642SERBSF10,636

642SERBSF10,636

Site Name (Subject):	UNION OIL CO. SE TERM
Site ID (Document ID):	NCD000609974
Document Name (DocType):	Preliminary Assessment/Site Inspection (PA/SI)
Report Segment:	
Description:	Phase II Screening Site Investigation
Date of Document:	9/29/1992
Date Received:	
Box: *Enter SF and # with no spaces*	SF10,636
Access Level:	PUBLIC
Division:	WASTE MANAGEMENT
Section:	SUPERFUND
Program (Document Group):	SERB (SERB)
Document Category:	FACILITY

Print Report for Record | **Go to New Blank Record** | **Go to New Record - (default to last record values)** | **Delete Record**

State of North Carolina
Department of Environment, Health, and Natural Resources
Division of Solid Waste Management
P.O. Box 27687 · Raleigh, North Carolina 27611-7687

James G. Martin, Governor
William W. Cobey, Jr., Secretary

William L. Meyer
Director

September 29, 1992

Mr. Craig Benedikt
EPA NC CERCLA Project Officer
EPA Region IV Waste Division
345 Courtland Street, NE
Atlanta, Georgia 30365

RE: Phase II, Screening Site Investigation
Union Oil Company, S.E. Terminal
Greensboro, Guilford County, North Carolina
NCD 000 609 974

Dear Mr. Benedikt:

Enclosed herewith is the Phase II, Screening Site Investigation (SSI) by the North Carolina Superfund Section for Union Oil Company, S.E. Terminal, (NCD 000 609 974).

The North Carolina Superfund Section is recommending that the site proceed to the Expanded Site Investigation stage on a medium priority basis.

If you have any questions, please contact me at 919-733-2801.

Sincerely,

Harry Zinn
Environmental Engineer
Contracts Management Branch
NC Superfund Section

HZ\gj

Enclosure

cc: Dexter Matthews
file

STATE OF
NORTH CAROLINA

Department of Environment, Health,
and Natural Resources
Division of Solid Waste Management
Superfund Section

SCREENING SITE INVESTIGATION REPORT

Union Oil Company, SE Terminal
Greensboro, Guilford County, North Carolina
NCD 000 609 974

September 29, 1992

By:

Division of Solid Waste Management
Superfund Section

SCREENING SITE INVESTIGATION REPORT

Union Oil Company SE Terminal
NCD 000 609 974
Greensboro, Guilford County, North Carolina

CERCLA

September 29, 1992

Prepared by:

Superfund Section
Solid Waste Management Division
North Carolina Department of Environment, Health, and Natural Resources

TABLE OF CONTENTS

Executive Summary

1.0 Introduction

2.0 Site Description and Regulatory History

2.1 Location
2.2 Site Layout
2.3 Topography and Land Use
2.4 Permit & Regulatory History
2.5 Description of Earlier Investigations

3.0 Operational History & Waste Characteristics

3.1 Ownership History
3.2 Site Use History
3.3 Process and Waste Disposal History
3.4 Remedial Actions to Date

4.0 Groundwater

4.1 Geologic and Hydrogeologic Setting
4.2 Groundwater Supply and Groundwater Users
4.3 Groundwater Sampling and Sampling Results
4.4 Summary of Groundwater Pathway Concern

5.0 Surface Water

5.1 Surface Water Pathway
5.2 Climate and Meteorology
5.3 Surface Water Supplies and Surface Water Users
5.4 Critical, Sensitive Environments and Fisheries
5.5 Surface Water Sampling and Sampling Results
5.6 Summary of Surface Water Pathway Concerns

6.0 Soil Exposure

6.1 On-Site Population
6.2 Off-Site Contamination
6.3 Schools and Day Care Facilities
6.4 Terrestrial Sensitive Environments and Resources
6.5 Soil Sampling and Sampling Results
6.6 Summary of Soil Pathway Concerns

7.0 Air

7.1 Surrounding Population and Nearest Individual
7.2 Sensitive Environments
7.3 Air Sampling and Sampling Results
7.4 Summary of Air Pathway Concerns

8.0 Summary and Conclusions

APPENDIX A: ANALYTICAL DATA
APPENDIX B: QA\QC

EXECUTIVE SUMMARY

Union Oil Company, S.E. Terminal began operations in 1929. It was purchased by Gulf Oil Company in 1980. In 1985 the facility was purchased by Standard Oil of Ohio. In 1990 British Petroleum Oil became the current owner. The site is a tank farm consisting of four tanks with a combined capacity of 185,000 barrels inside one bermed area and seven tanks with a combined capacity of 331,000 barrels in a second bermed area. The Union Oil Company, S.E.Terminal entered the North Carolina RCRA system on August 14, 1980. Union Oil Company was deleted as a treater, storer, and disposer under RCRA in 1982 and is currently listed as a generator. The hazardous wastes currently generated are, American Petroleum Institutes (API) slop oil solids, API separator sludge, and leaded tank bottoms.

The site lies within the Carolina Slate Belt of the Piedmont Physiographic Province, which is characterized by gently rolling topography with moderately steep slopes along the drainage ways. The slate belt consists of folded and fractured metamorphic bedrock, granite, gabbro and diorite, overlain by residual material termed saprolite. The groundwater used by some of the residents in the area is obtained from the saprolite/bedrock hydrologic system. The rest of the people obtain their drinking water from surface water intakes located both upstream and downstream from the site.

A Preliminary Assessment performed by the North Carolina Department of Environment, Health, and Natural Resources, Superfund Section recommended the site proceed on a low priority basis. Consequently, on June 13, 1992 the North Carolina Superfund Section along with NUS Corporation conducted a Phase II Site Screening Investigation.

A total of twenty six (26) environmental samples were collected at the site. Results of the sampling event indicate surface soils are contaminated with metals, soil borings are contaminated with metals and volatile organic compounds, and the shallow groundwater is contaminated with metals, volatile organic compounds, and base neutral extractable compounds. No drinking water wells were tested, however, contamination of the drinking water is suspected. No sampling of the surface water was performed, however, fisheries, surface water intakes and a recreational area located downstream from the site are suspected of being contaminated. Therefore, the North Carolina Superfund Section is recommending that the site proceed to the Expanded Site Investigation stage on a medium priority basis.

Date: 29 September 1992

Prepared by: Harry Zinn
NC Superfund Section
NC Department of Environment, Health, and Natural Resources

Site: Union Oil Company, SE Terminal
6801 West Market Street
Greensboro, NC

EPA ID No.: NCD 000 609 974

1.0 INTRODUCTION

Under authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA), and in accordance with a cooperative agreement under Section 104 of CERCLA between the US EPA and the NC Department of Environment, Health, and Natural Resources, the NC Superfund Section conducted a Site Investigation (SI) of the Union Oil Company, SE Terminal in Greensboro, Guilford County, NC. The purpose of this investigation was to collect information concerning conditions at the site sufficient to assess the threat posed to human health and the environment and to determine the need for additional investigation under CERCLA or other authority, and, if appropriate, support site evaluation using the Hazard Ranking System (HRS) for proposal to the National Priorities List (NPL). The investigation included reviewing previous information, sampling waste and environmental media to test preliminary assessment (PA) hypotheses and to evaluate and document HRS factors, collecting additional non-sampling information, and interviewing nearby residents. The actual sampling of the site was conducted by NUS Corporation, a Field Investigation Team (FIT) contractor for the US EPA, Region IV.

2.0 SITE DESCRIPTION AND REGULATORY HISTORY

2.1 LOCATION

Union Oil Company, S.E. Terminal is located at 6801 West Market Street in Greensboro, North Carolina. The coordinants of the site are 36° 04' 43.5" latitude and 79° 55' 24.0" longitude.

2.2 SITE LAYOUT

Union Oil Company, S.E. Terminal is located on the western side of Greensboro. The site is bordered on the north by Market Street and is surrounded on the other three sides by other Bulk Petroleum Distribution Terminals. The site is surrounded by a six foot fence topped with barbed wired. Access is via a guarded gate (Ref. 3). The site has been used as a Bulk Petroleum Distribution Terminal since 1929.

2.3 TOPOGRAPHY AND LAND USE

Union Oil Company is located west of Greensboro within the Carolina Slate Belt of the Piedmont Physiographic Province, which is characterized by gently rolling topography with moderately steep slopes along the drainage ways.

The site is located in a heavily industrialized area. It is surrounded on three sides by other Bulk Petroleum Distribution Terminals and on the fourth side by a railroad and a major road (Ref.3).

2.4 PERMIT AND REGULATORY HISTORY

Union Oil Company, S.E. Terminal first entered the North Carolina RCRA program on August 14, 1980 (Ref. 7). The facility filed a Part A application for a Hazardous Waste Permit on November 7, 1980 (Ref. 6). Union Oil Company was deleted as a treater, storer, and disposer under RCRA on March 4, 1982 (Ref. 8). Union Oil Company was in full compliance with generator standards during an inspection on March 23, 1982 (Ref. 9). On March 30, 1984 the facility's interim status was terminated (Ref. 10). The site was again found in compliance during a generator inspection on October 11, 1987 (Ref. 11). The facility is currently listed as a generator under RCRA (Ref. 7). The facility was granted a National Pollutant Discharge Elimination System permit, which expired June 30, 1981 (Ref. 6).

2.5 DESCRIPTION OF EARLIER INVESTIGATIONS

The Preliminary Assessment dated 1/22/85 recommended the site proceed to a Phase I Screening Site Inspection (SSI) on a low priority basis. The Phase I SSI recommended the site proceed to a Phase II SSI on 7/5/90.

SUMMERFIELD, N. C.
N3607.5—W7952.5/7.5
1969
AMS 5056 III NW—SERIES V842

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STATE OF NORTH CAROLINA
HIGHWAY AND PUBLIC WORKS COMMISSION

GREENSBORO QUADRANGLE
NORTH CAROLINA-GUILFORD CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)

Greensboro Water System - Total Coverage
Greensboro Water System - Single Line Extensions
High Point Water System

Nearest School
Nearest Residence
Nearest Well

Mapped, edited, and published by the Geological Survey
Control by USGS, USC&GS, and North Carolina Geodetic Survey
Culture and drainage in part compiled from aerial photographs taken 1948
Topography by plane-table methods 1951
Polyconic projection. 1927 North American datum
10,000-foot grid based on North Carolina coordinate system
1000-meter Universal Transverse Mercator grid ticks, zone 17, shown in blue
Revisions shown in purple compiled from aerial photographs taken 1968. This information not field checked
Purple tint indicates urban areas

SCALE 1:24 000
CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION
Heavy-duty — Light-duty
Medium-duty — Unimproved dirt
Interstate Route — U. S. Route — State Route

UTM GRID AND 1968 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

QUADRANGLE LOCATION

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, WASHINGTON, D. C. 20242
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

GUILFORD, N. C.
N3600—W7952.5/7.5
1951
PHOTOREVISED 1968
AMS 5056 III SW—SERIES V842

Mapped, edited, and published by the Geological Survey
Control by USGS, USC&GS and North Carolina Geodetic Survey
Culture and drainage in part compiled from aerial photographs taken 1948.
Topography by plane-table surveys 1951
Polyconic projection. 1927 North American datum
10,000-foot grid based on North Carolina coordinate system
1000-meter Universal Transverse Mercator grid ticks, zone 17, shown in blue
Red tint indicates area in which only landmark buildings are shown
Revisions shown in purple compiled from aerial photographs taken 1968. This information not field checked
Purple tint indicates extension of urban areas

To place on the predicted North American Datum 1983, move the projection lines 10 meters south and 20 meters west as shown by dashed corner ticks

SCALE 1:24 000
CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

UTM GRID AND 1968 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

QUADRANGLE LOCATION

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

GREENSBORO, N. C.
36079-A7-TF-024
1951
PHOTOREVISED 1968
DMA 5056 III SE—SERIES V842

3.0 OPERATIONAL HISTORY AND WASTE CHARACTERISTICS

3.1 OWNERSHIP HISTORY

Union Oil Company, S.E. Terminal began operations in 1929. In 1980 the site was purchased by Gulf Oil Company. Standard Oil of Ohio became the owner in 1985 and sold the site to British Petroleum Oil in 1989. They are the present owners of the facility (Ref. 3,4).

3.2 SITE USE HISTORY

Since its formation in 1929 the site has been used as a Bulk Petroleum Distribution Terminal. The Union Oil Company receives oil from the Colonial Pipelines and distributes it to trucks and tank cars (Ref. 5).

3.3 PROCESS AND WASTE DISPOSAL HISTORY

No records exist of the waste disposal practices prior to 1980. On-site disposal of tank sludges and petroleum additives are suspected to have occurred from 1929 to 1980.

Since 1980 no on-site waste disposal has occurred. The current waste generated consist of; American Petroleum Institute (API) separator sludge, API separator slop oil, and leaded tank bottoms.

3.4 REMEDIAL ACTIONS TO DATE

No known releases or remedial actions have occurred at the site to date.

4.0 GROUNDWATER

4.1 GEOLOGIC AND HYDROGEOLOGIC SETTING

The site lies within the Carolina Slate Belt of the Piedmont Physiographic Province, which is characterized by gently rolling topography with moderately steep slopes along the drainage ways. The slate belt consists of folded and fractured metamorphic bedrock, granite, gabbro and diorite, overlain by residual material termed saprolite.

The groundwater used by some of the residents in the area is obtained from the saprolite/bedrock hydrologic system. The rest of the people obtain their drinking water from surface water intakes located both upstream and downstream from the site. In the saprolite, groundwater occurs within intergranular pore spaces (Ref. 16,pg 4). In the bedrock, groundwater occurs within joints, fractures, and other secondary openings (Ref. 12, plate 1). The frequency, size and interconnection of both joints and fractures diminishes with depth (Ref. 16,pg 4). There are few openings at depths greater than 400 feet (Ref. 15, pg 12). The saprolite has a hydraulic conductivity of less than $1x10^{-7}$ cm/sec (Ref. 12). The depth to the groundwater in the site area is about 15 feet below land surface (Ref. 15).

4.2 GROUNDWATER SUPPLY AND GROUNDWATER USERS

Groundwater from private wells and three community water well systems is the only source of drinking water for 3017 residents within four miles of the site (Ref. 33).

The total population using groundwater within 4 miles of the site is estimated as follows:

Radius	Population (cum.)
0-1/4 MILE	34
¼-½ MILE	58
½-1 MILE	315
1-2 MILES	691
2-3 MILES	1738
3-4 MILES	3017

These numbers were obtained by (1) counting the houses not served by municipal systems, (2) multiply the number of houses by 2.44 (the number of residents per house for Guilford County in 1990), and, (3) adding the population served by community water systems on wells (Ref. 33). The closest well is located at the Airport Mobile Home Park, located across Market Street, approximately 200 feet, and serves 17 residents (Ref. 3).

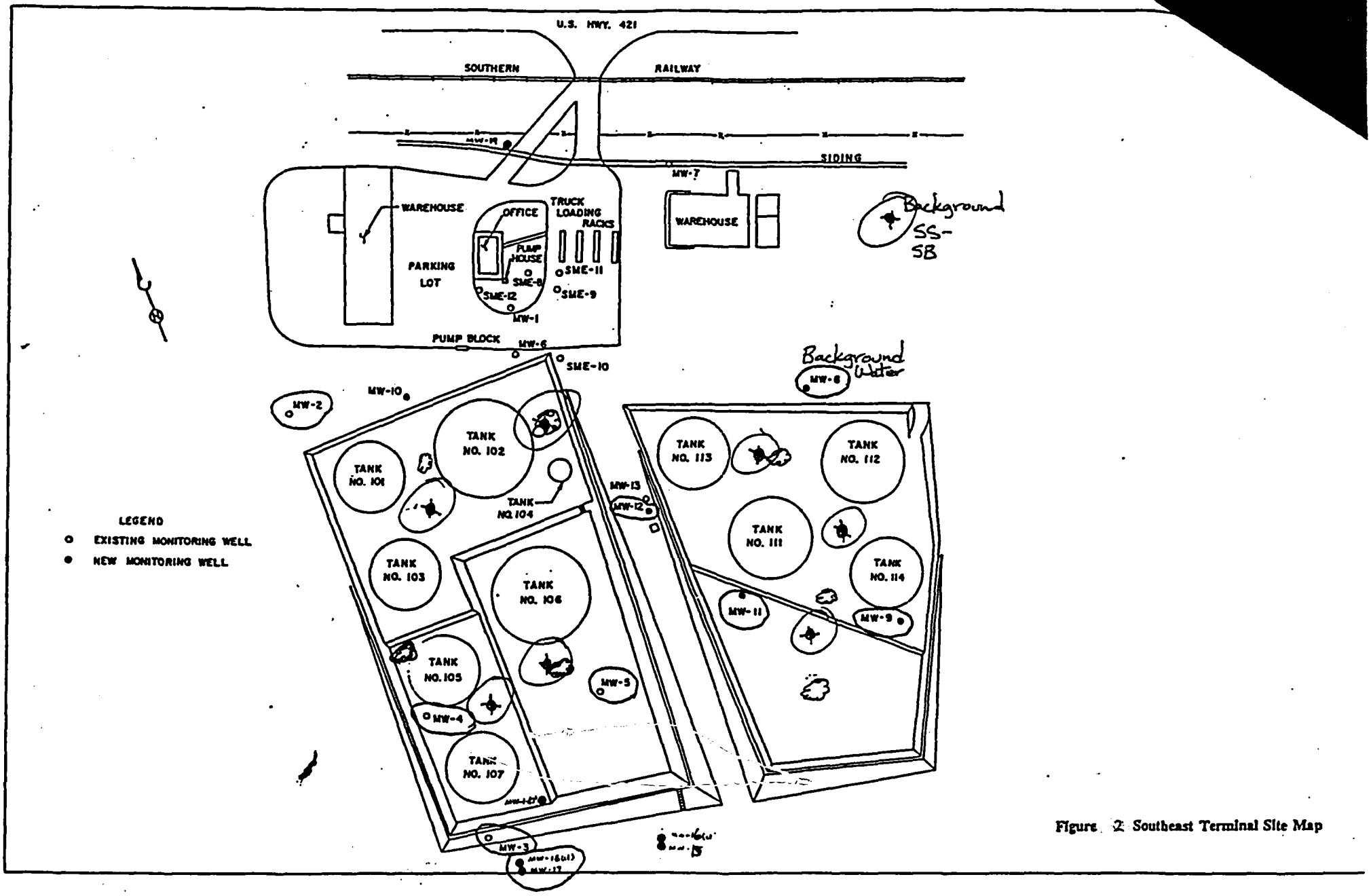


Figure 2 Southeast Terminal Site Map

4.3 GROUNDWATER SAMPLING AND SAMPLING RESULTS

Nine (9) groundwater samples (MW02, MW03, MW04, MW05, MW09, MW12, MW13, MW17, MW18) were obtained by NUS personnel. The groundwater samples were collected from some new and some existing monitoring wells as shown on Figure 2. There are no records of the construction of the wells or the depths. All the samples collected on the site were contained, preserved, and held in accordance with the Standard Operating Procedures (SOP).

Upon completion of the sampling event, the NUS samples were divided and the Organics were sent to Recra Environmental Inc., 8320 Guilford Rd. Building F, Columbia, MD, 21046, and the Inorganics were sent to Skinner and Sherman, 300 Second Ave., Waltham, MA, 02254. The results listed in this report reflect data validation.

MW08

This sample was collected from a well located north of Tank 112 outside of the berm, and upgradient of the areas of contamination. No VOC's or BNA's were detected in any significant concentrations. Chromium (98ppb) was the only inorganic compound detected in any concentration exceeding the U.S. EPA Maximum Contaminant Level (MCL) which is 50ppb for chromium. Since no other groundwater sample had any concentration of chromium near the MCL this will be used as a clean background sample.

MW02

This sample was collected from a well located north of Tank 101 outside the berm. No VOC's or BNA's were detected in any significant concentrations. Calcium (1500ppb) was the only inorganic compound detected in any significant concentration.

MW03

This sample was collected from a well located south of Tank 107 on the outside portion of the berm. Benzene (28ppb) was the only VOC detected in a significant concentration. No BNA's were detected in any significant concentrations. Calcium (720ppb) was the only inorganic compound detected in a significant concentration.

MW04

This sample was collected from a well located southwest of Tank 105 inside of the berm. No VOC's, BNA's or inorganic compounds were detected in any significant concentrations.

MW05

This sample was collected from a well located south of Tank 106 inside the berm. No VOC's or BNA's were detected in any significant concentrations, however two BNA TIC's were detected. Calcium (980ppb) and sodium (6100ppb) were detected in significant concentrations.

MW09

This sample was collected from a well located south of Tank 114 inside the berm. No VOC's or BNA's were detected in any significant concentrations, however one BNA TIC was detected. Manganese (960ppb) and mercury (0.74ppb) were detected in significant concentrations.

MW12

This sample was collected from a well located between the berms of the two tank areas. Acetone (68000ppb), benzene (17000ppb), toluene (32000ppb), ethylbenzene (2600Jppb) and $xylene_{(total)}$(12000ppb) were the VOC's detected in significant concentrations. Two TIC's were also detected. Naphthalene (490ppb), and 2-methylnaphthalene (150ppb) were the BNA's detected in significant concentrations. Seven BNA TIC's were also detected. Calcium (400ppb) and lead (140ppb) were the inorganic compounds detected in significant concentrations.

MW13

This sample was collected from a well located between the berms and north of MW12. No VOC's, BNA's or inorganic compounds were detected in any significant concentrations.

MW17

This sample was collected from a well located south of Tank 107 outside the berm. No VOC's or BNA's were detected in any significant concentrations. Calcium (36000ppb) and sodium (7400ppb) were the inorganic compounds detected in significant concentrations.

MW18

This sample was collected from a well located in the vicinity and just north of MW17. Benzene (40ppb), toluene (110ppb) and $xylene_{(total)}$(28ppb) were the VOC's detected in significant concentrations. No BNA's were detected in any significant concentrations. Calcium (23000ppb) and sodium (8600ppb) were the inorganic compounds detected in significant concentrations.

4.4 SUMMARY OF GROUNDWATER PATHWAY CONCERN

The groundwater both inside and outside the bermed areas around the tanks have been contaminated with acetone, benzene, toluene, $xylenes_{(total)}$, two VOC TIC's, naphthalene, 2-methylnaphthalene, several BNA TIC's, and calcium, lead, manganese, and sodium. The single detection of mercury is within concentration levels normally found in soils in the Eastern United States or cannot be attributed to the site. Groundwater contamination has occurred on-site. Several homes in the area utilizing the saprolite/bedrock aquifer as their source of drinking water. Drinking water contamination may have occurred. Therefore, the groundwater pathway is a pathway of concern.

5.0 SURFACE WATER

5.1 SURFACE WATER PATHWAY

Based on the USGS 7.5 minute series topographic maps (Figure 1) and on-site reconnaissance, the drainage pathway from the site has been identified. Surface water drains 1,000 feet south-southwest into a pond. No observable surface pathway connects this pond to a second pond approximately 200 feet southwest of the first pond, however, some form of connection is suspected. The second pond drains west into an unnamed tributary which flows 3.4 miles to the East Fork Deep River. The East Fork Deep River flows 1.1 miles until it enters High Point Lake. After traveling 2.3 miles through High Point Lake, it exits as Deep River and flows as such for the remainder of the 15-mile migration pathway.

5.2 CLIMATE AND METEOROLOGY

In the area of Greensboro, the mean annual precipitation is 44 inches and the mean annual evaporation is 40 inches resulting in a net annual precipitation of 4 inches (Ref. 17). The 2-year 24-hour rainfall in this area is approximately 3.75 inches (Ref. 18).

5.3 SURFACE WATER SUPPLIES AND SURFACE WATER USERS

The city of High Point obtains its water supply from an intake located on the Deep River, just below the High Point Lake dam 6.8 miles downstream from the site (Ref. 22). High Point services 32,500 connections (Ref. 32).

The Jamestown Water Department obtains its water from the Oakdale treatment facility on the Deep River, approximately 3.3 miles below the High Point Lake dam 10.1 miles downstream from the site. This system serves 1,000 residences and 150 businesses (Ref. 23).

The majority of the people in the Greensboro area are served by the Greensboro Water Department (GWD). The GWD obtains its water from Lake Townsend, Lake Higgins, and Lake Brandt, all of which are located upstream of the site (Ref. 26).

5.4 CRITICAL, SENSITIVE ENVIRONMENTS, AND FISHERIES

No wetlands, sensitive environments, or habitats for threatened or endangered species occur along the surface water pathway or within target distances of the site (Ref. 38). No wetlands occur within 15 miles downstream of the site (Ref. 37).

The unnamed tributary is not fished. East Fork Deep River and Deep River are

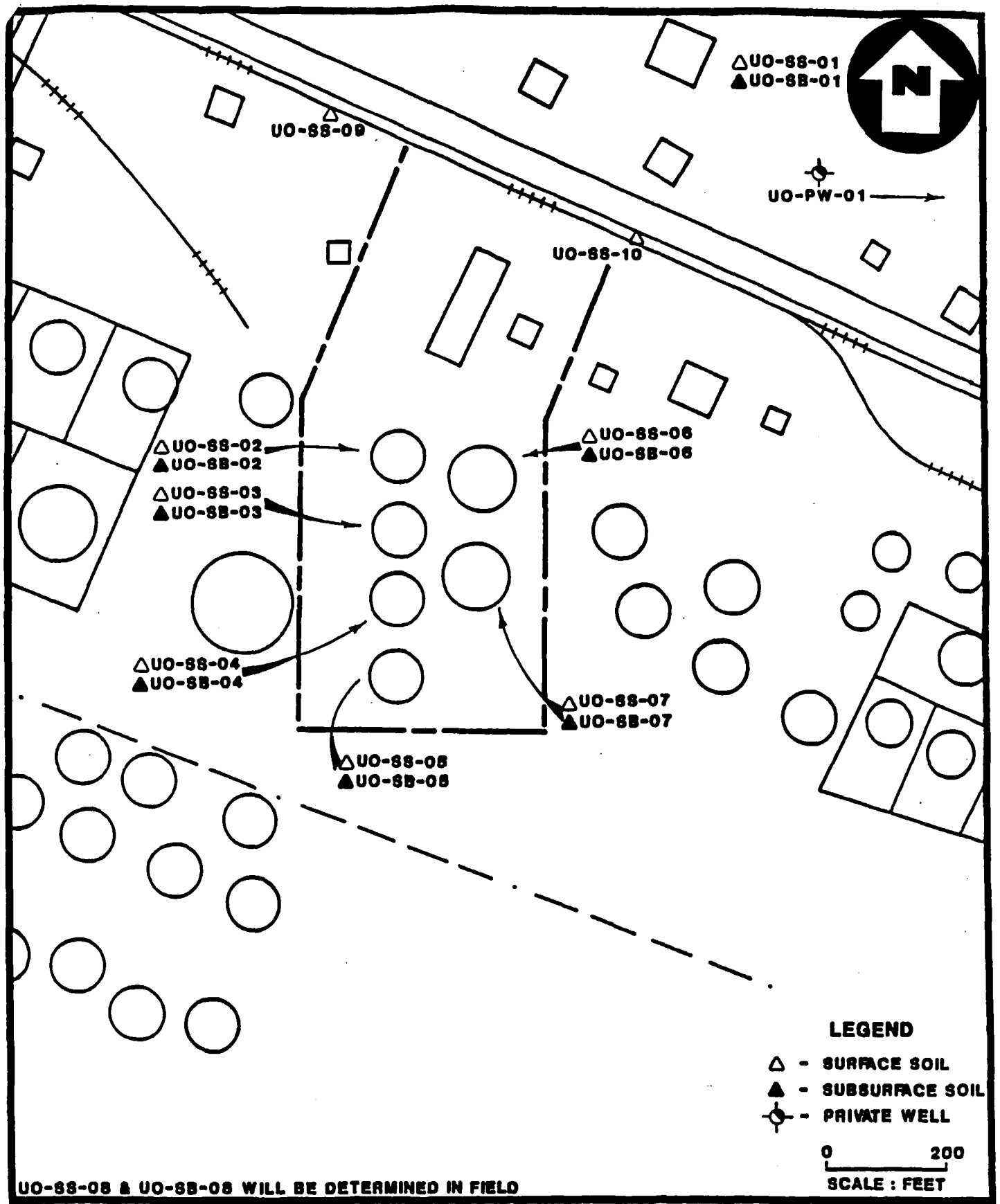
lightly fished, and High Point Lake is heavily fished for striped bass, largemouth bass, and crappie and is considered a major recreational area (Ref. 34). The site is not located in any flood plain (Ref. 25).

5.5 SURFACE WATER SAMPLING AND SAMPLING RESULTS

No surface water samples were collected during the sampling event.

5.6 SUMMARY OF SURFACE WATER PATHWAY CONCERNS

The possibility of overland runoff and/or groundwater to surface water interface leads to the suspicion of contaminated surface water and the contamination of fisheries, surface water intakes and a major recreational area downstream of the site. Therefore, the surface water pathway is a pathway of concern.



BASE MAP IS AN ENLARGED PORTION OF THE U.S.G.S. 7.5 MINUTE QUADRANGLE MAP GUILFORD, NORTH CAROLINA, 1968.

SAMPLE LOCATION MAP
UNION OIL S.E. TERMINAL
GREENSBORO, GUILFORD COUNTY,
NORTH CAROLINA

FIGURE -3

NUS CORPORATION

6.0 SOIL EXPOSURE

6.1 ON-SITE POPULATION

There are currently three (3) full time employees working at the site (Ref. 28).

6.2 OFF-SITE POPULATION

The site is situated between the two high population areas of Greensboro and High Point. The population within the 1/4, 1/2, 1, 2, 3, and 4 mile radius of the site was obtained from the North Carolina Center for Geographic Information and Analysis Utilizing the 1990 U.S. Census data.

Radius	Population (cum.)
0-¼ Mile	36
¼-½ Mile	226
½-1 Mile	1652
1-2 Miles	12,421
2-3 Miles	22,964
3-4 Miles	44,632

6.3 SCHOOLS AND DAY-CARE FACILITIES

No day-care facilities are near the site. The nearest school is located 1.5 miles away (Ref. 3). The nearest residence is located across Market Street 200 feet from the site in the Airport Mobil Home Park.

6.4 TERRESTRIAL SENSITIVE ENVIRONMENTS AND RESOURCES

No terrestrial sensitive environments or resource usage occurs within the area of observed contamination (Ref. 38).

6.5 SOIL SAMPLING AND SAMPLING RESULTS

Eight (8) surface soil samples (SS01-SS08), one (1) sediment sample (SD01), and eight (8) soil boring samples (SB01-SB08) were collected to characterize the site. All the samples collected on the site were contained, preserved, and held in accordance with the Standard Operating Procedures (SOP). The location of the soil sample points is shown on Figure 3, except SSO8, SB08, and SD01. There are no records of the locations that these samples were collected at.

Upon completion of the sampling event, the NUS samples were divided and the Organics were sent to Recra Environmental Inc., 8320 Guilford Rd. Building F, Columbia, MD, 21046, and the Inorganics were sent to Skinner and Sherman,

300 Second Ave., Waltham, MA, 02254. The results listed in this report reflect data validation.

SS01
This sample was taken from an area upgradient from areas of possible contamination east of the warehouse. No Volatile Organic Compounds (VOC's), Base Neutral Acid Extractables (BNA's), or Inorganic Compounds were found in any significant concentrations.

SB01
This sample was collected from the same point as SS01. No VOC's, BNA's, or Inorganic Compounds were detected in any significant concentrations.

SS02
This sample was collected from a point west of Tank 101 inside the berm. No VOC's or BNA's were detected in any significant concentrations. Nickel (40ppm) was the only inorganic compound found in a significant concentration.

SB02
This sample was collected from the same point as SS02. No VOC's or BNA's were detected in any significant concentrations. Barium (32ppm), magnesium (400ppm), and nickel (40ppm) were the only inorganic compounds found in significant concentrations.

SS03
This sample was collected from a point southwest of Tank 103 inside the berm. No VOC's, BNA's or Inorganic Compounds were detected in any significant concentrations.

SB03
This sample was collected from the same point as SS03. No VOC's or BNA's were detected in any significant concentrations. Zinc (22ppm) was the only inorganic compound found in a significant concentration.

SS04
This sample was collected from a point southwest of Tank 105. No VOC's or BNA's were detected in any significant concentrations. Arsenic (3.1Jppm), chromium (110ppm), lead (63ppm), nickel (15ppm) and zinc (46ppm) were the only inorganic compounds found in significant concentrations. The pesticide dieldrin (5.9ppb) was detected in a significant concentration.

SB04
This sample was collected from the same point as SS04. No VOC's or BNA's were detected in any significant concentrations. Barium (33ppm), and calcium

(580ppm) were the only inorganic compounds found in significant concentrations.

SS05
This sample was collected from a point west of Tank 107 inside the berm. No VOC's, BNA's or Inorganic Compounds were detected in any significant concentrations.

SB05
This sample was collected from the same point as SS05. Toluene (98ppb), ethylbenzene (140ppb), and $xylenes_{(total)}$(1500ppb) were the VOC's detected in significant concentrations. No BNA's were detected in any significant concentrations. Barium (56ppm), cobalt (16ppm), magnesium (490ppm) and nickel (8.6ppm) were the inorganic compounds detected in significant concentrations.

SS06
This sample was collected from a point east of Tank 102 inside the berm. No VOC's or BNA's were detected in any significant concentrations. Beryllium (1.2ppm), calcium (3400ppm), lead (500ppm), nickel (18ppm), potassium (1800ppm), sodium (380ppm), and zinc (370ppm) were the inorganic compounds detected in significant concentrations.

SB06
This sample was collected from the same point as SS06. No VOC's or BNA's were detected in any significant concentrations. Barium (55ppm), cobalt (21ppm), copper (110ppm), and magnesium (420ppm) were the inorganic compounds detected in significant concentrations.

SS07
This sample was collected from a point southeast of Tank 106 inside the berm. No VOC's or BNA's were detected in any significant concentrations. Lead (230ppm), potassium (690ppm), and zinc (150ppm) were the inorganic ompounds detected in significant concentrations.

SB07
This sample was collected from the same point as SS07. No VOC's, BNA's or Inorganic Compounds were detected in any significant concentrations.

6.6 SUMMARY OF SOIL PATHWAY CONCERNS

Surface soils inside the bermed areas around the tanks have been contaminated with lead, nickel, and zinc. The single detections of arsenic, beryllium, calcium, chromium, sodium, and dieldrin are within concentration levels normally found in soils in the Eastern United States or cannot be attributed to the site.

Soil borings inside the bermed areas around the tanks have been contaminated with toluene, ethylbenzene, xylenes$_{(total)}$, several BNA TIC's and barium, calcium, cobalt, copper, manganese, nickel, and zinc.

Because of the limited access to the site and the lack of day-care, school facilities, or residences in the area the soil pathway is not the pathway of most concern.

7.0 AIR

7.1 SURROUNDING POPULATION AND NEAREST INDIVIDUAL

The site is situated between the two high population areas of Greensboro and High Point. The population within the 1/4, 1/2, 1, 2, 3, and 4 mile radius of the site was obtained from the North Carolina Center for Geographic Information and Analysis Utilizing the 1990 U.S. Census data.

Radius	Population (cum.)
0-¼ Mile	36
¼-½ Mile	226
½-1 Mile	1652
1-2 Miles	12,421
2-3 Miles	22,964
3-4 Miles	44,632

The nearest residence is located across Market Street 200 feet from the site in the Airport Mobil Home Park.

7.2 SENSITIVE ENVIRONMENTS

No sensitive environments located within the four (4) mile radius have been contaminated.

7.3 AIR SAMPLING AND SAMPLING RESULTS

No air sampling was performed during the sampling event. At this time there are no known unpermitted air releases from the site.

7.4 SUMMARY OF AIR PATHWAY CONCERNS

No releases of contaminants to the air are suspected, therefore, the air pathway is not a pathway of concern.

8.0 SUMMARY AND CONCLUSIONS

Based on the analytical results of the sampling event at Union Oil Company, S.E. Terminal, the following areas have had environmental releases of hazardous contaminants that may be associated with the site:

- The groundwater both inside and outside the bermed areas around the tanks have been contaminated with acetone, benzene, toluene, $xylenes_{(total)}$, two VOC TIC's, naphthalene, 2-methylnaphthalene, several BNA TIC's, and calcium, lead, manganese, and sodium.

- Surface soils inside the bermed areas around the tanks have been contaminated with lead, nickel, and zinc.

- Soil borings inside the bermed areas around the tanks have been contaminated with toluene, ethylbenzene, $xylenes_{(total)}$, several BNA TIC's and barium, calcium, cobalt, copper, manganese, nickel, and zinc.

No air releases have been documented, therefore, the air pathway is not the pathway of most concern. Groundwater contamination has occurred on-site and with several homes in the area utilizing the saprolite/bedrock aquifer as their source of drinking water, therefore, drinking water contamination may have occurred. The possibility of overland runoff and/or groundwater to surface water interface leads to the suspicion of contaminated surface water and the contamination of fisheries, surface water intakes and a major recreational area downstream of the site. Therefore, the groundwater and the surface water pathways are the pathways of most concern. The North Carolina Superfund Section recommends that Union Oil Company, S.E. Terminal proceed to the Expanded Site Investigation (ESI) phase on a medium priority basis.

REFERENCES
Union Oil Company SE Terminal
NCD 000 609 974

1. U.S. Environmental Protection Agency, 1990. Hazard Ranking System; Final Rule. 55 FR 51532, December 14, 1990.

2. U.S. Environmental Protection Agency, 1991. Superfund Chemical Data Matrix (SCDM). Office of Solid Waste and Emergency Response. Directive 9345.1-13. Revised semi-annually.

3. NUS Corporation Field Logbook No. F4-1878 for Union Oil Corporation, S.E. Terminal, TDD No. F4-8911-76. Documentation of facility reconnaissance, December 11, 1989.

4. EPA General Information (EPA Form 3510-1) and Hazardous Waste Permit Application (EPA Form 3510-3) for Union Oil Corporation, S.E. Terminal, Greensboro, North Carolina. Filed by R.E. Wohlgemuth, Vice-President, Northern Region, November 7, 1980.

5. RCRA Inspection Report for Union Oil Corporation, S.E. Terminal, Greensboro, North Carolina. Filed by J.H. Deakins, District Sanitarian, August 25, 1982.

6. Potential Hazardous Waste Site Preliminary Assessment (EPA Form 2070-12) and attachments for Union Oil Corporation, S.E. Terminal. Filed by Lee Crosby and D. Mark Durway, North Carolina Department of Human Resources, January 22, 1985.

7. Jim Edwards, Compliance Officer telephone conversation with Joan Dupont, NUS Corporation, March 14, 1990. Subject: RCRA information.

8. O.W. Strickland, Head, Solid and Hazardous Waste Management Branch, Environmental Health Section, letter to B.L. Swinney of the Gulf Oil Corporation, March 4, 1982. Subject: RCRA information.

9. J.H. Deakins, Waste Management Inspector, memorandum to O.W. Strickland, Heat, Solid and Hazardous Waste Management Branch, March 23, 1984. Subject: RCRA information for Union Oil Corporation, S.E. Terminal.

10. O.W. Strickland, Head, Solid and Hazardous Waste Management Branch, Environmental Section. Letter to John T. Ross of Union Oil Corporation, S.E. Terminal, March 13, 1984. Subject: Permit information.

11. Generator Inspection Form Park 262, Union Oil Corporation, S.E. Terminal, Greensboro, North Carolina. Inspection date: October 17, 1989; obtained from state files.

12. The North Carolina Geological Survey and John M. Parker, III in accordance with the State Geologic Map Advisory Committee, Geologic Map of North Carolina, (1985).

13. M.J. Mundorff, Geology and Groundwater in the Greensboro Area, North Carolina, Bulletin Number 55, (Raleigh: USGS. 1948),pp. 23, 76-78, plate 1.

14. U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Guilford County, North Carolina, December 1977), p.1.

15. Charles C. Daniel, III and N. Bonar Sharpless, Groundwater Supply Potential and Procedures for Well Site Selection, Upper Cape Fear River Basin, (USGS, 1983), pp. 7, 11-12, 38, 59.

16. Edwin O. Floyd and Richard R. Peach, An Appraisal of the Groundwater Resources of the Upper Cape Fear River Basin North Carolina, Groundwater Bulletin Number 20, (USGS and the North Carolina Office of Water and Air Resources, 1974), pp. 3-4, 6, 17).

17. U.S. Department of Commerce, Climatic Atlas of the United States (Washington, D.C.: GPO, June 1968) Reprint: 1983, National Oceanic and Atmospheric Administration, p.63.

18. U.S. Department of Commerce, Rainfall Frequency Atlas of the United States, Technical Paper No. 40 (Washington, D.C.: GPO, 1961).

19. Charles C. Daniel, III, Statistical Analysis Relating Well Yield in Construction Practices and Siting of Wells in the Piedmont and Blue Ridge Provinces of North Carolina, Water Resources Investigations Report 86-4132, (Washington, D.C.: GPO, 1987),pp.9-10.

20. U.S. Environmental Protection Agency, Uncontrolled Hazardous Waste Site Ranking System: A Users Manual (HW-10), originally published in the July 16, 1982, Federal Register (Washington, D.C.: GPO, 1984) p.15.

21. U.S. Geological Survey, 7.5 minute series Topographic Quadrangle Maps of North Carolina: Greensboro, North Carolina 1951 (Photorevised 1968), Summerfield, North Carolina 1969, Guilford, North Carolina 1951 (PR 1968), scale 1:24,000.

22. Wayne Slayton, Water and Sewer Supervisor, Telephone conversation with Michael Profit, NUS Corporation, May 3, 1988. Subject: Water and intakes in the High Point area.

23. John Frezell, Town Manager, telephone conversation with Eric Corbin, NUS Corporation, May 18, 1989. Subject: Water and intakes in the High Point area.

24. Fishing information for North Carolina City Lake Fishing in the Central Piedmont, North Carolina Wildlife Resources Commission, Revised September 1985.

25. Federal Emergency Management Agency, Flood Insurance Rate Map City of Greensboro, North Carolina, Community-Panel Number 375351 0009C, revised September 30, 1988.

26. Don Grubbs, Guilford County Water Department, Greensboro, North Carolina, telephone conversation with Joan Dupont, NUS Corporation, May 9, 1988. Subject: Water information.

27. North Carolina Center for Geographic Information and Analysis (CGIA). Population Table for site.

28. Memo to File from Harry Zinn on October 16, 1992. Present number of employees at Union Oil SE Terminal.

29. North Carolina Natural Heritage Program Element List for Guilford County, June 21, 1989.

30. Memo to File from Harry Zinn on October 16, 1992. Child Day Care Facilities in Vicinity of Union Oil Camp.

31. Memo to File from Harry Zinn on October 14, 1992. Current Coverage of the Greensboro Water Supply System.

32. Memo to file from Harry Zinn on October 15, 1992. Greensboro and High Point Water System's Sources.

33. North Carolina Dept. of Public Health, Public Water Supply Section. Print out of public water systems in the vicinity of Union Oil Company, SE Terminal.

34. Memo to File from Harry Zinn on October 15, 1992. Fisheries on the Deep River.

35. US Geological Survey Water Data Report NC-88-1. Water Resources Data, North Carolina, Water Year 1988.

36. US Dept. of Agriculture, Soil Conservation Service, October 1989, Hydric Soils of North Carolina.

37. US Department of Agriculture, Soil Conservation Services, December 1977, Soil Survey of Guilford County, NC.

38. Memo to File from Harry Zinn on October 14, 1992. Sensitive Environments in the Vicinity of Union Oil SE Terminal.

39. Memo to Superfund Section from Hal Bryson, August 17, 1992. Update on status of Well Head Protection Programs in North Carolina.

REFERENCES

REFERENCE 1

Reference 1

Federal Register

Friday
December 14, 1990

Part II

Environmental Protection Agency

40 CFR Part 300

Hazard Ranking System; Final Rule

REFERENCE 2

Reference 2

SCDM
Summary Tables
10/29/91

REFERENCE 3

Reference 3

76

"Rite in the Rain."
WEATHERPROOF

LEVEL

NOTEBOOK NO. 311

E4-1878

Union Oil Co. S.E. Terminal
Greensboro, Guilford County, NC
Simonia O. DeLaine, Project Manager
TDD No. 74-8911-76
Dec 11, 1989

a product of
J. L. DARLING CORPORATION
TACOMA, WASHINGTON 98421 U.S.A.

LOGBOOK REQUIREMENTS
REVISED - NOVEMBER 29, 1988

NOTE: ALL LANGUAGE SHOULD BE FACTUAL AND OBJECTIVE

1. Record on front cover of the Logbook: TDD No., Site Name, Site Location, Project Manager.
2. All entries are made using ink. Draw a single line through errors. Initial and date corrections.
3. Statement of Work Plan, Study Plan, and Safety Plan discussion and distribution to field team with team members' signatures.
4. Record weather conditions and general site information.
5. Sign and date each page. Project Manager is to review and sign off on each logbook daily.
6. Document all calibration and pre-operational checks of equipment. Provide serial numbers of equipment used onsite.
7. Provide reference to Sampling Field Sheets for detailed sampling information.
8. Describe sampling locations in detail and document all changes from project planning documents.
9. Provide a site sketch with sample locations and photo locations.
10. Maintain photo log by completing the stamped information at the end of the logbook.
11. If no site representative is on hand to accept the receipt for samples, an entry to that effect must be placed in the logbook.
12. Record I.D. numbers of COC and receipt for sample forms used. Also record numbers of destroyed documents.
13. Complete SMO information in the space provided.

I have read and understand the work Plan for this Recon.

Simonia Delaine
(Simonia Delaine)

Margo West
Margo E. Weston

Sheri Pamatbalar
Sheri Pamatbalar

#2

The weather is cold, 35°.

There is snow on the ground. Very cloudy day.

Nearest Resident with a well is across the street about from the sites

Mr. Lackey 6706 William Buckeye W. Market St.

There are seven trailers in the Park.

The fence has posted no trespassing sign which is in good condition. It is also barb wire. The is one gate, no good gate.

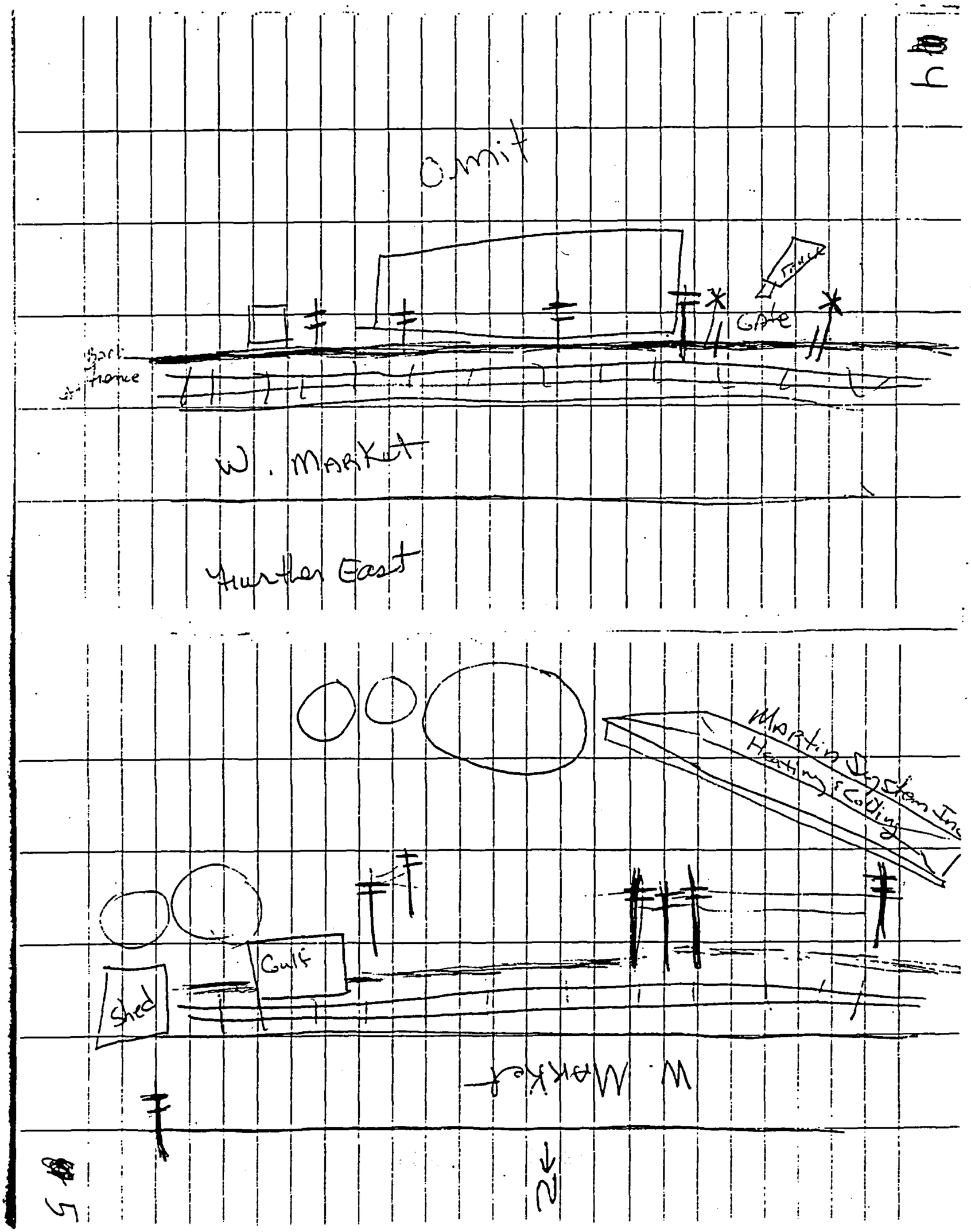
Dirt

N

Antonio Dodson

12/11/89

#3


Martin System Inc
Heating & Cooling
Gulf
Shed
W. Market
N
Omit
Tower
Gate
Further East
W. Market

6

Tanks are dike and good condition. Drums are located on the east side. Drums are not on crates.

BOAT is the Airport.

Mobile Home Park. Mr. William Buchholy 6706 W. Market St.

Drainages ditch runs parallel to W. Market.

Alat is active, no air emission sources

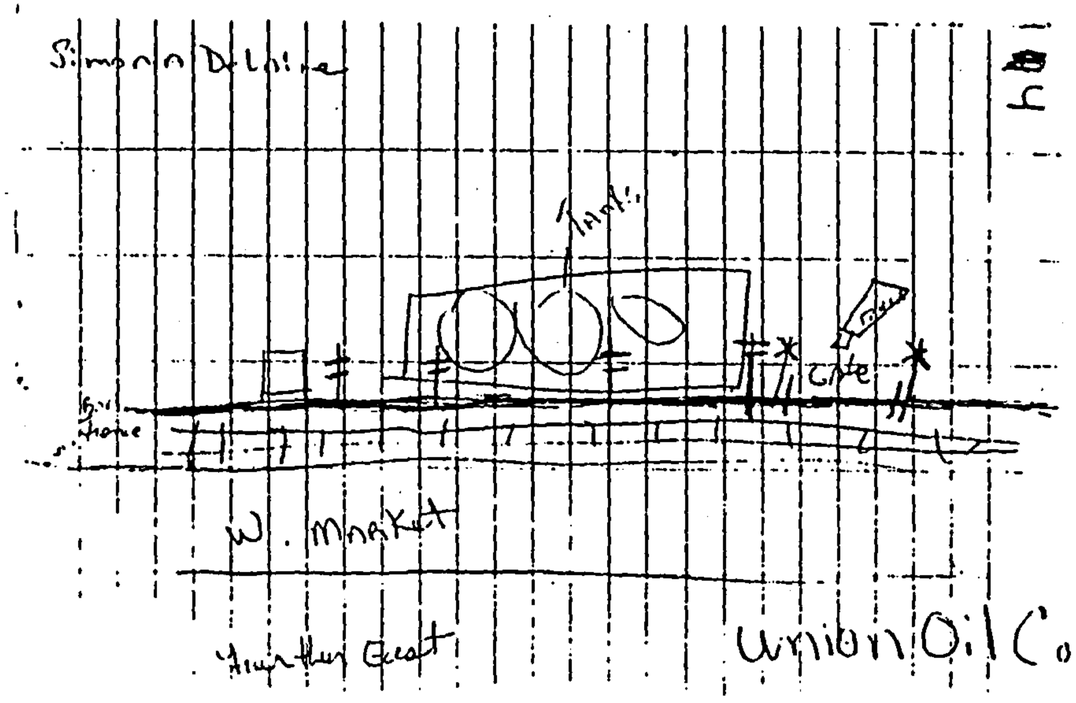
12/11/89

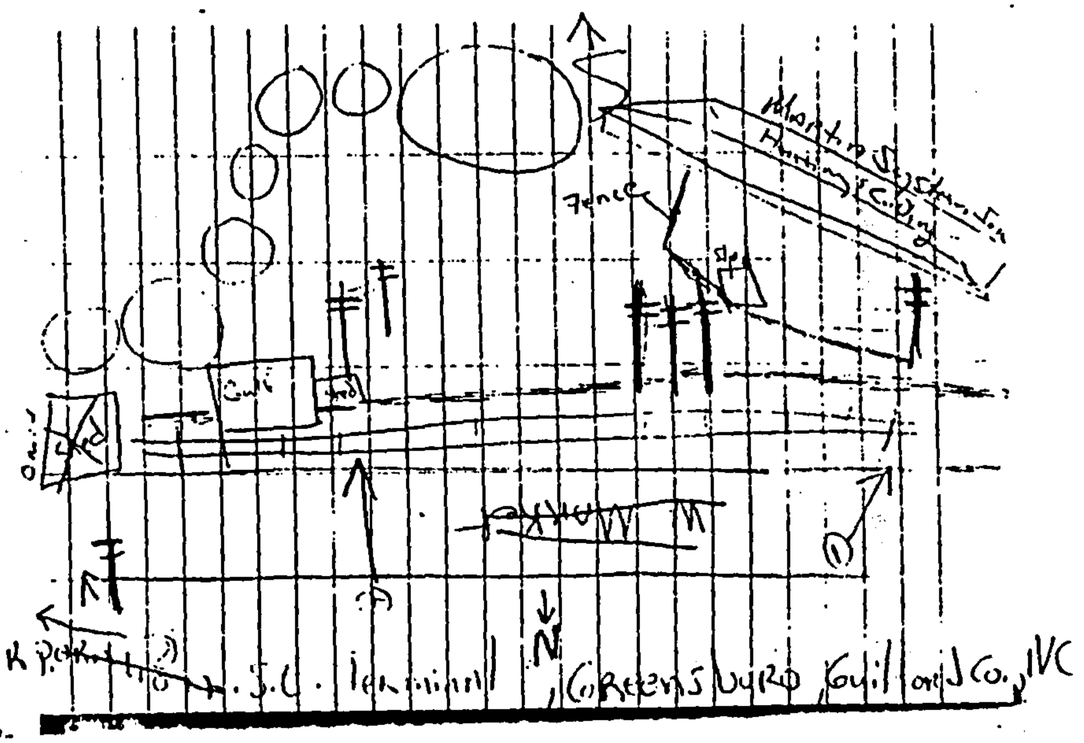
Thereon industry and moderate homes in the area.

The dikes are earthens.

There are no schools or daycares in the area.

8


Simonin Deline
Tank
Crate
Shore
W. Market
Another Coast
Union Oil Corporation


Fence
Tank
Tank
Tank
N
J.C. Terminal
Greensburg Oil and Co. INC

10

Mr. Lackey said there are about 7 trailers in the park. They all drink from it, and have never had a problem.

10:00 went to City Tax Office

11:00 went to County Office for Deed information.

1971 Pure Oil ~~and~~ sold as Union Oil

1990 Owner is British Petroleum Oil
Union Oil under the Gulf Oil Company name since 1929

[signature]
12/11/87

11

12

13

REFERENCE 4

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

Reference 4 Vo. 158-R0175

FORM 1 GENERAL

EPA

U.S. ENVIRONMENTAL PROTECTION AGENCY

GENERAL INFORMATION

Consolidated Permits Program

(Read the "General Instructions" before starting.)

9974

Ref 2

LABEL ITEMS

I. EPA I.D. NUMBER

III. FACILITY NAME

V. FACILITY MAILING ADDRESS

VI. FACILITY LOCATION

PLEASE PLACE LABEL IN THIS SPACE

...ICTIONS

...en provided, affix ...Review the inform... ...is incorrect, cross ...correct data in the ...ow. Also, if any of ...nt *(the area to the ...sts the information that should ...* ...e provide it in the proper fill-in area(s) below. If the label is complete and correct, you need not complete Items I, III, V, and VI *(except VI-B which must be completed regardless)*. Complete all items if no label has been provided. Refer to the instructions for detailed item descriptions and for the legal authorizations under which this data is collected.

II. POLLUTANT CHARACTERISTICS

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

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

III. NAME OF FACILITY

SKIP ~~GULF OIL CORPORATION~~ / UNION OIL CO SOUTHERN TERMINAL

IV. FACILITY CONTACT

A. NAME & TITLE *(last, first, & title)*: ROSS JOHN T PLANT MANAGER

B. PHONE *(area code & no.)*: 919 292 3211

FACILITY MAILING ADDRESS

A. STREET OR P.O. BOX: P O BOX 11335

B. CITY OR TOWN: GREENSBORO

C. STATE: NC

D. ZIP CODE: 27409

FACILITY LOCATION

A. STREET, ROUTE NO. OR OTHER SPECIFIC IDENTIFIER: 801 W MARKET STREET

B. COUNTY NAME: GUILFORD

C. CITY OR TOWN: GREENSBORO

D. STATE: NC

E. ZIP CODE: 27409

F. COUNTY CODE *(if known)*:

* NPDES PERMIT EXPIRATION 6-30-81

CONTINUED FROM THE FRONT

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

A. FIRST	B. SECOND
5171 (specify) PETROLEUM BULK STATION	(specify)
C. THIRD	**D. FOURTH**
(specify)	(specify)

VIII. OPERATOR INFORMATION

A. NAME: SOUTHEAST TERMINALS

B. Is the name listed in Item VIII-A also the owner? ☐ YES ☒ NO

C. STATUS OF OPERATOR (Enter the appropriate letter into the answer box; if "Other", specify.)
F = FEDERAL
S = STATE
P = PRIVATE
M = PUBLIC (other than federal or state)
O = OTHER (specify)

P (specify) PRIVATE

D. PHONE (area code & no.): A 919 299 2611

E. STREET OR P.O. BOX: P O BOX 11007

F. CITY OR TOWN: GREENSBORO

G. STATE: NC

H. ZIP CODE: 27409

IX. INDIAN LAND

Is the facility located on Indian lands? ☐ YES ☒ NO

X. EXISTING ENVIRONMENTAL PERMITS

A. NPDES (Discharges to Surface Water)	9 N	NC0026247	
D. PSD (Air Emissions from Proposed Sources)	9 P		
B. UIC (Underground Injection of Fluids)	9 U		
E. OTHER (specify)	9		(specify)
C. RCRA (Hazardous Wastes)	9 R		
E. OTHER (specify)	9		(specify)

XI. MAP

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

XII. NATURE OF BUSINESS (provide a brief description)

REDISTRIBUTION TERMINAL FOR PETROLEUM PRODUCTS

XIII. CERTIFICATION (see instructions)

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

A. NAME & OFFICIAL TITLE (type or print)	B. SIGNATURE	C. DATE SIGNED
R. E. WOHLGEMUTH VICE PRESIDENT-NORTHERN REGION	R E Wohlgemuth	NOV. 07 1980

COMMENTS FOR OFFICIAL USE ONLY

...s are spaced for elite type, i.e., 12 characters/inch). Form Approved OMB No. 158-R0...

3 RCRA

EPA

ENVIRONMENTAL PROTECTION AGENCY

HAZARDOUS WASTE PERMIT APPLICATION

Consolidated Permits Program

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

I. EPA I.D. NUMBER

F	N	C	T	0	0	0	6	0	9	9	7	4

FOR OFFICIAL USE ONLY

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

II. FIRST OR REVISED APPLICATION

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

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

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

FOR EXISTING FACILITIES, PROVIDE THE DATE *(yr., mo., & day)* OPERATION BEGAN OR THE DATE CONSTRUCTION COMMENCED *(use the boxes to the left)*

C	YR.	MO.	DAY
8	29	12	00

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

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

YR.	MO.	DAY

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

[ ] 1. FACILITY HAS INTERIM STATUS

[ ] 2. FACILITY HAS A RCRA PERMIT

III. PROCESSES — CODES AND DESIGN CAPACITIES

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

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

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

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
Storage:		
CONTAINER *(barrel, drum, etc.)*	S01	GALLONS OR LITERS
TANK	S02	GALLONS OR LITERS
WASTE PILE	S03	CUBIC YARDS OR CUBIC METERS
SURFACE IMPOUNDMENT	S04	GALLONS OR LITERS
Disposal:		
INJECTION WELL	D79	GALLONS OR LITERS
LANDFILL	D80	ACRE-FEET *(the volume that would cover one acre to a depth of one foot)* OR HECTARE-METER
LAND APPLICATION	D81	ACRES OR HECTARES
OCEAN DISPOSAL	D82	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	D83	GALLONS OR LITERS

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
Treatment:		
TANK	T01	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	T02	GALLONS PER DAY OR LITERS PER DAY
INCINERATOR	T03	TONS PER HOUR OR METRIC TONS PER HOUR; GALLONS PER HOUR OR LITERS PER HOUR
OTHER *(Use for physical, chemical, thermal or biological treatment processes not occurring in tanks, surface impoundments or incinerators. Describe the processes in the space provided; Item III-C.)*	T04	GALLONS PER DAY OR LITERS PER DAY

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

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

C DUP T/A C 1

LINE NUMBER	A. PROCESS CODE (from list above)	B. PROCESS DESIGN CAPACITY 1. AMOUNT (specify)	B. 2. UNIT OF MEASURE (enter code)	FOR OFFICIAL USE ONLY	LINE NUMBER	A. PROCESS CODE (from list above)	B. 1. AMOUNT	B. 2. UNIT OF MEASURE (enter code)	FOR OFFICIAL USE ONLY
X-1	S02	600	G		5				
X-2	T03	20	E		6				
1	S01	0 TO 3,200	G		7				
2	S02	0 TO 2,000	G		8				
3	T01	0 TO 2,000	G		9				
4					10				

Continued from the front.

III. PROCESSES *(continued)*

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

DESIGN CAPACITY

2 - API SEPERATORS 2,000 GALLONS/DAY EACH

2 - API SEPERATOR SLOP OIL TANKS 1,000 GALLONS EACH

DRUM STORAGE OF LEADED TANK SLUDGE 2,000 GALLONS

SEE ATTACHMENT FOR OPERATION PLAN

V. DESCRIPTION OF HAZARDOUS WASTES

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

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

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

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

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

D. PROCESSES

1. PROCESS CODES:
   For listed hazardous waste: For each listed hazardous waste entered in column A select the code*(s)* from the list of process codes contained in Item III to indicate how the waste will be stored, treated, and/or disposed of at the facility.
   For non—listed hazardous wastes: For each characteristic or toxic contaminant entered in column A, select the code*(s)* from the list of process codes contained in Item III to indicate all the processes that will be used to store, treat, and/or dispose of all the non—listed hazardous wastes that possess that characteristic or toxic contaminant.
   Note: Four spaces are provided for entering process codes. If more are needed: (1) Enter the first three as described above; (2) Enter "000" in the extreme right box of Item IV-D(1); and (3) Enter in the space provided on page 4, the line number and the additional code*(s)*.

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

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

1. Select one of the EPA Hazardous Waste Numbers and enter it in column A. On the same line complete columns B,C, and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.
2. In column A of the next line enter the other EPA Hazardous Waste Number that can be used to describe the waste. In column D(2) on that line enter "included with above" and make no other entries on that line.
3. Repeat step 2 for each other EPA Hazardous Waste Number that can be used to describe the hazardous waste.

EXAMPLE FOR COMPLETING ITEM IV *(shown in line numbers X-1, X-2, X-3, and X-4 below)* — A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non—listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

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

...from page 2.
...photocopy this page before completing if you have more than 26 wastes to list.

Form Approved OMB No. 158-S80004

EPA I.D. NUMBER (enter from page 1): N C T 0 0 0 6 0 9 9 7 4 — T/A: | C: 1

FOR OFFICIAL USE ONLY: S: W | DUP | T/A: | C: 2 | DUP

IV. DESCRIPTION OF HAZARDOUS WASTES (continued)

LINE NO.	A. EPA HAZARD. WASTE NO. (enter code)	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (enter code)	D. PROCESSES 1. PROCESS CODES (enter)	D. PROCESSES 2. PROCESS DESCRIPTION (if a code is not entered in D(1))
1	K049	0 TO 2000	G	S02 T01	SLOP OIL FROM API SEPERATOR
2	K051	0 TO 1000	G	S01 S02	TEMPORARY DRUM STORAGE OF API SEPERATOR SLUDGE
3	K052	0 TO 2000	G	S01	TEMPORARY DRUM STORAGE OF LEADED TANK BOTTOMS
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					

CONTINUE ON REVERSE

Continued from the front.

IV. DESCRIPTION OF HAZARDOUS WASTES (continued)

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

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

F N C T 0 0 0 6 0 9 9 7 4 T/A 6

V. FACILITY DRAWING

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

VI. PHOTOGRAPHS

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

VII. FACILITY GEOGRAPHIC LOCATION

LATITUDE *(degrees, minutes, & seconds)*	LONGITUDE *(degrees, minutes, & seconds)*
35 16 37 N	080 55 53 W

VIII. FACILITY OWNER

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

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

1. NAME OF FACILITY'S LEGAL OWNER	2. PHONE NO. *(area code & no.)*
E GULF OIL CORPORATION	804-358-8406

3. STREET OR P.O. BOX	4. CITY OR TOWN	5. ST.	6. ZIP CODE
F P. O. Box 11287	G RICHMOND	VA	23230

IX. OWNER CERTIFICATION

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

A. NAME *(print or type)*	B. SIGNATURE	C. DATE SIGNED
R. E. WOHLGEMUTH VICE PRESIDENT-NORTHERN REGION	R E Wohlgemuth	NOV. 07 1980

X. OPERATOR CERTIFICATION

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

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

 CONTINUE ON PAGE 5

OPERATION PLAN

The problems with this facility that are covered by RCRA are the disposal of leaded tank sludge, the disposal of API separator sludge, the disposal of chemical additive residue inside steel drums, the temporary storage of leaded tank sludge and/or API Separator sludge in steel drums, and the temporary storage of steel drums that have chemical additive residue inside them.

Leaded Tank Sludge - Due to the release of a recent EPA Regulation Information Memorandum (RIM) the storage tanks are not considered to be storage facilities for leaded tank sludge. In the event a tank is removed from service and requires the removal of leaded tank sludge, the leaded tank sludge will be:

A. If hazardous carrier services are available and an approved disposal site is available, the leaded tank sludge will be shipped to the disposal site in accordance with RCRA provisions.

B. If either hazardous carrier services or an approved disposal site is not available, the leaded tank sludge will be placed in steel drums for temporary storage until the requirements for off-site permanent disposal can be fulfilled. These drums will be stored on the "temporary storage" area on-site and above ground.

API Separator Sludge - The sludge from the API separator will be handled in the same manner as the leaded tank sludge.

The recovered product from the API separator is temporarily stored in a 1,000 gallon underground tank. Because surface active agents are kept from the API separator, there is never an emulsion of oil and water formed. This makes the recovery of product from the API separator very easy. The recovered product is blended into the next pipeline receipt of the appropriate product.

Temporary Storage Site - A temporary storage site will be provided on-site for drums containing either leaded tank sludge, API separator sludge, and/or drums with chemical residue. All drums will be stored above grade. Every effort will be made to store them in a manner that will prevent deterioration of the drums.

REFERENCE 5

RCRA Inspection Report

Reference 5

1) Facility Information

Union Oil Company Southeast Terminal
6801 W. Market Street
Greensboro, N.C. 27419

2) Facility Contact

J.H. Kimball, Jr., Terminal Foreman

3) Survey Participants

J.H. Kimball, Jr., Terminal Foreman
Robert Shifflet, Guilford County Health Department
J.H. Deakins, District Sanitarian

4) Date of Inspection

August 25, 1982

5) Applicable Regulations

40 CFR, Part 262, Standards for Generators

6) Scope of Survey

RCRA Interim Status Inspection

7) Facility Description

Union Oil Company is a fuel storage and distribution depot. The facility handles gasoline, fuel oil and heating oil. This facility handles Union and Gulf Oil products. Union Oil has 4 tanks with 185,000 barrel capacity and Gulf Oil has 7 tanks with 331,000 barrel capacity. The facility receives oil from Colonial Pipeline and distributes to trucks and tank cars. Hazardous waste from the operation is tank bottoms based on ignitability. The bottoms are cleaned by a private contractor and handled by Troy L. Griffin Oil, Inc., RFD 2, Jefferson, GA, 30549, ID#GAD991275934. This facility was in compliance with RCRA standards for generators on the date of this inspection.

8) Site Deficiencies

REFERENCE 6

Reference 6

EPA

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

I. IDENTIFICATION

01 STATE	02 SITE NUMBER
NC	D000609974

II. SITE NAME AND LOCATION

01 SITE NAME (Legal, common, or descriptive name of site)	02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER
Union Oil Co. Southeast Terminal	P.O. Box 11007 (6801 West Market Street)

03 CITY	04 STATE	05 ZIP CODE	06 COUNTY	07 COUNTY CODE	08 CONG DIST
Greensboro	NC	27409	Guilford	41	06

09 COORDINATES LATITUDE	LONGITUDE
35° 16' 37". N	080° 55' 53". W

10 DIRECTIONS TO SITE (Starting from nearest public road)

Located at 6801 West Market Street which is approx. 2 mi. SW of Guilford College, and approx. 0.4 mi. W of Persimmon Grove Church on the left-hand side of W. Market Street.

III. RESPONSIBLE PARTIES

01 OWNER (If known)	02 STREET (Business, mailing, residential)
Gulf Oil Corp.	P.O. Box 11287

03 CITY	04 STATE	05 ZIP CODE	06 TELEPHONE NUMBER
Richmond	VA	23230	(804) 254-0200

07 ~~OPERATOR~~ (Owner as of 3-1-85)	08 STREET (Business, mailing, residential)
Standard Oil Co. of Ohio	P.O. Box 7117

09 CITY	10 STATE	11 ZIP CODE	12 TELEPHONE NUMBER
Atlanta	GA	30357	(404) 897-7825

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: 11 / 7 / 80 (MONTH DAY YEAR) ☐ B. UNCONTROLLED WASTE SITE (CERCLA 103 c) DATE RECEIVED: / / (MONTH DAY YEAR) ☐ C. NONE

IV. CHARACTERIZATION OF POTENTIAL HAZARD

01 ON SITE INSPECTION

☐ YES DATE / / (MONTH DAY YEAR)

☒ NO

BY (Check all that apply)

☐ A. EPA ☐ B. EPA CONTRACTOR ☐ C. STATE ☐ D. OTHER CONTRACTOR

☐ E. LOCAL HEALTH OFFICIAL ☐ F. OTHER: _____ (Specify)

CONTRACTOR NAME(S): _____

02 SITE STATUS (Check one)

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

03 YEARS OF OPERATION

1929 (BEGINNING YEAR) | _____ (ENDING YEAR) ☐ UNKNOWN

04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED

Leaded tank sludges and miscellaneous petroleum additives were potentially buried on site.

05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION

According to Mike Jennings (see sources), on-site disposal of tank sludges probably occured between the period 1929 to 1980. Facility maintains an underground storage tank for API seperator sludge.

V. PRIORITY ASSESSMENT

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

☐ A. HIGH (Inspection required promptly) ☐ B. MEDIUM (Inspection required) ☒ C. LOW (Inspect on time available basis) ☐ (No further action needed, complete current disposition form)

VI. INFORMATION AVAILABLE FROM

01 CONTACT	02 OF (Agency/Organization)	03 TELEPHONE NUMBER
J. H. Kimbell	Union Oil Co. - Greensboro	(919 299-2611

04 PERSON RESPONSIBLE FOR ASSESSMENT	05 AGENCY	06 ORGANIZATION	07 TELEPHONE NUMBER	08 DATE
Lee Crosby / D. Mark Durway	NC DHR	S&HW	(919 733-2178	1 / 22 / 85 (MONTH DAY YEAR)

EPA FORM 2070-12 (7-81)

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 2 - WASTE INFORMATION

I. IDENTIFICATION

01 STATE	02 SITE NUMBER
NC	D000609974

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 PHYSICAL STATES (Check all that apply)

- ☐ A. SOLID
- ☐ B. POWDER, FINES
- ☒ C. SLUDGE
- ☐ D. OTHER _____ (Specify)
- ☐ E. SLURRY
- ☒ F. LIQUID
- ☐ G. GAS

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

TONS Unknown

CUBIC YARDS _____

NO. OF DRUMS _____

03 WASTE CHARACTERISTICS (Check all that apply)

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

III. WASTE TYPE

CATEGORY	SUBSTANCE NAME	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS
SLU	SLUDGE	Unknown		
OLW	OILY WASTE	Unknown		
SOL	SOLVENTS			
PSD	PESTICIDES			
OCC	OTHER ORGANIC CHEMICALS			
IOC	INORGANIC CHEMICALS			
ACD	ACIDS			
BAS	BASES			
MES	HEAVY METALS	Unknown		

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

01 CATEGORY	02 SUBSTANCE NAME	03 CAS NUMBER	04 STORAGE/DISPOSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION
K049	Slop Oil Solids	-		Unknown	
K051	API Separator Sludge		Potential on-site	"	
K052	Leaded Tank Bottoms		burial prior to 1980	"	

V. FEEDSTOCKS (See Appendix for CAS Numbers)

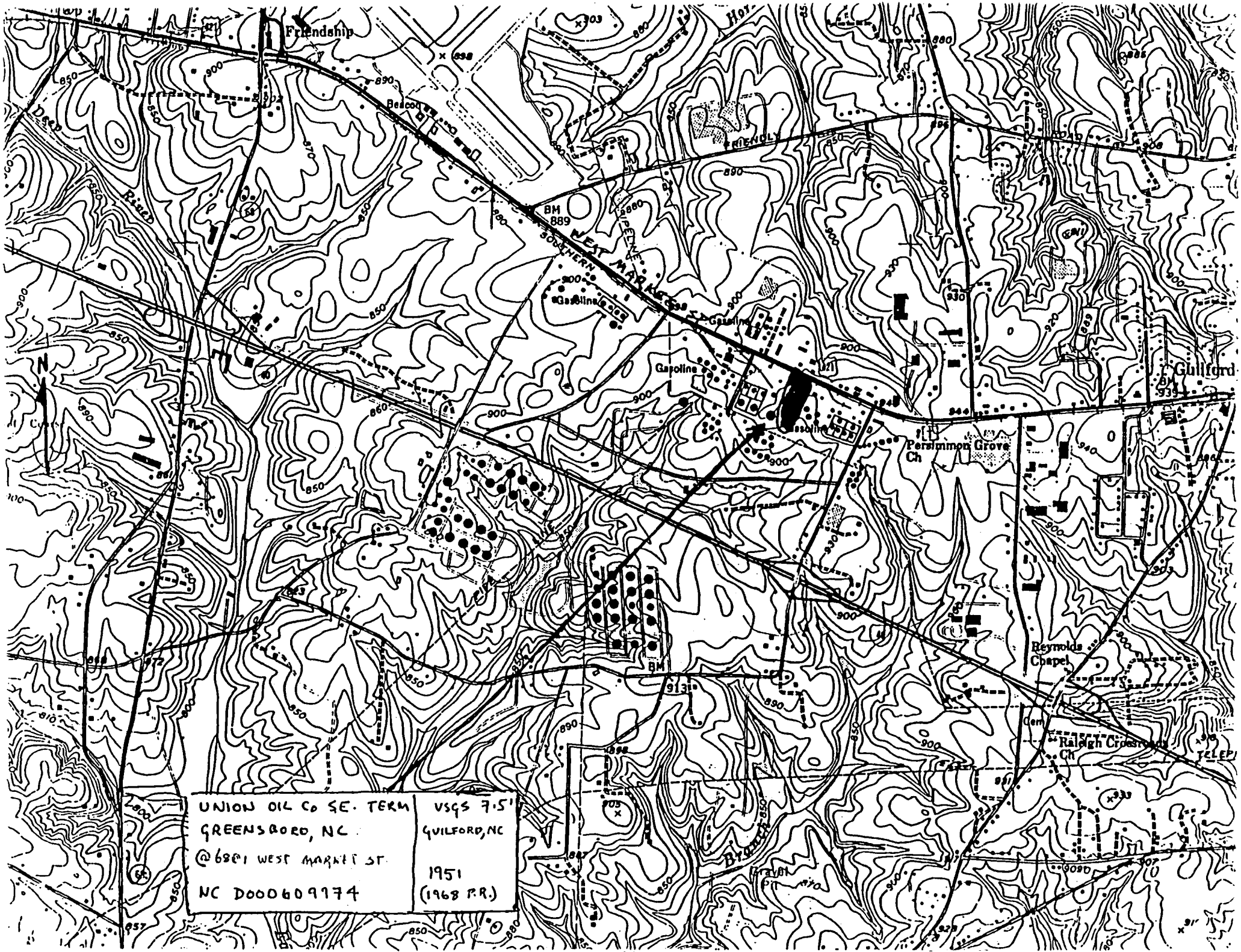
CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER	CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER
FDS	N/A		FDS		
FDS			FDS		
FDS			FDS		
FDS			FDS		

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

1. RCRA, Part A, 11-7-80
2. RCRA inspection report, 4-18-84.
3. Mike Jennings @ Gulf Oil Corp., Richmond, Va, telephone conversation, 1-14-85. (Operations Mgr.)

EPA FORM 2070-12 (7-81)

2


Friendship
Deep
Raleigh
Hoi-
Beacon
FRIENDLY
ROAD
BM
889
SOUTHERN
NEAT MARKET ST
Gasoline
Gasoline
Gasoline
Gasoline
Guilford
Persimmon Grove
Ch
Reynolds
Chapel
Raleigh Crossroads
Ch
BM
913
Brown
Gravel
Pit
N
UNION OIL Co SE. TERM
GREENSBORO, NC
@ 6801 WEST MARKET ST
NC D000609974
USGS 7.5'
GUILFORD, NC
1951
(1968 P.R.)

REFERENCE 7

NUS CORPORATION AND SUBSIDIARIES **TELECON NOTE**

Reference 7

CONTROL NO.	DATE: March 14, 1990	TIME: 4:45 a.m.

DISTRIBUTION: Union Oil Co. SE Terminal

BETWEEN: Jim Edwards, Compliance Officer	OF: N.C. Hazardous Waste Compliance Program Raleigh, N.C.	PHONE: (919) 733-2178

AND: Joan Dupont, NUS Corporation

Joan J. Dupont

DISCUSSION:

Union Oil Co. SE Terminal
Greensboro, Guilford Co.
NCD00609974

The Union Oil Co. SE Terminal first entered North Carolina's RCRA system on August 14, 1980. The facility filed a Part A application in 1980. The facility withdrew from interim status, but the termination date was not listed in Mr. Edwards' database. The facility is currently classified as a generator under RCRA.

REFERENCE 8

DIVISION OF HEALTH SERVICES
P.O. Box 2091
Raleigh, N.C. 27602-2091

Ronald H. Levine, M.D., M.P.H.
STATE HEALTH DIRECTOR

1/6/87

Reference 8

D

Date: March 4, 1982

Mr. B. L. Swinney
Gulf Oil Corporation
P.O. Box 11287
Richmond, Virginia 23230

Re: Facility ID NO. NCT000609974

Dear Mr. Swinney:

Based on information supplied by you we have processed and accepted at the State level your request for the facility identified with the above ID number to receive the indicated change in classification under RCRA:

Add as	Delete as	
☐	☐	generator
☐	☐	transporter
☐	☒	treater
☐	☒	storer
☐	☒	disposer
☐	☐	small generator

We are advising EPA of the change in your status. Please notify us if there is any further change in your operations which would again affect your status. Your EPA ID NO. is ☐ is not ☒ being cancelled.

Cordially,

O. W. Strickland, Head
Solid & Hazardous Waste Management Branch
Environmental Health Section

OWS

cc: John Herrmann
EPA Region IV
Emil Breckling

REFERENCE 9

Reference 9

Ronald H. L

STATE HEALTH DIRECTOR

DIVISION OF HEALTH SERVICES
P.O. Box 2091
Raleigh, N.C. 27602-2091

RECEIVED
MAR 28 1984
SOLID & HAZARDOUS WASTE MANAGEMENT BRANCH

ENTERED
APR 2 1984
DATA PROCESSING

Date: 3-23-84

MEMORANDUM

TO: O. W. Strickland, Head
Solid & Hazardous Waste Management Branch

FROM: J. H. Deakins
Waste Mgt. Spec.

NAME: Union Oil Co. Southeast Terminal
P.O. Box 18007 (City) Greensboro, N.C. 27419

EPA ID No.: NCD006099974
Contact: J. H. Kimbell

A RCRA (✓) Generator, ( ) Transporter, ( ) Interim Status, ( ) Final Status, compliance inspection was conducted on 3-23-84 (mo/day/yr). The inspection can be classified as a ( ) annual inspection (Gen, Trans.), ( ) semi-annual inspection (TSD), (✓) follow-up inspection, ( ) other, specify _____.

The above subject company was found (✓) in full compliance ( ) in violation ( ) all previous violations existing ( ) previous violations existing along with additional ones. (Note: You should complete a check sheet to signify the additional violations).

DHS Form 3010 (Rev. 10-83)
Solid & Hazardous Waste

REFERENCE 10

Ronald H. Levine, M.D., M.P.H.
STATE HEALTH DIRECTOR

DIVISION OF HEALTH SERVICES
P.O. Box 2091
Raleigh, N.C. 27602-2091

Reference 10

7

March 13, 1984

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Mr. John T. Ross
Union Oil Co., S.E. Terminal
P.O. Box 11335
Greensboro, N.C. 27409

Re: NCD000609974

Dear Mr. Ross:

On November 21, 1983, in response to a formal call for part B of a permit application, an officer of your company advised this Branch that a part B application would not be filed. Following this, on January 29, 1984 and February 1, 1984, the Solid and Hazardous Waste Management Waste Management Branch of the Department of Human Resources published a legal notice in the Raleigh papers, announcing its intention to deny a permit and terminate interim status for a number of plants, including yours.

You are now advised that this plant has been denied a permit as a hazardous waste treatment, storage, or disposal facility and its interim status has been formally terminated. As of March 30, 1984, the operators of it may not treat or dispose of hazardous waste, nor store it for more than 90 days from the of accumulation.

If you have any questions about this matter, please call or write to Mr. Keith Lawson at this office.

Very sincerely,

O. W. Strickland, Head
Solid and Hazardous Waste Management Branch
Environmental Health Section

OWS/KL: tl

REFERENCE 11

Reference 11

GENERATOR INSPECTION FORM - PART 262

Name of Site	EPA I.D.	County
Union Oil Co. Southeast Terminal	NCD006109974	Guilford
Location	**Inspection Date**	**Signature of Inspector(s)**
P.O. Box 11007, Greensboro	10-17-89	[illegible]
Compliance Date		**Signature of Facility Contact**
27409		x [illegible]

An inspection of your facility has been made this date and you are notified of the violations, if any, marked below with a cross (X).

SUBPART A - GENERAL

1. Hazardous Waste Determination (262.11)
   - C Subpart D waste (b)
   - C Subpart C waste (c)(1)(2)

2. EPA Identification Numbers
   - C EPA generator number (a)
   - C EPA transporter/facility (c)

SUBPART B - THE MANIFEST

3. General Requirements (262.20)
   - C proper manifest (a)
   - C permitted facility (b)

4. Required Information (262.21)
   - C document number (a)(1)
   - C generator identification (a)(2)
   - C transporter identification (a)(3)
   - C facility identification (a)(4)
   - C D.O.T. description (a)(5)
   - C total quantity (a)(6)
   - C certification (b)

5. Number of Copies (262.22)
   - C minimum number

6. Use of the Manifest (262.23)
   - C generator handwritten signature (a)(1)
   - C transporter signature/date (a)(2)
   - C retain copy (a)(3)
   - C copies to transporter (b)

SUBPART C - PRE-TRANSPORT REQUIREMENTS

7. Packaging (262.30)
   - C D.O.T. compliance

8. Labeling (262.31)
   - C D.O.T. compliance

9. Marking (262.32)
   - C D.O.T. compliance (a)
   - C "HAZARDOUS WASTE" label (b)

10. Placarding (262.33)
    - C D.O.T. compliance

11. Accumulation Time (262.34)
    - C Subpart I; J (a)(1)
    - C accumulation date (a)(2)
    - C "Hazardous Waste" (a)(3)
    - C Subpart C; D (a)(4)*
    - C personnel training (a)(4)*

*Cite specific violations of 40 CFR 265 under remarks

SUBPART D - RECORDKEEPING AND REPORTING

12. Recordkeeping (262.40)
    - C manifest retention (a)
    - C annual/exception report (b)
    - C test/waste analysis (c)

CONTAINER/TANK INSPECTION FORM - PART 265

Union Oil Co.	NCD000609974	10-17-89
Name of Site	EPA I.D.	Inspection Date

SUBPART I - USE AND MANAGEMENT OF CONTAINERS

no waste on site

1. Condition Of Containers (265.171)
   - ___ leakage
   - ___ past leakage (evidence)
   - ___ severe rusting
   - ___ structural defect

2. Compatibility Of Waste With Containers (265.172)
   - ___ visual evidence of noncompliance (leakage, corrosion)

3. Management of Containers (265.173)
   - ___ closed (a)
   - ___ improper handling or storage (b)

4. Inspections (265.174)
   - ___ weekly (minimum)

5. Special Requirements For Ignitable or Reactive Waste (265.176)
   - ___ 15m (50 ft)

6. Special Requirements For Incompatible Waste (265.177)
   - ___ mixing (a)
   - ___ unwashed container (b)
   - ___ separation (c)

SUBPART J - TANKS N/A

1. General Operating Requirements (265.192)
   - ___ compatibility (a)(b)
   - ___ uncovered tank precautions (c)
   - ___ overflow prevention (d)

2. Waste Analysis and Trial Tests (265.193)*
   *Section not applicable to a generator only
   - ___ waste analysis/trial test

3. Inspections (265.194)
   - ___ discharge control equipment (a)(1)
   - ___ monitoring equipment (a)(2)
   - ___ waste level (a)(3)
   - ___ construction material (a)(4)
   - ___ surrounding area (a)(5)
   - ___ assessment schedule/procedures (b)

4. Closure (265.197)
   - ___ plan on-site

5. Special Requirements For Ignitable Or Reactive Waste (265.198)
   - ___ properly stored (a)(1)(2)(3)
   - ___ buffer requirements (b)

6. Special Requirements For Incompatible Wastes (265.199)
   - ___ properly stored (a)
   - ___ tank washed (b)

REMARKS: _____

Union Oil Co.
Greensboro
10-17-89

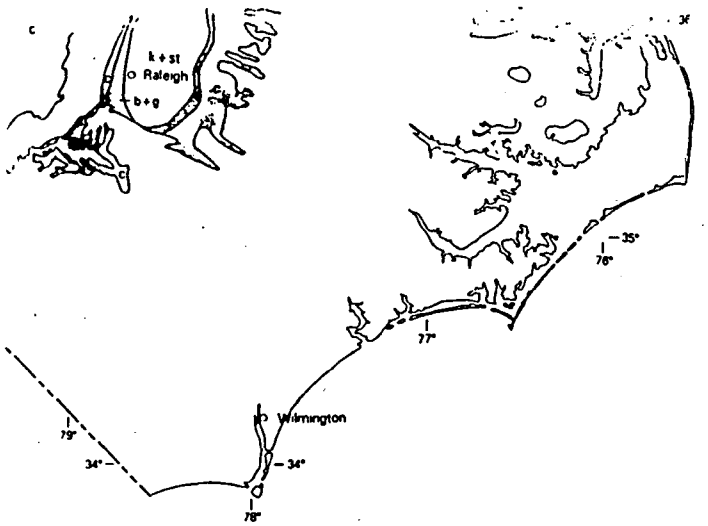
13. Annual Reporting (262.41)
C submitted (a)(1-6)
C submitted (b)

14. Exception Reporting (262.42)
C transporter contact (a)
C exception report (b)(1)(2)

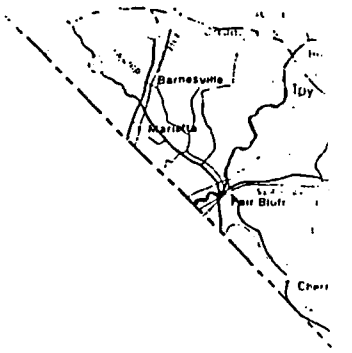
REMARKS: no violation

REFERENCE 12

Reference 12



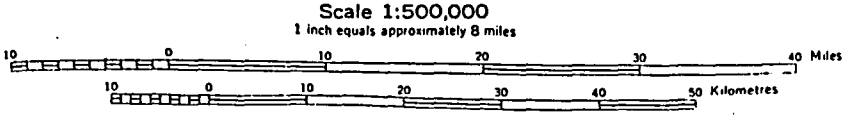
ORPHIC FACIES
384



GEOLOGIC MAP OF NORTH CAROLINA

1985

Scale 1:500,000
1 inch equals approximately 8 miles



DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT
S. Thomas Rhodes, Secretary

Division of Land Resources
Stephen G. Conrad, Director and State Geologist

Compiled by

The North Carolina Geological Survey
Philip M. Brown, Chief Geologist

Edward R. Burt, III
P. Albert Carpenter, III
Rebecca M. Enos
Billie J. Flynt, Jr.
Patricia E. Gallagher
Charles W. Hoffman
Carl E. Merschat
William F. Wilson

and

John M. Parker, III
State Geologic Map Coordinator
in association with
The State Geologic Map Advisory Committee

Charles C. Almy, Jr.
J. Robert Butler
Paul D. Fullagar
Richard Goldsmith
Robert D. Hatcher, Jr.
S. Duncan Heron, Jr.
J. Wright Horton, Jr.
Roy L. Ingram
Stuart W. Maher
Richard L. Mauger
James A. Miller
Loren A. Raymond
Thomas E. Shufflebarger, Jr.
Norman F. Sohl
Scott W. Snyder
Edward F. Stoddard
Frederick M. Swain
Daniel A. Textoris
Paul A. Thayer
H. D. Wagener
Lauck W. Ward
Walter H. Wheeler
Steven P. Yurkovich
Victor A. Zullo

STATE OF NORTH CAROLINA

JAMES G. MARTIN, GOVERNOR

ıER PIEDMONT, CHAUGA BELT, ıITH RIVER ALLOCHTHON, AND ſOWN MOUNTAINS ANTICLINORIUM

METAMORPHIC ROCKS

ıREVARD FAULT ZONE — "Fish scale" schist and phyllonite, interlayered with feldspathic metasandstone, marble lenses

EISS AND SCHIST — Inequigranular, locally abundant potas- ar and garnet; interlayered and gradational with calc-silicate nanite-mica schist, mica schist, and amphibolite. Contains ıses of granitic rock

ED BIOTITE GNEISS — Strongly foliated; minor layers of te and muscovite schist

T — Garnet, staurolite, kyanite, or sillimanite occur locally; d layers of quartz schist, micaceous quartzite, calc-silicate te gneiss, amphibolite, and phyllite

TE AND BIOTITE GNEISS — Interlayered; minor layers and hornblende gneiss, metagabbro, mica schist, and granitic

TE — Metamorphosed mafic extrusive and intrusive rock; ıornblende gneiss, thin layers of mica schist, calc-silicate rarely, marble. Also includes small masses of metadiorite gabbro

TIC BIOTITE GNEISS — Poorly layered to massive; mega- microcline and quartz; local mica schist, amphibolite, and ıeiss

— Interlayered with quartz-muscovite schist, contains ı, andalusite, kyanite, or sillimanite

WACKE AND MUSCOVITE-BIOTITE SCHIST — Meta- s (biotite gneiss) interlayered and gradational with muscovite- ıist; minor marble and granitic rock

VACKE, AMPHIBOLITE, AND KYANITE SCHIST — Meta- s (biotite gneiss) interlayered and gradational with amphibo- ranite schist; minor ultramafic and granitic rock

VACKE — Contains quartz and microcline porphyroblasts

EISS — Interlayered with calc-silicate rock, metaconglomer- ıbolite, sillimanite-mica schist, and granitic rock

ID SCHIST — Includes phyllonite and interlayered biotite

ULAR BIOTITE GNEISS — Weakly foliated to massive, con- ıclase megacrysts and, rarely, larger megacrysts of quartz ar

LASTIC GNEISS — Massive to foliated, granodioritic, mig-

A SCHIST — Interlayered with amphibolite

EISS (Middle Proterozoic, 1192 my; 27) — Megacrystic, in tains amphibolite

INTRUSIVE ROCKS

Dikes, gray to black

E GRANITE (Mississippian, 351 my; 20 21) — Massive to ated; contains pegmatites, lithium-bearing on east side

AD GRANITE GNEISS (Devonian to Silurian, 409 my) — ar to porphyritic, massive to well foliated, contains biotite

CHARLOTTE AND MILTON BELTS

METAMORPHIC ROCKS

CZbf — FINE-GRAINED BIOTITE GNEISS — Massive to strongly foliated; minor layers of amphibolite and muscovite schist

CZfg — FELSIC MICA GNEISS — Interlayered with biotite and hornblende gneiss and schist

CZbg — BIOTITE GNEISS AND SCHIST — Inequigranular and megacrystic; abundant potassic feldspar and garnet; interlayered and gradational with calc-silicate rock, sillimanite-mica schist, mica schist, and amphibolite. Contains small masses of granitic rock

CZv — METAVOLCANIC ROCK — Interbedded felsic to mafic tuffs and flowrock

CZmv — MAFIC METAVOLCANIC ROCK — Metamorphosed basaltic to andesitic tuffs and flows, grayish green to black. Locally includes hypabyssal intrusives and minor felsic metavolcanic rock

CZfv — FELSIC METAVOLCANIC ROCK — Metamorphosed dacitic to rhyolitic flows and tuffs, light gray to greenish gray; minor mafic and intermediate metavolcanic rock

CZq — QUARTZITE — Massive to well foliated; contains andalusite, kyanite, or sillimanite, chloritoid, and pyrite

CZph — PHYLLITE AND SCHIST — Minor biotite, pyrite, and sillimanite; includes minor quartzite

INTRUSIVE ROCKS

Jd — DIABASE — Dikes, gray to black

PPg — GRANITIC ROCK (Pennsylvanian to Permian, 265-325 my; 11,9) — Megacrystic to equigranular. Churchland Plutonic Suite (Western group) - Churchland, Landis, and Mooresville intrusives

DSg — GRANITE OF SALISBURY PLUTONIC SUITE (Devonian to Silurian, 385-415 my; 5) — Pink, massive to weakly foliated. Gold Hill, Kannapolis, Salisbury, Southmont, and Yadkin intrusives

DSs — SYENITE OF CONCORD PLUTONIC SUITE (Silurian, 404 my; 9) — Includes the Concord ring dike

DOgb — GABBRO OF CONCORD PLUTONIC SUITE (Devonian to Ordovician, 399-479 my; 24) — Barber, Concord, Farmington, Mecklenburg, and Weddington intrusives

DOg — GRANITIC ROCK — Locally pinkish gray, massive to weakly foliated; contains hornblende

SHELTON GRANITE GNEISS (Silurian, 429 my; 21) — Poorly foliated, lineated granitic to quartz monzonitic gneiss

PzZq — METAMORPHOSED QUARTZ DIORITE — Foliated to massive

PzZg — METAMORPHOSED GABBRO AND DIORITE — Foliated to massive

PzZm — METAMORPHOSED MAFIC ROCK — Metagabbro, metadiorite, and mafic plutonic-volcanic complexes

META-ULTRAMAFIC ROCK — Metamorphosed dunite and peridotite; serpentinite, soapstone, and other altered ultramafic rock. Only larger bodies shown

CZg — METAMORPHOSED GRANITIC ROCK — Megacrystic, well foliated; locally contains hornblende

CAROLINA SLATE BELT

METAMORPHIC ROCKS

CZy — YADKIN FORMATION — Metamorphosed graywacke, volcanic sandstone, and siltstone; interbedded with mafic and intermediate metavolcanic flows and tuffs

CZmd — METAMUDSTONE AND META-ARGILLITE — Thin to thick bedded; bedding plane and axial-planar cleavage common; interbedded with metasandstone, metaconglomerate, and metavolcanic rock
- $CZmd_3$ - Floyd Church Formation
- $CZmd_2$ - Cid Formation
- $CZmd_1$ - Tillery Formation

} (southwest of Asheboro)

CZmv — MAFIC METAVOLCANIC ROCK — Metamorphosed basaltic flows and tuffs, dark green to black; interbedded with felsic and intermediate metavolcanic rock and metamudstone
- $CZmv_1$ - Cid Formation (southwest of Asheboro)

CZfv — FELSIC METAVOLCANIC ROCK — Metamorphosed dacitic to rhyolitic flows and tuffs, light gray to greenish gray; interbedded with mafic and intermediate metavolcanic rock, meta-argillite, and metamudstone
- $CZfv_2$ - Cid Formation (southwest of Asheboro)
- $CZfv_1$ - Uwharrie Formation (at Asheboro and to south)

CZiv — INTERMEDIATE METAVOLCANIC ROCK — Metamorphosed andesitic tuffs and flows, medium to dark grayish green; minor felsic and mafic metavolcanic rock

CZv — METAVOLCANIC ROCK — Interbedded felsic to mafic tuffs and flowrock

CZve — METAVOLCANIC-EPICLASTIC ROCK — Metamorphosed argillite, mudstone, volcanic sandstone, conglomerate, and volcanic rock

CZc — VOLCANIC METACONGLOMERATE — Includes metagraywacke and metamudstone

CZph — PHYLLITE AND SCHIST — Locally laminated and pyritic; includes phyllonite, sheared fine-grained metasediment, and metavolcanic rock. In Lilesville granite aureole, includes hornfels (CZph₁), and biotite gneiss and schist (CZbg)

INTRUSIVE ROCKS

Jd — DIABASE — Dikes, gray to black

PPg — GRANITIC ROCK (Pennsylvanian to Permian, 265-325 my; 11) — Megacrystic to equigranular. Lilesville granite

PPgb — PEE DEE GABBRO (Pennsylvanian, 314 my; 21) — Dark gray to black, medium to fine grained, massive

PzZq — METAMORPHOSED QUARTZ DIORITE — Foliated to massive

PzZg — METAMORPHOSED GABBRO AND DIORITE — Foliated to massive

PzZm — METAMORPHOSED MAFIC ROCK — Metagabbro, metadiorite, and mafic plutonic-volcanic complexes

META-ULTRAMAFIC ROCK — Metamorphosed dunite and peridotite, serpentinite, soapstone, and other altered ultramafic rock. Only larger bodies shown

CZg — METAMORPHOSED GRANITIC ROCK (Late Proterozoic to late Cambrian, 520-650 my;) — Megacrystic, well foliated, locally contains hornblende. Chapel Hill, Chatham, Farrington, Meadow Flats, Mt. Moriah, Parks Crossroads plutons, and Roxboro and Vance County suites

AMPHIBOL includes layered

BIOTITE places and ampl

CZms MICA SCHI cludes gneiss,

CZig INJECTED and dikes

FELSIC MI mica gar

LINEATED muscovi tion and

CZph PHYLLITE sheared

Jr RHYOLITE crysts of clay amy

Jd DIABASE —

PPg GRANITIC crystic to

PPmg FOLIATED 270-320 Wise an

PzZg METAMOR

META-ULT serpenti bodies

CZg METAMOR 520-650 blende,

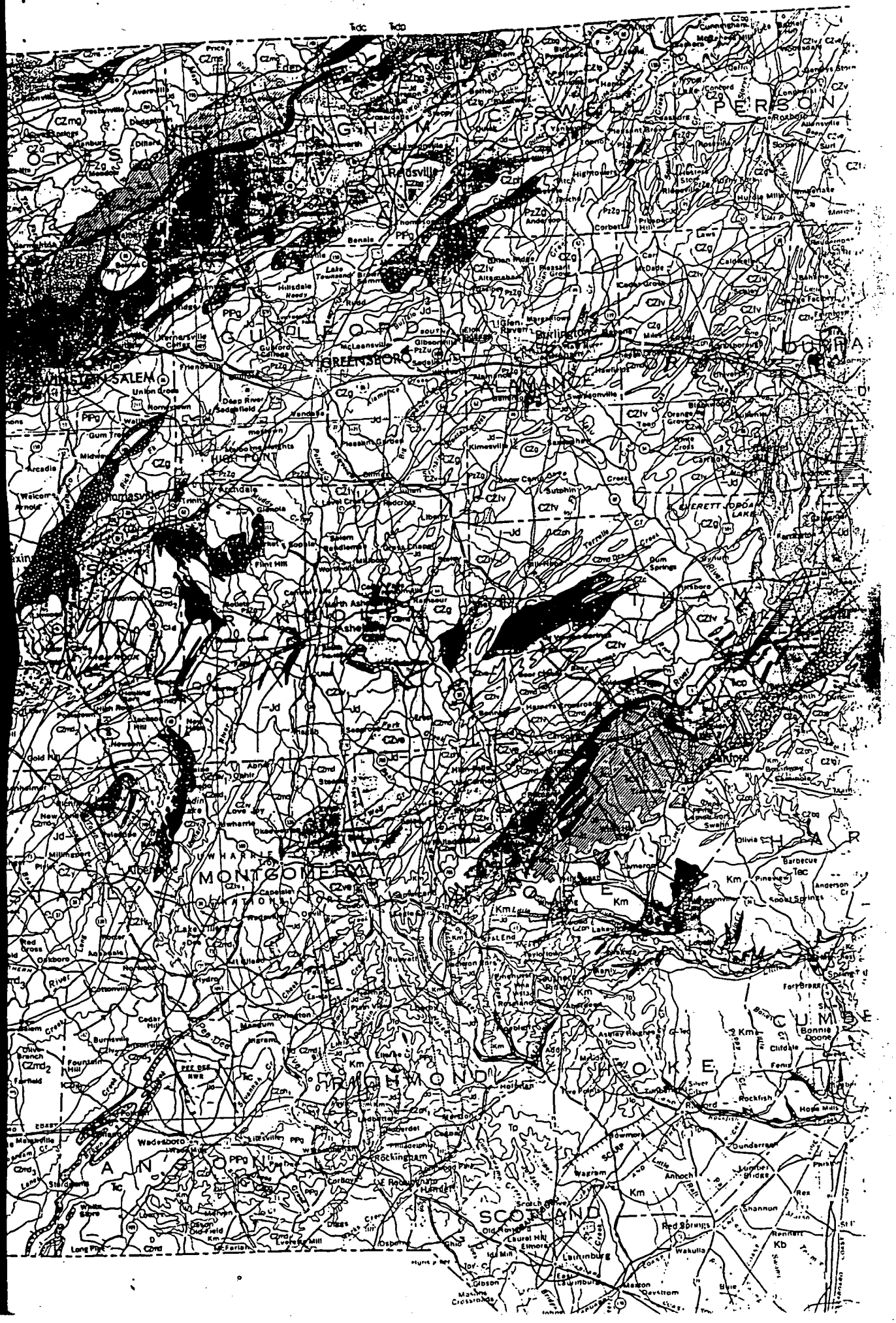
NEWARK SUPER

DAN RIVER G

Jd DAN RIVE sandsto and mu

Jds STONE stone

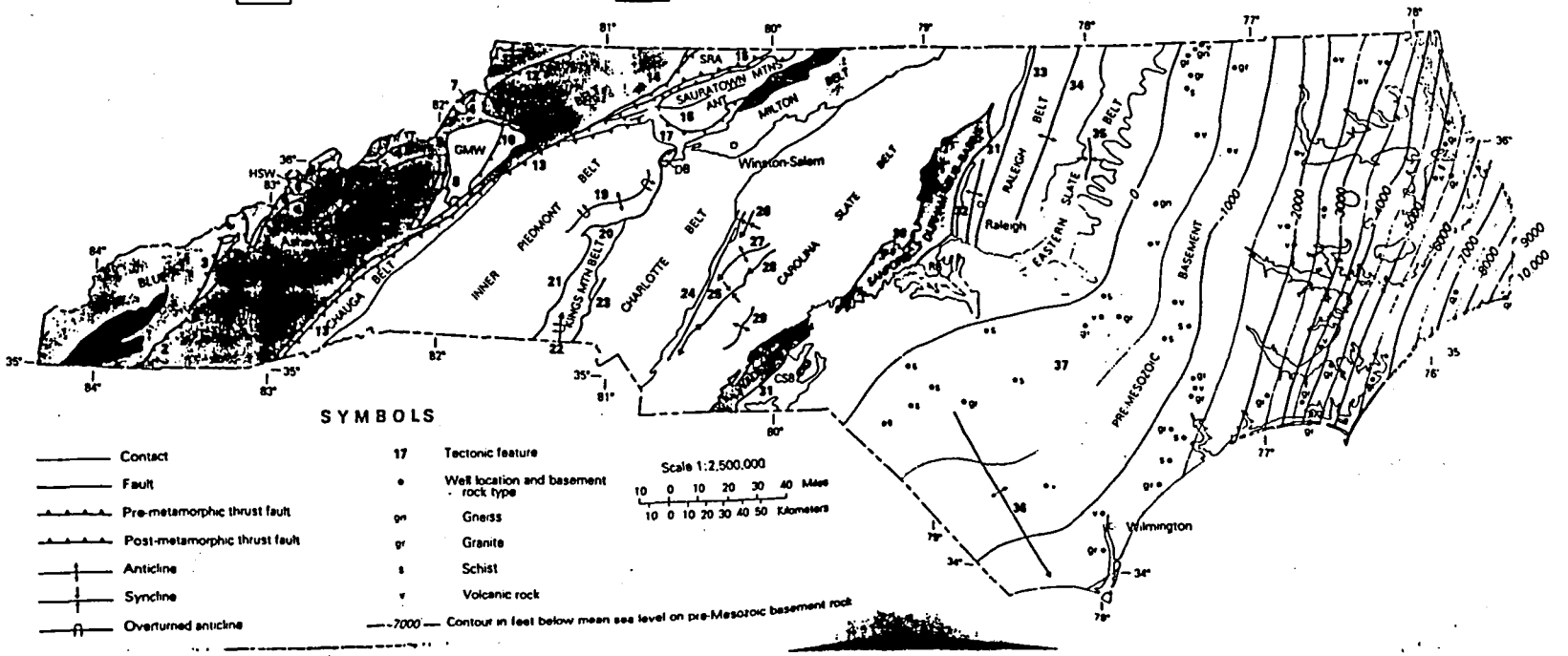
CONV B


PERSON
CASWELL
ROCKINGHAM
GUILFORD
DURHAM
ALAMANCE
GREENSBORO
WINSTON-SALEM
HIGH POINT
Randleman
Asheboro
MONTGOMERY
RICHMOND
SCOTLAND
Laurinburg
Lumberton
Pinehurst
Southern Pines
Aberdeen
Rockingham
Wadesboro
Mt. Gilead
Troy
Carthage
Pittsboro
Siler City
Sanford
Lillington
Dunn
Fayetteville
Raeford
Hamlet
Red Springs
Maxton
Pembroke
Rowland
Ashley Heights
Bonnie Doone
Cliffdale
Fort Bragg
Spring Lake
Hoke
Cumberland

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



REFERENCE 13

Reference 13

NORTH CAROLINA
DEPARTMENT OF CONSERVATION AND DEVELOPMENT
R. BRUCE ETHERIDGE, DIRECTOR

DIVISION OF MINERAL RESOURCES
JASPER L. STUCKEY, STATE GEOLOGIST

BULLETIN NUMBER 55

Geology and Ground Water IN THE Greensboro Area, North Carolina

BY

M. J. MUNDORFF

PREPARED IN COOPERATION WITH THE GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR

RALEIGH
1948

CONTENTS

	Page
Abstract	viii
Introduction	1
Location of area and scope of the investigation	1
Acknowledgments	2
Geography	2
Introduction	2
Area and population	2
Agriculture and industry	2
Mineral resources	3
Climate	3
Precipitation	3
Temperature	4
Drainage	4
Physiography	4
Geology	7
Introduction	7
Summary of rock units and their water-bearing properties	8
Areal distribution and character of the rocks	7
Gneiss	7
Quartzite and schist	10
Greenstone schist	11
Sericite schist	12
Slates	12
Sheared granite	13
Diorite	15
Porphyritic granite	15
Triassic (Newark group)	16
Ground water	18
Source	18
Occurrence	18
The water table	19
Fluctuations of the water table	20
Records of water-level fluctuations in the Greensboro area	21
Utilization of ground water	23
Dug wells	23
Bored wells	24
Drilled wells	24

CONTENTS—CONTINUED

	Page
Factors to be considered in selecting a well site	25
Rock texture	26
Cleavage and schistosity	26
Bedding planes	26
Joints and fractures	26
Quartz veins	26
Dikes	26
Completion and testing of drilled wells	27
The rock units and their water-bearing properties	28
Introduction	28
Relative water-bearing properties of the rock units	28
Effect of topographic location	30
Relation of depth of well to yield	32
Gneiss	32
Quartzite and schist	35
Greenstone schist	37
Sericite schist	39
Slate	40
Sheared granite	42
Diorite	45
Porphyritic granite	46
Triassic (Newark group)	47
County descriptions	49
Introduction	49
Alamance County	50
Geography, physiography, and drainage	50
Geology	50
Ground water	51
Municipal supplies	53
Caswell County	62
Geography, physiography, and drainage	62
Geology	62
Ground water	63
Municipal supplies	64
Forsyth County	69
Geography, physiography, and drainage	69
Geology	69
Ground water	69
Municipal supplies	71

CONTENTS—CONTINUED

	Page
Guilford County	76
Geography, physiography, and drainage	76
Geology	77
Ground water	77
Municipal supplies	79
Rockingham County	90
Geography, physiography, and drainage	90
Geology	91
Ground water	92
Municipal supplies	93
Stokes County	100
Geography, physiography, and drainage	100
Geology	101
Ground water	102
Municipal supplies	104

ILLUSTRATIONS

Plate 1. Geologic map of the Greensboro area, North Carolina ..... after 6

2. Map of the Greensboro area, North Carolina, showing location of wells and springs listed in the report ..... after 49

3. View illustrating the flatness of the upland surfaces, which are remnants of the uplifted and dissected peneplane 5

4. View of the escarpment along the southeastern side of the Triassic basin at Madison 5

5. Interbedded gneiss and schist in northwestern Forsyth County, three quarters of a mile east of Yadkin River on State Highway 67 9

6. Sauratown Mountain from the south.

7. Sheared granite with inclusions of older gneiss, both cut by mafic dikes 14

8. Close-up of the sheared granite 14

9. A. Porphyritic granite intimately intruded into biotite gneiss and schist near Oak Ridge in Guilford County. B. Close-up showing coarse texture of the granite 16

10. Drilling rigs used in the two principal methods of drilling wells in the Greensboro area: A. Cable tool (percussion) method. B. Core-drilling with chilled shot 24

ILLUSTRATIONS—CONTINUED

		Page
11.	Bedded gneiss in a quarry at Stacey, Rockingham County	35
12.	Slate containing quartz veins through the fractures of which ground water circulates	42
13.	Granite quarry in east edge of Winston-Salem	44
14.	Triassic arkosic sandstone and shale between Walnut Cove and Madison	47
Figure 1.	Index map of North Carolina showing the location of the Greensboro area and other places where ground-water investigations have been made	1
2.	Cross-section of the Triassic basin near Walnut Cove, showing the physiography and structure	6
3.	Diagram illustrating several types of rock interstices	19
4.	Diagrammatic section illustrating the relation of the water table to the topography	20
5.	Hydrographs of observation wells in the Greensboro area showing the height of water above the assumed datum near the end of each month	21
6.	Fluctuations of the water levels in two observation wells and cumulative departure from normal precipitation at nearby stations	22
7.	A. Average yield, per foot of well, of wells in the different rock units. B. Average yield, per foot of well, according to range in depth. C. Average yield, per foot of well, according to topographic location	28
8.	Average yield, per foo tof well, of wells in the different rock units, according to range in depth	33
9.	Average yield, per foot of well, of wells in the different rock units, according to topographic location	34

ABSTRACT

The Greensboro area is in the north-central Piedmont of North Carolina and includes Alamance, Caswell, Forsyth, Guilford, Rockingham, and Stokes Counties.

The area includes 2,975 square miles and had a population of 438,404 in 1940.

The area lies entirely within the Piedmont province, which is characterized by flat to rolling upland surfaces, separated by stream valleys, with a few scattered monadnock hills.

Except for a belt of sandstones and shales along Dan River, the area is underlain by igneous and metamorphic rocks, consisting chiefly of gneiss, schist, slate, and granite.

Wells drilled in greenstone schist have a considerably higher average yield than wells in any other rock unit. The average yield of municipal and industrial wells in this rock is 55 gallons a minute. In granite, gneiss, and the Triassic sandstones and shales, the average yield of municipal and industrial wells is 33 to 35 gallons a minute.

Topographic location has an important bearing on the amount of water yielded by wells. The average yield of wells drilled in draws and valleys is more than 3½ times greater than the average yield of wells drilled on hills. It is probable that draws and valleys mark the location of sheared and fractured zones in which the rocks are saturated with water, whereas hills occupy areas of massive, unbroken rock which contain, and will yield, relatively little water.

Wells drilled where the weathered mantle is thick generally yield larger supplies than those drilled where it is thin.

The yield per foot of well generally decreases with depth and beyond 250 feet drops quite sharply, indicating that it is usually not advisable to drill beyond that depth if the well has not obtained water when it reaches that depth.

Included in the report are a number of tables showing the relation of yield to type of rock, to topographic location, and to depth of wells. The report includes a chapter on the ground-water resources of each of the six counties with tables of well data, chemical analyses, and well logs.

GEOLOGY AND GROUND WATER IN THE GREENSBORO AREA, NORTH CAROLINA

INTRODUCTION

LOCATION OF AREA AND SCOPE OF THE INVESTIGATION

This report, the third of a series on the ground-water resources of the State, gives the results of an investigation of the ground-water resources in a part of the north-central Piedmont of North Carolina. The area consists of Alamance, Caswell, Forsyth, Guilford, Rockingham, and Stokes Counties.

The investigations on which the reports are based are being made through a continuing cooperative agreement between the North Carolina Department of Conservation and Development and the Geological Survey, U. S. Department of the Interior. The program is under the direction of Dr. J. L. Stuckey, State Geologist of North Carolina, and Dr. A. N. Sayre, Geologist in charge, Division of Ground Water, U. S. Geological Survey.

The first report, published as Bulletin 47 of the North Carolina Department of Conservation and Development, is a progress report giving general information on ground-water resources of the entire State, with particular emphasis on the Coastal Plain.

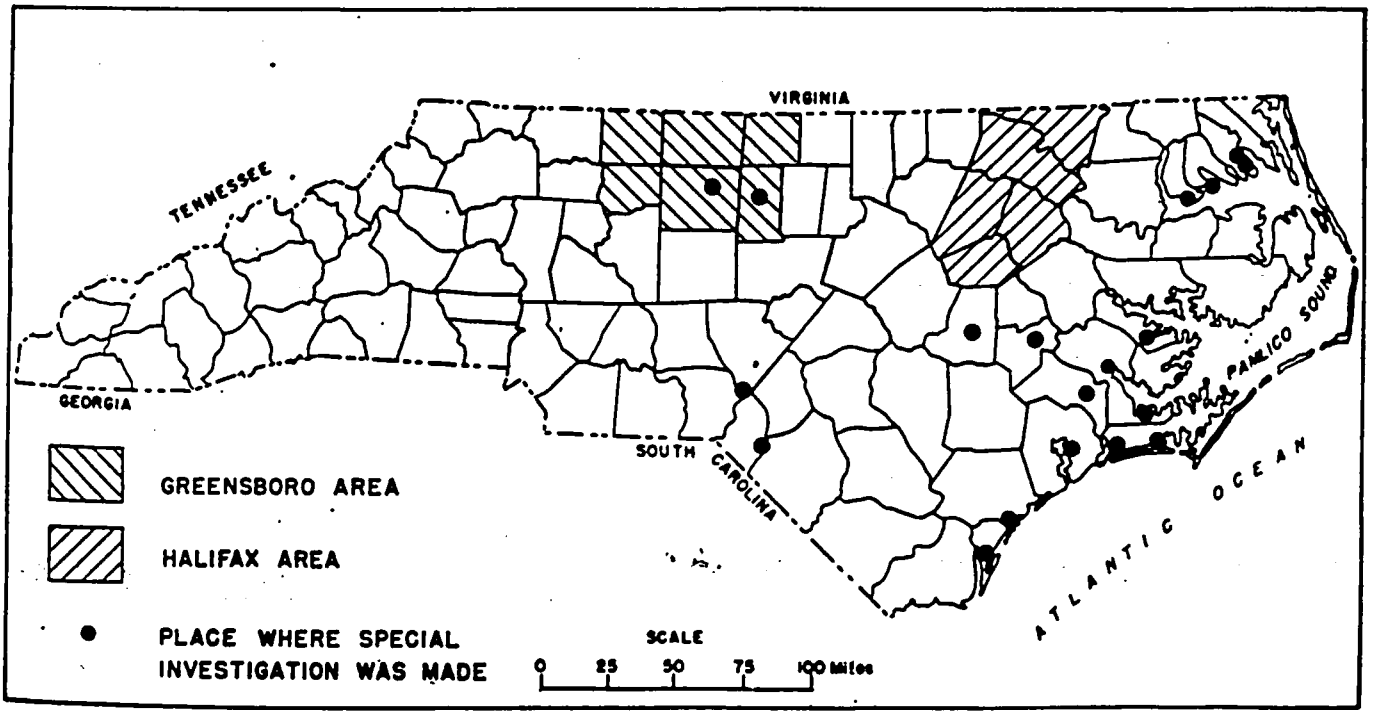


Fig. 1—Index map of North Carolina showing the location of the Greensboro area and other places where ground-water investigations have been made.

The second report, published as Bulletin 51, gives the results of an investigation of the ground-water resources of the Halifax area, including Edgecombe, Halifax, Nash, Northampton, and Wilson Counties.

Because of the many military establishments constructed in North Carolina during the war, most of which utilize ground water, a considerable amount of time has been devoted to special investigations and reports regarding ground-water supplies for military bases, war plants, and contiguous civilian housing areas. The index map (fig. 1) shows the areas in which investigations have been made.

The field work in the Greensboro area was done principally in the summers and autumns of 1942 and 1943 and consisted of obtaining data on about 1,300 wells, a number of springs, and the 23 municipal supplies, collecting samples of water, and noting the geologic and topographic setting of the wells. Information on the wells was obtained by interviewing well owners and operators and well drillers. A great deal of the information was given from memory and some of it, therefore, may be somewhat inaccurate.

During the course of the field work it was found that existing geologic maps were so generalized as to be wholly inadequate for use with the hydrologic data secured. Therefore, an additional 5 weeks were spent in the autumn of 1944 in mapping the geology on a reconnaissance scale. It should be emphasized that the geologic map (pl. 1) is based on these few weeks of field work plus notes made during the collection of hydrologic data in 1942 and 1943; and, in detail, the geology of the area is a great deal more complex than is shown by the map. Rocks of similar geologic and hydrologic characteristics have generally been mapped together. Also, some rocks of different kinds have been mapped together because they occur together in such a way that only mapping on a large scale, requiring a great deal of time, would permit their separation. The belt mapped as gneiss is a good example of this in that several types of gneiss and schist may alternate repeatedly in a short distance.

ACKNOWLEDGMENTS

Nearly all the chemical analyses were made by members of the Quality of Water Division, U. S. Geological Survey. The names of the analysts are given in the tables of analyses.

The writer wishes to acknowledge the courteous and generous assistance of the well owners, well drillers, school superintendents, superintendents of public water supplies, and many others. Without their aid the investigation could not have been successfully completed. Especial acknowledgment is due the well drillers, including the Carolina Drilling and Equipment Co., Danville Well Drilling Co., Heater Well Co., M. A. Holder, John Hopkins, W. B. Mayhew, J. A. Rich, F. L. Smith, J. Stafford, Sydnor Pump and Well Co., Virginia Machinery and Well Co., and Well Drillers Inc., who generously gave their time and effort in furnishing records of wells drilled by them.

GEOGRAPHY

INTRODUCTION

Area and population.—The Greensboro area is in the north-central part of the State, bordering the Virginia State line, and includes Alamance, Caswell, Forsyth, Guilford, Rockingham, and Stokes Counties, with a total area of 2,975 square miles. The location of the Greensboro area is shown in figure 1.

The area had a population of 438,404 in 1940, about 147 to the square mile, according to the U. S. Census Bureau report. There are 18 incorporated cities and towns with an aggregate population of 219,121, which is 50 percent of the total population of the area. Four cities, Burlington, Greensboro, High Point, and Reidsville, have a population of more than 10,000, and nine other cities and towns have a population of more than 1,000.

Agriculture and industry.—More than 79 percent of the area is included in farms, nearly half the total area of the farms, however, being woodland. The total value of the farm products in 1939, according to the 1940 census, was $20,599,677, tobacco accounting for slightly more than half the total. Other important products are livestock, dairy products, poultry and eggs, corn, wheat, hay, potatoes, and vegetables.

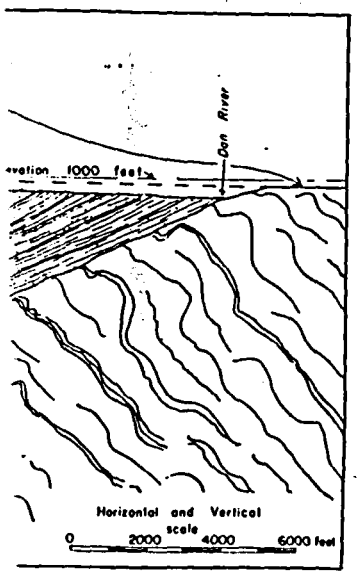
Manufacturing is the most important occupation in the area, with 67,607 wage earners being employed in 1939. The 1940 census report lists 526 manufacturing establishments in the Greensboro area. The total value added to that of the raw materials by the operations of these establishments in 1939, exclusive of the establishments in Forsyth and Rockingham Counties which are not reported, is more than $61,000,000. If these two counties were included, the total value added by manufacture probably would be well above $100,000,000. The textile industry, chiefly cotton, is the most important, employing about 65 percent of all factory workers. Tobacco manufacture, principally the manufacture of cigarettes, is next in importance, followed by furniture, food, chemicals, and lumber.

esistance to erosion; and because the beds ion were developed on the more resistant cks has considerably modified the drainage ple of structural control is that of the Dan the North Carolina-Virginia line, a distance outhward into the northwestern corner of belt of Triassic sediments between Walnut lows northeastward to Danville, Virginia, e contact between the Triassic shales and isses and schists is generally several hun- the river flows. Dan River meanders con- ainst the metamorphic rocks to the south- n the Triassic shales by the greater resist-

ic structure, though not in such a spectac-

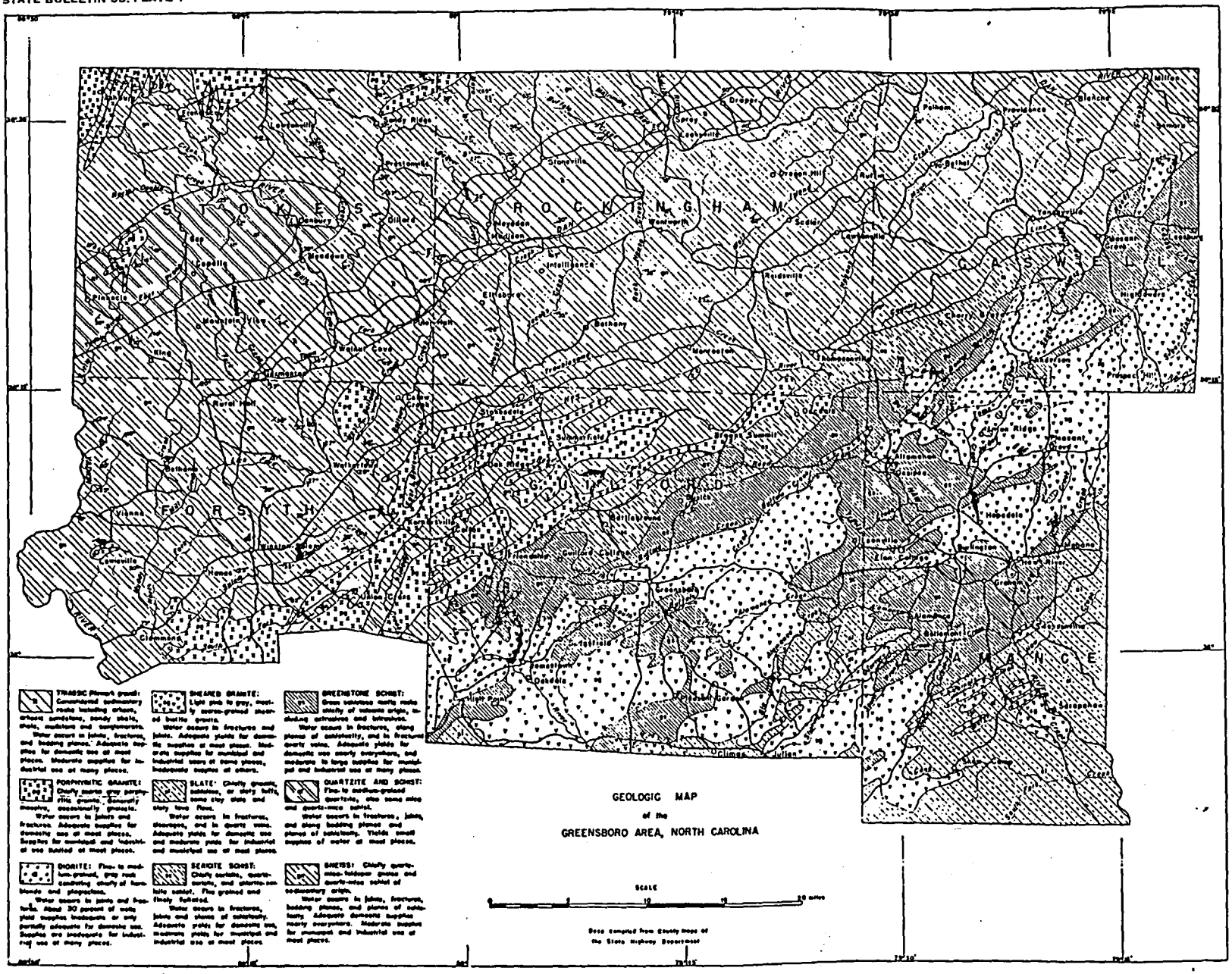
l in flat areas of considerable extent. Drain- f these areas in contrast to the complex

ly dissected and the topography is in the eas, remnants of the peneplane are pre- at. This uniformity is illustrated in plate



r the physiography and structure.

UNITED STATES DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY
IN COOPERATION WITH
NORTH CAROLINA DEPARTMENT OF CONSERVATION AND DEVELOPMENT



Above-normal rainfall during 1935 and 1936 resulted in high ground-water levels in the spring in 1935, 1936, and 1937. However, the excess of rain did not prevent the water level from declining to near-normal levels in the autumn of each year. Below-normal rainfall in the winter and spring of 1938 prevented the normal winter and spring rise; and although about the normal amount of rain fell during the remainder of the year, the water level in the Lindale well reached record low stages. Because of the above-normal rainfall during the last part of 1938 at Haw River, the Governor Holt well did not decline to record lows. Rainfall and water levels in both wells were not far from normal in 1939 and 1940. Below-normal rainfall in nearly every month of 1941 and in January 1942 resulted in record low levels in both wells during the first part of February 1942. Approximately normal rainfall during February and March did not suffice to raise the water level of either well back to normal, evidently because of a very large deficiency in soil moisture. With approximately normal rainfall during the remainder of the year, both wells were at below-normal levels. However, the water level at the end of the year was not far below normal and evidently the soil-moisture deficiency was not large because the water level made its usual spring recovery in 1943 with normal or below-normal rainfall. Above-normal rainfall in 1944 built up the water table to a very favorable position at the end of 1944, although no record high was reached.

UTILIZATION OF GROUND WATER

Ground water in the Greensboro area is obtained from wells and springs. The different types of wells include dug, bored, and drilled wells.

Dug wells.—More domestic water supplies in the Greensboro area are obtained from dug wells than from any other type. Dug wells in the area range from a few feet to nearly 100 feet in depth. The hole is generally dug between 30 and 60 inches in diameter. When the well is curbed with terra cotta or concrete pipe, the inside diameter usually is 24 to 30 inches. The inside diameter of masonry- or rock-curbed wells and uncurbed wells generally is somewhat greater. Dug wells have certain advantages over other types of wells but also have certain disadvantages. Probably the most important consideration that leads to the choice of a dug well is that of cost. Generally this is the least expensive method of obtaining a water supply, with the possible exception of bored wells. Furthermore, many wells on farms and on the fringes of towns are dug by the owner in his spare time or in slack seasons, so that there is no cash outlay from digging. However, cost is not always in favor of the dug well, particularly where bedrock is encountered before a satisfactory supply is obtained. The cost of dug wells under such conditions has been reported at several places to have exceeded the cost of the average drilled well in the neighborhood. A second advantage of the dug well is the large storage capacity as compared particularly with the small-diameter drilled wells. A well 24 inches in diameter will contain nearly 24 gallons of water per foot of depth, as compared to 1½ gallons and 1/6 gallon per foot of depth for wells 6 inches and 2 inches in diameter, respectively. Thus, even though the yield of a well may be very low, a fairly large quantity of water can be withdrawn in a short time.

Dug wells have two important disadvantages. Usually the depth of water in a dug well is not great, either because of the difficulty involved in digging below the water table or because bedrock is encountered. In periods of drought, therefore, many dug wells go dry. A second disadvantage is that the water in these wells is much more susceptible to pollution or contamination by the entrance of impure surface water. A survey made in Pennsylvania in 1930 and 1931, during which 17,665 water supplies were examined for purity, showed that the supplies from 90 percent of the drilled wells were safe whereas less than 50 percent of the supplies from dug wells were safe[1].

The danger of contamination of dug wells can be decreased by observing certain precautions. All dug wells should be covered tightly to prevent direct entrance of contaminating material, either solid or liquid. The well should be cased or curbed with tile or concrete pipe or similar material and the joints should be cemented to a depth of at least a few feet below the water table, but in any event to a depth of at least 10 feet below the surface. The space between the walls and the curbing should be filled, above the water-bearing bed, with clay. The dug well should be located several hundred feet from any source of contamination and up the ground-water slope from any nearby source of contamination.

[1] Lohman, Stanley W., Ground water in northeastern Pennsylvania; Pennsylvania Topog. and Geol. Survey Bull. W4, p. 40, 1937.

ANALYSES OF GROUND WATER FROM FORSYTH COUNTY, NORTH CAROLINA

(Analysts: E. W. Lohr and M. S. Berry, U. S. Geological Survey. Numbers at heads of columns correspond to numbers in table of well data)

(parts per million)

	2	3	93	124	164
Silicia (SiO_2)	31	28	22	31	29
Iron (Fe)	.02	.02	.03	.03	.03
Calcium (Ca)	5.7	22	64	23	6.7
Magnesium (Mg)	3.1	8.0	24	7.4	3.0
Sodium and Potassium (Na+K)	14	7.2	67	7.0	1.3
Carbonate (CO_3)	0	0	0	0	0
Bicarbonate (HCO_3)	63	112	46	92	30
Sulfate (SO_4)	3.2	9.1	10	17	3.7
Chloride (Cl)	1.2	1.5	225	5	1.2
Fluoride (F)	----------	----------	.0	.5	----------
Nitrate (NO_3)	.0	.0	47	2.0	2.2
Dissolved solids	89	130	603	143	71
Total hardness as $CaCO_3$	27	88	258	88	29
Date of collection	May 21, 1943	May 20, 1943	Oct. 16, 1942	Oct. 13, 1942	May 19, 1943
Depth (feet)	130	350	714	308	110
Chief aquifer	Gneiss	Gneiss	Gneiss	Granite	Granite

GUILFORD COUNTY

(Area, 651 square miles; population, 153,916)

Geography, physiography, and drainage.—Guilford County, in the south-central part of the Greensboro area, is the largest of the six counties and has the largest population. It has four incorporated cities and towns and about 14 unincorporated towns and villages. Greensboro, located in the center of the county, is the largest city and county seat. High Point, the only other city, is in the extreme southwestern corner of the county. Greensboro is an important center of textile manufacturing and High Point also has a number of textile factories, although it is better known as a center of furniture manufacturing. There are a few factories in the smaller towns and villages, but the remainder of the county is dominantly agricultural. Guilford County has a good system of paved roads and railroads, most of which radiate from Greensboro.

Guilford County is in the Piedmont physiographic province. Its surface is formed by the uplifted and partially dissected peneplane of that province. The land surface near the larger streams is gently rolling, with a relief of 100 to 150 feet. The interstream areas are broad and generally quite flat. No large trunk streams flow through or near Guilford County and therefore there are no deep valleys. Because the base-level is higher, dissection has generally been less extensive than in other counties of the Greensboro area. Guilford County is underlain by rocks of several different types. Because some of these differ considerably in resistance to erosion, both the topography and the drainage pattern are greatly influenced by the geology. However, topographic maps have not been made of any part of the county, and the geology is complex and at many places obscure, so that the exact relation of the topography and drainage to the geology cannot always be ascertained. The outstanding feature is the northeastward trend of the ridges and streams. Apparently some of the streams flow along or near the contact between different kinds of rocks, whereas others flow in weaker rocks, the more resistant rocks forming interstream divides. The major exception to the northeastward trend of the streams is Deep River, which flows southeastward chiefly across diorite and granite, which are uniformly resistant.

Practically all of Guilford County is drained by the two main branches of the Cape Fear River system, Haw River and Deep River. About 75 percent of the county is drained by Haw River and its tributaries, the most important of which are Reedy Fork, Buffalo Creek, and Alamance Creek. Practically all of the remaining 25 percent is drained by Deep River, only a few square miles of the southwest corner of the county draining southward into Yadkin River.

Geology.—The geology of Guilford County apparently is more complex than that of any other county of the Greensboro area. Seven of the nine geologic units crop out in Guilford County and the areal distribution of most of them is quite irregular.

The gneiss unit crops out in several irregular belts extending northeastward across the northwestern corner of the county. These belts are separated by areas of porphyritic granite, which was intruded into the gneiss. The principal rocks of the gneiss unit are banded quartz-mica-feldspar gneiss and quartz-mica schist. They are chiefly of sedimentary origin, and although the rocks have been greatly changed by metamorphism at many places the bedding planes can still be distinguished. The granite has intimately intruded the gneiss so that the boundaries between the two units necessarily are greatly generalized.

The greenstone schist crops out in large, irregularly shaped areas in the southeastern two-thirds of the county. These areas are separated by areas of sheared granite. The greenstone schist consists of a green fine- to medium-grained basic schistose rocks, chiefly of volcanic origin. At most places the rock is highly schistose but at a few places it is coarser and fairly massive.

The sericite schist crops out in a belt extending northeastward across the county from a point near Guilford College. It is closely associated with the greenstone schist and may be a metamorphosed tuff or possibly a metamorphosed clay. The rock is greatly weathered, and usually the only recognizable minerals are quartz, sericite and iron oxide, the latter apparently an oxidation product of chlorite and hornblende.

The slate unit is limited to a narrow, highly irregular belt extending across the southeastern corner of the county and to a small patch in the south edge of High Point. The rocks are mostly tuffaceous slates but include some clay slates.

The sheared granite is exposed over about 50 percent of the southeastern half of the county, where it forms a fairly continuous area interrupted by large patches of greenstone and slate. The granite is generally a moderately coarse pink schistose and gneissic rock consisting chiefly of quartz, biotite, and feldspar. The granite has been considerably metamorphosed and intensely sheared. The outstanding feature of the granite is the schistose and slaty dikes, which are green in color and greatly resemble the greenstone schists.

Diorite crops out at a number of places but was mapped separately at only two places. The outcrops otherwise are too small or not well enough exposed to map separately. Places where diorite crops out but is not shown on the map include the vicinity of Sedgefield, Pleasant Garden, along State highway 62 between Climax and High Point, and an area about 6 miles north of High Point. The diorite is a medium- to coarse grained, dark-gray to greenish-gray rock consisting chiefly of plagioclase and hornblende. It generally is massive but at a few places is somewhat schistose.

The porphyritic granite outcrops in irregular, elongated patches across the northwestern corner of the county, where it is closely associated with the gneiss. In places the gneiss has been completely assimilated by the granite but in other places the gneiss has only been impregnated by emenations from the granitic magma. Because the granite has so intimately intruded the gneiss and because every gradation between true granite and true gneiss can be found, the map is necessarily greatly generalized.

The porphyritic granite is generally coarse-grained and medium gray, with large phenocrysts of feldspar. The ground mass consists of quartz, biotite, and feldspar. At most places the granite is entirely massive, but at some places the granite has some of the schistosity of the gneiss.

Ground water.—Nearly all domestic water supplies, many industrial supplies, and one of the three municipal water supplies are obtained from wells.

Dug wells are extensively used for domestic supplies in rural districts. Generally they are from about 15 to 50 feet deep and 2½ to 4 feet in diameter. Wells can generally be dug deep enough in gneiss and schist that they will not go dry even during a drought. However, at some places in granite, diorite, greenstone schist, and slate, the rock is so close to the surface that dug wells frequently go dry.

Bored wells are used considerably in suburban areas and are cheaply and easily constructed. They are bored by power-driven earth augers and cannot go below the completely weathered zone. For this reason, they are not always successful in rocks such as granite and diorite, where the water table at times declines below the weathered zone. Most bored wells are cased, and where they are properly constructed and of sufficient depth that they will not go dry, they are a satisfactory source of supply. Dug and bored wells

obtain their water from the weathered rock material at and just below the water table. For this reason, extra precautions must be observed to prevent contamination.

There are a large number of drilled wells in Guilford County. Records of more than 350 drilled wells are given in the tables of well data. Many of these were core-drilled with chilled shot and are 2 or 3 inches in diameter. There are many other core-drilled wells in Guilford County which do not appear in the table. Core-drilled wells have the advantages of all drilled wells and are cheaper than the larger percussion-drilled wells. However, although they are satisfactory for domestic wells, their small size makes them unsatisfactory for most industrial plants. About 7 or 8 gallons a minute is the maximum rate at which water can be removed from a 2-inch well by a deep-well pump. The average yield of 157 wells 2 inches in diameter in Guilford County is 6 gallons a minute and the average yield of 20 wells 3 inches in diameter is 10½ gallons a minute. These quantities are near the maximum amount that can be pumped from wells of that diameter and suggest that many of the wells would yield more than can be withdrawn from the well.

Most industrial, and public-supply wells are drilled with a percussion drill and are from 4 to 8 inches in diameter. The 6-inch well is by far the commonest. The larger-diameter wells encounter more fractures and cracks than small-diameter wells. Also, because a larger pump can be used, more water can be pumped from a large-diameter well than from a small-diameter well.

Drilled wells, both core-drilled and churn-drilled, have certain advantages over dug or bored wells. Because they are generally tightly cased and the water is obtained from crevices in the rock, they are much less liable to contamination. The depth of water in the well is generally large in comparison with the fluctuation of the water level, so that the yield decreases only slightly during a drought.

A summary of data on drilled wells 3 inches or more in diameter is given below:

TABLE 16—SUMMARY OF DATA ON WELLS IN GUILFORD COUNTY
(Drilled wells 3 inches or more in diameter)

ACCORDING TO ROCK TYPE

Type of Rock	Number of Wells	Average Depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of Well	
Gneiss	20	123	1—50	15.6	0.126	5.0
Greenstone schist	67	163	1—200	36.5	.223	3.0
Sericite schist	8	116	5—20	11.1	.105	0
Slate	4	273	5—15	10.5	.039	0
Sheared granite	54	175	0—70	14.4	.093	13.0
Porphyritic granite	26	137	½—30	10.9	.079	3.8
All wells	179	158	0—200	22.0	.139	6.1

ACCORDING TO TOPOGRAPHIC LOCATION

Topographic Location	Number of Wells	Average Depth (feet)	Yield (gallons a minute)			Percent of wells yielding less than 1 gallon a minute
			Range	Average	Per foot of Well	
Hill	41	203	0—100	15.5	0.076	24.4
Flat	44	170	0—200	22.2	.131	2.3
Slope	55	130	2—120	21.8	.168	0
Draw	16	125	2½—75	22.8	.182	0
Valley	22	158	10—100	34.4	.218	0

REFERENCE 14

Reference 14

SOIL SURVEY OF

Guilford County, North Carolina

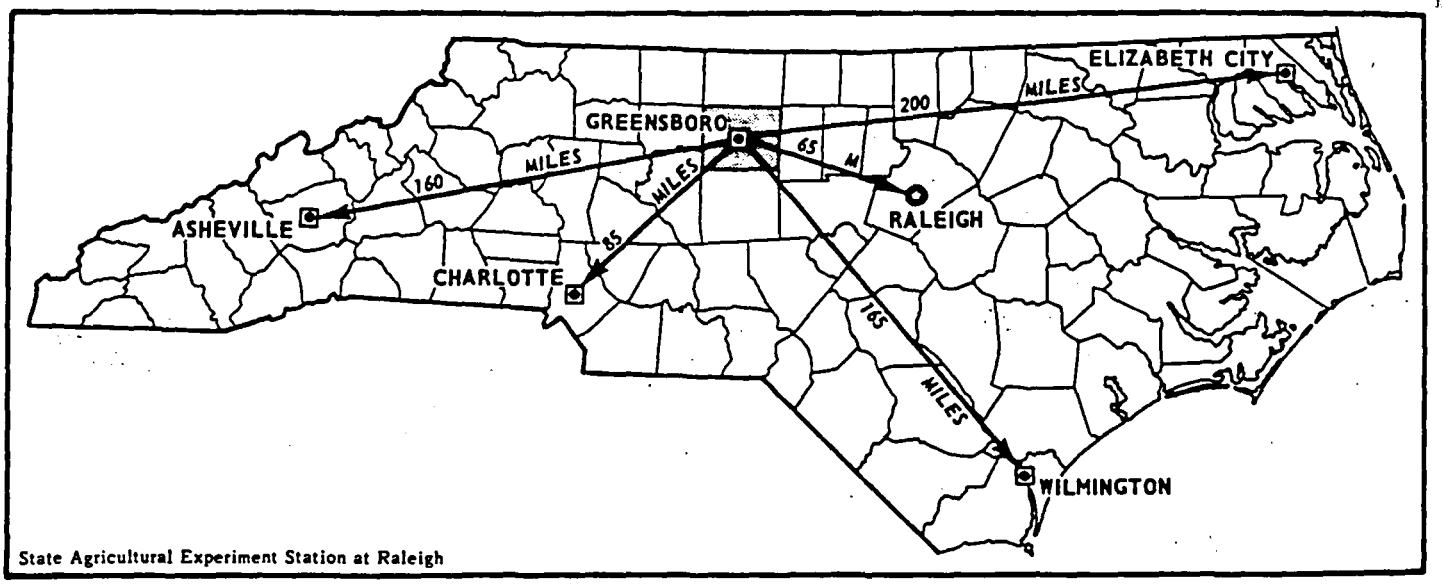
United States Department of Agriculture
Soil Conservation Service

In cooperation with
Board of Commissioners, Guilford County, North Carolina, and
North Carolina Agricultural Experiment Station

Contents

	Page
Index to soil mapping units	iv
Summary of tables	v
Foreword	vii
Introduction	1
General nature of the county	1
Climate	1
History	2
Cultural facilities	2
Industry and transportation	2
Water supply	3
Land use	3
How this survey was made	3
Soil map for general planning	4
1. Cecil-Madison association	4
2. Madison-Cecil association	5
3. Enon-Mecklenburg association	5
4. Wilkes-Enon association	5
5. Coronaca-Mecklenburg association	6
6. Appling-Vance-Helena association	6
7. Chewacla-Wehadkee-Congaree association	6
Soil maps for detailed planning	7
Soil descriptions and potentials	7
Planning the use and management of the soils	25
Crops and pasture	25
Yields per acre	26
Capability classification	27
Woodland management and productivity	27
Engineering	28
Building site development	29
Sanitary facilities	29
Construction materials	30
Water management	31
Recreation	32
Wildlife habitat	32
Soil properties	33
Engineering properties	34
Physical and chemical properties	34
Soil and water features	35
Soil test data	36
Classification of the soils	36
Soil series and morphology	36
Appling series	36
Cecil series	37
Chewacla series	37
Congaree series	37
Coronaca series	38
Enon series	38
Helena series	38
Iredell series	39
Madison series	39
Mecklenburg series	39
Sedgefield series	40
Vance series	40
Wehadkee series	41
Wilkes series	41
Classification	41
Formation of the soils	42
Climate	42
Plant and animal life	42
Relief	43
Time	43
Parent materials	43
Literature cited	44
Glossary	44
Tables beginning	49

Issued December 1977



Location of Guilford County in North Carolina.

SOIL SURVEY OF GUILFORD COUNTY, NORTH CAROLINA

By Ronald B. Stephens

Soils surveyed by E. H. Karnowski, R. B. Stephens, Marcus R. Bostian, R. L. Howard, Roger J. Leab, and Michael L. Sherrill, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with Board of Commissioners, Guilford County, North Carolina, and North Carolina Agricultural Experiment Station

Introduction

GUILFORD COUNTY is an agricultural, industrial, and urbanized county in north-central North Carolina (See map on facing page). It is bounded on the east by Alamance County, on the north by Rockingham County, on the west by Forsyth County, and on the south by Randolph County. The area of Guilford County is 415,940 acres. In 1970 the population was 288,590. The City of Greensboro is the county seat and is at the geographic center of the county.

Guilford County is in the Piedmont physiographic province. The county is generally rolling with moderately steep slopes along the drainageways.

Guilford County is rapidly growing into an industrial and urban county. Well diversified industry, government at all levels, educational institutions, wholesale and retail outlets, and transportation all contribute substantially to the economy of the county.

The northern part of the county is still primarily agricultural. Tobacco provides about 80 percent of the gross farm income from the major crops. Corn, hay, wheat, soybeans, oats, sweet potatoes, Irish potatoes, lespedeza seed, and cotton account for most of the remaining farm income. Beef and dairy livestock and poultry are also raised.

General Nature of the County

This section gives general facts about Guilford County. It briefly discusses climate, history, cultural facilities, industry and transportation, water supply, and land use.

Climate

Guilford County is hot and generally humid in summer because of its moist maritime air. Winter is moderately cold but short because the mountains to the west protect the county against many cold waves. Precipitation is quite evenly distributed throughout the year and is adequate for all crops.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Greensboro for the period 1951 to 1974. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on the length of the growing season.

In winter the average temperature is 40 degrees F, and the average daily low is 29 degrees. The lowest temperature on record, -1 degree, occurred at Greensboro on January 16, 1972. In summer the average temperature is 76 degrees, and the average daily high is 86 degrees. The highest temperature, 102 degrees, was recorded on June 27, 1954.

Growing degree days, shown in table 1, are equivalent to "heat units." Beginning in spring, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 22 inches, or 52 percent, usually fails during the period April through September, which includes the growing season for most crops. Two years in 10, the April-September rainfall is less than 19 inches. The heaviest 1-day rainfall during the period of record was 6.24 inches at Greensboro on October 15, 1954. Thunderstorms number about 47 each year, 29 of which occur in summer.

Average seasonal snowfall is 11 inches. The greatest snow depth at any one time during the period of record was 15 inches. On the average, 4 days have at least 1 inch of snow on the ground, but the number of days varies greatly from year to year.

The average relative humidity in midafternoon is about 55 percent. Humidity is higher at night in all seasons, and the average at dawn is about 85 percent. The percentage of possible sunshine is 64 percent in summer and 54 percent in winter. Prevailing winds are southwesterly. Average windspeed is highest, 9 miles per hour, in March.

In winter every few years heavy snow covers the ground for a few days to a week. Every few years in late summer or autumn, a tropical storm moving inland from

differences among the soils of Guilford County. Major differences among parent materials, such as differences in texture, can be observed in the field. Less distinct differences, such as differences in mineralogical composition, can be determined only by careful laboratory analysis.

The two broad classes of parent materials in Guilford County are residual materials and alluvium. Residual material is related to the underlying rock, from which it has weathered. Transported materials are related directly to the soils or rocks from which they were removed.

Guilford County is underlain by granite, diorite, slate, schist, and gneiss (*3*). Granite makes up about 48 percent of the underlying rock. Gneiss is found in the northwestern corner of the county and makes up about 15 percent. Schist underlies about 31 percent of the county. Minor amounts of diorite and slate make up the remaining underlying bedrock.

In Guilford County the parent materials of the residual soils derived primarily from acid and basic igneous and metamorphic rocks. The light-colored, acid rocks include granite, gneiss, and schist. Cecil and Appling soils formed in material derived from acid igneous and metamorphic rocks, as reflected in the low pH of these soils. In addition, the characteristics of the parent material have influenced the texture of these soils and of other more friable, coarser textured soils of this group. The dark-colored, basic rocks include diorite and gabbro. These rocks are the parent material of Iredell, Mecklenburg, and other soils of the county that are more plastic and finer in texture. The basic influence of the parent materials is reflected in the reaction of these soils: they are less acid than others in the county. A number of soils of Guilford County formed in mixed acid and basic rocks; for example, Coronaca, Helena, Sedgefield, and Wilkes soils. Greenstone schist makes up a large part of the mixed rocks. At various locations the mixture consists of weathered granitic rocks and dikes of basic, dark-colored rocks that intrude into the granite. These dikes vary considerably in width, and their sudden outcropping results in abrupt changes in kinds of soil. Many of the soils in such areas are mapped in the Helena-Sedgefield complex.

Transported parent materials are primarily alluvium and local alluvium, both of which may be young or old. Young alluvium has been deposited recently and consists of material that has been changed very little by the soil-forming processes. Old alluvium consists of material that has been deposited long enough for the soil-forming processes to change it in varying degrees. Local alluvium consists of soil material that has been transported short distances by water and has been deposited along small drainageways, in depressions, and at the foot of slopes. The principal soils that formed in alluvium along streams on flood plains are in the Congaree, Chewacla, and Wehadkee series.

Literature Cited

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) North Carolina Department of Conservation and Development, Division of Mineral Resources. 1948. Geology and ground water in the Greensboro area, North Carolina. Bull. 55, 108 pp., illus.

(4) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962]

(5) United States Department of Agriculture. 1960. Soil classification, a comprehensive system, 7th approximation. Soil Conserv. Serv., 265 pp., illus. [Supplements issued March 1967, September 1968, April 1969.]

(6) United States Department of Agriculture. [n.d.] Selected chapters from the unedited text of the soil taxonomy. [unpublished. available in the Soil Conservation Service State Office, Raleigh, North Carolina]

Glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single mapping unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Base saturation. The degree to which material having base exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Complex, soil. A mapping unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

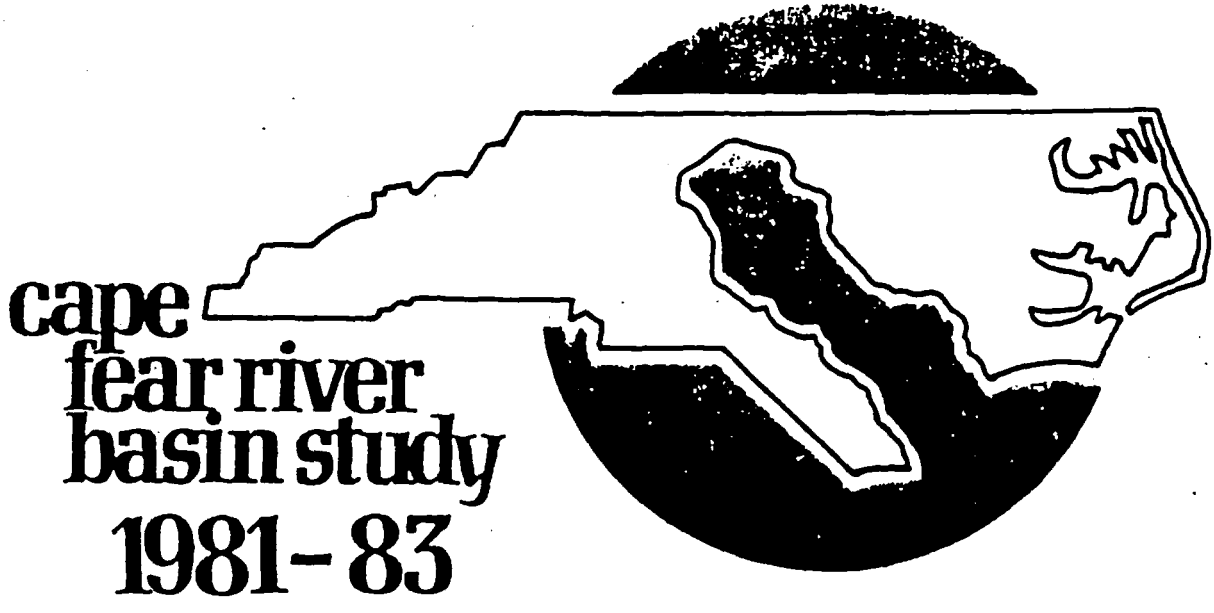
REFERENCE 15

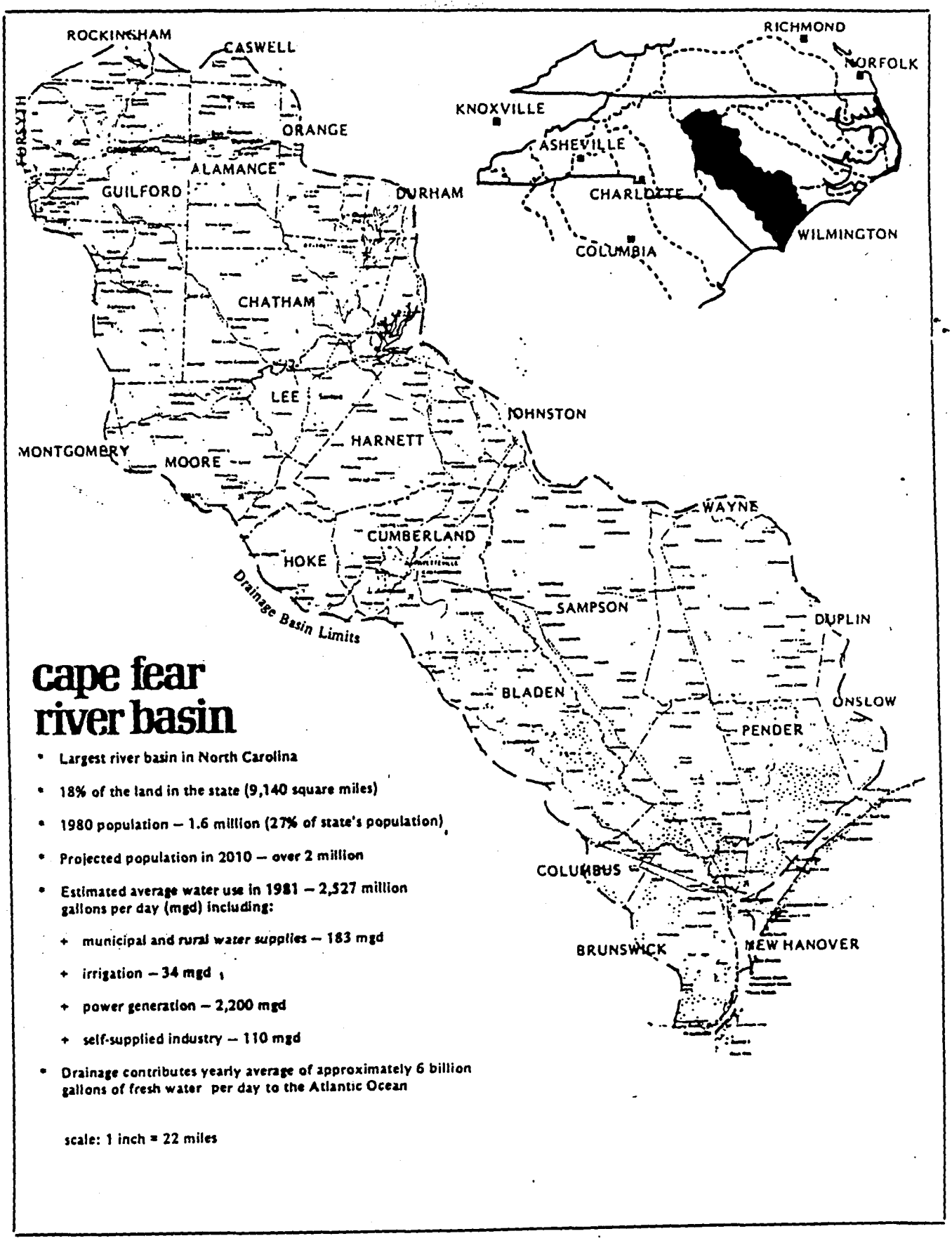
Reference 15

Bob Tooley

GROUND-WATER SUPPLY POTENTIAL AND PROCEDURES FOR WELL-SITE SELECTION

UPPER CAPE FEAR RIVER BASIN





cape fear river basin

- Largest river basin in North Carolina
- 18% of the land in the state (9,140 square miles)
- 1980 population – 1.6 million (27% of state's population)
- Projected population in 2010 – over 2 million
- Estimated average water use in 1981 – 2,527 million gallons per day (mgd) including:
  - municipal and rural water supplies – 183 mgd
  - irrigation – 34 mgd
  - power generation – 2,200 mgd
  - self-supplied industry – 110 mgd
- Drainage contributes yearly average of approximately 6 billion gallons of fresh water per day to the Atlantic Ocean

scale: 1 inch = 22 miles

GROUND-WATER SUPPLY POTENTIAL
AND
PROCEDURES FOR WELL-SITE SELECTION
UPPER CAPE FEAR RIVER BASIN

CAPE FEAR RIVER BASIN STUDY

Sponsored by

North Carolina Department of Natural
Resources and Community Development
and
U. S. Water Resources Council

1155 Archdale Building
P. O. Box 27687
Raleigh, NC 27611

(919) 733-4064

October, 1983

CONTENTS

	Page
Abstract	1
Introduction	3
Purpose and scope	4
Cooperation and participation	5
Description of the study area	6
Geography	6
Geology	6
Climate	11
Geohydrology	12
Ground-water availability	16
Storage	16
Recharge	20
Well-site selection criteria	26
Geologic units	26
Fractures	30
Regolith thickness	37
The ideal well site	38
Testing of the site-selection criteria	42
Rock Creek test site	42
Greensboro-High Point Regional Airport test site	45
Pumping test	52
Data evaluation	54
Conclusions	57
Summary	59
References	62
Glossary	64
Acknowledgments	inside back cover

ILLUSTRATIONS

Page

Figure 1. Map showing the regional setting of the upper Cape Fear River basin study area in the Piedmont physiographic province of North Carolina..... 7

2. Geologic map of the upper Cape Fear River basin showing locations and yields of high-yield wells as of 1982..... 9

3. Sketch showing principal components of the ground-water system in the Piedmont and Blue Ridge provinces in North Carolina..... 13

4. Block diagram showing a conceptual view of the unsaturated zone (lifted up), the water-table surface, and the direction of ground-water flow for a typical area in the Piedmont and Blue Ridge provinces of North Carolina..... 15

5. Graph showing variation of porosity and specific yield of saprolite with depth at the Georgia Nuclear Laboratory in northeast Georgia..... 19

6. Map of the upper Cape Fear River basin and locations of streamflow and precipitation stations used in the water-budget analysis..... 21

7. Graphs showing variation of monthly mean ground-water discharge for three unregulated drainage basins in the upper Cape Fear River basin, 1971-1980..... 24

8. Bar graph showing number of high-yield wells per square mile by geologic unit in the upper Cape Fear River basin..... 29

9. Map views of typical drainage patterns and block diagrams of associated land forms in the upper Cape Fear River basin..... 32

GROUND-WATER SUPPLY POTENTIAL AND PROCEDURES FOR WELL-SITE SELECTION IN THE UPPER CAPE FEAR RIVER BASIN, NORTH CAROLINA

By

Charles C. Daniel III and N. Bonar Sharpless

ABSTRACT

Population growth and industrial development in the 1,750 square mile upper Cape Fear River basin of the central North Carolina Piedmont has been increasing, and current surface-water supplies are approaching limits of capacity. Thus, other water sources need to be considered as alternatives in planning for future water supplies. Ground water is one alternative source of supply. Ground water supplies nearly half the population in the Piedmont and Blue Ridge areas of North Carolina. Ground water is used at a rate of about 200 million gallons per day, yet it is a vastly underutilized resource and little used for large municipal and industrial sources of water.

This report describes the most favorable areas for high-yield wells (yields equal to or greater than 50 gal/min), estimates the total ground water availability both in storage and from recharge, and describes a site-selection procedure for wells that is based on bedrock lithology, geomorphic analysis to locate fractures, and reconnaissance mapping to locate areas of thick regolith and a high water table.

Ground water is stored in the regolith and in the underlying fractured bedrock. The regolith averages about 50 feet thick and contains approximately 1.5 billion gallons per square mile of potentially available water. Seasonally this value ranges from 1.3 to 1.7 billion gallons per square mile. Storage capacity in the fractured bedrock is low and decreases to nearly zero below a depth of about 400 feet. Precipitation data from National Weather Service stations

at Graham, Greensboro, and High Point averaged 45.9 inches per year for the period 1971 through 1980. About 19 percent of this amount infiltrates to the water table to recharge the ground-water system.

The mafic volcanics unit is the most productive bedrock aquifer, having nearly three times as many high-yield wells as the sheared granite, porphyritic granite, felsic volcanics, mica gneiss, and diorite. High-yield wells are absent in the mica schist and argillite units. The sheared granite, based on outcrop area and well yield, is the second best unit for wells.

High-yield wells are most often found in draws or narrow valleys where the well site is underlain by thick regolith and highly fractured bedrock, and has a high water table. Drainage patterns provide clues to the presence or absence of fractured bedrock.

Drilling of test wells demonstrated the usefulness of the site-selection criteria for locating, in selected geologic units, wells with above average yields that penetrated zones of highly fractured rock at sites with thick regolith and a high water table. A well completed in the sheared granite near Gibsonville yielded 18 gallons per minute, above average for the sheared granite unit. A production well drilled in the mafic volcanics near the Greensboro-High Point Regional Airport yielded 50 gallons per minute, nearly twice the average for the unit. That well was tested by continuous pumping for 62 hours at an average rate of 38.5 gallons per minute. Eighteen additional wells, 4 in bedrock and 14 in the regolith, were monitored during the test. The water table assumed the shape of an elliptical cone with the long axis approximately parallel to the strike of foliation in the bedrock. Nearly all the pumped water was derived from storage in the regolith.

INTRODUCTION

Additional water supplies will be needed in the upper Cape Fear River basin as population and industrial development continue to increase. Development of additional surface-water sources will be confronted by a number of problems, including: (1) reservoirs compete with farming, housing, and industrial development, for available land; (2) many of the best reservoir sites, those in deep, narrow valleys, are in use; (3) less suitable sites having wider, shallower valleys, will require more land area. Shallow reservoirs also tend to have more water-quality problems associated with biologic activity than deeper reservoirs; and, (4) increasing land and construction costs will make new reservoirs very expensive to build. Thus, other water sources need to be considered as alternatives in planning for future water supplies.

Ground water has many attractive features as a source of supply. Ground water in the Piedmont province has a relatively low cost of development (Cederstrom, 1973). Generally, ground water in Piedmont areas, such as the upper Cape Fear River basin, is of good chemical quality and requires little treatment. Because of the large quantity of water in storage, the ground-water system usually can sustain moderate yields during annual drought periods. Use of ground water generally permits other land use activities if they do not impede the infiltration of recharge or diminish water quality.

Ground water is an important but underutilized water-supply source in the Piedmont province and hydrogeologically similar Blue Ridge province of North Carolina. Data from a recent survey (Mann, 1978) show that 13 percent of the 132 public water supplies serving 500 or more customers in the Piedmont rely on ground water. In 1975, out of a total population of 3,950,000 in the Piedmont and Blue Ridge of North Carolina, two million people relied on ground water as a source of supply (Heath, 1978). Ground-water use was approximately 200 million gallons per day.

Results of studies in other areas of the Piedmont similar to the upper Cape Fear River basin suggest that the ground-water system may possibly support large yields. For example, many wells in the Georgia Piedmont produce more than 100 gal/min (gallons per minute) and some yield nearly 500 gal/min (David Swanson, Georgia Geological Survey, written comm., 1979). Similarly, Cederstrom (1972) found that yields of 100 to 300 gal/min are not uncommon for bedrock wells in the Piedmont and Blue Ridge provinces from Maine to Virginia.

Purpose and Scope

The primary purpose of this study was to evaluate ground water as a source of large supplies for the upper Cape Fear River basin. The occurrence and quantities of ground water available, both in storage and from recharge by precipitation, are described in this report along with improved techniques for developing the resource and locating sites to drill wells which will have a good probability of offering high sustained yields. This report discusses findings made from January 1982 to May 1983.

The most favorable conditions for ground-water development were identified in an analysis of existing records of high-yield wells (yields greater than 50 gal/min) and correlations between well yield and rock type, topographic position, distance from streams, and regolith thickness.

Ground-water storage was estimated from water-level records, estimates of regolith thickness, and hydrologic properties of core samples from the north Georgia Piedmont. An estimate of the maximum ground-water availability was determined in water-budget analyses for several streams in the upper Cape Fear River basin using continuous streamflow records and rainfall data collected between 1971 and 1980. Ground-water recharge was estimated by hydrograph separation.

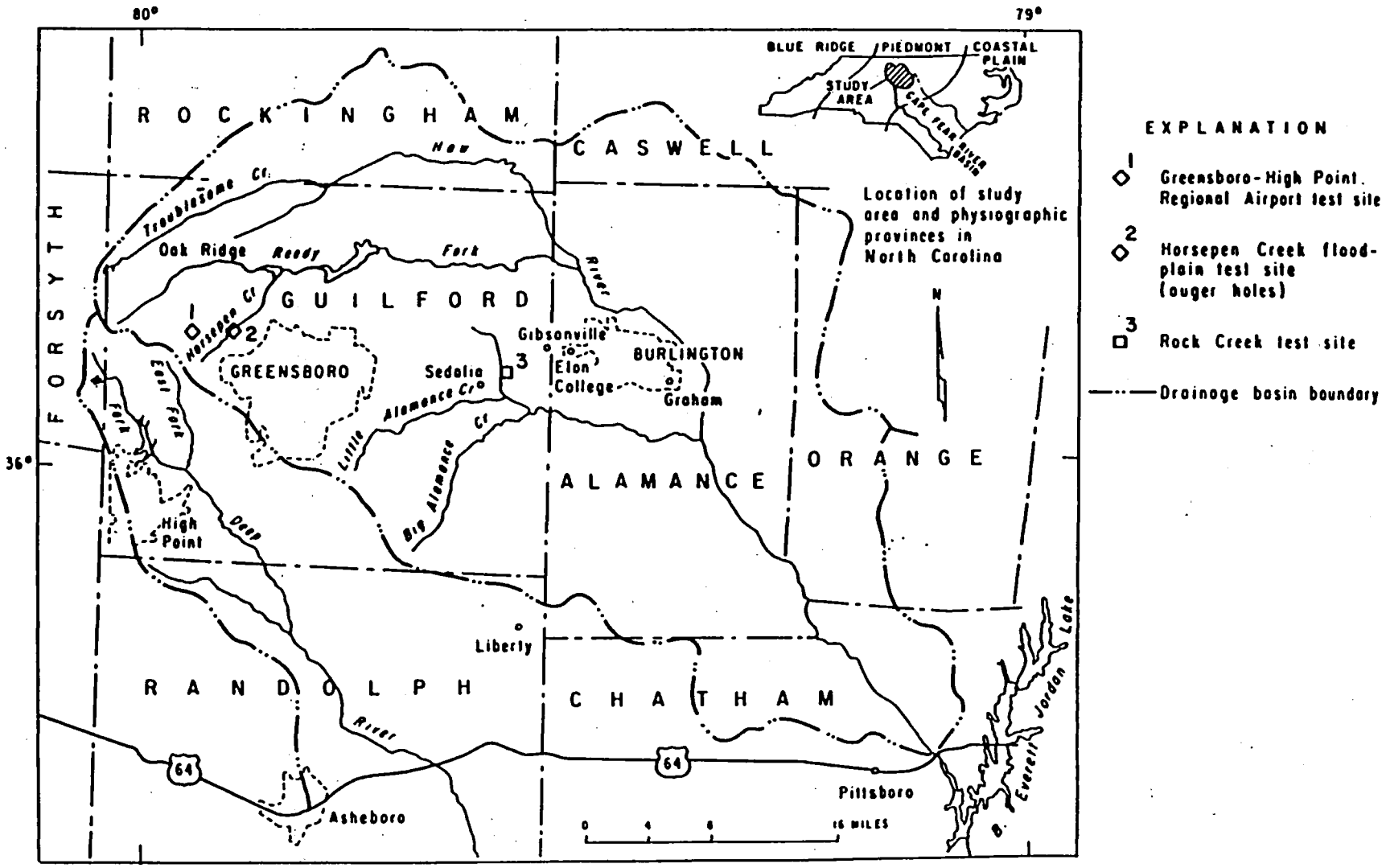


Figure 1.--Regional setting of the upper Cape Fear River basin study area in the Piedmont physiographic province of North Carolina.

Climate

The climate of the study area is temperate with distinct seasonal changes in weather. The coldest month is January with an average temperature of about 41 degrees Fahrenheit and the warmest month is July with an average temperature of about 78 degrees Fahrenheit. The average annual rainfall is approximately 45 inches. The growing season, that period without killing frosts, lasts from mid April to the end of October. The moderate weather and abundant rainfall support the lush growth of natural vegetation and crops of many kinds. Undeveloped areas are often heavily forested with stands of evergreen and deciduous trees. Fields and pastures support crops and grasses much of the year.

GEOHYDROLOGY

The principal components of the ground-water system in the study area are illustrated schematically in figure 3. The regolith consists of an unconsolidated or semiconsolidated mixture of clay and fragmental material ranging in size from silt and sand to boulders. The porosity of the regolith is on the order of 35 to 55 percent near land surface but decreases with depth as the degree of weathering decreases. Because of its high porosity, the regolith acts as a reservoir which slowly feeds water downward into the bedrock. The consolidated bedrock contains very little intergranular pore space. Rather, the water within the bedrock is contained primarily in planar secondary openings developed as a result of fracturing. Secondary porosity ranges from 1 to 10 percent in fractured crystalline rock (Freeze and Cherry, 1979, table 2.4). Porosities of 10 percent are atypical, whereas values of 1 to 3 percent are much more representative of the North Carolina Piedmont.

As a general rule, very few open fractures occur in bedrock of the Piedmont at depths greater than 400 feet (LeGrand, 1967). At greater depths, the pressure of the overlying material, or lithostatic pressure, holds these fractures closed and the porosity can be less than 1 percent. Fractures are most numerous and have the largest openings near the top of the bedrock. These fractures are the openings along which water can move.

The implications for the drilling of wells is obvious. The chances of penetrating open fractures and obtaining water (or additional water) at depths below 400 feet is low. In fact, 85 percent of the total possible yield from the average well is already obtained at a depth of 200 feet; the average yield increases only 5 percent by drilling to 300 feet (LeGrand, 1967). From the standpoint of ground-water production, two 200-foot deep wells are more effective, on

soil and saprolite as a reservoir and the desirability of having as large a reservoir as possible from which to draw water, the smaller drainages underlain by thick regolith seem to be better sites than the larger, broader stream bottoms which may only contain a thin veneer of alluvium on top of bedrock.

Using average casing depth of wells as an indication of regolith thickness (table 1), one might assume that the upland flats have the largest, thickest regolith reservoir and therefore represent the best location for a well site. However, under the influence of gravity ground water flows away from the hilltops and toward lower lying discharge areas along streams and lakes. Consequently wells in the lower part of a drainage area are able to intercept water flowing toward them and, in effect, derive water from a larger area because of the natural gradient toward the well. Wells on hilltops, on the other hand, must induce flow toward the well by pumping.

The Ideal Well Site

An ideal site would be located in the geologic unit having the greatest probability of high yields, have thick regolith, a high water table, be underlain by highly-fractured bedrock, and have a large contributing drainage area. High-yield geologic units of the area are known (fig. 8); regolith thickness can be estimated from existing well data (table 1); and fracture locations can be inferred from types of stream drainage patterns discussed earlier.

Sites having the greatest possible saturated thickness of regolith must also be identified. The porosity and specific yield of the regolith decrease with depth (fig. 5). Consequently, sites with a large saturated thickness of regolith, and a high water table, will have the greater amount of available water in storage. In addition, the higher the water table, the greater the available drawdown to wells (in comparison to a well of similar depth in an area with a low water table). In the upper Cape Fear River basin the regolith is generally thickest in the interstream areas and thinnest in the flood plains of perennial streams. On the other hand, the depth to

SUMMARY

Ground water is used by nearly half the population of the Piedmont and Blue Ridge provinces of North Carolina as their source of water supply, yet it is a vastly underutilized resource and little used for large municipal and industrial sources of water. In a 1978 survey, only 13 percent of the public water supplies serving 500 or more customers in this region were using ground water as a supply source.

In contrast to the small amount of ground water actually used (approximately 200 million gallons per day) the amount of potentially available water stored in the ground is very large. In the Piedmont and Blue Ridge provinces, ground water is stored in the regolith and in the underlying fractured bedrock. Nearly all of the storage capacity is in the regolith. The storage capacity within fractures in the bedrock is low and below a depth of about 400 feet the storage capacity decreases nearly to zero. In the upper Cape Fear River basin, the average thickness of the regolith is about 50 feet and the average depth to the water table 15 feet. Given that the remaining 35 feet is saturated with water and has a 20 percent drainable porosity, each square mile contains an estimated 1.5 billion gallons of water some of which drains to springs, streams, lakes, and wells. Due to seasonal changes in the water table, the amount of water in storage can vary from about 1.3 to 1.7 billion gallons per square mile.

On an annual basis, the change in ground-water storage is usually small and recharge will be about equal to ground-water discharge or base runoff. Within the upper Cape Fear River basin average annual precipitation is 45.9 inches per year or about 1,500 $(gal/min)/mi^2$. Of this amount, about 19 percent infiltrates to the water table and part is available to wells.

The most favorable area for ground-water development within the upper Cape Fear River basin is the area underlain by the mafic volcanics unit. The second best is the area underlain by the sheared granite unit. The likelihood of obtaining a high-yield well is

greatest in these areas. Selection of the best sites within any rock unit is based on considerations of topography and drainage patterns. The best well sites will be in topographically low areas having a high water table and large saturated thickness of regolith, all of which is underlain by highly fractured bedrock. The best sites are within the smaller valleys and draws of fracture-controlled intermittent streams. Drainage patterns provide clues as to the presence of fractured rock; drainage linears that cut across lithologic boundaries are a good indication of fracture control. Reconnaissance geologic mapping is used to confirm interpretations of drainage patterns, help determine the presence and thickness of regolith, and facilitate final site selection.

Two test sites were selected for evaluating the site selection procedure. One site was in the Rock Creek basin southwest of Gibsonville, an area underlain by sheared granite. The other site was in the Horsepen Creek basin, about 1 mile southeast of the Greensboro-High Point Regional Airport. The second site is in an area underlain by the mafic volcanics unit.

Between December 14, 1982 and April 26, 1983, two wells were drilled at the Rock Creek site and 20 wells were drilled at the airport site. Two potential production wells were drilled at each site; however, only one production well was successfully completed at each site. The Rock Creek well yielded about 18 gal/min, above average for the sheared granite. The airport well was pumped at rates as high as 65 gal/min, much more than the average yield of 28 gal/min for the mafic volcanics unit, as reported by Mundorff (1948).

The remaining wells at the airport were used for monitoring water levels during a pumping test of the production well, conducted May 9 to 13, 1983. The average pumping rate for 62 hours of continuous pumping was 38.5 gal/min and a total volume of 143,200 gallons was pumped from the well. Nearly all of this water was derived from storage in the regolith. Water levels in the production well declined to 153.5 feet below the top of the casing by the end of the test.

The final pumping level was 61.5 feet above the pump intake. Water levels in all 18 observation wells declined during the test; declines ranged from less than 1 foot to more than 13 feet. The water table assumed the shape of an elliptical cone by the end of the test. The long axis of the cone was approximately parallel to the strike of foliation in the bedrock, or N. 50° E.

After the pump was turned off the water level recovered to 28.6 feet below the top of the casing at the end of one hour and to 19.7 feet, within 1.9 feet of the starting level, after 14 hours.

The successful completion of wells at test sites chosen using site-selection criteria based on geologic units, fracture identification by geomorphic analysis, and regolith thickness, demonstrated the usefulness of the criteria for identifying well sites.

REFERENCES

American Geological Institute, 1974, Glossary of geology: Washington, D.C., American Geological Institute, 857 p.

Billings, M. P., 1972, Structural geology: Inglewood Cliffs, New Jersey, Prentice-Hall, Inc., 606 p.

Cederstrom, D. J., 1972, Evaluation of yields of wells in consolidated rocks, Virginia to Maine: U.S. Geological Survey Water-Supply Paper 2021, 38 p.

_____ 1973, Cost analysis of ground-water supplies in the North Atlantic region, 1970: U.S. Geological Survey Water-Supply Paper 2034, 48 p.

Daniel, J. F., 1976, Estimating evapotranspiration from streamflow records: Water Resources Research, June 1976, p. 360-364.

Fenneman, Nevin M., 1938, Physiography of Eastern United States: New York, McGraw-Hill Book Company, Inc., 714 p.

Freeze, R. A., and Cherry, J. A., 1979, Groundwater: Inglewood Cliffs, New Jersey, Prentice-Hall, Inc., 604 p.

Heath, R. C., 1978, Better utilization of ground water in the Piedmont and Mountain Region of the southeast, in Water conservation and water supplies -- Proceedings of a southeast regional conference: Georgia Institute of Technology, November 8-9, 1978, p. 145-160.

LeGrand, H. E., 1967, Ground water of the Piedmont and Blue Ridge provinces in the southeastern states: U.S. Geological Survey Circular 538, 11 p.

LeGrand, H. E., and Mundorff, M. J., 1952, Geology and ground water in the Charlotte area, North Carolina: North Carolina Department of Conservation and Development Bulletin 63, 88 p.

Mann, L. T., Jr., 1978, Public water supplies of North Carolina, A summary of water resources, use, treatment, and capacity of water-supply systems: U.S. Geological Survey Water-Resources Investigations 78-16, 61 p.

Mundorff, M. J., 1948, Geology and ground water in the Greensboro area, North Carolina: North Carolina Department of Conservation and Development Bulletin 55, 108 p.

_____ 1950, Flood-plain deposits of North Carolina Piedmont and mountain streams as a possible source of ground-water supply: North Carolina Department of Conservation and Development Bulletin 59, 20 p.

Rorabaugh, M. I., 1964, Estimating changes in bank storage and ground-water contribution to streamflow: Internat. Assoc. Sci. Hydrology Pub. 63, p. p. 432-441.

Stewart, J. W., 1962, Water-yielding potential of weathered crystalline rocks at the Georgia Nuclear Laboratory: U.S. Geological Survey Professional Paper 450-B, p. B106-B107.

Stuckey, J. L., 1958, Geologic map of North Carolina: North Carolina Department of Conservation and Development, Division of Mineral Resources, Raleigh, N.C.

Thornbury, William D., 1969, Principles of geomorphology: New York, John Wiley and Sons, Inc., 594 p.

REFERENCE 16

Reference 16

AN APPRAISAL OF THE GROUNDWATER RESOURCES OF THE UPPER CAPE FEAR RIVER BASIN NORTH CAROLINA

BY

EDWIN O. FLOYD, U.S. GEOLOGICAL SURVEY
RICHARD R. PEACE, N.C. DEPARTMENT OF NATURAL AND ECONOMIC RESOURCES

GROUNDWATER BULLETIN NUMBER 20
GROUNDWATER DIVISION
HARRY M. PEEK, CHIEF

OFFICE OF WATER AND AIR RESOURCES
EARLE C. HUBBARD, DIRECTOR

DEPARTMENT OF NATURAL AND ECONOMIC RESOURCES
JAMES E. HARRINGTON, SECRETARY

PREPARED COOPERATIVELY BY
UNITED STATES GEOLOGICAL SURVEY
AND THE
NORTH CAROLINA OFFICE OF WATER AND AIR RESOURCES
MAY 1974

AN APPRAISAL OF THE GROUND-WATER RESOURCES OF THE UPPER CAPE FEAR RIVER BASIN, NORTH CAROLINA

by

Edwin O. Floyd, U.S. Geological Survey

and

Richard Peace, N.C. Department of Natural and Economic Resources

INTRODUCTION

This report has been jointly prepared by the U.S. Geological Survey and the Division of Ground Water of the North Carolina Department of Natural and Economic Resources as a contribution to the interagency study of the water resources of the upper Cape Fear River basin. The report describes the occurrence, availability, chemical quality, and cost of development of the ground-water resources in the basin.

The authors wish to acknowledge the cooperation of Heater Well Company, Inc., McCall Brothers, Inc., and Bainbridge and Dance, Inc., in supplying estimates of well-drilling costs in the basin.

PURPOSE AND SCOPE

An adequate and dependable supply of good-quality water is a prime requisite to economic development of an area. The decision to use ground water or surface water as a source of supply should not be made until both sources are compared in terms of quantity, dependability, quality, and costs.

The purpose of this report is to supply information pertaining to the feasibility of using ground water as a source of supply in the upper Cape Fear River basin. Within the scope of this report, an appraisal of the ground-water resources can be made by discussing, in general terms, the following basic questions:

Table 1.-- Population supplied with water from surface-water and ground-water sources in the counties lying entirely or partly in the upper Cape Fear River basin.

County	Population in 1970	Population served with		Percent using ground water
		Ground water	Surface water	
Alamance	96,362	46,562	49,800	48
Chatham	29,554	21,854	7,700	74
Caswell	19,055	17,555	1,500	92
Durham	132,681	32,681	100,000	25
Guilford	288,590	66,293	222,297	23
Harnett	49,667	34,017	15,650	68
Lee	30,467	17,967	12,500	59
Montgomery	19,267	13,767	5,500	71
Moore	39,048	27,468	11,580	70
Orange	57,707	24,207	33,500	42
Randolph	76,358	53,858	22,500	71
Rockingham	72,402	31,702	40,700	44
Wake	228,453	91,653	136,800	40
Totals	1,139,611	479,584	660,027	42

GROUND-WATER RESOURCES

Occurrence of Ground Water

The source of all water in the upper part of the Cape Fear River basin is precipitation, about 45 inches each year. Most of the precipitation runs overland to streams and is classed as "surface runoff." Another large part is returned to the atmosphere through evaporation and by transpiration of plants. Ten to 15 percent of the total amount percolates to the water table and becomes ground water. Beneath the water table, ground water is stored in and is transmitted through the openings in the rocks to points of discharge, such as wells and streams.

The rocks underlying the basin generally occur in two distinct zones. The uppermost zone is formed by weathering of the underlying bedrock. The residual material formed by weathering is referred to as saprolite. It usually consists of clay with lesser amounts of sand and large rock fragments. The thickness of saprolite in the upper Cape Fear River basin ranges from a few feet or less near rock outcrops to somewhat more than 100 feet. The average thickness on most hills and ridges is 30 feet.

Saprolite that has been eroded from the hills and transported to the stream valleys to form the flood plains is called alluvium, which may range in composition from clay to boulders. Its thickness is generally less than 20 feet.

The saprolite in the basin is underlain by unweathered bedrock. It consists of several different types of rock, most of which have similar hydrologic properties. The different rock types will be discussed in another section of this report.

The saprolite and fractured parts of the bedrock form the ground-water reservoir of the basin. The quantity of water that can be stored or transmitted by the saprolite-bedrock reservoir is dependent on the size, shape, and abundance of their contained openings. In the saprolite, ground water occurs in the pore spaces between particles. In bedrock, water occurs in the sheetlike openings developed along fractures in the rock.

The bedrock has been subjected to great stresses during its long geologic history and comprises a complex reservoir system. The degree of fracturing of the rocks resulting from these stresses varies greatly from place to place, ranging from very small, widely spaced fractures to zones of intensely broken rocks that are tens or hundreds of feet wide. Generally, bedrock fractures are only fractions of an inch in size and spaced a few inches to several feet apart. As a rule, the fractures decrease in number and size with depth. Data show that zones of significant fracturing extend to depths of more than 800 feet. The range of depth and degree of fracturing is not adequately known and considerable exploratory drilling will be necessary to ascertain the structure of the reservoir system.

One of the basic concepts of ground-water hydrology is that aquifers function both as a reservoir to store water and as a pipeline to transmit water. The quantity of water that can be stored depends on the porosity of the aquifer material. The ability to transmit water depends on the permeability and thickness of the aquifer material. The porosity usually is between 20 and 50 percent in saprolite whereas the porosity of bedrock is generally a fraction of 1 percent. The permeability of both materials generally is between 1 and 100 gpd (gallons per day) per square foot. Obviously, the water in storage in a unit volume of saprolite is many times greater than in an equal volume of bedrock. However, the thickness of the water-bearing zone in bedrock is generally several times greater than the thickness of the saturated part of the saprolite. In most cases it is useful to consider that the saprolite functions as the reservoir and that the bedrock functions as the pipeline.

Geologic Units

The occurrence of ground water in the upper Cape Fear River basin is influenced to a large extent by the local geology. The type and structure of the rocks have a strong influence on such factors as topography and the thickness of the saprolite.

LeGrand (1967) has shown that the yield of wells in the Piedmont region, which includes the upper Cape Fear River basin, is related to the topography at the well site and to the thickness of the saprolite. The highest-yielding wells are almost invariably located in topographically low areas, such as draws and stream valleys. The lowest-yielding wells are generally located near the tops of hills and ridges.

The differences in yield in different topographic situations apparently reflect the composite effect of several factors. Chief among these is the number and size of fractures in the bedrock. Valleys are believed to be located where fractures are most abundant, whereas the hills and ridges suggest the presence of relatively massive (unfractured) rock. Another factor is the tendency of the ground water to move toward valleys from the adjoining ridges, so that more water is available to pumping wells in valleys. A third factor, and one of the most important, is the infiltration of water from streams into the fractured rock when ground-water levels are lowered by pumping.

The thickness of saprolite is important because, as noted earlier, the saprolite functions as a reservoir. When fractured-rock wells are pumped, water slowly seeps downward from the saprolite into the fractures in the rock. Thus, the thicker the saprolite the larger the volume of water available for withdrawal. From what was said in the preceding paragraph about stream infiltration in valley areas, it is apparent that the thickness of saprolite is of greatest significance to the yield of wells in upland areas. In uplands underlain by 25 to 50 feet of saprolite, the sustained yield of wells may be double that of wells in uplands underlain by only 5 to 10 feet of saprolite.

Quantity of Available Ground Water

During extended dry periods the flow of streams in the basin is sustained by ground water discharging from the adjacent aquifers. The volume of ground water discharged to streams is an indication of the amount of water available for development from the ground-water reservoir.

Comprehensive quantitative studies of the amount of ground water available for development in the upper part of the Cape Fear River basin have not been made. However, based on studies in similar areas, it is estimated that the streamflow equaled or exceeded 70 percent of the time is a reliable indicator of the amount of ground water available.

Figure 3 shows areas of approximately-equal ground-water discharge, based on the flow of streams equaled or exceeded 70 percent of the time. The area encompassed by each coincides with the areas underlain by the three principal hydrologic units and represents the average rate of ground-water discharge to streams, in millions of gallons per day per square mile of

ground-water development, and after spending thousands of dollars in drilling wells they still do not have an adequate supply of water. However, the ground-water resources of the basin are adequate to meet demands many times larger than those presently being met. To minimize future problems, development of ground-water supplies for industries and municipalities should be carefully designed and managed by qualified professional personnel.

Pollution

Even though ground water is better protected from pollution than surface water, there are many places where pollutants are known to have found their way into the aquifers. With increased development of an area, there comes an increasing potential for pollution of the ground-water resource. Sanitary land fills are becoming more numerous and in each case provide almost direct connection between the refuse and the water table. Sewage, fertilizers, and industrial wastes are common agents of stream pollution, and, if unchecked, they may preclude the development of potentially large ground-water supplies from some of the stream valleys in the basin.

CONCLUSIONS

Large amounts of water are stored in the rocks underlying the upper part of the Cape Fear River basin. Dependable ground-water supplies can be developed from these rocks in all parts of the basin if the hydrologic conditions are properly evaluated and the wells and well fields are designed accordingly.

The chemical quality of the ground water in the basin is generally suitable for most uses. However, excessive concentrations of iron, hardness, and chloride occur in some local areas. Where necessary, the objectionable constituents can be effectively and economically reduced or removed by treatment of the water.

It is not within the scope of this report to provide exact data for development of water supplies at specific sites. However, with the available data, it is possible to predict, within acceptable limits, the general hydrologic conditions over a sizable area. Even in similar geologic and topographic situations, the hydrologic conditions can differ greatly within a short distance. For this reason, it is rarely possible to predict accurately the conditions at a specific site prior to actual on-site testing.

The different geologic, hydrologic, and economic conditions that had to be considered in appraising the ground-water resources of the basin make it necessary that certain generalized assumptions be made in estimating the costs of development. On these assumptions were based the estimated costs of construction and operation of hypothetical wells. These estimates are valid only for a comparison with estimates of costs of developing a supply from surface-water sources or from the different geologic units in the basin. Because of these assumptions, the estimates given are neither appropriate nor intended for use in detailed planning of a specific system. Planning and design of specific systems require geologic and hydrologic data from the actual project site and also the services of consulting ground-water hydrologists and qualified well-drilling contractors.

SELECTED REFERENCES

Bain, G. L., and Thomas, J. T., 1966, Geology and ground water in the Durham area, North Carolina: North Carolina Dept. of Water Resources, Ground-Water Bull. No. 7, 147 p.

Jackson, N. M., Jr., Public water supplies of North Carolina; Part 1, Northern Piedmont: North Carolina Dept. of Nat. and Econ. Resources, Office of Water and Air Resources.

Jackson, N. M., Jr., Public water supplies of North Carolina; Part 2, Southern Piedmont: North Carolina Dept. of Nat. and Econ. Resources, Office of Water and Air Resources.

LeGrand, H. E., 1967, Ground water of the Piedmont and Blue Ridge Provinces in the southeastern States: U.S. Geol. Survey Circ. 538, 11 p.

Mundorff, M. J., 1948, Geology and ground water in the Greensboro area, North Carolina Dept. of Conserv. and Devel. Bull. 55, 108 p.

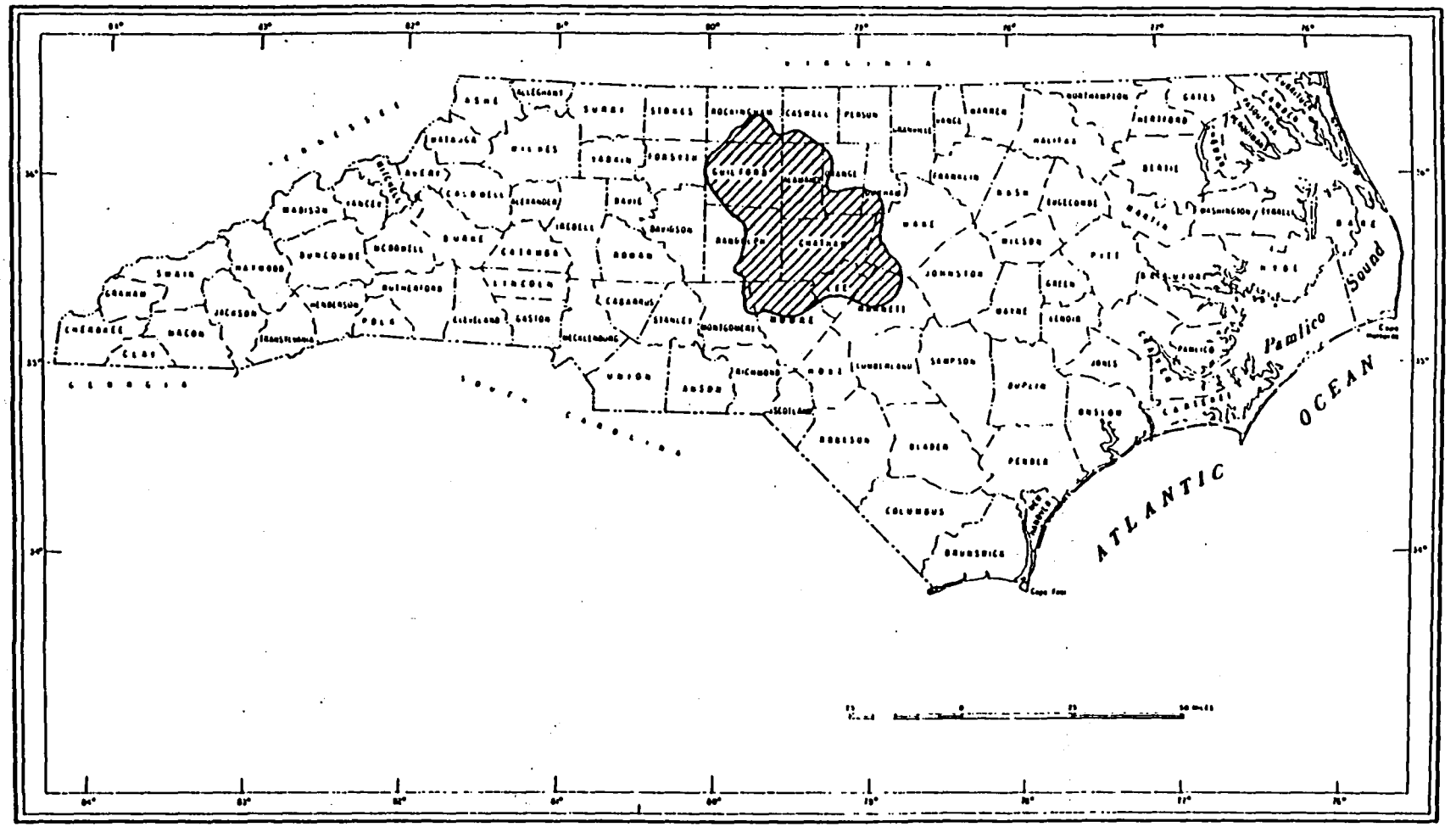
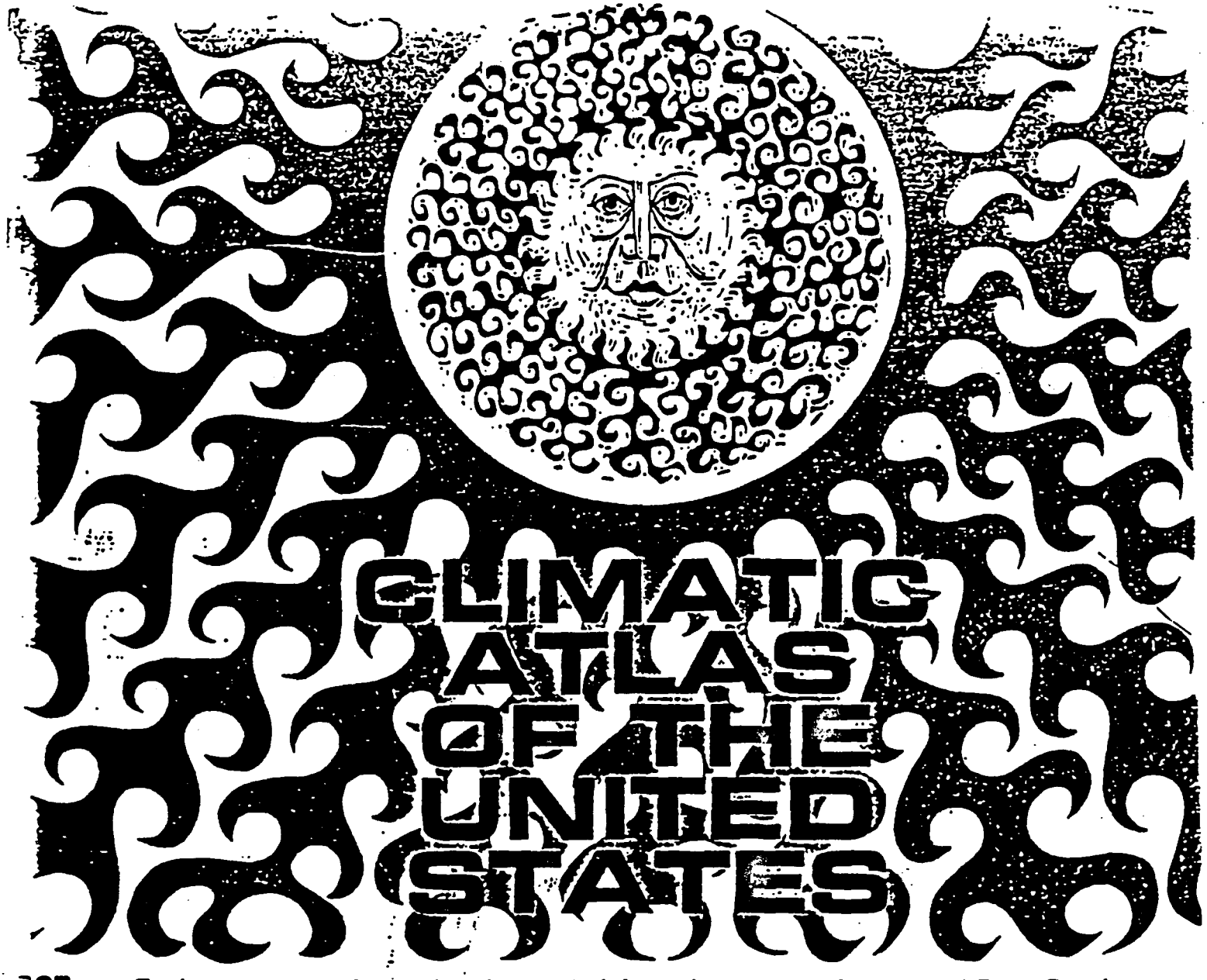


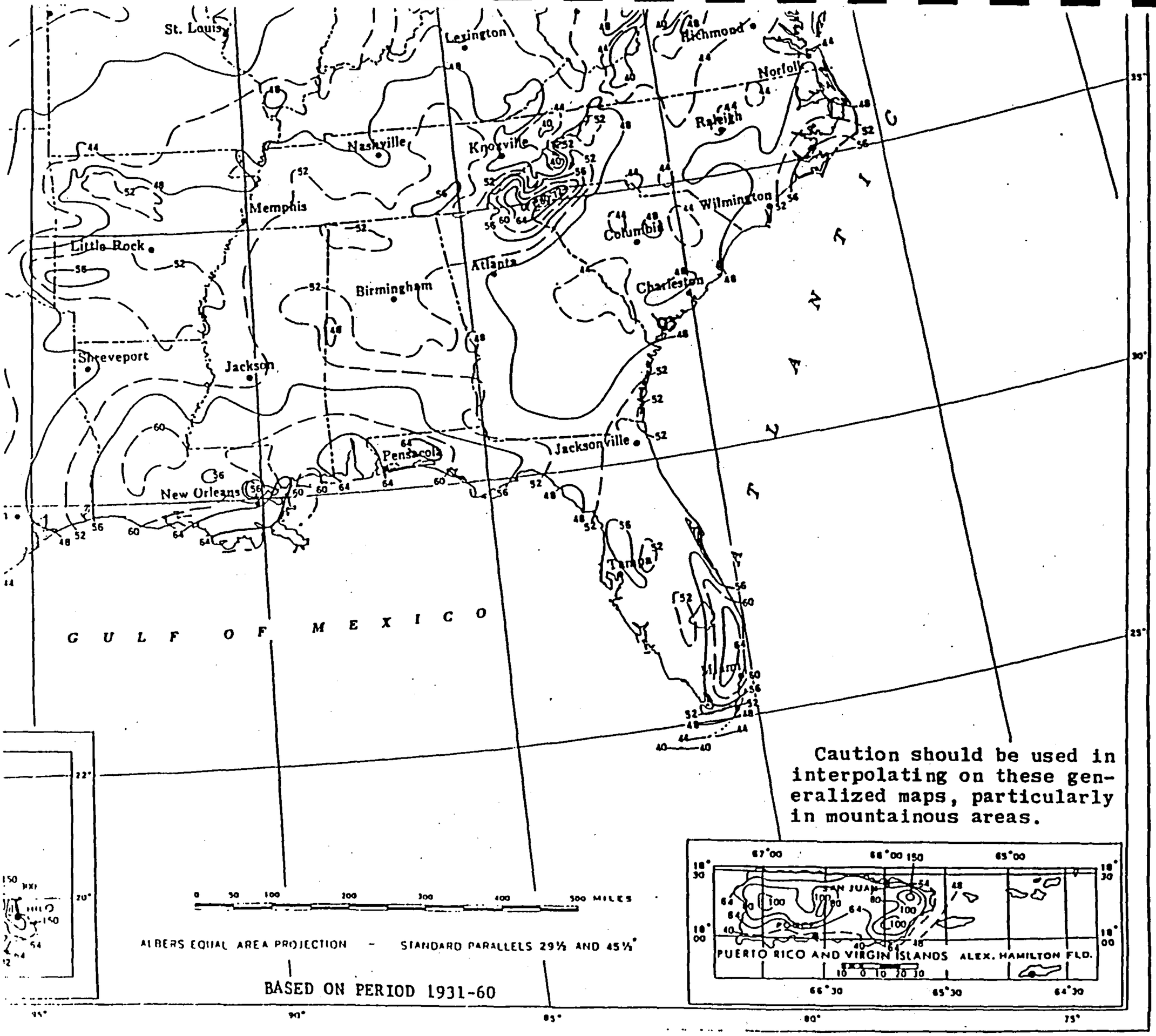
Figure 1. Map of North Carolina showing the location of the upper part of the Cape Fear River basin.

REFERENCE 17

Referece 17



RCE . Environmental Science Services Administration . Environmental Data Service



Caution should be used in interpolating on these generalized maps, particularly in mountainous areas.

.AKE EVAPORATION

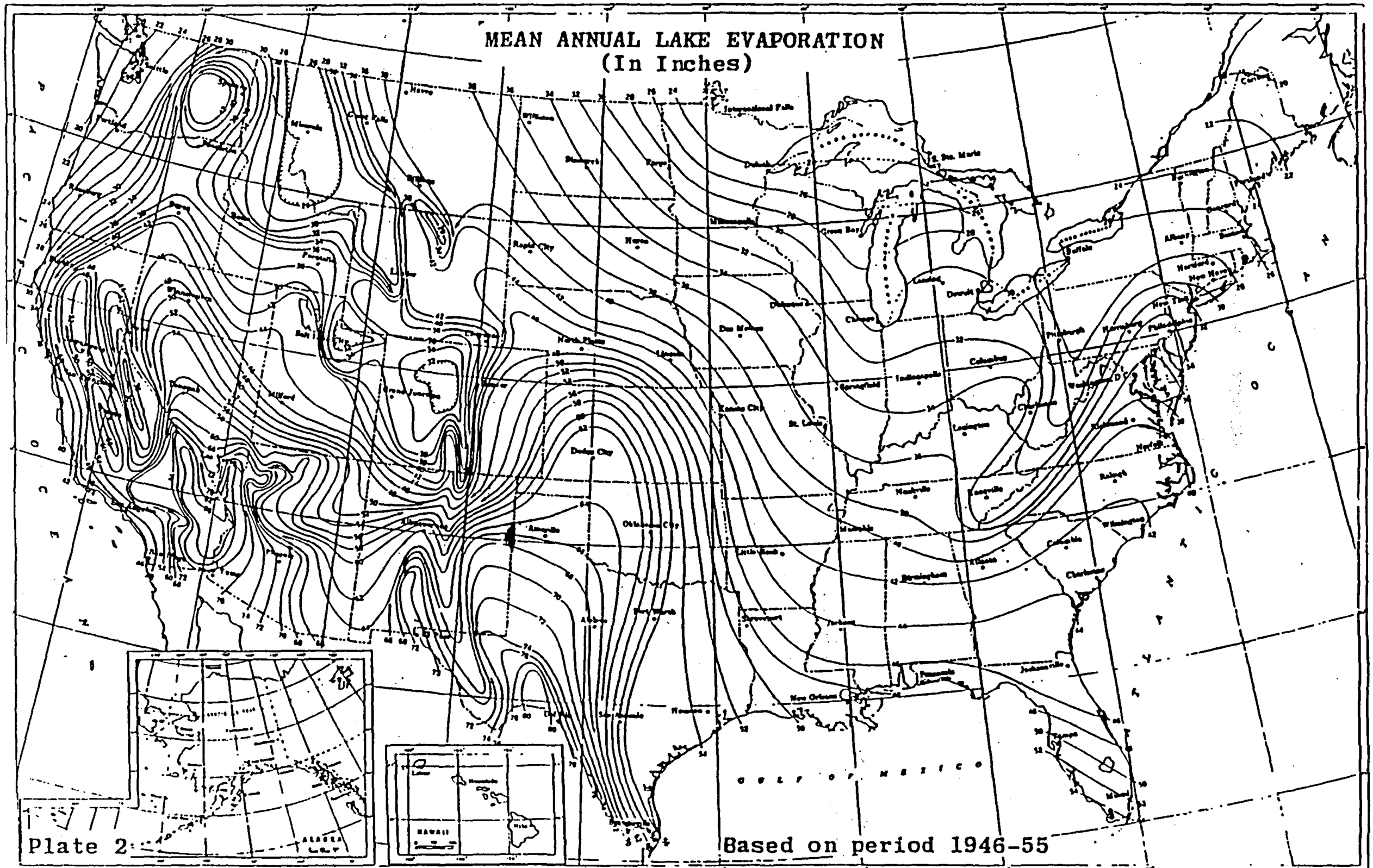


Plate 2

Based on period 1946-55

U.S. DEPARTMENT OF COMMERCE
C. R. Smith, Secretary

ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
Robert M. White, Administrator

ENVIRONMENTAL DATA SERVICE
Woodrow C. Jacobs, Director

JUNE 1968

REPRINTED BY THE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
1983

REFERENCE 18

DEPARTMENT OF COMMERCE
[illegible] H. Hodges, Secretary

WEATHER BUREAU
F. W. Reichelderfer, Chief

TECHNICAL PAPER NO. 40

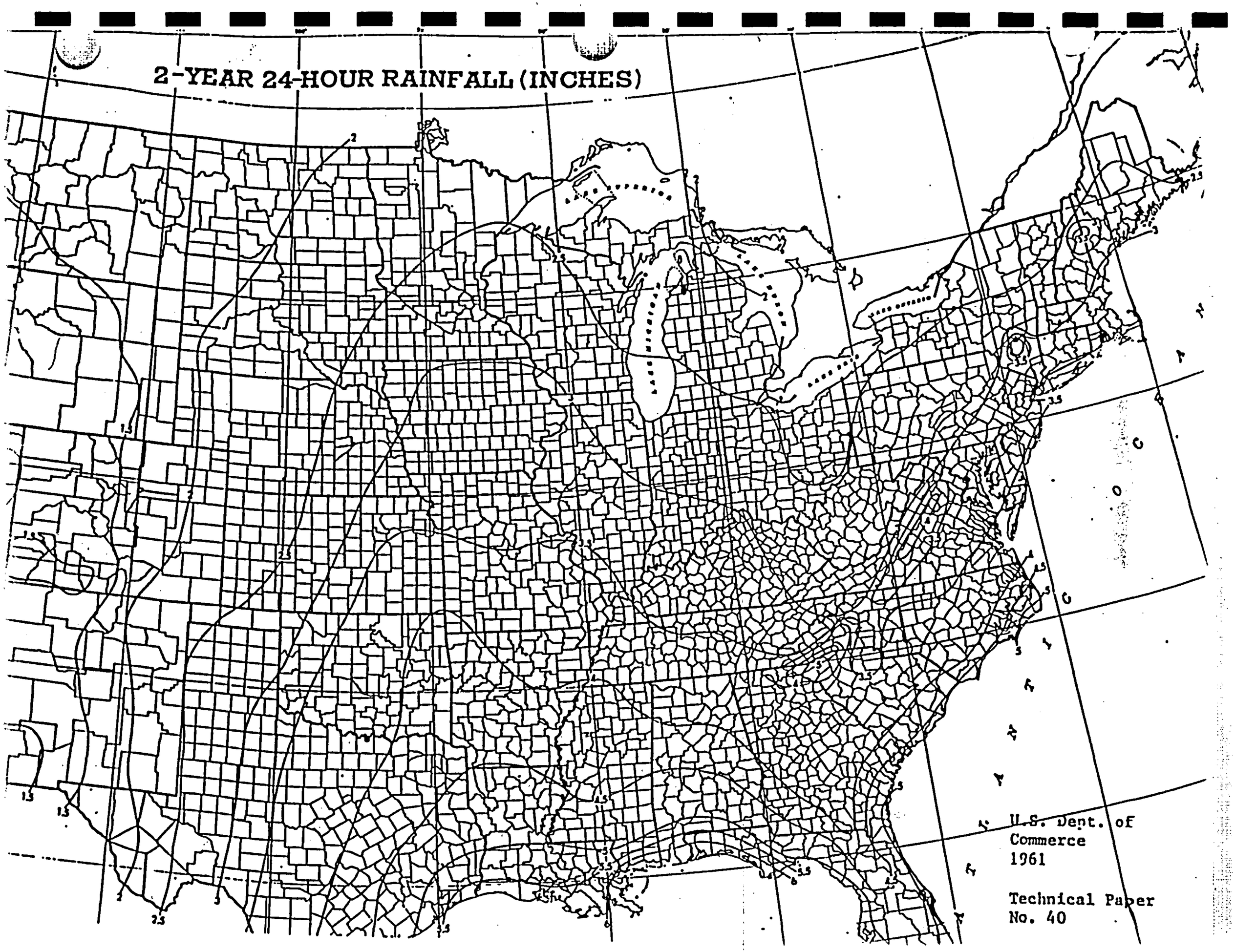
RAINFALL FREQUENCY ATLAS OF THE UNITED STATES

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

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

PROPERTY OF EPA
FIT IV

Reference 18


2-YEAR 24-HOUR RAINFALL (INCHES)
U.S. Dept. of Commerce
1961
Technical Paper No. 40

REFERENCE 19

Reference 19

STATISTICAL ANALYSIS RELATING WELL YI TO CONSTRUCTION PRACTICES AND SITIN OF WELLS IN THE PIEDMONT AND BLUE RID PROVINCES OF NORTH CAROLINA

U.S. GEOLOGICAL SURVEY

WATER RESOURCES INVESTIGATIONS REPORT 86-4132

Prepared in cooperation with the

North Carolina Department of Natural Resources

and Community Development

U.S. GEOLOGICAL SURVEY

WATER RESOURCES INVESTIGATIONS REPORT 86-4132

Errata sheet

References were omitted from captions to figures 3 and 6 on pages 7 and 19 respectively. The correct captions are as follows:

Figure 3.--Physical setting of the ground-water system in North Carolina (From Heath, 1980).

Figure 6.--Geologic belts, terranes, and some major structural features within the Piedmont and Blue Ridge provinces of North Carolina (From Brown, P.M., and Parker, J.M., III, 1985).

The equation on page 33 is incorrect as shown. The equation should read:

$$\text{yield} = a - b(\text{depth}) + c(\text{depth} \times \text{diameter}) - d(\text{depth}^2 \times \text{diameter})$$

where a, b, c, and d are regression coefficients.

STATISTICAL ANALYSIS RELATING WELL YIELD TO CONSTRUCTION PRACTICES AND SITING OF WELLS IN THE PIEDMONT AND BLUE RIDGE PROVINCES OF NORTH CAROLINA

By Charles C. Daniel III

U.S. GEOLOGICAL SURVEY

Water Resources Investigations Report 86-4132

Prepared in cooperation with the

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES
AND COMMUNITY DEVELOPMENT

Raleigh, North Carolina

1987

HANKINSON

CONTENTS

	Page
Abstract	1
Introduction	2
Purpose and scope	4
Previous investigations	5
Description of the study area	5
Physiography	5
Geology	9
Hydrogeologic units	10
Geologic belts and terranes	18
Compilation of the data base and statistical procedures	18
Information categories in the data base	18
Statistical procedures	24
Relation of well yield to construction practices and siting of wells	26
Results of the analysis	26
Well yields by hydrogeologic unit	41
Well yields by geologic belts and terranes	45
Summary and conclusions	47
References	51

ILLUSTRATIONS

	Page
Figure 1. Map of North Carolina showing area of investigation, counties, and physiographic provinces	3
2. Index map of North Carolina showing study areas of reconnaissance ground-water investigations that were the sources of well data for this study	6
3. Map and geologic cross section showing the physical setting of the ground-water system in North Carolina	7
4. Index map of North Carolina showing areas of geologic maps used in compilation of the hydrogeologic unit map of the Piedmont and Blue Ridge provinces	16
5. Hydrogeologic unit map of Guilford and Alamance Counties and vicinity in the north-central Piedmont of North Carolina	17
6. Map showing geologic belts, terranes, and some major structural features within the Piedmont and Blue Ridge provinces of North Carolina	19
7. Graph showing variation of average yield, average depth, and average yield per foot of well depth with wellbore diameter	34
8-10. Contour plots of trend surfaces showing:	
8. Relation between well yield, total well depth, and well diameter for wells located in draws and valleys	36

Page

Figure 9. Relation between well yield, total well depth, and well diameter for wells located on slopes and flats 37
10. Relation between well yield, total well depth, and well diameter for wells located on hills and ridges 38

11. Graph showing variation of average yield and yield per foot of well depth with depth for wells having diameters between 5.5 and 6.5 inches 39
12. Contour plot of trend surface showing relation between yield per foot of well depth, total well depth, and well diameter. 42

13-14. Graphs showing:

13. Average yield of wells of average construction in the hydrogeologic units of the Piedmont and Blue Ridge provinces of North Carolina. 46
14. Average yield of wells of average construction in the geologic belts and terranes of the Piedmont and Blue Ridge provinces of North Carolina 48

TABLES

Page

Table 1. Classification and lithologic description of hydrogeologic units in the Piedmont and Blue Ridge provinces of North Carolina. 11
2. Geologic belts and terranes of the Blue Ridge, Piedmont, and Coastal Plain provinces of North Carolina. 20
3. Total number of entries for each variable in the water-well data base 22
4. Average and median values of selected well characteristics according to topographic setting compared to statistics for all wells 27
5. Summary statistics defining depth to water, casing depth, and saturated thickness of regolith according to topographic group in the Blue Ridge and Piedmont physiographic provinces. 30
6. Relation of selected well characteristics to the use of the well. 32
7. Relation of well yields to hydrogeologic unit and topography 43

COVER PHOTOGRAPH: Drilling of a test well in Guilford County near the Greensboro-High Point Regional Airport, December 16, 1982. Yield at time of photograph approximately 50 gallons per minute. (Photograph by Charles C. Daniel, U.S. Geological Survey.)

STATISTICAL ANALYSIS RELATING WELL YIELD TO CONSTRUCTION PRACTICES AND SITING OF WELLS IN THE PIEDMONT AND BLUE RIDGE PROVINCES OF NORTH CAROLINA

By Charles C. Daniel III

ABSTRACT

A statistical analysis was made of data from more than 6,200 water wells drilled in the fractured crystalline rocks of the Blue Ridge, Piedmont, and western edge of the Coastal Plain where crystalline rocks underlie sediments at shallow depths. The study area encompassed 65 counties in western North Carolina, an area of 30,544 mi^2, comprising nearly two-thirds of the State. Additional water supplies will be needed in western North Carolina as population and industrial development continue to increase. Ground water is an attractive alternative to surface water sources for moderate to large supplies. The statistical analysis was made to identify the geologic, topographic, and construction factors associated with high-yield wells.

It is generally held that the crystalline rocks of the Blue Ridge and Piedmont provinces yield only small amounts of water to wells, that water is obtained from vertical fractures that pinch out at a depth of about 300 feet because of lithostatic pressure, and that the function of a large diameter well is primarily for storage. These concepts are reasonable when based upon the average well drilled in these rocks: a domestic well, 125 feet deep, 6 inches or less in diameter, and located on a hill or ridge. However, statistical analysis shows that wells in draws or valleys have average yields three times those of wells on hills and ridges. Wells in the most productive hydrogeologic units have average yields twice those of wells in the least productive units. Wells in draws and valleys in the most productive units average five times more yield than wells on hills and ridges in the least productive units.

Well diameter can have a significant influence on yield; for a given depth, yield is directly proportional to well diameter. Maximum well yields are obtained from much greater depths than previously believed. For

example, the average yield of 6-inch diameter wells located in draws and valleys can be expected to reach a maximum of about 45 gallons per minute at depths of 500 to 525 feet; for similarly located 12-inch diameter wells, the average yield can be expected to reach a maximum of about 150 gallons per minute at depths of 700 to 800 feet.

INTRODUCTION

Additional water supplies will be needed in the Piedmont and Blue Ridge provinces of North Carolina (fig. 1) as population and industrial development continue to increase. Municipal and industrial water supplies are derived almost exclusively from surface water sources. However, the potential for further development of surface water is limited, and ground water is an attractive alternative for moderate to large water supplies.

Ground water has many attractive features as a source of supply. Ground water in the crystalline rocks of the Piedmont and Blue Ridge provinces has a relatively low cost of development (Cederstrom, 1972). Generally, ground water in these areas is of good chemical quality and requires little treatment. Because of the large quantity of water in storage, the ground-water system usually can sustain moderate yields during seasonal dry periods. The use of ground water generally permits other land-use activities if they do not impede the infiltration of recharge or diminish water quality.

The crystalline rocks underlying the Blue Ridge and Piedmont have the reputation for furnishing only small quantities of ground water. This impression is the outgrowth of drilling large numbers of domestic wells, which do not represent efforts to obtain quantities of water beyond the minimum requirement of 2 to 10 gal/min. About 70 percent of all wells drilled in the Blue Ridge and Piedmont are for domestic supply and most were located and drilled without regard to geology, topography, and optimal construction. There are, however, a significant number of wells that yield a few tens to a few hundreds of gallons per minute. Additional high-yield wells likely could be developed at carefully selected sites throughout the area.

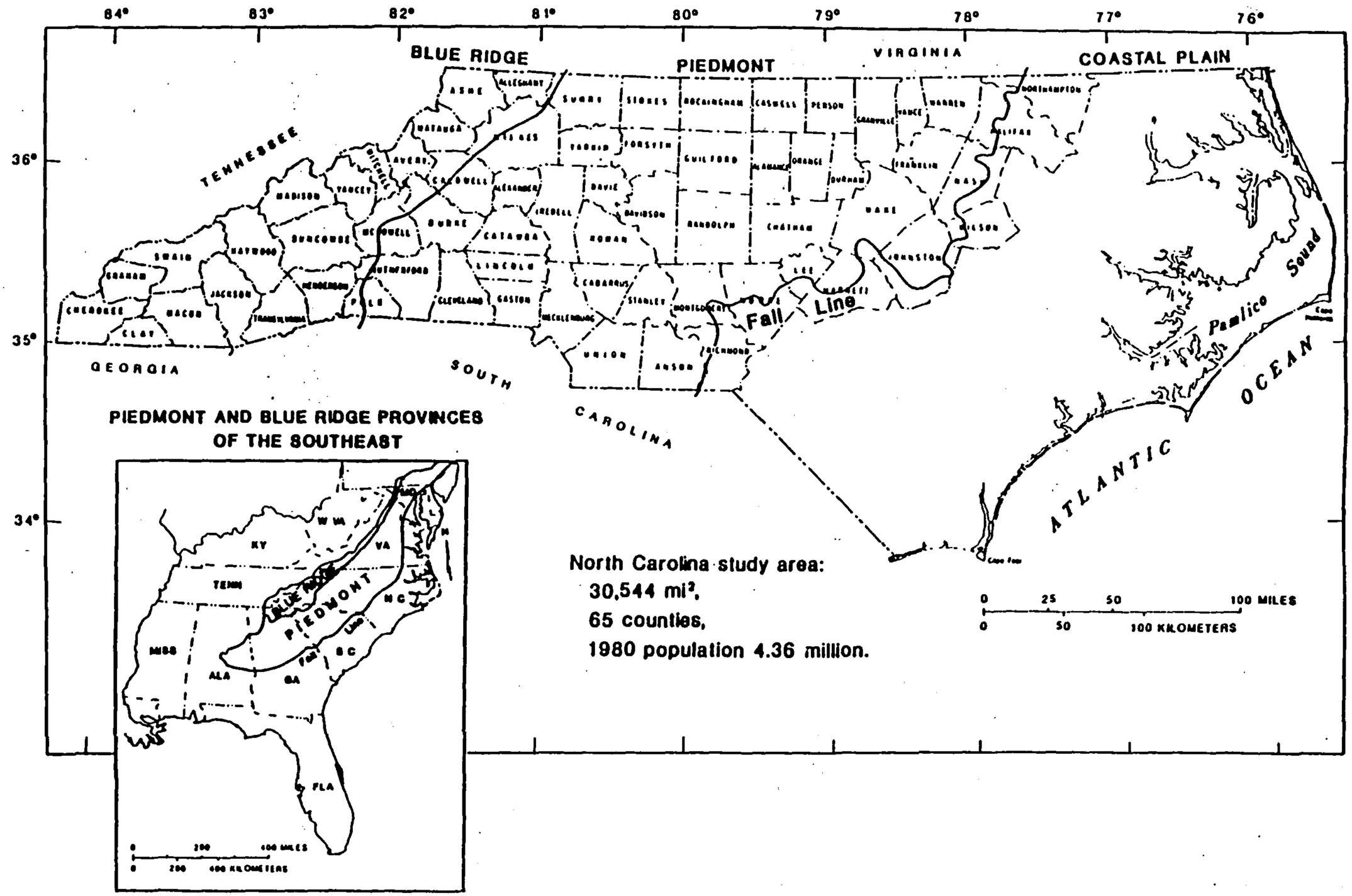


Figure 1.--Area of investigation showing counties and physiographic provinces.

Results of studies in several areas of the Piedmont, both within and outside North Carolina, show that the ground-water system can support large well yields. For example, Daniel and Sharpless (1983) reported finding more than 300 wells in an eight-county area of central North Carolina that produce 50 gal/min or more. Cressler and others (1983) found a substantial number of wells in the Georgia Piedmont that yield more than 100 gal/min and some that yield nearly 500 gal/min. They also found 66 mainly industrial and municipal wells that had been in use for periods of 12 to more than 30 years without experiencing declining yields. Similarly, Cederstrom (1972) found that yields of 100 to 300 gal/min are not uncommon for bedrock wells in the Piedmont and Blue Ridge provinces from Maine to Virginia.

To evaluate the potential for large ground-water supplies in the Piedmont and Blue Ridge provinces of North Carolina, the U.S. Geological Survey, in cooperation with the North Carolina Department of Natural Resources and Community Development, conducted a five-year study of ground-water resources in the region. This report is part of that study.

Purpose and Scope

The purpose of this report is to describe a statistical analysis of data from a large number of water wells in the Piedmont and Blue Ridge provinces of North Carolina that was undertaken to identify factors associated with high-yield wells.

The statistical analysis was made by using hydrologic, geologic, topographic, and well-construction data obtained from records of more than 6,200 water wells. The wells are in an area including all of the Blue Ridge and Piedmont provinces in the State and an adjoining narrow strip at the western edge of the Coastal Plain province where a number of wells draw water from Piedmont crystalline rocks at shallow depth beneath the sedimentary cover. The study area encompassed all of 65 counties in North Carolina, an area of 30,544 mi^2, comprising nearly two-thirds of the State (fig. 1).

The Coastal Plain has little relief in contrast to the adjoining Piedmont. It is marked by sluggish streams flowing in broad valleys cut into predominately sand and clay units that thicken seaward from a feather edge at the Fall Line. Along the western edge of the Coastal Plain, the sediments are underlain at shallow depth by crystalline Piedmont rocks (fig. 3).

Geology

The geology of the Piedmont and Blue Ridge is extremely complex. All major classes of rocks--metamorphic, igneous, and sedimentary--are represented, although metamorphic rocks are the most abundant. The metamorphic and igneous rocks range in composition from felsic to ultramafic and range in age from Precambrian in the Blue Ridge to Triassic and Jurassic in the Piedmont. The metamorphism of the rocks varies in grade from low rank to high rank, that is, varying in degree of recrystallization and destruction of the original texture; many have been folded and refolded during multiple metamorphic and orogenic events. The rocks are broken and displaced by numerous faults and zones of shearing, some of which are many miles in length. Nearly everywhere are rock fractures without displacement called joints. The joints commonly cluster in groups orientated about one or more preferred directions. Within the crystalline rocks of the Piedmont are downfaulted basins (grabens) filled with sedimentary rocks of Triassic age.

There have been three or more periods of igneous intrusion (Fullagar, 1971) with the emplacement of plutonic bodies ranging in size from batholiths down to dikes, sills, and veins. Most instrusions have been metamorphosed, deformed, and fractured, but some are massive and have little or no foliation. All rocks have been subjected to uplift, weathering, and erosion, which resulted in the widening of fractures and the formation of new openings such as stress-relief fractures. These breaks in the otherwise solid rock are the conduits for ground-water flow. All of the events and processes that are part of the geologic history of the area have given the hydrogeologic system properties that control the present-day movement and circulation of ground water.

Bedding and planes of metamorphic foliation generally are folded and tilted and can have almost any attitude and orientation. Fractures, bedding, and foliation create inhomogeneities in the rocks, with the result that permeability is usually greatest parallel to bedding and foliation and zones of fracture concentration, and least at right angles to the plane of these features.

Bedrock may be exposed at land surface on steep slopes, rugged hilltops, or in stream valleys, but nearly everywhere else is overlain by unconsolidated material to depths of more than a hundred feet. Collectively this unconsolidated material, which is composed of saprolite, alluvium, and soil, is referred to as regolith. Saprolite is clay-rich, residual material derived from in-place weathering of the bedrock. When the bedrock weathers to form saprolite, the relict structures generally are retained and the directional properties of permeability are also retained. In many valleys the saprolite has been removed by erosion, and bedrock is exposed or thinly covered by alluvial deposits. Soil is nearly everywhere present as a thin mantle on top of both the saprolite and alluvium. The water-storing and transmitting characteristics of bedrock and regolith and the hydrologic relation between them determines the water-supply potential of the ground-water system in the Piedmont and Blue Ridge provinces.

Hydrogeologic Units

Within the Piedmont and Blue Ridge of North Carolina there are hundreds of rock units which have been defined and named by various conventions more in keeping with classical geologic nomenclature than hydrologic terminology. The geologic nomenclature does little to reflect the water-bearing potential of the different units. To overcome this shortcoming and to reduce the number of rock units to the minimum necessary to reflect the differences in water-bearing potential, a classification scheme based on origin, composition, and texture was devised (table 1). The rationale behind the hydrogeologic units shown in table 1 is the hypothesis that these factors would be linked not only to a rock's primary porosity but also to its susceptibility to the development of secondary porosity in the form of

unit(s). The yield data used for this comparison also were corrected to an average 154-foot depth and 6-inch diameter. A regression analysis of well yields in the various belts is shown in figure 14. The average difference in yield between belts is 0.9 gal/min. Average yield varies from a low of about 11.5 gal/min for the Smith River allocthon (SR) and Triassic basins (TR) to a high of about 23 gal/min for the Blue Ridge belt (BR). Analysis of variance tests found that the average yield of belts at the upper and lower ends of the data are significantly different. The inequalities significant at the 0.95 confidence level are also shown in figure 14.

The belts with the highest yields, the Blue Ridge (BR), Chauga (CA), and Inner Piedmont (IP), are dominated by high rank metasedimentary rocks, mafic gneisses, schists, and quartzites, and include smaller areas of metaigneous rocks, all of which have above average yields. The Charlotte belt (CH), which is characterized by igneous rocks intruded into country rocks of metavolcanic and metaigneous origin (Fullagar, 1971), and the Carolina slate belt (CS), which is dominated by metavolcanic rocks (Butler and Ragland, 1969), both are belts having low average yields.

The areas containing sedimentary rocks, the Triassic basins (TR) and the western edge of the Coastal Plain (CP), are far apart in average yield with the Triassic basins having the next-to-lowest yield and the Coastal Plain the third highest.

SUMMARY AND CONCLUSIONS

A statistical analysis was made of data from more than 6,200 wells drilled in the crystalline rocks of the Blue Ridge, Piedmont, and the western edge of the Coastal Plain where crystalline rocks underlie sediments at shallow depths. This analysis was made to identify factors associated with high-yield wells. The data were classified according to geologic belts, hydrogeologic units composed of similar rock types, topographic setting, total and saturated thickness of regolith, water level, casing depth, yield, total depth, well diameter, and water use.

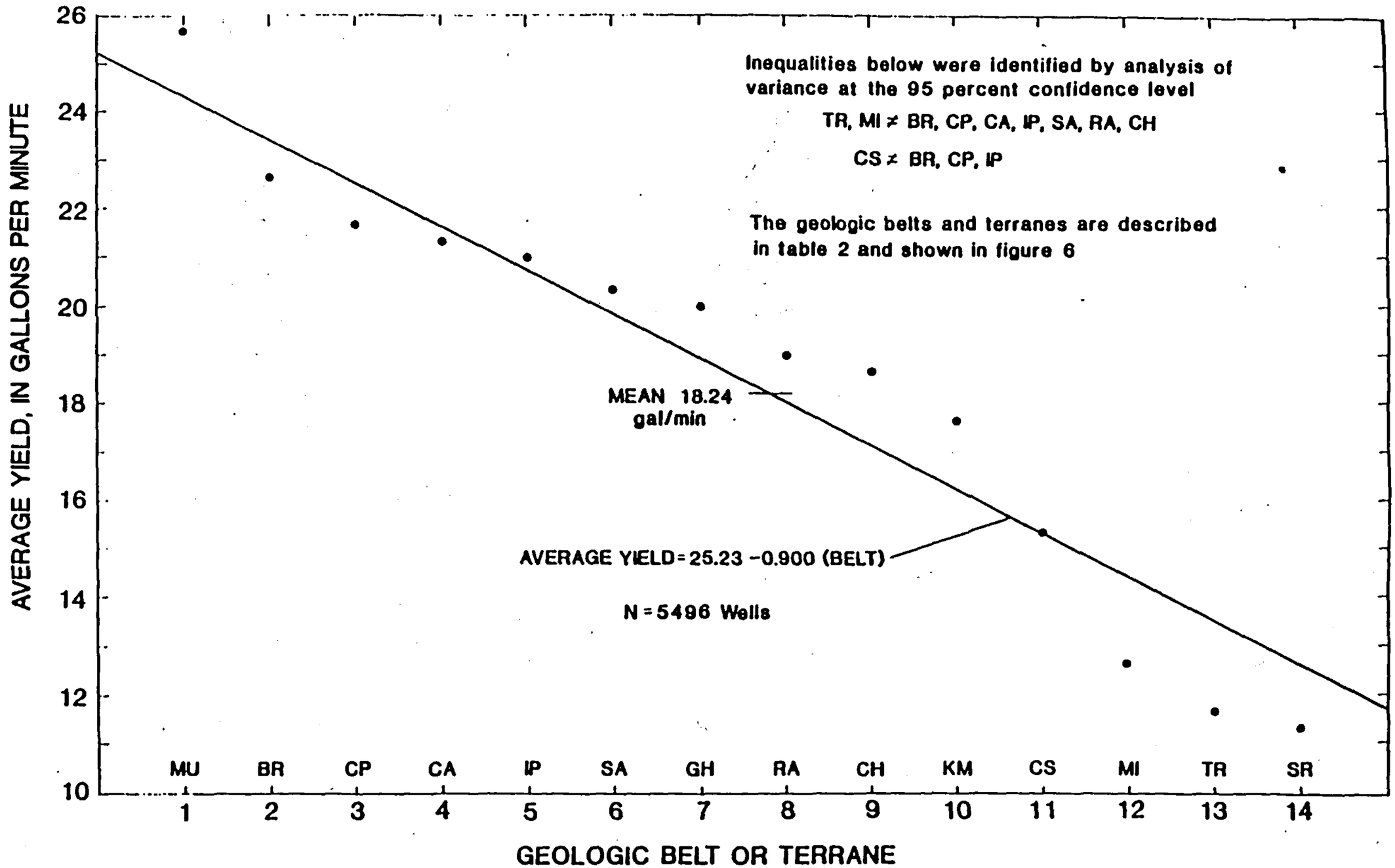


Figure 14.--Average yield of wells of average construction in the geologic belts and terranes of the Piedmont and Blue Ridge provinces of North Carolina.

Six topographic settings were combined into three groups based on well yields: hills and ridges, slopes and flats, and draws and valleys. Wells on hills and ridges had the lowest yields (averaging about 10 gal/min), wells in draws and valleys, the greatest (averaging about 30 gal/min). Regolith thickness was about the same regardless of topographic group, but saturated thickness was least (about 19 feet) under hills and ridges and greatest (about 34 feet) under draws and valleys. Average yields in the geologic belts and hydrogeologic units ranged from about 11 to 25 gal/min. There was considerable scatter in yields in all geologic belts and hydrogeologic units. Of 14 geologic belts, 10 were statistically different on the basis of well yield, as were 9 of 21 hydrogeologic units.

About 70 percent of the wells were drilled for domestic use and, on the average, yielded about 11 gal/min; 80 percent of these wells were located on hills and ridges. The 30 percent of the wells drilled for public supply and commercial-industrial supply yielded about 30 gal/min on the average; about 50 percent of these wells were located in draws and valleys. The domestic wells had an average depth of about 125 feet, the public-supply and commercial-industrial wells about 225 feet. Fewer than 2 percent of the domestic wells were 8 inches in diameter or larger, whereas nearly 25 percent of the public-supply and commercial-industrial wells were 8 inches or larger.

Selecting the most favorable hydrogeologic unit or geologic belt alone can improve the chance of increasing the yield of the average 6-inch diameter, 154-foot deep well from about 11 to 12 gal/min to about 23 to 24 gal/min, about a two-fold increase. Considering topography alone, the average well on hills and ridges can be expected to average less than 12 gal/min, whereas wells in draws and valleys can be expected to average about 29 gal/min, an increase of 2.4 times. When the factors of hydrogeologic unit or geologic belt are considered in combination with topographic setting, the range in yields is even greater. Wells in draws and valleys in the most productive units average five times more yield than wells on hills and ridges in the least productive units.

The statistical analysis supported some concepts and criteria for well-site selection, such as the siting of a well with regard to topography. More importantly, however, the analysis indicates that some previously held concepts may be in error. First and foremost is the generally held concept that the crystalline rocks yield only small amounts of water to wells. The analysis showed that this concept may be due to cultural bias. Most wells drilled in these rocks are small diameter, are located primarily on hills and ridges--the poorest possible sites for wells--and are drilled only to depths where sufficient water for a domestic supply is obtained. In the same theme, well diameter has not been considered to have much effect on yield--a large-diameter well was considered a storage tank. Statistical analysis shows, however, that for a given depth the yield of a well is directly proportional to the well diameter. The larger the diameter the greater the yield.

Well construction in crystalline rocks has long been based on the concept of a well intersecting near vertical open fractures and joints that because of lithostatic pressure, pinch out at depths of about 300 feet. As a result, the drilling of many wells has been arbitrarily stopped when the depth of 300 feet was reached. The average well, whether domestic or commercial-industrial, is not even that deep. The analysis indicates that very few wells have been drilled deep enough to test the full potential of the sites. For example, the average yield of 6-inch diameter wells located in draws or valleys reaches a maximum of about 45 gal/min at depths of 500 to 525 feet; the average yield of 12-inch diameter wells located in draws or valleys reaches a maximum of about 150 gal/min at depths of 700 to 800 feet.

Whatever the hydrogeologic unit or topographic location, the chances of obtaining high yields are enhanced by increasing the depth and diameter of the well to a much greater extent than previously thought.

REFERENCES

Bain, G.L., 1966, Geology and ground-water resources of the Durham area, North Carolina: North Carolina Department of Water Resources Ground-Water Bulletin 7, 147 p.

Brown, P.M., and Parker, J.M., III, compilers, 1985, Geologic map of North Carolina: North Carolina Department of Natural Resources and Community Development, 1 sheet, scale 1:500,000.

Burt, E.R., 1981, Geologic map of Region H, North Carolina: North Carolina Geological Survey, Open-File Map no. NCGS 81-4, scale 1:125,000.

Butler, J.R., and Ragland, P.C., 1969, A petrochemical survey of plutonic intrusions in the Piedmont, southeastern Appalachians, U.S.A.: Contributions to Mineralogy and Petrology, v. 24, p. 164-190.

Carpenter, P.A., III, 1982, Geologic Map of Region G, North Carolina, Regional Geology Series 2: North Carolina Department of Natural Resources and Community Development, Geological Survey Section, scale 1:125,000.

Cedarstrom, D.J., 1972, Evaluation of yields of wells in consolidated rocks, Virginia to Maine: U.S. Geological Survey Water-Supply Paper 2021, 38 p.

Conrad, S.G., Carpenter, P.A., III, and Wilson, W.F., 1975, Physiography, geology and mineral resources, in Clay, J.W., Orr, D.M., and Stuart, A.W., eds., North Carolina atlas, portrait of a changing southern state: Chapel Hill, North Carolina, University of North Carolina Press, p. 112-127.

Cressler, C.W., Thurmond, C.J., and Hester, W.G., 1983, Ground water in the Greater Atlanta Region: Georgia Department of Natural Resources Environmental Protection Division, Georgia Geologic Survey Information Circular 63, 144 p.

Daniel, C.C., III, and Sharpless, N.B., 1983, Ground-water supply potential and procedures for well-site selection in the upper Cape Fear River basin, North Carolina: North Carolina Department of Natural Resources and Community Development, 73 p.

Dodson, C.L., and Laney, R.L., 1968, Geology and ground-water resources of the Murphy area, North Carolina: North Carolina Department of Water and Air Resources Ground-Water Bulletin 13, 113 p.

Eder, B.K., Davis, J.M., and Robinson, P.J., 1983, Variations in monthly precipitation over North Carolina: University of North Carolina Water Resources Research Institute Report no. 185, 50 p.

Espenshade, G.H., Rankin, D.W., Shaw, K.W., and Neuman, R.B., 1975, Geologic map of the east half of the Winston-Salem Quadrangle, North Carolina-Virginia: U.S. Geological Survey, Miscellaneous Investigations Series, Geologic Quadrangle Map I-709-B, scale 1:250,000.

Fenneman, N.M., 1938, Physiography of Eastern United States: New York, McGraw-Hill, 714 p.

Floyd, E.O., 1965, Geology and ground-water resources of the Monroe area, North Carolina: North Carolina Department of Water Resources Ground-Water Bulletin 5, 109 p.

Fullagar, P.D., 1971, Age and origin of plutonic intrusions in the Piedmont of the southeastern Appalachians: Geological Society of America Bulletin, v. 82, p. 2845-2862.

Goldsmith, Richard, Milton, D.J., and Horton, J.W., Jr., 1982, Simplified preliminary geologic map of the Charlotte 1° x 2° quadrangle, North Carolina and South Carolina: U.S. Geological Survey, Open-File Report 82-56, scale 1:250,000.

Hadley, J.B., and Nelson, A.E., 1971, Geologic map of the Knoxville Quadrangle, North Carolina, Tennessee, and South Carolina: U.S. Geological Survey, Geologic Quadrangle Map I-654, scale 1:250,000.

Heath, M.S., and Coffield, H.I., III, 1970, Cases and materials on ground water law--with particular reference to the law of North Carolina: Chapel Hill, North Carolina, University of North Carolina Institute of Government, 72 p.

Heath, R.C., 1980, Basic elements of ground-water hydrology with reference to conditions in North Carolina: U.S. Geological Survey Water-Resources Investigations Open-File Report 80-44, 86 p.

LeGrand, H.E., 1954, Geology and ground water in the Statesville area, North Carolina: North Carolina Department of Conservation and Development Bulletin 68, 68 p.

-----1967, Ground water of the Piedmont and Blue Ridge provinces in the southeastern states: U.S. Geological Survey Circular 538, 11 p.

LeGrand, H.E., and Mundorff, M.J., 1952, Geology and ground water in the Charlotte area, North Carolina: North Carolina Department of Conservation and Development Bulletin 63, 88 p.

Marsh, O.T., and Laney, R.L., 1966, Reconnaissance of the ground-water resources in the Waynesville area, North Carolina: North Carolina Department of Water Resources Ground-Water Bulletin 8, 131 p.

May, V.J., and Thomas, J.D., 1968, Geology and ground-water resources in the Raleigh area, North Carolina: North Carolina Department of Water and Air Resources Ground-Water Bulletin 15, 135 p.

McDaniel, R.D., 1980, Geologic map of Region K, North Carolina: North Carolina Geological Survey, Open-File Map No. NCGS 80-2, scale 1:125,000.

Mundorff, M.J., 1946, Ground water in the Halifax area, North Carolina: North Carolina Department of Conservation and Development Bulletin 51, 76 p.

-----1948, Geology and ground water in the Greensboro area, North Carolina: North Carolina Department of Conservation and Development Bulletin 55, 108 p.

Peace, R.R., Jr., and Link, D.R., 1971, Geology and ground-water resources of northwestern North Carolina: North Carolina Department of Water and Air Resources Ground-Water Bulletin 19, 135 p.

Pusey, R.D., 1960, Geology and ground water in the Goldsboro area, North Carolina: North Carolina Department of Water Resources Ground-Water Bulletin 2, 77 p.

Ragland, P.C., Hatcher, R.D., Jr., and Whittington, David, 1983, Juxtaposed Mesozoic diabase dike sets from the Carolinas: A preliminary assessment: Geology, July 1983, vol. 11, p. 394-399.

Rankin, D.W., Espenshade, G.H., and Neuman, R.B., 1972, Geologic map of the west half of the Winston-Salem Quadrangle, North Carolina, Virginia, and Tennessee: U.S. Geological Survey, Miscellaneous Geologic Investigations Series, Geologic Quadrangle Map I-709-A, scale 1:125,000.

Reinemund, J.A., 1955, Geology of the Deep River coal field, North Carolina: U.S. Geological Survey Professional Paper No. 246, 159 p.

SAS Institute Inc., 1982a, SAS user's guide: basics, 1982 edition: Cary, North Carolina, SAS Institute, Inc., 923 p.

-----1982b, SAS user's guide: statistics, 1982 edition: Cary, North Carolina, SAS Institute, Inc., 584 p.

Schipf, R.G., 1961, Geology and ground-water resources of the Fayetteville area: North Carolina Department of Water Resources Ground-Water Bulletin 3, 99 p.

Seiders, V.M., 1981, Geologic map of the Asheboro, North Carolina, and adjacent areas: U.S. Geological Survey, Miscellaneous Investigations Map I-1314, scale 1:62,500.

Snipes, D.S., Padgett, G.S., Hughes, W.S., and Springston, G.E., 1983, Ground-water quantity and quality in fracture zones in Abbeville County, South Carolina: Clemson, South Carolina, Clemson University Water Resources Research Institute Technical Report No. 102, 54 p.

Steel, R.G.D., and Torrie, J.H., 1960, Principles and procedures of statistics,. with special reference to the biological sciences: New York, McGraw-Hill, 481 p.

Stromquist, A.A., Choquette, P.W., and Sundelius, H.W., 1971, Geologic map of the Denton Quadrangle, central North Carolina: U.S. Geological Survey, Geol. Quad. Map GQ-872, scale 1:62,500.

Stromquist, A.A., and Sundelius, H.W., 1975, Interpretive geologic map of the bedrock showing radioactivity, and aeromagnetic map of the Salisbury, Southmont, Rockwell, and Gold Hill Quadrangles, Rowan and Davidson Counties, North Carolina: U.S. Geological Survey, Miscellaneous Investigations Series, Map I-888 (sheet 1 of 2), scale 1:48,000.

Stuckey, J.L., 1958, Geologic map of North Carolina: Raleigh, North Carolina, North Carolina Department of Conservation and Development, Division of Mineral Resources, scale 1:500,000.

Sumsion, C.T., and Laney, R.L., 1967, Geology and ground-water resources of the Morganton area, North Carolina Department of Water Resources Ground-Water Bulletin 12, 119 p.

Trapp, Henry, Jr., 1970, Geology and ground-water resources of the Asheville area, North Carolina: North Carolina Department of Water and Air Resources Ground-Water Bulletin 16, 127 p.

Weigand, P.W., and Ragland, P.C., 1970, Geochemistry of Mesozoic dolerite dikes from eastern North America: Contributions to Minerology and Petrology, v. 29, p. 195-214.

Wilson, W.F., 1979, Geology of Wilson County, North Carolina: North Carolina Department of Natural Resources and Community Development, Division of Land Resources, Geological Survey Section, Open-File Map NCGS 79-2, scale 1:125,000.

-----1981, Geology of Halifax County, North Carolina: North Carolina Geological Survey, Open-File Map NCGS 81-3, scale 1:125,000.

Wilson, W.F., Carpenter, P.A., III, and Parker, J.M., III, 1981, Geologic map of Region J, North Carolina, in A guide for North Carolina mineral resource development and land use planning, Regional Geology Series 1, North Carolina Department of Natural Resources and Community Development, Geological Survey Section, scale 1:125,000.

Wilson, W.F., and Spence, W.H., 1979, Geology of Nash County, North Carolina: North Carolina Department of Natural Resources and Community Development, Division of Land Resources, Geological Survey Section, Open-File Map NCGS 79-3, scale 1:125,000.

☆U.S. GOVERNMENT PRINTING OFFICE 1987—748-188/40040

REFERENCE 20

Reference 20

Uncontrolled Hazardous Waste Site Ranking System

A Users Manual
(HW-10)

Originally Published in
the July 16, 1982, *Federal Register*

United States
Environmental Protection
Agency

1984

FOREWORD

The method for ranking hazardous substance facilities that is described in this document was developed by The MITRE Corporation under contract to the U.S. Environmental Protection Agency. The method has benefited from extensive review and comment by EPA personnel, state officials, and interested parties in the private sector.

TABLE OF CONTENTS

		Page
LIST OF ILLUSTRATIONS		vi
LIST OF TABLES		vii
1.0	INTRODUCTION	1
2.0	USING THE HAZARD RANKING SYSTEM - GENERAL CONSIDERATIONS	7
3.0	GROUND WATER MIGRATION ROUTE	9
3.1	Observed Release	9
3.2	Route Characteristics	9
3.3	Containment	16
3.4	Waste Characteristics	16
3.5	Targets	24
4.0	SURFACE WATER ROUTE	29
4.1	Observed Release	29
4.2	Route Characteristics	29
4.3	Containment	34
4.4	Waste Characteristics	34
4.5	Targets	34
5.0	AIR ROUTE	39
5.1	Observed Release	39
5.2	Waste Characteristics	39
5.3	Targets	44
6.0	COMPUTING THE MIGRATION HAZARD MODE SCORE, S_M	47
7.0	FIRE AND EXPLOSION	49
7.1	Containment	49
7.2	Waste Characteristics	49
7.3	Targets	52
8.0	DIRECT CONTACT	57
8.1	Observed Incident	57
8.2	Accessibility	57
8.3	Containment	59
8.4	Waste Characteristics	59
8.5	Targets	59

LIST OF TABLES

Table Number		Page
1	Comprehensive List to Rating Factors	3
2	Permeability of Geologic Materials	15
3	Containment Value for Ground Water Route	17
4	Waste Characteristics Values for Some Common Chemicals	20
5	Persistence (Biodegradability) of Some Organic Compounds	21
6	Sax Toxicity Ratings	22
7	NFPA Toxicity Ratings	23
8	Values for Facility Slope and Intervening Terrain	31
9	Containment Values for Surface Water Route	35
10	Values for Sensitive Environment (Surface Water)	37
11	NFPA Reactivity Ratings	41
12	Incompatible Materials	43
13	Values for Land Use (Air Route)	46
14	NFPA Ignitability Levels and Assigned Values	51
15	Values for Sensitive Environments (Fire and Explosion)	54

1.0 INTRODUCTION

The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) (PL 96-510) requires the President to identify the 400 facilities in the nation warranting the highest priority for remedial action. In order to set the priorities, CERCLA requires that criteria be established based on relative risk or danger, taking into account the population at risk; the hazardous potential of the substances at a facility; the potential for contamination of drinking water supplies, for direct human contact, and for destruction of sensitive ecosystems; and other appropriate factors.

This document describes the Hazard Ranking System (HRS) to be used in evaluating the relative potential of uncontrolled hazardous substance facilities to cause human health or safety problems, or ecological or environmental damage. Detailed instructions for using the HRS are given in the following sections. Uniform application of the ranking system in each State will permit EPA to identify those releases of hazardous substances that pose the greatest hazard to humans or the environment. However, the HRS by itself cannot establish priorities for the allocation of funds for remedial action. The HRS is a means for applying uniform technical judgement regarding the potential hazards presented by a facility relative to other facilities. It does not address the feasibility, desirability, or degree of cleanup required. Neither does it deal

TABLE 1

COMPREHENSIVE LIST TO RATING FACTORS

HAZARD MODE	FACTOR CATEGORY	FACTORS		
		GROUND WATER ROUTE	SURFACE WATER ROUTE	AIR ROUTE
Migration	Route Characteristics	• Depth to Aquifer of Concern • Net Precipitation • Permeability of Unsaturated Zone • Physical State	• Facility Slope and Intervening Terrain • One-Year 24-Hour Rainfall • Distance to Nearest Surface Water • Physical State	
	Containment	• Containment	• Containment	
	Waste Characteristics	• Toxicity/Persistence • Hazardous Waste Quantity	• Toxicity/Persistence • Hazardous Waste Quantity	• Reactivity/Incompatibility • Toxicity • Hazardous Waste Quantity
	Targets	• Ground Water Use • Distance to Nearest Well/ Population Served	• Surface Water Use • Distance to Sensitive Environment • Population Served/Distance to Water Intake Downstream	• Land Use • Population Within 4-Mile Radius • Distance to Sensitive Environment
Fire and Explosion	Containment	• Containment		
	Waste Characteristics	• Direct Evidence • Ignitability • Reactivity • Incompatibility • Hazardous Waste Quantity		
	Targets	• Distance to Nearest Population • Distance to Nearest Building • Distance to Nearest Sensitive Environment • Land Use • Population Within 2-Mile Radius • Number of Buildings Within 2-Mile Radius		
Direct Contact	Observed Incident	• Observed Incident		
	Accessibility	• Accessibility of Hazardous Substances		
	Containment	• Containment		
	Toxicity	• Toxicity		
	Targets	• Population Within 1-Mile Radius • Distance to Critical Habitat		

The ranking of facilities nationally for remedial action will be based primarily on S_M. S_{FE} and S_{DC} may be used to identify facilities requiring emergency attention.

REFERENCE 21

Reference 21

SEE APPENDIX A FIGURE 1

REFERENCE 22

NUS CORPORATION AND SUBSIDIARIES **TELECON NOTE**

Reference 22

CONTROL NO. TDD No. F4-8803-42	DATE: May 3, 1988	TIME: 1315

DISTRIBUTION: Custom Finishers, Inc., High Point, North Carolina

BETWEEN: Wayne Slaydon, Water &Sewer Supervisor	OF: City of High Point Water & Sewer	PHONE: (919) 883-3465

AND: Michael Profit, NUS Corporation

MP 5-3-88

DISCUSSION:

High Point obtains its water from High Point city lake located northeast of town. The intake is located in Deep River, just below the dam which forms High Point Lake. System serves 30,000 connections within the city limits; the population of High Point is 62,000. The system is branching out to serve currently unserved areas of Guilford County between High Point and Greensboro.

REFERENCE 23

NUS CORPORATION AND SUBSIDIARIES **TELECON NOTE**

Reference 23

CONTROL NO.	DATE: 4/24/89	TIME: 1630

DISTRIBUTION:

BETWEEN: John Frezell, Town Manager	OF: Town Hall of Jamestown	PHONE: (704) 454-1138

AND: Eric Corbin, NUS Corporation

Eric Corbin 5/18/89

DISCUSSION:

Mr. Frezell was contacted in an effort to determine the source of water for the Jamestown Water Department. He stated that they purchase water from the High Point Water Dept., from the Greensboro Water Dept., and they have a surface water intake located at the Oakdale treatment facility on the Deep River. He further stated that they served at 1,000 residences and at 150 businesses.

REFERENCE 24

FISHING INFORMATION FOR NORTH CAROLINA

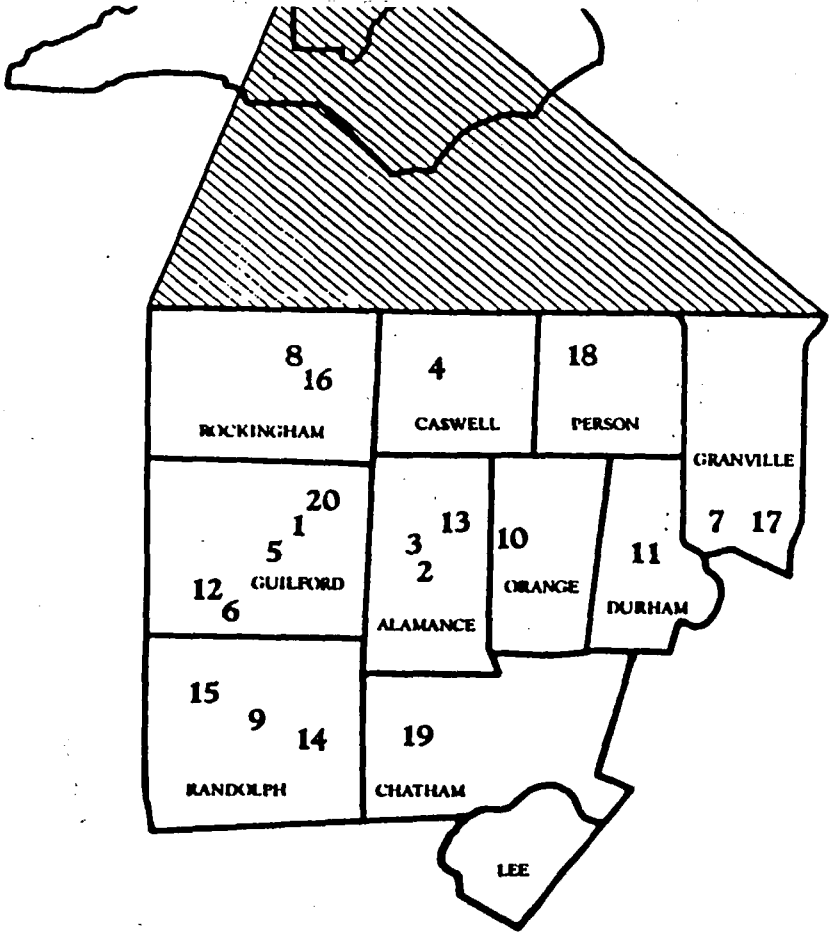
CITY LAKE FISHING in the Central Piedmont

Reference 24

Revised Edition

Roger Jones, Fishery Biologist
Division of Boating and Inland Fisheries

September 1985
North Carolina Wildlife Resources Commission



1. Brandt
2. Old Burlington City
3. Cammack
4. Farmer
5. Higgins
6. High Point
7. Holt
8. Hunt
9. Lucas
10. Michael
11. Michie
12. Oak Hollow
13. Quaker Creek
14. Ramseur
15. Reese
16. Reidsville City
17. Rogers
18. Roxboro
19. Siler City
20. Townsend

Figure 1

FOR NORTH CAROLINA CENTRAL REGION

Roger Jones, Fishery Biologist

Division of Inland Fisheries
North Carolina Wildlife Resources Commission
Raleigh, North Carolina

Introduction

Municipal water supply reservoirs are an important water resource in the central Piedmont area of North Carolina. These reservoirs are located in the most densely populated areas of the state and thus receive extensive use which includes sport fishing. The primary purpose of this brochure is to provide the sportsmen of North Carolina with information about fishing in these central Piedmont city lakes. The lakes are found in an 11 county area (see map) that forms the Wildlife Resources Commission's District Five. The Commission has entered into written agreements with several municipalities to develop fish management for each of these lakes. Presently, there are eight lakes under such agreements in this area but fisheries management assistance has been provided upon request by city governments at an additional 12 lakes.

Commission activities being conducted on these water supply reservoirs include fish population surveys, creel surveys, fish stockings, and aquatic vegetation control. The Commission has also cooperated with municipalities to install fish attractors or reefs in many lakes to provide cover for numerous kinds of fish in hopes of improving angler success. Information gathered from these and similar activities over extended periods of time provide the basis for making fishery management decisions including selecting and evaluating size and creel limits and stocking forage and game fish species.

The lakes are listed in alphabetical order and are followed by short paragraphs describing their location, size and fishery. A guide to the facilities available at each lake can be found near the end of this brochure.

Lake Brandt

Lake Brandt, a raw water source for the City of Greensboro, is located north of the city on Reedy Fork Creek with access near the dam off SR 2303 (Guilford Co.). This lake covers 810 surface acres and has been managed by the North Carolina Wildlife Resources Commission (N.C.W.R.C.) under the small lakes program since May 1968. The major game fishes of Lake Brandt are bluegill, crappie and largemouth bass. This lake supports a very good trophy bass fishery and crappie fishing is considered good in the early spring months. Threadfin shad and channel catfish have been stocked over the past few years, the shad providing forage for crappie and largemouth bass while the catfish were stocked to supplement natural reproduction. The lake also supports large populations of white catfish and bullheads, which are under-harvested, and several large carp are caught each spring. Lake Brandt is closed to fishing on Tuesdays during the fishing season and for the entire duck hunting season. Night fishing was started in 1985 for one day a week during the summer months. This should provide additional fishing opportunity especially for catfish and crappie which are commonly active at night.

Old Burlington City Lake

Old City Lake, a primary water supply for the City of Burlington, is located on Stoney Creek near the small community of Hopedale with access off SR 1730 via NC 62 north (Alamance Co.). This lake covers 350 acres and is downstream from Lake Cammack. The old lake supports fair to good bass fishing with the best chances of catching a lunker bass occurring during November and December. Crappie fishing is good with nice stringers caught during the spring months. Bream fishing is excellent with plentiful catches of 8-10 inch sunfish. Striped bass x white bass hybrids are occasionally caught with reports of some fish in excess of 5 pounds. These fish were originally stocked in Lake Cammack and have migrated downstream. Outboard motors are restricted to 10HP on the Old City Lake.

Lake Cammack

Lake Cammack, formerly called Lake Burlington, is a narrow "Y" shaped lake covering 840 acres. The lake serves as a secondary raw water supply for the City of Burlington and has been managed under the small lakes program since December 1967. Cammack is located north of Burlington on Stoney Creek with access at the marina off SR 1002 (Alamance Co.). This lake supports many kinds of fish including the Morone hybrid. Hybrids were stocked in the early 1980s to provide an additional sport fish. According to local anglers, the hybrids are best caught during the fall months and many fish are in the 7-8 pound class. The largemouth bass population is fair with numerous small fish caught in the spring. However, Cammack is noted for its frequent catches of lunker bass (8 pounds and above) during the late fall and winter months. Many of these lunker bass are caught by jigging in the old stream channels. The lake also supports fair to good populations of chain pickerel (jack) and redear sunfish (shellcracker). Jack are caught in the winter months by trolling in the upper portions of the lake. Also, anglers report frequent catches of white bass from Cammack during the early spring months. A zoned fishing area is located upstream in both arms of the lake.

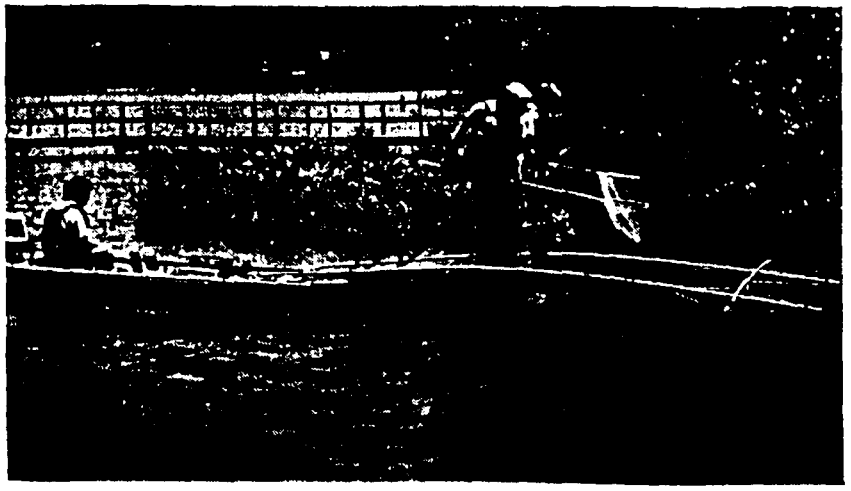
Lake Farmer

Lake Farmer serves as primary source of raw water for the City of Yanceyville and is located on Country Line Creek southwest of the town. Access to the lake is via a new road running west from SR 1156 (Old Hwy. 62) about 3 miles from Yanceyville (Caswell Co.). The lake covers 369 acres and was filled in 1983. The N.C.W.R.C. stocked Lake Farmer in 1984 with largemouth bass, bluegill and redear sunfish. The lake will open to public fishing in 1986 and should provide anglers with excellent fishing.

High Point Lake

High Point Lake, a primary source of raw water for the City of High Point, is an impoundment of the Deep River located in the city with access at the boat dock off US 29-70A (Guilford Co.). The lake covers approximately 356 acres and was placed in the small lakes program in 1968. Dominant game fishes present are bluegill, pumpkinseed, crappie, Morone hybrids and largemouth bass. Many nice stringers of crappie are caught during the spring months. Largemouth bass fishing is considered fair to good with a few lunker bass taken during the early spring months. Hybrid bass fishing is good and the lake held the state record a few years ago. Other species found in the lake are shellcracker, bullheads, robin, pickerel and carp. Several large carp and channel catfish are caught each year. Excellent pier fishing is available for panfishing in the cove adjacent to the marina. The lake has been stocked occasionally with threadfin shad to provide adequate forage for crappie.

Surveys



Electrofishing is one method that fisheries biologists use to sample fish populations

Lake Higgins

Lake Higgins, a secondary raw water source for the City of Greensboro, is located north of the City on Bush Creek (tributary of Reedy Fork Creek) with access off SR 2135 via US 220 north (Guilford Co.) and covers 287 acres. It was placed in the small lakes program in May 1968. Largemouth bass fishing is fair with an occasional lunker taken throughout the year; however, most of the fish caught average around 12 inches in length. Threadfin shad are stocked frequently to provide forage for crappie and largemouth bass. Lake Higgins also has been stocked with channel catfish and Morone hybrids. Hybrids are caught frequently with some fish topping the scales at 10-12 pounds. Nice stringers of 3 to 4-pound channel catfish often are caught during late spring and summer months. The crappie fishing is considered fair to good by local anglers with the best fishing occurring in the spring of the year around brush piles and bridge crossings. Higgins is closed to fishing on Mondays during the fishing season. Pier fishing is available at the lake. Night fishing was started in 1985 for one day a week during the summer months. This should provide excellent fishing opportunity for hybrid bass and catfish species. Fishing licenses are sold at the lake.

Lake Holt

Lake Holt, formerly called Lake Butner, serves as a primary source of raw water for the City of Butner. The lake is located on Knapp of Reeds Creek northwest of the town with access off SR 1004 near the intersection of SR 1103 and SR 1112 (Granville Co.). Lake Holt covers 330 acres and is surrounded mostly by game lands property which provides a scenic background. Ten kinds of fish have been collected in fish samples conducted by the N.C.W.R.C. with bluegill, pumpkinseed, white perch, yellow perch and largemouth bass being numerous. Largemouth bass fishing is considered fair by local anglers with average size around 12-14 inches. Stringers of white perch averaging 8-10 inches are frequently caught in 6-8 feet of water over rocky shoals during the spring months. Channel catfish have been stocked into Lake Holt and are a favorite with many local anglers.

REFERENCE 25

APPROXIMATE SCALE IN FEET

500 0 500

Reference 25

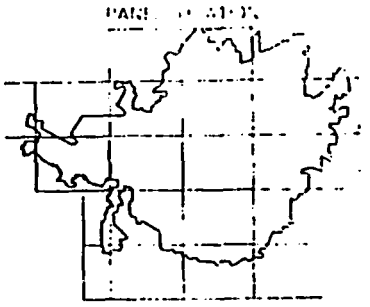
NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

CITY OF
GREENSBORO, NORTH CAROLINA
GUILFORD COUNTY

PANEL 11 OF 23

SEE MAP INDEX FOR PANELS NOT PRINTED



COMMUNITY-PANEL NUMBER

375351 0011 C

MAP REVISED:

SEPTEMBER 30, 1988

Federal Emergency Management Agency

REFERENCE 26

NUS CORPORATION AND S... **TELECON NOTE**

CONTROL NO. F4-8803-58	DATE: May 9, 1988	TIME: 3:00 p.m.

DISTRIBUTION:

Glass, E. H. Co. Landfill
Cone Mills Corp. - White Oak Plant

BETWEEN: Don Grubbs	OF: Guilford Co. Water Dept. Greensboro, N. C.	PHONE: (919) 373-2055

AND: Joan Dupont, NUS Corporation

Joan Dupont 5/9/88

DISCUSSION:

The Guilford County Water Department obtains its water supply from Lake Townsend, Lake Higgins, and Lake Brandt. The county has two raw water lines; water from Lakes Brandt and Higgins is treated at Mitchell and water from Lake Townsend is treated at Townsend. Water from the different lines is probably combined somewhere in the distribution system; Mr. Grubbs said he would have to check pipeline maps to verify this. The water system has approximately 66,000 accounts (i.e., connections).

Inside the city limits of Greensboro, approximately 99.9% of the people are served by the county water system. Water is also provided by the county in its service areas outside the city limits; however, residents outside the city limits are not required to be hooked up to the water and sewer lines. Mr. Grubbs did not know how to find out which residents were not hooked up, other than going through individual account records.

From the dam at Lake Townsend, Guilford County's water service lines go south. Mr. Grubbs was not sure whether areas north of Guilford's service areas (i.e., south of Lakes Townsend and Jeannette) are on wells and septic tanks. Residences along service area boundary lines are served by county water. There are no other water service areas immediately north of Guilford County's water service areas; the next closest water service area to the north is located in Reidsville, in Rockingham County.

Lake Jeannette was formerly called Richland Lake, among other names. It is owned by the Cone Mills Corporation and has been developed by the company as a residential area. The residents are on Guilford County water.

Groundwater wells in the Greensboro area are approximately 150 feet deep or deeper; Mr. Grubbs has a well that is approximately 360 feet deep and supplies good water. He did not know the depth of the water table.

REFERENCE 27

Reference 27

Site Name: Union Oil Southeast Terminal
Site Number: NCD 000 609 974

Site Location: Greensboro, N.C.
Guilford County
Latitude: 36 04 39.0
Longitude: 79 55 24.5

Date: October 21, 1992

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	36	36	18	18
>1/4 to 1/2 mile	190	226	142	160
>1/2 to 1 mile	1,426	1,652	935	1,095
>1 to 2 miles	10,769	12,421	5,668	6,763
>2 to 3 miles	10,543	22,964	4,564	11,327
>3 to 4 miles	21,668	44,632	8,730	20,057

Note: The populations and number of households within specified target distance rings were calculated for the NC Superfund Section by the NC State 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.

REFERENCE 28

Ref. 28

MEMO

DATE: October 16, 1992

TO: File

FROM: Harry Zinn HZ

RE: Employee Count
Union Oil Company, S.E. Terminal
Greensboro, Guilford County, North Carolina
NCD 000 609 974

On October 16, 1992 I talked to Mr. Rob Piatt, (919-299-2611) of Union Oil, Southeast Terminal concerning the number of employees at the facility. Mr. Piatt informed me that there are presently 3 full-time employees. I also asked what the source of water was at the facility. Mr. Piatt said that a well supplied the water, however, bottled water was supplied for drinking since the well cannot be used for this purpose.

HZ\gj

REFERENCE 29

Reference 29

EXPLANATION OF SPECIES STATUS CODES

The attached output from the N.C. Natural Heritage Program database is a listing of the elements (rare species, geologic features, natural communities, special animal habitats) known to occur in your geographic area of interest. Following is an explanation of the four columns of status codes on the righthand side of the printout.

STATE STATUS

Plants:

From Sutter, R.D., L. Mansberg, and J.H. Moore. 1983. Endangered, threatened, and rare plant species of North Carolina: a revised list. ASB Bulletin 30:153-163, and updated lists of the Natural Heritage and Plant Conservation Programs.

E = Endangered
T = Threatened
SC = Special Concern
PP = Primary Proposed
SR = Significantly Rare

E,T,and SC species are protected by state law (the Plant Protection and Conservation Act, 1979); the other two categories indicate rarity and the need for population monitoring, as determined by the Plant Conservation and Natural Heritage Programs.

Animals:

From Cooper, J.E., S.S. Robinson, and J.B. Funderburg (Eds.). 1977. Endangered and Threatened Plants and Animals of North Carolina. N.C. Museum of Natural History, Raleigh, NC. 444 pages + i-xvi, and updated lists of the Natural Heritage Program.

E = Endangered
T = Threatened
SR = Significantly Rare
SC = Special Concern
UNK= Undetermined
EX = Extirpated

FEDERAL STATUS

From Endangered & Threatened Wildlife and Plants, April 10, 1987. 50 CFR 17.11 & 17.12. Department of Interior. Established by the Endangered Species Act of 1973, as amended.

E = Taxa currently listed as Endangered
T = Taxa currently listed as Threatened
PE = Taxa currently proposed for listing as Endangered
PT = Taxa currently proposed for listing as Threatened

Taxa under review for possible listing ("candidate species"):

C1 = Taxa with sufficient information to support listing
C2 = Taxa without sufficient information to support listing

GLOBAL RANK (STATE RANK)

The Nature Conservancy's system of measuring rarity and threat status. "Global" refers to worldwide, "State" to statewide.

G1 = Critically imperiled globally because of extreme rarity or otherwise very vulnerable to exinction throughout its range.

G2 = Imperiled globally because of rarity or otherwise vulnerable to extinction throughout its range.

G3 = Either very rare and local throughout its range, or found locally in a restricted area.

G4 = Apparently secure globally, though it may be quite rare in parts of its range (especially at the periphery).

G5 = Demonstrably secure globally, though it may be quite rare in parts of its range (especially at the periphery).

GU = Possibly in peril but status uncertain; need more information.

GX = Believed to be extinct throughout range.

Q = a suffix attached to the Global Rank indicating questionable taxonomic status.

T_ = an additional status for the subspecies or variety; the G rank then refers only to the species as a whole.

State rank codes follow the same definitions, except substitute the words, "in the state," for "globally" or "throughout its range."

Compact

06/30/89

NORTH CAROLINA NATURAL HERITAGE PROGRAM ELEMENT LIST

scientific and common name	state stat	fed stat	state rank	glob rank
ETHEOSTOMA COLLIS	SC		S3	G3
CAROLINA DARTER				
MEANDER SCARS				
CAMBARUS CATAGIUS	T	C2		G1G3
GREENSBORO BURROWING CRAYFISH				
HESPERIA LEONARDUS	UNK		S2?	G4
LEONARD'S SKIPPER				
DENTARIA MULTIFIDA	SR		S1	G5Q
DIVIDED TOOTHWORT				
EPILOBIUM LEPTOPHYLLUM	PP		S2	G5
NARROWLEAF WILLOWHERB				
NESTRONIA UMBELLULA	T	C2	S3	G3G4
NESTRONIA				

REFERENCE 30

Ref. 30

MEMO

DATE: October 16, 1992

TO: File

FROM: Harry Zinn HZ

RE: Child Day Care Facilities
Union Oil Company, S.E. Terminal
Greensboro, Guilford County, North Carolina
NCD 000 609 974

On October 16, 1992 I reviewed the Alphabetical Listing by County of Child Day Care Operations in Private Homes and Facilities, published by the North Carolina Department of Human Resources, Division of Facility Services on May 17, 1990. No Day Care Centers were listed in the vicinity of the site.

HZ\gj

REFERENCE 31

Ref. 31

MEMO

DATE: October 14, 1992

TO: File

FROM: Harry Zinn HZ

RE: Greensboro Water Supply
Union Oil Company, S.E. Terminal
Greensboro, Guilford County, North Carolina
NCD 000 609 974

On October 14, 1992 I talked to Mr. Richard Hoffman, (919-373-2074) of the Greensboro Department of Public Works, Water and Sewer Department about the expansion of the Greensboro water system since 1989. Mr. Hoffman stated that several of the water mains have been extended on the western side of Greensboro, however, most of the new connections have been made to new subdivisions with only a few of the existing groundwater users in this area being connected to the supply system. Therefore, the map of the Greensboro water supply system, supplied by Mr.Donald Grubbs of the Greensboro Water and Sewer Division in 1989, will be used for the groundwater population count.

HZ\gj

REFERENCE 32

Ref. 32

MEMO

DATE: October 15, 1992

TO: File

FROM: Harry Zinn HZ

RE: Greensboro and High Point Water Supplies
Union Oil Company, S.E. Terminal
Greensboro, Guilford County, North Carolina
NCD 000 609 974

On October 15, 1992 I talked to Mr. Richard Hoffman, (919-373-2074) of the Greensboro Department of Public Works, Water and Sewer Department about the source of water for the Greensboro water system. Mr. Hoffman stated that the Greensboro water system uses surface water supplied by impoundments on the Reedy Fork Creek, Beaver Creek, and Horsepen Creek. All of these intakes are located upstream of either site.

I also talked to Mr. Tom Gore, (919-883-3167) of the High Point Water Department concerning the source of water for the High Point water system. Mr. Gore stated that presently all of the water for their system is withdrawn from High Point Lake, referred to as City Lake. Oak Hollow Lake, located upstream on the Deep River, is used as a supplemental stand-by source. The High Point system currently services 32,500 connections.

HZ\gj

REFERENCE 33

Reference 33

Top

PMMGRID STATE N.C. PUBLIC WATER SUPPLY SYSTEM 10/23/92

ACTIVE SYSTEMS

GRID LATITUDE: 360100 / 360830, LONGITUDE: 795000 / 800000

PWS ID	SYSTEM NAME	TYPE	POPULATION	RES.PERSON WORK PHONE	SOURCE NAME	SOURCE TYPE	SOURCE AVAIL.	LATITUDE	LONGITUDE
~~0241111~~	~~HICKORY RUN MHP~~	~~C~~	~~399~~	~~9192995020~~	~~WELL~~	~~G~~	~~P~~	~~360100~~	~~795400~~
	~~HICKORY RUN MHP~~	~~C~~	~~399~~	~~9192995020~~	~~WELL~~	~~G~~	~~P~~	~~360100~~	~~795400~~
0241116	HIDDEN VALLEY MHP	C	240	9192821151	WELL #1	G	P	360430	795445
	HIDDEN VALLEY MHP	C	240	9192821151	WELL #2	G	P	360430	795440
~~0241188~~	~~GUILFORD SUBSIDIARY I~~	~~C~~	~~200~~	~~9196682714~~	~~WELL~~	~~G~~	~~P~~	~~360400~~	~~800000~~
	~~GUILFORD SUBSIDIARY I~~	~~C~~	~~200~~	~~9196682714~~	~~WELL~~	~~G~~	~~P~~	~~360410~~	~~795930~~
0241193	DON AIRE ACRES	C	112	9196650817	WELL	G	P	360650	795600
~~0241198~~	~~LAUREL ACRES~~	~~C~~	~~25~~	~~9196650817~~	~~WELL #1~~	~~G~~	~~P~~	~~360810~~	~~795930~~
~~0241426~~	~~CROSS OF CHRIST LUTHERAN CH~~	~~N~~	~~125~~	~~9192724770~~	~~WELL~~	~~G~~	~~P~~	~~360650~~	~~795255~~
~~0241428~~	~~GUILFORD COLLEGE METH CH~~	~~N~~	~~600~~	~~9192991832~~	~~WELL~~	~~G~~	~~P~~	~~360611~~	~~795215~~
~~0241429~~	~~JESSUP GROVE BAPTIST CHURCH~~	~~N~~	~~175~~	~~9196680615~~	~~WELL~~	~~G~~	~~P~~	~~360830~~	~~795330~~
~~0241436~~	~~NEWGARDENS FRIEND MEETING~~	~~N~~	~~500~~	~~9192725407~~	~~WELL~~	~~G~~	~~P~~	~~360509~~	~~795010~~
~~0241443~~	~~LUTHERAN CH OF THE RESUR~~	~~N~~	~~100~~	~~9192924904~~	~~WELL~~	~~G~~	~~P~~	~~360515~~	~~795445~~
~~0241446~~	~~FELLOWSHIP PRESBYTERIAN CHURCH~~	~~N~~	~~100~~	~~9192885177~~	~~WELL~~	~~G~~	~~P~~	~~360745~~	~~795130~~
~~0241447~~	~~HICKORY GROVE METH CH~~	~~N~~	~~75~~	~~9192998361~~	~~WELL~~	~~G~~	~~P~~	~~360245~~	~~795530~~
~~0241448~~	~~SEDGEFIELD LAKE METHODIST CH~~	~~N~~	~~35~~		~~WELL~~	~~G~~	~~P~~	~~360215~~	~~795330~~
~~0241455~~	~~MIDWAY BAPTIST CHURCH~~	~~N~~	~~180~~	~~9194542819~~	~~WELL~~	~~G~~	~~P~~	~~360150~~	~~795515~~
~~0241456~~	~~JAMESTOWN PRESBYTERIAN CHURCH~~	~~N~~	~~155~~	~~9194543710~~	~~WELL~~	~~G~~	~~P~~	~~360145~~	~~795530~~
~~0241464~~	~~SEDGEFIELD PRESBYTERIAN CHURCH~~	~~N~~	~~100~~	~~9192994061~~	~~WELL~~	~~G~~	~~P~~	~~360100~~	~~795245~~
~~0241469~~	~~CSC CONCRETE~~	~~P~~	~~70~~	~~9196682742~~	~~WELL~~	~~G~~	~~P~~	~~360600~~	~~800000~~
~~0241481~~	~~SOUTHERN LIFE CLUB~~	~~N~~	~~40~~	~~9192994274~~	~~WELL~~	~~G~~	~~P~~	~~360215~~	~~795545~~
	~~SOUTHERN LIFE CLUB~~	~~N~~	~~45~~	~~9192994274~~	~~WELL~~	~~G~~	~~P~~	~~360215~~	~~795545~~
	~~SOUTHERN LIFE CLUB~~	~~N~~	~~45~~	~~9192994274~~	~~WELL~~	~~G~~	~~P~~	~~360215~~	~~795545~~
~~0241492~~	~~CEDARWOOD SWIMMING POOL~~	~~N~~	~~240~~	~~9194541414~~	~~WELL~~	~~G~~	~~P~~	~~360115~~	~~795600~~
~~0241504~~	~~GUILFORD WILDLIFE CLUB~~	~~N~~	~~50~~	~~9192803856~~	~~WELL~~	~~G~~	~~P~~	~~360800~~	~~795015~~
~~0241505~~	~~TWIN OAKS GOLF COURSE~~	~~N~~	~~75~~	~~9190555270~~	~~WELL~~	~~G~~	~~P~~	~~360215~~	~~795445~~
~~0241508~~	~~DEEP RIVER GOLF COURSE~~	~~N~~	~~25~~	~~9196682101~~	~~WELL~~	~~G~~	~~P~~	~~360430~~	~~795000~~
~~0241511~~	~~LONGVIEW GOLF COURSE~~	~~N~~	~~75~~	~~9192944018~~	~~WELL~~	~~G~~	~~P~~	~~360600~~	~~795430~~
	~~LONGVIEW GOLF COURSE~~	~~N~~	~~75~~	~~9192944018~~	~~WELL~~	~~G~~	~~P~~	~~360641~~	~~795041~~
~~0241510~~	~~SHINING LIGHT BAPT CH~~	~~N~~	~~25~~	~~9192997695~~	~~WELL~~	~~G~~	~~P~~	~~360320~~	~~795450~~
	~~SHINING LIGHT BAPT CH~~	~~N~~	~~25~~	~~9192997695~~	~~WELL~~	~~G~~	~~P~~	~~360542~~	~~795042~~
~~0241547~~	~~BARN DINNER THEATRE~~	~~N~~	~~100~~	~~9192722214~~	~~WELL~~	~~G~~	~~P~~	~~360715~~	~~795505~~
~~0241549~~	~~CH OF JESUS CHRIST LAT DAY ST~~	~~N~~	~~340~~	~~9199938522~~	~~WELL~~	~~G~~	~~P~~	~~360700~~	~~795510~~
~~0241551~~	~~VICKS BAR-B-Q~~	~~N~~	~~25~~	~~9194543313~~	~~WELL~~	~~G~~	~~P~~	~~360155~~	~~795020~~
~~0241550~~	~~BEL AIRE SANDWICH SHOP~~	~~N~~	~~75~~	~~9196687386~~	~~WELL~~	~~G~~	~~P~~	~~360730~~	~~795715~~
~~0241592~~	~~FRIENDSHIP GULF~~	~~N~~	~~150~~		~~WELL~~	~~G~~	~~P~~	~~360350~~	~~795430~~
~~0241624~~	~~SAMP UUHARRIE~~	~~N~~	~~175~~	~~9190522559~~	~~WELL~~	~~G~~	~~P~~	~~360215~~	~~795506~~
~~0241630~~	~~FRIENDLY RD INN~~	~~N~~	~~100~~	~~9192925805~~	~~WELL~~	~~G~~	~~P~~	~~360510~~	~~795430~~
~~0241632~~	~~JAMESTOWN PARK GRILL~~	~~N~~	~~25~~	~~9194544912~~	~~WELL~~	~~G~~	~~P~~	~~360150~~	~~795620~~
~~0241634~~	~~RAINES DI RITE~~	~~N~~	~~25~~	~~9192976120~~	~~WELL~~	~~G~~	~~P~~	~~360440~~	~~795245~~
~~0241644~~	~~GREENSBORO MONTESSORI SCHOOL~~	~~P~~	~~195~~	~~9196690112~~	~~WELL~~	~~G~~	~~P~~	~~360930~~	~~795450~~
~~0241655~~	~~GUILFORD COLLEGE BIBLE CHURCH~~	~~N~~	~~100~~	~~9194547133~~	~~WELL~~	~~G~~	~~P~~	~~360800~~	~~795720~~
~~0241657~~	~~TRIAD CHILD CARE~~	~~P~~	~~25~~	~~9192682223~~	~~WELL~~	~~G~~	~~P~~	~~360735~~	~~795750~~
~~0242121~~	~~HEATHER GLEN S/D~~	~~C~~	~~154~~	~~9192492010~~	~~WELL~~	~~G~~	~~P~~	~~360530~~	~~795740~~
	~~HEATHER GLEN S/D~~	~~C~~	~~154~~	~~9192492010~~	~~WELL~~	~~G~~	~~P~~	~~360535~~	~~795607~~

Guilford Co

Davidson Co?

C = community
P = non-transient non-community
N = non-community

G = ground

permanent

By H.J.Zinn NCDEHNR Superfund Section
10/23/92

Union Oil Southeast Terminal
NCD 000 609 974
Water Supply Population

Domestic Wells

Radius	House Count	Density	Population	Cum. Population
0-1/4	7	2.44	17	17
1/4-1/2	10	2.44	24	41
1/2-1	7	2.44	17	58
1-2	154	2.44	376	434
2-3	383	2.44	935	1369
3-4	524	2.44	1279	2648

Community Wells and Others

Radius	Population	Cum. Population	
0-1/4	17	17	Airport Mobile Home Park
1/4-1/2	0	17	
1/2-1	240	257	PWS ID 0241116
1-2	0	257	
2-3	112	369	PWS ID 0241193
3-4	0	369	

Total Groundwater Population

Radius	Population	Cum. Population
0-1/4	34	34
1/4-1/2	24	58
1/2-1	257	315
1-2	376	691
2-3	1047	1738
3-4	1279	3017

REFERENCE 34

Ref. 34

MEMO

DATE: October 15, 1992

TO: File

FROM: Harry Zinn HZ

RE: Fisheries on the Deep River
Union Oil Company, S.E. Terminal
Greensboro, Guilford County, North Carolina
NCD 000 609 974

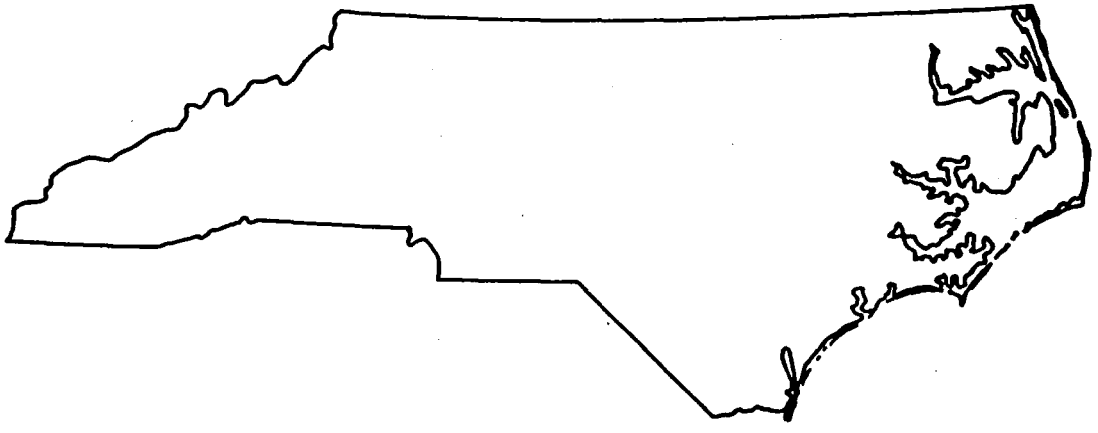
On October 15, 1992 I talked to Ms. Sherri Brunt, (919-449-7625) a Biologist of the North Carolina Wildlife Resources Commission, concerning fishing on the Deep River, High Point Lake, and the tributaries feeding the Deep River in the vicinity of the site. Ms. Brunt stated that no fishing occurs on the unnamed tributary which runs from the site to the East Fork Deep River. Light fishing occurs on the East Fork Deep River as well as on the Deep River itself. High Point Lake is heavily fished for striped bass, largemouth bass, catfish, and crappie.

HZ\gj

REFERENCE 35

Reference 35

Water Resources Data North Carolina Water Year 1988



U.S. GEOLOGICAL SURVEY WATER-DATA REPORT NC-88-1

Prepared in cooperation with the North Carolina Department of Natural Resources and Community Development, and with other State, municipal, and Federal agencies

571-4600

CAPE FEAR RIVER BASIN

02099000 EAST FORK DEEP RIVER NEAR HIGH POINT, NC

LOCATION.--Lat 36°02'15", long 79°56'46", Guilford County, Hydrologic Unit 03030003, on left bank 5 ft upstream from bridge on Secondary Road 1541, 3.3 mi upstream from High Point Dam, and 5.2 mi northeast of High Point College, High Point.

DRAINAGE AREA.--14.8 mi^2.

PERIOD OF RECORD.--July 1928 to current year.

REVISED RECORDS.--WSP 1723: 1929(M). WDR NC-80-1: Drainage area.

GAGE.--Water-stage recorder. Datum of gage is 764.02 ft above National Geodetic Vertical Datum of 1929. Intake pipe extended to downstream side of bridge since Mar. 1, 1934.

REMARKS.--No estimated daily discharges. Records good. Slight diurnal fluctuation at low flow during growing season. Maximum discharge, 6,300 ft^3/s, gage height, 10.87 ft, from floodmark, from rating curve extended above 1,600 ft^3/s on basis of contracted-opening measurement of peak flow. Maximum discharge, 496 ft^3/s, also occurred June 18, 1988. Mimimum discharge, 0.6 ft^3/s, result of temporary regulation. Minimum unregulated, 1.0 ft^3/s, Aug. 8, 1977.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988, DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4.0	4.7	8.4	14	11	7.9	8.7	6.2	4.7	3.1	3.3	4.6
2	3.5	5.2	7.5	22	10	7.7	8.6	6.1	4.5	2.7	3.2	4.2
3	3.3	8.8	7.1	28	13	7.8	8.4	6.0	9.7	2.6	3.1	3.6
4	3.2	8.0	6.4	51	85	8.0	14	18	5.5	2.5	3.4	13
5	3.2	7.9	5.9	26	29	7.9	9.5	22	4.6	2.6	3.8	17
6	3.6	7.7	5.6	15	17	7.5	10	11	4.4	2.3	3.0	5.1
7	4.5	7.7	5.5	10	14	7.7	14	9.0	4.1	2.2	3.0	4.0
8	8.4	7.7	5.5	15	13	7.7	11	7.8	4.0	18	2.8	3.3
9	8.1	8.3	5.5	12	12	11	9.0	7.8	22	10	2.8	44
10	3.4	34	36	11	12	15	8.1	27	11	15	2.7	29
11	3.4	21	35	10	11	11	7.7	10	5.9	10	3.0	7.0
12	3.3	8.7	14	10	12	9.1	16	7.5	5.4	4.9	3.3	5.7
13	3.5	6.8	9.8	14	10	12	11	6.7	4.8	5.2	2.6	5.0
14	3.6	6.4	9.0	14	9.2	9.3	8.7	6.2	4.2	5.1	2.5	4.6
15	3.8	5.9	39	11	11	8.3	8.1	9.7	3.8	3.4	2.5	7.5
16	3.8	5.4	21	10	15	7.8	8.1	30	3.8	3.7	2.4	3.9
17	3.8	6.9	12	13	10	7.7	7.3	103	5.9	3.0	2.3	19
18	3.7	7.4	9.9	50	9.5	9.8	8.5	48	73	2.8	2.1	14
19	3.8	5.6	8.9	49	13	22	46	15	7.4	2.5	2.0	6.8
20	3.8	5.5	8.5	109	13	11	18	11	7.7	2.6	3.1	5.9
21	3.9	5.1	8.5	36	11	10	12	8.7	7.6	45	4.2	4.9
22	3.9	4.8	8.8	21	9.4	8.9	10	7.7	5.3	52	18	3.9
23	4.1	4.8	7.6	16	9.2	8.7	9.4	17	4.9	45	4.6	3.7
24	4.1	4.8	7.1	14	10	8.7	8.8	24	4.9	12	3.9	3.5
25	4.2	4.8	18	20	8.8	11	7.6	9.3	4.3	11	3.0	3.9
26	4.3	5.1	11	18	8.5	25	7.3	7.5	3.9	9.3	2.6	3.7
27	12	31	22	13	8.5	16	7.5	6.9	4.4	5.9	2.4	3.7
28	6.9	13	44	11	8.2	12	11	6.1	3.2	5.8	2.6	3.5
29	4.8	20	25	11	8.0	11	7.2	5.6	3.1	4.5	68	3.4
30	4.3	11	14	11	---	9.8	6.7	5.4	3.3	3.7	28	3.6
31	4.2	---	12	10	---	9.2	---	5.2	---	3.5	5.8	---
MEAN	4.46	9.47	14.1	21.8	14.2	10.5	10.9	15.2	8.04	9.74	6.45	8.17
MAX	12	34	44	109	85	25	46	103	73	52	68	44
MIN	3.2	4.7	5.5	10	8.0	7.5	6.7	5.2	3.1	2.2	2.0	3.3
IN.	.35	.71	1.10	1.70	1.03	.82	.82	1.18	.61	.76	.50	.62

STATISTICS OF MONTHLY FLOW DATA FOR PERIOD OF RECORD, BY WATER YEAR (WY)

MEAN	11.0	11.3	16.4	22.9	27.5	24.8	19.2	14.4	12.4	13.2	12.3	12.7
MAX	79.5	39.2	48.5	82.9	83.0	106.3	71.6	58.8	61.5	97.5	55.9	88.9
(WY)	1960	1980	1933	1978	1979	1975	1987	1978	1969	1975	1949	1979
MIN	1.88	2.35	3.53	4.32	6.48	6.76	5.52	4.57	3.41	2.93	2.87	1.74
(WY)	1942	1942	1942	1942	1931	1967	1942	1941	1986	1977	1941	1954

SUMMARY STATISTICS	FOR 1988 WATER YEAR		FOR PERIOD OF RECORD	
AVERAGE FLOW	11.1		16.5	
HIGHEST ANNUAL MEAN			34.1	1978
LOWEST ANNUAL MEAN			7.28	1967
HIGHEST DAILY MEAN	109	Jan 20	1670	Sep 24 1947
LOWEST DAILY MEAN	2.0	Aug 19	1.1	Aug 8 1977
INSTANTANEOUS PEAK FLOW	496*	May 17	6300*	Sep 24 1947
INSTANTANEOUS PEAK STAGE	2.77	May 17	10.87*	Sep 24 1947
INSTANTANEOUS LOW FLOW	1.2	Aug 24	0.6*	Jan 17 1981
ANNUAL RUNOFF (INCHES)	10.2		15.1	
10 PERCENTILE	22		26	
50 PERCENTILE	8.0		6.8	
95 PERCENTILE	2.5		2.6	

* See REMARKS.

CAPE FEAR RIVER BASIN

02099500 DEEP RIVER NEAR RANDLEMAN, NC

LOCATION.--Lat 35°54'06", long 79°51'05", Randolph County, Hydrologic Unit 03030003, on left bank 500 ft downstream from bridge on Secondary Road 1929, 0.2 mi downstream from Coltrane's Mill, 0.5 mi south of Guilford County line, 4.8 mi upstream from Muddy Creek, and 7 mi north of Randleman.

DRAINAGE AREA.--125 mi^2.

PERIOD OF RECORD.--October 1928 to current year.

REVISED RECORDS.--WSP 782: 1929-30. WSP 1383: 1934-35, 1941. WSP 1723: 1929(M). WDR NC-81-1: Drainage area.

GAGE.--Water-stage recorder. Datum of gage is 638.11 ft above National Geodetic Vertical Datum of 1929 (levels by U. S. Army Corps of Engineers).

REMARKS.--No estimated daily discharges. Records good. Large diurnal fluctuation at times at low flow caused by Coltrane's mill. Some regulation by Oak Hollow Reservoir and High Point Lake (stations 02098495, 02099096). City of High Point diverted an average of 16.9 ft^3/s for municipal water supply during water year; 15.7 ft^3/s was discharged as treated effluent into Richland Creek above station and 6.1 ft^3/s into Rich Fork Creek in Pee Dee River basin. Maximum discharge, 20,000 ft^3/s, gage height, 32.2 ft, from floodmark, from rating curve extended above 7,100 ft^3/s on basis of contracted-opening measurement of peak flow at bridge 1.5 mi upstream.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988, DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	27	21	94	70	72	43	48	37	25	19	20	31
2	21	19	91	142	70	40	44	35	23	13	15	22
3	19	25	87	145	82	41	47	31	26	11	16	19
4	18	20	87	315	438	41	73	62	25	12	16	11
5	18	18	52	226	320	42	79	158	21	13	16	44
6	22	53	38	111	177	40	58	95	19	14	16	29
7	57	74	38	74	116	39	77	61	20	13	15	21
8	25	77	39	82	97	41	86	48	19	14	14	19
9	22	49	24	73	86	42	58	39	48	50	14	58
10	19	147	161	61	76	86	48	62	94	22	15	249
11	17	273	206	55	70	80	46	94	38	333	15	91
12	22	113	92	52	82	57	73	51	26	108	16	49
13	18	86	58	61	74	62	99	39	18	133	16	34
14	23	81	48	84	59	63	60	33	12	95	15	22
15	19	80	369	60	58	52	51	38	17	69	14	23
16	24	47	265	51	85	46	51	76	19	31	14	22
17	19	33	142	54	70	39	47	366	19	24	13	33
18	20	44	112	264	61	42	45	720	20	21	13	76
19	20	30	58	318	68	101	254	197	20	21	15	58
20	19	22	45	865	101	83	215	113	27	25	38	41
21	16	40	42	459	78	67	111	69	90	68	54	31
22	21	74	58	233	63	50	78	53	29	205	24	42
23	21	77	46	151	57	46	60	46	27	83	11	40
24	20	47	40	115	58	45	55	179	17	117	19	26
25	20	33	76	160	54	46	52	84	19	54	16	49
26	19	25	71	205	49	143	46	52	25	42	16	26
27	43	209	91	117	46	144	43	42	92	28	15	17
28	48	117	442	89	47	84	63	26	32	21	14	19
29	24	109	269	79	44	63	53	31	21	18	307	18
30	21	83	110	74	---	56	46	24	21	82	60	16
31	20	---	77	72	---	53	---	25	---	24	42	---
MEAN	23.3	70.9	111	159	95.1	60.5	72.2	96.3	30.3	57.5	29.2	41.2
MAX	57	273	442	865	438	144	254	720	94	333	307	249
MIN	16	18	24	51	44	39	43	24	12	11	11	11
IN.	.21	.63	1.02	1.46	.82	.56	.64	.89	.27	.53	.27	.37

STATISTICS OF MONTHLY FLOW DATA FOR PERIOD OF RECORD, BY WATER YEAR (WY)

MEAN	68.1	78.6	127.5	194.5	230.9	215.7	164.6	102.9	78.5	84.9	77.1	76.4
MAX	458.5	354.1	389.2	644.9	584.2	697.2	528.5	444.9	351.0	465.1	310.7	542.8
(WY)	1960	1986	1933	1937	1960	1975	1936	1978	1982	1975	1949	1947
MIN	5.78	9.56	16.8	15.8	38.6	54.4	27.6	23.5	16.7	17.2	17.1	10.5
(WY)	1931	1932	1934	1942	1986	1967	1985	1977	1933	1947	1945	1941

SUMMARY STATISTICS	FOR 1988 WATER YEAR		FOR PERIOD OF RECORD	
AVERAGE FLOW	70.5		124.5	
HIGHEST ANNUAL MEAN			229.9	1978
LOWEST ANNUAL MEAN			45.9	1967
HIGHEST DAILY MEAN	865	Jan 20	12000	Sep 25 1947
LOWEST DAILY MEAN	11	Jul 3	1.2	Nov 12 1933
INSTANTANEOUS PEAK FLOW	1440	May 17	20000*	Sep 25 1947
INSTANTANEOUS PEAK STAGE	8.61	May 17	32.2*	Sep 25 1947
INSTANTANEOUS LOW FLOW	4.3	Nov 26	0.5	Nov 28 1931
ANNUAL RUNOFF (INCHES)	7.66		13.5	
10 PERCENTILE	143		238	
50 PERCENTILE	47		51	
95 PERCENTILE	15		12	

* See REMARKS.

REFERENCE 36

Reference 36

Hydric Soils of North Carolina

United States Department of Agriculture
Soil Conservation Service
Raleigh, North Carolina

October, 1989

(THE "HYDRIC CRITERIA NUMBER" COLUMN INDICATES WHAT CAUSED THE SOIL TO BE INCLUDED IN THE HYDRIC LIST. SEE THE "CRITERIA FOR HYDRIC SOILS" TO DETERMINE THE MEANING OF THIS COLUMN.)

SERIES AND SUBGROUP	TEMPER-ATURE	DRAIN-AGE CLASS	HIGH WATER TABLE DEPTH	HIGH WATER TABLE MONTHS	PERM. WITHIN 20 INCHES	FLOODING FREQUENCY	FLOODING DURATION	FLOODING MONTHS	HYDRIC CRI-TERIA NUMBER	CAPABILITY CRITICAL PHASE CRITERIA	CAPABILITY CLASS AND SUB-CLASS
TREBLOC (MS0086)	THERMIC	P	0.5-1.0	JAN-APR	<6.0	NONE-COMMON	V.BRIEF	JAN-APR	2B2	NONE,RARE,OCCAS	3W
TYPIC PALEAQUULTS										FREQ	5W
TUCKERMAN (AR0061)	THERMIC	P	0.5-1.5	DEC-APR	<6.0	NONE-COMMON	V.BRIEF-LONG	DEC-APR	2B2,4	0-1% RARE	3W
TYPIC OCHRAQUALFS										1-3% RARE	3W
										FREQ,V.BRIEF, BRIEF,OCCAS	4W
UNA (MS0021)	THERMIC	P	0.5-1.0	NOV-APR	<6.0	COMMON	BRIEF-LONG	JAN-MAR	2B2,4	OCCAS	3W
TYPIC HAPLAQUEPTS										FREQ	4W
UNA, PONDED (MS0116)	THERMIC	P	+2 -0.5	JAN-DEC	<6.0	FREQUENT	V.LONG	JAN-DEC	2B2,3, 4	ALL	7W
TYPIC HAPLAQUEPTS											
WASDA (NC0007)	THERMIC	VP	0 -1.0	NOV-MAY	<6.0	NONE-RARE			2B2	UNDRAINED	6W
HISTIC HUMAQUEPTS										DRAINED	3W
WEEKSVILLE (NC0004)	THERMIC	VP	0 -1.0	DEC-MAR	<6.0	NONE-RARE			2B2	DRAINED	3W
TYPIC HUMAQUEPTS										UNDRAINED	6W
WEHADKEE (NC0052)	THERMIC	P	0 -1.0	NOV-MAY	<6.0	COMMON	BRIEF	NOV-JUN	2B2	DRAINED	4W
TYPIC FLUVAQUENTS										UNDRAINED	6W
WESTON (AR0062)	THERMIC	P	0.5-1.5	DEC-APR	<6.0	NONE			2B2	ALL	3W
TYPIC OCHRAQUULTS											
WILBANKS (NC0101)	THERMIC	VP	0 -1.0	NOV-MAY	<6.0	FREQUENT	BRIEF	NOV-MAR	2B2	DRAINED	4W
CUMULIC HUMAQUEPTS										UNDRAINED	6W

REFERENCE 37

Reference 37

SOIL SURVEY OF

Guilford County, North Carolina

United States Department of Agriculture
Soil Conservation Service

In cooperation with

Board of Commissioners, Guilford County, North Carolina, and
North Carolina Agricultural Experiment Station

t—35 to 40 inches; brownish yellow (10YR 6/8) clay loam; few fine distinct red mottles; weak medium angular blocky structure; firm, sticky and plastic; few thin faint patchy clay films on faces of peds; many medium white (10YR 8/1) weathered fragments of rock; very strongly acid; gradual wavy boundary.

1—40 to 50 inches; mottled brownish yellow (10YR 6/8), white (10YR 8/1), and red (2.5YR 4/8) clay loam; massive; firm, slightly sticky and slightly plastic; common medium white weathered fragments of rock; 85 percent saprolite; very strongly acid; gradual wavy boundary.

2—50 to 72 inches; mottled brownish yellow (10YR 6/8), red (2.5YR 4/8), and white (10YR 8/1) clay loam; massive; friable; 90 percent saprolite; very strongly acid.

The solum ranges from 24 to 48 inches in thickness. Depth to bedrock more than 60 inches.

The Ap horizon is brown or yellowish brown sandy loam or fine sandy loam.

The B2t horizon is yellowish red, strong brown, or yellowish brown lay or sandy clay. The B3 horizon is yellowish red, strong brown, or rownish yellow clay loam or sandy clay loam. The B horizon is strongly acid or very strongly acid.

The C horizon is sandy loam, sandy clay loam, or clay loam.

Vehadkee Series

The Wehadkee series consists of poorly drained, moderately permeable soils that formed in alluvium derived from schist, gneiss, granite, phyllite, and other metamorphic and igneous rocks. These soils are on stream flood plains. Slopes are 0 to 1 percent.

Typical pedon of Wehadkee silt loam approximately 3.5 miles southwest of Kimesville on State Road 3343, 200 feet north of State Road 3343, and 155 feet west of Stinking Quarter Creek:

Ap—0 to 8 inches; brown (10YR 5/3) silt loam; few fine distinct yellowish red mottles; weak medium granular structure; very friable; many fine roots; few fine flakes of mica; medium acid; clear wavy boundary.

B21g—8 to 12 inches; grayish brown (10YR 5/2) silt loam; common fine distinct yellowish red mottles; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; many fine and few medium roots; few fine flakes of mica; medium acid; clear wavy boundary.

B22g—12 to 16 inches; light brownish gray (10YR 6/2) silt loam; few fine distinct dark brown mottles; weak medium subangular blocky structure; friable; few medium roots and root channels; few fine flakes of mica; medium acid; gradual wavy boundary.

B23g—16 to 20 inches; gray (10YR 6/10) silty clay loam; few fine distinct dark brown mottles; weak medium subangular blocky structure; friable, slightly sticky slightly plastic; few fine flakes of mica; medium acid; gradual wavy boundary.

B24g—20 to 48 inches; gray (10YR 5/1) loam; few fine distinct brownish yellow mottles; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; few fine flakes of mica; slightly acid; gradual wavy boundary.

Cg—48 to 80 inches; gray (10YR 6/1) loam; few fine distinct yellowish brown mottles; massive; friable; common fine and medium white soft fragments; few fine flakes of mica; slightly acid.

The solum ranges from 30 to 60 inches in thickness. Depth to bedrock is more than 60 inches. Few to many fine flakes of mica occur throughout the profile.

The A horizon is gray, dark grayish brown, grayish brown, or brown silt loam or fine sandy loam.

The B2 horizon is gray, grayish brown, or light brownish gray loam, silt loam, sandy clay loam, or silty clay loam. The B horizon is medium acid to neutral.

The C horizon is sandy loam or sand, commonly mixed with gravel.

Wilkes Series

The Wilkes series consists of well drained, moderately slowly permeable soils that formed in residuum weathered from diorite, hornblende schist, and related rocks that are moderately high in content of ferromagnesian minerals or that formed in a mixture of acidic and basic rocks. These soils are on side slopes that generally border drainageways. Slopes are 6 to 45 percent.

Typical pedon of Wilkes sandy loam, 6 to 10 percent slopes, approximately 3 miles east of High Point on State Road 1141, between Register Creek and Deep River, and 30 feet east of State Road 1141 and 30 feet southeast of power pole:

Ap—0 to 7 inches; dark brown (10YR 4/3) sandy loam; weak medium granular structure; very friable; many fine roots; few fine pores; common small gravel; slightly acid; clear smooth boundary.

B1—7 to 11 inches; brownish yellow (10YR 6/6) sandy loam; few small pockets of sandy clay loam; few fine distinct strong brown mottles; weak medium subangular blocky structure; friable; few fine and medium roots; few fine pores; common small gravel; medium acid; clear wavy boundary.

B2t—11 to 18 inches; yellowish brown (10YR 5/6) clay loam; moderate medium angular blocky structure; firm, sticky and plastic; few medium roots and root channels; few fine pores; common thin distinct discontinuous clay films on faces of peds; medium acid; clear wavy boundary.

C1—18 to 26 inches; yellowish brown (10YR 5/8) clay loam; massive; friable; many fine and medium white and black weathered fragments of rock; 85 percent saprolite; medium acid; clear wavy boundary.

C2—26 to 52 inches; yellowish brown (10YR 5/6) loamy coarse sand; massive; very friable; 90 percent saprolite; slightly acid.

The solum ranges from 10 to 20 inches in thickness. Depth to bedrock is 40 to 80 inches.

The A horizon is dark brown, yellowish brown, dark grayish brown, pale brown, and grayish brown sandy loam or loam.

The B1 horizon, if present, is strong brown or brownish yellow sandy loam, sandy clay loam, or loam. The B2t horizon is brownish yellow, light olive brown, or yellowish brown clay, clay loam, or sandy clay loam. The B3 horizon, if present, is olive brown or strong brown sandy clay loam or clay loam. Reaction is medium acid to neutral.

The C horizon is sandy loam or coarse loamy sand.

Classification

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to the latest literature available (*5, 6*).

The system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the bases for classification are the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 17 the soils of the survey area are classified according to the system. Classes of the system are briefly discussed in the following paragraphs.

trial areas. Slope, runoff, erosion, and slow permeability are the main limitations in the use and management of this soil.

This soil has moderate potential for tobacco, corn, soybeans, and small grain. Minimum tillage and crop residue management help to control runoff and erosion. Conservation practices such as maintaining sod in drainageways, constructing terraces and diversions, stripcropping, establishing field borders, contour farming, and using crop rotations that include close-growing crops also help to conserve soil and water. The potential for hay and pasture plants such as ladino clover, red clover, fescue, and sericea lespedeza is moderately high. Proper pasture management helps to ensure adequate protective cover, which reduces runoff and controls erosion.

The potential for most urban uses is low because of slow permeability and low strength. The potential is moderate for recreation areas because of slow permeability.

This soil has moderately high potential for broadleaf and needleleaf trees. The dominant trees are white oak, black oak, post oak, northern red oak, southern red oak, blackjack oak, cedar, maple, hickory, loblolly pine, shortleaf pine, and Virginia pine. The main understory species are dogwood, holly, and sassafras. There are no major limitations in the use and management of this soil for woodland. Capability unit IVe-3; woodland group 3o.

VaD—Vance sandy loam, 10 to 15 percent slopes. This well drained soil is on narrow side slopes on uplands. The mapped areas are 3 to 10 acres or more in size.

Typically, the surface layer is brown sandy loam about 6 inches thick. The subsoil is 34 inches thick; the upper part is mottled strong brown clay, and the lower part is mottled brownish yellow clay loam. The underlying material, to a depth of 72 inches, is mottled brownish yellow, white, and red clay loam.

Included with this soil in mapping are a few small areas of soils that have a clay loam surface layer. Also included are a few small areas of Appling, Cecil, and Enon soils.

The organic-matter content of the surface layer is low. Permeability is slow, available water capacity is low, and the shrink-swell potential is moderate. Reaction of the subsoil is strongly acid or very strongly acid. Depth to bedrock is more than 60 inches. The seasonal high water table is at a depth of more than 6 feet.

Most areas of the soil are forested. The rest are in pasture. Slope, runoff, erosion, and slow permeability are the main limitations in the use and management of this soil.

This soil has low potential for crops because of slope and erosion. It has low potential for hay and pasture plants. Proper pasture management helps to ensure adequate protective cover, which reduces runoff and controls erosion.

The potential for most urban and recreation uses is low because of slow permeability.

This soil has a moderately high potential for broadleaf and needleleaf trees. The dominant trees are white oak, black oak, post oak, northern red oak, southern red oak, blackjack oak, cedar, maple, hickory, loblolly pine, shortleaf pine, and Virginia pine. The main understory species are dogwood, holly, and sassafras. There are no major limitations in the use and management of this soil for woodland. Capability unit IVe-3; woodland group 3o.

VuB—Vance-Urban land complex, 2 to 10 percent slopes. This complex consists of areas of Vance soils and Urban land so small or so intricately mixed that it was not practical to map them separately. The complex consists of about 40 to 60 percent Vance soils and about 30 to 50 percent Urban land.

Vance soils are well drained and are on side slopes on the uplands. Typically, the surface layer is brown sandy loam about 6 inches thick. The subsoil is 34 inches thick; the upper part is mottled strong brown clay, and the lower part is mottled brownish yellow clay loam. The underlying material, to a depth of 72 inches, is mottled brownish yellow, white, and red clay loam.

Urban land consists of areas where the original soil has been cut, filled, graded, paved, or otherwise changed to the extent that most soil properties have been so altered that a soil series is not recognized. These areas are used for shopping centers, factories, municipal buildings, apartment complexes, parking lots, or other uses where buildings are closely spaced or the soil is covered with pavement. Slope is generally modified to fit the needs of the site. The extent of site modification varies greatly. Many areas have had little disturbance, and many areas have been cut or filled.

Included in mapping are a few areas of Appling and Cecil soils.

Determination of use and management of these areas generally requires onsite investigation. Not placed in interpretive groups.

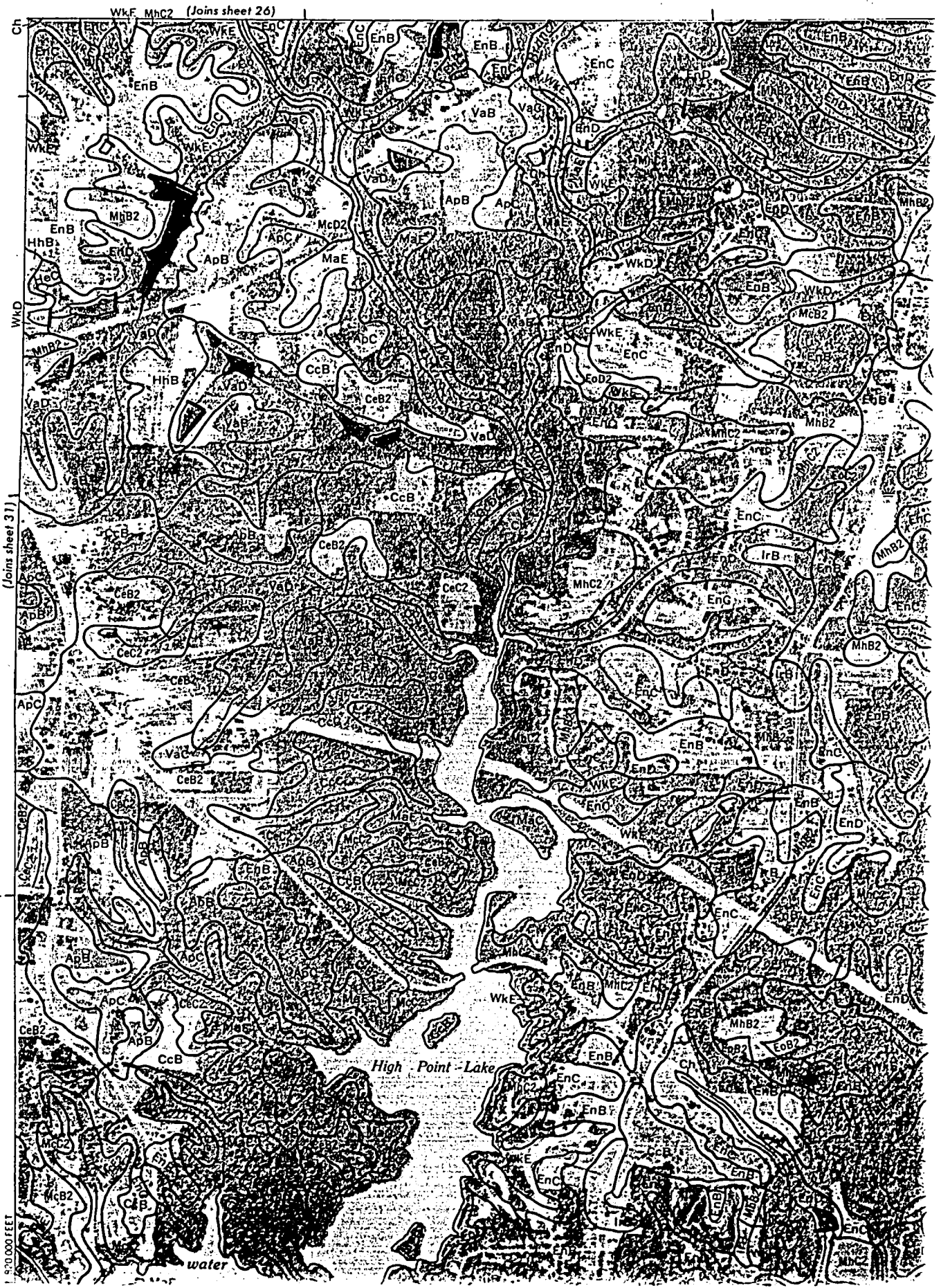
Wh—Wehadkee silt loam. This nearly level, poorly drained soil is on broad flood plains along creeks and streams. The mapped areas are 4 to 50 acres or more in size.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is 40 inches thick; the upper part is mottled grayish brown silt loam, the middle part is mottled light brownish gray silt loam, and the lower part is mottled gray silty clay loam and mottled gray loam. The underlying material, to a depth of 80 inches, is mottled gray loam.

Included with this soil in mapping are a few small areas of soils that have a loam or fine sandy loam surface layer. Also included are a few small areas of Chewacla soils.

The organic-matter content of the surface layer is medium. Permeability is moderate, available water capacity is medium, and the shrink-swell potential is low. Reaction of the subsoil is medium acid to neutral. Depth to bedrock is more than 60 inches. The seasonal high water table is at or near the surface. This soil is frequently flooded for brief periods.

Most areas of this soil are forested. The rest are dominantly in pasture. Wetness and flooding are the main limitations in the use and management of this soil.


N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 26)
(Joins sheet 31)
High Point Lake
water

REFERENCE 38

Ref. 38

MEMO

DATE: October 14, 1992

TO: File

FROM: Harry Zinn HZ

RE: Natural Heritage Program Visit
Union Oil Company, S.E. Terminal
Greensboro, Guilford County, North Carolina
NCD 000 609 974

On October 14, 1992 I went to the Natural Heritage program office to investigate the possible location(s) of threatened or endangered species in the vicinity of the site. No threatened or endangered species were listed in this area.

REFERENCE 39

Reference 39

MEMORANDUM

To: Superfund Section Staff

From: Hal Bryson HB

Date: August 17, 1992

Subject: Update on Status of Well Head Protection Programs in N.C.

Carl Bailey of the DEM's Groundwater Section has provided me with the following information regarding the establishment of Well Head Protection Areas (WHPAs) in North Carolina:

- Currently there are no WHPAs in North Carolina.

- A number of local governments in the state have been funded by EPA "demonstration grants" to initiate the development of local Well Head Protection Programs; however, the formal designation of WHPAs can not be initiated until the Groundwater Section has a program approved by EPA -- such approval would grant authority to the DEM to formally establish WHPAs in local areas.

- Formal approval by EPA of the Groundwater Section's WHPA Program is expected within 12 to 18 months.

- Counties currently attempting to develop local WHPA programs include Bladen, Buncombe, Columbus, Gaston, Lee, Moore, Randolph, Robeson, Scotland, and Stokes.

The Superfund Section should contact Mr. Bailey in another year or so to update this information.

HCB\whpamem

APPENDIX A
ANALYTICAL DATA

Sampling was performed by NUS Corporation on June 12 and 13, 1991. The samples were analyzed, however, no record of the results are in the files received by the North Carolina, Superfund Section. A data validation package is in the file.

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-TB-01
SAMPLE LOCATION:
TRIP BLANK #01

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 0700 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC 63	4-50946
2	40ML VIAL GLASS	VOA		DBC 63	~~4-~~47,48
1	1 Liter Polypropylene	METALS		MDBF	~~4-~~49
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-TB-01S
SAMPLE LOCATION:
TRIP BLANK #01S

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-12-91 TIME: 0700 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC 64	4- 50862
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO- PB 01
SAMPLE LOCATION:
PRESERVATIVE BLANK
01

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS
2) RON YOUNG
3) LARRY GRIER
4) SCOTT SINGLETON
5)
6)
7)
8)

DATE SAMPLED: 6-12-91 TIME: 0700 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC ~~63~~	4-
2	40ML VIAL GLASS	VOA		DBC ~~63~~	4-
1	1 Liter Polypropylene	METALS		MDBF 63	4-50949
1	1 Liter Polypropylene	CYANIDE		MDBF 63	~~4-~~ 50

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-MW-15
SAMPLE LOCATION:
MONITORING WELL #15

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 1245 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC 31	4-50863
2	40ML VIAL GLASS	VOA		DBC 31	~~4-~~64, 65
1	1 Liter Polypropylene	METALS		MDBF 31	~~4-~~66
1	1 Liter Polypropylene	CYANIDE		MDBF 31	~~4-~~67

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS: H_2O BLANK

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO- MW 14
SAMPLE LOCATION:
MONITORING WELL 14

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 1300 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC 32	4-50868
2	40ML VIAL GLASS	VOA		DBC 32	~~4-~~69,70
1	1 Liter Polypropylene	METALS		MDBF 32	~~4-~~71
1	1 Liter Polypropylene	CYANIDE		MDBF 32	4-72

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS: H20 SPIKE

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-MW-07
SAMPLE LOCATION: MONITORING WELL #07

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 1320 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF 33	4-50873
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS: ICS

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-MW-08
SAMPLE LOCATION: MONITORING WELL #08

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 0845 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.	X0291013	DBC 51	4-50951,52
2	40ML VIAL GLASS	VOA	B0255033	DBC 51	4-53,54,55,56
1	1 Liter Polypropylene	METALS	~~X0291013~~ LB	MDBF 51	4-57,58
1	1 Liter Polypropylene	CYANIDE	~~X0291013~~ LB	MDBF 51	4-59,60
			X0158013		
			X0158013		

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS: MATRIX DUPLICATE

TIME:				
COND.(μmhos/cm):	2,50	X10		
pH:	5,37			
TEMP.:	72			

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SD-02
SAMPLE LOCATION: SEDIMENT #02

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LD 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 1335 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC 34	4-50874
1	4 OZ., GLASS	VOA		DBC 34	~~4-~~ 75~~1~~76
1	8 OZ., GLASS	METAL/CYANIDE		MDBF 34	~~4-~~ 76 LD 75

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS: SOIL BLANK

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SD-01
SAMPLE LOCATION:
SEDIMENT #01

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-~~16~~ 13 -91 TIME: 1000 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0164023	DBC 50	4-50943
1	4 OZ., GLASS	VOA	W0229013	DBC 50	4-~~45~~ 44
1	8 OZ., GLASS	METAL/CYANIDE	0164023	MDBF 50	4- 45

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SS-01
SAMPLE LOCATION: SURFACE SOIL #01

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LD 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-12-91 TIME: 1445 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0164023	DBC 36	4-50901
1	4 OZ., GLASS	VOA	W0229013	DBC 36	4-02
1	8 OZ., GLASS	METAL/CYANIDE	0164023	MDBF 36	4-03

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SS-02
SAMPLE LOCATION:
SURFACE SOIL #02

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-12-91 TIME: 1510 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0164023	DBC 38	4-50907
1	4 OZ., GLASS	VOA	W0229013	DBC 38	4-08
1	8 OZ., GLASS	METAL/CYANIDE	0164023	MDBF 38	4-09

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SS-03
SAMPLE LOCATION:
SURFACE SOIL #03

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LB 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-12-91 TIME: 1525 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0164023	DBC 40	4-50913
1	4 OZ., GLASS	VOA	WO229013	DBC 40	4-14
1	8 OZ., GLASS	METAL/CYANIDE	0164023	MDBF 40	4-15

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SS-04
SAMPLE LOCATION:
SURFACE SOIL #04

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-12-91 TIME: 1545 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0164023	DBC 43	4-50922
1	4 OZ., GLASS	VOA	W0229013	DBC 43	4-23
1	8 OZ., GLASS	METAL/CYANIDE	0164023	MDBF 43	4-24

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SS-05
SAMPLE LOCATION:
SURFACE SOIL #05

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS
2) RON YOUNG
3) LARRY GRIER YB
4) SCOTT SINGLETON
5)
6)
7)
8)

DATE SAMPLED: 6-13-91 TIME: 0825 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0164023	DBC 44	4-50925
1	4 OZ., GLASS	VOA	W0229013	DBC 44	4-26
1	8 OZ., GLASS	METAL/CYANIDE	0164023	MDBF 44	4-27

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SS-06
SAMPLE LOCATION:
SURFACE SOIL #06

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 1225 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0164023	DBC 46	4-50931
1	4 OZ., GLASS	VOA	W0229013	DBC 46	4-32
1	8 OZ., GLASS	METAL/CYANIDE	0164023	MDBF 46	4-33

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SS-07
SAMPLE LOCATION:
SURFACE SOIL #07

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6- -91 TIME: 1200 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0163023	DBC 48	4-450937
1	4 OZ., GLASS	VOA	W0229013	DBC 48	4-38
1	8 OZ., GLASS	METAL/CYANIDE	0163023	MDBF 48	4-39

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SS-08
SAMPLE LOCATION: SURFACE SOIL #08

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13 -91 TIME: 1140 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0163023	DBC 61	4-50856
1	4 OZ., GLASS	VOA	W0229013	DBC 61	4-57
1	8 OZ., GLASS	METAL/CYANIDE	0163023	MDBF 61	4-58

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SB-01
SAMPLE LOCATION:
SUBSURFACE SOIL #01

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LB 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-12-91 TIME: 1455 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0164023	DBC 37	4-50904
1	4 OZ., GLASS	VOA	W0229013	DBC 37	4-05
1	8 OZ., GLASS	METAL/CYANIDE	0164023	MDBF 37	4-06

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:
MATRIX DUPLICATE

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SB-02
SAMPLE LOCATION:
SUBSURFACE SOIL #02

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-12-91 TIME: 1515 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0164023	DBC 39	4-50910
1	4 OZ., GLASS	VOA	WD229013	DBC 39	4-11
1	8 OZ., GLASS	METAL/CYANIDE	0164023	MDBF 39	4-12

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SB-03
SAMPLE LOCATION:
SUBSURFACE SOIL #03

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER YB 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-12-91 TIME: 1530 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0164023	DBC 41	4-50916
1	4 OZ., GLASS	VOA	W0229013	DBC 41	~~4-~~17
1	8 OZ., GLASS	METAL/CYANIDE	0164023	MDBF 41	~~4-~~18

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SB-04
SAMPLE LOCATION:
SUBSURFACE SOIL #04

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER YA 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-12-91 TIME: 1555 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0164023	DBC 42	4-50919
1	4 OZ., GLASS	VOA	W0229013	DBC 42	4-20
1	8 OZ., GLASS	METAL/CYANIDE	0164023	MDBF 42	4-21

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SB-05
SAMPLE LOCATION: SUBSURFACE SOIL #05

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 0830 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0164023	DBC 45	4-50928
1	4 OZ., GLASS	VOA	W0229013	DBC 45	4-29
1	8 OZ., GLASS	METAL/CYANIDE	0164023	MDBF 45	4-30

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SB-06
SAMPLE LOCATION:
SUBSURFACE SOIL #06

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 1235 ~~1225~~ HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0164023	DBC 47	4-50934
1	4 OZ., GLASS	VOA	W0229013	DBC 47	4-35
1	8 OZ., GLASS	METAL/CYANIDE	0164023	MDBF 47	4-36

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SB07
SAMPLE LOCATION:
SUBSURFACE SOIL #07

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS
2) RON YOUNG
3) LARRY GRIER
4) SCOTT SINGLETON
5)
6)
7)
8)

DATE SAMPLED: 6-13-91 TIME: 1210 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0163023	DBC 49	4-50940
1	4 OZ., GLASS	VOA	W0229013	DBC 49	4-41
1	8 OZ., GLASS	METAL/CYANIDE	0163023	MDBF 49	4-42

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-SB-08
SAMPLE LOCATION:
SUBSURFACE SOIL #08

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LB 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 1150 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.	0163023	DBC 62	4-50859
1	4 OZ., GLASS	VOA	0163023	DBC 62	~~4-~~60
1	8 OZ., GLASS	METAL/CYANIDE	0163023	MDBF 62	~~4-~~61

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.		DBC	4-
2	40ML VIAL GLASS	VOA		DBC	4-
1	1 Liter Polypropylene	METALS		MDBF	4-
1	1 Liter Polypropylene	CYANIDE		MDBF	4-

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):				
pH:				
TEMP.:				

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-MW02
SAMPLE LOCATION:
MONITORING WELL #02

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 1045 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.	X0291013	DBC 55	4-50976
2	40ML VIAL GLASS	VOA	B0255033	DBC 55	4-77, 78
1	1 Liter Polypropylene	METALS	X0158013	MDBF 55	4-79
1	1 Liter Polypropylene	CYANIDE	X0158013	MDBF 55	4-80

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):	77.1	X10		
pH:	5.75			
TEMP.:	82.1			

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-MW-03
SAMPLE LOCATION:
MONITORING WELL #03

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 1255 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.	X0291013	DBC 58	4-50991
2	40ML VIAL GLASS	VOA	B0255033	DBC 58	4-92, 93
1	1 Liter Polypropylene	METALS	X0158013	MDBF 58	4-94
1	1 Liter Polypropylene	CYANIDE	X0158013	MDBF 58	4-95

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):	4.33	X10		
pH:	5.14			
TEMP.:	74.9			

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-MW04
SAMPLE LOCATION:
MONITORING WELL 04

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 1110 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.	X0291013	DBC 56	4-50981
2	40ML VIAL GLASS	VOA	B025503	DBC 56	~~4-~~82,83
1	1 Liter Polypropylene	METALS	X0158013	MDBF 56	~~4-~~84
1	1 Liter Polypropylene	CYANIDE	X0158013	MDBF 56	~~4-~~85

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):	1.74	X10		
pH:	5.06			
TEMP.:	75.1			

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-MW-05
SAMPLE LOCATION:
MONITORING WELL #05

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LD 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 1125 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.	X0291013	DBC 57	4-50986
2	40ML VIAL GLASS	VOA	B0255033	DBC 57	~~4-~~87, 88
1	1 Liter Polypropylene	METALS	X0158013	MDBF 57	~~4-~~89
1	1 Liter Polypropylene	CYANIDE	X0158013	MDBF 57	4-90

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):	7.20	x10		
pH:	5.14			
TEMP.:	75.9			

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-MW-09
SAMPLE LOCATION: MONITORING WELL #09

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 0925 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.	X0291013	DBC 52	4-50961
2	40ML VIAL GLASS	VOA	B0255033	DBC 52	4-62,63
1	1 Liter Polypropylene	METALS	X0158013	MDBF 52	4-64
1	1 Liter Polypropylene	CYANIDE	X0158013	MDBF 52	4-65

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):	2,25	X10		
pH:	4.79			
TEMP.:	72.1			

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-MW-12
SAMPLE LOCATION:
MONITORING WELL - 12

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LH 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 0950 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.	X0291013	DBC 54	4-50971
2	40ML VIAL GLASS	VOA	B025503	DBC 54	A-72, 73
1	1 Liter Polypropylene	METALS	X0158013	MDBF 54	A-74
1	1 Liter Polypropylene	CYANIDE	X0158013	MDBF 54	A-75

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):	2.67	X10		
pH:	5.34			
TEMP.:	73			

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-MW-13
SAMPLE LOCATION:
MONITORING WELL #13

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 0935 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.	X0291013	DBC 53	4-50966
2	40ML VIAL GLASS	VOA	B0255033	DBC 53	4-67, 68
1	1 Liter Polypropylene	METALS	X0158013	MDBF 53	4-69
1	1 Liter Polypropylene	CYANIDE	X0158013	MDBF 53	4-70

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):	3.41	X10		
pH:	5.35			
TEMP.:	73.7			

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-MW-17
SAMPLE LOCATION:
MONITORING WELL #17

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 1010 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.	X0291013	DBC 59	4-50996
2	40ML VIAL GLASS	VOA	B0255033	DBC 59	4-97, 98
1	1 Liter Polypropylene	METALS	X0158013	MDBF 59	4-99
1	1 Liter Polypropylene	CYANIDE	X0158013	MDBF 59	4-51000

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):	1163	X100		
pH:	9.16			
TEMP.:	75.7			

NUS CORPORATION SAMPLING FIELD SHEET

SITE: UNION OIL COMPANY
TDD NO: F4-9105-21

CASE NUMBER: 16599
PROJECT NUMBER: 91-727
SAS NUMBER:

ADDRESS: 6801 WEST MARKET STREET
GUILFORD COUNTY
GREENSBORO, NORTH CAROLINA

SAMPLE CODE: UO-MW-18
SAMPLE LOCATION:
MONITORING WELL #18

CONTACT: CHARLIE WELLS
PHONE: (919)299-2611

SAMPLED BY:

1) ALVIN WILLIAMS 3) LARRY GRIER LG 5) 7)
2) RON YOUNG 4) SCOTT SINGLETON 6) 8)

DATE SAMPLED: 6-13-91 TIME: 1015 HRS

SOIL/SEDIMENT SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	8 OZ., GLASS	EXT. ORG.		DBC	4-
1	4 OZ., GLASS	VOA		DBC	4-
1	8 OZ., GLASS	METAL/CYANIDE		MDBF	4-

WATER SAMPLE

NO.	CONTAINER	ANALYSIS	CONTAINER LOT #	SAMPLE NO.	TAG NO.
1	1 GALLON GLASS	EXT. ORG.	X0291013	DBC 60	4-50851
2	40ML VIAL GLASS	VOA	B255033	DBC 60	4-52,53
1	1 Liter Polypropylene	METALS	X158013	MDBF 60	4-54
1	1 Liter Polypropylene	CYANIDE	X158013	MDBF 60	4-55

FIELD MEASUREMENTS

Prepared by:	
Date Prepared:	
Log Book #:	F4-2936

REMARKS:

TIME:				
COND.(μmhos/cm):	1,82	X100		
pH:	7.87			
TEMP.:	74.9			

SENDER'S COPY

PART # 105972 NCREV REV. 10/88 © 1988 T.E.C.
SENDER'S COPY 1/90

DESCRIPTION	OF	
	2 OF 2	5942
	OF	5942019912
	OF	5942019921
	OF	5942019937
	OF	5942019946

PACKAGE TRACKING NUMBER

QUESTIONS? CALL 800-23[illegible] FREE.

4435777614

TERMS AND CONDITIONS

SENDER'S COPY

Sender's Account Number | Date 6/4/95

1 From (Your Name) Please Print | Your Phone Number (Very Important) 404-998-7710
Company NUS CORPORATION | Department/Mail No.
Street Address 1727 CONGRESS PARKWAY STE 410
City TUCKER | State | Zip

2 To (Recipient's Name) Please Print ANTONIO TORANEY
Company SKADDEN, ARPS, SLATE, MEAGHER & SHERMAN
Street Address 360 BOSTON POST RD AVE
City WALTHAM | State MA

YOUR INTERNAL BILLING REFERENCE INFORMATION (First 24 characters will appear on invoice)

H IF HOLD FOR PICK-UP, Print FEDEX Address Here
Street Address
City | State

3 PAYMENT: 1 ☐ Bill Sender 2 ☐ Bill Recipient's FedEx Acct. No. 3 ☐ Bill 3rd Party FedEx Acct. No. 4 ☐ Bill Credit Card
Check Box if Applicable | Fill in Account Number Below (req'd.) | Fill in Account Number Below (req'd.) | Fill in Credit Card Number below
5 ☐ Cash/Check Acct./Credit Card No. | Exp. Date

4 SERVICES (Check only one box)

Priority Overnight Service (Delivery by next business morning)†
11 ☒ YOUR PACKAGING
18 ☐ FEDEX LETTER
12 ☐ FEDEX PAK
13 ☐ FEDEX BOX
14 ☐ FEDEX TUBE

Standard Overnight Service (Delivery by next business afternoon)†
51 ☐
56 ☐ FEDEX LETTER*
52 ☐ FEDEX PAK*
53 ☐ FEDEX BOX
54 ☐ FEDEX TUBE

Economy Distribution Service (formerly Standard Air) (Delivery by second business day)†
30 ☐ ECONOMY DIST. SVC.

Heavyweight Service (for Extra Large or any package over 150 lbs)
70 ☐ HEAVYWEIGHT**
80 ☐ DECLARED HEAVYWEIGHT**

†Delivery commitment may be later in some areas.
*Declared Value Limit $100
**Call for delivery schedule.

DELIVERY AND SPECIAL HANDLING (Check all boxes required)
1 ☐ HOLD FOR PICK-UP (Fill in Box H)
2 ☒ DELIVER WEEKDAY
3 ☐ DELIVER SATURDAY (Extra charge) (Not available to all locations)
4 ☐ DANGEROUS GOODS (Extra charge)
5 ☐
6 ☐ DRY ICE
7 ☐ OTHER SPECIAL SERVICE
8 ☐
9 ☐ SATURDAY PICK-UP (Extra charge)
10 ☐
11 ☐
12 ☐ HOLIDAY DELIVERY (Extra charge)

PACKAGES	WEIGHT in Pounds	Total Declared Value (for sale)
1	54	
1	54	
Total 2	Total 108	Total

DIM SHIPMENT (Chargeable Weight) ☐ _____ lbs.

Received At
1 ☐ Regular Stop 3 ☐ Drop Box
2 ☐ On-Call Stop 4 ☐ BSC 5 ☐ Station

FedEx Emp. No. 16

SERVICE CONDITIONS, DECLARED VALUE AND LIMIT OF LIABILITY

Use of this label constitutes your agreement to the service conditions in our current Service Guide, available upon request. Ask your FedEx courier for a copy of this Guide for information.

We will not be responsible for any claim in excess of $100 per package, whether the result of loss, damage, delay, misdelivery or misinformation, unless you declare a higher value, pay an additional charge, and document your actual loss in the time period stated in our Service Guide. Maximum amount limitations found in the current Express Service Guide apply. Your right to assert claims against Federal Express for any loss, including intrinsic value of the package, expedited service, income interest, profit, attorney's fees, costs, and other forms of damage whether direct, incidental, consequential, or special is limited to the greater of $100 or the declared value specified in Box 5. Recovery cannot exceed actual documented loss. Maximum for items of extraordinary value is the Declared Value for FedEx Letter and FedEx Pak packages.

Independent of paid shipment, Federal Express will at your request and with some limitations, refund all transportation charges. See Service Guide for further information.

Sender authorizes Federal Express to deliver this shipment without obtaining a delivery signature and shall indemnify and hold harmless Federal Express from any claims resulting therefrom.

5 Release Signature:

Date/Time 6/7/95 1020

FEDERAL EXPRESS

USE THIS AIRBILL FOR SHIPMENTS WITHIN THE CONTINENTAL U.S.A., ALASKA AND HAWAII
USE THE INTERNATIONAL AIR WAYBILL FOR SHIPMENTS TO PUERTO RICO AND ALL NON U.S. LOCATIONS
QUESTIONS? CALL 800-238-5355 TOLL FREE.

AIRBILL PACKAGE TRACKING NUMBER 8644163334

1104M 1 8644163334

SENDER'S COPY

Sender's Federal Express Account Number: 1089-2044-6
Date: 6/14/91

From (Your Name) Please Print: GREG LAMPY
Your Phone Number (Very Important): 404-938-7710
Company: MUS CORPORATION
Department/Floor No.:
Street Address: 1927 LAKESIDE PARKWAY STE 614
City: TUCKER State: GA ZIP Required: 30085

To (Recipient's Name) Please Print: MARK HOLLOWAY
Recipient's Phone Number (Very Important): 301-381-2200
Company: RECON ENVIRONMENTAL INC
Department/Floor No.:
Exact Street Address (No Post Office Box): 8320 GUILFORD ROAD SUITE F
City: COLUMBIA State: MD ZIP Required: 21046

YOUR INTERNAL BILLING REFERENCE INFORMATION (First 24 characters will appear on invoice.)

IF HOLD FOR PICK-UP, Print FEDEX Address Here
Street Address:
City: State: ZIP Required:

SHIPMENT BILLING: 1 [X] Bill Sender Acct No Req'd 2 [ ] Bill Recipient's FedEx Acct No Fill in Account Number below 3 [ ] Bill 3rd Party FedEx Acct No. Fill in Account Number below (req'd) 4 [ ] Bill Credit Card Fill in Credit Card Number below
[ ] Cash/Check Acct./Credit Card No.

SERVICES (Check only one box)

Priority Overnight Service (Delivery by next business morning†)
11 [X] YOUR PACKAGING
18 [ ] FEDEX LETTER *
12 [ ] FEDEX PAK *
13 [ ] FEDEX BOX
14 [ ] FEDEX TUBE

Standard Overnight Service (Delivery by next business afternoon†)
51 [ ]
56 [ ] FEDEX LETTER *
52 [ ] FEDEX PAK *
53 [ ] FEDEX BOX
54 [ ] FEDEX TUBE

Economy Distribution Service (formerly Standard Air) (Delivery by second business day†)
30 [ ] ECONOMY DIST. SVC.

Heavyweight Service (for Extra Large or any package over 150 lbs.)
70 [ ] HEAVYWEIGHT **
80 [ ] DEFERRED HEAVYWEIGHT **

†Delivery commitment may be later in some areas
*Declared Value Limit $100
**Call for delivery schedule

DELIVERY AND SPECIAL HANDLING (Check services required)
1 [ ] HOLD FOR PICK-UP (Fill in Box H)
2 [X] DELIVER WEEKDAY
3 [ ] DELIVER SATURDAY (Extra charge) (Not available to all locations) [ ]
4 [ ] DANGEROUS GOODS (Extra charge)
5 [ ]
6 [ ] DRY ICE lbs.
7 [ ] OTHER SPECIAL SERVICE
8 [ ]
9 [ ] SATURDAY PICK-UP (Extra charge)
10 [ ]
11 [ ]
12 [ ] HOLIDAY DELIVERY (If offered) (Extra charge)

PACKAGES	WEIGHT	Value
1	94	
1	56	
Total 3	Total 74	Total

DIM SHIPMENT (Chargeable Weight) [ ] _____ lbs.

Received At: 1 [ ] Regular Stop 2 [ ] On-Call Stop 3 [ ] Drop Box 4 [ ] BSC 5 [ ] Station

FedEx Emp No: 66 Date/Time: 6/14 1020

SERVICE CONDITIONS, DECLARED VALUE AND LIMITATION OF LIABILITY

We will not be responsible for any claim in excess of $100 per package whether the result of loss, damage, delay, misdelivery or nondelivery, unless you declare a higher value and pay an additional charge, but no claim shall in any event exceed your declared value. Maximum Declared Value for Express Service Guide sales. Your right to recover from Federal Express for any loss, including but not limited to, loss of profit, loss of sales, income, interest, profit, attorney's fees, costs, and other forms of damage whether direct, incidental, consequential, or special is limited to the greater of $100 or the declared value specified in the air. Recovery cannot exceed actual documented loss. The maximum Declared Value for FedEx Letter and FedEx Pak packages is $100.00. In these and other circumstances Federal Express will at your request and with some limitations, refund all transportation charges paid. See Service Guide for further information.

Sender authorizes Federal Express to deliver this shipment without obtaining a delivery signature and shall indemnify and hold harmless Federal Express from any claims resulting therefrom.

5 Release Signature:

Federal Express Use
Base Charges
Declared Value Charge
Other 1
Other 2
Total Charges

REVISION DATE 4/90
PART #119501 NCREC 7/90
FORMAT #027
027
© 1990 P.E.C. PRINTED IN U.S.A.

SENDER'S COPY

FEDERAL EXPRESS MULTIPLE PACKAGE SHIPMENT LABELS

SHIPMENT DATE	MASTER AIRBILL NUMBER		DESCRIPTION		DESCRIPTION		DESCRIPTION	
6/14/91	8644163334	2 OF 3	5942020253	3 OF 3	5942020262	1 OF	5942020271	5942020287

5942020296

NUS CORPORATION
UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
Region 4 Field Investigation Team

RECEIPT FOR SAMPLES

NUS CORPORATION
1927 LAKESIDE PARKWAY
SUITE 614
TUCKER, GA 30084

PROJECT NO.	PROJECT NAME	NAME & LOCATION OF FACILY/SITE
91 727	UNION OIL COMPANY	6801 WEST MARKET ST GREENSBORO, NORTH CAROLINA
SAMPLERS: (SIGNATURE) Larry Grier Alvin Williams		

STATION NO. V0-	1991 DATE	TIME	COMP	GRAB	STATION LOCATION/DESCRIPTION	NO. OF CONTAINERS	SPLIT SAMPLES Y OR N	SAMPLE TAG NO.S/REMARKS
SS01	6/12	1445		X	SURFACE SOIL #01	0	N	4-50901,02,03
SB01	6/12	1455		X	SUBSURFACE SOIL #01	0	N	04,05,06 TAG#'S ARE EPA/NUS
SS02	6/12	1510		X	SURFACE SOIL #02	0	N	07,08,09 TAG#'S REFER TO STATION
SB02	6/12	1515		X	SUBSURFACE SOIL #02	0	N	10,11,12 #FOR SAMPLE IDENTITY
SS03	6/12	1525		X	SURFACE SOIL #03	0	N	13,14,15
SB03	6/12	1530		X	SUBSURFACE SOIL #03	0	N	16,17,18
SB04	6/12	1555		X	SUBSURFACE SOIL #04	0	N	19,20,21
SS04	6/12	1545		X	SURFACE SOIL #04	0	N	22,23,24
SS05	6/13	0825		X	SURFACE SOIL #05	0	N	25,26,27
SB05	6/13	0830		X	SUBSURFACE SOIL #05	0	N	28,29,30
SS06	6/13	1225		X	SURFACE SOIL #06	0	N	31,32,33
SB06	6/13	1235		X	SUBSURFACE SOIL #06	0	N	34,35,36
SS07	6/13	1200		X	SURFACE SOIL #07	0	N	37,38,39
SB07	6/13	1210		X	SUBSURFACE SOIL #07	0	N	40,41,42
SD01	6/13	1000		X	SEDIMENT #01	0	N	43,44,45
SS08	6/13	1140		X	SURFACE SOIL #08	0	N	450856,57,58
SB08	6/13	1150		X	SUBSURFACE SOIL #08	0	N	59,60,61

SPLIT SAMPLES TRANSFERRED BY:	DATE	SPLIT SAMPLES RECEIVED BY ☐ OR DECLINED BY ☒ FEW	DATE/TIME
(PRINT) Alvin Williams	6/13/91	(PRINT) CHARLES E. WELLS	6-13-91 1315
(SIGN) Alvin Williams	TIME	(SIGN) Charles E. Wells	TELEPHONE
		TITLE TERMINAL MANAGER	919-299-2611

DISTRIBUTION: Original to Coordinator Field Files: Copy to facility/site representative

NO. 4-0534

NUS CORPORATION
UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
Region 4 Field Investigation Team

RECEIPT FOR SAMPLES

NUS CORPORATION
1927 LAKESIDE PARKWAY
SUITE 614
TUCKER, GA 30084

PROJECT NO.	PROJECT NAME	NAME & LOCATION OF FACILY/SITE
91-727	UNION OIL COMPANY	6801 WEST MARKET ST. GREENSBORO, NORTH CAROLINA

SAMPLERS: (SIGNATURE) Larry Grier Alvin Williams

STATION NO. 00-	1991 DATE	TIME	COMP	GRAB	STATION LOCATION/DESCRIPTION	NO. OF CONTAINERS	SPLIT SAMPLES Y OR N	SAMPLE TAG NO.S/REMARKS
MW-08	6/13	0845		X	MONITORING WELL #08	0	N	450951,52,53,54,55,56,57,58,59,60
MW-09	6/13	0925		X	MONITORING WELL #09	0	N	61,62,63,64,65 TAG #'S ARE EPA / NUS
MW-11	6/13	0935		X	MONITORING WELL# 11	0	N	66,67,68,69,70 TAG #'S REFER TO
MW-12	6/13	0950		X	MONITORING WELL# 12	0	N	71,72,73,74,75 STATION # FOR SAMPLE
MW-02	6/13	1045		X	MONITORING WELL# 02	0	N	76,77,78,79,80 ~~IDENTITY~~ ID
MW-04	6/13	1110		X	MONITORING WELL# 04	0	N	81,82,83,84,85
MW-05	6/13	1125		X	MONITORING WELL# 05	0	N	86,87,88,89,90
MW03	6/13	1255		X	MONITORING WELL# 03	0	N	91,92,93,94,95
MW17	6/13	1010		X	MONITORING WELL#17	0	N	96,97,98,99,451000
MW 18	6/13	1015		X	MONITORING WELL# 18	0	N	450851,52,53,54,55

SPLIT SAMPLES TRANSFERRED BY:	DATE	SPLIT SAMPLES RECEIVED BY ☐ OR DECLINED BY ☑ CEW	DATE/TIME
(PRINT) Alvin Williams	6-13-91	(PRINT) CHARLES E. WELLS	6-13-91 1315
(SIGN) Alvin Williams	TIME 1315	(SIGN) Charles E. Wells	TELEPHONE 919-299-2611
		TITLE TERMINAL MANAGER	

DISTRIBUTION: Original to Coordinator Field Files: Copy to facility/site representative

NO. 4-0607

EPA

United States Environmental Protection Agency
Contract Laboratory Program Sample Management Office
PO Box 818 Alexandria, VA 22313
703-557-2490 FTS 557-2490

Organic Traffic Report
(For CLP Use Only)

Case Number: 16599
SAS No. (if applicable): —

1. Type of Activity (Check one)
☐ ENF ☐ NPLD ☐ RA ☒ SI ☐ STSI
☐ ER ☐ O&M ☐ RD ☐ ST ☐ Other (Specify)
☐ ESI ☐ PA ☐ RIFS ☐ STPA

2. Region Number: 4
Sampling Co.: FIT
Sampler (Name): ALVIN WILLIAMS

4. Date Shipped: 6/13/91
Carrier: FED EXPRESS
Airbill Number: 8644163334

Non-Superfund Program: —

Site Name: UNION OIL COMPANY
City, State: GREENSBORO, NC
Site Spill ID: —

3. Ship To: LARRY HOLLADAY
RECRA ENVIRONMENTAL, INC
8320 GUILFORD ROAD, BLDG F
COLUMBIA, MD. 21046
(301) 381 2288

Triple volume required for matrix spike/duplicate aqueous sample.

Ship medium and high concentration samples in paint cans.

See reverse for additional instructions.

5. Sample Description (Enter in Column A)
1. Surface Water
2. Ground Water
3. Leachate
4. Rinsate
5. Soil/Sediment
6. Oil (SAS)
7. Waste (SAS)
8. Other (SAS) (Specify)

IF VOA SAMPLE PRESERVED INDICATE IN COLUMN C WITH Y OR N.

CLP Sample Number (From labels)	(A) Sample Description (From box 5)	(B) Concentration L=low M=med H=high	(C) RAS Analysis VOA	BNA	Pest/PCB	ARO/TOX	(D) Special Handling	(E) Station Location UO-	(F) Date/Time of Sample Collection	(G) Corresponding CLP Inorganic Sample Number
DBC 51	2	L	✓	✓	✓		MATRIX DUPLICATE	MW 08	6/13/91 0845	MDBF51
DBC 52	2	L	✓	✓	✓			MW 09	" " 0945	" " 52
" " 53	2	L	✓	✓	✓			MW 13	" " 0935	" " 53
" " 54	2	L	✓	✓	✓			MW 12	" " 0950	" " 54
" " 55	2	L	✓	✓	✓			MW 02	" " 1045	" " 55
" " 56	2	L	✓	✓	✓			MW 04	" " 1110	" " 56
" " 57	2	L	✓	✓	✓			MW 05	" " 1125	" " 57
" " 58	2	L	✓	✓	✓			MW 03	" " 1255	" " 58
" " 59	2	L	✓	✓	✓			MW 17	" " 1010	" " 59
" " 60	2	L	✓	✓	✓			MW 18	6/13/91 1015	" " 60
DBC 61	5	L	✓	✓	✓			SS 08	6/13/91 1140	MDBF 61
DBC 62	5	L	✓	✓	✓			SB 08	6/13/91 1150	MDBF 62
DBC 63	1	L	✓	✓	✓			TB01W	6/12 0700	MDBF 63
DBC 64	5	L	✓					TB01S	6/12 0700	
" " 31	2	L	✓	✓	✓		H2O Blank	MW 15	6/13 1245	MDBF 31
" " 32	2	L	✓	✓	✓		H2O Spike	MW 14	" " 1300	" " 32
" " 34	5	L	✓	✓	✓		Soil Blank	SD 02	" " 1335	" " 34
DBC 35	5	L	✓	✓	✓		Soil Spike	SD 03	6/13 1345	

...oi n Co ... nk - SMO Co White - Lab Co y for Return to SMO Yellow - Lab Copy

EPA

United States Environmental Protection Agency
Contract Laboratory Program Sample Management Office
PO Box 818 Alexandria, VA 22313
703-557-2490 FTS 557-2490

Organic Traffic Report
(For CLP Use Only)

Case Number: 16599
SAS No. (if applicable): —

1. Type of Activity (Check one)
☐ ENF ☐ NPLD ☐ RA ☒ SI ☐ STSI
☐ ER ☐ O&M ☐ RD ☐ ST ☐ Other (Specify)
☐ ESI ☐ PA ☐ RIFS ☐ STPA

Non-Superfund Program: —

Site Name: UNION OIL COMPANY

City, State: GREENSBORO, NC

Site Spill ID: —

2. Region Number: 4
Sampling Co.: FIT
Sampler (Name): ALVIN WILLIAMS

3. Ship To: LARRY HOLLADAY
RECRA ENVIRONMENTAL, INC.
8320 GUILFORD ROAD, BLDG F
COLUMBIA, MD 21046
(301) 381-2288

4. Date Shipped: 6/13/91
Carrier: FED. EXPRESS
Airbill Number: 8644463334

Triple volume required for matrix spike/duplicate aqueous sample.

Ship medium and high concentration samples in paint cans.

See reverse for additional instructions.

5. Sample Description (Enter in Column A)
1. Surface Water
2. Ground Water
3. Leachate
4. Rinsate
5. Soil/Sediment
6. Oil (SAS)
7. Waste (SAS)
8. Other (SAS) (Specify)

IF VOA SAMPLE PRESERVED INDICATE IN COLUMN C WITH Y OR N.

CLP Sample Number (From labels)	(A) Sample Description (From box 5)	(B) Concentration L=low M=med H=high	(C) RAS Analysis VOA	BNA	Pest/PCB	ARO/TOX	(D) Special Handling	(E) Station Location UD-	(F) Date/Time of Sample Collection	(G) Corresponding CLP Inorganic Sample Number
DBC 36	5	L	✓	✓	✓			SS01	6/12/91 1445	MDBF 36
DBC 37	5	L	✓	✓	✓		MATRIX DUPLICATE	SB01	6/12/91 1455	MDBF 37
" 38	5	L	✓	✓	✓			SS02	6/12/91 1510	" 38
" 39	5	L	✓	✓	✓			SB02	" 1515	" 39
" 40	5	L	✓	✓	✓			SS03	" 1525	" 40
" 41	5	L	✓	✓	✓			SB03	" 1530	" 41
" 42	5	L	✓	✓	✓			SB04	" 1555	" 42
" 43	5	L	✓	✓	✓			SS04	" 1545	" 43
" 44	5	L	✓	✓	✓			SB04	6/13/91 0825	" 44
" 45	5	L	✓	✓	✓			SS05	6/13/91 0830	" 45
" 46	5	L	✓	✓	✓			SS06	" 1225	" 46
" 47	5	L	✓	✓	✓			SB06	" 1235	" 47
" 48	5	L	✓	✓	✓			SS07	" 1200	" 48
DBC 49	5	L	✓	✓	✓			SB07	6/13/91 1210	MDBF 49
DBC 50	5	L	✓	✓	✓			SD01	6/13/91 1000	MDBF 50

EPA

United States Environmental Protection Agency
Contract Laboratory Program Sample Management Office
PO Box 818 Alexandria, VA 22313
703-557-2490 FTS 557-2490

Inorganic Traffic Report
(For CLP Use Only)

Case Number: 16599
SAS No. (if applicable): —

1. Type of Activity (Check one)
☐ ENF ☐ NPLD ☐ RA ☒ SI ☐ STSI
☐ ER ☐ O&M ☐ RD ☐ ST ☐ Other (Specify)
☐ ESI ☐ PA ☐ RIFS ☐ STPA

Non-Superfund Program: —

Site Name: UNION Oil COMPANY

City, State: GREENSBORO, NC

Site Spill ID: —

2. Region Number: 4

Sampling Co.: FET

Sampler (Name): ALVIN WILLIAMS

3. Ship To: ANTONIA BENNEY
SKINNER & SHERMAN
300 SECOND AVE
WALTHAM, MA 02254
(617) 890 7200

4. Date Shipped: 6/13/91

Carrier: FED EXPRESS

Airbill Number: 8635377614

Double volume required for matrix spike/duplicate aqueous sample.

Ship medium and high concentration samples in paint cans.

See reverse for additional instructions.

5. Sample Description (Enter in Column A)
1. Surface Water
2. Ground Water
3. Leachate
4. Rinsate
5. Soil/Sediment
6. Oil (SAS)
7. Waste (SAS)
8. Other (SAS) (Specify)

CLP Sample Number (From labels)	(A) Sample Description (From box 5)	(B) Concentration L=low M=med H=high	(C) List Preservative Used/Vol	(D) RAS Analysis: Total or Dissolved Metals	(D) Cyanide	(D) Low Conc. Sow: Nitrate/Nitrite	(D) Low Conc. Sow: Fluoride	(E) Special Handling	(F) Station Location UO-	(G) Date/Time of Sample Collection	(H) Corresponding Organic Sample Number
MDBF36	5	L		✓	✓				SS01	6/12/91 1445	DBC 36
" " 37	5	L		✓	✓			MATRIX DUPLICATE	SB01	6/12/91 1465	" " 37
" " 38	5	L		✓	✓				SS02	" " 1510	" " 38
" " 39	5	L		✓	✓				SB02	" " 1515	" " 39
" " 40	5	L		✓	✓				SS03	" " 1525	" " 40
" " 41	5	L		✓	✓				SB03	" " 1530	" " 41
" " 42	5	L		✓	✓				SB04	" " 1555	" " 42
" " 43	5	L		✓	✓				SS04	" " 1545	" " 43
" " 44	5	L		✓	✓				SS05	6/13/91 0825	" " 44
" " 45	5	L		✓	✓				SB05	6/13/91 0830	" " 45
" " 46	5	L		✓	✓				SS06	" " 1225	" " 46
" " 47	5	L		✓	✓				SB06	" " 1235	" " 47
" " 48	5	L		✓	✓				SS07	" " 1200	" " 48
" " 49	5	L		✓	✓				SB07	" " 1210	" " 49
" " 50	5	L		✓	✓				SD01	" " 1000	" " 50
" " 31	2	L		✓	✓			H2O blank	MW15	" " 1245	" " 31

EPA

United States Environmental Protection Agency
Contract Laboratory Program Sample Management Office
PO Box 818 Alexandria, VA 22313
703-557-2490 FTS 557-2490

Inorganic Traffic Report
(For CLP Use Only)

Case Number: 16599

SAS No. (if applicable): —

1. Type of Activity (Check one)
☐ ENF ☐ NPLD ☐ RA ☒ SI ☐ STSI
☐ ER ☐ O&M ☐ RD ☐ ST ☐ Other (Specify)
☐ ESI ☐ PA ☐ RIFS ☐ STPA

Non-Superfund Program: —

Site Name: UNION OIL COMPANY

City, State: GREENSBORO, NC

Site Spill ID: —

2. Region Number: 4

Sampling Co.: FIT

Sampler (Name): ALVIN WILLIAMS

3. Ship To: ANTONIA BENNEY
SKINNER + SHERMAN
300 SECOND AVE
WALTHAM, MA 02254
(617) 890 7200

4. Date Shipped: 6/13/91

Carrier: FED EXPRESS

Airbill Number: 8635777614

Double volume required for matrix spike/duplicate aqueous sample.

Ship medium and high concentration samples in paint cans.

See reverse for additional instructions.

5. Sample Description (Enter in Column A)
1. Surface Water
2. Ground Water
3. Leachate
4. Rinsate
5. Soil/Sediment
6. Oil (SAS)
7. Waste (SAS)
8. Other (SAS) (Specify)

CLP Sample Number (From labels)	(A) Sample Description (From box 5)	(B) Concentration L=low M=med H=high	(C) List Preservative Used/Vol	(D) RAS Analysis: Total or Dissolved Metals	Cyanide	Low Conc. Sow: Nitrate/Nitrite	Fluoride	(E) Special Handling	(F) Station Location UD-	(G) Date/Time of Sample Collection	(H) Corresponding Organic Sample Number
MDBF51	2	L		✓	✓			MATRIX DUPLICATE	MW 08	6/13/91 0845	DBC 51
" " 52	2	L		✓	✓				MW 09	" " 0925	" " 52
" " 53	2	L		✓	✓				MW 13	" " 0935	" " 53
" " 54	2	L		✓	✓				MW 12	" " 0950	" " 54
" " 55	2	L		✓	✓				MW 02	" " 1045	" " 55
" " 56	2	L		✓	✓				MW 04	" " 1110	" " 56
" " 57	2	L		✓	✓				MW 05	" " 1125	" " 57
" " 58	2	L		✓	✓				MW 03	" " 1255	" " 58
" " 59	2	L		✓	✓				MW 17	" " 1010	" " 59
" " 60	2	L		✓	✓				MW 18	" " 1015	" " 60
" " 61	5	L		✓	✓				SS08	" " 1140	" " 61
" " 62	5	L		✓	✓				SB08	" " 1150	" " 62
" " 32	2	L		✓	✓			H2O Spike	MW 14	" " 1300	" " 31
" " 33	2	L		✓	✓			ICS	MW 07	" " 1320	
MDBF34	5	L		✓	✓			soil Blank	SD 02	6/13/91 1335	DBC 34
MDBF63	1	L		✓	✓				PB-01	6-12-91 0700	DBC 63

NUS CORPORATION
UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
Region 4 Field Investigation Team

Inorg

CHAIN OF CUSTODY RECORD

NUS CORPORATION
1927 LAKESIDE PARKWAY
SUITE 614
TUCKER, GA 30084

PROJECT NO. 91 727

PROJECT LEADER ALVIN Williams

REMARKS AIR# 8635777614
2 COOLERS

PROJECT NAME/LOCATION

SAMPLE TYPES
1. SURFACE WATER
2. GROUND WATER
3. POTABLE WATER
4. WASTEWATER
5. LEACHATE
6. SOIL SEDIMENT
7. SLUDGE
8. WASTE
9. AIR
10. FISH
11. OTHER _____

SAMPLERS (SIGN) Larry Grier

CIRCLE/ADD parameters desired. List no. of containers submitted

ANALYSES: WATER — METALS, CYANIDE, VOA, EXT ORG/PEST/PCB; SOIL/SED — VOA, EXT ORG/PEST/PCB, METALS/CN

VO STATION NO.	SAMPLE TYPE	1991 DATE	TIME	COMP	GRAB	STATION LOCATION/DESCRIPTION	TOTAL CONTAINERS	METALS	CYANIDE	VOA	EXT ORG/PEST/PCB			VOA	EXT ORG/PEST/PCB	METALS/CN		TAG NO./SAMPLE NO.	LAB USE ONLY
SS01	6	6/12	1445		X	SURFACE SOIL #01	1									1		MDBF36/450903	
SB01	6	6/12	1455		X	SUBSURFACE SOIL #01	1									1		" " 37/06	
SS02	6	6/12	1510		X	SURFACE SOIL #02	1									1		" " 38/09	
SB02	6	6/12	1515		X	SUBSURFACE SOIL #02	1									1		" " 39/12	
SS03	6	6/12	1525		X	SURFACE SOIL #03	1									1		" " 40/15	
SB03	6	6/12	1530		X	SUBSURFACE SOIL #03	1									1		" " 41/18	
SB04	6	6/12	1555		X	SUBSURFACE SOIL #04 LD	1									1		" " 42/21	
SS04	6	6/12	1545		X	SURFACE SOIL #04	1									1		" " 43/24	
SS05	6	6/13	0825		X	SURFACE SOIL #05	1									1		" " 44/27	
SB05	6	6/13	0830		X	SUBSURFACE SOIL #05	1									1		" " 45/30	
SS06	6	6/13	1225		X	SURFACE SOIL #06	1									1		" " 46/33	
SB06	6	6/13	1235		X	SUBSURFACE SOIL #06	1									1		" " 47/36	
SS07	6	6/13	1200		X	SURFACE SOIL #07	1									1		" " 48/39	
SB07	6	6/13	1210		X	SUBSURFACE SOIL #07	1									1		" " 49/42	
SD01	6	6/13	1000		X	SEDIMENT #01	1									1		" " 50/45	
MW15	2	6/13	1245		X	MONITORING WELL #15	2	1	1									MDBF31/450866,67	

RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)
LARRY GRIER	6/13/91	FED EXPRESS			
(SIGN) Larry Grier		(SIGN)	(SIGN)		(SIGN)
RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)
(SIGN)		(SIGN)	(SIGN)		(SIGN)

DISTRIBUTION: White and pink copies accompany sample shipment to laboratory. Pink copy retained by laboratory.

NUS CORPORATION
UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
Region 4 Field Investigation Team

Inorg.

CHAIN OF CUSTODY RECORD

NUS CORPORATION
1927 LAKESIDE PARKWAY
SUITE 614
TUCKER, GA 30084

PROJECT NO. 91 727

PROJECT LEADER ALVIN WILLIAM

REMARKS Air # 8635777614
2 COOLERS

PROJECT NAME/LOCATION

SAMPLE TYPES
1. SURFACE WATER
2. GROUND WATER
3. POTABLE WATER
4. WASTEWATER
5. LEACHATE
6. SOIL SEDIMENT
7. SLUDGE
8. WASTE
9. AIR
10. FISH
11. OTHER

SAMPLERS (SIGN) Larry Grier

CIRCLE/ADD parameters desired. List no. of containers submitted

UO-STATION NO.	SAMPLE TYPE	DATE (19 91)	TIME	COMP	GRAB	STATION LOCATION/DESCRIPTION	TOTAL CONTAINERS	ANALYSES WATER: METALS	WATER: CYANIDE	WATER: VOA	WATER: EXT ORG/PEST/PCB	SOIL/SED: VOA	SOIL/SED: EXT ORG/PEST/PCB	SOIL/SED: METALS/CN	TAG NO./SAMPLE NO.	LAB USE ONLY
MW08	2	6/13	0845		X	MONITORING WELL #08	4	2	2						MDBF51 / 450957,8,9,60	
MW09	2	6/13	0925		X	MONITORING WELL #09	2	1	1						" " 52 / 64,65	
MW13	2	6/13	0935		X	" " " #13	2	1	1						" " 53 / 69,70	
MW12	2	6/13	0950		X	" " " #12	2	1	1						" " 54 / 74,75	
MW02	2	6/13	1045		X	" " " #02	2	1	1						" " 55 / 79,80	
MW04	2	6/13	1110		X	" " " #04	2	1	1						" " 56 / 84,85	
MW05	2	6/13	1125		X	" " " #05.	2	1	1						" " 57 / 89,90	
MW03	2	6/13	1255		X	" " " #03	2	1	1						" " 58 / 94,95	
MW17	2	6/13	1010		X	" " " #17	2	1	1						" " 59 / 99,451000	
MW18	2	6/13	1015		X	MONITORING WELL #18	2	1	1						" " 60 / 450854,55	
SS08	6	6/13	1140		X	SURFACE SOIL #08	1					1			" " 61 / 58	
SB08	6	6/13	1150		X	SUBSURFACE SOIL #08	1					1			" " 62 / 61	
PB01	1	6/12	0700		X	PRESERVATIVE BLANK #01W	2	1	1						" " 63 / 450949,50	
MW14	2	6/13	1300		X	MONITORING WELL #14	2	1	1						" " 31 / 450871,72	
MW07	2	6/13	1320		X	" " " " #07	1	1							" " 33 / 73	
SD02	6	6/13	1335		X	SEDIMENT # 02								1	MDBF 34 / 75	

RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)
LARRY GRIER	6/13/91	FED. EXPRESS			
(SIGN) Larry Grier		(SIGN)	(SIGN)		(SIGN)
RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)
(SIGN)		(SIGN)	(SIGN)		(SIGN)

Pink retained b laborator

NUS CORPORATION
UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
Region 4 Field Investigation Team

CHAIN OF CUSTODY RECORD

NUS CORPORATION
1927 LAKESIDE PARKWAY
SUITE 614
TUCKER, GA 30084

PROJECT NO. 91 727
PROJECT LEADER ALVIN WILLIAM
REMARKS AIR # 8644163334
3 COOLERS
PROJECT NAME/LOCATION

SAMPLE TYPES
1. SURFACE WATER
2. GROUND WATER
3. POTABLE WATER
4. WASTEWATER
5. LEACHATE
6. SOIL SEDIMENT
7. SLUDGE
8. WASTE
9. AIR
10. FISH
11. OTHER

SAMPLERS (SIGN) Larry Grier

UD STATION NO.	SAMPLE TYPE	19 91 DATE	TIME	COMP	GRAB	STATION LOCATION/DESCRIPTION	TOTAL CONTAINERS	METALS	CYANIDE	VOA	EXT ORG/PEST/PCB	VOA	EXT ORG/PEST/PCB	METALS/CN	TAG NO./SAMPLE NO.	LAB USE ONLY
SS01	6	6/12	1445		X	SURFACE SOIL #01	2					1	1		DBC36 / 4-50901,02	
SB01	6	6/12	1455		X	SUBSURFACE SOIL #01	2					1	1		DBC-37 / 04,05	
SS02	6	6/12	1510		X	SURFACE SOIL #02	2					1	1		" 38 / 07,08	
SB02	6	6/12	1515		X	SUBSURFACE SOIL #02	2					1	1		" 39 / 10,11	
SS03	6	6/12	1525		X	SURFACE SOIL #03	2					1	1		" 40 / 13,14	
SB03	6	6/12	1530		X	SUBSURFACE SOIL #03	2					1	1		" 41 / 16,17	
SB04	6	6/12	1555		X	SUBSURFACE SOIL #04	2					1	1		" 42 / 19,20	
SS04	6	6/12	1545		X	SURFACE SOIL #04	2					1	1		" 43 / 22,23	
SS05	6	6/13	0825		X	SURFACE SOIL #05	2					1	1		" 44 / 25,26	
SB05	6	6/13	0830		X	SUBSURFACE SOIL #05	2					1	1		" 45 / 28,29	
SS06	6	6/13	1225		X	SURFACE SOIL #06	2					1	1		" 46 / 31,32	
SB06	6	6/13	1235		X	SUBSURFACE SOIL #06	2					1	1		" 47 / 34,35	
SS07	6	6/13	1200		X	SURFACE SOIL #07	2					1	1		" 48 / 37,38	
SB07	6	6/13	1210		X	SUBSURFACE SOIL #08	2					1	1		" 49 / 40,41	
SD01	6	6/13	1000		X	SEDIMENT #01	2					1	1		" 50 / 43,44	
TB01W	1	6/12	0700		X	TRIP BLANK	3			2	1				" 63 / 46,47,48	

RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)
LARRY GRIER	6/13/91	FED. EXPRESS			
(SIGN) Larry Grier		(SIGN)	(SIGN)		(SIGN)
RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)
(SIGN)		(SIGN)	(SIGN)		(SIGN)

DISTRIBUTION: White and pink (original)

NUS CORPORATION
UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
Region 4 Field Investigation Team

CHAIN OF CUSTODY RECORD

NUS CORPORATION
1927 LAKESIDE PARKWAY
SUITE 614
TUCKER, GA 30084

Org.

PROJECT NO. 91 727

PROJECT LEADER ALVIN WILLIAMS

PROJECT NAME/LOCATION

REMARKS AIR # 8644163334
3 COOLERS
~~SD03, 6 6/13/91~~ ~~SEDIMENT~~ 03 ~~1 CONTAINERS~~ ~~Time: 1345~~ ~~DBC 35, 450877~~ FAG #

SAMPLE TYPES
1. SURFACE WATER
2. GROUND WATER
3. POTABLE WATER
4. WASTEWATER
5. LEACHATE
6. SOIL SEDIMENT
7. SLUDGE
8. WASTE
9. AIR
10. FISH
11. OTHER

SAMPLERS (SIGN) Larry Grier

CIRCLE/ADD parameters desired. List no. of containers submitted

UO - STATION NO.	SAMPLE TYPE	19 91 DATE	TIME	COMP	GRAB	STATION LOCATION/DESCRIPTION	TOTAL CONTAINERS	METALS	CYANIDE	VOA	EXT ORG/PEST/PCB	VOA	EXT ORG/PEST/PCB	METALS/CN	TAG NO./SAMPLE NO.	LAB USE ONLY
								ANALYSES				WATER		SOIL/SED		
MW08	2	6/13	0845		X	MONITORING WELL #08	6		4	2					DBC 51/450951,2,3,4,5,6,7,8,9,10	
MW09	2	6/13	0925		X	" " " #09	3		2	1					DBC 52/61,62,63	
MW13	2	6/13	0935		X	" " " #13	3		2	1					" 53/66,67,68	
MW12	2	6/13	0950		X	" " " #12	3		2	1					" 54/71,72,73	
MW02	2	6/13	1045		X	" " " #02	3		2	1					" 55/76,77,78	
MW04	2	6/13	1110		X	" " " #04	3		2	1					" 56/81,82,83	
MW05	2	6/13	1125		X	" " " #05	3		2	1					" 57/86,87,88	
MW03	2	6/13	1255		X	" " " #03	3		2	1					" 58/91,92,93	
MW17	2	6/13	1010		X	MONITORING WELL #17	3		2	1					" 59/96,97,98	
MW18	2	6/13	1015		X	" " " #18	3		2	1					" 60/450851,52,53	
SS08	6	6/13	1140		X	SURFACE SOIL # 08	2				1	1			DBC 61/56,57	
SB08	6	6/13	1150		X	SUBSURFACE SOIL #08	2				1	1			DBC 62/59,60	
TB015	6	6/12	0700		X	TRIP BLANK 015	1				1				DBC 64/450862	
MW15	2	6/13	1245		X	MONITORING WELL #15	3		2	1					" 31/63,64,65	
MW14	2	6/13	1300		X	" " " #14	3		2	1					" 32/68,69,70	
SD02	6	6/13	1335		X	SEDIMENT # 02	2				1	1			DBC 34/74,76	

RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)
LARRY GRIER	6/13/91	FED. EXPRESS			
(SIGN) Larry Grier		(SIGN)	(SIGN)		(SIGN)
RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)
(SIGN)		(SIGN)	(SIGN)		(SIGN)

DISTRIBUTION: White and pink copies accompany sample shipment to laboratory. Pink copy retained by laboratory.

NUS CORPORATION
UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
Region 4 Field Investigation Team

029

CHAIN OF CUSTODY RECORD

NUS CORPORATION
1927 LAKESIDE PARKWAY
SUITE 614
TUCKER, GA 30084

PROJECT NO. 91 727

PROJECT LEADER ALVIN WILLIAMS

REMARKS AIR # 8644163334
3 COOLERS

PROJECT NAME/LOCATION

SAMPLE TYPES
1. SURFACE WATER
2. GROUND WATER
3. POTABLE WATER
4. WASTEWATER
5. LEACHATE
6. SOIL SEDIMENT
7. SLUDGE
8. WASTE
9. AIR
10. FISH
11. OTHER

SAMPLERS (SIGN) Larry Grier

CIRCLE/ADD parameters desired. List no. of containers submitted

STATION NO. (20)	SAMPLE TYPE	DATE (19 91)	TIME	COMP	GRAB	STATION LOCATION/DESCRIPTION	TOTAL CONTAINERS	METALS	CYANIDE	VOA	EXT ORG/PEST/PCB	VOA	EXT ORG/PEST/PCB	METALS/CN	TAG NO./SAMPLE NO.	LAB USE ONLY
SD03	6	6/13	1345		X	SEDIMENT #03	1					1			DBC 35/450877	

RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)
LARRY GRIER	6/13/91	FED EXPRESS			
(SIGN) Larry Grier		(SIGN)	(SIGN)		(SIGN)
RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)
(SIGN)		(SIGN)	(SIGN)		(SIGN)

DISTRIBUTION: White and pink copies accompany sample shipment to laboratory. Pink copy retained by laboratory.

APPENDIX B
QA \ QC

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

RECEIVED
SEP 10 1991
SUPERFUND SECTION

C-586-9-1-23

September 5, 1991

Mr. Harvey Allen
North Carolina Department of Health and Natural Resources
Superfund Section
401 Oberlin Road
Raleigh, North Carolina 27604

Subject: Data Transmittal
Union Oil Company, SE Terminal
Greensboro, North Carolina
TDD No. F4-9105-21

Dear Mr. Allen:

Enclosed is the complete analytical data package for the above subject site inspection. If you have any questions, please call me at (404) 938-7710.

Very truly yours,

R. Roger Franklin
Director of Field Operations

RRF/gwn

Enclosure

cc: Debbie Vaughn-Wright, EPA