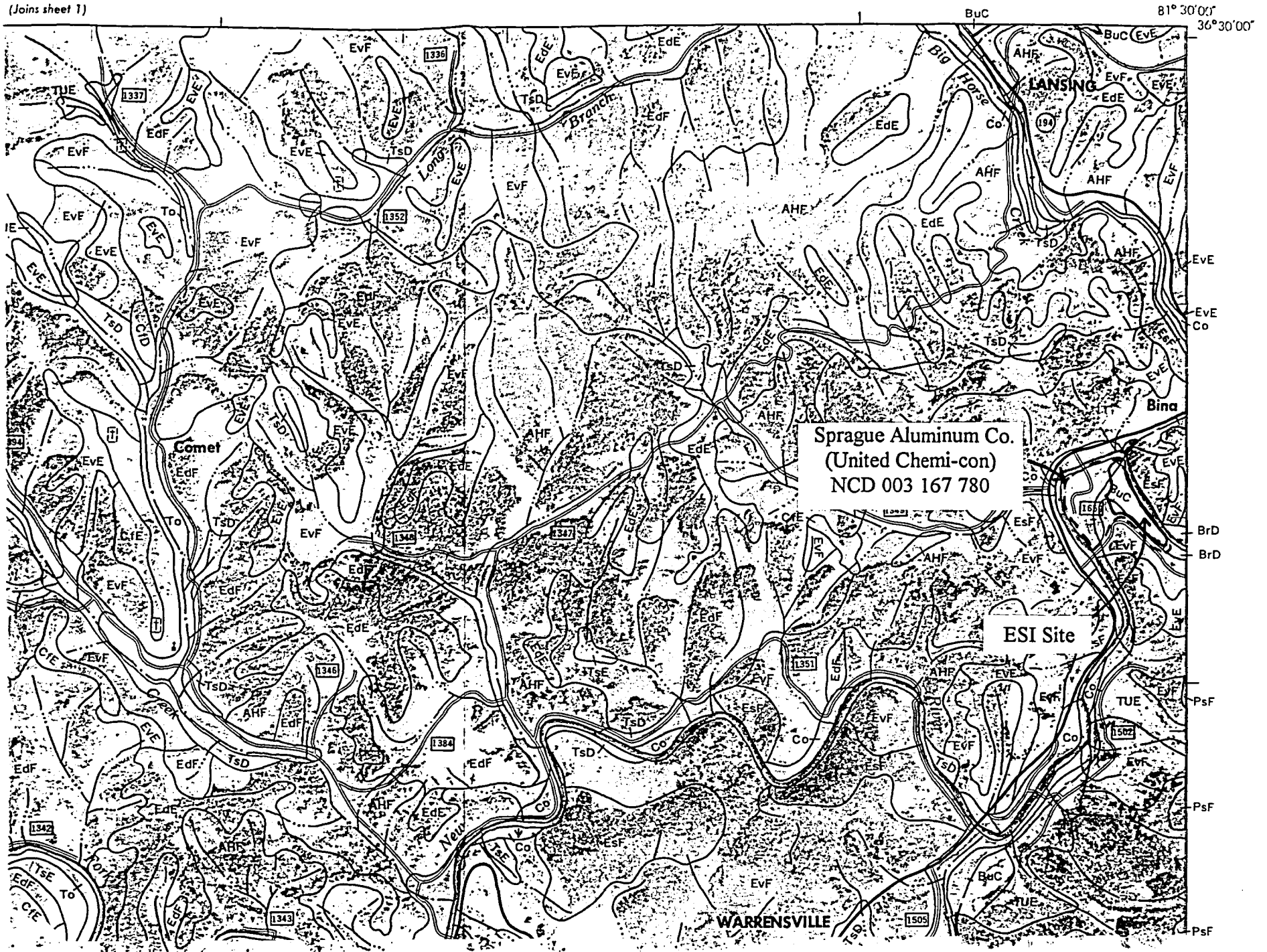
Included in mapping are small areas of Ashe, Edneyville, Watauga, Porters, and Tusquitee soils. The well drained Edneyville and Watauga soils are intermingled throughout this unit. The somewhat excessively drained Ashe soils are on the steeper parts of the unit. The well drained Porters soils are on the north-facing slopes at the higher elevations, and the well drained Tusquitee soils are in small drainageways. Also included are a few areas of eroded soils, where the surface layer is sandy clay loam. A few gullies may be present. The included areas make up about 20 percent of this unit.

Most of the acreage of this Evard soil is in woodland. Some areas are in pasture.

The dominant trees are white pine, white oak, scarlet oak, and chestnut oak. In some areas along drainageways, the major trees that provide a canopy are

SHEET NUMBER 5

ASHE COUNTY, NORTH CAROLINA



Ref. 22

Bob

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Basic Elements of Ground-Water Hydrology With Reference to Conditions in North Carolina

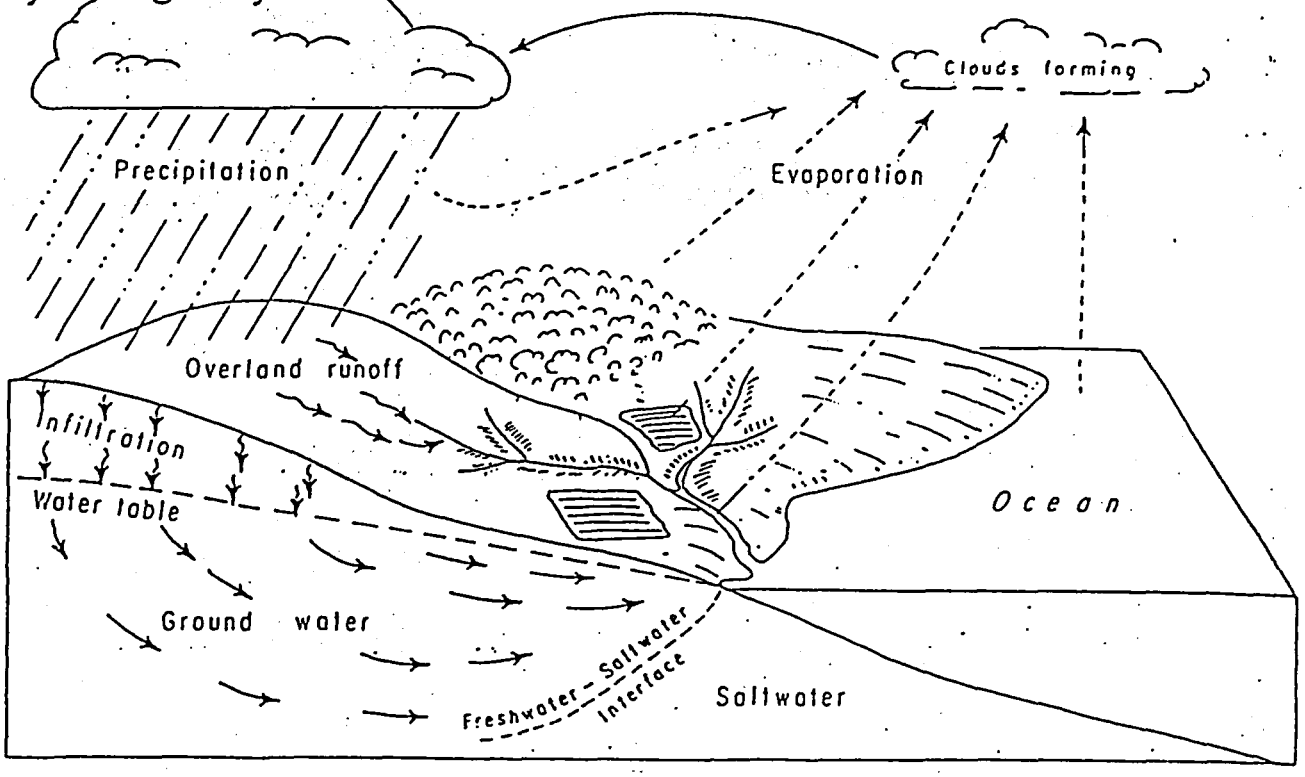
By Ralph C. Heath

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.

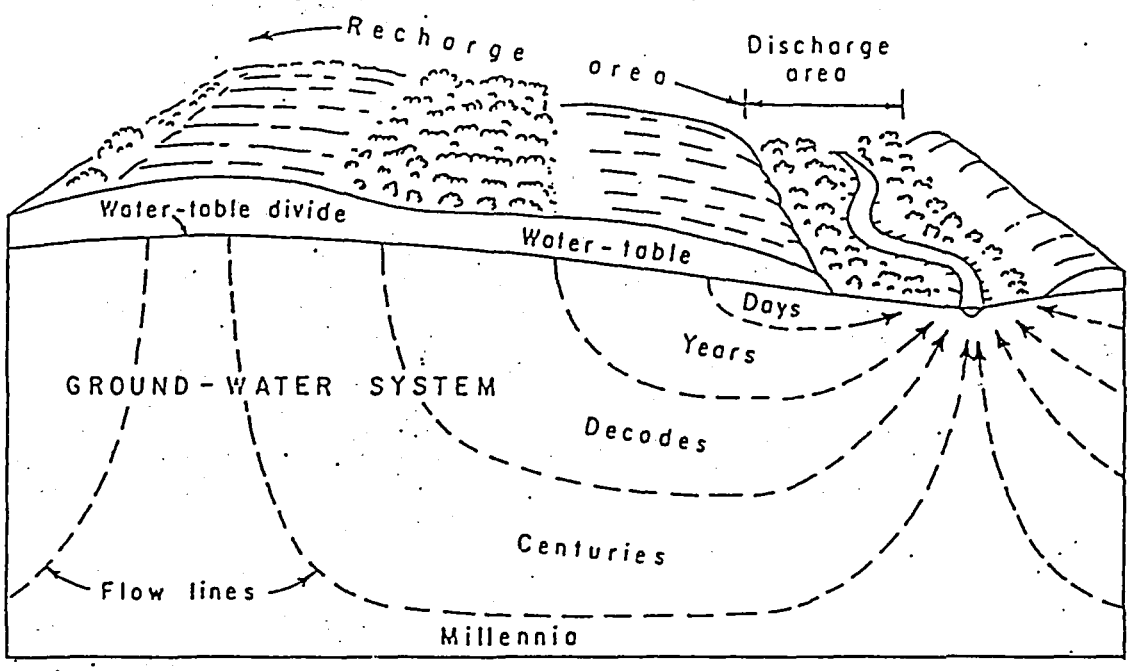
The first infiltration replaces soil moisture and thereafter the excess percolates slowly across the intermediate zone to the zone of saturation. The water in the zone of saturation moves downward and laterally to sites of ground-water discharge such as springs on hillsides or seeps in the bottoms of 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



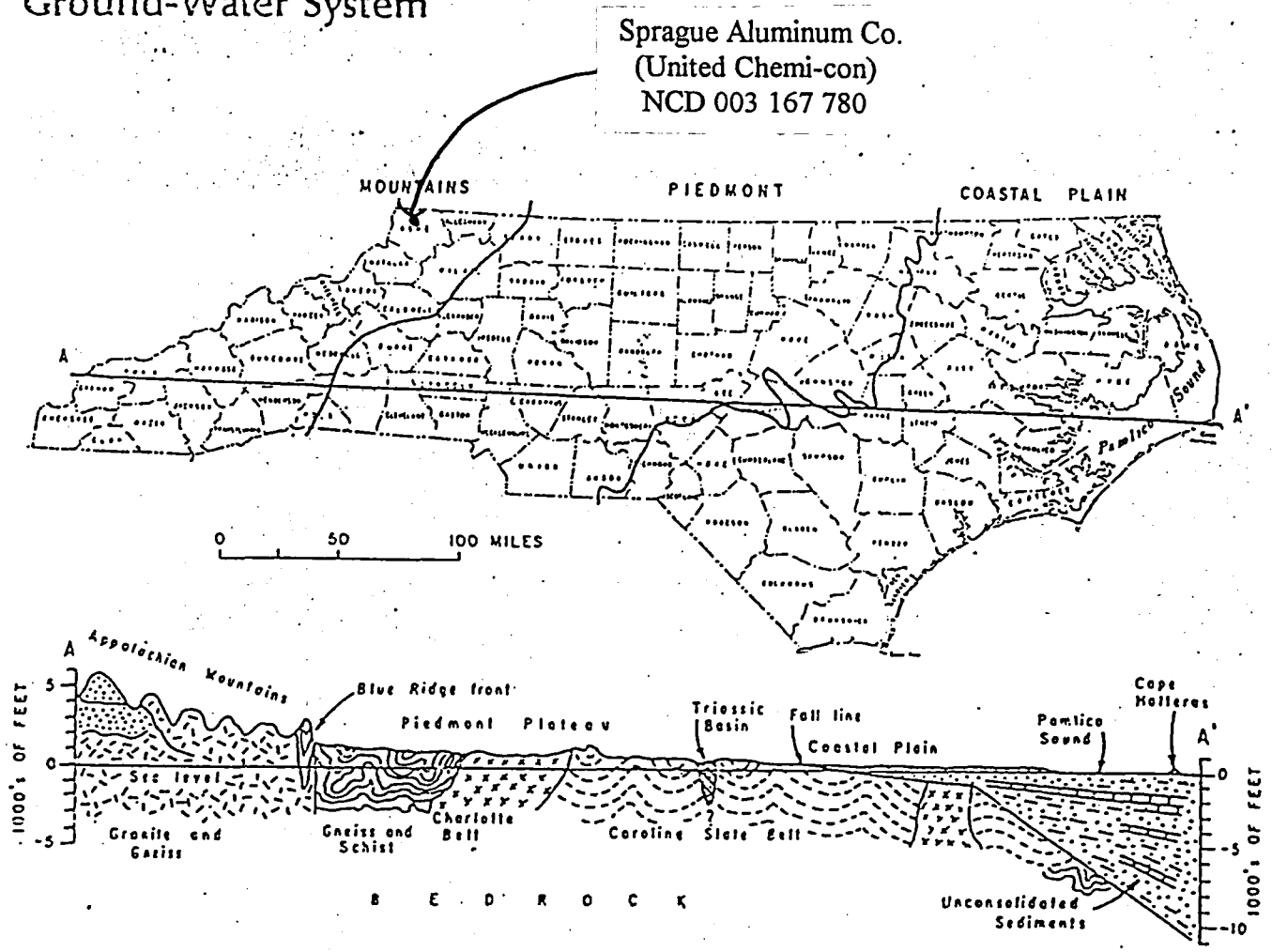
The aquifers and confining beds underlying any area comprise the *ground-water system* of the area. Hydraulically, this system serves two functions: (1) it stores water to the extent of its porosity, and (2) it transmits water from recharge areas to discharge areas. Thus, a ground-water system serves 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.

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.

Water-Bearing Rocks

The rocks underlying the surface of North Carolina form the environment in which ground water occurs and moves.

Geologists divide all rocks exposed at the Earth's surface into one of two great classes: (1) igneous, or (2) sedimentary. *Igneous rocks* are those that have formed from a molten or partially-molten state. Some types of igneous rocks, including granite, solidify at great depth below the land surface and are referred to as intrusive igneous rocks. Other igneous rocks form from lava or volcanic ash ejected onto the surface and are referred to as extrusive igneous rocks.

Sedimentary rocks are rocks formed by the accumulation of sediment in water or from the air. Most sedimentary rocks are unconsolidated (soil-like) at the time of formation. If they are, in time, buried deeply enough, or if they undergo certain chemical changes, they may become consolidated.

Both igneous and sedimentary rocks may, over the course of geologic time, reach depths beneath the Earth's crust at which they are subjected to great heat and pressure. This may alter both their structural characteristics and their mineral composition to such an extent that they are changed into *metamorphic rocks.* Depending on their original mode of origin, they may be referred to, for example, as metavolcanic or metasedimentary rocks.

North Carolina is underlain by an unusually large number of different types of rocks, including representatives of both the igneous and sedimentary classes and types of both classes that have been subjected to metamorphism. The major types of rocks are shown on the accompanying generalized geological map.

The Piedmont and mountain regions are underlain by igneous and metamorphosed igneous and sedimentary rocks that are referred to collectively as *bedrock*. They form broad northeast - southwest trending zones in which the rocks are of similar composition and origin. Most of these rocks were formed in the Precambrian and Paleozoic Eras of the Earth's history and thus are at least several hundred million years old. The bedrock in the Piedmont and mountains is exposed at the surface along steep hillsides and stream channels and in roadcuts. In most other areas they are covered by unconsolidated material formed from the breakdown of the bedrock in the process referred to by geologists as weathering. This layer of weathered material is referred to as *saprolite* or *residuum.*

The Coastal Plain region is also underlain by the same types of igneous and methamorphic rocks as those present in the Piedmont. However, in the Coastal Plain they are covered by unconcolidated sedimentary deposits which range in thickness from a few feet along the Fall Line to about 10,000 ft. at Cape Hatteras. (See the geologic section in PHYSICAL SETTING OF THE GROUND-WATER SYSTEM.) The sediments underlying the Coastal Plain include sand, clay, beds composed of seashells, and limestone.

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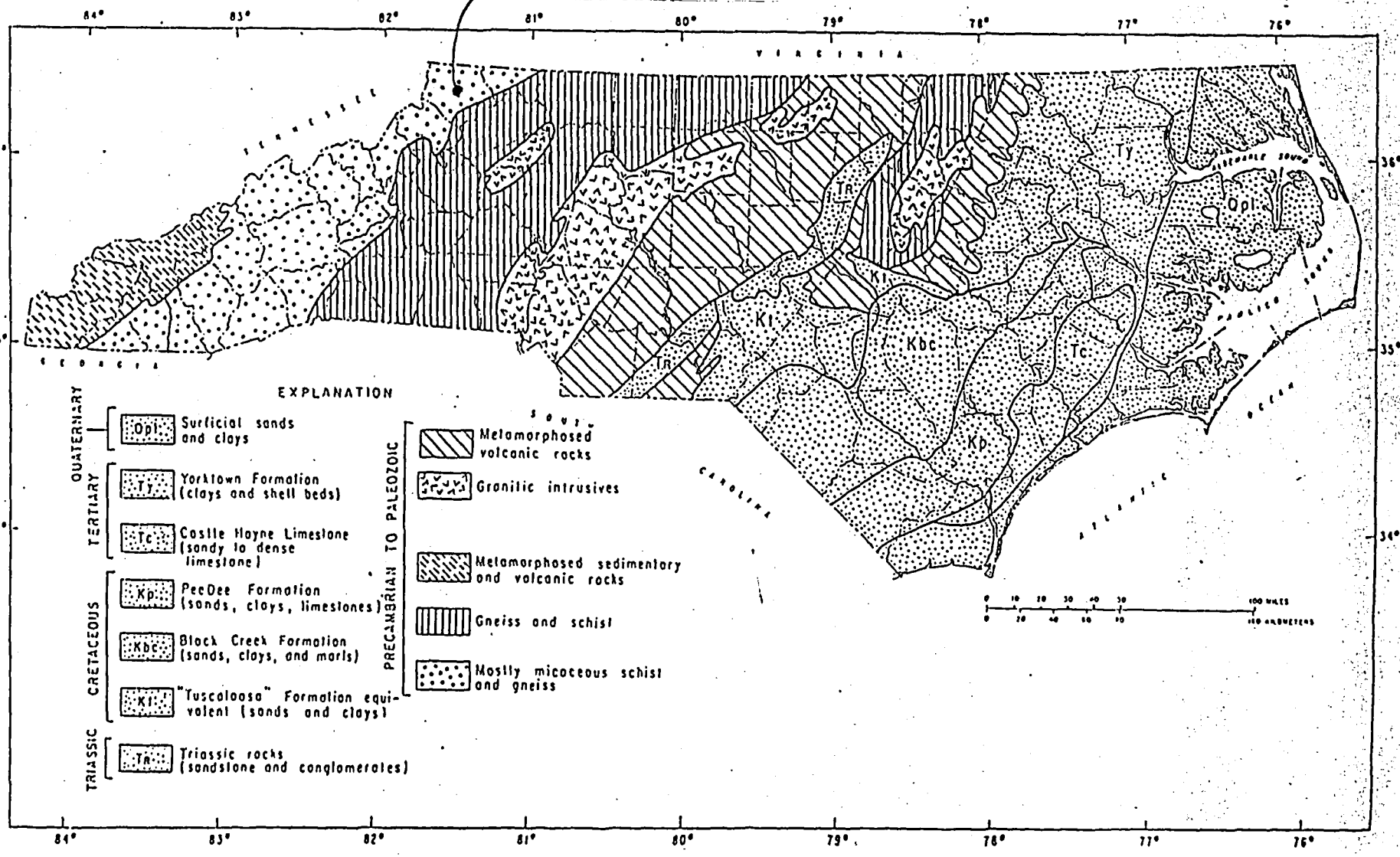
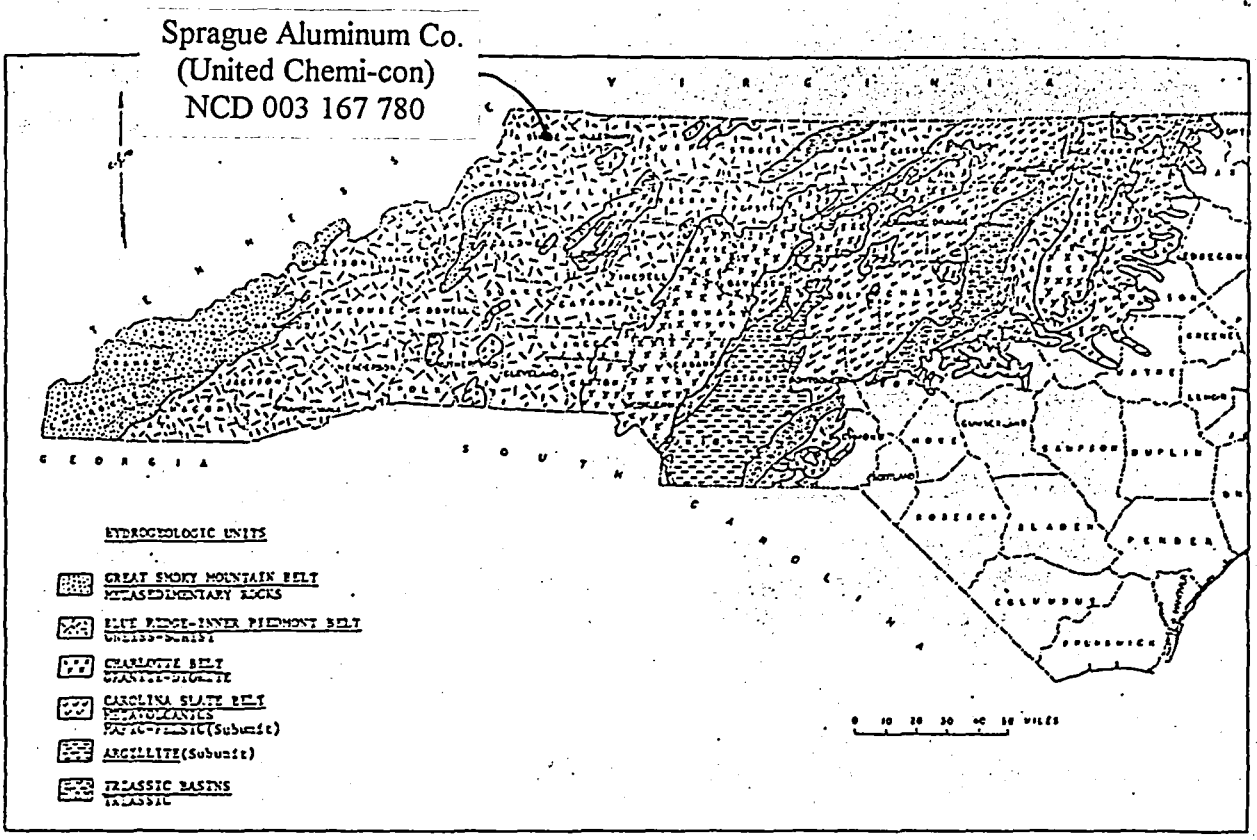


Rock Units and Aquifers in the Piedmont and Mountains



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.

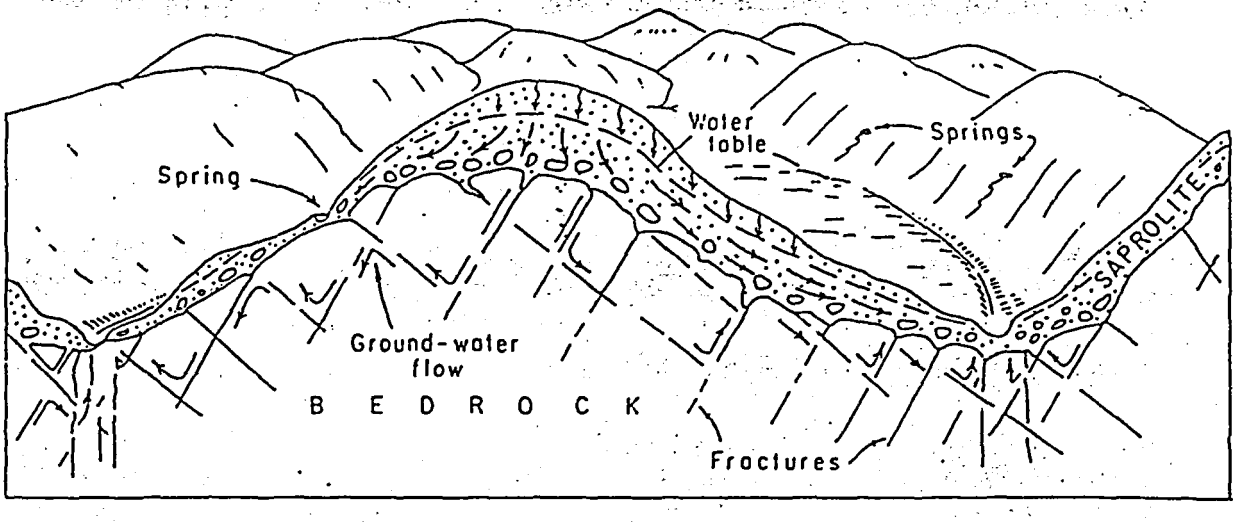
The bedrock underlying the Piedmont and mountains consists of many different types of igneous and metamorphosed igneous and sedimentary rocks. The Generalized Geological Map of North Carolina accompanying the discussion of WATER-BEARING ROCKS divides the bedrock in the Piedmont and mountains into six 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.

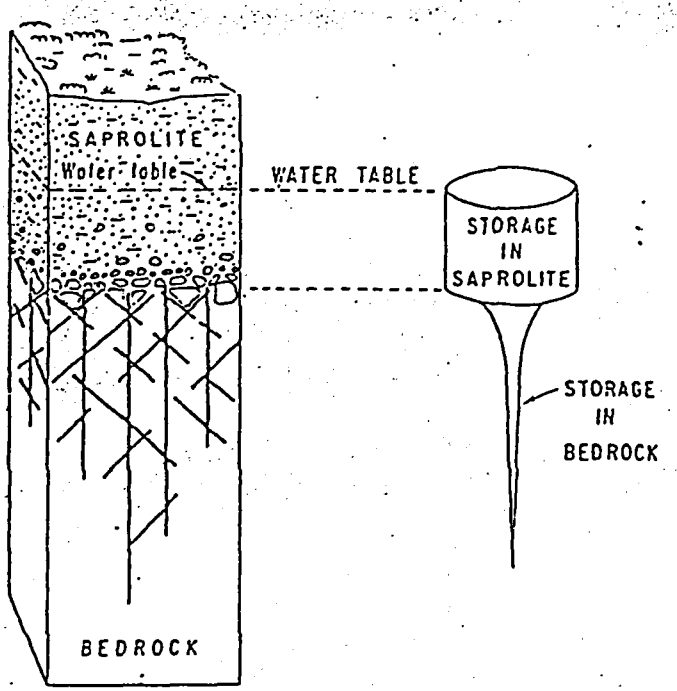
Faults are formed during earthquakes and generally contain larger and more extensive openings than those developed along joints. Joints, however, are far more numerous than faults.

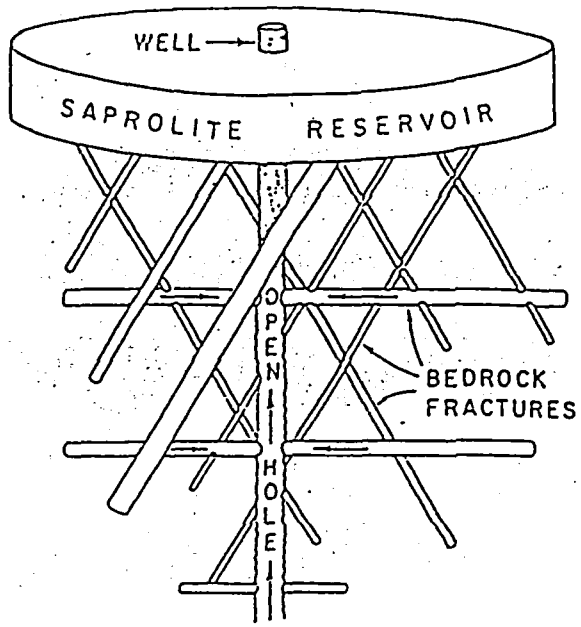
Fractures (joints and faults) are more abundant under valleys, draws, and other surface depressions than under hills. In fact, geologists assume that it is the presence of fractures that determined the position of valleys in the first place. Fractures tend to be more closely-spaced and the openings developed 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





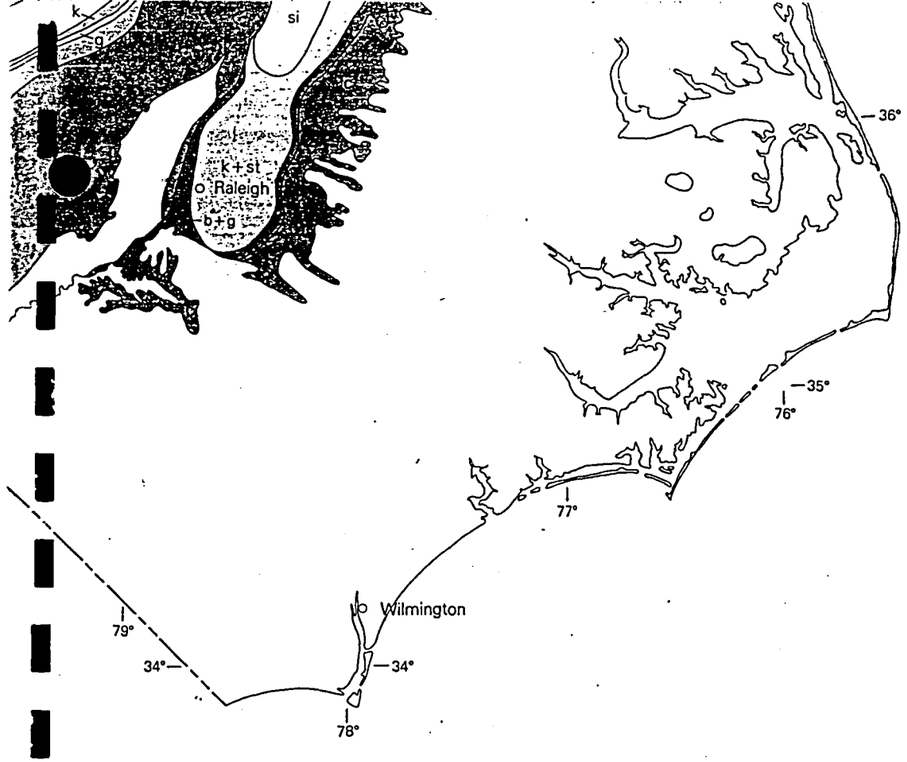
One of the most basic concepts of ground-water hydrology is that aquifers function both as reservoirs, in which water is in storage, and as pipelines, which transmit water from one point to another. This is referred to as the *reservoir-pipeline concept.* This concept forms a useful basis on which to discuss the hydraulic characteristics of the Piedmont and mountain ground-water system.

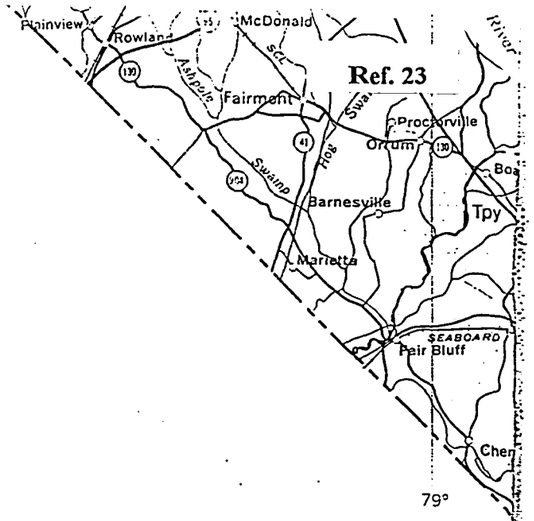
The reservoir (storage) function of aquifers depends on the porosity. The pipeline function depends on the hydraulic conductivity and the thickness of the aquifer. The approximate range in porosity and hydraulic conductivity for the saprolite and bedrock is shown in the following table.

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.





AMORPHIC FACIES

er,

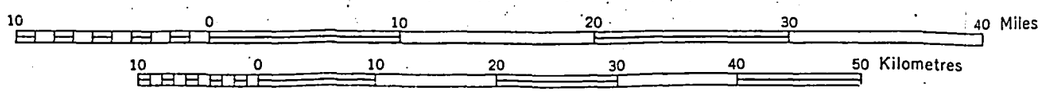
R O L I N A

GEOLOGIC MAP OF NORTH CAROLINA

1985

Scale 1:500,000

1 inch equals approximately 8 miles



MURPHY BELT

METAMORPHIC ROCKS

Zmb — MINERAL BLUFF FORMATION — Quartz-chlorite-sericite schist and phyllite with thin quartzite layers and minor interbedded graphitic schist, garnet-mica schist, staurolite schist, cross-biotite schist, and dark slate

MURPHY MARBLE, ANDREWS FORMATION, AND NOTTELY QUARTZITE, UNDIVIDED —
Murphy Marble: calcareous to dolomitic
Andrews Formation: calcareous cross-biotite schist
Nottely Quartzite: meta-orthoquartzite with slate

Zb — BRASSTOWN FORMATION — Cross-biotite schist; includes micaceous quartzite in lower part

Znt — NANTAHALA FORMATION AND TUSQUITEE QUARTZITE, UNDIVIDED
Nantahala Formation: slate and metasiltstone, dark gray, laminated to thin bedded, sulfidic
Tusquitee Quartzite: white to light yellowish gray, numerous, thin slate layers

INTRUSIVE ROCKS

AMPHIBOLITE — Equigranular, massive to well foliated, dioritic to basaltic dikes and sills; variably metamorphosed

BLUE RIDGE BELT

SEDIMENTARY AND METAMORPHIC ROCKS

Cr — ROME FORMATION — Shale and siltstone, variegated red to brown; interbedded fine-grained sandstone and shaly dolomite

SHADY DOLOMITE — Light gray, fine grained, massive, locally thin bedded or ribboned

CHILHOWEE GROUP

Ccu — UPPER CHILHOWEE — Vitreous quartz arenite, white to light gray; interbedded sandy siltstone and shale. Erwin and Hampton formations of Hot Springs window

Ccl — LOWER CHILHOWEE — Feldspathic arenite, white to yellowish gray. Minor silty shale, feldspathic siltstone, and conglomerate in lower part. Includes Unicoi Formation of Hot Springs window

OCOEE SUPERGROUP

ZwC — WALDEN CREEK GROUP, UNDIVIDED — Slate to metasiltstone, local limy beds and pods; interbedded with quartz-pebble metaconglomerate and metasandstone

Zss — SANDSUCK FORMATION — Slate and metasiltstone, dark green to black. Metaconglomerate lentils in upper part; calcareous metasandstone, sandy metalimestone, and quartzite in lower part

Zgs — GREAT SMOKY GROUP, UNDIVIDED — Thick metasedimentary sequence of massive to graded beds of metagraywacke and metasiltstone with interbedded graphitic and sulfidic slate and schist

Zd — DEAN FORMATION — Sericite schist with cross-biotite, staurolite, and garnet porphyroblasts; interbedded metagraywacke and quartz-pebble metaconglomerate

Zhha — METASANDSTONE, METAGRAYWACKE, METASILTSTONE, AND MICA SCHIST — Beds and lenses of calc-silicate rock locally abundant; garnet, staurolite, and cross-biotite porphyroblasts common in fine-grained layers. Includes Hughes Gap and Hothouse formations in southern area; Horse Branch Member of Ammons Formation and Grassy Branch Formation in northern area

WEHUTTY FORMATION — Slate to schist, dark gray, graphitic and sulfidic; includes mica schist, metagraywacke, and metaconglomerate

Zch — COPPERHILL FORMATION — Metagraywacke, massive, graded bedding common; includes dark-gray slate, mica schist, and nodular calc-silicate rock

Zchs — SLATE OF COPPERHILL FORMATION — Slate to phyllite, dark gray, graphitic, sulfidic; includes metagraywacke with local graded bedding

Zf — PHYLLITE — Dark olive gray, graphitic and sulfidic

Za — ANAKEESTA FORMATION — Slate to schist, dark gray, graphitic and sulfidic; includes interbedded argillaceous, feldspathic metagraywacke

Zbg — BOYD GAP FORMATION — Dark gray, highly-sulfidic slate and metasiltstone interbedded and gradational with metagraywacke. Stratigraphic position uncertain. In Cherokee County includes upper part of Buck Bald Formation

Zrb — RICH BUTT SANDSTONE — Feldspathic; interbedded with dark argillaceous layers and laminae. Stratigraphic position uncertain

Zs — SNOWBIRD GROUP, UNDIVIDED — Feldspathic metasiltstone, metasandstone, and phyllite. Basal schist contains lenses of quartz-pebble conglomerate

Zsp — PIGEON SILTSTONE — Thin bedded to laminated, commonly cross-bedded, metamorphosed; locally includes argillite and calcareous and ankeritic metasiltstone grading to silty metalimestone

ROARING FORK SANDSTONE — Greenish gray, fine to medium grained, locally cross-bedded, metamorphosed; interbedded metasiltstone and phyllite

LONGARM QUARTZITE — Cross-bedded, feldspathic, locally conglomeratic; includes dark slate and metasiltstone

Zz — WADING BRANCH FORMATION — Sandy slate to coarse-grained pebbly metagraywacke with local graded bedding. Basal quartz-sericite schist or phyllite

MOUNT ROGERS FORMATION

Zmf — Metafelsite (Late Proterozoic, 820 my; 26) — Light-colored porphyritic extrusive rock

Zml — Metagraywacke — Interlayered with metaconglomerate, laminated metasiltstone, and slate; minor calcareous metasandstone, green-

Zabs — ALLIGATOR BACK FORMATION

Mica schist and phyllite — Laminated to thin layered; interlayered with minor biotite-muscovite gneiss and amphibolite

Zabg — Gneiss — Finely laminated to thin layered; locally contains massive gneiss and micaceous granule conglomerate; includes schist, phyllite, and amphibolite

Amphibolite — Equigranular, massive to well foliated, interlayered, rarely discordant, metamorphosed intrusive and extrusive mafic rock; may include metasedimentary rock

ASHE METAMORPHIC SUITE AND TALLULAH FALLS FORMATION

Zatw — Metagraywacke — Foliated to massive, locally conglomeratic; interlayered and gradational with mica schist, muscovite-biotite gneiss, and rare graphitic schist

Zatm — Muscovite-biotite gneiss — Locally sulfidic; interlayered and gradational with mica schist, minor amphibolite, and hornblende gneiss

Mica schist — Locally sulfidic and graphitic; minor interlayered mica gneiss and amphibolite

Zatb — Biotite gneiss — Interlayered with biotite-garnet gneiss, biotite-muscovite schist, garnet-mica schist, and amphibolite

Amphibolite — Equigranular, massive to well foliated, interlayered, rarely discordant, metamorphosed intrusive and extrusive mafic rock; may include metasedimentary rock

Zco — COWEETA GROUP — Quartz dioritic gneiss, feldspar-quartz-biotite gneiss, metasandstone and quartzite, alumino-silicate schist, garnetiferous biotite gneiss, and minor amphibolite. Quartz dioritic gneiss predominant

ZYbn — BIOTITE GNEISS — Migmatitic; interlayered and gradational with biotite-garnet gneiss and amphibolite; locally abundant quartz and alumino-silicates. Stratigraphic position uncertain

Amphibolite — Equigranular, massive to well foliated, interlayered, rarely discordant, metamorphosed intrusive and extrusive mafic rock; may include metasedimentary rock

UNCONFORMITY

Ygg — GRANODIORITIC GNEISS (Middle Proterozoic, 1175 my; 2) — Greenish gray to pinkish gray, porphyroclastic to mylonitic; epidote, sericite, and chlorite common

Ytg — TOXAWAY GNEISS (Middle Proterozoic, 1203 my; 12) — Poorly foliated to well foliated, equigranular to inequigranular, granitic

Ybgg — BIOTITE GRANITIC GNEISS (Late to Middle Proterozoic, 950-1250 my; 14) — Pinkish gray to light gray, massive to well foliated, granitic to quartz monzonitic; includes variably mylonitized orthogneiss and paragneiss, interlayered amphibolite, calc-silicate rock, and marble. Includes granites of the Bryson City area, Straight Fork window, and Elk Park Plutonic Suite

Amphibolite — Equigranular, massive to well foliated, interlayered, rarely discordant, metamorphosed intrusive and extrusive mafic rock; may include metasedimenary rock

Ymg — MIGMATITIC BIOTITE-HORNBLENDE GNEISSES (Middle Proterozoic, 1214 my; 12) — Layered biotite-granite gneiss, biotite-hornblende gneiss, amphibolite, calc-silicate rock; locally contains relict granulite facies rock

Amphibolite — Equigranular, massive to well foliated, interlayered, rarely discordant, metamorphosed intrusive and extrusive mafic rock; may include metasedimentary rock

INTRUSIVE ROCKS

PEGMATITES (Devonian to Silurian, 390-435 my; 21) — Lenticular to tabular dikes and sills, unfoliated, granitic to granodioritic. Too small to show separately; areas of abundance and economic importance shown by pattern

TRONDHJEMITES — Postmetamorphic dikes and sills, fine-grained, locally porphyritic, weakly foliated to massive granodiorite to tonalite. Too small to show separately; areas of abundance shown by pattern

Dqd — QUARTZ DIORITE TO GRANODIORITE (Devonian, 390 my; 4) — Contains biotite, muscovite, and xenocrysts. Includes Whiteside Mountain, Stone Mountain, Mount Airy, Spruce Pine, and other smaller plutons

Org — RABUN GNEISS (Ordovician, 450-500 my; 13) — Weakly to well foliated, granitic to quartz monzonitic

META-ULTRAMAFIC ROCK — Metamorphosed dunite, local peridotite; serpentinite, soapstone, and other altered ultramafic rock. Only larger bodies shown

AMPHIBOLITE — Equigranular, massive to well foliated, dioritic to basaltic dikes and sills; variably metamorphosed

Zg — METAMORPHOSED GRANITIC ROCK (Late Proterozoic, 680-710 my; 25, 27) — Massive to foliated, locally mylonitic. Beech, Crossnore, Brown Mountain, Lansing, and other granitic rocks

Zm — MAX PATCH GRANITE — Mottled pink and light green, coarse grained to porphyritic, massive; contains biotite

BAKERSVILLE METAGABBRO (Late Proterozoic, 734 my; 16) — Thin dikes and sills. Not shown separately; areas of abundance shown by pattern

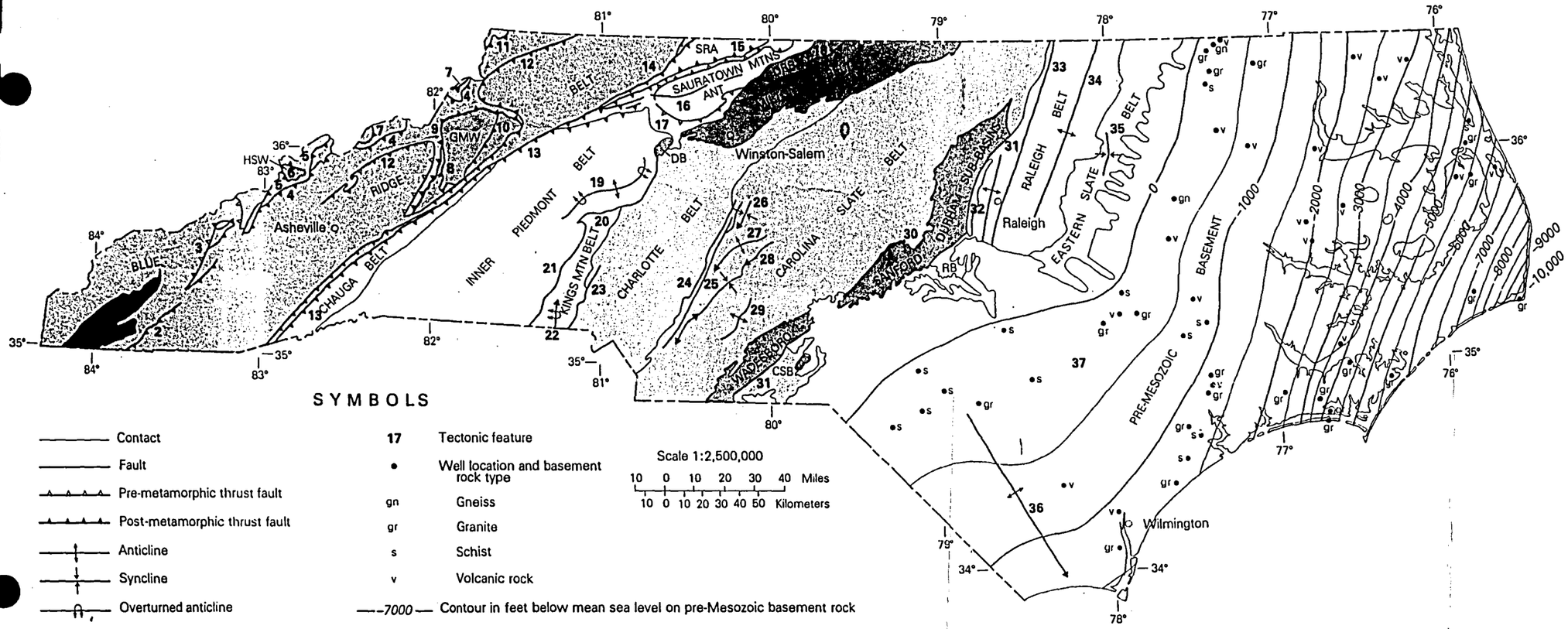
Sprague Aluminum Co.
(United Chemi-con)
NCD 003 167 780

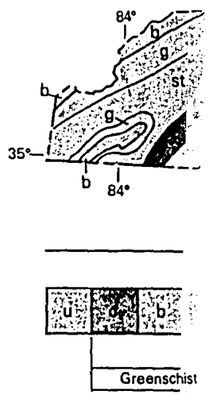
81°

G E O R G I A

EXPLANATION

- MURPHY BELT
- HSW — HOT SPRINGS WINDOW
- GMW — GRANDFATHER MOUNTAIN WINDOW
- SRA — SMITH RIVER ALLOCHTHON
- BLUE RIDGE BELT
- CHAUGA BELT
- INNER PIEDMONT BELT
- KINGS MOUNTAIN BELT
- SAURATOWN MOUNTAINS ANTICLINORIUM
- CHARLOTTE BELT
- MILTON BELT
- CSB — CAROLINA SLATE BELT
- TRIASSIC BASINS
  - DURHAM, SANFORD } SUB-BASINS
  - WADESBORO BASIN
  - DAN RIVER BASIN (DRB)
  - DAVIE BASIN (DB)
- RB — RALEIGH BELT
- EASTERN SLATE BELT





SYMBOLS

- Contact
- Fault
- Pre-metamorphic thrust fault
- Post-metamorphic thrust fault
- Anticline
- Syncline
- Overturned anticline
- Direction of plunge
- 17 — Tectonic feature
- • — Well location and basement rock type
- gn — Gneiss
- gr — Granite
- s — Schist
- v — Volcanic rock
- —7000— Contour in feet below mean sea level on pre-Mesozoic basement rock

Scale 1:2,500,000

10 0 10 20 30 40 Miles

10 0 10 20 30 40 50 Kilometers

MAP SHOWING MAJOR LITHO-TECTONIC FEATURES

REFERENCES FOR TECTONIC FEATURES

1. Mary King Mountain fault

10. Unnamed fault and
11. Unnamed fault

18. Dan River fault
Stone, R.W., 1912, Coal on Dan River, North Carolina:

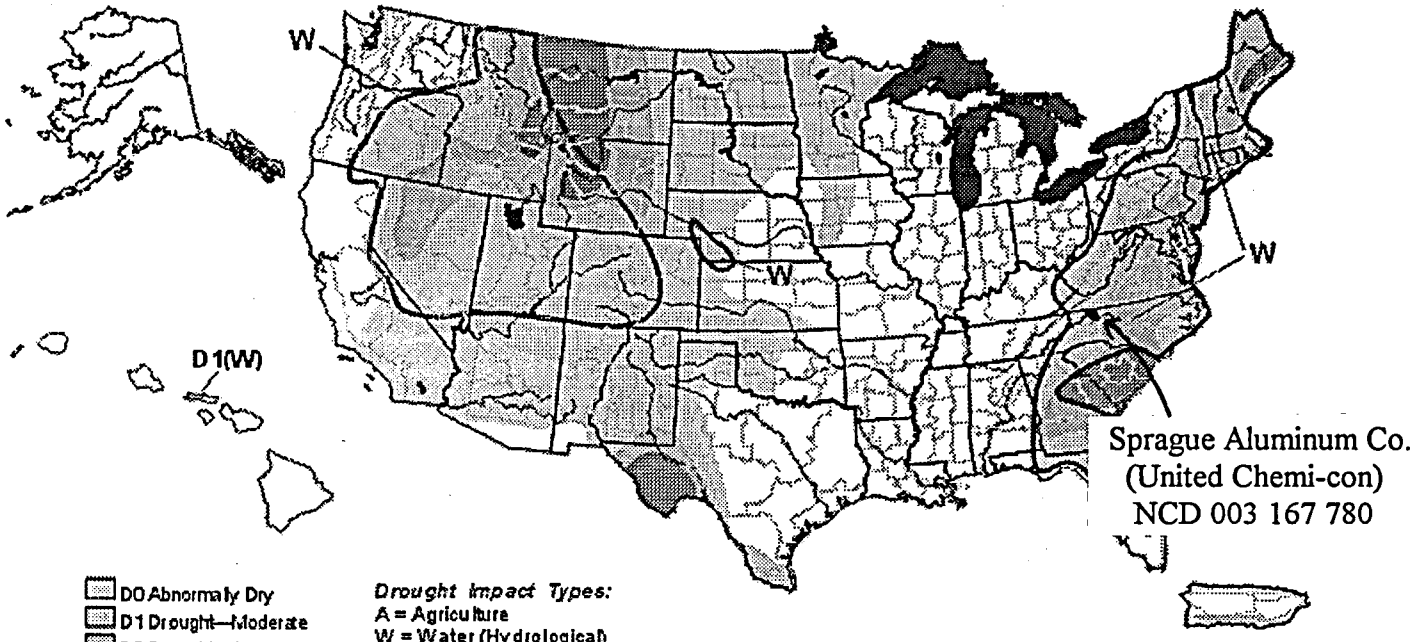
28. New London syncline and
29. Troy anticline
Conley, J.F., 1962, Geology of the Albemarle Quad-

Ref. 24

The data cutoff for Drought Monitor maps is Tuesday at 8 a.m. Eastern Standard Time. The maps, which are based on analysis of the data, are released each Thursday at 8:30 a.m. Eastern Time.

U.S. Drought Monitor

February 12, 2002
Valid 8 a.m. EST



D0 Abnormally Dry
D1 Drought—Moderate
D2 Drought—Severe
D3 Drought—Extreme
D4 Drought—Exceptional

Drought Impact Types:
A = Agriculture
W = Water (Hydrological)
F = Fire danger (Wildfires)
Delineates dominant impacts
(No type = All3 impacts)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/monitor/monitor.html

Released Thursday, February 14, 2002
Author: Mark Svoboda, NDMC

Click on the icons below for animated maps.

6 weeks.....12 weeks

The drought indicators that are synthesized into the Drought Monitor map are on this website, under Forecasts and Current Conditions.
This summary map is based on a multi-index drought classification scheme.
For local details and impacts, please contact your State Climatologist or Regional Climate Center.
Other Drought Monitoring Links
Contact People

National Drought Summary -- February 12, 2002

The East: The New England area welcomed beneficial precipitation last week (0.5 to 1 inch or more) as a storm swept across New York, Vermont, New Hampshire and Maine. Things are still very dry, however, and impacts continue to be felt as wells and streams continue to lag in their recovery. Although the recent wetness has helped, it has only served to stave off the deteriorating conditions found throughout the region. Consequently, the drought depiction on the map remains virtually unchanged in this region.

A little farther south in the Mid-Atlantic, things have again started to worsen after a recent brief reprieve. Moderate (D1) and severe (D2) drought conditions have again expanded north and west out of Virginia and into Maryland, Pennsylvania and West Virginia. A drought emergency was announced this week for several counties in southern and eastern Pennsylvania, while counties in southeastern New York and western New Jersey are under a drought warning. Unfortunately, high pressure has been pushing recent storms either just to the south or to the north of this region.

The Southeast: A strong winter storm passed through the South and Southeast early last week, bringing with it snow and rain. In general, 1 to 2 inches or more fell across Alabama, Georgia, and the Carolinas. Although this has been welcome in the moderate (D1), severe (D2) and extreme (D3) drought-affected areas, it is by no means a signal that the region has rid itself of the drought. Even after the recent rains, long-term and short-term deficits remain in Georgia and the Carolinas, with amounts running 2 to 4 inches below normal during the winter months alone. In addition, long-term impacts are still being felt after 4 years of drought in the region. Parts of Georgia, northern Florida and South Carolina have seen deficits on the order of 6 to 9 inches over the October 1, 2001, to February 11, 2002, time period.

The Plains and Midwest: Another strong storm swept through the Plains and up into the Great Lakes, but the heavy snow didn't really materialize in the drought-affected areas. The story was the wind and the speed at which it passed through. Concerns about the effects of this winter's wind and dryness on the winter wheat is warranted given the general lack of snow cover from both a moisture and protection standpoint.

After heavy rains the week before, parts of southern Oklahoma and western and northern Texas saw the recent wet trend continue last week. In general, drought conditions continue to improve in the region and, as a result, these areas have seen a reduction in both the intensity and spatial extent of the drought.

Conditions continue to worsen with each passing week this winter in parts of western Nebraska, the Dakotas and Minnesota. Last week's storm brought a lot of wind but not much snow, leaving most areas of these states high and dry. Moderate (D1) drought has now expanded through the Nebraska Panhandle and into the southwestern part of the state. Abnormally (D0) dry conditions retreated a little in southeastern South Dakota and northeastern Nebraska where precipitation amounts were more favorable. At the same time, abnormally (D0) dry conditions have now expanded to cover all of North Dakota.

The West: In the West, the "rich got richer and the poor got poorer" as all but the Pacific NW saw another dry week. High Santa Ana winds over the weekend and an abnormally dry winter wet season have led to heightened concerns of fire in southern California and the Desert Southwest. Snowpacks are very low and continue to fall near or below 50% of average over a great deal of the Intermountain West and Desert Southwest basins. Accompanying the low snowpack are lagging snow water equivalent values and precipitation amounts. Since October 1, 2001, virtually all of Arizona and southern California have

seen less than half of their normal precipitation (or more), with deficits generally running on the order of 2 to 6 inches. As a result, abnormally (D0) dry conditions continue to expand in Arizona and southern California while Arizona has also seen moderate (D1) drought conditions creep into the northern reaches of the state. Better news is to be had in the north, where the continued storm track through the Pacific NW has led to an improvement in eastern Washington, and the Idaho Panhandle, where a retreat of the abnormally (D0) dry and moderate (D1) drought areas is now evident. Snowpack, snow water equivalent and streamflow forecasts are showing above-normal levels across the board in this area.

Hawaii and Puerto Rico: A quiet week followed the generous rains of the past few weeks in Hawaii with the moderate (D1 W) drought there being more of a long-term water supply issue for future user/producer demands, rather than a direct short-term dryness impact on agriculture. This led to a shift from A (agricultural) to a W (hydrological) label on the island of Molokai. There are no changes to Puerto Rico this week.

Looking Ahead: Weather features to watch in the next 2 weeks that may affect areas experiencing dryness include: 1) high pressure should dominate the weather picture across most of the country through the weekend and into early next week, leading to above-normal temperatures (especially in the northern Plains) and little in the way of precipitation in all but the Pacific NW and parts of the Southeast (FL and GA), where cooler temperatures and rains/snow are expected; 2) looking out past the next 5 days shows a general trend toward above-normal precipitation across the northern half of the country along with above-normal temperatures; 3) expect cooler and wetter conditions to prevail over the Pacific NW over the next week or so, and the Rio Grande basin should see better odds of below-normal precipitation over the same time frame; 4) ridging should keep Hawaii pretty quiet and dry for the most part over the next week or so.

Author: Author: Mark Svoboda, National Drought Mitigation Center

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Ref. 25

Subject: Re: PWS data source listing
Date: Tue, 19 Feb 2002 16:15:13 -0500
From: Martha M Fillinger <Martha.Fillinger@ncmail.net>
Organization: NC DENR
To: Stuart Parker <Stuart.Parker@ncmail.net>

There are two transient non-community ground water systems in this area:

PWSID	System Name	PWS_TYPE	RTL_POP	SourceName	SRC_TYPE	SRC_AVL	SRC_LAT	SRC_LONG
0105482	RIVER HOUSE BED & BREAKFAST	N	30	WELL #1	G	P	363046.310	812432.910
0105484	RIVERSIDE INC	N	25	WELL #1	G	P	363011.806	812327.666

Stuart Parker wrote:

> Hello Martha,
>
> I see the on-line data review is still unavailable. I was interested in a small area (mainly to rule out surface source intakes). The boundary coordinates are as follows:
>
> North 36 deg, 29', 30" to 36 deg, 31', 30"
>
> West 81 deg, 23', 00" to 81 deg, 26', 30"
>
> Thank you,
>
> Stuart Parker,
> NC Superfund Section

Martha M Fillinger <Martha.Fillinger@ncmail.net>
Applications Analyst/Programmer
Public Water Supply Section
DENR, Division of Environmental Health

SPRAGUE ALUMINUM
NCD 003 167 780
Lansing, NC

NCDENR Public Water Supply database (edited):

For: SF Parker,
NC Superfund Section
Date: July 27, 2001
Lat: 36°25'00" to 36°32'30"; Longitude: 81°25'30" to 81°35'00"

OUT	0105015	JEFFERSON, TOWN OF	C	1582	3362462165	WELL #6	G E	362503.864 812737.371
1A	0105020	LANSING, TOWN OF	C	200	3363843938	WELL #5	G P	362949.253 813037.383
1B	0105020	LANSING, TOWN OF	C	200	3363843938	WELL #7	G P	363009.290 813030.410
	~~0105400~~	~~FAMILY CENTRAL~~	~~N~~	~~60~~	~~3362463234~~	~~WELL #1~~	~~G P~~	~~362550.111 812606.029~~
	~~0105400~~	~~FAMILY CENTRAL~~	~~N~~	~~60~~	~~3362463234~~	~~WELL #2~~	~~G P~~	~~362548.651 812605.451~~
	~~0105400~~	~~FAMILY CENTRAL~~	~~N~~	~~60~~	~~3362463234~~	~~WELL #3~~	~~G P~~	~~362553.142 812606.893~~
2	0105406	ASHE COUNTY M SCH	P	450	3362467175	WELL #1	G P	362746.681 813030.369
	~~0105414~~	~~ASHE COUNTY PARK~~	~~N~~	~~25~~	~~3369829828~~	~~WELL #1~~	~~G P~~	~~362616.081 812823.330~~
	~~0105417~~	~~ASHELAWN MEM GDNS~~	~~N~~	~~25~~	~~3369822121~~	~~WELL #1~~	~~G P~~	~~362616.782 812547.812~~
	~~0105439~~	~~ELDRETH REST & MOTEL~~	~~N~~	~~200~~	~~3362468845~~	~~WELL #1~~	~~G P~~	~~362514.010 812720.010~~
3	0105441	UNITED CHEMI-CON	P	450	3363842551	WELL #1	G P	362849.711 813022.872
	~~0105470~~	~~NCARNG JEFFRSN ARM~~	~~N~~	~~25~~	~~3369823777~~	~~WELL #1~~	~~G P~~	~~362600.897 812758.024~~
	~~0105474~~	~~BLEVINS STORE~~	~~N~~	~~25~~	~~3369822854~~	~~WELL #1~~	~~G P~~	~~362811.041 812621.848~~
	~~0105476~~	~~ISABEL'S KITCHEN~~	~~N~~	~~50~~	~~3362462714~~	~~WELL #1~~	~~G P~~	~~362529.222 813002.033~~
	~~0105479~~	~~J R'S GROCERY & PRDCE~~	~~N~~	~~50~~	~~3362464938~~	~~WELL #1~~	~~G P~~	~~362547.780 813020.656~~
	~~0105487~~	~~SHELBY'S RESTAURANT~~	~~N~~	~~75~~	~~3363841222~~	~~WELL #1~~	~~G P~~	~~362732.717 813059.759~~
	~~0105492~~	~~NORTHWEST FOOD MKT~~	~~N~~	~~25~~	~~3363842229~~	~~WELL #1~~	~~G P~~	~~362733.539 813057.887~~
4	0105500	DOT-SMETHPORT MAINT	P	50	3366679111	WELL	G P	362554.372 813053.586
5A	0105503	BLUE RIDGE ELEM SCH	P	550	3362467175	WELL #1	G P	362745.822 813152.277
5B	0105503	BLUE RIDGE ELEM SCH	P	550	3362467175	WELL #2	G P	362737.765 813151.403
	~~0105511~~	~~MOUNTAIN GROCERY~~	~~N~~	~~25~~	~~3363844204~~	~~WELL 1~~	~~G P~~	~~362736.766 813108.439~~

Ref. 26

Ref. 27

Profiles of General Demographic Characteristics 2000

Issued May 2001

2000 Census of Population and Housing

North Carolina

U.S. Department of Commerce
Donald L. Evans,
Secretary

Economics and Statistics Administration
J. Lee Price,
Acting Under Secretary for Economic Affairs

U.S. CENSUS BUREAU
William G. Barron, Jr.,
Acting Director

Table DP-1. Profile of General Demographic Characteristics: 2000

Geographic Area: Ashe County, North Carolina

[For information on confidentiality protection, nonsampling error, and definitions, see text]

Subject	Number	Percent
Total population	**24,384**	**100.0**
SEX AND AGE		
Male	12,031	49.3
Female	12,353	50.7
Under 5 years	1,295	5.3
5 to 9 years	1,295	5.3
10 to 14 years	1,358	5.6
15 to 19 years	1,439	5.9
20 to 24 years	1,269	5.2
25 to 34 years	2,950	12.1
35 to 44 years	3,644	14.9
45 to 54 years	3,728	15.3
55 to 59 years	1,572	6.4
60 to 64 years	1,457	6.0
65 to 74 years	2,328	9.5
75 to 84 years	1,490	6.1
85 years and over	559	2.3
Median age (years)	42.1	(X)
18 years and over	19,557	80.2
Male	9,524	39.1
Female	10,033	41.1
21 years and over	18,764	77.0
62 years and over	5,207	21.4
65 years and over	4,377	18.0
Male	1,853	7.6
Female	2,524	10.4
RACE		
One race	24,248	99.4
White	23,691	97.2
Black or African American	162	0.7
American Indian and Alaska Native	79	0.3
Asian	57	0.2
Asian Indian	13	0.1
Chinese	7	-
Filipino	9	-
Japanese	9	-
Korean	9	-
Vietnamese	-	-
Other Asian [1]	10	-
Native Hawaiian and Other Pacific Islander	2	-
Native Hawaiian	1	-
Guamanian or Chamorro	-	-
Samoan	-	-
Other Pacific Islander [2]	1	-
Some other race	257	1.1
Two or more races	136	0.6
Race alone or in combination with one or more other races: [3]		
White	23,821	97.7
Black or African American	185	0.8
American Indian and Alaska Native	146	0.6
Asian	67	0.3
Native Hawaiian and Other Pacific Islander	6	-
Some other race	303	1.2

Subject	Number	Percent
HISPANIC OR LATINO AND RACE		
Total population	**24,384**	**100.0**
Hispanic or Latino (of any race)	590	2.4
Mexican	440	1.8
Puerto Rican	16	0.1
Cuban	26	0.1
Other Hispanic or Latino	108	0.4
Not Hispanic or Latino	23,794	97.6
White alone	23,440	96.1
RELATIONSHIP		
Total population	**24,384**	**100.0**
In households	24,083	98.8
Householder	10,411	42.7
Spouse	6,184	25.4
Child	5,964	24.5
Own child under 18 years	4,450	18.2
Other relatives	851	3.5
Under 18 years	293	1.2
Nonrelatives	673	2.8
Unmarried partner	318	1.3
In group quarters	301	1.2
Institutionalized population	235	1.0
Noninstitutionalized population	66	0.3
HOUSEHOLD BY TYPE		
Total households	**10,411**	**100.0**
Family households (families)	7,422	71.3
With own children under 18 years	2,726	26.2
Married-couple family	6,184	59.4
With own children under 18 years	2,116	20.3
Female householder, no husband present	877	8.4
With own children under 18 years	429	4.1
Nonfamily households	2,989	28.7
Householder living alone	2,685	25.8
Householder 65 years and over	1,257	12.1
Households with individuals under 18 years	2,957	28.4
Households with individuals 65 years and over	3,129	30.1
Average household size	2.31	(X)
Average family size	2.75	(X)
HOUSING OCCUPANCY		
Total housing units	**13,268**	**100.0**
Occupied housing units	10,411	78.5
Vacant housing units	2,857	21.5
For seasonal, recreational, or occasional use	1,974	14.9
Homeowner vacancy rate (percent)	1.7	(X)
Rental vacancy rate (percent)	9.8	(X)
HOUSING TENURE		
Occupied housing units	**10,411**	**100.0**
Owner-occupied housing units	8,428	81.0
Renter-occupied housing units	1,983	19.0
Average household size of owner-occupied units	2.32	(X)
Average household size of renter-occupied units	2.30	(X)

- Represents zero or rounds to zero. (X) Not applicable.

[1] Other Asian alone, or two or more Asian categories.

[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.

[3] In combination with one or more of the other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.

Source: U.S. Census Bureau, Census 2000.

MEMORANDUM

To: File
From: Stuart F. Parker, Hydrogeologist
Date: February 15, 2002
Subject: Sprague Aluminum
NCD 003 167 780
Groundwater Targets

SFP updated potential groundwater target data on this site by performing a house count on USGS base. The Jefferson, NC 7-1/2 minute topographic quadrangle was photorevised in 1998, but the other quadrangles were the same as at the time of the 1991 SSI and 1993 SIP reports. SFP also obtained updated municipal/community well data from the NC Division of Water Quality, Public Water Supply Section. Based on these data, and the year 2000 Census Mean Household Population (2.32) in Ashe County, the following groundwater population was derived:

Radial Distance (miles):	Residence Count	Residential Well Population	Community Well Population	Total Radial Population
> 0.0 - 0.25	9	21	450	471
> 0.25 - 0.5	41	95	0	95
> 0.5 - 1.0	102	237	0	237
> 1.0 - 2.0	264	612	650	1262
> 2.0 - 3.0	411	954	550	1504
>3.0 - 4.0	837	1942	50	1992
Total:		3861	1700	5561

SFP also reviewed the State Government website *http://www.deh.enr.state.nc.us/pws/wellhead/update/approved_wellhead_plans.htm*, to determine whether wellhead protection areas existed near the site. The nearest approved WHPAs were in Jefferson and West Jefferson, NC, both outside the study area.

MEMO

TO: Superfund Section Staff

FROM: Melanie Bryson
Environmental Engineer
NC Superfund Section

DATE: October 1, 2001

SUBJECT: Update on Status of Wellhead Protection Programs in N.C.

I received an email from Mr. Gale Johnson, Public Water Supply (919) 715-2853, with an updated list of Approved Wellhead Protection Programs in N.C. Only one, Williamston, has been added since May 1, 2001.

Copies of some wellhead protection area maps are located on the PWS website at:

http://www.deh.enr.state.nc.us/pws/wellhead/update/wellhead_protection_program.htm

Through the above-mentioned website, you may also view a list of the approved wellhead protection plans as well as guidance as to what the plans require. Please note, however, that the list located on the PWS website has not been updated.

PWS has copies of all the sites in their files maintained on topo maps, which they are in the process of slowly transferring to GIS format.

Ref. 29

LEAD AND COPPER MONITORING SUMMARY REPORT

MAIL TO: W. E. Venrick, Chief
Public Water Supply Section
Post Office Box 29536
Raleigh, North Carolina 27626-0536

SAMPLE SITE JUSTIFICATION/COLLECTION METHOD CERTIFICATION

System Name: UNITED CHEMI-CON

Type: ☐ CWS ☐ NTNCWS

Address: 185 McNeil Rd.
Lansing, NC 28643

Size:
- ☐ >100,000
- ☐ 10,001 to 100,000
- ☐ 3,301 to 10,000
- ☐ 501 to 3,300
- ☒ 101 to 500
- ☐ ≤100

Telephone number: 910-384-2551
System ID #: 01-05-441
Contact Person: James E. Egner

THE SUMMARY REPORT OF LEAD & COPPER TAP WATER SAMPLES MUST BE ATTACHED TO THIS DOCUMENT

# of tap samples required 5 # of tap samples submitted 5

TARGETING CRITERIA

# of single-family structures with copper pipes with lead solder installed between 1982 and 1987 or lead pipes and/or lead service lines (*Tier 1*)	2
# of multi-family structures with copper pipes with lead solder installed between 1982 and 1987 or lead pipes and/or lead service lines:	
If multi-family residences make up over 20 percent of the total service connections (*Tier 1*)	
If multi-family residences make up 20 percent or less of the total service connections (*Tier 2*)	
# of buildings containing copper pipes with lead solder installed between 1982 and 1987 or lead pipes and/or lead service lines (*Tier 2*)	1
# of sites that contain copper pipes with lead solder installed before 1983 (to be used only if first condition has been exhausted) (*Tier 3*)	2
# of sites with plastic plumbing and brass faucets (*Exceptional Case F-1*)	
# of sites with water softeners (*Exceptional Case F-2*)	
TOTAL	5

Explanation of Tier 2, Tier 3, and Exceptional sites (attach additional pages if necessary):

LEAD SERVICE LINE SITES

of samples required to be drawn from lead service line sites

# of samples actually drawn from lead service line sites

Difference (explain differences other than zero)

Method used to identify lead service line sites (attach additional pages if necessary):

RECEIVED SEP - 2 1997 PUBLIC WATER SUPPLY

LEAD AND COPPER 90th PERCENTILE SUMMARY[1]

Public Water System ID#: 01-05-441 Date: 8-5-97

Name of System: UNITED CHEMI-CON

Summary of ~~Six Months~~ Annual Period Beginning: 1997

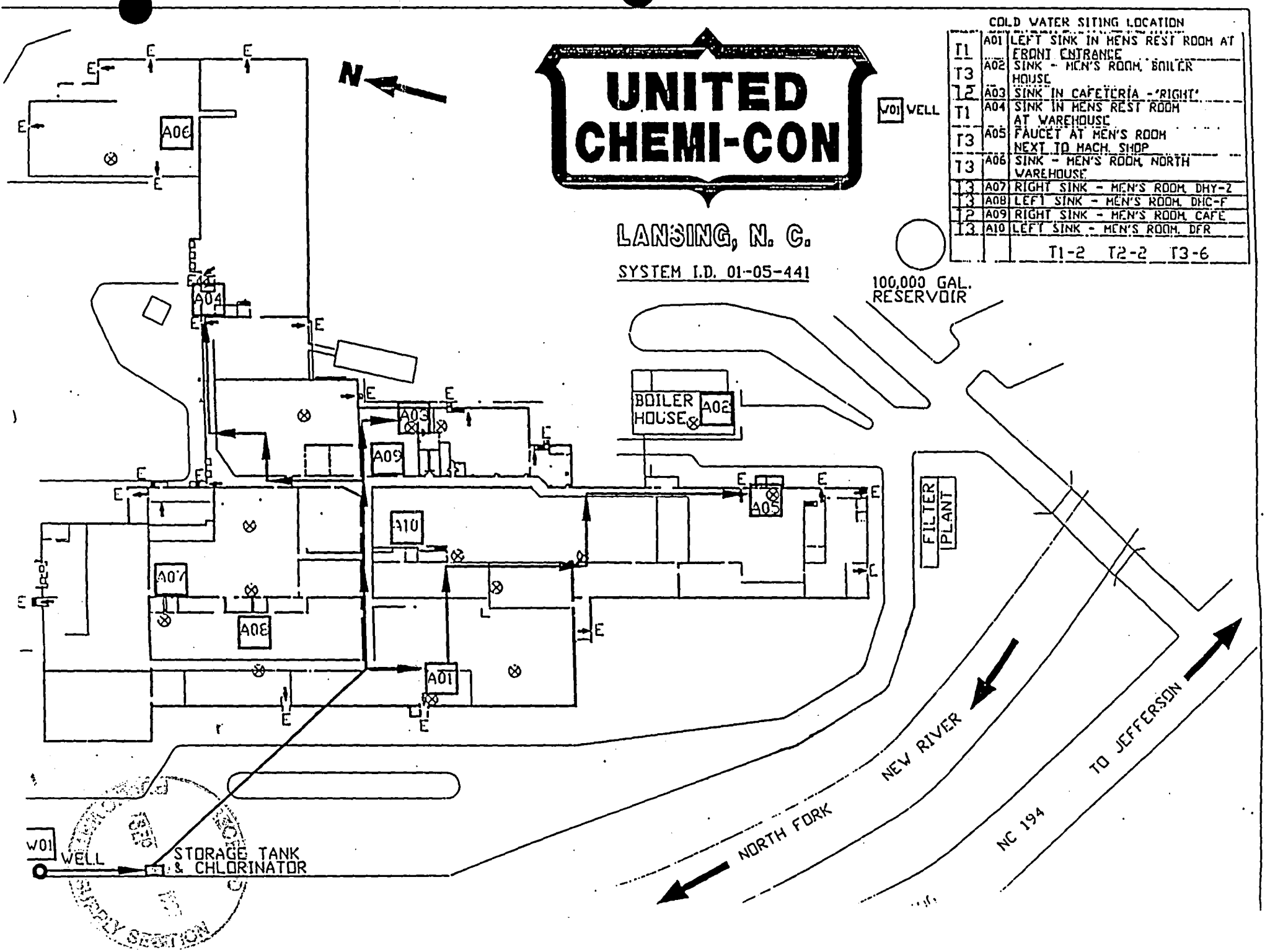
LEAD SAMPLES			
90th Percentile Level = .002			
No.	Location[3] Code	Target Category	Lead[2] mg/l
1	A01	T1	<.002
2	A03	T2	<.002
3	A07	T3	<.002
4	A10	T3	<.002
5	A04	T1	.003

COPPER SAMPLES			
90th Percentile Level = .0385			
No.	Location[3] Code	Target Category	Copper[2] mg/l
1	A03	T2	.007
2	A10	T3	.008
3	A01	T1	.015
4	A07	T3	.033
5	A04	T1	.044

[1] 90th Percentile Level = Concentration in the sample with sequence number yielded by 0.09 x number of samples. (Only 10% of the samples have higher lead or copper values.)

[2] Arrange in ascending order. (Place results of all lead or copper samples taken during a six-month period in order from the sample with the lowest concentration at the top to the sample with the highest concentration at the bottom.) Attach additional pages if necessary.

[3] Attach a location code key showing the alphanumeric location code in descending order and the corresponding address of the sample site.


UNITED CHEMI-CON
LANSING, N. C.
SYSTEM I.D. 01-05-441
N
COLD WATER SITING LOCATION
T1 A01 LEFT SINK IN MENS REST ROOM AT FRONT ENTRANCE
T3 A02 SINK - MEN'S ROOM, BOILER HOUSE
T2 A03 SINK IN CAFETERIA - 'RIGHT'
T1 A04 SINK IN MENS REST ROOM AT WAREHOUSE
T3 A05 FAUCET AT MEN'S ROOM NEXT TO MACH. SHOP
T3 A06 SINK - MEN'S ROOM, NORTH WAREHOUSE
T3 A07 RIGHT SINK - MEN'S ROOM, DHY-2
T3 A08 LEFT SINK - MEN'S ROOM, DHC-F
T2 A09 RIGHT SINK - MEN'S ROOM, CAFE
T3 A10 LEFT SINK - MEN'S ROOM, DFR
T1-2 T2-2 T3-6
W01 WELL
100,000 GAL. RESERVOIR
BOILER HOUSE
FILTER PLANT
NEW RIVER
NORTH FORK
NC 194
TO JEFFERSON
W01 WELL
STORAGE TANK & CHLORINATOR

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(910) 766-7846
Fax (910) 766-2314

JUL 1 3 1995

068138

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3
WATER SYSTEM ID#: 0 1 - 0 5 - 4 4 1 COUNTY: Ashe
NAME OF SYSTEM: United Chemi-Con
SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)
MONITORING TYPE: (1) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)
SAMPLE TYPE: (1) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)
Collected on: DATE 0 6/2 1/9 5 (MM/DD/YY) TIME: 0 8:2 0 A M (HH:MM AM or PM
Location Where Collected: Sink in Cafeteria "right"
Location Code: A 0 3 Entry Point (w) Y,N Collected By: Jackie D Hremale (signature)
Sample Site Type: (2) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:

United Chemi-Con
185 McNeil Rd
Sparta NC 28643
TELEPHONE # (910) 384-2551

FIRST DRAW CERTIFICATION: ☒ YES ☐ NO

"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☒ YES ☐ NO

"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	125	.034
1030	Lead, mg/l	125	<.002
1016	Calcium, mg/l	101	
1044	Orthophosphate, mg/l	162	
1049	Silica, mg/l		
1064	Conductivity, µmhos/cm	145	
1925	pH, units	135	
1927	Alkalinity, mg/l	142	
1996	Water Temperature, °C	130	

TYPE TREATMENT:
( ) NONE
(X) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

( ) SAMPLE UNSATISFACTORY
Date Analyses Begun: 6/29/95
Date Analyses Completed: 6/30/95
Laboratory Log #: 76517
COMMENTS: Rec'd 6/21/95 @ 335

( ) RESAMPLE REQUESTED
Time Analyses Begun: 1:30 P M
Time Analyses Completed: 8:30 P M
Certified By: [signature]

RECEIVED JUL 7 1995 PUBLIC WATER SUPPLY SECTION

205

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(910) 766-7846
Fax (910) 766-2314

068133

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3
WATER SYSTEM ID#: 0 1 - 0 5 - 4 4 1 COUNTY: Ashe
NAME OF SYSTEM: United Chemi-Con
SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)
MONITORING TYPE: (1) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)
SAMPLE TYPE: (1) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)
Collected on: DATE 0 6 / 2 1 / 9 5 (MM/DD/YY) TIME: 0 8 : 4 0 A M (HH:MM AM or PM)
Location Where Collected: Sink - Mens Room - Boiler House
Location Code: A 0 2 Entry Point (✓) Y,N Collected By: [signature] (signature)
Sample Site Type: (3) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:

United Chemi-Con
185 McNeil Rd
Lansing NC 28643

TELEPHONE # (910) 384-2551

FIRST DRAW CERTIFICATION: ☒ YES ☐ NO

"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☒ YES ☐ NO

"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	101	.087
1030	Lead, mg/l	125	<.002
1016	Calcium, mg/l	101	
1044	Orthophosphate, mg/l	162	
1049	Silica, mg/l		
1064	Conductivity, µmhos/cm	145	
1925	pH, units	135	
1927	Alkalinity, mg/l	142	
1996	Water Temperature, °C	130	

TYPE TREATMENT:
( ) NONE
(X) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

RECEIVED JUL 7 1995 PUBLIC WATER SUPPLY SECTION

( ) SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED

Date Analyses Begun: 6/23/95 Time Analyses Begun: 11:00A M
Date Analyses Completed: 6/30/95 Time Analyses Completed: 2:30P M
Laboratory Log #: 76518 Certified By: [signature]
COMMENTS: Rec'd 6/21 @ 335

705

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(910) 766-7846
Fax (910) 766-2314

JUL 15 1995

068140

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3
WATER SYSTEM ID#: 0 1 - 0 5 - 4 4 1 COUNTY: Ashe
NAME OF SYSTEM: United Chemi-Con
SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)
MONITORING TYPE: (1) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)
SAMPLE TYPE: (1) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)
Collected on: DATE 0 6 / 2 1 / 9 5 (MM/DD/YY) TIME: 0 9 : 1 0 A M (HH:MM AM or PM
Location Where Collected: Right Sink - Mens Room DHY-Z
Location Code: A 0 7 Entry Point (✓) Y,N Collected By: Leslie D Hammack (signature)
Sample Site Type: (3) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:
United Chemi-Con
185 McNeil Rd
Jonesville NC 28643
TELEPHONE # (910) 364-2551

FIRST DRAW CERTIFICATION: ☒ YES ☐ NO
"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☒ YES ☐ NO
"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	101	.078
1030	Lead, mg/l	125	<.002
1016	Calcium, mg/l	101	---.---
1044	Orthophosphate, mg/l	162	---.---
1049	Silica, mg/l	---	---.---
1064	Conductivity, µmhos/cm	145	---.---
1925	pH, units	135	---.---
1927	Alkalinity, mg/l	142	---.---
1996	Water Temperature, °C	130	---.---

TYPE TREATMENT:
( ) NONE
(✓) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

RECEIVED JUL 7 1995 PUBLIC WATER SUPPLY SECTION

( ) SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED
Date Analyses Begun: 6/29/95 Time Analyses Begun: 11:00A M
Date Analyses Completed: 6/30/95 Time Analyses Completed: 12:30P M
Laboratory Log #: 76520 Certified By: [signature]
COMMENTS: Rec'd 6/21 @ 335

705

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(910) 766-7846
Fax (910) 766-2314

JUL 13 1995

068141

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3
WATER SYSTEM ID#: 0 1 - 0 5 - 4 4 1 COUNTY: Ashe
NAME OF SYSTEM: United Chemi-Con
SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)
MONITORING TYPE: (1) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)
SAMPLE TYPE: (1) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)
Collected on: DATE 06/21/95 (MM/DD/YY) TIME: 09:00 AM (HH:MM AM or PM
Location Where Collected: LeFt Sink - Men's Room - DFR
Location Code: A 1 0 Entry Point (Y) Y,N Collected By: [signature] (signature)
Sample Site Type: (3) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:

United Chemi-Con
185 McNeill Rd
Lansing NC 28643

TELEPHONE # (910) 384-2551

FIRST DRAW CERTIFICATION: ☑ YES ☐ NO

"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☑ YES ☐ NO

"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	125	.016
1030	Lead, mg/l	125	<.002
1016	Calcium, mg/l	101	
1044	Orthophosphate, mg/l	162	
1049	Silica, mg/l		
1064	Conductivity, µmhos/cm	145	
1925	pH, units	135	
1927	Alkalinity, mg/l	142	
1996	Water Temperature, °C	130	

TYPE TREATMENT:
( ) NONE
(X) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

RECEIVED JUL 7 1995 PUBLIC WATER SUPPLY SECTION

( ) SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED

Date Analyses Begun: 6/29/95 Time Analyses Begun: 1:30P M
Date Analyses Completed: 6/30/95 Time Analyses Completed: 2:30P M
Laboratory Log #: 76519 Certified By: [signature]
COMMENTS: Rec'd 6/21 @ 3:35

705

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(910) 766-7846
Fax (910) 766-2314

JUL 13 1995

068142

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3
WATER SYSTEM ID#: 0 1 - 0 5 - 4 4 1 COUNTY: Ashe
NAME OF SYSTEM: United Chemi-Con
SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)
MONITORING TYPE: (1) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)
SAMPLE TYPE: (1) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)
Collected on: DATE 0 6 / 2 1 / 9 5 (MM/DD/YY) TIME: 0 8 : 1 0 AM (HH:MM AM or PM
Location Where Collected: Sink in Mens Rest Room @ Warehouse
Location Code: 4 0 4 Entry Point (Y) Y,N Collected By: Jackie O Roberts (signature)
Sample Site Type: (1) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:

United Chemi-Con
185 McNeil Rd
Lansing NC 28643

TELEPHONE # (910) 384-2551

FIRST DRAW CERTIFICATION: ☒ YES ☐ NO

"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☒ YES ☐ NO

"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	101	.159
1030	Lead, mg/l	125	<.002
1016	Calcium, mg/l	101	
1044	Orthophosphate, mg/l	162	
1049	Silica, mg/l		
1064	Conductivity, µmhos/cm	145	
1925	pH, units	135	
1927	Alkalinity, mg/l	142	
1996	Water Temperature, °C	130	

TYPE TREATMENT:
( ) NONE
(X) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

RECEIVED JUL 7 1995 PUBLIC WATER SUPPLY SECTION

( ) SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED

Date Analyses Begun: 6/23/95 Time Analyses Begun: 11:00 AM
Date Analyses Completed: 6/30/95 Time Analyses Completed: 2:30 PM
Laboratory Log #: 76516 Certified By: Donna Perry
COMMENTS: Rec'd 6/21/95 @ 3:35

705

Ashe

January 11, 1995

Mr. Dean Hovermale
United Chemi-Con
185 McNeil Road
Lansing, North Carolina 28643

Re: Lead and Copper Reduced Monitoring
United Chemi-Con
01-05-441, Ashe County

Dear Mr. Hovermale:

Based on the information provided, your public water system meets the lead and copper action levels during each of the two consecutive six-month monitoring periods beginning January 1, 1994. Therefore, the system may reduce the number of sample sites as specified in the second column below and reduce the frequency of sampling to once per calendar year. Any system subject to reduced monitoring that exceeds the lead or copper action level shall return to standard monitoring.

System size (No. people served)	No. of sites (standard monitoring)	No. of sites (reduced monitoring)
>100,000	100	50
10,001-100,000	60	30
3,301-10,000	40	20
501-3,300	20	10
101-500	10	5
≤100	5	5

A water system that reduces the number and frequency of sampling shall collect the samples during the months of June, July, August or September form the most high risk sites included in the pool of targeted sampling sites.

If you have any questions concerning this matter, please feel free to contact Siraj Chohan at telephone (919) 715-3221.

Sincerely,

C. Thomas Cross
Environmental Engineer
Water Quality Compliance Branch
Public Water Supply Section

CTC
CTC:SMC:dh

cc: Lee G. Spencer, Regional Engineer
Richard J. Durham

State of North Carolina
Department of Environment,
Health and Natural Resources
Division of Environmental Health
Public Water Supply Section

James B. Hunt, Jr., Governor
Jonathan B. Howes, Secretary
Richard K. Rowe, Director

DEHNR

August 3, 1994

01-[illegible] VOC 08/94 ASHE
UNITED CHEM-CON
MON [illegible] OF ENVIR [illegible]
185 HOWELL RD
LANSING NC 28643-[illegible]

Re: Permission to Reduce Volatile Organic Chemical (VOC) Monitoring from Quarterly to Annually using Grandfathered Data

Our records indicate that VOC samples collected at your water system before December 31, 1992 do not show detection of any contaminants listed in 141.61(a)(2) through (21) (see enclosure). Therefore, your water system may reduce VOC monitoring from quarterly to annually. The annual samples must be collected from each entry point to the distribution system after treatment. This reduction does not apply to the other Phase II/V contaminants, such as the pesticides/SOCs/PCBs.

For water systems that started the Phase II/V VOC monitoring in 1994 (community systems serving between 3,301 and 100 population, schools and health care facilities), this reduction means no additional quarterly monitoring is required for VOCs in 1994. The next annual sampling is due in 1995. If your water system is in this group and has not yet sampled in 1994, you must sample before the end of 1994.

For water systems that were not required to collect a Phase II/V VOC sample until 1995 (community systems serving fewer than 101 population and non-transient, non-community systems other than schools and health care facilities), this reduction means one annual VOC sample must be collected in 1995. This one sample will satisfy the initial Phase II/V monitoring requirements for VOCs.

Groundwater systems must monitor annually for three consecutive years with no regulated VOC being above the detection limit before you may request permission to sample once every three years. Surface water systems will not be allowed to reduce monitoring less than annually.

If you have questions, please contact Hornlean Chen at (919) 715-3222.

Sincerely,

W.E. Venrick

W.E. Venrick, Chief
Public Water Supply Section

WEV:HC:spm
Enclosure
cc: Regional Engineer

P.O. Box 29536, Raleigh, North Carolina 27626-0536 Telephone 919-733-2321 FAX 919-715-3242
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State of North Carolina
Department of Environment,
Health and Natural Resources
Division of Environmental Health
Public Water Supply Section

James B. Hunt, Jr., Governor
Jonathan B. Howes, Secretary
Richard K. Rowe, Director

DEHNR

February 25, 1994

01-05-441 LCV 02/94 ASHE
UNITED CHEMI-CON
RON WATSON OR ENVIR COORD NOW
185 MCNEIL RD
LANSING NC 28643-8301

Re: Notice of Violation of the Initial Lead and Copper Tap Water Monitoring and Reporting

The Lead and Copper Rule requires all small community and non-transient non-community water systems to complete the first six-month initial tap water sampling and monitoring for lead and copper by December 31, 1993 and report the 90th percentile lead and copper concentrations within the first ten days following the end of the monitoring period. According to our records your system has failed to submit all required monitoring information on time as specified in Section 141.90 of the rule; therefore, you are in violation of the drinking water regulations and must notify the public in the following manner:

1. Hand delivery or continuous posting in conspicuous places within the area served by the system of a notice which must inform persons using the water of your failure to have the water properly analyzed and explain what will be done to prevent monitoring failure in the future. A copy of the notice delivered or posted shall be provided to this office within ninety (90) days. Posting shall continue until monitoring and reporting has been performed but in no case for less than two (2) weeks.

2. Repeat notification with written notice to each customer by mail delivery or by hand delivery at least once every three (3) months until such time as sampling and reporting is performed. A copy of the notice shall be submitted to this office with each repeat notification.

3. Provide multi-lingual notifications if thirty percent (30%) of the residents served are non-English speaking.

A separate violation is incurred for each day of non-compliance with the notification requirements. Failure to properly notify your customers and failure to take corrective actions are violations of the state and federal drinking water regulations and may be punished by a fine or an administrative penalty.

Oxford Laboratories, Inc.

Analytical and Consulting Chemists
1316 South Fifth Street
Wilmington, N.C. 28401
(919) 763-9793

ENTERED NOV 1 3 1995

TRIHALOMETHANE ANALYSIS

LABORATORY ID#: 37721

WATER SYSTEM ID#: 01-05-441 COUNTY: Ashe

NAME OF SYSTEM: United Chemi-Con

TYPE OF SAMPLE: E (D=Distribution, E=Entry, M=Maximum, S=Special)

COLLECTED ON: DATE: 07/19/95 (MM/DD/YY) TIME: 09:40 AM (HH:MM XM)

LOCATION WHERE COLLECTED: Formation

COLLECTED BY: Dean Hovermale LOCATION/SOURCE CODE: A05

MAIL RESULTS TO:

United Chemi-Con
485 McNeil Rd
Lansing NC 28634
TELEPHONE # (910) 384-2551

033071

TYPE OF SUPPLY:
( ) COMMUNITY
(X) NTNC
( ) NON-COMMUNITY
( ) PRIVATE

WATER SOURCE(S):
(X) GROUND
( ) SURFACE
( ) PURCHASED

CONTAM CODE	NAME	METHOD CODE	RESULTS	ALLOW. LIMITS
***	**********	*****	*********	*****
2941	CHLOROFORM, mg/l	2 15	<.0010	0.100
2942	BROMOFORM, mg/l	2 15	<.0010	0.100
2943	BROMODICHLOROMETHANE, mg/l	2 15	<.0005	0.100
2944	CHLORODIBROMOMETHANE, mg/l	2 15	<.0005	0.100
2950	TOTAL TRIHALOMETHANES, mg/l	2 15	<.0010	0.100

TYPE TREATMENT:
( ) NONE
(X) CHLORINATED
( ) FLUORIDATED
( ) FILTERED
( ) ALUM
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) PHOSPHATE, IRON CONTROL
( ) PHOSPHATE, MANG. CONTROL
( ) PHOSPHATE, CORR. CONTROL
( ) OTHER

SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED ( )

DATE ANALYSES BEGUN: 07/20/95 DATE ANALYSES COMPLETED: 07/21/95

CERTIFIED BY: Ann McMillan

COMMENTS:
78058 PO #L95381

Submitted by Hydro Analytical 95W8308

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(919) 766-7846
Fax (919) 766-2314

045312

RECEIVED JAN 26 1995 PWS KEYE

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3
WATER SYSTEM ID#: 0 1 - 0 5 - 4 4 1 COUNTY: Ashe
NAME OF SYSTEM: United Chemi-Con
SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)
MONITORING TYPE: (1) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)
SAMPLE TYPE: (1) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)
Collected on: DATE 06/15/94 (MM/DD/YY) TIME: 10:15 AM (HH:MM AM or PM)
Location Where Collected: A08 - DH4/F men's Room
Location Code: A08 Entry Point (Y/N): Y,N Collected By: Judi D. Hovermale (signature)
Sample Site Type: (3) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:
United Chemi-Con
185 McNeil Rd
Lansing NC 28043
TELEPHONE # (910) 384-2551

FIRST DRAW CERTIFICATION: ☒ YES ☐ NO
"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☒ YES ☐ NO
"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	125	.048
1030	Lead, mg/l	125	<.002
1016	Calcium, mg/l	101	
1044	Orthophosphate, mg/l	162	
1049	Silica, mg/l		
1064	Conductivity, µmhos/cm	145	
1925	pH, units	135	
1927	Alkalinity, mg/l	~~142~~	
1996	Water Temperature, °C	130	

TYPE TREATMENT:
( ) NONE
(X) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

( ) SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED
Date Analyses Begun: 06/22/94 Time Analyses Begun: 11:20 AM
Date Analyses Completed: 06/22/94 Time Analyses Completed: 3:00 PM
Laboratory Log #: 59069 Certified By: Teresa Day
COMMENTS: JW. 3:00 6/15/94

RECEIVED JUN 27 1994 PWS

705

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(910) 766-7846
Fax (910) 766-2314

045313

K PWSD EYE D JAN 26 1995

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3
WATER SYSTEM ID#: 0 1 - 0 5 - 4 4 1 COUNTY: Ashe
NAME OF SYSTEM: United Chem-Con
SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)
MONITORING TYPE: (1) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)
SAMPLE TYPE: (1) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)
Collected on: DATE 06/15/94 (MM/DD/YY) TIME: 10:00 AM (HH:MM AM or PM)
Location Where Collected: A09 - Case men's room
Location Code: A 0 9 Entry Point (N) Y,N Collected By: Leslie D. Horenuk (signature)
Sample Site Type: (2) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:

United Chem-Con
185 McNeil Rd
Lansing NC 28043

TELEPHONE # (910) 384-2551

FIRST DRAW CERTIFICATION: ☑ YES ☐ NO

"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☑ YES ☐ NO

"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	125	.030
1030	Lead, mg/l	125	<.002
1016	Calcium, mg/l	101	
1044	Orthophosphate, mg/l	162	
1049	Silica, mg/l		
1064	Conductivity, µmhos/cm	145	
1925	pH, units	135	
1927	Alkalinity, mg/l	142	
1996	Water Temperature, °C	130	

TYPE TREATMENT:
( ) NONE
(X) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

( ) SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED

Date Analyses Begun: 06/22/94 Time Analyses Begun: 11:20 AM
Date Analyses Completed: 06/22/94 Time Analyses Completed: 3:00 PM
Laboratory Log #: 59063 Certified By: [signature]
COMMENTS: JN. Rec. 6/15/94 3:00

RECEIVED JUN 27 1994 PWSD

205

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(910) 766-7846
Fax (910) 766-2314

045314

RECEIVED JAN 26 1995

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3
WATER SYSTEM ID#: 0 1 - 0 5 - 4 4 1 COUNTY: Ashe
NAME OF SYSTEM: United Chemi-Con
SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)
MONITORING TYPE: ( ) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)
SAMPLE TYPE: ( ) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)
Collected on: DATE 0 6 / 1 5 / 9 4 (MM/DD/YY) TIME: 0 9 : 5 5 AM (HH:MM AM or PM)
Location Where Collected: A10 DFR mens Room
Location Code: A 1 0 Entry Point (Y,N) Y Collected By: Leslie D. Hoeremel (signature)
Sample Site Type: (3) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:

United Chemi-Con
185 McNeil Rd
Lansing NC 28043

TELEPHONE # (910) 384-2551

FIRST DRAW CERTIFICATION: ☑ YES ☐ NO

"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☑ YES ☐ NO

"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	125	.013
1030	Lead, mg/l	125	<.002
1016	Calcium, mg/l	101	
1044	Orthophosphate, mg/l	162	
1049	Silica, mg/l		
1064	Conductivity, µmhos/cm	145	
1925	pH, units	135	
1927	Alkalinity, mg/l	142	
1996	Water Temperature, °C	130	

TYPE TREATMENT:
( ) NONE
(X) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

( ) SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED

Date Analyses Begun: 06/22/94 Time Analyses Begun: 11:20AM
Date Analyses Completed: 06/22/94 Time Analyses Completed: 3:00PM
Laboratory Log #: 59064 Certified By: Denise Perry
COMMENTS: Rec 6/15/94 @ 3:00

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205

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(919) 766-7846
Fax (919) 766-2314

045307

RECEIVED JUN 26 1995 PWS

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3

WATER SYSTEM ID#: 01-05-441 COUNTY: Ashe

NAME OF SYSTEM: United Chemi-Con

SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)

MONITORING TYPE: (1) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)

SAMPLE TYPE: (1) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)

Collected on: DATE 06/15/94 (MM/DD/YY) TIME: 09:10 AM (HH:MM AM or PM)

Location Where Collected: A03 - Cafeteria Sink

Location Code: A03 Entry Point (M) Y,N Collected By: [signature] (signature)

Sample Site Type: (2) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:

United Chemi-Con
185 McNeil Rd
Lansing NC 28043

TELEPHONE # (910) 384-2551

FIRST DRAW CERTIFICATION: ☐ YES ☐ NO

"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☒ YES ☐ NO

"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	125	.014
1030	Lead, mg/l	125	<.002
1016	Calcium, mg/l	101	
1044	Orthophosphate, mg/l	162	
1049	Silica, mg/l		
1064	Conductivity, µmhos/cm	145	
1925	pH, units	135	
1927	Alkalinity, mg/l	~~142~~	
1996	Water Temperature, °C	130	

TYPE TREATMENT:
( ) NONE
(X) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

( ) SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED

Date Analyses Begun: 06/22/94 Time Analyses Begun: 11:20 AM

Date Analyses Completed: 06/22/94 Time Analyses Completed: 3:00 PM

Laboratory Log #: 59067 Certified By: [signature]

COMMENTS: JW. 6/15/94 Rec. 3:00

RECEIVED JUN 27 1994 PWSS

205

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(919) 766-7846
Fax (919) 766-2314

045308

RECEIVED MAY 26 1995 PWS EYE

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3

WATER SYSTEM ID#: 0 1 - 0 5 - 4 4 1 COUNTY: Ashe

NAME OF SYSTEM: United Chemi-Con

SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)

MONITORING TYPE: (1) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)

SAMPLE TYPE: (1) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)

Collected on: DATE 06/15/94 (MM/DD/YY) TIME: 09:55 AM (HH:MM AM or PM)

Location Where Collected: A04 Warehouse Mens Sink

Location Code: A04 Entry Point (N) Y,N Collected By: Linda D. Hommel (signature)

Sample Site Type: (1) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:

United Chemi-Con
185 McNeil Rd
Lansing NC 28043

TELEPHONE # (910) 384-2551

FIRST DRAW CERTIFICATION: ☑ YES ☐ NO

"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☑ YES ☐ NO

"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	125	.043
1030	Lead, mg/l	125	.003
1016	Calcium, mg/l	101	
1044	Orthophosphate, mg/l	162	
1049	Silica, mg/l		
1064	Conductivity, µmhos/cm	145	
1925	pH, units	135	
1927	Alkalinity, mg/l	142	
1996	Water Temperature, °C	130	

TYPE TREATMENT:
( ) NONE
(✓) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

( ) SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED

Date Analyses Begun: 06/22/94 Time Analyses Begun: 11:20 AM

Date Analyses Completed: 06/22/94 Time Analyses Completed: 3:00 PM

Laboratory Log #: 59666 Certified By: [signature]

COMMENTS: JW Rec. 6/15/94 3:00

RECEIVED JUN 27 1994 PWSS

705

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(919) 766-7846
Fax (919) 766-2314

045309

RECEIVED JAN 26 1995 PWS

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3
WATER SYSTEM ID#: 0 1 - 0 5 - 4 4 1 COUNTY: Ashe
NAME OF SYSTEM: United Chemi-Con
SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)
MONITORING TYPE: (1) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)
SAMPLE TYPE: (1) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)
Collected on: DATE 06/15/94 (MM/DD/YY) TIME: 10:10 AM (HH:MM AM or PM)
Location Where Collected: A05 - Machine Shop mens faucet
Location Code: A05 Entry Point (Y/N) Y,N Collected By: Julie D. Arnmole (signature)
Sample Site Type: (3) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:

United Chemi Con
185 McNeil Rd
Lansing NC 28043
TELEPHONE # (910) 384-2551

FIRST DRAW CERTIFICATION: ☑ YES ☐ NO

"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☑ YES ☐ NO

"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	125	.048
1030	Lead, mg/l	125	<.002
1016	Calcium, mg/l	101	
1044	Orthophosphate, mg/l	162	
1049	Silica, mg/l		
1064	Conductivity, µmhos/cm	145	
1925	pH, units	135	
1927	Alkalinity, mg/l	142	
1996	Water Temperature, °C	130	

TYPE TREATMENT:
( ) NONE
(✓) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

( ) SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED

Date Analyses Begun: 06/22/94 Time Analyses Begun: 11:30 AM
Date Analyses Completed: 06/22/94 Time Analyses Completed: 3:00 PM
Laboratory Log #: 59062 Certified By: Teresa Perry
COMMENTS: Rec. 6/15/94 @ 3:00

RECEIVED JUN 27 1994 PWS

705

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(919) 766-7846
Fax (919) 766-2314

045310

PWS RECEIVED JAN 26 1995

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3
WATER SYSTEM ID#: 0 1 - 0 5 - 4 4 1 COUNTY: Ashe
NAME OF SYSTEM: United Chemi-Con
SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)
MONITORING TYPE: (1) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)
SAMPLE TYPE: (1) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)
Collected on: DATE 06/15/94 (MM/DD/YY) TIME: 09:45 AM (HH:MM AM or PM)
Location Where Collected: A06 - North warehouse - mens room
Location Code: A 0 6 Entry Point (W) Y,N Collected By: Leslie D. Honermann (signature)
Sample Site Type: (3) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:
United Chemi-Con
185 McNeil Rd
Lansing NC 28043
TELEPHONE # (910) 384-2551

FIRST DRAW CERTIFICATION: ☑ YES ☐ NO
"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☑ YES ☐ NO
"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	125	.032
1030	Lead, mg/l	125	<.002
1016	Calcium, mg/l	101	
1044	Orthophosphate, mg/l	162	
1049	Silica, mg/l		
1064	Conductivity, µmhos/cm	145	
1925	pH, units	135	
1927	Alkalinity, mg/l	142	
1996	Water Temperature, °C	130	

TYPE TREATMENT:
( ) NONE
(X) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

( ) SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED
Date Analyses Begun: 06/22/94 Time Analyses Begun: 11:20 AM
Date Analyses Completed: 06/22/94 Time Analyses Completed: 3:00 PM
Laboratory Log #: 59065 Certified By: Teresa Day
COMMENTS: JW. 6/15/94 3:00 pm

RECEIVED JUN 27 1994 PWSS

205

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(919) 766-7846
Fax (919) 766-2314

045311

PWS KEYED JAN 26 1995

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3
WATER SYSTEM ID#: 0 1 - 0 5 - 4 9 1 COUNTY: Ashe
NAME OF SYSTEM: United Chemi-Con
SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)
MONITORING TYPE: (1) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)
SAMPLE TYPE: (1) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)
Collected on: DATE 6/15/94 (MM/DD/YY) TIME: 09:30 AM (HH:MM AM or PM)
Location Where Collected: A07 - DH4/2 men's Room
Location Code: A07 Entry Point (N) Y,N Collected By: Jeshie D. Hammond (signature)
Sample Site Type: (3) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:
United Chemi-Con
185 McNeil Rd
Lansing NC 28643
TELEPHONE # (910) 384-2551

FIRST DRAW CERTIFICATION: ☑ YES ☐ NO
"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☑ YES ☐ NO
"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	125	.025
1030	Lead, mg/l	125	<.002
1016	Calcium, mg/l	101	
1044	Orthophosphate, mg/l	162	
1049	Silica, mg/l		
1064	Conductivity, µmhos/cm	145	
1925	pH, units	135	
1927	Alkalinity, mg/l	~~142~~	
1996	Water Temperature, °C	130	

TYPE TREATMENT:
( ) NONE
(X) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

( ) SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED
Date Analyses Begun: 06/22/94 Time Analyses Begun: 11:20 AM
Date Analyses Completed: 06/22/94 Time Analyses Completed: 3:00 PM
Laboratory Log #: 59061 Certified By: [signature]
COMMENTS: Rec. 6/15/94 3:00 JN

205

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(910) 766-7846
Fax (910) 766-2314

045305

RECEIVED JAN 26 1995 PWS

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3
WATER SYSTEM ID#: 0 1 - 0 5 - 4 4 1 COUNTY: Ashe
NAME OF SYSTEM: United Chemi-Con
SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)
MONITORING TYPE: (1) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)
SAMPLE TYPE: (1) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)
Collected on: DATE 0 6/1 5/9 4 (MM/DD/YY) TIME: 0 9:2 0 M (HH:MM AM or PM)
Location Where Collected: A01 - Front Entrance - men's sink
Location Code: A 0 1 Entry Point (N) Y,N Collected By: [signature] (signature)
Sample Site Type: (1) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:
United Chemi-Con
185 McNeil Rd
Lansing NC 28043
TELEPHONE # (910) 384-2551

FIRST DRAW CERTIFICATION: ☒ YES

"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☒ YES ☐ NO

"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	125	.019
1030	Lead, mg/l	125	<.002
1016	Calcium, mg/l	101	
1044	Orthophosphate, mg/l	162	
1049	Silica, mg/l		
1064	Conductivity, µmhos/cm	145	
1925	pH, units	135	
1927	Alkalinity, mg/l	142	
1996	Water Temperature, °C	130	

TYPE TREATMENT:
( ) NONE
(X) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

( ) SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED

Date Analyses Begun: 06/22/94 Time Analyses Begun: 11:20AM
Date Analyses Completed: 06/22/94 Time Analyses Completed: 3:00P M
Laboratory Log #: 59068 Certified By: [signature]
COMMENTS: Rec. 6/15/94 JW. 3:00

RECEIVED JUN 27 1994 PWSS

205

HYDRO ANALYTICAL LABORATORIES

6300 Ramada Drive, Box C-2
Clemmons, NC 27012
(919) 766-7846
Fax (919) 766-2314

045306

PWS RECEIVED JAN 26 1995

LEAD AND COPPER ANALYSES

LABORATORY ID#: 3 7 7 3 3
WATER SYSTEM ID#: 0 1 - 0 5 - 4 4 1 COUNTY: Ashe
NAME OF SYSTEM: United Chemi-Con
SYSTEM TYPE: (2) (1=Community; 2=Non-transient Non-community; 3=Other)
MONITORING TYPE: (1) (1=Tap Water; 2=Water Quality Parameter; 3=Source Water)
SAMPLE TYPE: (1) (1=Routine; 2=Repeat; 3=Plan Approval; 4=Other)
Collected on: DATE 6/15/94 (MM/DD/YY) TIME: 10:25 AM (HH:MM AM or PM)
Location Where Collected: A02 - Boiler House - mens sink
Location Code: A02 Entry Point (Y/N): Y,N Collected By: Leslie D. Haverlale (signature)
Sample Site Type: (3) (1=Tier I; 2=Tier II; 3=Tier III; 4=Other)

MAIL RESULTS TO:
United Chemi-Con
185 McNeil Rd
Lansing NC 28043

TELEPHONE # (910) 384-2551

FIRST DRAW CERTIFICATION: ☒ YES ☐ NO

"Sample is one-liter in volume and has stood motionless in the water lines for at least six hours prior to collection."

SAMPLE INSTRUCTION CERTIFICATION: ☒ YES ☐ NO

"I have received proper guidance and instructions for the collection of this sample."

CONTAM CODE	NAME	METHOD CODE	RESULTS
1022	Copper, mg/l	125	.053
1030	Lead, mg/l	125	<.002
1016	Calcium, mg/l	101	
1044	Orthophosphate, mg/l	162	
1049	Silica, mg/l		
1064	Conductivity, µmhos/cm	145	
1925	pH, units	135	
1927	Alkalinity, mg/l	142	
1996	Water Temperature, °C	130	

TYPE TREATMENT:
( ) NONE
(X) CHLORINATED
( ) FLUORIDATED
( ) ACID
( ) LIME
( ) SODA ASH
( ) CAUSTIC
( ) WATER SOFTENER
( ) POTASSIUM PERMANGANATE
( ) ORTHOPHOSPHATE
( ) SILICA
( ) HEXAMETHAPHOSPHATE
( ) OTHER

( ) SAMPLE UNSATISFACTORY ( ) RESAMPLE REQUESTED

Date Analyses Begun: 06/22/94 Time Analyses Begun: 11:20 AM
Date Analyses Completed: 06/22/94 Time Analyses Completed: 3:00 PM
Laboratory Log #: 59060 Certified By: Teresa Perry
COMMENTS: Rec. 3:00 6/15/94 JN.

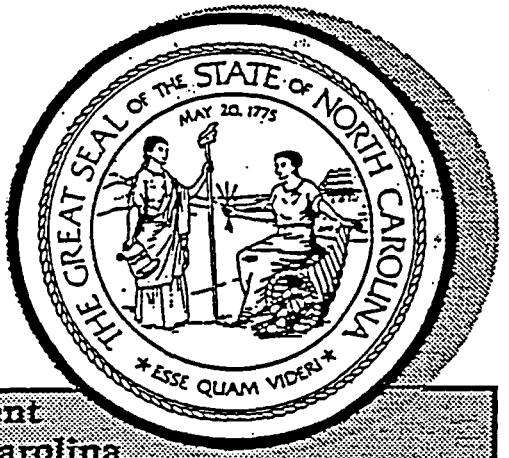
RECEIVED JUN 27 1994

205

Ref. 30

STATE OF
NORTH CAROLINA
DEPARTMENT OF
ENVIRONMENT, HEALTH,
AND NATURAL RESOURCES

Classifications and Water Quality Standards Assigned to The Waters of the New River Basin



Division of Environmental Management
Raleigh, North Carolina

Reprint from North Carolina Administrative Code: 15A NCAC 2B .0307
Current through: March 1, 1993

SECTION .0300 - ASSIGNMENT OF STREAM CLASSIFICATIONS

.0301 CLASSIFICATIONS: GENERAL

(a) Schedule of Classifications. The classifications assigned to the waters of the State of North Carolina are set forth in the schedules of classifications and water quality standards assigned to the waters of the river basins of North Carolina, 15A NCAC 2B .0302 to .0317. These classifications are based upon the existing or contemplated best usage of the various streams and segments of streams in the basin, as determined through studies and evaluations and the holding of public hearings for consideration of the classifications proposed.

(b) Stream Names. The names of the streams listed in the schedules of assigned classifications were taken as far as possible from United States Geological Survey topographic maps. Where topographic maps were unavailable, U.S. Corps of Engineers maps, U.S. Department of Agriculture soil maps, and North Carolina highway maps were used for the selection of stream names.

(c) Classifications. The classifications assigned to the waters of North Carolina are denoted by the letters WS-I, WS-II, WS-III, WS-IV, WS-V, B, C, SA, SB, and SC in the column headed "class." A brief explanation of the "best usage" for which the waters in each class must be protected is given as follows:

Fresh Waters

Class WS-I:	waters protected as water supplies which are in natural and undeveloped watersheds; point source discharges of treated wastewater are permitted pursuant to Rules .0104 and .0211 of this Subchapter; local programs to control nonpoint source and stormwater discharge of pollution are required; suitable for all Class C uses;
Class WS-II:	waters protected as water supplies which are generally in predominantly undeveloped watersheds; point source discharges of treated wastewater are permitted pursuant to Rules .0104 and .0211 of this Subchapter; local programs to control nonpoint source and stormwater discharge of pollution are required; suitable for all Class C uses;
Class WS-III:	waters protected as water supplies which are generally in low to moderately developed watersheds; point source discharges of treated wastewater are permitted pursuant to Rules .0104 and .0211 of this Subchapter; local programs to control nonpoint source and stormwater discharge of pollution are required; suitable for all Class C uses;
Class WS-IV:	waters protected as water supplies which are generally in moderately to highly developed watersheds; point source discharges of treated wastewater are permitted pursuant to Rules .0104 and .0211 of this Subchapter; local programs to control nonpoint source and stormwater discharge of pollution are required; suitable for all Class C uses;
Class WS-V:	waters protected as water supplies which are generally upstream and draining to Class WS-IV waters; no categorical restrictions on watershed development or treated wastewater discharges are required, however, the Commission or its designee may apply appropriate management requirements as deemed necessary for the protection of downstream receiving waters (15A NCAC 2B .0203); suitable for all Class C uses;
Class B:	primary recreation and any other usage specified by the "C" classification;
Class C:	aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture.

Tidal Salt Waters

Class SA:	shellfishing for market purposes and any other usage specified by the "SB" and "SC" classification;
Class SB:	primary recreation and any other usage specified by the "SC" classification;
Class SC:	aquatic life propagation and survival, fishing, wildlife, and secondary recreation.

Supplemental Classifications

Trout Waters:	Suitable for natural trout propagation and maintenance of stocked trout;
Swamp Waters:	Waters which have low velocities and other natural characteristics which are different from adjacent streams;
NSW:	Nutrient Sensitive Waters which require limitations on nutrient inputs;
HQW:	High Quality Waters which are waters that are rated as excellent based on biological and physical/chemical characteristics through division monitoring or special studies, native and special native trout waters (and their tributaries) designated by the Wildlife Resources Commission, primary nursery areas (PNA) designated by the Marine Fisheries Commission and other functional nursery areas designated by the Wildlife Resources Commission, critical habitat areas designated by the Wildlife Resources Commission or the Department of Agriculture, all water supply watersheds which are either classified as WS-I or WS-II or those for which a formal petition for reclassification as WS-I or WS-II has been received from the appropriate local government and accepted by the Division of Environmental Management and all Class SA waters.
ORW:	Outstanding Resource Waters which are unique and special waters of exceptional state or national recreational or ecological significance which require special protection to maintain existing uses.

(d) Water Quality Standards. The water quality standards applicable to each classification assigned are those established in 15A NCAC 2B .0200, Classifications and Water Quality Standards Applicable to the Surface Waters of North Carolina, as adopted by the North Carolina Environmental Management Commission.

(e) Index Number.

(1) Reading the Index Number. The index number appearing in the column so designated is an identification number assigned to each stream or segment of a stream, indicating the specific tributary progression between the main stem stream and the tributary stream.

(2) Cross-Referencing the Index Number. The inclusion of the index number in the schedule is to provide an adequate cross reference between the classification schedules and an alphabetic list of streams.

(f) Classification Date. The classification date indicates the date on which enforcement of the provisions of Section 143-215.1 of the General Statutes of North Carolina became effective with reference to the classification assigned to the various streams in North Carolina.

(g) Reference. Copies of the schedules of classifications adopted and assigned to the waters of the various river basins may be obtained at no charge by writing to:

Director
Division of Environmental Management
Department of Environment, Health, and Natural Resources
Post Office Box 29535
Raleigh, North Carolina 27626-0535

(h) Places where the schedules may be inspected:

Division of State Library
Archives -- State Library Building
109 E. Jones Street
Raleigh, North Carolina.

(i) Unnamed Streams.

(1) Any stream which is not named in the schedule of stream classifications carries the same classification as that assigned to the stream segment to which it is tributary except:

(A) unnamed streams specifically described in the schedule of classifications; or

(B) unnamed freshwaters tributary to tidal saltwaters will be classified "C"; or

(C) after November 1, 1986, any newly created areas of tidal saltwater which are connected to Class SA waters by approved dredging projects will be classified "SC" unless case-by-case reclassification proceedings are conducted.

(2) The following river basins have different policies for unnamed streams entering other states or for specific areas of the basin:

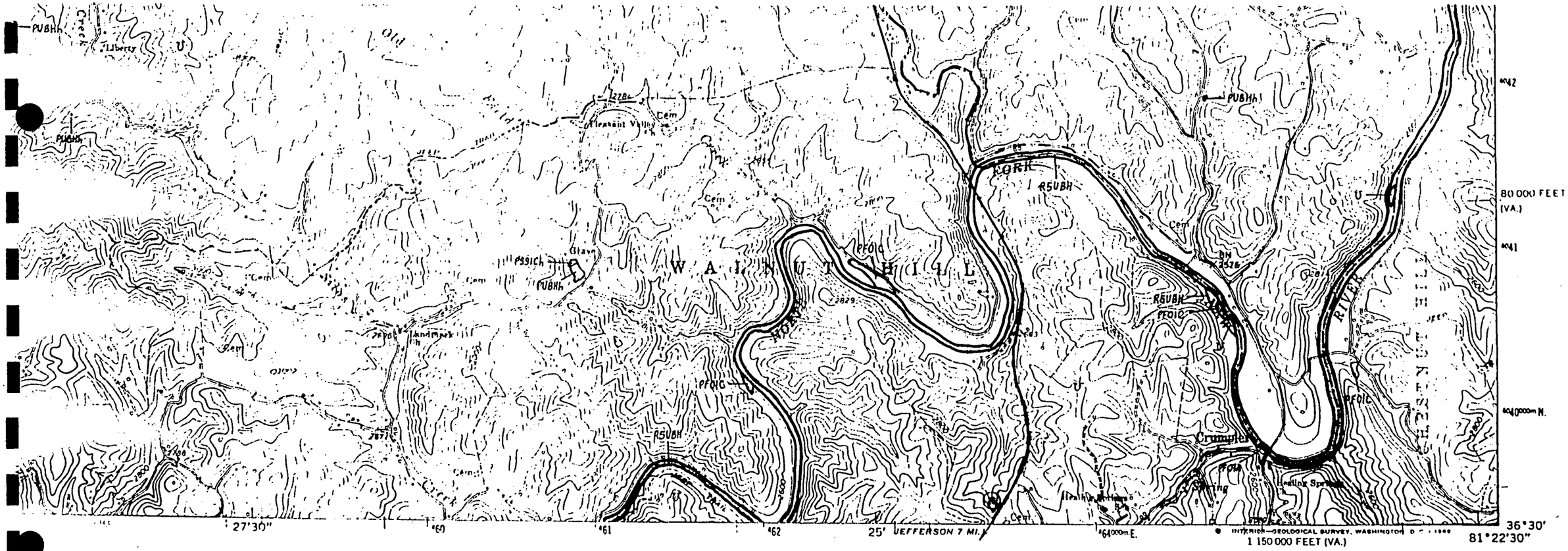
.0307 NEW RIVER BASIN

Name of Stream	Description	Class	Classification Date	Classification Index No.
	River			
Ore Knob Branch	From source to Peak Creek	B Tr +	2/1/93	10-1-35-3
Little Peak Creek	From source to Peak Creek	B Tr +	2/1/93	10-1-35-4
Nathans Creek	From source to South Fork New River	B Tr +	2/1/93	10-1-36
Long Branch	From source to Nathans Creek	B Tr +	2/1/93	10-1-36-1
Cranberry Creek (Mulberry Creek)	From source to South Fork New River	B Tr +	2/1/93	10-1-37
Laurel Fork	From source to Cranberry Creek	B Tr +	2/1/93	10-1-37-1
Meadow Fork	From source to Cranberry Creek	B Tr +	2/1/93	10-1-37-2
Piney Fork	From source to Cranberry Creek	B Tr +	2/1/93	10-1-37-3
Maple Branch	From source to Piney Fork	B Tr +	2/1/93	10-1-37-3-1
Reeves Branch	From source to Piney Fork	B Tr +	7/1/89	10-1-37-3-2
Wolf Branch	From source to Cranberry Creek	B Tr +	7/1/89	10-1-37-4
Piney Branch	From source to Cranberry Creek	B Tr +	7/1/89	10-1-37-5
Beaver Branch	From source to Cranberry Creek	B Tr +	7/1/89	10-1-37-6
Prathers Creek	From source to South Fork New River	B Tr +	7/1/89	10-1-38
Crab Fork	From source to Prathers Creek	B Tr +	7/1/89	10-1-38-1
North Fork New River	From source to Three Top Creek	C Tr +	2/1/93	10-2-(1)
Mine Branch	From source to North Fork New River	C Tr +	2/1/93	10-2-2
Maine Branch	From source to North Fork New River	C Tr +	2/1/93	10-2-3
South Branch	From source to North Fork New River	C Tr +	2/1/93	10-2-4
Snyder Branch	From source to North Fork New River	C Tr +	2/1/93	10-2-5
Rush Branch	From source to North Fork New River	C Tr +	2/1/93	10-2-6
Hoskin Fork	From source to North Fork New River	C Tr +	2/1/93	10-2-7
Doe Branch	From source to Hoskin Fork	C Tr +	2/1/93	10-2-7-1
Wallace Branch	From source to Hoskin Fork	C Tr +	2/1/93	10-2-7-2
Wilson Branch	From source to Hoskin Fork	C Tr +	2/1/93	10-2-7-3
Brush Fork	From source to North Fork New River	C Tr +	2/1/93	10-2-8
Pine Mountain Branch	From source to Brush Fork	C Tr +	2/1/93	10-2-8-1
Rock (Stone) Creek	From source to North Fork New River	C Tr +	2/1/93	10-2-9
Monkey Branch	From source to Rock (Stone Creek	C Tr +	2/1/93	10-2-9-1
Roundabout Creek	From source to North Fork New River	C Tr +	2/1/93	10-2-10
Graybeal Branch	From source to Roundabout Creek	C Tr +	2/1/93	10-2-10-1
Cabbage Creek	From source to Roundabout Creek	C Tr +	2/1/93	10-2-10-2
Unnamed Tributary to North Fork New River at Knox Knitting Co.	From source to North Fork New River	C +	2/1/93	10-2-11
North Fork New River	From Three Top Creek to New River	C +	2/1/93	10-2-(12)
Three Top Creek	From source to North Fork New River	C Tr +	2/1/93	10-2-13
Big Branch	From source to Three Top Creek	C Tr +	2/1/93	10-2-13-1
Ben Bolen Creek	From source to Three Top Creek	C Tr +	2/1/93	10-2-13-2
Long Hope Creek	From source to Three Top Creek	C Tr +	2/1/93	10-2-13-3
Big Laurel Creek	From source to North Fork New River	C Tr +	2/1/93	10-2-14
Dixon Creek	From source to Big Laurel Creek	C Tr +	2/1/93	10-2-14-1
Kilby Creek	From source to Big Laurel Creek	C Tr +	2/1/93	10-2-14-2
Woodard Branch	From source to Big Laurel Creek	C Tr +	2/1/93	10-2-14-3
Cut Laurel Creek	From source to Big Laurel Creek	C Tr +	2/1/93	10-2-14-4
Swift Branch	From source to Big Laurel Creek	C Tr +	2/1/93	10-2-14-5

.0307 NEW RIVER BASIN

Name of Stream	Description	Class	Classification Date	Classification Index No.
Soup Bean Branch	From source to Big Laurel Creek	C Tr +	2/1/93	10-2-14-6
Roaring Fork (Roaring Fork Creek)	From source to Big Laurel Creek	C Tr +	2/1/93	10-2-14-7
East Fork Roaring Fork	From source to Roaring Fork	C Tr +	2/1/93	10-2-14-7-1
Big Branch	From source to Big Laurel Creek	C Tr +	2/1/93	10-2-14-8
Little Laurel Creek	From source to Big Laurel Creek	C +	2/1/93	10-2-14-9
Rich Hill Creek	From source to North Fork New River	C Tr +	2/1/93	10-2-15
Copeland Creek	From source to North Fork New River	C Tr +	2/1/93	10-2-16
Mill Creek	From source to North Fork New River	C Tr +	2/1/93	10-2-17
Sugar Tree Branch (Sugar Branch)	From source to North Fork New River	C Tr +	2/1/93	10-2-18
Stagg Creek	From source to North Fork New River	C Tr +	2/1/93	10-2-19
Buffalo Creek	From source to North Fork New River	C Tr +	2/1/93	10-2-20
Little Buffalo Creek	From source to Buffalo Creek	C Tr +	2/1/93	10-2-20-1
Claybank Creek	From source to Little Buffalo Creek	C Tr +	2/1/93	10-2-20-1-1
Big Horse Creek (Horse Creek)	From source to North Carolina-Virginia State Line	C Tr+	2/1/93	10-2-21-(1)
Big Horse Creek (Horse Creek)	From North Carolina-Virginia State Line to lower Ashe County County SR 1361	C Tr HQW	8/1/90	10-2-21-(1.5)
Baldwin Branch	From North Carolina-Virginia State Line to Big Horse Creek	C Tr HQW	8/1/90	10-2-21-2
Ripshin Branch	From source to Big Horse Creek	C Tr HQW	8/1/90	10-2-21-3
Mud Creek (Mud Fork)	From North Carolina-Virginia State Line to Big Horse Creek	C HQW	8/1/90	10-2-21-4
Big Horse Creek	From lower Ashe County SR 1361 to Ashe County SR 1353 at Tuckerdale	C Tr +	2/1/93	10-2-21-(4.5)
Little Windfall Branch	From source to Big Horse Creek	C Tr +	2/1/93	10-2-21-5
Big Windfall Branch (Windfall Creek)	From source to Big Horse Creek	C Tr +	2/1/93	10-2-21-6
Big Horse Creek (Horse Creek)	From Ashe County SR 1353 at Tuckerdale to North Fork New River	C +	2/1/93	10-2-21-(7)
Little Horse Creek	From source to Big Horse Creek	C Tr +	2/1/93	10-2-21-8
Middle Fork Little Horse Creek	From source to Little Horse Creek	C Tr +	2/1/93	10-2-21-8-1
South Fork Little Horse Creek	From source to Little Horse Creek	C +	2/1/93	10-2-21-8-2
Roaring Branch	From source to South Fork Little Horse Creek	C +	2/1/93	10-2-21-8-2-1
Greer Branch	From source to Roaring Branch	C +	2/1/93	10-2-21-8-2-1-1
Long Branch	From source to Little Horse Creek	C +	2/1/93	10-2-21-8-3
Old Field Branch (Grass Branch)	From source to Big Horse Creek	C Tr +	2/1/93	10-2-21-9
Piney Creek	From source to North Fork New River	C Tr +	2/1/93	10-2-22
Little Piney Creek	From source to Piney Creek	C +	2/1/93	10-2-22-1
Little Phoenix Creek	From source to North Fork New River	C Tr +	2/1/93	10-2-23
Silas Creek	From source to North Fork New River	C Tr +	2/1/93	10-2-24
Long Shoals Creek	From source to North Fork New River	C Tr +	2/1/93	10-2-25
Foster Springs Branch	From source to Long Shoals Creek	C Tr +	2/1/93	10-2-25-1

Ref. 31



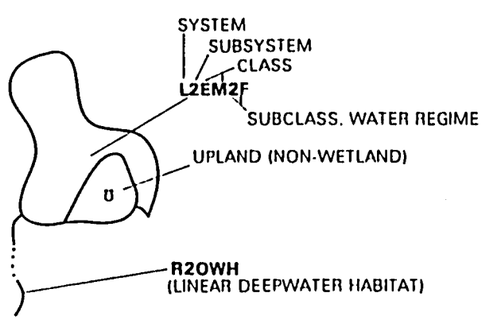
GRASSY CREEK, NC.-VA.

SPECIAL NOTE

This document was prepared primarily by stereoscopic analysis of high altitude aerial photographs. Wetlands were identified on the photographs based on vegetation, visible hydrology, and geography in accordance with **Classification of Wetlands and Deepwater Habitats of the United States** (FWS/OBS - 79/31 December 1979). The aerial photographs typically reflect conditions during the specific year and season when they were taken. In addition, there is a margin of error inherent in the use of the aerial photographs. Thus, a detailed on the ground and historical analysis of a single site may result in a revision of the wetland boundaries established through photographic interpretation. In addition, some small wetlands and those obscured by dense forest cover may not be included on this document.

Federal, State and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, State or local government or to establish the geographical scope of the regulatory programs of government agencies. **Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, State or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.**

SYMBOLOGY EXAMPLE



U — Primarily represents upland areas, but may include unclassified wetlands such as man-modified areas, non photo-identifiable areas and/or unintentional omissions.

NOTES TO THE USER

- Wetlands which have been field examined are indicated on the map by an asterisk (*).
- Additions or corrections to the wetlands information displayed on this map are solicited. Please forward such information to the address indicated.
- Subsystems, Classes, Subclasses, and Water Regimes in *italics* were developed specifically for NATIONAL WETLANDS INVENTORY mapping.
- Some areas designated as R4SB, R4SBW, OR R4SBJ (INTERMITTENT STREAMS) may not meet the definition of wetland.
- This map uses the class Unconsolidated Shore (US). On earlier NWI maps that class was designated Beach/Bar (BB), or Flat (FL). Subclasses remain the same in both versions.

AERIAL PHOTOGRAPHY

DATE:	4 / / 83	DATE:	/ /
SCALE:	1:58 000	SCALE:	
TYPE:	CIR	TYPE:	

U.S. DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

Prepared by National Wetlands Inventory

1990

2 — INTERTIDAL

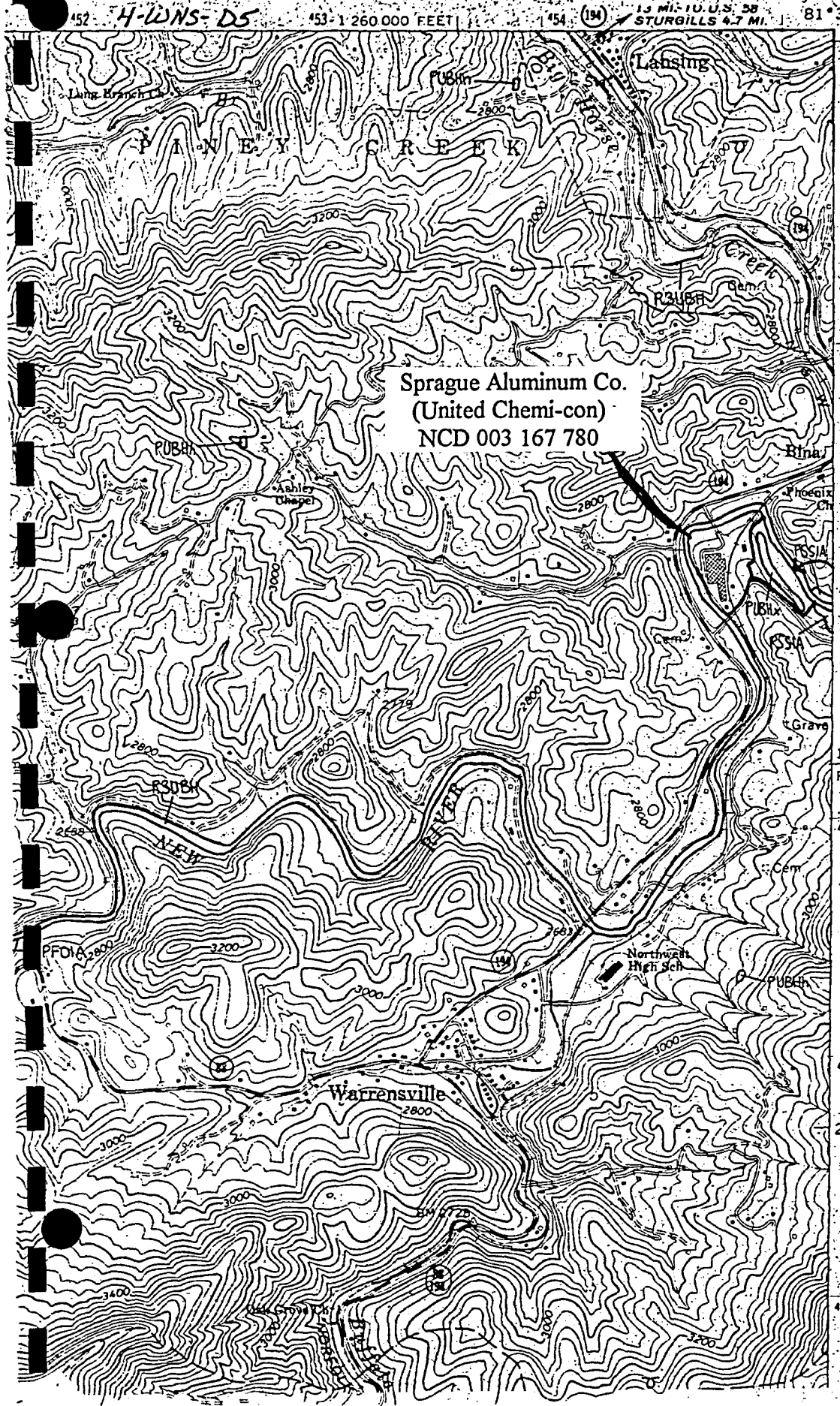
E — ESTUARINE

1 — SUBTIDAL

2 — INTERTIDAL

SYSTEM

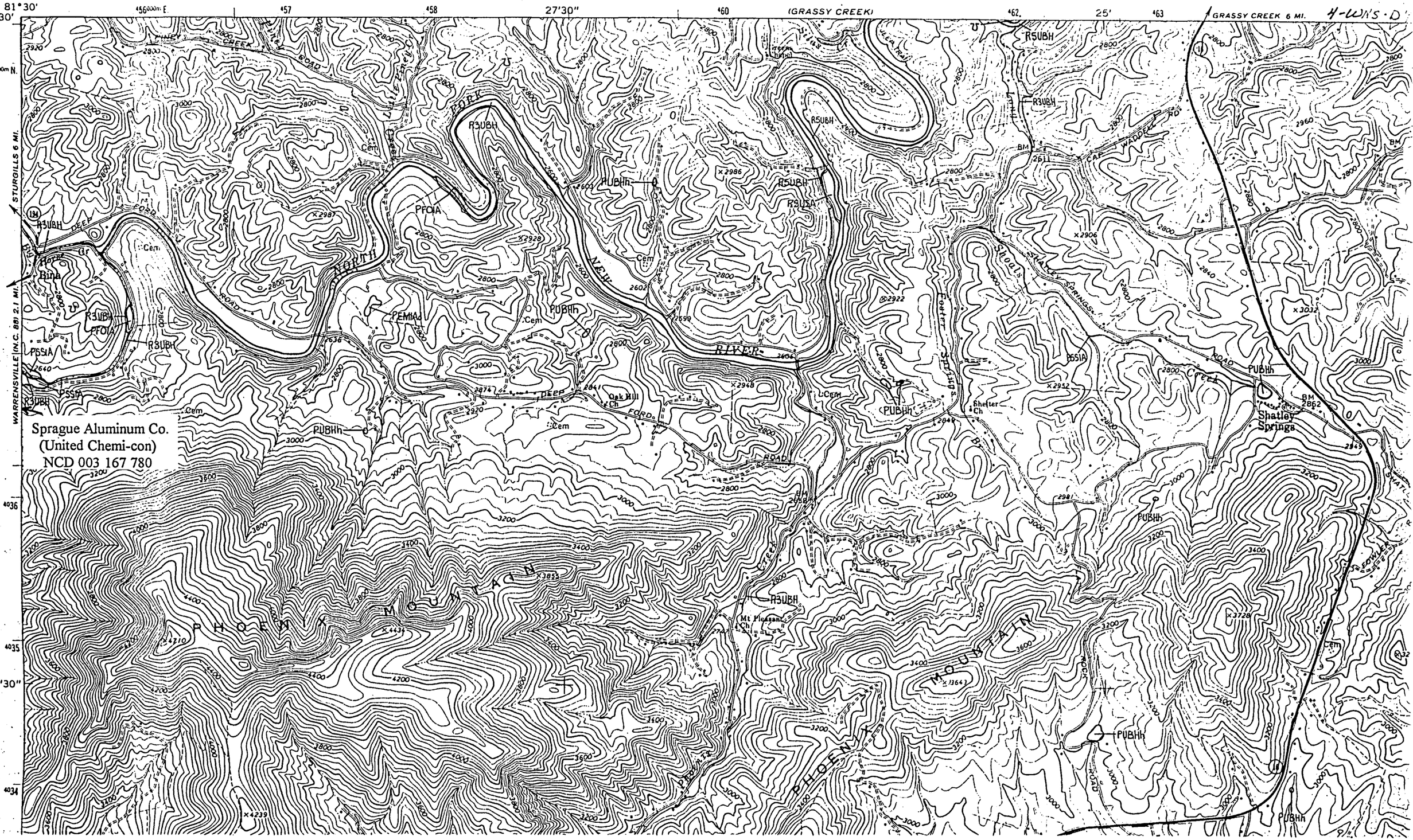
SUBSYSTEM


H-WNS-D5
13 MI. TO U.S. 58
STURGILLS 4.7 MI.
81°30'
36°30'
Lansing
PINEY CREEK
Long Branch Ch
Sprague Aluminum Co.
(United Chemi-con)
NCD 003 167 780
ESI Site
Ashley Chapel
Phoenix Ch
Cem
Grave
NEW RIVER
Northwest High Sch
Warrensville
1 000 000 FEET
27'30"

NATIONAL WETLANDS INVENTORY

UNITED STATES DEPARTMENT OF THE INTERIOR

JEFFERSON, N. C.



MEMORANDUM

To: File
From: Stuart F. Parker, Hydrogeologist
Date: February 25, 2002
Subject: Sprague Aluminum
NCD 003 167 780
Rare Species Update

SFP visited the NC Natural Heritage Program offices in Raleigh, NC to update information on rare species identified in the study area, including portions of the Park, Grassy Creek, Warrensville and Jefferson 7-1/2 minute topographic quadrangles. Twelve animal and nineteen plant species were identified. Four species were listed as endangered or threatened in NC and/or the US. The data are summarized in the attached tables.

Animal Species:	Common Name:	NC Status:	US Status:	SWP Distance:	Radial Distance:
Bolotopera rossi	(a stonefly)	SR	- -	- -	3.8
Ephemerella berneri	(a mayfly)	SR	- -	13	3.6
Exoglossum laurae	Tonguetied minnow	SR	- -	1.0	0.5
Ceraclea mentiea	(a caddisfly)	SR	- -	1.0	0.4
Phenocobius teretulus	Konawa minnow	SR	FSC	13	0.6
Ceraclea slossonae	(a caddisfly)	SR	- -	1.0	0.7
Heteroclon petersii	(a mayfly)	SR	- -	0.9	0.7
Zapada chila	(a stonefly)	SR	- -	- -	4.0
Attaneuria ruralis	(a stonefly)	SR	- -	13	- -
Neophylax fuscus	(a caddisfly)	SR	- -	13	- -
Vireo gilvus	Warbling vireo (bird)	SR	- -	14.5	- -
Lasmigona Subdividis	**Greenfloater (mussel)**	**E**	FSC	14.5	- -
Plant Species:	Common Name:	NC Status:	US Status:	SWP Distance:	Radial Distance:
Houstonia montana	**Mountain Bluet**	**E**	**E**	- -	1.7
Saxifraga caroliniana	Carolina Saxifrage	C	FSC	0.2	0.2
Lindbergia brachyptera	Lindberg's Maple-moss	SR	- -	- -	3.1
Orthotrichum obtusifolium	Blunt Bristlemoss	SR	- -	- -	3.1
Meehania cordata	Meehania	SR	- -		1.1
Panax trifoleus	Dwarf Ginseng	SR	- -	- -	1.1
Aconitum reclinatum	Trailing Wolfsbane	SR	- -	- -	1.6

Carex manhartii	Manhart's Sedge	C	FSC	- -	1.3
Allium byrdickii	White Ramps	SR/PSC	- -	- -	1.7
Minuartia groenlandia	Greenland Sandwort	C	- -	- -	1.7
Gymnoderma linaere	**Rockgnome Lichen**	**T**	**E**	- -	1.7
Carex misera	Wretched Sedge	SR	- -	- -	1.7
Woodsia appachiania	Appalachian Cliff Fern	SR	- -	- -	1.8
Phlox subulata	Moss Pink	SR	- -	- -	1.8
Geum radiatum	**Cliff Avens**	**E-SC**	**E**	- -	1.8
Huperzia appalachiana	Appalachian Fir Clubmoss	C	- -	- -	1.8
Lilium grayi	Grays Lily	TSC	FSC	- -	1.9
Pyrola elliptica	Elliptic Shinleaf	C	- -	- -	2.1
Parnassia grandifolia	Large-leafed Grass of Parnassus	C/PT	- -	- -	2.2

NC:
E = Endangered
T = Threatened
SC = Special Concern
C = Candidate
SR = Significantly Rare
P = Proposed

US:
E = Endangered
T = Threatened
C = Candidate
FSC = Federal Species of Concern
P = Proposed

Animal Species:	Common Name:	NC Status:	US Status:	SWP Distance:	Radial Distance:
Bolotopera rossi	(a stonefly)	SR	- -	- -	3.8
Ephemerella berneri	(a mayfly)	SR	- -	13	3.6
Exoglossum laurae	Tonguetied minnow	SR	- -	1.0	0.5
Ceraclea mentiea	(a caddisfly)	SR	- -	1.0	0.4
Phenocobius teretulus	Konawa minnow	SR	FSC	13	0.6
Ceraclea slossonae	(a caddisfly)	SR	- -	1.0	0.7
Heteroclon petersii	(a mayfly)	SR	- -	0.9	0.7
Zapada chila	(a stonefly)	SR	- -	- -	4.0
Attaneuria ruralis	(a stonefly)	SR	- -	13	- -
Neophylax fuscus	(a caddisfly)	SR	- -	13	- -
Vireo gilvus	Warbling vireo (bird)	SR	- -	14.5	- -
Lasmigona Subdividis	**Greenfloater (mussel)**	**E**	FSC	14.5	- -
Plant Species:	Common Name:	NC Status:	US Status:	SWP Distance:	Radial Distance:
Houstonia montana	**Mountain Bluet**	**E**	**E**	- -	1.7
Saxifraga caroliniana	Carolina Saxifrage	C	FSC	0.2	0.2
Lindbergia brachyptera	Lindberg's Maple-moss	SR	- -	- -	3.1
Orthotrichum obtusifolium	Blunt Bristlemoss	SR	- -	- -	3.1
Meehania cordata	Meehania	SR	- -		1.1
Panax trifoleus	Dwarf Ginseng	SR	- -	- -	1.1
Aconitum reclinatum	Trailing Wolfsbane	SR	- -	- -	1.6

Carex manhartii	Manhart's Sedge	C	FSC	- -	1.3
Allium byrdickii	White Ramps	SR/PSC	- -	- -	1.7
Minuartia groenlandia	Greenland Sandwort	C	- -	- -	1.7
Gymnoderma linaere	**Rockgnome Lichen**	**T**	**E**	- -	1.7
Carex misera	Wretched Sedge	SR	- -	- -	1.7
Woodsia appachiania	Appalachian Cliff Fern	SR	- -	- -	1.8
Phlox subulata	Moss Pink	SR	- -	- -	1.8
Geum radiatum	**Cliff Avens**	**E-SC**	**E**	- -	1.8
Huperzia appalachiana	Appalachian Fir Clubmoss	C	- -	- -	1.8
Lilium grayi	Grays Lily	TSC	FSC	- -	1.9
Pyrola elliptica	Elliptic Shinleaf	C	- -	- -	2.1
Parnassia grandifolia	Large-leafed Grass of Parnassus	C/PT	- -	- -	2.2

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NATURAL HERITAGE PROGRAM LIST OF THE RARE ANIMALS OF NORTH CAROLINA*

1997 Edition

compiled by Harry E. LeGrand Jr., Vertebrate Zoologist
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North Carolina Natural Heritage Program
Division of Parks and Recreation
Department of Environment, Health, and Natural Resources

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* This list is dynamic and is revised frequently as further data become available. New species are added to the list, and others are dropped from the list for various reasons. The list will be revised periodically, generally every two years. If you are using a copy of this list which is more than a year old (check the edition date at the top of the first page), it might be invalid and you should request a new version. Further information on these species may be obtained by contacting the North Carolina Natural Heritage Program, Division of Parks and Recreation, Department of Environment, Health, and Natural Resources, P.O. Box 27687, Raleigh, NC 27611-7687 or the Nongame and Endangered Wildlife Program, North Carolina Wildlife Resources Commission, 512 North Salisbury Street, Raleigh, NC 27611.

LIST FORMAT

Species are grouped by major taxa. The vertebrates are arranged by class, beginning with the most advanced phylogenetically (mammals). Within a given taxa, species are listed alphabetically by scientific name. The following information is presented for each species on the list. "Status" is a word or phrase that indicates the degree of protection (if any), based on rarity, of a species; "rank" is a numerical scale of the rarity of a species, regardless of legal protection.

Scientific Name.

Common Name. For most groups, these names are not standardized.

North Carolina Status. Endangered, Threatened, and Special Concern species of mammals, birds, reptiles, amphibians, freshwater fishes, and freshwater and terrestrial mollusks have legal protection status in North Carolina (Wildlife Resources Commission). In addition to the above categories, the Natural Heritage Program maintains computer and map files on Significantly Rare species, as well as species considered Extirpated. Paper files only are maintained for a few of the above species; these species are indicated by the phrase "not tracking."

STATUS CODE	STATUS	DEFINITION
E	Endangered	"Any native or once-native species of wild animal whose continued existence as a viable component of the State's fauna is determined by the Wildlife Resources Commission to be in jeopardy or any species of wild animal determined to be an 'endangered species' pursuant to the Endangered Species Act." (Article 25 of Chapter 113 of the General Statutes; 1987).
T	Threatened	"Any native or once-native species of wild animal which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, or one that is designated as a threatened species pursuant to the Endangered Species Act." (Article 25 of Chapter 113 of the General Statutes; 1987).
SC	Special Concern	"Any species of wild animal native or once-native to North Carolina which is determined by the Wildlife Resources Commission to require monitoring but which may be taken under regulations adopted under the provisions of this Article." (Article 25 of Chapter 113 of the General Statutes; 1987).

STATUS CODE	STATUS	DEFINITION
SR	Significantly Rare	Any species which has not been listed by the N.C. Wildlife Resources Commission as an Endangered, Threatened, or Special Concern species, but which exists in the state in small numbers and has been determined by the N.C. Natural Heritage Program to need monitoring. (This is a N.C. Natural Heritage Program designation.) Significantly Rare species include "peripheral" species, whereby North Carolina lies at the periphery of the species' range (such as Purple Gallinule). The designation also includes marine and estuarine fishes identified as "Vulnerable" by the N.C. State Museum of Biological Sciences (Ross et al., 1988, Endangered, Threatened, and Rare Fauna of North Carolina. Part II. A Reevaluation of the Marine and Estuarine Fishes).
EX	Extirpated.	A species which is no longer believed to occur in the state.
W	Watch List	Any other species believed to be of conservation concern in the state because of scarcity, declining populations, threats to populations, or inadequacy of information to assess its rarity (see page ?? for a more complete discussion).
*	—	Species is a game animal, and therefore (by law) cannot be listed for State protection as E, T, or SC.
#	—	Species proposed for Endangered status, but not adopted by the Wildlife Resources Commission; species is protected from taking.
@	—	Species proposed for Special Concern status, but not adopted by the Wildlife Resources Commission; species is protected from taking.

STATUS CODE	STATUS	DEFINITION
E	Endangered	A taxon "which is in danger of extinction throughout all or a significant portion of its range" (Endangered Species Act, Section 3).
T	Threatened	A taxon "which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (Endangered Species Act, Section 3).
C	Candidate	"Taxa for which the [U.S. Fish and Wildlife] Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species. Proposed rules have not yet been issued because this action is precluded at present by other listing activity. Development and publication of proposed rules for these taxa are anticipated. The Service encourages State and other Federal agencies as well as other affected parties to give consideration to these taxa in environmental planning." (*Federal Register*, February 28, 1996). Taxa formerly considered as "Category 1" are now considered as "Candidate". NOTE: No animal taxon in North Carolina is currently considered as a "Candidate" for Federal listing.
FSC	(Federal) Species of Concern [also known as Species at Risk]	"... the Service is discontinuing the designation of Category 2 species as candidates in this notice. The Service remains concerned about these species, but further biological research and field study are needed to resolve the conservation status of these taxa. Many species of concern will be found not to warrant listing, either because they are not threatened or endangered or because they do not qualify as species under the definition in the [Endangered Species] Act. Others may be found to be in greater danger of extinction than some present candidate taxa. The Service is working with the States and other private and public interests to assess their need for protection under the Act. Such species are the pool from which future candidates for listing will be drawn." (*Federal Register*, February 28, 1996). The Service suggests that such taxa be considered as "Species of Concern" or "Species at Risk", neither of which has official status. The N.C. Natural Heritage Program uses "(Federal) Species of Concern" in this document for those taxa formerly considered as Category 2.
P_	Proposed	Species currently proposed, as either endangered or threatened. Species formally proposed receive some protection by law.

Scientific Name Province: Habitat	Common Name	Status N.C.	 U.S.	Rank N.C.	 Global
Vermivora pinus M: low elevation brushy fields and thickets [breeding season only]	Blue-winged Warbler	SR		S2B,SZN	G5
Vireo gilvus M: groves of hardwoods along rivers and streams [breeding season only]	Warbling Vireo	SR		S2B,SZN	G5

REPTILES

Alligator mississippiensis CT: fresh to slightly brackish lakes, ponds, rivers, and marshes	American Alligator	T	T (S/A)[9]	S3	G5
Apalone spinifera spinifera M: large streams in the French Broad system	Eastern Spiny Softshell	SC		S1	G5T5
Caretta caretta T: nests on beaches; forages in ocean and sounds	Loggerhead	T	T	S2B,S2N	G3
Chelonia mydas T: nests on beaches; forages in ocean and sounds	Green Turtle	T	T	S1B,SZN	G3
Clemmys muhlenbergii MP: bogs, wet pastures, wet thickets	Bog Turtle	T	FSC, PT(S/A)	S2	G3
Crotalus adamanteus C: pine flatwoods, savannas, pine-oak sandhills	Eastern Diamondback Rattlesnake	SR#		S1	G5
Deirochelys reticularia C: quiet waters of ponds, ditches, and sluggish streams	Chicken Turtle	SR		S3	G5
Dermochelys coriacea T: oceans, rarely in sounds	Leatherback	E	E	SZN	G3
Eretmochelys imbricata T: oceans, very rarely in sounds	Hawksbill	E	E	SZN	G3
Heterodon simus C: sandy woods, particularly pine-oak sandhills	Southern Hognose Snake	SR	FSC	S3	G4G5
Lampropeltis getula sticticeps T: maritime forests, thickets, and grasslands on the Outer Banks	Outer Banks Kingsnake	SC		S2	G5T2Q
Lepidochelys kempii T: ocean and sounds	Atlantic Ridley	E	E	SAB,SZN	G1

[9] T(S/A) = Threatened due to Similarity of Appearance. "The American Alligator is threatened due to Similarity of Appearance with other rare crocodilians, and is listed for trade purposes. The species is no longer biologically endangered or threatened, and is not subject to Section 7 consultation." (U.S. FWS)

Scientific Name Province: Habitat	Common Name	Status N.C.	 U.S.	Rank N.C.	 Global
Etheostoma mariae C: streams of Lumber drainage, mainly in the sandhills; perhaps in adjacent Pee Dee drainage	Pinewoods Darter	SC		S3	G3
Etheostoma perlongum C: Lake Waccamaw (endemic to North Carolina)	Waccamaw Darter	T		S1	G1Q
Etheostoma podostemone P: large streams in Dan River system	Riverweed Darter	SC		S2	G3
Etheostoma simoterum M: streams of French Broad drainage (formerly)	Snubnose Darter	SC		SH	G5
Etheostoma vulneratum M: streams of Little Tennessee system; perhaps extirpated from French Broad system	Wounded Darter	SC		S2	G3
Exoglossum laurae M: New drainage	Tonguetied Minnow	SR		S2	G4
Exoglossum maxillingua P: streams of Dan River system	Cutlips Minnow	E		S1	G5
Fundulus waccamensis C: large natural lakes (Lakes Waccamaw and Phelps) (endemic to North Carolina)	Waccamaw Killifish	SC	FSC	S1	G1
Heterandria formosa C: streams and lakes near Wilmington	Least Killifish	SC		S1	G5
Hiodon tergisus M: French Broad River	Mooneye	SC		S1	G5
Hybopsis monacha (see Cyprinella monacha)					
Hybopsis rubrifrons (see Notropis rubescens)					
Hybopsis zanema (see Cyprinella zanema)					
Hybopsis, new species [Cape Fear Chub] (merged with Cyprinella zanema)					
Hypentelium roanokense P: Dan drainage	Roanoke Hog Sucker	SR		S3	G3
Ichthyomyzon bdellium M: French Broad drainage	Ohio Lamprey	SR		S1	G3G4
Lampetra aepyptera CP: Tar and Neuse drainages	Least Brook Lamprey	SC		S2	G5
Lampetra appendix M: French Broad drainage	American Brook Lamprey	T		S1	G5
Lepomis megalotis M: French Broad drainage	Longear Sunfish	SR*		SH	G5
Lucania goodei C: stream in Wilmington area	Bluefin Killifish	SC		S1	G5
Luxilus chrysocephalus M: Cane River system	Striped Shiner	T		S1	G5

Scientific Name Province: Habitat	Common Name	Status N.C.	 U.S.	Rank N.C.	 Global
Percina aurantiaca M: Tennessee drainages	Tangerine Darter	SR		S3	G3G4
Percina burtoni M: South Toe River; formerly in French Broad drainage	Blotchside Darter	E		S1	G2
Percina caprodes M: Tennessee drainages	Logperch	T		S1	G5
Percina macrocephala M: French Broad River; probably extirpated	Longhead Darter	SC	FSC	SX	G3
Percina oxyrhynchus M: New drainage	Sharpnose Darter	SC		S1	G4
Percina sciera M: French Broad drainage	Dusky Darter	E		SH	G5
Percina squamata M: Tennessee drainages	Olive Darter	SC	FSC	S2S3	G3
Phenacobius teretulus M: New drainage	Kanawha Minnow	SC	FSC	S2S3	G3
Polyodon spathula M: French Broad River	Paddlefish	E	FSC	SH	G4
Scartomyzon ariommus P: Dan drainage	Bigeye Jumprock	SC		S2	G2
Semotilus lumbee C: streams in the sandhills	Sandhills Chub	SC		S3	G3
Stizostedion canadense M: French Broad and Hiwassee rivers	Sauger	SR*		S2	G5
Thoburnia hamiltoni P: Dan drainage	Rustyside Sucker	E		S1	G2

MARINE AND ESTUARINE FISHES

Acipenser brevirostrum TC: brackish water of large rivers and estuaries; spawns in freshwater areas	Shortnose Sturgeon	E	E	S1	G3
Acipenser oxyrhynchus TC: coastal waters, estuaries, large rivers	Atlantic Sturgeon	SC		S3	G3
Eleotris pisonis T: fresh to brackish ponds, river mouths, and estuaries	Spinycheek Sleeper	SR		S2	G5
Evorthodus lyricus T: shallow tidal water, salt marsh pools	Lyre Goby	SR		S2	GU
Gobionellus stigmaticus T: shallow salt or brackish water	Marked Goby	SR		S2	G?
Hypsoblennius ionthas T: shallow bays, estuaries, tidal creeks	Freckled Blenny	SR		S2	GU
Microphis brachyurus T: warm fresh to brackish water	Opossum Pipefish	SR		S1	G5
Oostethus brachyurus (see Microphis)					

Scientific Name Province: Habitat	Common Name	Status N.C.	 U.S.	Rank N.C.	 Global
Elliptio steinstansana PC: Tar River drainage, primarily Swift Creek (endemic to North Carolina)	Tar Spinymussel	E	E	S1	G1
Elliptio waccamawensis C: Lake Waccamaw and vicinity (endemic to North Carolina; possibly in adjacent South Carolina)	Waccamaw Spike	T	FSC	S1	G1G2Q
Epioblasma capsaeformis M: French Broad River (formerly reported)	Oyster Mussel	EX	FSC	SX	G2
Fusconaia barnesiana M: Little Tennessee River	Tennessee Pigtoe	E		S1	G2G3
Fusconaia masoni CP: most Atlantic drainages, in lower Piedmont and upper Coastal Plain; also in Black River in lower Coastal Plain	Atlantic Pigtoe	T	FSC	S1	G2
Fusconaia subrotunda M: French Broad River (formerly reported)	Long-solid	EX		SX	G4
Lampsilis cariosa PC: a number of river systems; mainly near the Fall Line	Yellow Lampmussel	T	FSC	S1	G4
Lampsilis crocata C: Lake Waccamaw and vicinity; possibly Orton Pond	Waccamaw Lampmussel	SC		S1	G1Q (GU)
Lampsilis fasciola M: French Broad, Pigeon, and Little Tennessee rivers; currently known only in last river	Wavy-rayed Lampmussel	SC		S1	G4
Lampsilis fullerkati C: Lake Waccamaw and vicinity (endemic to North Carolina and adjacent South Carolina)	Waccamaw Fatmucket	T	FSC	S1	G1Q
Lampsilis radiata CP: a number of river systems	Eastern Lampmussel	SC		S1S2	G5 (G4)
Lasmigona decorata P: Catawba and Pee Dee drainages in Union County (endemic to this area and adjacent South Carolina)	Carolina Heelsplitter	E	E	S1	G1
Lasmigona holstonia M: Mills River; formerly in Valley Creek in Cherokee County	Tennessee Heelsplitter	E	FSC	S1	G2G3
Lasmigona subviridis CPM: Tar, Neuse, and Cape Fear systems downstate; New and Watauga systems in mountains	Green Floater	E	FSC	S1	G3
Leptodea ochracea CP: a number of systems, primarily in the Coastal Plain; abundant in Lake Waccamaw	Tidewater Mucket	SC		S1	G4
Ligumia nasuta C: Chowan, Roanoke, and Cape Fear systems	Eastern Pondmussel	SC		S1	G4 (G3)

Scientific Name Province: Habitat	Common Name	Status N.C.	 U.S.	Rank N.C.	 Global
Anthopotamus verticis P: Recorded in Yadkin R. (Caldwell) and Flat R. (Person) but probably is more widespre widespread	a mayfly	SR		S3	G?
Baetisca becki PC: Swift Crk. (Nash), Fishing Crk. (Edgecombe)	a mayfly	SR		S1	G?
Baetisca laurentina PC: Lower Jacobs Fork (Catawba), Trent R. (Jones)	a mayfly	SR		SU	G?
Baetisca obesa C: Known in NC only from the lower Tar R. (Edgecombe, Pitt)	a mayfly	SR		S1	G?
Barbaetis benfieldi M: Jacob Fork (Burke), French Broad R. (Transylvania), Caney Fork (Jackson); may be undersampled -- narrow window of collectibility	a mayfly	SR		S1	G?
Cercobrachys etowah P: Known in NC only from the Tar R.; taxonomically difficult	a mayfly	SR		S1	G?
Choroterpes basalis CP: Waccamaw River (Columbus, Brunswick), Drowning Crk. (Richmond); P: Bear Creek (Chatham), Lanes Creek (Union), UT Laurens Creek (Union), Dutchmans Creek (?)	a mayfly	SR		S2	G?
Dannella lita MP: Recorded in twenty streams and rivers in Mountains and Piedmont	a mayfly	SR		S3	G?
Dolania americana C: Only known NC occurrence is from the Black River (Sampson); not seen since 1974	a mayfly	SR	FSC	SH	G2
Drunella longicornis M: Recorded from nine streams and rivers in the Mountains, from Watauga R. (Watauga) to Williamson Crk. (Transylvania)	a mayfly	SR		S3	G?
Ephemerella argo C: Lower Little R. (Hoke), Naked Crk. (Richmond), Drowning Crk. (Richmond), Lumber R. (Robeson, Scotland); needs more sampling in the spring	Argo Ephemerellan Mayfly	SR	FSC	S2	G1G3
Ephemerella berneri PM: Probably widespread in clean streams and rivers with Podostemum	a mayfly	SR		S3	G?
Ephemerella floripara C: New state record	a mayfly	SR		S1?	G?

Scientific Name Province: Habitat	Common Name	Status N.C.	 U.S.	Rank N.C.	 Global
Heterocloeon petersi M: Definite specimens from three mountain streams: Ivy Crk. (Madison), S. Fk. New R. (Ashe), N. Fk. New R. (Ashe); may be more widespread in mountain rivers; difficult to id	a mayfly	SR		S2S3	G?
Homoeoneuria cahabensis P: S. Fk. Yadkin (Davie), S. Fk. Catawba R. (Lincoln), Hunting Crk. (Iredell), Third Crk. (Rowan), Second Broad R. (Rutherford)	a mayfly	SR		S1S2	G1G3
Leptohyphes robacki P: Uwharrie River	a mayfly	SR		S1	G?
Litobrancha recurvata M: Known from eight or nine rivers and streams in the Mountains, from Watauga R. (Avery, Watauga) to upper Nantahala R. (Macon)	a mayfly	SR		S3	G?
Macdunnoa brunnea MP: French Broad R. (Buncombe), Mills R. (Henderson); P: Hunting Crk (Davie, Iredell), Leepers Crk (Gaston), Yadkin R. (Wilkes), Swift Crk. (Nash)	a mayfly	SR		S2S3	G?
Pseudiron centralis P: no locality data	a mayfly	SR		S2S3	G?
Tortorpus incertus P: Only one NC specimen known, from Tar R. (Franklin)	a mayfly	SR		S1	G?

INSECTS -- STONEFLIES[14]

Attaneuria ruralis MC: Cataloochee Crk. (Haywood), W. Fk. Pigeon R. (Haywood), S. Fk. New R. (Ashe); Naked Crk. (Richmond)	a stonefly	SR		S2?	G?
Bolotoperla rossi M: Known from eight streams and rivers in the Mountains, from Ashe County to Transylvania County	a stonefly	SR		S3	G?
Diploperla morgani PM: Surry, Burke, Caldwell, McDowell; Ashe, Clay, Jackson, Macon, Swain	a stonefly	SR		S3	G?

[14] This list was developed by the Biological Assessment group of the N.C. Division of Water Quality.

Scientific Name Province: Habitat	Common Name	Status N.C.	 U.S.	Rank N.C.	 Global
Isoperla frisoni MP: Known from six streams and rivers in the Mountains, from the New R.(Ashe) to Whiteoak Crk. (Macon); also found in the Dan R. (Stokes)	a stonefly	SR		S3	G?
Isoperla n. sp. 10 C: Known only from the Sandhills of NC	a stonefly	SR		S1	G?
Megaleuctra williamsi M: UT Cullasaja R. (Macon), Cove Crk. (Haywood), Mull Crk. (Jackson); possibly undersampled -- semi-aquatic	a stonefly	SR		S1	G?
Pteronarys proteus M: Howard Creek	a stonefly	SR		S1S2	G?
Shipsa rotunda CPM: Known from twelve streams in Mountains, Piedmont, and Coastal Plain	a stonefly	SR		S2S3	G?
Zapada chila M: Beech Flat Prong (Swain), also in Ashe County; hard to id and may be undersampled -- occurs in small streams	a stonefly	SR		S1S2	G?

INSECTS -- CADDISFLIES[15]

Agapetus jocassee M: Reported from NC, but without occurrence data	a caddisfly	SR	FSC	SR	G?
Ceraclea cancellata CP: Naked Creek, Roanoke River	a caddisfly	SR		S1S2	G?
Ceraclea joannae P: Only known occurrence is from Little River (Montgomery); distinctive species whose habitat has probably not been undersampled	a caddisfly	SR		S1	G?
Ceraclea mentiea MP: Big Horse Crk. (Ashe), North and South Forks of New R. (Ashe, Alleghany); Mayo R. (Rockingham)	a caddisfly	SR		S2?	G?
Ceraclea slossonae M: N. Fk. New R. (Ashe), Johns R. (Burke); may be more numerous but difficult to id	a caddisfly	SR		S2?	G?
Ceraclea tarsipunctata P: Cane Creek, Yadkin River, Long Creek	a caddisfly	SR		S3	G?
Ceratopsyche bifida M: Known from nine streams and rivers in the Mountains	a caddisfly	SR		S3	G?

[15] This list was developed by the Biological Assessment group of the N.C. Division of Water Quality.

Scientific Name Province: Habitat	Common Name	Status N.C.	 U.S.	Rank N.C.	 Global
Dibusa angata P: S. Yadkin R. (Davie), Eno R. (Durham), Little R. (Wake), Little R. (Durham), Cane Crk. (Orange)	a caddisfly	SR		S3?	G?
Diplectrona metaqui P: Known in NC only from Hanging Rock State Park (Stokes) but has possibly been undersampled -- occurs in small streams	a caddisfly	SR		S1?	G?
Goera fuscula M: Whiteoak Creek and other small streams	a caddisfly	SR		S3	G?
Helicopsyche paralimnella M: Fires Crk. (?), Bearwallow Crk. (Transylvania) (confined to SW Mtns in NC)	a caddisfly	SR	FSC	S2	G?
Hydropsyche carolina M: Whitewater R. (Macon)	a caddisfly	SR		S1	G?
Hydroptila englishi ?: Reported from NC, but without occurrence data	a caddisfly	SR	FSC	SR	G?
Madeophylax altus M: Recorded only from Mt. Mitchell but probably occurs elsewhere	Mount Mitchell Caddisfly	SR	FSC	SU	G?
Matrioptila jeanae PM: Known from ten streams and rivers in the Mountains and Piedmont; poorly sampled due to occurrence in small streams	a caddisfly	SR		S3	G?
Micrasema burksi M: Known from eleven streams in the Mountains, from Avery to Clay County	a caddisfly	SR		S3	G?
Micrasema sprulesi PM: Known from eight streams and rivers, primarily in the Mountains but also in the Mayo R. (Rockingham)	a caddisfly	SR		S3	G?
Neophylax fuscus MP: Johns R. (Caldwell), S. Fk New R. (Ashe), N. Fk. New R. (Ashe), New R. (Alleghany), Alleghany Crk. (Alleghany); Swift Crk. (Nash), Little Fishing Crk. (Halifax)	a caddisfly	SR		S3	G?
Palaeagapetus celsus M: Wilson Crk. (Avery), Boone Fork (Watuaga); may be undersampled due to occurrence in small streams	a caddisfly	SR		S2?	G?
Psilotreta frontalis M: Indian Creek, Ravens Fork Creek	a caddisfly	SR		S2	G?
Psilotreta labida C: Drowning Creek, Dry Creek, Big Tuni Creek, Horse Creek, Nicks Creek	a caddisfly	SR		S3	G?

Scientific Name Province: Habitat	Common Name	Status N.C.	 U.S.	Rank N.C.	 Global
Speyeria diana MP: rich woods and adjacent edges and openings; believed extirpated from the lower Piedmont; host plants -- violets (Viola)	Diana Fritillary	SR	FSC	S3	G3
Speyeria idalia M: wet or dry meadows, bogs, open hilltops; host plants -- violets (Viola)	Regal Fritillary	SR	FSC	S1	G3

INSECTS -- GRASSHOPPERS AND KATYDIDS[19]

Eotettix pusillus C: sandhills (wet swales?)	Little Eastern Grasshopper	SR		S2?	G2G3
Melanoplus angustipennis impiger C: sandhills	Narrow-winged Melanoplus	SR		S1S3	G4
Melanoplus attenuatus C: wet swales in pinewoods	Slender-bodied Melanoplus	SR		S1S3	G2G3
Melanoplus cherokee M: woodlands, 1800' - 5100'	Cherokee Melanoplus	SR		S1S3	G4
Melanoplus decorus C: savannas, flatwoods, low pocosins	a short-winged Melanoplus	SR		S3	G3?
Melanoplus divergens M: glades and balds, 1800' - 4717'	Divergent Melanoplus	SR		S1S3	G2G3
Melanoplus mirus PC: open woodlands	a short-winged Melanoplus	SR		S2S3	G2G3
Melanoplus nigrescens CT: pinewoods and maritime forests	Black-sided Spur-throat Grasshopper	SR		S1S3	GU
Melanoplus nubilius C: flatwoods, savannas, sandhills	a short-winged Melanoplus	SR		S3	G3?
Melanoplus serrulatus M: valleys and lower slopes, Nantahala Mountains	Serrulate Melanoplus	SR		S1S3	G1G3
Melanoplus viridipes eurycerus M: woodlands and forest edges	Green-legged Melanoplus	SR		S1S3	G4G5T4T5
Montezumina modesta C: pinewoods and other habitats	Montezuma Katydid	SR		SU	GU
Scudderia septentrionalis M: forests	Northern Bush Katydid	SR		SH	G3?
Stethophyma celata C: bogs, wet tallgrass prairies	Broad-winged Sedge Grasshopper	SR		S1S2	G2?Q
Trimerotropis saxatalis M: lichen-covered rock outcrops	Rock-loving Grasshopper	SR		S1S2	G2G3

[19] State ranks are based primarily on the following published sources: Rehn and Hebard, 1910 and 1916; Blatchley, 1920; Hebard, 1935 and 1937; Brimley, 1938; Dakin, et al., 1970; Otte, 1979 and 1981; and Helfer, 1987. Additional information was supplied through NC NHP field surveys and inspection of the insect collections at the N.C. Department of Agriculture and at N.C. State University.

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NATURAL HERITAGE PROGRAM LIST OF THE RARE PLANTS OF NORTH CAROLINA*
1997 Edition

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North Carolina Natural Heritage Program
Division of Parks and Recreation
Department of Environment, Health and Natural Resources

ACKNOWLEDGMENTS ii

NATURAL HERITAGE PROGRAM LIST OF THE RARE PLANTS OF NORTH CAROLINA 1
- VASCULAR PLANTS 9
- MOSSES 35
- LIVERWORTS 38
- HORNWORTS 41
- LICHENS 42

SUPPLEMENT TO THE
- NATURAL HERITAGE PROGRAM LIST OF THE RARE PLANTS OF NORTH CAROLINA 43
- NORTH CAROLINA PLANT WATCH LIST 45
  - VASCULAR PLANTS 47
  - MOSSES 70
  - LIVERWORTS 71
  - HORNWORTS 72
  - LICHENS 72
- REGIONALLY RARE PLANT (WITHIN-STATE DISJUNCT) LIST 73
- POTENTIAL NEW TO NORTH CAROLINA PLANTS 75

ADDENDUM 1: 1997 SIGNIFICANT PLANT LIST REVISIONS 81

ADDENDUM 2: NORTH CAROLINA NATURAL HERITAGE PROGRAM ENDANGERED AND RARE PLANT FIELD SURVEY FORM 83

INDEX 85

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* This list is dynamic, being revised frequently as further data become available. *If you are using a copy of this list which is more than a year old* (check the edition date at the top of the first page), *it may be out of date and you should contact the Natural Heritage Program for important updates.* Further information on these species may be obtained by contacting the North Carolina Natural Heritage Program, Division of Parks and Recreation, Department of Environment, Health, and Natural Resources, P.O. Box 27687, Raleigh, NC 27611-7687 or the North Carolina Plant Conservation Program, Department of Agriculture, P.O. Box 27647, Raleigh, NC 27611-7647.

Cover illustration by Caren Caljouw

common to latin over Ref.

NCNatural.com/wildSUM/endangrd.html

North Carolina Status. Endangered, Threatened, and Special Concern species have legally protected status in North Carolina through NC PCP. NC NHP maintains computer and map files on Endangered, Threatened, Candidate, and Significantly Rare species; paper files are maintained on Watch List species.

STATUS CODE	STATUS	DEFINITION
E	Endangered	"Any species or higher taxon of plant whose continued existence as a viable component of the State's flora is determined to be in jeopardy" (GS 19B 106: 202.12). (Endangered species may not be removed from the wild except when a permit is obtained for research, propagation, or rescue which will enhance the survival of the species.)
T	Threatened	"Any resident species of plant which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range" (GS 19B 106:202.12). (Regulations are the same as for Endangered species.)
SC	Special Concern	"Any species of plant in North Carolina which requires monitoring but which may be collected and sold under regulations adopted under the provisions of [the Plant Protection and Conservation Act]" (GS 19B 106:202.12). (Special Concern species which are not also listed as Endangered or Threatened may be collected from the wild and sold under specific regulations. Propagated material only of Special Concern species which are also listed as Endangered or Threatened may be traded or sold under specific regulations.)
C	Candidate	Species which are very rare in North Carolina, generally with 1-20 populations in the state, generally substantially reduced in numbers by habitat destruction (and sometimes also by direct exploitation or disease). These species are also either rare throughout their ranges (fewer than 100 populations total) or disjunct in North Carolina from a main range in a different part of the country or world. Also included are species which may have 20-50 populations in North Carolina, but fewer than 50 populations rangewide. These are species which have the preponderance of their distribution in North Carolina and whose fate depends largely on their conservation here. Also included are many species known to have once occurred in North Carolina but with no known extant occurrences in the state (historical or extirpated species); if these species are relocated in the state, they are likely to be listed as Endangered or Threatened. If present land use trends continue, candidate species are likely to merit listing as Endangered or Threatened.
SR	Significantly Rare	Species which are very rare in North Carolina, generally with 1-20 populations in the state, generally substantially reduced in numbers by habitat destruction (and sometimes also by direct exploitation or disease). These species are generally more common somewhere else in their ranges, occurring in North Carolina peripherally to their main ranges, mostly in habitats which are unusual in North Carolina. Also included are some species with 20-100 populations in North Carolina, if they also have only 50-100 populations rangewide and are declining.

W	Watch List	Any other species believed to be rare and of conservation concern in the state but not warranting active monitoring at this time (see the Watch List section in the Supplement for a more complete discussion).
P_	Proposed	A species which has been formally proposed for listing as Endangered, Threatened, or Special Concern, but has not yet completed the legally mandated listing process.

United States Status is designated by the U.S. Fish and Wildlife Service. Federally listed Endangered and Threatened species are protected under the provisions of the Endangered Species Act of 1973, as amended. Unless otherwise noted, definitions are taken from the *Federal Register*, Vol. 55, No. 35, Septmeber 30, 1993 (50 CFR Part 17).

NOTE: In February 1996, the U.S. Fish and Wildlife Service revised its categories for the Candidate (=Status Review) list.

- Taxa formerly considered as 'Category 1' candidates for listing are now considered as 'Candidate'.
- Taxa formerly considered as 'Category 2' candidates are now no longer being maintained by the Service as Candidate or Status Review taxa. The Service suggests that such taxa be considered as 'Species of Concern' or 'Species at Risk', neither of which has official status. The NC NHP uses '(Federal) Species of Concern' in this document for those taxa formerly considered as Category 2.
- Taxa formerly considered as 'Category 3' candidates are now no longer being maintained by the Service. These were taxa: 1) for which the Service has persuasive evidence of extinction (Category 3A); 2) that do not represent distinct entities meeting the Act's Definition of 'species' (Category 3B); or 3) that have proven to be more abundant or widespread, or not subject to any identifiable threat (Category 3C).

STATUS CODE	STATUS	DEFINITION
E	Endangered	A taxon "which is in danger of extinction throughout all or a significant portion of its range" (Endangered Species Act, Section 3).
T	Threatened	A taxon "which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range (Endangered Species Act, Section 3).
C	Candidate	"Taxa for which the [Fish and Wildlife] Service has on file enough substantial information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened. Proposed rules have not yet been issued because this action is precluded at present by other listing activity. Development and publication of proposed rules on these taxa are anticipated. The Service encourages State and other Federal agencies as well as other affected parties to give consideration to these taxa in environmental planning." (*Federal Register*, February 28, 1996). Taxa formerly considered as 'Category 1' are now considered as 'Candidate'.

FSC	(Federal) Species of Concern	"... the Service is discontinuing the designation of Category 2 species as candidates in this notice. The Service remains concerned about these species but further biological research and field study are needed to resolve the conservation status of these taxa. Many species of concern will be found not to warrant listing, either because they are not threatened or endangered or because they do not qualify as species under the definition in the [Endangered Species] Act. Others may be found to be in greater danger of extinction than some present candidate taxa. The Service is working with the States and other private and public interests to assess their need for protection under the Act. Such species are the pool from which future candidates for listing will be drawn." (*Federal Register*, February 28, 1996).
P_	Proposed	"Taxa already proposed to be listed as "endangered or threatened. Taxa formally proposed as endangered or threatened receive some legal protection. Species listed as proposed candidates are species which are in the process of being added to the federal candidate list.

North Carolina Rank. North Carolina ranks are based on The Nature Conservancy's (TNC) system of measuring rarity and threat status. This system is now widely used by other agencies and organizations, as the best available scientific and objective assessment of a species' rarity at the state level.

RANK	NUMBER OF EXTANT POPULATIONS	DESCRIPTION
S1	1-5	Critically imperiled in North Carolina because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation (local extinction) from the state.
S2	6-20	Imperiled in North Carolina because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state.
S3	21-100	Rare or uncommon in North Carolina.
S4	100-1000	Apparently secure in North Carolina, with many occurrences.
S5	1000+	Demonstrably secure in North Carolina.
SA	--	Accidental in state.
SH	0?	Of historical occurrence in North Carolina, perhaps not having been verified in the past 20 years, and suspected to be still extant.
SR	--	Reported from North Carolina, but without persuasive documentation which would provide a basis for either accepting or rejecting the report.
SX	0	Apparently extirpated from North Carolina.
SU	--	Possibly in peril in North Carolina but status uncertain; need more information.
S?	--	Unranked, or rank uncertain.

Scientific Name / Province: Habitat (Counties of Occurrence)	Common Name	Status NC	Status US	Rank NC	Rank Global
VASCULAR PLANTS					
Abies fraseri	Fraser Fir	C	FSC	S2	G2
M: spruce-fir forests (Avery*, Buncombe*, Caldwell*, Clay, Jackson*, Mitchell*, Swain*, Transylvania*, Watauga*, Yancey*)					
Aconitum reclinatum	Trailing Wolfsbane	SR	-	S3	G3G4
M: rich coves, seepage slopes, boulderfields, rocky stream banks, mainly associated with mafic rocks (Ashe*, Avery*, Buncombe*, Caldwell, Graham*, Graham*, Macon*, Mitchell*, Transylvania*, Watauga*, Yancey*)					
Adiantum capillus-veneris	Venus Hair Fern	C/PE	-	S1	G5
C: coquina limestone (marl) outcrops (also adventitious on mortar of old stone walls in Wilmington, New Hanover County) (Columbus*)					
Adlumia fungosa	Climbing Fumitory	SR	-	S2	G4
M: coves and cliffs (Alleghany, Buncombe*, Haywood*, Henderson, Jackson, Macon, Madison*, Yancey*)					
Aeschynomene virginica	Virginia Jointvetch	E	T	S1	G2
C: tidal marshes and wet ditches (Beaufort*, Craven, Hyde*, Lenoir)					
Agalinis aphylla	Scale-leaf Gerardia	SR	-	S3	G3G4
CS: wet savannas and sandhill/pocosin ecotones (Brunswick*, Carteret*, Columbus*, Craven*, Cumberland*, Duplin, Hoke*, Jones, New Hanover, Onslow*, Pender*, Sampson)					
Agalinis decemloba	Piedmont Gerardia	SR	-	S2	G4
PMS: dry, open sites (Buncombe, Burke, Durham*, Forsyth, Granville*, Guilford, Harnett*, Henderson, Hoke*, Orange*, Randolph*, Richmond*, Rutherford, Scotland*, Swain, Transylvania, Wake*, Warren*, Wilkes)					
Agalinis linifolia	Flaxleaf Gerardia	SR	-	S3	G3G4
C: savannas, clay-based Carolina bays, depression ponds, and other wet, open habitats (Bladen*, Brunswick*, Carteret, Columbus*, Craven*, Cumberland, Dare, Hoke*, New Hanover*, Onslow*, Pender*, Robeson*, Sampson*, Scotland*)					
Agalinis virgata	Branched Gerardia	SR	-	S2	G3G4
CS: savannas (Brunswick, Carteret*, Craven*, Duplin, New Hanover*, Onslow*, Pender*, Scotland*)					
Agropyron (see *Elymus*)					
Agrostis mertensii (= *Agrostis borealis*)	Arctic Bentgrass	C	-	S1	G5
M: high elevation rocky summits and balds (Avery*, Mitchell, Yancey*)					
Allium burdickii (not in RAB)	White Ramps	SR/PSC	-	S1?	G4G5
M: cove forests (Buncombe?, Mitchell*, Transylvania?)					
Allium cuthbertii	Striped Garlic	C	-	S1	G3G4
PM: low elevation granitic domes and other rocky sites with circumneutral soils (Alexander*, Chatham?, Madison, Wilkes)					
Allium sp. 1 (not in RAB)	Savanna Onion	C	-	S1	G1
C: wet savannas (Brunswick*, Onslow*, Pender*)					
Alnus viridis ssp. *crispa* (= *Alnus crispa*)	Green Alder	C	-	S1	G5T5
M: balds (Avery*, Mitchell*)					
Amaranthus pumilus	Seabeach Amaranth	T	T	S2	G2
C: ocean beaches and island-end flats (Brunswick*, Carteret*, Currituck*, Dare*, Hyde*, New Hanover*, Onslow*, Pender*)					

Scientific Name Province: Habitat (Counties of Occurrence)	Common Name	Status NC	Status US	Rank NC	Rank Global
Carex decomposita C: blackwater swamp forests (Brunswick*, New Hanover, Warren)	Cypress Knee Sedge	SR	-	S1	G4
Carex deflexa (not in RAB) M: high elevation seepy forests (Haywood?, Jackson?)	A Sedge	C	-	S1	G5
Carex eburnea M: calcareous outcrops (Madison*)	Bristle-leaf Sedge	SR	-	S1	G5
Carex exilis S: seepage bogs (Cumberland*, Harnett*, Hoke*, Moore)	Coastal Sedge	T	-	S1	G5
Carex hitchcockiana (not in RAB) M: moist to dryish forests over calcareous or mafic rocks (Jackson*)	Hitchcock's Sedge	C	-	S1	G5
Carex hormathodes (not in RAB) C: marshes (Currituck*)	A Sedge	SR	-	S1	G4G5
Carex impressinervia (not in RAB) P: wet forests (Montgomery*)	Ravine Sedge	C	FSC	S1	G1G2
Carex jamesii PC: rich woods, especially over mafic rocks (Caswell*, Durham*, Halifax, Lee*, Northampton)	James's Sedge	SR	-	S1	G5
Carex leptonervia M: rich cove forests and seepage slopes (Avery, Buncombe*, Clay, Haywood, Henderson*, Macon*, Madison, Swain)	A Wood Sedge	C	-	S1	G4
Carex lupuliformis CP: moist bottomlands, especially in calcareous or mafic areas (Forsyth, Granville, Jones*, Pamlico)	Hop-like Sedge	C	-	S1	G3?
Carex lutea (not in RAB) C: savanna-swamp forest ecotones, over coquina limestone (marl) (Onslow*, Pender*)	Golden Sedge	C/PE	PFSC	S1	G1
Carex manhartii (*C. purpurifera* in part) M: rich cove forests (Ashe*, Avery*, Cherokee*, Clay*, Haywood*, Jackson*, Macon*, Transylvania*)	Manhart's Sedge	C	FSC	S2	G2?
Carex meadii PM: low wet places over diabase (Durham, Granville*, Orange)	Mead's Sedge	SR	-	S1	G4G5
Carex misera M: high elevation rock outcrops (Ashe*, Avery*, Buncombe*, Clay*, Haywood*, Henderson*, Jackson*, Macon*, Mitchell*, Swain*, Transylvania*, Watauga*, Yancey*)	Wretched Sedge	SR	-	S3	G3
Carex oligosperma (not in RAB) M: seeps and bogs (Ashe*, Avery*, Mitchell*, Watauga*)	Few-seeded Sedge	C/PE	-	S1	G4
Carex pedunculata (not in RAB) M: rich cove forests (Henderson*, Polk*, Transylvania*)	Longstalk Sedge	C	-	S1	G5
Carex projecta CMP: bogs, marshes, swamps (Avery, Cherokee, Cumberland, Iredell, Madison*, Mecklenburg, Mitchell*, Swain, Transylvania*)	Necklace Sedge	C	-	S1	G5
Carex purpurifera (= RAB in part only) M: low elevation, rich forests over limestone or marble (Cherokee*, Graham*, Swain*)	Purple Sedge	C	FSC	S1	G4?
Carex radfordii (not in RAB) M: rich cove forests in the Blue Ridge escarpment region (Jackson*)	Radford's Sedge	C	-	S1	G2
Carex reniformis CP: swamps, open wet areas (Johnston, Wake)	Kidney Sedge	SR	-	SH	G4?
Carex roanensis (not in RAB) M: forests (McDowell*, Mitchell*)	Roan Sedge	C	FSC	S1	G1
Carex schweinitzii M: bogs and swamp forests (Henderson*)	Schweinitz's Sedge	E	FSC	S1	G3
Carex socialis (not in RAB) C: streambeds and riverbanks (Columbus*, Cumberland*)	Social Sedge	SR	-	S1	G3?

Scientific Name Province: Habitat (Counties of Occurrence)	Common Name	Status NC	Status US	Rank NC	Rank Global
Euphorbia purpurea M: forests, especially over mafic rock (Ashe*, Buncombe*, Clay*, Graham*, Haywood*, Jackson*, Macon*, Madison*, Mitchell*, Swain*, Watauga, Yancey*)	Glade Spurge	C	FSC	S2	G3
Euphorbia (also see *Chamaesyce*)					
Eustachys glauca (= *Chloris glauca*) C: salt marshes (New Hanover)	Saltmarsh Fingergrass	SR	-	SH	G4
Filipendula rubra M: bogs, wet meadows (Buncombe, Haywood*, Macon, Watauga, Yancey*)	Queen-of-the-Prairie	E	-	S1	G4G5
Fimbristylis perpusilla (not in RAB) C: drawdown zones of blackwater rivers (Brunswick*, Columbus*)	Harper's Fimbry	T	FSC	S1	G2G3
Fothergilla major MP: dry ridgetop or bluff forests (Burke*, Chatham*, Gaston, Montgomery*, Orange*, Polk, Randolph, Rutherford* Stanly*, Stokes*, Surry, Transylvania*)	Large Witch-alder	C	-	S2	G3
Frasera caroliniensis (= *Swertia caroliniensis*) M: deciduous forests (Cherokee, Clay*, Macon*)	Columbo	SR	-	S2S3	G5
Gaillardia aestivalis S: sandhills (Cumberland, Hoke*, Moore, Richmond*, Scotland*)	Sandhills Gaillardia	C	-	S1	G5
Galactia mollis S: sandhills (Brunswick, Cumberland*, Hoke*, Richmond*, Scotland*, Wayne)	Soft Milk-pea	C	-	S2	G4G5
Gale (see *Myrica*)					
Gelsemium rankinii C: floodplains of blackwater rivers and streams (Brunswick*, Columbus*, New Hanover*, Pender*)	Swamp Jessamine	SR	-	S2	G5
Gentiana flavida (= *Gentiana alba*) M: habitat not known (Watauga)	Yellow Gentian	C	-	SH	G4
Gentiana (also see *Gentianopsis*)					
Gentianopsis crinita (= *Gentiana crinita*) M: glades, serpentine barrens, open sites over basic rocks (Ashe*, Clay*, Macon, Watauga*)	Fringed Gentian	E-SC	-	S1	G4
Geum aleppicum M: bogs (Avery, Swain*)	Yellow Avens	C	-	S1	G5
Geum geniculatum M: high elevation forests, streambanks, seepage slopes (Avery*, Caldwell*, Mitchell*, Watauga*)	Bent Avens	T	FSC	S2	G2
Geum laciniatum var. *trichocarpum* M: bogs (Avery*)	Rough Avens	C	-	S1	G5T?
Geum radiatum M: high elevation rocky summits (Ashe*, Avery*, Buncombe*, Burke, Mitchell*, Transylvania*, Watauga*, Yancey*)	Cliff Avens, Spreading Avens	E-SC	E	S1	G1
Gillenia (see *Porteranthus*)					
Glyceria laxa (= *G. canadensis* var. *laxa*) M: seeps (Alleghany, Haywood*, Henderson, Macon, Transylvania*)	Lax Mannagrass	SR	-	S1	G5
Glyceria nubigena M: high elevation seeps (Graham*, Haywood*, Swain*)	Smoky Mountain Mannagrass	T	FSC	S2	G2
Glyceria (also see *Torreyochloa*)					
Gnaphalium helleri var. *helleri* (not in RAB) PS: dry woodlands, openings, and glades, especially over mafic rocks (Anson, Cabarrus*, Davidson, Durham, Forsyth, Franklin, Granville*, Guilford, Halifax, Harnett, Hoke*, Mecklenburg*, Montgomery*, Moore, Orange, Person, Rowan, Scotland, Union*, Wake*)	Heller's Rabbit Tobacco	SR	-	S2?	G4G5T3
Gnaphalium helleri var. *micradenium* (not in RAB) P: dry woodlands (Caswell*, Granville, Person*, Stokes)	Small Rabbit Tobacco	C	-	S1	G4G5T3

Scientific Name Province: Habitat (Counties of Occurrence)	Common Name	Status NC	Status US	Rank NC	Rank Global
Hexastylis naniflora P: rich deciduous forests, bluffs, and ravines (Burke*, Catawba*, Cleveland*, Lincoln*, Polk*, Rutherford*)	Dwarf-flowered Heartleaf	E/PT	T	S2	G2
Hexastylis rhombiformis (not in RAB) MP: cove forests (Buncombe*, Burke?, Henderson*, Polk*, Transylvania*)	French Broad Heartleaf	C	FSC	S2	G2
Hibiscus aculeatus C: savannas (Carteret*, New Hanover, Robeson)	Savanna Hibiscus, Comfortroot	C	-	SH	G4G5
Hierochloe odorata (not in RAB) M: bogs (Ashe*, Macon*, Watauga)	Holy Grass	PE	-	S1	G5
Hottonia inflata CP: pools in black- or brown-water swamps, interdune ponds (Bertie, Chatham, Currituck, Dare*, Edgecombe, Gates*, Halifax, Hertford, Johnston*, Lenoir, Martin*, Northampton*, Perquimans)	Water Violet	C	-	S2	G4
Houstonia longifolia var. *glabra* (not in RAB) M: high elevation granitic domes, rarely other outcrops (Clay, Haywood, Jackson*, Macon*, Transylvania*)	Granite Dome Bluet	SR	-	S2	G4G5T2
Houstonia montana (= *Hedyotis purpurea* var. *m.*; not in RAB) M: high elevation rocky summits, grassy balds (Ashe*, Avery*, Mitchell*, Watauga*, Yancey*)	Mountain Bluet	E	E	S2	G2Q
Hudsonia montana M: gorge rim outcrops, rocky summits, pine-oak/heath ridges (Burke*, McDowell*)	Mountain Golden-heather	E	T	S1	G1
Hudsonia tomentosa C: openings in maritime forest, blowouts, dunes and medaños (Currituck*, Dare*)	Woolly Beach Heather	SR	-	S2	G5
Huperzia appalachiana (= *Lycopodium selago*) M: high elevation rocky summits, seeps, fens (Ashe*, Avery*, Buncombe*, Haywood, Jackson*, Mitchell*, Rutherford*, Transylvania*, Watauga*, Yancey*)	Appalachian Fir-clubmoss	C	-	S2	G3G4
Huperzia porophila (= *Lycopodium porophilum*) M: in spray zone of waterfalls (Jackson*, Macon*, Polk?, Rutherford*, Transylvania*)	Rock Fir-clubmoss	C	-	S2	G4
Hydrastis canadensis MP: cove forests, other rich deciduous forests (Buncombe*, Haywood, Jackson*, Macon*, Madison*, Polk*, Rockingham*, Swain*, Watauga)	Goldenseal	E-SC	-	S2	G4
Hydrophyllum macrophyllum M: rich woods, especially rocky calcareous forests and cliffs (Buncombe*, Haywood*, Jackson*, Madison*, Yancey*)	Largeleaf Waterleaf	SR	-	S2	G5
Hymenophyllum tayloriae M: moist grottoes and spray cliffs in escarpment gorges with high rainfall (Jackson*, Macon, Transylvania)	Gorge Filmy Fern	C	-	S1S2	G1G2
Hypericum adpressum C: boggy places (Halifax, New Hanover, Northampton)	Bog St. John's-wort	C	FSC	SH	G2G3
Hypericum nitidum C: low pinelands, pools (Brunswick*, Onslow*, Pender*)	Carolina St. John's-wort	SR	-	S1	G4
Hyoericum sp.1 (see Watch List)					
Hypericum suffruticosum C: pine savannas (Bladen, Sampson)	Pineland St. John's-wort	SR	-	SH	G4G5
Hypoxis sessilis CS: savannas, pinelands (Columbus?, Hoke?, Pender*)	Sessile Yellow Stargrass	C	-	S1	G4
Ilex amelanchier CS: blackwater swamps and riverbanks, clay-based Carolina bays (Brunswick*, Columbus*, Harnett, Hoke*, Montgomery*, Pender*, Richmond*, Robeson*, Scotland*)	Sarvis Holly	SR	-	S3	G4
Ilex collina (not in RAB) M: bogs, wet streamsides, or high elevation forests (Ashe*, Haywood*, Swain*, Watauga*)	Long-Stalked Holly	T	-	S1	G3
Ilex longipes (= *I. decidua* var. *longipes*) P: upland forests and woodlands (Anson, Gaston, Mecklenburg, Wilson)	Georgia Holly	C	-	SH	G5
Ipomoea imperati (= *I. stolonifera*) C: sea beaches and foredunes (Brunswick*, Carteret*, New Hanover)	Beach Morning-glory	SR	-	S1	G5

Scientific Name Province: Habitat (Counties of Occurrence)	Common Name	Status NC	Status US	Rank NC	Rank Global
Lilium grayi M: bogs, wet meadows, seeps, grassy balds, high elevation forests (Alleghany*, Ashe*, Avery*, Buncombe*, Caldwell*, Henderson?, McDowell*, Mitchell*, Watauga*, Yancey*)	Gray's Lily	T-SC	FSC	S3	G3
Lilium iridollae S: peaty seepage bogs (Cumberland*, Harnett*, Hoke*, Lee*, Moore*, Nash, Northampton, Richmond, Scotland*)	Sandhills Bog Lily	C/PT	FSC	S1	G1G2
Lilium philadelphicum var. *philadelphicum* M: grassy balds, glades (Alleghany*, Ashe*, Avery*, Haywood*, Mitchell*, Polk, Swain, Watauga*, Yancey*)	Wood Lily	C	-	S1	G5T?
Limosella australis (= *L. subulata*) C: tidal marshes (Currituck*)	Awl-leaf Mudwort	C	-	S1	G4G5
Lindera melissifolia (= *L. melissaefolia*) C: Carolina bays, upland depressions, and other wet areas (Bladen*, Cumberland*, Sampson*)	Southern Spicebush	E	E	S1	G2
Lindera subcoriacea (not in RAB) SP: streamhead pocosins, white cedar swamps, bogs (Anson*, Cumberland*, Hoke*, Lee*, Montgomery*, Moore*, Richmond*, Robeson*, Scotland*)	Bog Spicebush	E	FSC	S2	G2
Linum floridanum var. *chrysocarpum* (not in RAB) C: pine savannas (Brunswick*, Pender*)	Yellow-fruited Flax	SR	-	S1	G4T3?
Linum sulcatum var. *sulcatum* P: diabase glades (Granville)	Glade Flax	C	-	SH	G5T5
Liparis loeselii MC: seeps, bay swamps (Alleghany*, Ashe, Avery, Dare*, Jackson, Rutherford, Swain*, Watauga)	Fen Orchid	C	-	S1	G5
Lipocarpha micrantha (= *Hemicarpha micrantha*) C: drawdown zones of blackwater rivers, salt marshes (Columbus*, Dare)	Small-flowered Hemicarpha	SR	-	S1	G4
Listera cordata (see Watch List)					
Lithospermum canescens P: diabase glades, open woods over diabase (Durham*, Granville*)	Hoary Puccoon	SR	-	S1	G5
Litsea aestivalis C: limesink ponds, other pools (Bladen*, Brunswick*, Carteret*, Craven*, Cumberland*, Gates*, New Hanover*, Onslow*, Sampson*, Wayne*)	Pondspice	C	FSC	S2	G3
Lobelia boykinii (not in NC in RAB) C: clay-based Carolina bays, wet pine savannas (Bladen, Cumberland*, Hoke*, Onslow*, Scotland*)	Boykin's Lobelia	C	FSC	S1	G2
Lonicera canadensis M: bogs, moist woods (Haywood*, Jackson*, Macon*, Mitchell, Swain, Watauga*, Yancey)	American Fly-honeysuckle	SR	-	S2	G5
Lonicera flava MP: thin soils around rock outcrops, mainly mafic (Buncombe*, Burke*, Henderson*, Jackson*, McDowell*, Polk*, Rutherford*)	Yellow Honeysuckle	SR	-	S3	G5?
Lophiola aurea (= *Lophiola americana*) C: very wet, mucky habitats in pine savannas (Brunswick*, Columbus*, New Hanover*)	Golden Crest	E	-	S1	G4
Lotus helleri (= *Lotus purshianus* var. *helleri*) P: open woods over clay soils, roadsides (Cabarrus*, Caswell, Davidson*, Davie, Granville*, Iredell, Mecklenburg*, Moore*, Person, Rockingham*, Rowan*, Stanly, Union*, Warren)	Carolina Birdfoot-trefoil	C	FSC	S3	G3
Ludwigia alata C: interdune ponds, marshes (Brunswick, Camden*, Carteret*, Currituck*, Dare*, Hyde*, New Hanover, Onslow, Pasquotank*, Tyrrell)	Winged Seedbox	SR	-	S2	G3G4
Ludwigia lanceolata C: interdune ponds, open wet areas (Brunswick, Carteret*, Dare, New Hanover?)	Lanceleaf Seedbox	C	-	S1	G3
Ludwigia linifolia C: limesink ponds (Brunswick*, Carteret*, Columbus*, New Hanover*, Onslow*, Scotland*)	Flaxleaf Seedbox	SR	-	S2	G4

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Ludwigia ravenii (not in RAB) C: savannas, swamps, marshes, wet open places (Brunswick, Chowan, Columbus*, Craven, Duplin, Gates, Jones, New Hanover, Pamlico, Sampson)	Raven's Seedbox	C	-	S2?	G2?
Ludwigia suffruticosa CS: limesink ponds, clay-based Carolina bays (Bladen, Brunswick*, New Hanover*, Robeson*, Scotland*)	Shrubby Seedbox	SR	-	S2	G5
Luziola fluitans (=*Hydrochloa caroliniensis*) C: pools, lakes, streams (Brunswick, Columbus*, Hyde, Pender*, Perquimans, Richmond*, Robeson, Scotland*, Tyrrell, Wayne)	Southern Water Grass	SR	-	S1S2	G4G5
Lycopodiella inundata (not in RAB) M: bogs and seeps (Avery*, Watauga*)	Bog Clubmoss	C	-	S1	G5
Lycopodium (see *Huperzia, Lycopodiella*)					
Lysimachia asperulifolia (= *L. asperulaefolia*) CS: pocosin/savanna ecotones, pocosins (Beaufort, Bladen*, Brunswick*, Carteret*, Columbus, Cumberland*, Harnett*, Hoke*, New Hanover*, Onslow*, Pamlico*, Pender*, Richmond, Scotland*)	Rough-leaf Loosestrife	E	E	S3	G3
Lysimachia fraseri M: forests, roadsides (Buncombe, Haywood, Henderson, Jackson*, Macon*, Transylvania*)	Fraser's Loosestrife	E	FSC	S2	G3
Macbridea caroliniana C: blackwater swamps, savanna/pocosin ecotones, ditches (Bladen*, Brunswick*, Columbus*, Jones, Onslow, Pender*, Robeson*, Sampson)	Carolina Bogmint	C/PT	FSC	S2	G2G3
Magnolia macrophylla P: rich deciduous forests (Cumberland, Gaston*, Iredell*, Lincoln, Rowan, Wake*)	Bigleaf Magnolia	SR	-	S2	G5
Malaxis bayardii (not in RAB) MP: upland forests (Burke, McDowell*, Rowan, Watauga)	Appalachian Adder's-mouth	SR	-	S1	G3
Malaxis spicata C: maritime swamp forests, calcareous but mucky outer coastal plain swamps (Brunswick, Carteret*, Chowan*, Dare*, Jones)	Florida Adder's-mouth	SR	-	S1	G4?
Manisuris (see *Coelorachis*)					
Marshallia grandiflora MP: bogs, dry basic soils (Henderson, Polk)	Large-fl. Barbara's Buttons	C	FSC	SH	G2
Marshallia sp. 1 (not in RAB) P: clayey upland soils over diabase (Granville*)	Butner Barbara's Buttons	C	-	S1	G1
Marshallia trinervia M: habitat not known (Macon)	Broadleaf Barbara's Buttons	C	-	SH	G3
Matelea decipiens PC: thin woodlands over mafic or calcareous rocks (Alexander*, Burke*, Davidson, Durham*, Franklin*, Granville*, Hertford, Jones, Orange, Polk, Rutherford, Stanly*, Wake*)	Glade Milkvine	SR	-	S2	G5
Meehania cordata M: cove forests, boulderfields (Alleghany, Ashe*, Avery, Haywood*, Madison, Watauga*, Yancey)	Meehania	SR	-	S2	G5
Melanthium woodii (not in RAB) (= *Veratrum woodii*) M: habitat not known (Polk)	Ozark Bunchflower	C	-	SH	G5
Melica nitens M: open calcareous woods (Madison*)	Three-flowered Melic	SR	-	S1	G5
Menyanthes trifoliata (not in RAB) M: bogs (Watauga*)	Buckbean	T	-	S1	G5
Milium effusum M: high elevation forests or openings (Swain)	Millet-grass	C	-	SH	G5
Minuartia godfreyi (= *Arenaria godfreyi*) C: tidal freshwater marshes (Craven*, Jones)	Godfrey's Sandwort	E	FSC	S1	G1
Minuartia groenlandica (= *Arenaria glabra* var. *groenl.*) MP: high elevation and low elevation rocky summits (Alleghany*, Ashe*, Avery*, Burke*, Mitchell*, Stokes, Surry)	Greenland Sandwort	C	-	S2	G5
Minuartia uniflora (= *Arenaria uniflora*, incl. *M. alab.*) P: granite flatrocks (Anson*, Rowan, Rutherford*)	Single-flowered Sandwort	E	-	S1	G4

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Monotropsis odorata (including var. *lehmaniae*) PM: dry forests and bluffs (Alamance, Alleghany, Buncombe, Burke*, Caldwell, Catawba*, Chatham?, Cleveland*, Durham*, Henderson, Jackson*, Macon, McDowell*, Orange*, Person, Polk, Rutherford*, Stokes*, Swain, Transylvania*, Wake)	Sweet Pinesap	C	FSC	S3	G3
Muhlenbergia glabriflora (not in RAB) P: clay soils (Durham)	Clay-pan Muhly	C	-	SH	G4?
Muhlenbergia glomerata M: olivine barrens, fens, mafic cliffs (Ashe*, Clay*)	Bristly Muhly	C	-	S1	G5
Muhlenbergia sobolifera M: dripping cliffs and rocky slopes (McDowell, Mitchell, Transylvania)	Rock Muhly	C	-	SH	G5
Muhlenbergia torreyana (not in RAB) CS: cypress savannas (Brunswick*, Cumberland*, Hoke*, Onslow*, Richmond*, Robeson*)	Pinebarren Smokegrass	E	-	S1	G3
Myrica gale (= *Gale palustris*) M: bogs (Henderson*)	Sweet Gale	E	-	S1	G5
Myriophyllum laxum CS: limesink ponds, waters of natural lakes (Brunswick*, Carteret*, Craven*, Cumberland*, Hoke*, Onslow*)	Loose Watermilfoil	T	FSC	S1	G3
Myriophyllum tenellum (not in RAB) C: waters of natural lakes (Bladen*, Tyrell), Washington*)	Leafless Watermilfoil	C	-	S1	G5
Narthecium americanum M: bogs (Henderson)	Bog Asphodel	E	C	SX	G2
Nestronia umbellula (see Watch List)					
Oenothera perennis MPC: bogs (Ashe*, Avery, Burke*, Clay*, Hertford, Iredell, Jackson*, Macon*, Transylvania, Tyrrell)	Perennial Sundrops	C	-	S1	G5
Oldenlandia boscii (not in NC in RAB) C: clay-based Carolina bays (Brunswick*, Columbus*, Scotland*)	Bosc's Bluet	SR	-	S1	G5
Orbexilum macrophyllum (= *Psoralea macrophylla*) M: low mountain forests or outcrops? (habitat not known) (Polk)	Bigleaf Scurfpea	E	FSC	SH	GH
Orbexilum onobrychis (= *Psoralea onobrychis*) (see Watch List)					
Orbexilum pedunculatum var. *pedunculatum* (= *Psor. ps. v. egland.*) (see Watch List)					
Oxypolis canbyi (not in RAB) C: clay-based Carolina bays (Scotland*)	Canby's Cowbane	E	E	S1	G2
Pachysandra procumbens P: cove forests (Polk*)	Allegheny Spurge	C	-	S1	G4G5
Panax quinquefolius (see Watch List)					
Panax trifolius (= *P. trifolium*) MP: cove forests, northern hardwoods, other rich forests (Ashe*, Buncombe*, Caldwell*, Caswell*, Cherokee*, Clay*, Durham*, Graham*, Haywood*, Jackson, Macon*, Orange, Swain, Wake*, Watauga*)	Dwarf Ginseng	SR	-	S3	G5
Panicum flexile PM: glades and openings over mafic rocks (Ashe, Durham, Granville*, Orange)	Wiry Panic Grass	SR	-	S1	G4G5
Panicum lithophilum (not in RAB) MP: soil islands on granite domes (Alexander?, Franklin*, Transylvania, Wake*)	Flatrock Panic Grass	C	-	S1	G3G4
Panicum tenerum CS: wet savannas, sandhill seeps, limesink ponds (Brunswick*, Carteret*, Columbus*, Cumberland*, Moore, New Hanover*, Onslow*, Sampson*, Scotland*)	Southeastern Panic Grass	SR	-	S3	G4
Panicum (also see *Dichanthelium*)					
Parnassia caroliniana CS: wet savannas (Bladen*, Brunswick*, Columbus*, Cumberland*, Harnett*, Hoke*, Lee, Onslow*, Pender*)	Carolina Grass-of-parnassus	E	FSC	S2	G3
Parnassia grandifolia MCP: fens and seeps over calcareous or mafic rocks (Alleghany*, Ashe*, Avery, Brunswick*, Buncombe, Clay*, Columbus*, Haywood*, Macon*, McDowell*, Transylvania*)	Large-lvd. Grass-of-parnassus	C/PT	-	S1	G3G4

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Parthenium auriculatum (= *P. integrifolium* var. *a.*) PM: glades and openings over mafic rocks (Burke*, Durham*, Franklin*, Granville*, Guilford, Macon, Mecklenburg, Montgomery*, Orange, Person*, Rockingham, Union*, Warren)	Glade Wild Quinine	C	-	S2	G3?Q
Paspalum dissectum CP: mudflats, other open wet areas (Brunswick*, Columbus*, Mecklenburg, Pender*, Scotland*)	Mudbank Crown Grass	SR	-	S1	G4?
Pedicularis lanceolata M: bottomlands, swampy woods (Buncombe, Cherokee, Clay*, Haywood*, Jackson, Macon)	Swamp Lousewort	C	-	S1	G5
Pellaea wrightiana P: rock outcrops, mafic or with nutrient-rich seepage (Alexander*, Stanly*)	Wright's Cliff-brake	E-SC	-	S1	G5
Peltandra sagittifolia (= *P. sagittaefolia*) C: pocosins, other wet, peaty sites (Brunswick*, Carteret*, Columbus, Craven, Dare*, Jones, New Hanover*, Onslow*, Pender*)	Spoonflower	SR	-	S2S3	G3G4
Peplis (see *Didiplis*)					
Phacelia covillei PC: bottomlands, rich lower slopes (Alamance*, Chatham*, Harnett*, Lee*, Moore*, Vance*)	Buttercup Phacelia	C	-	S2	G2?Q
Phaseolus sinuatus SC: sandhills (Cumberland*, Harnett*, Hoke*, Moore*, Richmond*, Scotland*)	Sandhills Bean	C	-	S3	G3
Phegopteris connectilis (= *Thelypteris phegopteris*) M: spray zone of waterfalls, spruce-fir forests, high elevation seepage bogs (Haywood*, Jackson*, Macon*, Swain*, Transylvania*)	Northern Beech Fern	C	-	S1	G5
Phlox subulata M: outcrops and glades, especially over mafic rocks (Ashe*, Buncombe*, Jackson, Madison, Yancey*)	Moss Pink	SR	-	S1	G5
Pinguicula pumila C: savannas (Brunswick*, Carteret*, New Hanover, Pender*)	Small Butterwort	SR	-	S2	G4
Pityopsis graminifolia var. *graminifolia* C: savannas, pine flatwoods, sandy roadsides (Bladen, Brunswick*, Columbus*)	A Silkgrass	SR	-	S1?	G5T4
Plantago cordata P: beds of small, slate-bottomed, perennial streams (Davidson*)	Heart-leaf Plantain	E	-	S1	G4
Plantago sparsiflora C: wet savannas (Bladen, Brunswick*, Columbus*, Pender*)	Pineland Plantain	E	FSC	S1	G2
Platanthera flava var. *herbiola* (not in RAB) M: bogs and moist forests (Buncombe, Clay, Forsyth?, Graham, Haywood*, Jackson, Macon, Yancey)	Northern Green Orchid	SR	-	S1?	G4T4Q
Platanthera grandiflora (= *Habenaria psycodes* var. *g.*) M: bogs, seeps, grassy balds, high elevation moist forests and banks (Alleghany*, Avery*, Buncombe, Clay*, Haywood*, Macon*, McDowell, Watauga*, Yancey)	Large Purple-fringed Orchid	SR	-	S2	G5
Platanthera integra (= *Habenaria integra*) CMP: savannas (Brunswick*, Carteret*, Cherokee?, Columbus*, Craven*, Forsyth?, Henderson?, Onslow, Pamlico, Pender*, Robeson, Rowan?)	Yellow Fringeless Orchid	T	-	S1	G4
Platanthera integrilabia (= *Habenaria bleph.* var. *i.*) M: bogs (Cherokee, Henderson)	White Fringeless Orchid	E	FSC	SX	G2
Platanthera nivea (= *Habenaria nivea*) C: wet savannas (Beaufort, Bladen, Brunswick*, Columbus, Craven*, Dare, Hoke, New Hanover*, Pender*, Robeson)	Snowy Orchid	T	-	S1	G5
Platanthera peramoena (= *Habenaria peramoena*) MP: bogs, forests (Buncombe, Burke, Caldwell, Clay, Durham*, Forsyth, Guilford*, Haywood, Henderson, Jackson*, Macon, Mitchell, Orange*, Swain, Transylvania*, Warren, Watauga, Yancey)	Purple Fringeless Orchid	C	-	S1	G5
Poa paludigena (not in RAB) M: bogs (Ashe*, Avery*, Watauga)	Bog Bluegrass	E	FSC	S1	G3
Poa palustris M: spruce-fir forests, grassy balds (Avery*, Haywood, Henderson, Macon*, Mitchell*, Polk, Swain, Watauga, Yancey)	Swamp Bluegrass	SR	-	S1	G5

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Poa saltuensis (= *Poa languida*) M: olivine barrens (Clay*, Haywood*)	A Bluegrass	C	-	S1	G5?
Polygala grandiflora SC: sandhills (Richmond*, Robeson, Scotland*)	Showy Milkwort	SR	-	S2	G5?
Polygala hookeri C: savannas (Bladen, Brunswick*, Carteret*, Columbus, Craven, New Hanover, Onslow, Pender*, Sampson)	Hooker's Milkwort	C	-	S2	G3
Polygonella articulata C: sandhills (Gates)	Coast Jointweed	C	-	SX	G5
Polygonum glaucum C: ocean and sound beaches (Beaufort, Brunswick*, Carteret*, Dare, Hyde, New Hanover, Onslow)	Seabeach Knotweed	C	-	S1	G3
Polygonum hirsutum CS: limesink ponds, clay-based Carolina bays, drawdown zones of blackwater riverbanks (Brunswick*, Carteret, Onslow, Richmond*, Scotland*)	Hairy Smartweed	SR	-	S1	G4G5
Ponthieva racemosa C: blackwater forests and swamps, especially over marl (Beaufort, Brunswick*, Carteret*, Craven*, Jones*, Onslow*, Pender*)	Shadow-witch	SR	-	S2	G4G5
Porteranthus stipulatus (= *Gillenia stipulata*) P: forests and open woods, mainly over mafic rocks (Cabarrus, Chatham, Davidson*, Durham, Granville*, Lee, Montgomery, Moore, Orange, Person*, Union*, Wake*)	Indian Physic	SR	-	S2	G5
Portulaca smallii P: granite flatrocks and diabase glades (Cabarrus*, Forsyth, Franklin*, Granville*, Rowan*, Wake*)	Small's Portulaca	T	-	S2	G3
Potamogeton confervoides SC: beaverponds and old millponds on blackwater creeks (Cumberland*, Gates*, Hoke*, Moore*, Richmond*, Scotland*)	Conferva Pondweed	C	FSC	S2	G3G4
Prenanthes roanensis M: grassy balds, high elevation forests and outcrops (Alleghany*, Ashe*, Avery*, Buncombe*, Clay*, Graham*, Haywood*, Jackson*, Macon*, McDowell, Mitchell*, Surry, Swain*, Transylvania*, Yancey*)	Roan Rattlesnakeroot	SR	-	S3	G3
Prosartes maculata (see Watch List)					
Prunus pumila var. *susquehanae* MP: rocky forests (Durham, Henderson)	Susquehanna Cherry	C	-	SH	G5T4
Psilocarya (see *Rhynchospora*)					
Psilotum nudum (not in NC in RAB) C: acid swamp (Chowan*)	Whiskfern	C	-	S1	G5
Psoralea (see *Orbexilum, Pediomelum*)					
Pteroglossaspis ecristata (= *Eulophia ecristata*) C: pinelands (Bladen, Cumberland, Hoke*, New Hanover)	Spiked Medusa	E	FSC	S1	G2G3
Ptilimnium costatum C: tidal swamps or marshes (New Hanover*)	Ribbed Bishopweed	C	-	S1	G3G4
Ptilimnium nodosum (including *Ptilimnium fluviatile*) P: rocky riverbeds (Chatham*, Granville*, Lee)	Harperella	E	E	S1	G2
Ptilimnium sp. 1 (not in RAB) C: tidal freshwater marshes (Brunswick*, New Hanover*, Pender)	Carolina Bishopweed	C	-	S1	G2
Pycnanthemum torreyi (not in RAB) PM: dry upland forests and woodlands, over mafic rocks (Alexander, Ashe, Granville, Orange, Wilkes)	Torrey's Mountain-mint	C	-	SH	G2
Pyrola elliptica (not in RAB) M: moist forests (Ashe)	Elliptic Shinleaf	C	-	SH	G5
Pyxidanthera barbulata var. *brevifolia* S: sandhills (Cumberland*, Harnett*, Hoke*, Moore*)	Sandhills Pyxie-moss	E	FSC	S2	G4T2
Quercus austrina CP: bluff and bottomland forests (Anson*, Bladen, Craven*, Harnett, Johnston, Jones*, Montgomery*, Sampson, Union, Wayne)	Bluff Oak	SR	-	S1	G5
Quercus ilicifolia P: dry summits and rocky woods on Piedmont monadnocks (Burke*, Gaston*, Stokes*, Surry*)	Bear Oak	SR	-	S1	G5

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Sarracenia jonesii (not in RAB) M: bogs (Buncombe, Henderson*, Transylvania*)	Mountain Sweet Pitcher Plant	E-SC	E	S1	G3T1
Sarracenia minor C: savannas (Bladen, Brunswick*, Columbus*, Cumberland, New Hanover)	Hooded Pitcher Plant	SR	-	S1	G4G5
Sarracenia oreophila (not in RAB) M: seepage bogs (Clay*)	Green Pitcher Plant	E-SC	E	S1	G2
Satureja (see *Calamintha*)					
Saxifraga caroliniana M: high to middle elevation moist cliffs and rock outcrops (Alleghany, Ashe*, Avery*, Buncombe, Cleveland*, Graham*, Jackson, Macon*, Madison*, Mitchell*, Rutherford, Watauga*, Yancey*)	Carolina Saxifrage	C	FSC	S2	G2
Saxifraga pensylvanica MP: bogs, seeps (Wake*, Watauga*)	Swamp Saxifrage	C	-	S1	G5
Schisandra glabra C: rich slopes and floodplain "islands" (Martin*)	Magnolia Vine	T-SC	-	S1	G4
Schoenoplectus acutus C: natural lakes (Carteret, Craven, Dare, Hyde)	Hardstem Bulrush	SR	-	SH	G5
Schoenoplectus etuberculatus CS: blackwater creeks (Brunswick*, Columbus*, Craven, Cumberland*, Harnett, Hoke*, Hyde, Johnston, Moore*, Onslow*, Pender, Richmond*, Scotland*, Wayne)	Canby's Bulrush	SR	-	S3	G3G4
Schoenoplectus subterminalis S: blackwater creeks (Cumberland*, Harnett*, Hoke*, Moore, Richmond*, Scotland*)	Swaying Bulrush	SR	-	S3	G4G5
Schwalbea americana SC: savannas and moist to dryish pinelands with frequent fire (Bladen, Cumberland*, Hoke*, Moore*, Pender, Scotland)	Chaffseed	E	E	S1	G2
Scirpus flaccidifolius (not in RAB) C: swamp forests (Northampton*)	Reclining Bulrush	C	FSC	S1	G2
Scirpus lineatus (= *S. fontinalis* in RAB) C: low rich woods over marl (Brunswick*, Craven*, Jones*, Onslow*, Pender*)	Drooping Bulrush	C	-	S2	G4
Scirpus pendulus (= *S. lineatus* in RAB) P: wet places over mafic rocks (such as diabase) (Durham, Granville*, Onslow*)	Rufous Bulrush	SR	-	S1	G5
Scleria baldwinii C: wet savannas (Brunswick*, Carteret*, Columbus*)	Baldwin's Nutrush	C	-	S1	G4
Scleria georgiana CS: savannas (Brunswick*, Carteret*, Columbus*, Craven*, Hoke*, New Hanover*, Onslow*, Robeson*, Scotland*)	Georgia Nutrush	SR	-	S2	G4
Scleria reticularis (sensu stricto) CS: clay-based Carolina bays, limesink ponds (Brunswick*, Cumberland*, Hoke*, New Hanover*, Onslow*, Robeson*, Sampson*, Scotland*)	Netted Nutrush	SR	-	S2	G4
Scleria verticillata C: savannas over coquina limestone ("marl"), intermediate swales (Brunswick*, Carteret*, Columbus*, Dare, Hyde, Onslow, Pender*)	Savanna Nutrush	C	-	S1	G5
Scutellaria arguta (not in RAB) M: rocky forests, boulderfields (Buncombe, Mitchell)	Appalachian Skullcap	C	-	SH	G1G3Q
Scutellaria australis (not in RAB) PS: alluvial forests (Granville*, Johnston, Lee, Orange, Richmond)	Southern Skullcap	C	-	S1	G?
Scutellaria galericulata (not in RAB) M: habitat not known (Yancey)	Hooded Skullcap	C	-	SH	G5
Scutellaria leonardii (not in RAB) P: diabase glades (Durham*, Granville*, Moore*, Orange*)	Shale-barren Skullcap	C	-	S1	G4
Scutellaria nervosa P: alluvial forests (Chatham, Durham, Granville*, Jackson?, Northampton*, Wake, Warren)	Veined Skullcap	SR	-	S1	G5
Scutellaria saxatilis MP: northern hardwoods forests, rocky woodlands (Ashe*, Burke*, Mitchell, Rutherford*, Watauga)	Rock Skullcap	C	-	S2	G4?

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Vaccinium hirsutum M: ridgetop red oak forests, oak hickory forests, pine oak heath (Cherokee*, Graham*, Swain*)	Hairy Blueberry	C	FSC	S3	G3
Vaccinium macrocarpon MC: bogs, seeps, pocosins (Alleghany*, Ashe*, Avery*, Bladen, Brunswick*, Burke*, Cumberland*, Currituck, Dare*, Haywood*, Tyrrell*, Watauga*)	Cranberry	C	-	S2	G4
Veratrum (see *Melanthium*)					
Verbena riparia P: habitat not known (Caldwell?, Stanly?)	Riverbank Vervain	C	FSC	SH	GH
Verbesina walteri (not in RAB) M: rich cove forests (Polk*)	Walter's Crownbeard	C	-	SH	G3?
Veronica americana MC: seeps, bogs (Alleghany*, Ashe*, Avery*, Craven?, Madison*, Mitchell, Watauga*, Yancey)	American Speedwell	SR	-	S2	G5
Viola appalachiensis (not in RAB) M: olivine barrens (Clay*)	Appalachian Violet	C	-	S1	G4?Q
Waldsteinia lobata (not in RAB) M: streambanks and ravines (Jackson, Transylvania)	Lobed Barren-strawberry	C	-	SH	G2?
Warea cuneifolia S: sandhills (Harnett, Hoke*)	Carolina Pineland-cress	C	-	S1	G4
Woodsia appalachiana (= *W. scopulina*) M: cliffs, rock outcrops (Alleghany*, Ashe, Buncombe, McDowell*, Polk*, Surry*, Wilkes)	Appalachian Cliff Fern	SR	-	S1	G4
Woodsia ilvensis M: cliffs, rock outcrops (Alleghany*, Ashe*, Surry*)	Rusty Cliff Fern	SR	-	S1	G5
Xyris brevifolia C: savannas, other low wet areas (Brunswick*, Columbus, Onslow*, Pender*)	Shortleaf Yellow-eyed-grass	SR	-	S2	G4G5
Xyris chapmanii (not in RAB) S: mucky sandhill seeps (Cumberland*, Harnett*, Hoke*, Moore*, Richmond*, Scotland*)	Chapman's Yellow-eyed-grass	C	-	S2	G3
Xyris difformis var. *floridana* (not in RAB) C: savannas (Onslow*, Robeson)	Florida Yellow-eyed-grass	C	-	S1	G5T4T5
Xyris elliottii (not in NC in RAB) C: low wet areas (Brunswick*, Craven*, Hoke*, Moore*, Onslow*, Pender*)	Elliott's Yellow-eyed-grass	SR	-	S1	G4
Xyris flabelliformis C: savannas (Bladen*, Brunswick*, Carteret, Cumberland*, New Hanover*, Onslow*)	Savanna Yellow-eyed-grass	C	-	S2	G4
Xyris scabrifolia (not in RAB) S: sandhill seeps and bogs (Cumberland*, Harnett*, Hoke*, Moore*, Richmond*, Scotland*)	Roughleaf Yellow-eyed-grass	C	FSC	S2	G3
Xyris serotina C: savannas (Pender*)	Acid-swamp Yellow-eyed-grass	SR	-	S1	G3G4
Yucca gloriosa C: dunes (Brunswick*, Carteret*, Dare*, Hyde*, New Hanover, Onslow*)	Moundlily Yucca	SR	-	S2?	G4?
Zephyranthes sp. 1 (=*Z. simpsoni*, misapplied in RAB) C: roadsides, calcareous coastal fringe forest (Brunswick*)	Carolina Atamasco Lily	C	-	S2?	G2?
Zigadenus elegans ssp. *glaucus* (= *Z. glaucus*) M: calcareous rock outcrops (Buncombe, McDowell*, Yancey)	White Camas	C	-	S1	G5T4?
Zigadenus leimanthoides M: high elevation rocky summits, thin soil at high elevations (Ashe, Avery*, Burke*, Yancey)	Pinebarren Death-camas	C	-	S1	G4Q

MOSSES

Barbula (see *Bryoerythrophyllum*)					
Bartramidula wilsonii (= *B. cernua*) M: in spray zones of waterfalls, moist rocks in humid gorges (Jackson*, Macon, Rutherford, Transylvania*)	Dwarf Apple Moss	SR	-	S1	G3?
Brachydontium trichodes M: on moist rocks in spruce-fir forests (Mitchell*, Swain)	Peak Moss	C	-	S1	G2

Scientific Name Province: Habitat (Counties of Occurrence)	Common Name	Status NC	Status US	Rank NC	Rank Global
Entodon sullivantii M: on rocks or bark in humid gorges and cove forests (Buncombe, Caldwell, Graham, Macon, McDowell, Polk, Transylvania*)	Sullivant's Entodon	SR	-	S2	G3G4
Eucladium verticillatum M: on moist calcareous rocks (McDowell)	Lime-seep Eucladium	SR	-	S1	G5
Eurhynchium (see *Platyhypnidium*)					
Fissidens hallii C: on bark in cypress-gum swamps (Jones)	Hall's Pocket Moss	C	-	S1	G2
Grimmia (see *Coscinodon*)					
Homalia trichomanoides M: in spray zones of waterfalls, on rocks in humid gorges (Avery*, Jackson, Macon, McDowell, Transylvania*)	Lime Homalia	C	-	S1	G5
Homaliadelphus sharpii M: on dry mafic or calcareous rocks in gorges (Jackson)	Sharp's Homaliadelphus	C	-	S1	G2G3
Hygrohypnum closteri MP: on rocks submersed in streams (McDowell, Orange, Polk, Swain)	Closter's Brook-hypnum	SR	-	S1	G3
Leptodontium excelsum M: on bark of Fraser Firs and Red Spruces in spruce-fir forests (Avery, Haywood, Jackson, Swain, Transylvania)	Grandfather Mtn. Leptodontium	C	-	S1	G2?
Leptodontium flexifolium M: high elevation rocky summits and moist calcareous rocks (Ashe, Avery, Haywood, Swain, Transylvania, Yancey)	Pale-margined Leptodontium	SR	-	S1	G5
Leptohymenium sharpii (= *Pterigynandrum sharpii*) M: moist rocks in spruce-fir forests (Haywood, Yancey)	Mount Leconte Moss	C	FSC	S1	G1
Lindbergia brachyptera M: bark of hardwoods (Ashe, Cherokee)	Lindberg's Maple-moss	SR	-	S1	G5
Macrocoma sullivantii MP: bark of cedar or hardwoods (Clay, Jackson*, Macon*, Swain*, Transylvania*, Wilkes*)	Sullivant's Maned-moss	SR	-	S2	G3G5
Mnium (see *Plagiomnium*)					
Orthodontium pellucens MP: moist felsic or calcareous rocks (Stokes, Swain)	Translucent Orthodontium	C	-	S1	G3?
Orthotrichum keeverae P: on trees around low elevation granitic domes (Alexander*, Wilkes*)	Keever's Bristle-moss	E	FSC	S1	G1
Orthotrichum obtusifolium M: bark of hardwoods (Ashe)	Blunt Bristle-moss	SR	-	S1	G5
Palamocladium leskeoides M: calcareous rocks in humid gorges (Jackson)	Palamocladium	C	-	S1	G3G5
Plagiomnium carolinianum (= *Mnium carolinianum*) M: rocks and streambanks in humid gorges (Jackson, Macon, Swain, Transylvania*)	Carolina Star-moss	C	FSC	S2	G2G3
Platydictya confervoides M: calcareous rocks (Madison, McDowell)	Alga-like Matted-moss	SR	-	S1	G4G5
Platyhypnidium pringlei (= *Eurhynchium pringlei*) M: rocks and streambanks in humid gorges, spray zones of waterfalls (Polk, Transylvania*)	Pringle's Eurhynchium	C	FSC	S1	G2
Pterigynandrum (see *Leptohymenium*)					
Rhabdoweisia crenulata M: moist rocks in cove forests in humid gorges (Jackson*, McDowell*)	Himalayan Ribbed-weissia	C	-	S1	G3G4
Rhachithecium perpusillum (= *Tortula propagulosa*) PM: bark of hardwoods (Cleveland, Iredell, McDowell, Mecklenburg, Surry, Wilkes)	Budding Tortula	C	-	S1S2	G1G2
Rhytidium rugosum M: high elevation rocky summits, grassy balds, glades, over mafic rocks (Ashe*, Avery*, Buncombe, Caldwell*, Mitchell*, Watauga*)	Golden Tundra-moss	SR	-	S2	G5

Scientific Name Province: Habitat (Counties of Occurrence)	Common Name	Status NC	Status US	Rank NC	Rank Global
LICHENS					
Anaptychia setifera M: high elevation rocky summits (Mitchell*)	A Foliose Lichen	SR	-	S1	G3G4
Anzia americana M: on bark of trees in humid gorges (Transylvania)	A Foliose Lichen	C	-	S1	G2
Anzia ornata C: on bark of trees (Duplin)	A Foliose Lichen	SR	-	SH	G3
Cetraria arenaria M: high elevation rocky summits (Ashe*, Avery*, Macon, Mitchell*, Watauga*)	A Foliose Lichen	SR	-	S2	G4
Cetrelia cetrarioides M: on bark of deciduous or coniferous trees at high elevations (spruce-fir zone) (Buncombe, Haywood, Jackson, Mitchell, Swain, Yancey)	A Foliose Lichen	SR	-	S2	G3
Cladonia psoromica M: fens and glades over amphibolite rock (Ashe*)	Bluff Mtn. Reindeer Lichen	C	FSC	S1	G1
Ephebe americana M: high elevation rocky summits (Haywood, Jackson, Watauga)	A Fruticose Lichen	C	-	S1	G2G3
Ephebe lanata MP: on rocks in rapidly flowing water (Jackson, Macon, Stokes)	A Fruticose Lichen	SR	-	S1	G5
Ephebe solida M: on rocks in rapidly flowing water (Macon, Transylvania)	A Fruticose Lichen	SR	-	S1	G3G4
Gymnoderma lineare M: high elevation rock outcrops, outcrops in humid gorges (Ashe*, Avery*, Buncombe*, Graham*, Jackson*, Mitchell*, Rutherford*, Swain*, Transylvania*, Yancey*)	Rock Gnome Lichen	T	E	S2	G2
Heterodermia appalachensis MP: rocks or bark (Avery, Jackson, Stokes, Transylvania)	A Foliose Lichen	SR	-	S1S2	G2G4
Hydrothyria venosa MP: submersed in brooks and streams (Avery*, Buncombe*, Cherokee*, Clay*, Graham*, Haywood*, Jackson*, Macon*, Stokes, Swain*, Transylvania*)	An Aquatic Lichen	C	-	S2	G3
Hypotrachyna sinuosa M: on twigs or rocks at high elevations (spruce-fir zone) (Haywood, Jackson, Mitchell, Yancey)	A Foliose Lichen	SR	-	S1	G5
Hypotrachyna virginica M: on twigs or rocks at high elevations (spruce-fir zone) (Avery, Buncombe, Haywood, Mitchell, Swain, Yancey)	A Foliose Lichen	C	-	S1S2	G1G3
Melanelia stygia (= *Parmelia stygia*) M: high elevation rocky summits (Ashe, Avery*, Buncombe*, Haywood, Mitchell*, Yancey*)	A Foliose Lichen	SR	-	S1S2	G4G5
Pannaria conoplea (= *P. pityrea*) M: on bark at high elevations (Haywood)	A Foliose Lichen	SR	-	S1	G3G4
Parmelia (see *Melanelia*)					
Physcia pseudospeciosa M: high elevation granitic domes (Alleghany, Jackson)	A Foliose Lichen	C	-	S1	G1?
Porpidia diversa M: high elevation rocky summits	A Crustose Lichen	SR	-	S1	G2G3
Porpidia herteliana M: high elevation rocky summits	A Crustose Lichen	SR	-	S1?	G2G3
Sticta limbata M: on bark of hardwoods at high elevations (Haywood)	A Foliose Lichen	SR	-	S1	G3G4
Teloschistes flavicans C: on twigs in maritime forests (Brunswick*, Carteret*)	Sunrise Lichen	SR	-	S1	G3G4
Xanthoparmelia monticola (= *Parmelia monticola*) M: high elevation rocky summits (Buncombe, Haywood, Jackson, Mitchell)	A Foliose Lichen	C	-	S2?	G2

Ref. 35

Federal Register

Friday
December 14, 1990

Part II

Environmental Protection Agency

40 CFR Part 300
Hazard Ranking System; Final Rule

2.4.2.1.5). (Do not include this minimum size requirement in evaluating any other factor of this pathway.) Assign this highest value as the containment factor value for the aquifer being evaluated. Enter this value in Table 3-1.

If no source at the site meets the minimum size requirement, then select the highest value assigned to the sources at the site and assign it as the containment factor value for the aquifer being evaluated. Enter this value in Table 3-1.

3.1.2.2 *Net precipitation.* Assign a net precipitation factor value to the site. Figure 3-2 provides computed net precipitation factor values, based on site location. Where necessary, determine the net precipitation factor value as follows:

- Determine monthly precipitation and monthly evapotranspiration:
  - Use local measured monthly averages.
  - When local data are not available, use monthly averages from the nearest National Oceanographic and Atmospheric Administration weather station that is in a similar geographic setting.

TABLE 3-2.—CONTAINMENT FACTOR VALUES FOR GROUND WATER MIGRATION PATHWAY

Source	Assigned value
All Sources (Except Surface Impoundments, Land Treatment, Containers, and Tanks)	
Evidence of hazardous substance migration from source area (i.e., source area includes source and any associated containment structures).	10
No liner	10
No evidence of hazardous substance migration from source area, a liner, *and*:	
(a) None of the following present: (1) maintained engineered cover, or (2) functioning and maintained run-on control system and runoff management system, or (3) functioning leachate collection and removal system immediately above liner.	10
(b) Any one of the three items in (a) present	9
(c) Any two of the items in (a) present	7
(d) All three items in (a) present plus a functioning ground water monitoring system	5
(e) All items in (d) present, plus no bulk or non-containerized liquids nor materials containing free liquids deposited in source area.	3
No evidence of hazardous substance migration from source area, double liner with functioning leachate collection and removal system above and between liners, functioning ground water monitoring system, *and*:	
(f) Only one of the following deficiencies present in containment: (1) bulk or noncontainerized liquids or materials containing free liquids deposited in source area, or (2) no or nonfunctioning or nonmaintained run-on control system and runoff management system, or (3) no or nonmaintained engineered cover.	3
(g) None of the deficiencies in (f) present	0
Source area inside or under maintained intact structure that provides protection from precipitation so that neither runoff nor leachate is generated, liquids or materials containing free liquids not deposited in source area, and functioning and maintained run-on control present.	0
Surface Impoundment	
Evidence of hazardous substance migration from surface impoundment	10
No liner	10
Free liquids present with either no diking, unsound diking, or diking that is not regularly inspected and maintained	10
No evidence of hazardous substance migration from surface impoundment, free liquids present, sound diking that is regularly inspected and maintained, adequate freeboard, *and*:	
(a) Liner	9
(b) Liner with functioning leachate collection and removal system below liner, and functioning ground water monitoring system.	5
(c) Double liner with functioning leachate collection and removal system between liners, and functioning ground water monitoring system.	3
No evidence of hazardous substance migration from surface impoundment and all free liquids eliminated at closure (either by removal of liquids or solidification of remaining wastes and waste residues).	Evaluate using All sources criteria (with no bulk or free liquid deposited).
Land Treatment	
Evidence of hazardous substance migration from land treatment zone	10
No functioning, maintained, run-on control and runoff management system	10
No evidence of hazardous substance migration from land treatment zone *and*:	
(a) Functioning and maintained run-on control and runoff management system	7
(b) Functioning and maintained run-on control and runoff management system, and vegetative cover established over entire land treatment area.	5
(c) Land treatment area maintained in compliance with 40 CFR 264.280	0

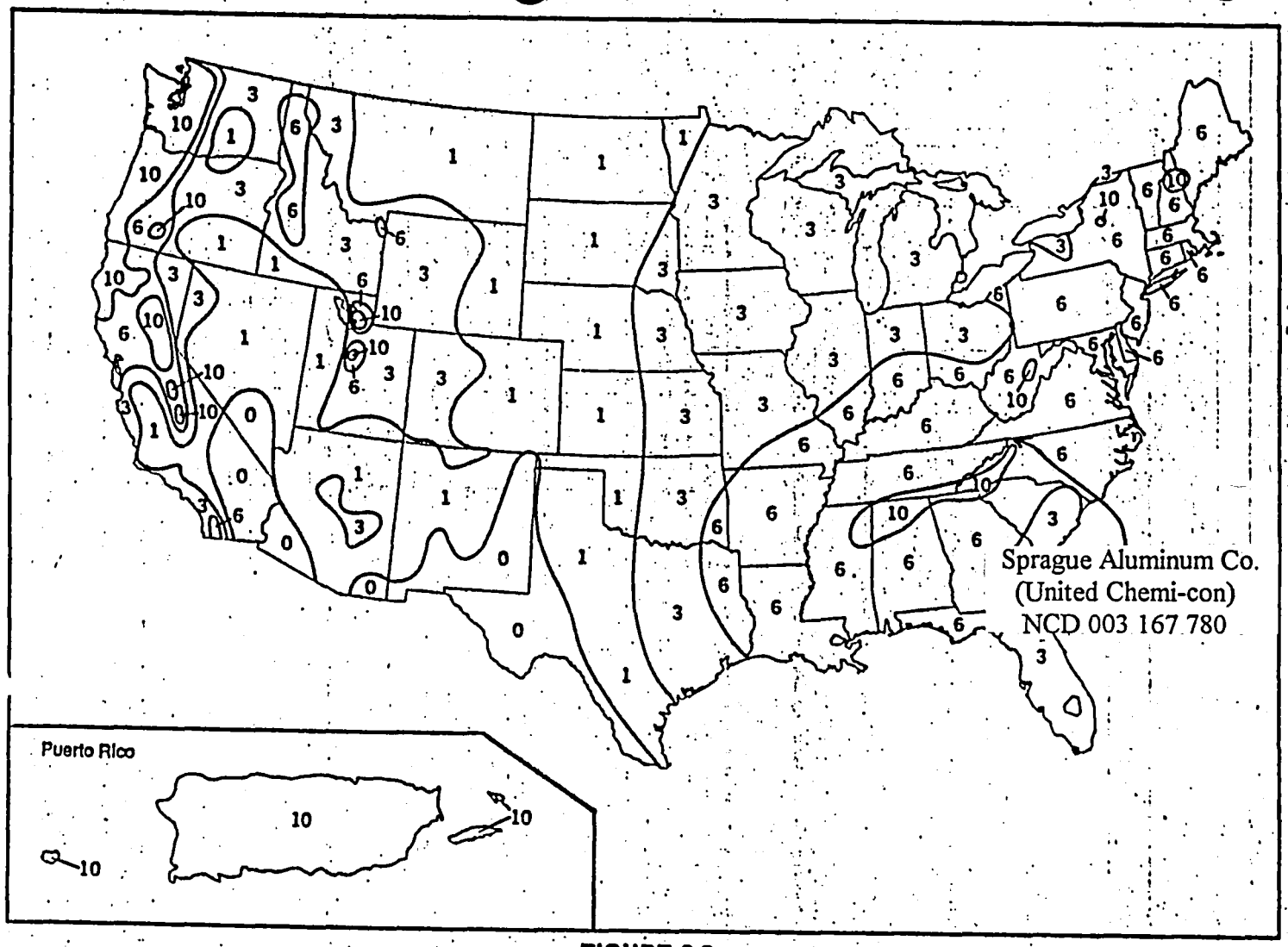


FIGURE 3-2
NET PRECIPITATION FACTOR VALUES

TABLE 3-6.—HYDRAULIC CONDUCTIVITY OF GEOLOGIC MATERIALS

Type of material	Assigned hydraulic conductivity [a] (cm/sec)
Clay; low permeability till (compact unfractured till); shale; unfractured metamorphic and igneous rocks	10^{-8}
Silt; loesses; silty clays; sediments that are predominantly silts; moderately permeable till (fine-grained, unconsolidated till, or compact till with some fractures); low permeability limestones and dolomites (no karst); low permeability sandstone; low permeability fractured igneous and metamorphic rocks	10^{-6}
Sands; sandy silts; sediments that are predominantly sand; highly permeable till (coarse-grained, unconsolidated or compact and highly fractured); peat; moderately permeable limestones and dolomites (no karst); moderately permeable sandstone; moderately permeable fractured igneous and metamorphic rocks	10^{-4}
Gravel; clean sand; highly permeable fractured igneous and metamorphic rocks; permeable basalt; karst limestones and dolomites	10^{-2}

[a] Do not round to nearest integer.

TABLE 3-7.—TRAVEL TIME FACTOR VALUES [a]

Hydraulic conductivity (cm/sec)	Thickness of lowest hydraulic conductivity layer(s) [b] (feet)			
	Greater than 3 to 5	Greater than 5 to 100	Greater than 100 to 500	Greater than 500
Greater than or equal to 10^{-3}	35	35	35	25
Less than 10^{-3} to 10^{-5}	35	25	15	15
Less than 10^{-5} to 10^{-7}	15	15	5	5
Less than 10^{-7}	5	5	1	1

[a] If depth to aquifer is 10 feet or less or if, for the interval being evaluated, all layers that underlie a portion of the sources at the site are karst, assign a value of 35.

[b] Consider only layers at least 3 feet thick. Do not consider layers or portions of layers within the first 10 feet of the depth to the aquifer.

Determine travel time only at locations within 2 miles of the sources at the site, except: if observed ground water contamination attributable to sources at the site extends more than 2 miles beyond these sources, use any location within the limits of this observed ground water contamination when evaluating the travel time factor for any aquifer that does not have an observed release. If the necessary subsurface geologic information is available at multiple locations, evaluate the travel time factor at each location. Use the location having the highest travel time factor value to assign the factor value for the aquifer. Enter this value in Table 3-1.

3.1.2.5 *Calculation of potential to release factor value.* Sum the factor values for net precipitation, depth to aquifer, and travel time, and multiply this sum by the factor value for containment. Assign this product as the potential to release factor value for the aquifer. Enter this value in Table 3-1.

3.1.3 *Calculation of likelihood of release factor category value.* If an observed release is established for an aquifer, assign the observed release factor value of 550 as the likelihood of release factor category value for that aquifer. Otherwise, assign the potential to release factor value for that aquifer as the likelihood of release value. Enter the value assigned in Table 3-1.

3.2 *Waste characteristics.* Evaluate the waste characteristics factor category for an aquifer based on two factors: toxicity/mobility and hazardous waste quantity. Evaluate only those hazardous substances available to migrate from the sources at the site to ground water. Such hazardous substances include:

- Hazardous substances that meet the criteria for an observed release to ground water.
- All hazardous substances associated with a source that has a ground water containment factor value greater than 0 (see sections 2.2.2, 2.2.3, and 3.1.2.1).

3.2.1 *Toxicity/mobility.* For each hazardous substance, assign a toxicity factor value, a mobility factor value, and a combined toxicity/mobility factor value as specified in the following sections. Select the toxicity/mobility factor value for the aquifer being evaluated as specified in section 3.2.1.3.

3.2.1.1 *Toxicity.* Assign a toxicity factor value to each hazardous substance as specified in Section 2.4.1.1.

3.2.1.2 *Mobility.* Assign a mobility factor value to each hazardous substance for the aquifer being evaluated as follows:

- For any hazardous substance that meets the criteria for an observed release by chemical analysis to one or more aquifers underlying the sources at the site, regardless of the aquifer being evaluated, assign a mobility factor value of 1.
- For any hazardous substance that does not meet the criteria for an observed release by chemical analysis to at least one of the aquifers, assign that hazardous substance a mobility factor value from Table 3-8 for the aquifer being evaluated, based on its water solubility and distribution coefficient (K_d).
- If the hazardous substance cannot be assigned a mobility factor value because data on its water solubility or distribution coefficient are not available, use other hazardous substances for which information is available in evaluating the pathway.

TABLE 3-8.—GROUND WATER MOBILITY FACTOR VALUES [a]

Water solubility (mg/l)	Distribution coefficient (K_d) (ml/g)			
	Karst [c]	≤ 10	>10 to 1,000	>1,000
Present as liquid [b]	1	1	0.01	0.0001
Greater than 100	1	1	0.01	0.0001
Greater than 1 to 100	0.2	0.2	0.002	2×10^{-5}
Greater than 0.01 to 1	0.002	0.002	2×10^{-6}	2×10^{-9}
Less than or equal to 0.01	2×10^{-6}	2×10^{-6}	2×10^{-7}	2×10^{-9}

[a] Do not round to nearest integer.
[b] Use if the hazardous substance is present or deposited as a liquid.
[c] Use if the entire interval from the source to the aquifer being evaluated is karst.

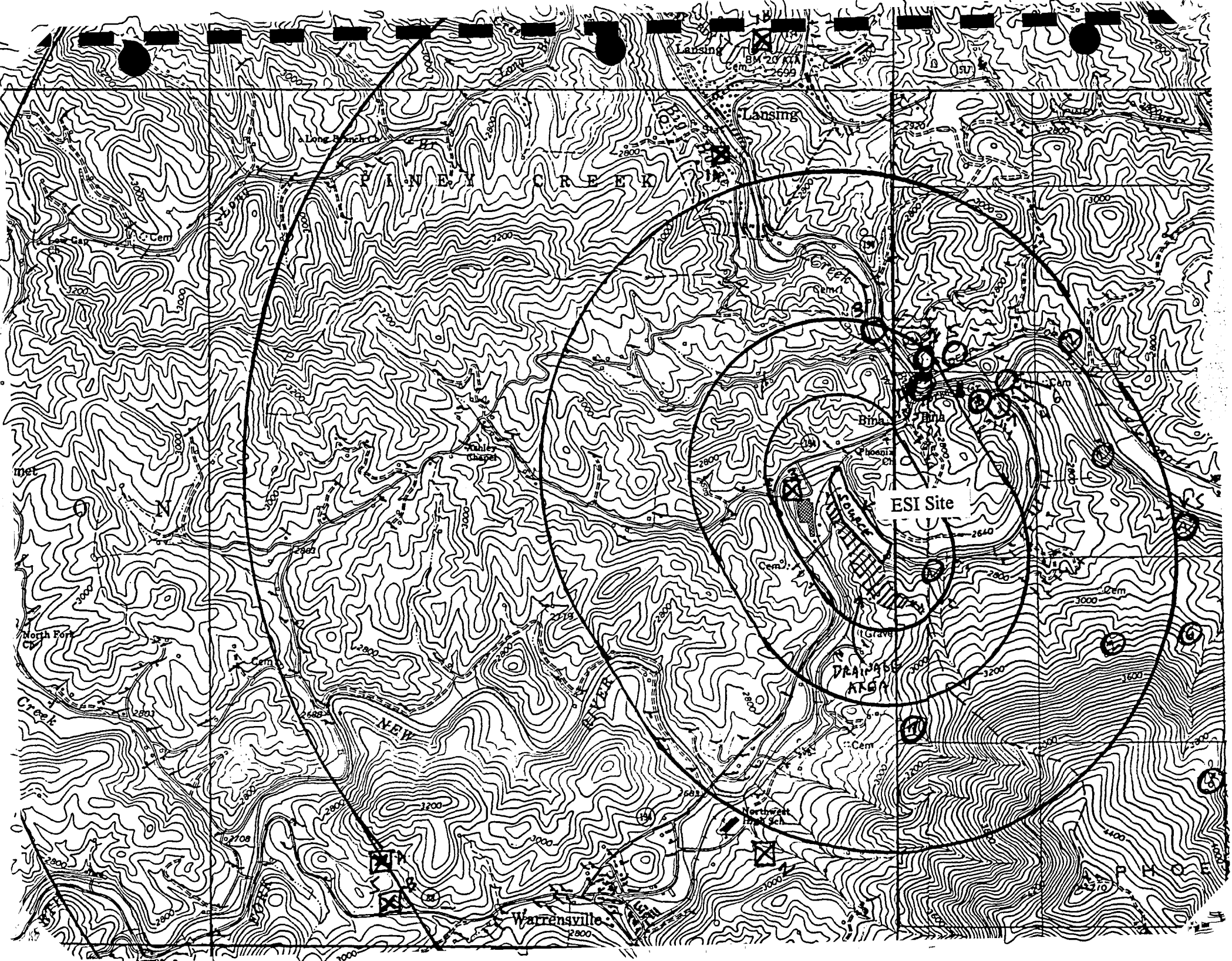
MEMORANDUM

To: File
From: Stuart F. Parker, Hydrogeologist
Date: March 5, 2002
Subject: Sprague Aluminum
NCD 003 167 780
Source and Drainage Areas

SFP used a Planix Tamaya electronic planimeter to determine the approximate surface areas of the site's former settling ponds, as well as the area of land upgradient of the ESI site which could potentially direct surface run-on to the source areas.

Using the 1:120 topographic map (1"=60') (Ref. 6), SFP identified eight on-site areas that were backfilled during pond closure. Planimetry measured their combined areas to be approximately 85,329 sq ft, or 1.96 acres.

Using a USGS 7-1/2 minute quadrangle, SFP measured the map area topographically upgradient from the ponds. Planimetry measured the area to be approximately 15.6 acres.


Lansing
Lansing
Long Branch Ch
PINEY CREEK
Low Gap
Cem
Creek
Cem
Bina
Bina
Phoenix Ch
Ashley Chapel
ESI Site
Cem
Cem
Cem
Cem
Grave
DRAINAGE AREA
Cem
North Fork Ch
Cem
Creek
NEW
RIVER
Northwest High Sch
Warrensville
NORTH
PHOE

Site Name: Sprague Aluminum Co.
Site Number: NCD 003 167 780

Site Location: Lansing, Ashe County, N.C.

Latitude: 36 28 45.5
Longitude: 081 30 09.5

Date: March 06, 2002

Calculation Results

Distance from Site Location	Population Per Ring	Population Cumulative	Number of Households Per Ring	Number of Households Cumulative
0 to 1/4 mile	12	12	5	5
>1/4 to 1/2 mile	43	55	19	24
>1/2 to 1 mile	162	217	72	96
>1 to 2 miles	769	986	358	454
>2 to 3 miles	883	1,869	395	849
>3 to 4 miles	1,698	3,567	777	1,626

Note The populations and number of households within specified target distance rings were calculated for the NC Superfund Section by the NC Center for Geographic Information and Analysis using the 1990 US Census data. These values were calculated by summing the population and the number of households data for each census block located within each target ring. For census blocks lying only partially within the ring, the per cent area of the block within the ring was multiplied by the population and household densities of the block.

NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT

MICHAEL F. EASLEY, GOVERNOR
WILLIAM G. ROSS, JR., SECRETARY
DEXTER R. MATTHEWS, DIRECTOR

Ref. 38

NCDENR

March 28, 2002

NCDENR Winston-Salem Regional Office (WSRO)
Attn: Sherri Knight, Regional Groundwater Supervisor
585 Waughton Street
Winston-Salem, NC 27107

Dear Ms Knight:

The NC Superfund Section recently conducted a site assessment at a portion of the former Sprague Aluminum (a.k.a., Sprague Electric) Co. capacitor plant near Lansing, Ashe County, NC. The capacitor plant is now operated by United Chemi-con (UC). The project site lies along the UC property's present northeast border, separating it from the North Fork New River.

The project site contained several unlined surface impoundments which the Sprague plant historically used to separate aluminum oxide from its process wastewater. The impoundments, which contained metalliferous sludges, were filled and covered with compacted soil during the mid 1990s. The primary purpose of the most recent investigation was to evaluate the likely impact of the impoundment sludges on the nearby North Fork New River. The concern was that mercury and other metals in the sludges could potentially migrate to the river via shallow groundwater. The river is a fishery and contains rare plant and animal species.

The NC Superfund Section conducted on-site sampling operations on October 29-30, 2001. Superfund personnel collected two subsurface sludge samples by hand auger, collected surface water and sediment samples at several river locations, and installed two temporary monitoring wells at locations between the impoundments and the river.

Samples were analyzed for metals at a federal contract laboratory. One of the sludge samples contained mercury (26 mg/kg). However, sampling results did not indicate metals contamination in the river. The NC Superfund Section's power drilling equipment met with refusal above the zone of saturation, and no groundwater samples were obtained. The potential therefore remains for groundwater contamination beneath the project site.

The UC facility's production well supplies up to 450 plant employees with drinking water. This well is located adjacent to the river, at a location 0.2 mile west, and 0.5 mile upstream, from the project site. The production well draws from fractured bedrock, and therefore could potentially intercept groundwater contaminants beneath the project site.

1646 MAIL SERVICE CENTER, RALEIGH, NORTH CAROLINA 27699-1646
401 OBERLIN ROAD, SUITE 150, RALEIGH, NC 27605
PHONE: 919-733-4996 \ FAX: 919-715-3605
AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER - 50% RECYCLED/10% POST-CONSUMER PAPER

At the time of the October 2001 sampling event, the Superfund Section anticipated that metals data for the UC production well would be on file at the NC Public Water Supply Section. In addition, extensive groundwater sampling had been conducted at UC in 1993 and summarized in two 1999 Comprehensive Site Assessment (CSA) reports. However, a subsequent review of these sources indicated that the production well had been tested repeatedly for lead and copper, but not for mercury or other metals.

Based on the October 2001 surface water and sediment results, the NC Superfund Section recommended that the EPA designate the project site for no further remedial action under CERCLA. However, the NC Superfund Section strongly recommends that the UC production well be tested for mercury and other RCRA metals as soon as possible, in order to address potential drinking water contamination. If you have any questions, please call me at (919) 733-2801.

Sincerely,

Stuart F. Parker, Hydrogeologist
NC Superfund Section

cc: file