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CENTRAL CAROLINA TIRE
PHASE III SCRAP TIRE MONOFILL LANDFILL

SITE APPLICATION

HARNETT COUNTY, NORTH CAROLINA

Fac/Perm/Co ID# 43-04 | Date 3/26/04 4/14/04 | Doc ID# Carmen Johnson

Prepared for

Central Carolina Tire Holdings
1616 McKoy Town Road
Cameron, North Carolina 28326

by

APPROVED
DIVISION OF WASTE MANAGEMENT
SOLID WASTE SECTION
DATE 5/21/04 BY DJB

Withers & Ravenel Inc
111 MacKen
Cary, North Ca

SITE SUITABILITY; 48+/- ACRE TIRE MONOFILL
PHASE III
RALEIGH CENTRAL FILE COPY
PERMIT NUMBER 43-04

February 5,

W&R Project No. 202334.01

NORTH CAROLINA LICENSED SEAL 1980 GEOLOGIST BRIAN J. BELLIS

Brian J. Bellis, L.G.

NORTH CAROLINA PROFESSIONAL SEAL 025990 ENGINEER J. STEFAN BRAY

Stefan Bray, P.E.

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NCDENR
North Carolina Department of Environment and Natural Resources

Dexter R. Matthews, Director | Division of Waste Management | Michael F. Easley, Governor
William G. Ross Jr., Secretary

May 21, 2004

Mr. Thomas Womble, President
Central Carolina Holdings, LLC
d/b/a Central Carolina Tire Disposal
1616 McKoy Town Road
Cameron, North Carolina 28326

Re: General Conditions and Site Specific Design Requirements for the Proposed Central Carolina Holdings, LLC d/b/a Central Carolina Tire Disposal Phase III Tire Monofill, Harnett County, North Carolina

Dear Mr. Womble:

The Solid Waste Section (Section) of the Division of Waste Management, has completed its review of the site study application for Central Carolina Holdings, LLC d/b/a Central Carolina Tire Disposal Phase III Tire Monofill. The proposed monofill is located north of the existing Phase I/Phase II tire monofill and the facility is located at the end of State Road 1105 (S.R. 1105) in souther Harnett County. The site will be accessed from McKoy Town Road according to the site suitability plan. Pursuant to Rule .0503(1) and .0504(1), of the North Carolina Administrative Code 15A NCAC 13B, the Division is notifying Central Carolina Holdings, LLC d/b/a Central Carolina Tire Disposal that the site is considered suitable based on the information provide to the Section in documents prepared by Withers & Ravenel, Inc. (Withers). The site suitability documents are as follows:

1. Central Carolina Tire Phase III Scrap Tire Monofill Landfill - Site Application - prepared for Central Carolina Holdings, LLC; 1616 McKoy Town Road;Cameron, North Carolina 28326 dated 9 February 2004, received 23 February 2004. W&R project No. 202334.01.

Central Carolina Holdings, LLC d/b/a Central Carolina Tire Disposal is authorized to prepare an application for a permit to construct. This letter addresses the approved disposal area, scope for any additional subsurface investigations if required to prepare the construction plans for the disposal area and support facilities and design and construction standards for the referenced facility.

Section .0201 of the Solid Waste Management Rules (15A NCAC 13B) requires the Division to issue a solid waste permit in two parts. The first part is a Permit to Construct and the second part is a Permit to Operate. The Division may only issue a Permit to Operate after it determines that the facility has been constructed in accordance with the construction permit and that all pre-operative conditions have been met. **This letter is not a permit**. This letter only informs the applicant that they may proceed with their construction permit application. The final action the Division may take on a permit application is the issuance or denial of a permit.

APPROVED DISPOSAL AREA

General

Based upon information submitted in the 9 February 2004 site suitability application, the Solid Waste Section has determined that the proposed 48+/- acre footprint (of the total 255+/- acres that the facility encompasses with the tire processing area and existing Phase I & II) as shown on W&R Sheet No. 1-1 and drawing No. 00097C by Bennett Surveys, Inc. is suitable for the development of the tire monofill.

The footprint may be smaller based on site specific design and hydrogeologic design of the site monitoring system and/or future delineation of wetlands on the property, based on information in the Construction Plan.

GENERAL CONDITIONS AND SITE-SPECIFIC DESIGN REQUIREMENTS

The Section requires the submittal of a construction plan application for the first five-year development phase, as identified in the conceptual design plan, which is consistent with the requirements of 15A NCAC 13B .0201(e), including, but not limited to, the site specific criteria set forth in this letter.

Buffers

Horizontal buffers shall be as described in the conceptual design and as designated in Rule .0503(2)(f), and shall also include the following buffer criteria:

a) A 100-foot minimum buffer shall be maintained between facility boundaries and borrow areas, unless otherwise approved by the Division;

b) A minimum 50-foot buffer shall be maintained between borrow areas and delineated wetlands;

c) A minimum 50-foot buffer shall be maintained between disposal areas and delineated wetlands;

d) A minimum 50-foot buffer shall be maintained between facility activities and any sites of archeological, historical and/or cultural significance;

e). A minimum 200-foot buffer shall be maintained between the disposal area and the site property lines;

d) A minimum 50-foot buffer shall be maintained between facility activities and any sites of archeological, historical and/or cultural significance;

e). A minimum 200-foot buffer shall be maintained between the disposal area and the site property lines;

f). A minimum 500-foot buffer to wells(on-site or off-site) and off-site dwellings.

Central Carolina Holdings, LLC d/b/a Central Carolina Tire Disposal may utilize all remaining areas of the site, except buffer areas, for other solid waste management activities (such as recycling, TDF storage and processing) or for landfill support activities (such as stockpiling of cover material) upon approval by the Section.

Design and Construction Standards

1. The applicant must complete the application for a permit to construct consistent with Rule .0503(2) and .0504(2) and the general site conditions and design requirements of this letter.

2. A property survey (describing the metes and bounds of the entire property owned) sealed by a licensed North Carolina Surveyor, shall be submitted with the permit to construct application.

Additional Subsurface Investigation

Any necessary additional geologic and hydrogeologic information from Withers; along with ground water monitoring plan information shall be submitted as a component of the construction plan application. The report shall present the results of any additional subsurface investigations at the site and shall be consistent with the requirements of the Solid Waste Management Rules.

The Permit to Construct and the Permit to Operate will be issued to Central Carolina Holdings, LLC d/b/a Central Carolina Tire Disposal as owner of the property.

The Division encourages all solid waste management facilities to take an aggressive approach to comprehensive solid waste management in order to contribute towards the States' waste reduction goals and lessen dependency upon conventional disposal in a municipal solid waste landfill facility.

If you have any questions, or would like to schedule a meeting to discuss this letter, please contact our office at (919) 733-0692, Ext. 255.

Sincerely,

James C. Coffey
Section Chief
Solid Waste Section
Division of Waste Management

cc: Mark Fry, SWS
Jim Barber, SWS
Dennis Shackelford, SWS
Ms. Ellen Lorscheider, SWS
Vance Moore, Withers & Ravenel
Raleigh Central File: Harnett County; Permit 43-04

North Carolina
Department of Environment and Natural Resources
Division of Waste Management

Michael F. Easley, Governor
William G. Ross Jr., Secretary
Dexter R. Matthews, Director

May 7, 2004

Mr. Thomas Womble
1616 McKoy Town Road
Cameron, NC 38236
Subject: Central Carolina Tire Phase III Site Suitability
Harnett County, Permit # 43-04

Dear Mr. Womble,

I have reviewed the Central Carolina Tire Phase III Scrap Tire Monofill Landfill Site Application dated February 9, 2004. I do not need further information during the Site Suitability for this area of the landfill but would like to make you aware of several things that will be necessary to be included in the application for a Permit to Construct.

The Seasonal High groundwater represented during the Site Suitability was indicated to be in August of 2003. There was limited information presented in the report, only data presented from the piezometers which were installed during the Site Suitability for Phase III. Please include groundwater level information from the monitoring wells MW-1 through MW-9 for historical representation of a typical "season" and discuss with me before base grades are set within the footprint of the landfill. I have looked at the past historical data in the Solid Waste Section file room and it looks like August 2003 may not be representative of a typical season (although the closest data was October 2003 which showed groundwater levels to be low that season).

I will be available for discussion of the boring plan, future monitoring plan and any other aspects of the design application. I can be reached at 919-733-0692 ext 345, or by email at ellen.lorscheider@ncmail.net.

Sincerely,

Ellen Lorscheider

Ellen Lorscheider
Permitting Hydrogeologist

Cc: Brian Bellis, Withers & Ravenel
Jim Barber, SWS

WITHERS & RAVENEL
ENGINEERS | PLANNERS | SURVEYORS

February 9, 2004

Mr. Jim Barber
Branch Head
NCDENR Division of Waste Management
Solid Waste Section
401 Oberlin Road, Suite 150
Raleigh, NC 27605

Dear Mr. Barber:

On behalf of Central Carolina Tire (CCT), Withers & Ravenel, Inc. is pleased to submit five (5) copies of the Site Plan Application for the Central Carolina Tire Phase III Scrap Tire Monofill Landfill. The proposed Phase III landfill is located on the same site as the existing CCT Phase I/II Scrap Tire Monofill Landfill (Permit No. 43-04) and the existing CCT Scrap Tire Collection and Processing Site (Permit No. 43-08). The Site Application was prepared in accordance with 15A NCAC 13B Rule .0504(1).

Upon the Division's successful review of the enclosed Site Plan Application, CCT shall prepare a Permit To Construct Application for the proposed Phase III scrap tire monofill landfill.

If you have any questions or comments, or need any additional information during your review, please do hesitate to contact me at (919) 469-3340.

Very truly yours,

WITHERS & RAVENEL, INC.

Stefan Bray, P.E.

cc: Vance Moore, Withers & Ravenel
Thomas Womble, Central Carolina Tire

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Section 1
Summary Report

1.1 Introduction

Rule .0504 of the North Carolina Solid Waste Management Rules requires the owner and operator of a proposed new sanitary landfill facility to meet the requirements of Rule .0504 prior to submitting an application for a permit to construct the new facility. This document, referred to as the Site Study, contains the information to meet and comply with the requirements of Rule .0504.

The information provided in this Site Study is presented in the same order as in the Rules. Each section of this Site Study addresses a section of the rules.

- Section 2.0 presents the one-fourth mile aerial map in accordance with Rule .0504 (1)(a);
- Section 3.0 presents the two-mile map in accordance with Rule .0504 (1)(b);
- Section 4.0 presents the site hydrogeologic report prepared to meet the requirements of Rule .0504 (1)(c);
- Section 5.0 presents the approval of the Harnett County Board of Commissioners to site a landfill on the proposed property according to Rule .0504 (1)(e). All supporting documentation is provided as Attachment 5.1 and 5.2; and,
- Section 6.0 fulfills Rule .0504(1)(f). It provides information demonstrating that the proposed facility is in compliance with the siting standards in Rule .0503(1). All supporting documentation is provided as Attachment 6.1 and 6.2,

1.2 Overview of Harnett County and the Site

Harnett County, located in east-central North Carolina, has a population of approximately 93,000. The proposed tire monofill landfill site is located in the town of Cameron. The land immediately adjacent to the proposed Phase III disposal area is bordered on the south by the existing landfill, to the north by the existing tire collection and processing facility, to the west and north by forests and farmland, and to the east by forested lands.

The existing topography at the proposed site varies in elevation from 300 feet M.S.L. in the southeastern area to 360 feet M.S.L. in the northwestern area. On-site surface drainage travels primarily in a southeast direction, and ultimately discharges into the Cape Fear. There is one perennial or intermittent stream located on-site or within 500 feet of the property boundaries. This stream is located approximately 800 feet to the east of the proposed site.

According to the Federal Emergency Management Agency's (FEMA) Flood Insurance Map, the 100-year flood-plain does not encroach into the footprint of the proposed tire monofill landfill. Floodplains are discussed in greater detail in Sections 2 and 6 of this report. Conceptual design plans and layouts of the proposed Tire Monofill Facility are included as Figures 1-1 and 1-2.

As shown on Figures 1-1 and 1-2, the proposed layout of the Phase III scrap tire monofill will result in fill material into waters of the state regulated under Section 404 of the Clean Water Act. Discharge of fill materials into waters of the state shall be accomplished only as authorized by the U.S. Army Corps of Engineers and NCDENR-Division of Water Quality (404/401 permitting). Wetland permitting documentation shall be included in the future Permit To Construct application for the Phase III scrap tire monofill.

1.3 Background of the Central Carolina Tire Facility

The Central Carolina Tire facility is located approximately ten miles southeast of Cameron along NC 24/27. Specifically, the site is 8500 feet South of the intersection of NC Highway 24/27 and NC Highway 1105 (McKoy Town Road) on McKoy Town Road and approximately 1 mile northeast of Lake Surf. A copy of the survey plat for the property is included as Attachment 1-1.

The proposed Phase III Tire Monofill Landfill will be located on a 48-acre site adjacent to and generally north of the existing Central Carolina Tire Phases I/II Monofill Landfill (NC DENR Solid Waste Management landfill permit # 43-04), and generally south of the existing Scrap Tire Collection and Processing Facility (NC DENR Solid Waste Management landfill permit # 43-08 TP).

The existing Scrap Tire Collection and Processing Facility (NC DENR Solid Waste Management landfill permit # 43-08 TP) is located north of the proposed Phase III monofill. The approximate 26-acre collection and processing site is permitted to store, prior to processing, not more than 23,076 tires. A minimum of 75% of tire-derived products must be disposed in Central Carolina Tire Disposal's tire monofill or shipped off-site on an annual basis. Permit # 43-08 TP currently allows for tire collection and processing operations at the site and is subject to review every three years, on or before August 21, 2006.

The existing Central Carolina Tire Monofill (permit # 43-04) is located south of the proposed Phase III monofill and began disposal operations in 1992 (Phase I). Central Carolina Tire obtained a modification to Permit # 43-04 in February 1996. This modification, referred to as Phase II, allowed Central Carolina Tire to expand and place tires in the remaining 30.2-acres of the 40.7-acre site described in the original permit application. Central Carolina Tire currently operates within the approved Phase II area. Permit # 43-04 currently allows for the ongoing filling operations in Phase II and is subject to review every five years, on or before August 21, 2006.

The existing Central Carolina Tire Phases I/II Monofill Landfill (permit # 43-04) serves the residential, commercial, and industrial scrap tires generators in North Carolina and other states. The proposed Phase III Tire Monofill Landfill will continue to accept scrap tires generated in North Carolina and other states. Out-of-state tire disposal shall be subject to the requirements of 15A NCAC 13B .0108 (*OUT-OF-STATE WASTE IN SANITARY LANDFILLS*) and all other North Carolina Solid Waste Management Rules in effect at the time of the request.

The proposed Phase III tire monofill landfill shall receive scrap tire only. Based on current Central Carolina Tire estimates, the proposed facility is expected to receive approximately 26,500 tons of waste per year.

Central Carolina Tire currently uses a Cat® D-7 bulldozer, a Terex pan/scraper, and a Kobelco trackhoe to operate the Phase I/II tire monofill landfill. Central Carolina Tire will use the same equipment that is currently being used to operate the Phase III tire monofill landfill. The entrance facility and tire processing equipment for the existing Phase I/II tire monofill landfill will also be used for the proposed Phase III tire monofill landfill.

Drawings Under Seperate

Section 2
One-Fourth Mile Map

2.1 Introduction

Rule .0504 (1)(a) of the North Carolina Solid Waste Management Rules requires an aerial photograph on a scale of at least 1 inch equals 400 feet and a blueprint of the photograph accurately showing the area within one-fourth mile of the proposed site's boundaries with the following specifically identified:

- The entire property owned or leased by the person proposing the disposal site;
- Existing land use and zoning;
- The location of private residences and schools;
- The location of all homes, industrial buildings, public or private utilities, and roads;
- The location of wells, watercourses, dry runs, and other applicable details regarding the general topography; and
- Floodplains.

2.2 Proposed Disposal Site Property

W&R generated a 1 inch equals 400 feet map which details the entire aerial extent of the proposed tire monofill landfill and all surrounding properties within a one fourth mile radius. This map was compiled using aerial photography and a subsequent field visit to identify all pertinent features required by Rule .0504(1)(a) and to insure that no major changes had occurred since the aerial photograph was taken on March 10, 2003.

The property proposed for the Phase III Central Carolina Tire Monofill landfill facility is located on the approximate 255-acre tract that currently includes, but not limited to, the Phase I/II Central Carolina Tire Monofill (NC DENR Permit No. 43-04) and the Central Carolina Tire Disposal – Scrap Tire Collection and Processing Site (NC DENR Permit No. 43-08). The entire approximate 255-acre tract is owned by Central Carolina Holdings, LLC.

Within the approximate 240-acre Central Carolina Tire tract, the proposed Phase III landfill area is bordered on the south by the existing approximate 41-acre Phase I/II landfill and to the north by the existing approximate 26-acre tire collection and processing facility. The proposed Phase III Central Carolina Tire Monofill landfill consists of landfill footprint of approximately 48 acres. The location of the proposed Phase III landfill, as well as the location of the existing site facilities, is identified on Figure 2-1.

There is an existing 60' CP&L transmission line easement that runs along the western and southern boundary of the property. The easement is identified on Figure 2-1.

Land to the northwest and northeast of the Central Carolina Tire Monofill facility site is primarily open pasture that is wooded in the vicinity of drainage features within those pastures. The area to the east and south of the site is primarily undeveloped and wooded. Agricultural land borders the site to the southwest and a maintenance area for the existing landfill facility occupies land adjacent to the northwest edge of the study area.

2.3 Existing Land Use and Zoning

Figure 2-1 shows the existing land use within a one-fourth mile of the proposed landfill property boundary. Land use in the area closest to the property boundary is primarily residential/agricultural (RA-20). A few properties located in just north of the facility property boundary are located Industrial (I).

Land use in the area within a one-fourth mile of the proposed landfill property boundary is primarily residential housing, hog farming and forestry. Land to the northwest and northeast of the Central Carolina Tire Monofill facility site is primarily open pasture that is wooded in the vicinity of drainage features within those pastures. The area to the east and south of the site is primarily undeveloped and wooded. Animal operations areas are located south and west of the landfill property.

2.4 Private Residences and Schools

The locations of private residences are identified on Figure 2-1. There are no schools within one-fourth mile of the site.

2.5 Commercial and Industrial Buildings

There are no commercial or industrial buildings within one-fourth mile of the boundary of the Central Carolina Tire Monofill landfill facility site.

2.6 Potable Wells

The Harnett County Utilities Department is the only public water supply utility providing service within one-fourth mile of the landfill expansion site. Based on discussions with the Harnett County Utilities Department, some, but not all, of the households within one-fourth mile of the site are currently using the public waste supply lines. Therefore, it is assumed each single family homes has, and/or is currently using, a private well. A minimum of 500-foot separation will be maintained between the landfill and all private residence/wells.

2.7 Floodplains

W&R reviewed the Federal Emergency Management Agency's (FEMA) Flood Insurance Risk Map (effective 4-16-1990) which identifies 100-year floodplain areas. As shown in Figures 2-1 and 3-1, no portion of the proposed tire monofill landfill property lies within the 100-year floodplain. A copy of the effective FEMA Flood Insurance Risk Map is attached to this section as Appendix 2.1.

Drawings "Under Seperate Cover"

Section 3
Two-Mile Map

3.1 Introduction

Rule .0504 (1) (b) of the North Carolina Solid Waste Management Rules requires that a map on a scale of at least 1 inch equals 1000 feet showing the area within two miles of the proposed site's boundaries with the following specifically identified:

- Significant ground-water users;
- Potential or existing sources of ground-water and surface water pollution;
- Water intakes;
- Airport and runways; and
- Subdivisions.

All items discussed above are shown on figure 3-1 and discussed below.

3.2 Significant Groundwater Users

Through Environmental Data Resources, Inc. (EDR), an environmental database search firm, W&R reviewed files and databases of the North Carolina Department of Environment and Natural Resources (NCDENR) and the United States Environmental Protection Agency (EPA) to determine if public water supply wells exist within a two-mile radius of the proposed site. No public water supply wells were identified within two miles of the proposed site. All drinking water within a two-mile radius of the proposed site is supplied by either Harnett County Utilities Department's water distribution system or private wells. The EDR report is provided in the Appendix 3.1.

3.3 Potential Sources of Pollution

There are several sources of potential groundwater and surface water pollution within two miles of the proposed site's boundaries. All potential sources of pollution are identified on figure 3-1.

3.3.1 Local, State and Federal Environmental Regulatory Authorities and Databases

Through Environmental Data Resources, Inc. (EDR), an environmental database search firm, W&R reviewed files and databases of the North Carolina Department of Environment and Natural Resources (NCDENR) and the United States Environmental Protection Agency (EPA) to determine if either agency has been involved in any regulatory activities at or in the vicinity of the site. Facilities that treat, store, generate,

transport, or dispose of hazardous substances or petroleum products and any incidents of leaks, spills and dumping of hazardous substances or petroleum products may be found in one or more government listings. The EDR report is provided in the Appendix 3.2 and details of the reported are noted below.

3.3.2 National and State Priorities List; CERCLA

W&R reviewed the EDR listing of sites registered in the National and State Priorities Lists as "Superfund" sites under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). No CERCLA sites are listed for the subject property or within a two-mile radius of the subject property.

The Hazardous Substance Disposal Sites (HSDS) list contains locations of uncontrolled and unregulated hazardous waste sites. In addition, the Inactive Hazardous Sites Inventory (SHWS) list contains state hazardous waste site records and is the state equivalent of CERCLIS. No site is listed in the EDR report within two mile of the site for both databases. There are no other records of any HSDS or SHWS sites within two mile of the subject property listed in the EDR report.

3.3.3 Potential CERCLA

W&R reviewed the lists provided by EDR of sites registered in the Comprehensive Environmental Response Compensation and Liability Act as potential "Superfund" sites under the Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS). No potential CERCLA/"Superfund" sites are listed within a two-mile radius of the site.

3.3.4 RCRA

W&R reviewed the list provided by EDR of businesses that generate or transport hazardous waste registered under the Resource Conservation and Recovery Act (RCRA). The site and adjacent properties are not listed as a RCRA generating or transporting facilities. In addition, no treatment, storage, or disposal (TSD) facilities are reported in the EDR report as being located within a two-half mile radius of the subject property.

No RCRA sites are listed in the EDR Report within a two-mile radius of the site.

3.3.5 Hazardous Spill Incident Records

W&R reviewed NCDENR-Emergency Management Spills (EMS) and USEPA - Emergency Response Notification System (ERNS) databases pertaining to hazardous material spills provided in the EDR report. There were no spills listed in the EDR Report within a two-mile radius of the site.

3.3.6 UST Leak Incidents

W&R reviewed a list of leaking underground storage tank (LUST) incidents for Harnett County maintained by NCDENR and provided by the EDR report. No LUST incidents were listed within a two-mile radius of the site.

3.3.7 Registered USTs

W&R reviewed registered UST databases for Harnett County maintained by NCDENR for the site and all adjacent properties, as listed in the EDR report. No registered USTs are listed for the subject site.

The EDR report did not identify any registered USTs within two-miles of the site.

It should be noted that registration with the NCDENR of commercial USTs was not required prior to 1988. Additionally, registration for non-commercial USTs (e.g. residential) less than 1,100 gallons in capacity is not required with NCDENR. Therefore, if a UST system was used to store fuel for any heating system on the property, or to support agricultural or other operations there would be no written public record of it's use.

3.3.8 Solid Waste Landfills

The North Carolina Solid Waste Section database, as provided in the EDR report, was reviewed to determine if any solid waste facilities are within the vicinity of the subject property. This listing includes domestic waste landfills; industrial waste landfills; construction/demolition landfills; sludge landfills; ash landfills; and land clearing and inert debris landfills greater than 2-acres. The subject site is not listed as a solid waste landfill facility. One facility was listed in the Old Landfill Inventory (OLI) located within a half-mile radius of the site. The existing CCT Phase I/II tire monofill is located immediately south of the proposed Phase III tire monofill landfill.

3.3.9 Other Potential Sources

Farming and livestock activity is the largest potential source of groundwater pollution. There are two hog farms (permitted animal operations) located within two miles of the proposed site. Other sources of potential contamination include automobile and farm equipment storage, and salvage areas.

3.4 Surface Water Intakes

Through Environmental Data Resources, Inc. (EDR), an environmental database search firm, W&R reviewed files and databases of the North Carolina Department of Environment and Natural Resources (NCDENR) and the United States Environmental Protection Agency (EPA)

to determine if surface water intakes exist within a two-mile radius of the proposed site. The EPA Office of Drinking Water defines a public water system as any water system which provides water to at least 25 people for at least 60 days annually. Public water systems provide water from wells, rivers and other sources. No public water systems were identified within two miles of the proposed site. All drinking water within a two-mile radius of the proposed site is supplied by either Harnett County Utilities Department's water distribution system or private wells. The EDR report is provided in the Appendix 3.2.

W&R also reviewed files and databases compiled by the North Carolina Center for Geographic Information & Analysis to determine if surface water intakes exist within a two-mile radius of the proposed site. The North Carolina Center for Geographic Information & Analysis compiles information from various state and federal agencies and presents the information in maps for various North Carolina counties. The unit of government having jurisdiction over surface water intakes is the North Carolina Division of Water Quality. Review of the Harnett County map (prepared December 2003) identifies no surface water intakes within a two-mile radius of the proposed site. This conclusion is based on information provided on the map by the Division of Water Quality, effective 2003. A copy of the North Carolina Center for Geographic Information & Analysis map for Harnett County is provided in the Appendix 3.3.

3.5 Airports and Runways

There are no airports or runways within a two-mile radius of the proposed tire monofill landfill.

3.6 Residential Subdivisions

There are eight residential subdivisions identified within a two-mile radius of the proposed tire monofill site. The size of the subdivisions vary from a couple of homes to over 100. The locations of the subdivisions are shown on figure 3-1.

Drawings "Under Seperate Cover"

APPENDIX 3.1

ENVIRONMENTAL DATA RESOURCES, INC
AREA STUDY REPORT

The EDR Area Study Report

Study Area
Central Carolina Tire Monofill Landfill
Cameron, NC 28326

September 10, 2003

Inquiry number 1042095.1r

Environmental Data Resources, Inc.

***The* Source For Environmental Risk Management Data**

3530 Post Road
Southport, Connecticut 06890

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802
Internet: www.edrnet.com

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc. (EDR).

TARGET PROPERTY INFORMATION

ADDRESS

CENTRAL CAROLINA TIRE MONOFILL LANDFILL
CAMERON, NC 28326

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records within the requested search area for the following databases:

FEDERAL ASTM STANDARD

NPL	National Priority List
Proposed NPL	Proposed National Priority List Sites
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CERC-NFRAP	CERCLIS No Further Remedial Action Planned
CORRACTS	Corrective Action Report
RCRIS-TSD	Resource Conservation and Recovery Information System
RCRIS-LQG	Resource Conservation and Recovery Information System
RCRIS-SQG	Resource Conservation and Recovery Information System
ERNS	Emergency Response Notification System

STATE ASTM STANDARD

SHWS	Inactive Hazardous Sites Inventory
LUST	Incidents Management Database
UST	Petroleum Underground Storage Tank Database
OLI	Old Landfill Inventory
INDIAN UST	Underground Storage Tanks on Indian Land
VCP	Responsible Party Voluntary Action Sites

FEDERAL ASTM SUPPLEMENTAL

CONSENT	Superfund (CERCLA) Consent Decrees
ROD	Records Of Decision
Delisted NPL	National Priority List Deletions
FINDS	Facility Index System/Facility Identification Initiative Program Summary Report
HMIRS	Hazardous Materials Information Reporting System
MLTS	Material Licensing Tracking System
MINES	Mines Master Index File
NPL Liens	Federal Superfund Liens

EXECUTIVE SUMMARY

PADS..... PCB Activity Database System
DOD..... Department of Defense Sites
RAATS..... RCRA Administrative Action Tracking System
TRIS..... Toxic Chemical Release Inventory System
TSCA..... Toxic Substances Control Act
SSTS..... Section 7 Tracking Systems
FTTS..... FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

STATE OR LOCAL ASTM SUPPLEMENTAL

NC HSDS..... Hazardous Substance Disposal Site
AST..... AST Database
LUST TRUST..... State Trust Fund Database
IMD..... Incident Management Database

EDR PROPRIETARY HISTORICAL DATABASES

Coal Gas..... Former Manufactured Gas (Coal Gas) Sites

BROWNFIELDS DATABASES

Brownfields..... Brownfields Projects Inventory
INST CONTROL..... No Further Action Sites With Land Use Restrictions Monitoring
VCP..... Responsible Party Voluntary Action Sites

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified.

Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

STATE ASTM STANDARD

SWF/LF: The Solid Waste Facilities/Landfill Sites records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. The data come from the Department of Environment & Natural Resources' List of Solid Waste Facility Contacts in Alpha Order.

A review of the SWF/LF list, as provided by EDR, has revealed that there is 1 SWF/LF site within the searched area.

Site	Address	Map ID	Page
CENTRAL CAROLINA TIRE MONOFILL	SR 1105	1	3

EXECUTIVE SUMMARY

Please refer to the end of the findings report for unmapped orphan sites due to poor or inadequate address information.

MAP FINDINGS SUMMARY

Database	Total Plotted
FEDERAL ASTM STANDARD	
NPL	0
Proposed NPL	0
CERCLIS	0
CERC-NFRAP	0
CORRACTS	0
RCRIS-TSD	0
RCRIS Lg. Quan. Gen.	0
RCRIS Sm. Quan. Gen.	0
ERNS	0
STATE ASTM STANDARD	
State Haz. Waste	0
State Landfill	1
LUST	0
UST	0
OLI	0
INDIAN UST	0
VCP	0
FEDERAL ASTM SUPPLEMENTAL	
CONSENT	0
ROD	0
Delisted NPL	0
FINDS	0
HMIRS	0
MLTS	0
MINES	0
NPL Liens	0
PADS	0
DOD	0
RAATS	0
TRIS	0
TSCA	0
SSTS	0
FTTS	0
STATE OR LOCAL ASTM SUPPLEMENTAL	
NC HSDS	0
AST	0
LUST TRUST	0
IMD	0
EDR PROPRIETARY HISTORICAL DATABASES	
Coal Gas	0

MAP FINDINGS SUMMARY

Database	Total Plotted
BROWNFIELDS DATABASES	
Brownfields	0
INST CONTROL	0
VCP	0

NOTES:

Sites may be listed in more than one database

Coal Gas Site Search: No site was found in a search of Real Property Scan's ENVIROHAZ database.

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1 **CENTRAL CAROLINA TIRE MONOFILL** **SWF/LF** **S103595700**
SR 1105 **N/A**
CAMERON, NC

LF:

Facility Id:	P0429
Facility Telephone:	(919) 499-2301
Facility Fax:	(919) 499-4619
Contact:	THOMAS WOMBLE
Engineer:	Not reported
Waste Mgmt Specialist:	Robert Hearn
Contact Address:	PRESIDENT 1616 McKOY TOWN RD CAMERON, NC 28326
Public/Private:	PRIVATE
Facility Status:	OPEN
Lined:	False
Facility Type 1:	Tire Landfill (monofil)

ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
CAMERON	S104157345	STARFLIGHT SELF SERVICE	US 1 / SR 1182		IMD, LUST
CAMERON	U001187837	ARNOLDS. CORNER	ROUTE 1, BOX 40-A	28326	UST
CAMERON	U001187838	BOBBY HOLT SEPTIC TANK CO.	ROUTE 1, BOX 40-B	28326	LUST, UST
CAMERON	U001200864	BORDEN INC DAIRY	RT 2 BOX 158-A	28326	UST
CAMERON	U003562808	HARDY GULF SERVICE	HIGHWAY 24	28326	UST
CAMERON	U003562809	CAMERON FARM SUPPLY	HIGHWAY 24	28326	LUST, UST
CAMERON	S103916916	ATKIN'S GROCERY	HWY 24, RT. 3, BOX 68	28326	IMD, LUST
CAMERON	U001206086	CAMERON HILL FIRE TOWER	ROUTE 3, BOX 75	28326	UST
CAMERON	U001958929	SAWYERS GROCERY	HWY 87 N	28326	UST
CAMERON	U001192056	BEN DAVIS AUTO SERVICE	HIGHWAY 87, ROUTE 2	28326	UST
CAMERON	U001824051	THOMAS BROTHERS NURSERY INC.	U.S. HIGHWAY #1	28326	UST
CAMERON	S104913747	KELLY, OSSIE B.	US HIGHWAY 1 / SR 1182		IMD
CAMERON	U001199507	SHORT STOP #62	US HWY 1/GENR'L DELIVERY BOX 122	28326	UST
CAMERON	U003146706	DOUGLAS GENERAL	21163 NC HWY 24-27	28326	UST
CAMERON	U003853772	FUEL ZONE	2531 NC HWY 87 S	28326	UST
CAMERON	S105040824	CENTRAL CAROLINA TIRE PROCESSSING	1616 MCKOY TOWN ROAD	28326	SWF/LF
CAMERON	U001204788	UNION PINES HIGH SCHOOL	STATE ROAD 1805	28326	UST
VASS	S104919121	VASS TRUCK WRECK	US 1	28394	SHWS
VASS	U000820545	JOHN A. MCRAE	P.O. BOX 6, U.S. HIGHWAY 1	28394	UST
VASS	U001199470	TOMMY'S EXXON	P.O. BOX 429 / ROUTE 1	28394	UST
VASS	S104914473	HUDSON GULF SERVICE	121 U.S. HIGHWAY 1	28394	IMD
VASS	U001186632	KWIK SHOP NUMBER 12	225 US HIGHWAY NUMBER 1	28394	UST
VASS	U003145543	HUDSON GULF SERVICE	U.S. HIGHWAY 1	28394	UST
VASS	U001206284	VASS-LAKEVIEW ELEMENTARY SCHO	US HWY #1	28394	UST
VASS	U001187431	BRIGGS GROCERY	STAR RT - BOX 76-A	28394	UST
VASS	U001188045	DUNROVIN COUNTRY STORE	STAR ROUTE BOX 228	28394	UST

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Elapsed ASTM days: Provides confirmation that this EDR report meets or exceeds the 90-day updating requirement of the ASTM standard.

FEDERAL ASTM STANDARD RECORDS

NPL: National Priority List
Source: EPA
Telephone: N/A
National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 07/22/03
Date Made Active at EDR: 08/26/03
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 08/04/03
Elapsed ASTM days: 22
Date of Last EDR Contact: 08/04/03

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 3
Telephone 215-814-5418

EPA Region 4
Telephone 404-562-8033

EPA Region 6
Telephone: 214-655-6659

EPA Region 8
Telephone: 303-312-6774

Proposed NPL: Proposed National Priority List Sites
Source: EPA
Telephone: N/A

Date of Government Version: 06/10/03
Date Made Active at EDR: 08/26/03
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 08/04/03
Elapsed ASTM days: 22
Date of Last EDR Contact: 08/04/03

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System
Source: EPA
Telephone: 703-413-0223
CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 06/16/03
Date Made Active at EDR: 08/01/03
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 06/23/03
Elapsed ASTM days: 39
Date of Last EDR Contact: 06/23/03

CERCLIS-NFRAP: CERCLIS No Further Remedial Action Planned
Source: EPA
Telephone: 703-413-0223
As of February 1995, CERCLIS sites designated "No Further Remedial Action Planned" (NFRAP) have been removed from CERCLIS. NFRAP sites may be sites where, following an initial investigation, no contamination was found, contamination was removed quickly without the need for the site to be placed on the NPL, or the contamination was not serious enough to require Federal Superfund action or NPL consideration. EPA has removed approximately 25,000 NFRAP sites to lift the unintended barriers to the redevelopment of these properties and has archived them as historical records so EPA does not needlessly repeat the investigations in the future. This policy change is part of the EPA's Brownfields Redevelopment Program to help cities, states, private investors and affected citizens to promote economic redevelopment of unproductive urban sites.

Date of Government Version: 06/11/03
Date Made Active at EDR: 08/01/03
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 06/23/03
Elapsed ASTM days: 39
Date of Last EDR Contact: 06/23/03

CORRACTS: Corrective Action Report
Source: EPA
Telephone: 800-424-9346
CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 03/31/03
Date Made Active at EDR: 05/08/03
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 04/07/03
Elapsed ASTM days: 31
Date of Last EDR Contact: 06/09/03

RCRIS: Resource Conservation and Recovery Information System
Source: EPA
Telephone: 800-424-9346
Resource Conservation and Recovery Information System. RCRIS includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Conditionally exempt small quantity generators (CESQGs): generate less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste per month. Small quantity generators (SQGs): generate between 100 kg and 1,000 kg of hazardous waste per month. Large quantity generators (LQGs): generate over 1,000 kilograms (kg) of hazardous waste, or over 1 kg of acutely hazardous waste per month. Transporters are individuals or entities that move hazardous waste from the generator off-site to a facility that can recycle, treat, store, or dispose of the waste. TSDFs treat, store, or dispose of the waste.

Date of Government Version: 07/11/03
Date Made Active at EDR: 08/18/03
Database Release Frequency: Varies
Date of Data Arrival at EDR: 07/30/03
Elapsed ASTM days: 19
Date of Last EDR Contact: 06/26/03

ERNS: Emergency Response Notification System
Source: National Response Center, United States Coast Guard
Telephone: 202-260-2342
Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 12/31/02
Date Made Active at EDR: 02/03/03
Database Release Frequency: Annually
Date of Data Arrival at EDR: 01/27/03
Elapsed ASTM days: 7
Date of Last EDR Contact: 07/28/03

FEDERAL ASTM SUPPLEMENTAL RECORDS

BRS: Biennial Reporting System
Source: EPA/NTIS
Telephone: 800-424-9346
The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/99
Database Release Frequency: Biennially
Date of Last EDR Contact: 06/16/03
Date of Next Scheduled EDR Contact: 09/15/03

CONSENT: Superfund (CERCLA) Consent Decrees
Source: EPA Regional Offices
Telephone: Varies
Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: N/A
Database Release Frequency: Varies
Date of Last EDR Contact: N/A
Date of Next Scheduled EDR Contact: N/A

ROD: Records Of Decision
Source: EPA
Telephone: 703-416-0223
Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 07/09/03
Database Release Frequency: Annually
Date of Last EDR Contact: 07/07/03
Date of Next Scheduled EDR Contact: 10/06/03

DELISTED NPL: National Priority List Deletions
Source: EPA
Telephone: N/A
The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 07/22/03
Database Release Frequency: Quarterly
Date of Last EDR Contact: 08/04/03
Date of Next Scheduled EDR Contact: 11/03/03

FINDS: Facility Index System/Facility Identification Initiative Program Summary Report
Source: EPA
Telephone: N/A
Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 07/25/03
Database Release Frequency: Quarterly
Date of Last EDR Contact: 07/02/03
Date of Next Scheduled EDR Contact: 10/06/03

HMIRS: Hazardous Materials Information Reporting System
Source: U.S. Department of Transportation
Telephone: 202-366-4555
Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 03/31/03
Database Release Frequency: Annually
Date of Last EDR Contact: 07/23/03
Date of Next Scheduled EDR Contact: 10/20/03

MLTS: Material Licensing Tracking System
Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 04/23/03
Database Release Frequency: Quarterly
Date of Last EDR Contact: 07/02/03
Date of Next Scheduled EDR Contact: 10/06/03

MINES: Mines Master Index File
Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959

Date of Government Version: 06/07/03
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 06/30/03
Date of Next Scheduled EDR Contact: 09/29/03

NPL LIENS: Federal Superfund Liens
Source: EPA
Telephone: 205-564-4267
Federal Superfund Liens. Under the authority granted the USEPA by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner receives notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/91
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 05/27/03
Date of Next Scheduled EDR Contact: 08/25/03

PADS: PCB Activity Database System
Source: EPA
Telephone: 202-564-3887
PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 06/30/03
Database Release Frequency: Annually

Date of Last EDR Contact: 08/13/03
Date of Next Scheduled EDR Contact: 11/10/03

DOD: Department of Defense Sites
Source: USGS
Telephone: 703-648-5920
This data set consists of federally owned or administered lands, administered by the Department of Defense, that have any area equal to or greater than 640 acres of the United States, Puerto Rico, and the U.S. Virgin Islands.

Date of Government Version: 04/01/03
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 08/15/03
Date of Next Scheduled EDR Contact: 11/10/03

RAATS: RCRA Administrative Action Tracking System
Source: EPA
Telephone: 202-564-4104
RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/95
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 06/09/03
Date of Next Scheduled EDR Contact: 09/08/03

TRIS: Toxic Chemical Release Inventory System
Source: EPA
Telephone: 202-260-1531
Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/01
Database Release Frequency: Annually

Date of Last EDR Contact: 06/27/03
Date of Next Scheduled EDR Contact: 09/22/03

TSCA: Toxic Substances Control Act
Source: EPA
Telephone: 202-260-5521
Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/98
Database Release Frequency: Every 4 Years

Date of Last EDR Contact: 06/09/03
Date of Next Scheduled EDR Contact: 09/08/03

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
Source: EPA
Telephone: 202-564-2501

Date of Government Version: 04/15/03
Database Release Frequency: Quarterly

Date of Last EDR Contact: 06/23/03
Date of Next Scheduled EDR Contact: 09/22/03

SSTS: Section 7 Tracking Systems
Source: EPA
Telephone: 202-564-5008
Section 7 of the Federal Insecticide, Fungicide and Rodenticide Act, as amended (92 Stat. 829) requires all registered pesticide-producing establishments to submit a report to the Environmental Protection Agency by March 1st each year. Each establishment must report the types and amounts of pesticides, active ingredients and devices being produced, and those having been produced and sold or distributed in the past year.

Date of Government Version: 12/31/00
Database Release Frequency: Annually
Date of Last EDR Contact: 07/24/03
Date of Next Scheduled EDR Contact: 10/20/03

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-564-2501
FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 04/15/03
Database Release Frequency: Quarterly
Date of Last EDR Contact: 06/23/03
Date of Next Scheduled EDR Contact: 09/22/03

STATE OF NORTH CAROLINA ASTM STANDARD RECORDS

SHWS: Inactive Hazardous Sites Inventory
Source: Department of Environment, Health and Natural Resources
Telephone: 919-733-2801
State Hazardous Waste Sites. State hazardous waste site records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. Available information varies by state.

Date of Government Version: 07/14/03
Date Made Active at EDR: 08/18/03
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 07/22/03
Elapsed ASTM days: 27
Date of Last EDR Contact: 07/11/03

SWF/LF: List of Solid Waste Facilities
Source: Department of Environment and Natural Resources
Telephone: 919-733-0692
Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 04/29/03
Date Made Active at EDR: 05/08/03
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 04/29/03
Elapsed ASTM days: 9
Date of Last EDR Contact: 07/28/03

LUST: Incidents Management Database
Source: Department of Environment and Natural Resources
Telephone: 919-733-1315
Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 07/18/03
Date Made Active at EDR: 08/18/03
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 07/21/03
Elapsed ASTM days: 28
Date of Last EDR Contact: 06/09/03

UST: Petroleum Underground Storage Tank Database
Source: Department of Environment and Natural Resources
Telephone: 919-733-1308
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 02/11/03
Date Made Active at EDR: 06/26/03
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 06/09/03
Elapsed ASTM days: 17
Date of Last EDR Contact: 06/09/03

OLI: Old Landfill Inventory
Source: Department of Environment & Natural Resources
Telephone: 919-733-4996

Date of Government Version: 07/02/03
Date Made Active at EDR: 08/27/03
Database Release Frequency: Varies

Date of Data Arrival at EDR: 07/28/03
Elapsed ASTM days: 30
Date of Last EDR Contact: 07/28/03

VCP: Responsible Party Voluntary Action Sites
Source: Department of Environment and Natural Resources
Telephone: 919-733-4996

Date of Government Version: 06/05/03
Date Made Active at EDR: 06/26/03
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 06/05/03
Elapsed ASTM days: 21
Date of Last EDR Contact: 06/05/03

INDIAN UST: Underground Storage Tanks on Indian Land
Source: EPA Region 4
Telephone: 404-562-9424

Date of Government Version: N/A
Date Made Active at EDR: N/A
Database Release Frequency: Varies

Date of Data Arrival at EDR: N/A
Elapsed ASTM days: 0
Date of Last EDR Contact: N/A

STATE OF NORTH CAROLINA ASTM SUPPLEMENTAL RECORDS

HSDS: Hazardous Substance Disposal Site
Source: North Carolina Center for Geographic Information and Analysis
Telephone: 919-733-2090
Locations of uncontrolled and unregulated hazardous waste sites. The file includes sites on the National Priority List as well as those on the state priority list.

Date of Government Version: 06/21/95
Database Release Frequency: Biennially

Date of Last EDR Contact: 06/02/03
Date of Next Scheduled EDR Contact: 09/01/03

AST: AST Database
Source: Department of Environment and Natural Resources
Telephone: 919-715-6170
Facilities with aboveground storage tanks that have a capacity greater than 21,000 gallons.

Date of Government Version: 06/05/03
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 07/23/03
Date of Next Scheduled EDR Contact: 10/20/03

LUST TRUST: State Trust Fund Database
Source: Department of Environment and Natural Resources
Telephone: 919-733-1315
This database contains information about claims against the State Trust Funds for reimbursements for expenses incurred while remediating Leaking USTs.

Date of Government Version: 08/08/03
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 08/11/03
Date of Next Scheduled EDR Contact: 11/10/03

IMD: Incident Management Database
Source: Department of Environment and Natural Resources
Telephone: 919-733-1315
Groundwater and/or soil contamination incidents

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Date of Government Version: 07/24/03
Database Release Frequency: Quarterly

Date of Last EDR Contact: 07/28/03
Date of Next Scheduled EDR Contact: 10/27/03

EDR PROPRIETARY HISTORICAL DATABASES

Former Manufactured Gas (Coal Gas) Sites: The existence and location of Coal Gas sites is provided exclusively to EDR by Real Property Scan, Inc. ©Copyright 1993 Real Property Scan, Inc. For a technical description of the types of hazards which may be found at such sites, contact your EDR customer service representative.

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STATE OF NORTH CAROLINA BROWNFIELDS DATABASES RECORDS

Brownfields: Brownfields Projects Inventory
Source: Department of Environment and Natural Resources
Telephone: 919-733-4996
A brownfield site is an abandoned, idled, or underused property where the threat of environmental contamination has hindered its redevelopment. All of the sites in the inventory are working toward a brownfield agreement for cleanup and liabitliy control.

Date of Government Version: 12/31/02
Database Release Frequency: Varies

Date of Last EDR Contact: 08/18/03
Date of Next Scheduled EDR Contact: 11/03/03

VCP: Responsible Party Voluntary Action Sites
Source: Department of Environment and Natural Resources
Telephone: 919-733-4996

Date of Government Version: 06/05/03
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 06/05/03
Date of Next Scheduled EDR Contact: 10/13/03

INST CONTROL: No Further Action Sites With Land Use Restrictions Monitoring
Source: Department of Environment, Health and Natural Resources
Telephone: 919-733-2801

Date of Government Version: 07/14/03
Database Release Frequency: Quarterly

Date of Last EDR Contact: 07/22/03
Date of Next Scheduled EDR Contact: 10/13/03

OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

Oil/Gas Pipelines: This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines.

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

AHA Hospitals:
Source: American Hospital Association, Inc.
Telephone: 312-280-5991
The database includes a listing of hospitals based on the American Hospital Association's annual survey of hospitals.

Medical Centers: Provider of Services Listing
Source: Centers for Medicare & Medicaid Services
Telephone: 410-786-3000
A listing of hospitals with Medicare provider number, produced by Centers of Medicare & Medicaid Services, a federal agency within the U.S. Department of Health and Human Services.

Nursing Homes
Source: National Institutes of Health
Telephone: 301-594-6248
Information on Medicare and Medicaid certified nursing homes in the United States.

Public Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on elementary and secondary public education in the United States. It is a comprehensive, annual, national statistical database of all public elementary and secondary schools and school districts, which contains data that are comparable across all states.

Private Schools
Source: National Center for Education Statistics
Telephone: 202-502-7300
The National Center for Education Statistics' primary database on private school locations in the United States.

Daycare Centers: Child Care Facility List
Source: Department of Health & Human Services
Telephone: 919-662-4499

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002 from the U.S. Fish and Wildlife Service.

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APPENDIX 3.2

ENVIRONMENTAL DATA RESOURCES, INC
WELL SEARCH REPORT

The EDR Well Search Report
EDR Area Study

Well Search
Central Carolina Tire Monofill Landfill
Cameron, NC 28326

September 10, 2003

Inquiry number 1042095.1w

Environmental Data Resources, Inc.

The Source For Environmental Risk Management Data

3530 Post Road
Southport, Connecticut 06890

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802
Internet: www.edrnet.com

GEOCHECK VERSION 2.1
SUMMARY

FEDERAL DATABASE WELL INFORMATION

MAP ID	WELL ID

NO WELLS FOUND

STATE WATER WELL INFORMATION

MAP ID	WELL ID

NO WELLS FOUND

PUBLIC WATER SUPPLY SYSTEM INFORMATION

NO WELLS FOUND

USGS TOPOGRAPHIC MAP(S)

2435079-B1 OVERHILLS, NC
2435079-B2 LOBELIA, NC
2435079-C1 OLIVIA, NC
2435079-C2 MURCHISONTOWN, NC

AREA RADON INFORMATION

Federal Area Radon Information for Zip Code: 28326

Number of sites tested: 3

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	0.467 pCi/L	100%	0%	0%
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	Not Reported	Not Reported	Not Reported	Not Reported

Federal Area Radon Information for Zip Code: 28326

Number of sites tested: 3

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	0.467 pCi/L	100%	0%	0%
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	Not Reported	Not Reported	Not Reported	Not Reported

Federal EPA Radon Zone for HARNETT County: 3

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

GEOCHECK VERSION 2.1
SUMMARY

AREA RADON INFORMATION

Federal Area Radon Information for HARNETT COUNTY, NC

Number of sites tested: 4

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	0.250 pCi/L	100%	0%	0%
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	Not Reported	Not Reported	Not Reported	Not Reported

Federal EPA Radon Zone for MOORE County: 3

Note: Zone 1 indoor average level > 4 pCi/L.
: Zone 2 indoor average level >= 2 pCi/L and <= 4 pCi/L.
: Zone 3 indoor average level < 2 pCi/L.

Federal Area Radon Information for MOORE COUNTY, NC

Number of sites tested: 7

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	0.329 pCi/L	100%	0%	0%
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	Not Reported	Not Reported	Not Reported	Not Reported

NORTH CAROLINA GOVERNMENT WELL RECORDS SEARCHED

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

State Database: NC Radon
Source: Department of Environment & Natural Resources
Telephone: 919-733-4984
Radon Statistical and Non Statiscal Data

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

North Carolina Wildlife Resources/Game Lands
Source: Center for Geographic Information and Analysis
Telephone: 919-733-2090
All publicly owned game lands managed by the North Carolina Wildlife Resources Commission and as listed in Hunting and Fishing Maps for North Carolina Game Lands, 1989-90.

North Carolina Rare/Endangered Species and Natural Areas
Source: Natural Heritage Occurrence Sites Center for Geographic Information and Analysis
Telephone: 919-733-2090

North Carolina Public Water Supply Wells
Source: Department of Environmental Health
Telephone: 919-715-3243

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APPENDIX 3.3

MAP FOR HARNETT COUNTY
NORTH CAROLINA CENTER FOR GEOGRAPHIC INFORMATION & ANALYSIS

"Under Seperate Cover"

Section 4
Site Hydrogeologic Study

4.1 Introduction

The Site Hydrogeologic Study provides a detailed discussion of the hydrogeological conditions at the site as outlined below:

- Information regarding the local and regional geology and hydrogeology;
- Description of pertinent site hydrogeologic features including topography, springs, streams, surface water bodies, drainage swales, wells, rock outcrops, and groundwater discharge areas;
- Description of soil samples from and groundwater levels within an adequate number of borings to provide an understanding of subsurface conditions and groundwater flow;
- Results of tests designed to characterize the physical properties of soil encountered within the borings;
- Results of other tests performed to characterize better the site hydrogeology;
- Interpretations of the subsurface stratigraphy or lithology in the form of cross-sections that identify hydrogeologic units and stabilized groundwater elevations;
- Depth to groundwater information and water-table elevation data;
- Characterization of groundwater flow beneath the site;
- Groundwater elevation contour map(s) indicating the direction(s) of groundwater flow;
- A map showing the site topography and locations of soil borings and piezometers used in the study;
- Copies of soil boring logs, field testing logs, and piezometer or well construction records;
- Identification of site-specific geologic and hydrologic considerations; and,
- A report that summarizes the geological and hydrogeological evaluation of the site.

4.2 Local and Regional Geology and Hydrogeology

W&R provides the following information on the local and regional geology and hydrogeology based on review of available literature.

4.2.1 Local and Regional Geology

The proposed landfill site is located within the Coastal Plain Physiographic Province. The Coastal Plain of North Carolina is approximately 90 to 150 miles wide from the Atlantic Ocean westward to its boundary with the Piedmont province. This boundary is generally known as the Fall Line and is recognized as zones of rapids in streams that indicate a change of stream gradient as the streams pass from crystalline basement rocks of the Piedmont onto Coastal Plain sediments. The Coastal Plain consists of two natural subdivisions: the Tidewater and the Inner Coastal Plain (Winner and Coble, 1989). Stuckey (1965) identified three subdivisions of the Inner Coastal Plain. The proposed landfill site is located proximal to the Fall Line in the southwestern portion of the Inner Coastal Plain in the subdivision known as the Sand Hills.

The thickness of sediments and sedimentary rocks that comprise the Coastal Plain varies from zero at the Fall Line to greater than 10,000 feet at Cape Hatteras (Winner and Coble, 1989). Based on the proximity of the proposed site to the Fall Line and our knowledge of subsurface conditions in the general area, we expect the thickness of the Coastal Plain sediments or depth to crystalline bedrock to be between approximately 200 and 300 feet.

Land surface elevations in the vicinity generally range from approximately 250 feet above mean sea level (msl) at the base of primary stream valleys, to about 400 feet msl along inter-stream sand ridges. The topography of the general area can be described as gently rolling or of moderate relief, which is the result of stream dissection of uplands. Land surface elevations within the proposed landfill study area vary between approximately 300 feet msl to 370 feet msl.

In general, the sedimentary deposits of the Coastal Plain are characterized by: (1) mostly clastic sediments ranging from clay to gravel with lesser amounts of marine limestone, all overlying a foundation of crystalline basement rocks; (2) a generally eastward structural dip; (3) a general thickening of beds toward the east; and (4) the number of individual beds increasing in the eastward direction (Winner and Coble, 1989).

According to the Geologic Map of North Carolina (1985), the proposed landfill site is located within the outcrop area of the Cretaceous Age Middendorf Formation, although an overlying veneer of Quaternary Age surficial sedimentary deposits is noted to occur throughout the area. The surficial sediments of the Coastal Plain consist of undifferentiated clays, sands and gravels resulting from fluvial, eolian, lacustrine, and marine depositional processes. In the Sand Hills subdivision, the surficial deposits are mainly of fluvial or lacustrine origin and range in thickness from a few feet to as much as 30 feet (Winner and Coble, 1989).

The Geologic Map of North Carolina (1985) describes the Middendorf Formation as consisting of laterally discontinuous beds of sand, sandstone and mudstone, that are gray to pale gray with an orange mottled cast, with clay balls, iron concretions and cross-bedding

common. According to Winner and Coble (1989), the Middendorf Formation occurs primarily in the western portion of the Coastal Plain and "is composed of a heterogenous mix of fine to medium sand and silty clay beds, coarse channel sand, and thin laminated beds of sand and clay, all of non-marine origin. Cross-bedding, lenses, pinch-outs, and facies changes are common features in the Middendorf and are typical of sediments deposited in a deltaic environment. Other characteristic features of the Middendorf are its light color tones of white, tan, and red, and kaolinitic clay balls or clay fragments scattered throughout the sand beds in outcrops."

The Middendorf Formation is reported by Heron and Wheeler (1964) to unconformably overlie older Cretaceous Age sediments and sedimentary rocks. According to the Geologic Map of North Carolina (1985), the Middendorf Formation overlies sediments and sedimentary rocks of the Cape Fear Formation, which outcrops in primary stream valleys within Harnett County. The Geologic Map describes the Cape Fear Formation as consisting of sandstone and sandy mudstone, yellowish gray to bluish gray, and mottled red to yellowish orange. The sedimentary beds are reported to be indurated and laterally continuous, with blocky clay, graded bedding, faint cross bedding, feldspar and mica common. In the western portion of the Inner Coastal Plain, the Cape Fear Formation is expected to be underlain by crystalline basement rock of Cambrian or Precambrian Age (Winner and Coble, 1989).

4.2.2 Local and Regional Hydrogeology

The aquifer system within the area of Harnett County proposed for the landfill site is comprised of those Quaternary and Cretaceous sedimentary materials that are saturated with groundwater. Sandier zones of appreciable thickness and lateral extent constitute the water-bearing portions of the aquifer, while the silt or clay rich zones of appreciable thickness and lateral extent comprise the semi-confining beds that limit the vertical movement of groundwater within the aquifer system.

The surficial aquifer in the Coastal Plain generally consists of sandy Quaternary and or Cretaceous Age sedimentary deposits that occur near the land surface. This unit is of major importance to the hydrology of the area because it extends over a large part of the Coastal Plain and infiltration from rainfall provides the bulk of the recharge to the underlying aquifers. The aquifer transmits water laterally to streams and serves as a source bed holding the water that migrates downward to the underlying aquifers. The rate of recharge to the surficial aquifer depends on how rapidly rainfall can infiltrate into the sediments that comprise the aquifer. Surficial soils in the vicinity of the proposed landfill site are noted as having good infiltration capacity (Winner and Coble, 1989). Soils classified by Winner and Coble (1989) as having good infiltration capacity are those classified as being well drained to very well drained sandy soil and sandy loam and having vertical saturated permeabilities between 2 and 20 inches per hour. Heath (1980) estimated that the recharge rate to the surficial aquifer may be as much as 20 inches of equivalent rainfall per year for thick sandy soils. Based on our experience in the area and base-flow recession analyses conducted in a similar Coastal Plain setting, we would expect the groundwater recharge rate at the subject site to be between 10 and 15 inches per year. Winner and Coble (1985) estimate that the average percentage of sand in the surficial aquifer throughout the North Carolina Coastal

Plain is about 79 percent, and that the average horizontal hydraulic conductivity of the aquifer is approximately 29 feet per day (1×10^{-2} cm/sec).

The surficial aquifer at the proposed landfill site consists of the undifferentiated sandy Quaternary deposits and the underlying sandy deposits of the Middendorf Formation discussed in Section 4.2.1. Based on inspection and classification of soil samples from 20 borings advanced within or proximal to the proposed landfill area (see Sheet 4-1), the sandy deposits of the surficial aquifer range in thickness between 17 and 39 feet and are underlain by primarily fine-grained material described in the boring logs as gray silt and/or clay. The fine-grained deposits underlying the surficial aquifer are estimated to be deposits of the Middendorf Formation. Sufficient information is available to conclude that these fine-grained deposits are laterally continuous across the site, are of low permeability, and likely impede the vertical movement of groundwater. Thus, we expect that the silts and clays form the base of the surficial aquifer and act as a confining or semi-confining unit for aquifers that may occur at greater depth. None of the 20 borings penetrated the full vertical extent of the silts and clays, and based on descriptions of soil samples from boring WRB-16D, we expect that the thickness of these fine-grained materials is greater than 40 feet. However, we are not able to determine the total thickness or vertical extent of the gray silts and clays based on the available information.

Five hydrogeologic cross-sections were constructed from the boring log and piezometer construction information to illustrate the stratigraphy and groundwater-levels within the surficial aquifer at the site. The cross-sections shown on Sheets 4-2 through 4-5 depict subsurface profiles in directions parallel and perpendicular to the overall direction of groundwater flow within the surficial aquifer.

4.3 Field Observations

The following discussion provides a description of field observations including information on the topographic setting and groundwater discharge features within and proximal to the study area.

4.3.1 Topographic Setting

Land surface elevations at the proposed site range from approximately 300 feet msl at the location where the center of a natural drainage feature crosses the southern boundary of the study area, to approximately 369 feet msl in the northwestern portion. Surface drainage at the proposed site follows the existing land surface contours. The main topographic features that currently control the direction of the majority of surface drainage are the topographically high ground located in the northwestern portion of the site which appears to form a local watershed divide, and a southeastward sloping drainage feature which roughly bisects the southeastern portion of the site. The majority of the surface drainage within the study area is expected to move to the southeast down slope of the northwestern upland, and toward the southeast trending drainage feature. However, surface drainage to the northwest of the upland would be expected to be towards McCoy Road (SR 1105) and further to the northwest towards drainage features on the opposite side of the road.

Land to the northwest and northeast of the proposed landfill is primarily open pasture with localized wooded areas in the drainage features. The tire processing facility is located due north of the proposed landfill and adjacent to the southeastern side of McCoy Road. The area to the east and south of the site is primarily undeveloped and wooded. Agricultural land borders the site to the southwest and a maintenance area for the existing landfill facility occupies land adjacent to the northwest edge of the study area.

4.3.2 Groundwater Discharge Features

Throughout the Coastal Plain, the primary groundwater discharge areas for the surficial aquifer are the dendritic streams that dissect the terrain, and the associated wetlands occurring within their floodplains. Groundwater discharge may also occur through evapotranspiration in areas where the water table is located proximal to the land surface, or in other topographically low features such as ponds or lakes. Additionally, groundwater discharge may take the form of isolated springs or seeps that may occur in upland areas as a result of the presence of shallow clay or low permeability horizons that perch or trap infiltrating rainfall and divert movement of the water laterally to an area where the horizon intersects the land surface.

Seeps, springs, ponds or lakes were not observed within the limits of the proposed landfill site during our field investigation. Surface water in the form of puddles and saturated near surface soil was observed within the drainage feature that occurs within the southeastern portion of the site, outside the limits of the proposed landfill footprint. Groundwater discharge as baseflow to the stream within this feature, and through evapotranspiration likely occurs within this area.

4.4 Borings

The study area for the proposed landfill site is approximately 94 acres and 23 borings were advanced at 16 locations (WRB-1 through WRB-16) within the area to provide an understanding of the subsurface stratigraphy and groundwater flow conditions beneath the site. The proposed Phase III scrap tire monofill landfill comprises approximately 48-acres. The locations of these borings are indicated on Sheet 4-1. One shallow soil boring was advanced at each of these locations in order to characterize the stratigraphy and thickness of the unsaturated zone and underlying surficial aquifer. Deeper borings were advanced at seven of these locations (WRB-3D, WRB-4D, WRB-6D, WRB-8D, WRB-11D, WRB-12D, and WRB-16D) in order characterize the nature and extent of the fine-grained materials underlying the surficial aquifer across the site. The deep borings at these seven locations were assigned a "D" suffix (e.g. WRB-3D) while the paired shallow boring was denoted with "S" as a suffix (e.g. WRB-3S). Two-inch inner-diameter PVC piezometers were installed within each of the borings to facilitate the measurement of groundwater levels.

The borings were advanced using 4.5-inch inner diameter and 9-inch outer diameter hollow-stem augers powered by an all-terrain mounted mechanical drilling rig operated by Titan Atlantic Company. Soil samples were collected at five-foot intervals using a split-spoon sampler in accordance with standard penetration test procedures (ASTM D-1586). The W&R geologist that supervised the drilling process visually classified the soil samples in the field. Boring logs that include soil descriptions and piezometer installation details are

presented in Appendix 4A. Soil samples from selected intervals were submitted for geotechnical laboratory testing and classification purposes. Portions of three split-spoon samples and five Shelby tube (undisturbed) samples from selected borings were submitted for testing. Results of the laboratory tests are discussed further in Section 4.5.

After the last soil sample was collected from a given boring, a piezometer was installed in the borehole. Each piezometer was constructed of two-inch inner diameter PVC well casing with a section of 0.010-inch slot well screen attached to its lower end. A sand filter pack was installed in the annular space between the borehole and the well screen to a level approximately two feet above the top of the screen section. An approximately two-foot thick bentonite seal was then installed in the annular space above the sand pack, and the remainder of the annulus was backfilled with a cement/bentonite grout to the land surface. Following completion, each piezometer was developed by removing groundwater using a portable submersible pump. Top of casing and nearby ground elevations, and piezometer locations were determined by a W&R survey team lead by a North Carolina Registered Land Surveyor. Piezometer construction details and groundwater level data are summarized in Table 4-1.

4.5 Testing Program for Borings

A laboratory testing program was used to identify the general geotechnical properties of the predominant soil types in the area of investigation.

Six undisturbed soil samples were tested to provide estimates of the porosity and hydraulic conductivity of in-situ soils. The laboratory tests included natural moisture content, grain-size distribution, liquid limits, specific gravity, dry unit weight, and hydraulic conductivity tests. Laboratory test results for the samples, including Unified Soil Classification System classification, are summarized in Table 4-2, and presented in full in Appendix 4B.

The hydraulic conductivity of the clay-rich soils encountered in the borings was estimated based on the results of falling head rising tail-water permeability tests performed in the laboratory on the undisturbed samples that were not remolded or compacted. The laboratory hydraulic conductivities (K) for these fine-grained materials ranged from 2.2×10^{-7} cm/sec to 8.3×10^{-9} cm/sec (or 0.0006 to 0.0002 feet/day). The relatively low K values determined for the fine-grained material indicates that this unit should provide an effective base to the overlying surficial aquifer, and a barrier to the vertical migration of groundwater.

4.6 Stratigraphic Cross-Sections

W&R prepared stratigraphic cross-sections that identify hydrogeologic and stratigraphic or lithologic units. Sheets 4-2 through 4-5 present five stratigraphic cross-sections across the project site, both perpendicular and parallel to the primary direction of groundwater flow within the surficial aquifer.

4.7 Water Table Information

W&R prepared a tabulation of stabilized water-table elevations, an estimate of the seasonal high water table, and a discussion of any activities that have the potential for causing

water-table fluctuations, as follows.

4.7.1 Stabilized Water Table Elevations

Soil boring and piezometer installation activities began on June 30, 2003 with the drilling of boring WRB-2, and ended with the installation of piezometer WRB-12S on July 17, 2003. The piezometers were then developed using a portable submersible pump and a complete set of groundwater level readings was obtained on July 22, 2003. A second complete set of readings was obtained on July 31, which was 14 days after the drilling and piezometer installation activities were complete. W&R returned to the site on four separate occasions between August and December 2003 to obtain additional sets of groundwater level readings to assist in evaluating the position of the seasonal high water table, and ranges of water-table fluctuation. Stabilized depth to groundwater readings and groundwater elevations calculated from the readings obtained in July, August, September, November and December 2003 are presented in Table 4-3.

Groundwater levels within five of the seven deep piezometers (WRB-3D, WRB-4D, WRB-11D, WRB-12D, and WRB-16D) that are screened within the silts and clays underlying the surficial aquifer did not appear to have reached stability over the six-month water-level monitoring period. This conclusion is based on the increasingly higher groundwater elevations determined for each subsequent water level monitoring event (see Table 4-3). This finding is consistent with the very low hydraulic conductivity of the silts and clays determined through laboratory testing, and further implies that the silts and clays form the base of the surficial aquifer and impede the vertical movement of groundwater.

4.7.2 Estimated Seasonal High Water Table

As discussed in Section 4.7.1, stabilized depth to groundwater readings and groundwater elevations calculated from the readings obtained in July, August and September 2003 are presented in Table 4-3.

Review of the depth to groundwater measurements presented in Table 4-3 reveals that the highest water-table elevations, and therefore the shallowest depths to groundwater observed over the three-month water-level monitoring period occurred in August 2003. The shallowest depths to the water table measured on August 20, 2003 occurred in the vicinity of piezometers WRB-11S (2.04 feet below ground), and WRB-8S (2.12 feet below ground), both of which are located immediately adjacent to the surface water drainage feature that roughly bisects the southeastern portion of the proposed landfill site. The greatest depths to the water table occur in the upland portions of the site near surface water drainage divides, such as that near WRB-13S where the depth to the water table consistently exceeded 18 feet, and near WRB-5 where the depth to the water table consistently exceeded 14 feet.

In contrast, the greatest depths to the water table over the monitoring period occurred on September 24, 2003, when the depth to the water table increased an average of 2.2 feet. The range of water table elevation decrease (or depth to groundwater increase) from August 20, 2003 to September 24, 2003 was between 0.71 feet at piezometer WRB-12S, to 5.02 at piezometer WRB-15.

In order to evaluate how the August 2003 groundwater elevations might compare to seasonal high water-table conditions, W&R reviewed rainfall data obtained at a nearby location for the period beginning September 24, 2001 and ending September 24, 2003. The data included daily precipitation readings from the North Carolina State Climate Office weather station located at the water treatment plant in Carthage located approximately 12 miles to the east of the site. Review of cumulative rainfall totaled at the 24th of each month revealed that approximately 13.5 inches of precipitation had fallen during the month of August 2003. This amount was approximately 8.8 inches more than that measured in July 2003 (4.7 inches), and about 7.8 inches more than that in September 2003 (5.7 inches). Additionally, the total rainfall for the month of August 2003 was more than that recorded for any other month since September 2001, and was approximately 5.4 inches more than the second highest monthly total (September 2002, 8.1 inches). Given the sandy nature of the surficial aquifer we expect that water-table response to rain events or the lack thereof is relatively quick. This assumption is supported through correlation of the monthly rainfall data and water-table elevation data for the months of July, August and September 2003. Therefore, in consideration of the relatively high total rainfall amount for August 2003, we expect that the water table elevations measured at the site on August 20, 2003 are representative of seasonally high water table conditions for the purposes of this study.

Contours of the stabilized water-table elevations measured on August 20, 2003 are presented in Sheet 4-6. The configuration of the water-table surface as implied by the contours is generally similar to the overlying land surface topography, a relationship that is common in Inner Coastal Plain settings. The water-table elevation contours imply that the overall direction of groundwater flow within the surficial aquifer is towards the southeast on the southeastern side of the upland area near McCoy Road, and to the northwest on the northwest side of the upland area. The contours also suggest components of flow towards the surface water drainage feature that roughly bisects the southeastern portion of the site, and towards other similar features just beyond the study area boundary.

4.8 Components of Groundwater Flow

The following sections provide a discussion on the horizontal and vertical components of groundwater flow.

4.8.1 Groundwater Flow Direction

In the Coastal Plain, the direction of groundwater flow within the surficial aquifer is directly related to the configuration of the land surface topography and the position of discharge features. Contours of the stabilized water-table elevations measured on August 20, 2003 are presented on Sheet 4-6. The configuration of the water-table surface as implied by the contours is generally similar to the overlying land surface topography. The water-table elevation contours imply that the overall direction of groundwater flow within the surficial aquifer is consistent with that of the surface topography slope, that is, towards the southeast on the southeastern side of the upland area near McCoy Road, and towards the northwest on the northwest side of the upland area. The contours also suggest components of flow towards the surface water drainage feature that roughly bisects the southeastern portion of the site, and towards other similar features just beyond the study area boundary.

As discussed in Section 4.7.1, groundwater levels within five of the seven deep piezometers with screens positioned to measure hydraulic heads within the silts and clays that underlie the surficial aquifer did not reach stability over the six-month water-level monitoring period. Therefore we cannot calculate vertical flow gradients and thereby determine the vertical component of groundwater flow within the surficial aquifer at those locations at this time. However, based on previous experience within similar Coastal Plain settings, we expect that the vertical component of groundwater flow within the surficial aquifer would be downward in the upland portions of the site, and upward in the immediate vicinity of groundwater discharge features. The vertical component of groundwater flow was found to be consistently downward the two locations where deep water levels had stabilized (well pairs WRB-6S/6D and WRB-8S/8D).

4.8.2 Hydraulic Conductivity

Estimates of the horizontal hydraulic conductivity of the surficial aquifer were made by conducting falling and rising head water-level recovery tests on six of the shallow piezometers (WRB-1, WRB-2, WRB-4S, WRB-5, WRB-6S, and WRB-10). The horizontal hydraulic conductivity of the underlying silts and clays was estimated by conducting falling head water-level recovery tests on three of the deep piezometers (WRB-3D, WRB-8D and WRB-16D). The test data and hydraulic conductivity calculation worksheets are presented in Appendix 4C. The test results are summarized in Table 4-4.

The results of the tests suggest that the horizontal hydraulic conductivity of the surficial aquifer may range between 0.005 and 7 feet/day. The geometric mean hydraulic conductivity value for the surficial aquifer as determined from the test results was approximately 1 foot/day (or about 3×10^{-4} cm/s). In contrast, the geometric mean hydraulic conductivity of the underlying silts and clays (0.0004 feet/day or 1×10^{-7} cm/s) was found to be approximately three orders of magnitude lower than that of the surficial aquifer. The range of horizontal hydraulic conductivity calculated for the underlying silts and clays was between 0.00015 and 0.0016 feet/day, which is consistent with the range of vertical hydraulic conductivities determined through laboratory testing of undisturbed samples of that material (see Section 4.5).

4.8.3 Groundwater Flow Velocity

Based on the available information, the majority of groundwater storage and movement at the proposed landfill site occurs within the surficial aquifer. The underlying silts and clays have significantly lower hydraulic conductivity, therefore the lateral and vertical movement within these deposits is limited accordingly. In order to approximate the rate or average linear velocity of groundwater flow at any point within the surficial aquifer, reasonable estimates of the hydraulic conductivity, the hydraulic gradient, and the effective porosity of the surficial aquifer must be available. These three variables can be used to determine the average linear groundwater flow velocity in accordance with the following formula:

$$V_x = \frac{Kdh}{n_e dl}$$

Where,

V_x = average linear groundwater flow velocity
K = hydraulic conductivity
dh/dl = hydraulic gradient
n_e = effective porosity

In order to estimate the range of groundwater flow velocities associated with the surficial aquifer, we used the hydraulic conductivity estimates discussed in Section 4.8.2, the horizontal hydraulic gradient indicated on the water-table elevation contour map at each location where a water-level recovery test was conducted, and an estimate of the effective porosity (0.25) that is based on the grain-size distribution analyses discussed in Section 4.5 and the ternary diagram of Johnson (1967). The groundwater flow velocity estimates are summarized in Table 4-5. Using the estimates described above and presented in Table 4-5 we expect the groundwater flow velocities within the surficial aquifer to range between 0.002 and 0.44 feet/day with a geometric mean value of 0.08 feet/day.

4.9 Water-Table Elevation Contour Map

W&R has prepared a potentiometric (groundwater elevation) contour map to illustrate water-table elevations and directions of groundwater flow in the uppermost aquifer at the candidate site. The water-table elevation contour map is shown on Sheet 4-6. The positions of the contours are based on the seasonally high (see Section 4.7.2) water-table elevations measured on August 20, 2003 in the piezometers that are screened within the surficial aquifer. As discussed in Section 4.7.1, groundwater levels within five of the seven piezometers screened within the underlying silts and clays had not stabilized by the end of the three-month water-level monitoring period. Therefore, those data were not contoured.

4.10 Topographic Map of the Site

W&R prepared a map that shows topographic contours of the land surface, and the locations of all borings and piezometers used in the hydrologic study. The topographic map is shown on Sheet 4-1.

4.11 Logs, Notes and Records

W&R prepared copies of the boring logs, field logs and notes, piezometer construction records, and field test records be included as attachments to the Site Hydrologic Report. Copies of these records and the laboratory records for tests performed on selected soil samples are included as Appendicies A1 through A3.

4.12 Geologic and Hydrologic Considerations

The following discussion identifies other geologic and hydrologic features that are worthy of consideration.

4.12.1 Geologic and Hydrologic Features

The current understanding of the subsurface stratigraphy at the site is consistent with that described for sites located in similar Coastal Plain settings that have been studied by W&R

geologists and other investigators. Given the nominal 500-foot (approximately one-tenth mile) spacing between borings advanced during this study, we have attempted to identify only the larger scale hydrogeologic features, and characterize the uppermost groundwater flow regime accordingly. The main hydrogeologic features identified include the approximately 17 to 39 foot thick sandy surficial aquifer, which is underlain by laterally extensive fine-grained deposits of significantly lower permeability. Groundwater within the surficial aquifer discharges to local wetland areas and surface water drainage features, which are tributaries to larger streams within the coastal plain. The primary direction of groundwater flow within the surficial aquifer is consistent with that which would be inferred by topographic slopes and with the exception of the northwestern portion of the site, may be described as being primarily to the southeast.

While smaller scale hydrogeologic features such as shallow clay layers or lenses that may cause infiltrating rainwater to become perched above the water table have not been identified, it remains possible that such features may be present. However, the lack of seeps or wet areas within the upland portions of the site suggests that such features, if present, are not laterally extensive and do not intersect the land surface within the study area. If required by the Division, a more thorough evaluation of the presence or absence of such small-scale features will be part of a Design Hydrologic Study.

4.12.2 Groundwater Discharge and Recharge

In the Coastal Plain, infiltrating rainfall is the main source of recharge to the surficial aquifer. The surficial aquifer transmits water laterally to streams and serves as a groundwater reservoir. A portion of the groundwater within the surficial aquifer eventually migrates downward and recharges underlying deeper aquifers. Recharge to the surficial aquifer is typically greater in the late winter and spring when evapotranspiration rates are lower, and is dependent upon the duration and intensity of rainfall events, the permeability of the unsaturated materials above the water table, and the density of vegetation or artificial surfaces that occupy the land surface.

The surficial soils at the site are primarily sandy and as such would not impede the vertical movement of water to the extent that more clay rich soils might. Artificial surfaces that would impede the vertical movement of water such as large buildings, or asphalt/concrete roads or parking areas are not present on the site. The majority of the site is cleared of forest vegetation and the existing land surface is covered by untended grass, shrubs, scrub oak and young pines. More dense wetland type vegetation exists in the vicinity of the onsite surface water drainage features. Given the nature of the land surface features, we do not expect that groundwater discharge and recharge conditions would be substantially different than other natural settings within the Sandhills subregion of the Coastal Plain.

4.13 Proposed Groundwater Monitoring Plan

Based on our understanding of subsurface conditions gained by the results of field investigation activities documented herein, W&R is confident that groundwater moving away from the site can be effectively monitored using a network of shallow groundwater monitoring wells.

Given the present topographic character of the site and the directions of groundwater flow determined from stabilized water-table elevation measurements, we expect that a total of four shallow monitoring wells would be sufficient to accumulate the required background and downgradient groundwater quality data. Each of the four monitoring wells would be constructed of two-inch inner diameter schedule 40 PVC well screen and riser pipe and in accordance with the North Carolina Well Construction Standards specified in 15A NCAC 2C .0108. The screened section of each monitoring well would have 0.01-inch slots and would be 15-feet in length with the bottom of the screen set approximately ten feet below the water table encountered at the time of drilling, and the top of the screen approximately five feet above the water table, to ensure that samples of the uppermost groundwater within the surficial aquifer may be obtained throughout the year. Locking protective covers would be installed to prevent unauthorized access to the monitoring wells. Typical construction details for the monitoring wells are illustrated in Sheet 4-7.

The background monitoring well would be located in the vicinity of the existing topographic upland in the vicinity of where McCoy Road crosses the northeastern boundary of the proposed site. One of the downgradient monitoring wells would be located approximately 150 feet beyond the waste boundary along the northwesterly topographic slope to the northwest of McCoy Road. The remaining two downgradient monitoring wells would be located approximately 150 feet beyond the waste boundary along the southeasterly slope to the southeast of McCoy Road; one on either side of the surface water drainage feature that bisects that portion of the site.

The monitoring wells would be sampled semi-annually in accordance with North Carolina Department of Environment and Natural Resources, Division of Waste Management and EPA Region IV protocol, and the samples would be tested in a North Carolina certified analytical laboratory for 40 CFR Part 258 Appendix I volatile organic compounds and metals. A more detailed groundwater monitoring plan will be included as part of the design report for the proposed landfill site.

4.14 Report Summary

Groundwater flow within the uppermost aquifer at the proposed landfill site is primarily toward the southeast, with localized flow toward the surface water drainage feature that bisects the southeastern portion of the site, and toward the northwest in the northwestern portion of the site. Interpreted groundwater flow directions are consistent with downward surface topography slopes and indicate movement of groundwater from upland areas toward local surface water drainage features. We did not identify groundwater users located on or immediately downgradient of the proposed site.

The geology and hydrogeology of the proposed site are favorable with regard to accommodating a tire monofill for the following reasons:

- The site groundwater can be easily monitored due to the presence of a relatively permeable surficial aquifer of generally uniform composition, predictable groundwater flow

directions, and laterally extensive fine-grained deposits of low permeability that underlie the surficial aquifer.

- Based on review of water-table elevation data acquired during this study and past rainfall records for the general area, we conclude that the water-table elevations obtained in August 2003 may be used to represent the seasonal high groundwater table for the purposes of this study. Depths to the water table in the upland areas of the site were all greater than four feet at the time the August 2003 groundwater measurements were obtained.

- The fine-grained silt and clay deposits that underlie the surficial aquifer appear to be laterally extensive, and due to their low hydraulic conductivity, are expected to limit the movement of groundwater from the surficial aquifer to deeper aquifers. The hydraulic conductivity of the fine-grained deposits is expected to range between 0.00015 and 0.0016 ft/day.

- The local discharge areas for the surficial aquifer include the surface water drainage feature that bisects the southeastern portion of the site, and the drainage feature located to the northwest of the site. Collection and testing of surface water samples from these features is an economical means of monitoring the integrity of the proposed landfill facility.

4.15 References

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Stuckey, J.L., 1965, North Carolina: Its Geology and Mineral Resources, North Carolina Department of Conservation and Development, Raleigh, NC, 550p.

Johnson, A.I. 1967. Specific Yields for Geologic Materials. USGS Water Supply Paper 1662-D.

Heron, S.D., and Wheeler, W.H., 1964, The Cretaceous Formations along the Cape Fear River, North Carolina: Atlantic Coastal Plain Geological Association 5th Annual Field Excursion Guidebook, 55p.

TABLE 4-1
Monitoring Well Construction Details
Central Carolina Tire Monofill Siting Study
Harnet County, North Carolina
W&R Project No. 202334.01

Well Identity	Date Installed	Well Depth (ft BG)	TOC Elevation (ft MSL)	Ground Elevation (ft MSL)	Well Screen Depth (ft BG)	Well Screen Elevation (ft MSL)	Depth to GW 7/22/2003 (ft BTOC)	GW Elevation 7/22/2003 (ft MSL)	Depth to GW 7/31/2003 (ft BTOC)	GW Elevation 7/31/2003 (ft MSL)
							24-Hour Readings		14-Day Readings	
WRB - 1	7/3/2003	29.0	361.04	358.23	19.0 - 29.0	339.23 - 329.23	13.86	347.18	14.14	346.90
WRB - 2	6/30/2003	30.0	360.37	357.29	20.0 - 30.0	337.29 - 327.29	14.71	345.66	15.10	345.27
WRB - 3S	7/1/2003	20.0	363.41	360.60	10.0 - 20.0	350.60 - 340.60	15.89	347.52	16.60	346.81
WRB - 3D	7/3/2003	55.0	363.57	360.54	45.0 - 55.0	315.54 - 305.54	52.12	311.45	48.46	315.11
WRB - 4S	7/10/2003	35.0	355.27	352.86	20.0 - 35.0	332.86 - 317.86	10.37	344.90	10.69	344.58
WRB - 4D	7/15/2003	65.0	355.67	352.54	55.0 - 65.0	297.54 - 287.54	55.40	300.27	49.42	306.25
WRB - 5	7/10/2003	35.0	364.83	362.08	25.0 -35.0	337.08 - 327.08	18.83	346.00	19.13	345.70
WRB - 6S	7/10/2003	15.0	356.85	353.96	10.0 - 15.0	343.96 - 338.96	8.76	348.09	9.23	347.62
WRB - 6D	7/10/2003	35.0	357.20	354.01	25.0 - 35.0	329.01 - 319.01	9.17	348.03	9.63	347.57
WRB - 7	7/9/2003	29.0	347.30	344.03	19.0 - 29.0	325.03 - 315.03	11.00	336.30	11.32	335.98
WRB - 8S	7/16/2003	10.0	339.99	337.11	5.0 - 10.0	332.11 - 327.11	5.64	334.35	5.59	334.40
WRB - 8D	7/16/2003	35.0	340.20	337.12	25.0 - 35.0	312.12 - 302.12	10.52	329.68	8.96	331.24
WRB - 9	7/16/2003	40.0	351.22	348.10	10.0 - 40.0	338.10 - 308.10	9.74	341.48	10.27	340.95
WRB - 10	7/8/2003	35.0	338.18	335.13	25.0 - 35.0	310.13 - 300.13	14.82	323.36	15.44	322.74
WRB - 11S	7/15/2003	19.0	322.88	319.42	9.0 - 19.0	310.30 - 300.13	6.55	316.33	6.83	316.05
WRB - 11D	7/15/2003	60.0	322.46	319.30	50.0 - 60.0	269.30 - 259.30	40.17	282.29	26.56	295.90
WRB - 12S	7/17/2003	20.0	344.42	344.42	10.0 - 20.0	334.42 - 324.42	6.81	337.61	7.00	337.42
WRB - 12D	7/17/2003	40.0	345.02	344.29	30.0 - 40.0	314.29 - 304.29	NA	NA	NA	NA
WRB - 13	7/3/2003	45.0	333.19	329.92	35.0 - 45.0	294.92 - 284.92	22.91	310.28	23.07	310.12
WRB - 14	7/8/2003	35.0	328.36	325.33	25.0 - 35.0	300.33 - 290.33	16.02	312.34	15.90	312.46
WRB - 15	7/15/2003	30.0	330.32	327.36	20.0 - 30.0	307.36 - 297.36	12.30	318.02	13.69	316.63
WRB - 16S	7/3/2003	24.5	318.65	315.16	14.5 - 24.5	300.66 - 290.66	15.69	302.96	16.15	302.50
WRB - 16D	7/7/2003	60.0	318.41	315.73	50.0 - 60.0	265.73 - 255.73	47.17	271.24	36.30	282.11

Notes: ft BG = Feet Below Ground
ft MSL = Feet above Mean Sea Level
ft BTOC = Feet Below Top of Casing
GW = Groundwater
NA = Not applicable: No water present within well on this date.

TABLE 4-2
Summary of Geotechnical Laboratory Test Results
Central Carolina Tire Monofill Siting Study
Harnett County, North Carolina
W&R Project No. 202334.01

Sample ID	Sample Depth	Nat. Moist. (%)	LL	PI	Fines USCS	Gravel (%)	Sand (%)	Fines (%)	Specific Gravity	Dry Unit Weight (pcf)	Permeability (cm/sec.)	Manual Description
WRB-4S	33.5 - 33.9	16.5	50	28	CH	0.0	69.0	31.0	2.63	114.2	6.3×10^{-8}	Clayey Sand (SC)
WRB-6D	14.9 - 15.3	20.5	-	-	-	0	96	4	-	100.1	-	Poorly Graded Sand with Silt (SP)
WRB-8D	7.4 – 7.8	18.7	36	19	CL	0.0	24.8	75.2	2.64	100.9	2.2×10^{-7}	Sandy Lean Clay (CL)
WRB-11D	24.6 – 25.0	18.7	52	31	CH	0.0	19.7	80.3	2.66	108.1	8.3×10^{-9}	Sandy Fat Clay (CH)
WRB-13	42.4 – 42.6	18.6	32	17	CL	0.1	79.4	20.5	-	107.2	-	Clayey Sand (SC)
WRB-14	3.5 – 5.5	3.1	Nonplastic		-	0.2	95.1	4.7	2.63	-	-	Widely Graded Sand (SW)
WRB-15	16.1 – 16.5	17.5	40	24	CL	0.0	49.0	51.0	2.64	113.0	1.9×10^{-8}	Sandy Lean Clay (CL)
WRB-16D	23.1 – 23.5	42.5	68	39	CH	0.0	1.5	98.5	2.66	78.2	4.4×10^{-8}	Fat Clay (CH)

TABLE 4-3
Depth to Groundwater Measurements
Central Carolina Tire Monofill Siting Study
Harnet County, North Carolina
W&R Project No. 202334.01

Well #	TOC Elevation	NG Elevation	Piezometer Stick-up (ft)	7/22/2003 (depth BG)	7/22/2003 (depth BTOC)	7/22/2003 GW Elevation	7/31/2003 (depth BG)	7/31/2003 (depth BTOC)	7/31/2003 GW Elevation	8/20/2003 (depth BG)	8/20/2003 (depth BTOC)	8/20/2003 GW Elevation	9/24/2003 (depth BG)	9/24/2003 (depth BTOC)	9/24/2003 GW Elevation	11/4/2003 (depth BG)	11/4/2003 (depth BTOC)	11/4/2003 GW Elevation	12/15/2003 (depth BG)	12/15/2003 (depth BTOC)	12/15/2003 GW Elevation
WRB - 1	361.04	358.23	2.81	11.05	13.86	347.18	11.33	14.14	346.90	**9.60**	12.41	348.63	11.34	14.15	346.89	12.78	15.59	345.45	13.84	16.65	344.39
WRB - 2	360.37	357.29	3.08	11.63	14.71	345.66	12.02	15.10	345.27	**10.41**	13.49	346.88	12.22	15.30	345.07	13.51	16.59	343.78	14.38	17.46	342.91
WRB - 3S	363.41	360.60	2.81	13.08	15.89	347.52	13.79	16.60	346.81	**11.74**	14.55	348.86	14.54	17.35	346.06	15.94	18.75	344.66	17.04	19.85	343.56
WRB - 3D	363.57	360.54	3.03	49.09	52.12	311.45	45.43	48.46	315.11	37.38	40.41	323.16	28.97	32.00	331.57	24.37	27.40	336.17	22.25	25.28	338.29
WRB - 4S	355.27	352.86	2.41	7.96	10.37	344.90	8.28	10.69	344.58	**6.88**	9.29	345.98	8.54	10.95	344.32	9.59	12.00	343.27	10.27	12.68	342.59
WRB - 4D	355.67	352.54	3.13	52.27	55.40	300.27	46.29	49.42	306.25	36.14	39.27	316.40	26.81	29.94	325.73	22.17	25.30	330.37	20.11	23.24	332.43
WRB - 5	364.83	362.08	2.75	16.08	18.83	346.00	16.38	19.13	345.70	**14.70**	17.45	347.38	16.68	19.43	345.40	17.95	20.70	344.13	18.69	21.44	343.39
WRB - 6S	356.85	353.96	2.89	5.87	8.76	348.09	6.34	9.23	347.62	**4.95**	7.84	349.01	6.82	9.71	347.14	9.01	11.90	344.95	10.36	13.25	343.60
WRB - 6D	357.20	354.01	3.19	5.98	9.17	348.03	6.44	9.63	347.57	5.01	8.20	349.00	6.95	10.14	347.06	9.11	12.30	344.90	10.43	13.62	343.58
WRB - 7	347.30	344.03	3.27	7.73	11.00	336.30	8.05	11.32	335.98	**6.53**	9.80	337.50	8.28	11.55	335.75	9.41	12.68	334.62	9.90	13.17	334.13
WRB - 8S	339.99	337.11	2.88	2.76	5.64	334.35	2.71	5.59	334.40	**2.12**	5.00	334.99	3.07	5.95	334.04	4.07	6.95	333.04	5.88	6.76	333.23
WRB - 8D	340.20	337.12	3.08	7.44	10.52	329.68	5.88	8.96	331.24	5.28	8.36	331.84	4.89	7.97	332.23	4.84	7.92	332.28	4.92	8.00	332.20
WRB - 9	351.22	348.10	3.12	6.62	9.74	341.48	7.15	10.27	340.95	**5.61**	8.73	342.49	7.64	10.76	340.46	8.88	12.00	339.22	9.53	12.65	338.57
WRB - 10	338.18	335.13	3.05	11.77	14.82	323.36	12.39	15.44	322.74	**9.95**	13.00	325.18	13.55	16.60	321.58	16.46	19.51	318.67	18.05	21.10	317.08
WRB - 11S	322.88	319.42	3.46	3.09	6.55	316.33	3.37	6.83	316.05	**2.04**	5.50	317.38	3.84	7.30	315.58	4.50	7.96	314.92	4.14	7.60	315.28
WRB - 11D	322.46	319.30	3.16	37.01	40.17	282.29	23.40	26.56	295.90	17.97	21.13	301.33	16.51	19.67	302.79	15.34	18.50	303.96	14.40	17.56	304.90
WRB - 12S	334.42	334.42	0.00	6.81	6.81	327.61	7.00	7.00	327.42	**6.31**	6.31	328.11	7.02	7.02	327.40	7.67	7.67	326.75	9.00	9.00	325.42
WRB - 12D	345.02	344.29	0.73	NA	NA	NA	NA	NA	NA	40.20	40.93	304.09	38.57	39.30	305.72	36.72	37.45	307.57	34.57	35.30	309.72
WRB - 13	333.19	329.92	3.27	19.64	22.91	310.28	19.80	23.07	310.12	**18.28**	21.55	311.64	19.88	23.15	310.04	22.01	25.28	307.91	23.23	26.50	306.69
WRB - 14	328.36	325.33	3.03	12.99	16.02	312.34	12.87	15.90	312.46	**10.18**	13.21	315.15	13.63	16.66	311.70	17.57	20.60	307.76	19.10	22.13	306.23
WRB - 15	330.32	327.36	2.96	9.34	12.30	318.02	10.73	13.69	316.63	**7.02**	9.98	320.34	12.04	15.00	315.32	12.49	15.45	314.87	13.80	16.76	313.56
WRB - 16S	318.65	315.16	3.49	12.20	15.69	302.96	12.66	16.15	302.50	**10.72**	14.21	304.44	12.91	16.40	302.25	14.87	18.36	300.29	15.86	19.35	299.30
WRB - 16D	318.41	315.73	2.68	44.49	47.17	271.24	33.62	36.30	282.11	23.09	25.77	292.64	18.49	21.17	297.24	17.94	20.62	297.79	18.32	21.00	297.41

Notes: TOC = Top of piezometer casing
NG = Nearby ground surface
Elevations are in feet above mean sea level
ft = feet
depth BG = Depth below ground in feet
depth BTOC = Depth below top of casing in feet
NA = Not available: Well dry at the time of measurement
GW = Groundwater
Bold value indicates shallowest depth to water table measured between July and December 2003
Shaded row indicates data pertains to deep piezometer screened in silts and clays beneath surficial aquifer

TABLE 4-4
Hydraulic Conductivities Determined From Water-Level Recovery Tests
Central Carolina Tire Monofill Siting Study
Harnet County, North Carolina
W&R Project No. 202334.01

Location Identity	Total Depth (Ft BG)	Screen Interval (Ft BG)	Material Screened	Test Type	Calculated K (cm/s)	Calculated K (ft/d)	Geometric Mean (ft/d)
WRB-1	29	29 to 19	Surficial Aquifer	Falling Head	1.0E-03	2.8	
				Rising Head	1.0E-03	2.8	
WRB-2	30	30 to 20	Surficial Aquifer	Falling Head	1.5E-03	4.3	
				Rising Head	2.6E-03	7.4	
WRB-4S	35	35 to 20	Surficial Aquifer	Falling Head	1.4E-05	0.040	
				Rising Head	1.8E-06	0.005	
WRB-5	35	35 to 25	Surficial Aquifer	Rising Head	1.4E-03	4.0	
				Falling Head	1.7E-03	4.8	
WRB-6S	15	15 to 10	Surficial Aquifer	Falling Head	4.0E-04	1.1	
				Rising Head	4.1E-04	1.2	
WRB-10	35	35 to 25	Surficial Aquifer	Falling Head	2.5E-04	0.7	
				Rising Head	1.3E-04	0.4	0.91
WRB-3D	55	55 to 45	Gray Silts and Clays	Falling Head	7.1E-08	0.00020	
WRB-8D	35	35 to 25	Gray Silts and Clays	Falling Head	5.6E-07	0.0016	
WRB-16D	60	60 to 50	Gray Silts and Clays	Falling Head	5.4E-08	0.00015	0.00037

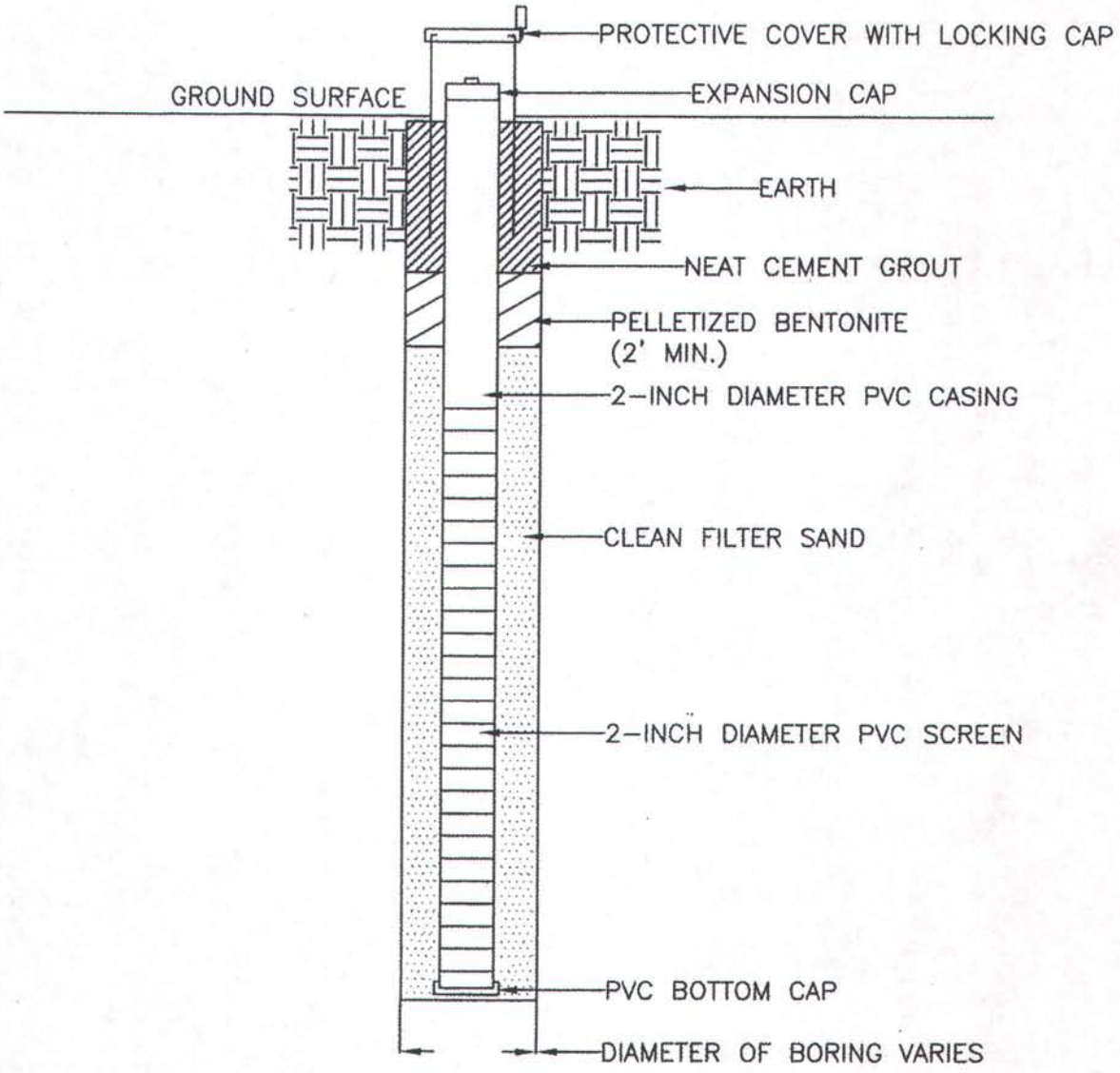
Notes: Ft BG = feet below ground
All tests conducted on 8/20/03
K = Hydraulic Conductivity
cm/s =centimeters per second
ft/d = feet per day

TABLE 4-5
Average Linear Groundwater Seepage Velocity Estimates
Central Carolina Tire Monofill Siting Study
Harnet County, North Carolina
W&R Project No. 202334.01

Location Identity	K Test Type	Calculated K (ft/d)	Average K (ft/d)	dh/dl at Location	Effective Porosity	Flow Velocity (ft/d)	Geometric Mean (ft/d)
WRB-1	Falling Head	2.8					
	Rising Head	2.8	2.8	0.02	0.25	0.25	
WRB-2	Falling Head	4.3					
	Rising Head	7.4	5.8	0.017	0.25	0.40	
WRB-4S	Falling Head	0.040					
	Rising Head	0.005	0.022	0.019	0.25	0.002	
WRB-5	Rising Head	4.0					
	Falling Head	4.8	4.4	0.025	0.25	0.44	
WRB-6S	Falling Head	1.1					
	Rising Head	1.2	1.1	0.017	0.25	0.08	
WRB-10	Falling Head	0.7					
	Rising Head	0.4	0.5	0.02	0.25	0.04	0.08

Notes: Ft BG = feet below ground
All tests conducted on 8/20/03
K = Hydraulic Conductivity
dh/dl = change in hydraulic head over change in horizontal distance
ft/d = feet per day

"Drawings Under Seperate Cover"



WELL NO. _____

SCREEN SLOT SIZE: _____

INSTALLATION DATE: _____

GROUNDWATER LEVEL: _____
(DEPTH BELOW GROUND SURFACE)

Withers & Ravenel
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111 MACKENAN DRIVE · CARY, N.C. 27511
919-460-8006 · FAX 919-460-6082

Central Carolina Tire

TYPICAL MONITORING WELL SCHEMATIC

DRAWN BY:	SCALE:	4-7
SB	NTS	
APPROVED BY:	DATE:	JOB NO:
ACP		

APPENDIX 4A

Boring Logs

WITHERS & RAVENEL
Engineering & Surveying, Inc.
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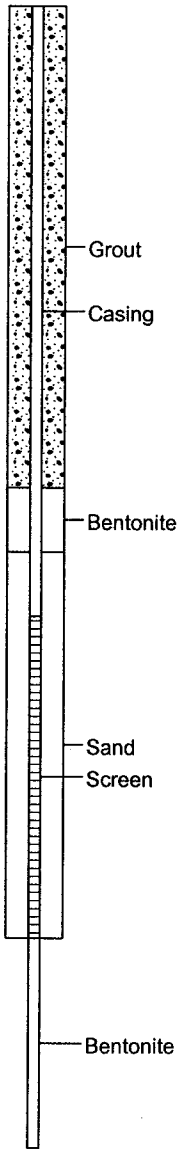
LOG OF BORING WRB-1

Central Carolina Tire
Project No. 202334.01

Date Started	: 6/30/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 6/30/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25" Hollow Stem Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND; Fine to Medium, Dry to Moist, Soft, Light Brown
5	CH	SILTY CLAY; Moist, Medium to Stiff, Beige
	SC	CLAYEY SAND; Fine to Medium, Moist to Very Moist , Moderate to Stiff, Light Brown
	SM	SILTY SAND; Very Fine to Fine, Very Moist to Wet, Light Brown.
10	SP	SAND; Fine to Coarse, Moderate, Wet, Light Brown/Purple
15	SC	SAND WITH CLAY; Very Fine to Fine, Moderate, Very Wet, Beige.
20	SC	CLAYEY SAND; Very Fine to Medium, Stiff to Very Stiff, Wet to Very Wet, Beige
25		
30	CH	SILTY CLAY WITH SAND; Very Stiff, Wet to Very Wet, Beige
	CH	CLAYEY, SILTY SAND; Very Fine to Very Coarse, Stiff to Very Stiff, Wet to Very Wet, Beige and Light Brown.
35		
40		

Well: WRB-1
Elev.:



Samples	Blow Count
1	2 5 15 18
2	4 7 6 5
3	3 6 7 9
4	8 7 7 11
5	7 6 17 20
6	9 10 18 21
7	7 8 19 20

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/3/03
Hole Dia.	: 9.0"
Drill. Method	: 4.25" Hollow Stem Auger
	:

WELL CASING

Joints	: Threaded
Material	: Sch. 40 PVC
Diameter	: 2 in
	:
WELL SCREENING	: 0.010" Slotted

NOTES

Bentonite Plug from 29.0 to 35.5' BLS

09-09-2003 2\02-330\02334.01\Boring Plan\WRB-1.bor

WITHERS & RAVENEL
Engineering & Surveying, Inc.
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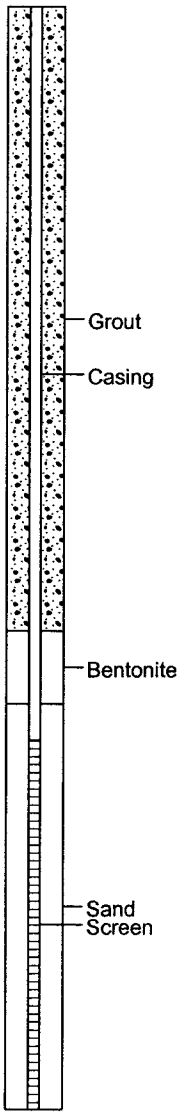
LOG OF BORING WRB-2

Central Carolina Tire
Project No. 202334.01

Date Started	: 6/30/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 6/30/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25" Stem Hollow Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SC	CLAYEY SAND; Very Fine to Fine, Light brown, Somewhat Moist to Moist, Medium.
	CH	SILTY CLAY WITH SAND; Beige, Stiff, Moist
5	SW	SANDS; Fine to Medium, Medium to Stiff Moist to Wet, Light Brown
10		
15	SW	SAND; Very Fine to Fine, Medium to Stiff, Wet to Very Wet, Beige and Purple.
20		
25	SW	SAND; Fine to Medium, Medium to Stiff, Wet to Very Wet, Beige and Purple
30	SC	CLAYEY SAND; Fine to Medium, Medium to Stiff, Wet to Very Wet, Beige.
35		

Well: WRB-2
Elev.:



Samples	Blow Count
1	15 21 23 25
2	5 7 12 12
3	6 11 17 20
4	9 15 19 19
5	5 17 17 21
6	11 6 7

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 6/30/03
Hole Dia.	: 9.0"
Drill. Method	: 4.25" Hollow Stem Auger
	:

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in.
	:
WELL SCREENING	: 0.010" Slotted

NOTES

Surficial Material has Been Stripped (By Pan)

09-04-2003 k:\02\02-330\02334.01\Boring Plan\WRB-2.bor

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LOG OF BORING WRB-3S

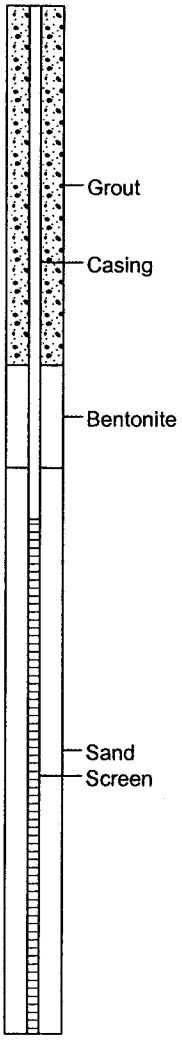
(Page 1 of 1)

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/1/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/1/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25" Stem Hollow Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND; Very Fine to Fine,Very Soft to Soft, Dry to Moist, Light Brown.
10		
15	SC	SAND WITH CLAY; Fine to Medium, Medium to Very Stiff, Wet to Very Wet, Light Brown.
20	SC	CLAYEY SAND; Fine to Medium, Medium, Very Wet, Fe Nodules Noted, Beige
25		

Well: WRB-3S
Elev.:



Samples	Blow Count
1	1
	2
	2
	3
2	5
	5
	5
	8
3	11
	15
	23
	33
4	5
	5
	6

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/1/03
Hole Dia.	: 9.0"
Drill. Method	: 4.25" Hollow Stem Auger
	:

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
	:
WELL SCREENING	: 0.010" Slotted

NOTES

Surfical material Has Been Stripped by Pan

09-04-2003 K:\02\02-330\02334.01\Boring Plan\WRB-3S.bor

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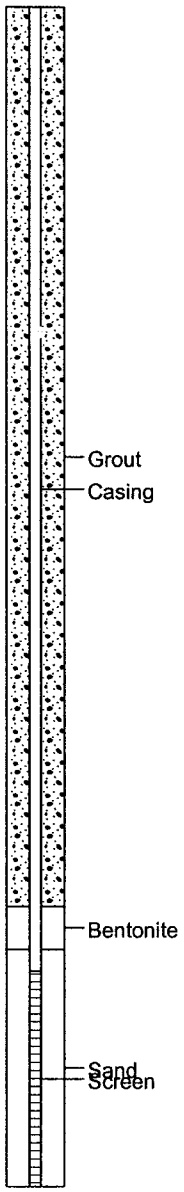
LOG OF BORING WRB-3D

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/3/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/3/03	Northing Coord.	:
Hole Diameter	: 6.0"	Easting Coord.	:
Drilling Method	: Mud Rotary	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0–10	SW	SAND ; Very Fine to Fine, Subangular, Non-Plastic, Loose, Moist to Wet, Light Brown.
10–15	SC	SAND WITH CLAY; Fine to Medium, Subangular, ~10% Fines, Low Plasticity, Very Firm, Wet to Very Wet, Light Brown
15–20	SC	CLAYEY SAND; Fine to Medium, Subangular, ~20% Fines, Low Plasticity, Loose, Beige.
20–30	SC	CLAYEY SAND ; Fine to Medium, Subangular, ~20% Fines, Low Plasticity, Very Loose, Very Wet, White and Purple.
30–35	CH	SILTY CLAY WITH SAND ; ~ 90% Fines, High Plasticity, Very Stiff to Hard, Wet, Gray.
35–40	SC	CLAYEY SAND ; Fine to Medium, Subangular, ~40% Fines, Medium Plasticity, Very Wet, Gray with Fe Staining.
40–60	CH	SILTY CLAY WITH SAND ; ~95% Fines, High Plasticity, Very Stiff to Hard, Wet, Gray .



Sample	Blow Count
1	9 8 10 13
2	8 11 9 10
3	24 32 33 39
4	8 8 7
5	4 2 1
6	3 3 4 4
7	13 25 30 50/5
8	12 31 31 35
9	17 26 44 45
10	14 18 32 34
11	7 18 30 43

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/3/03
Hole Dia.	: 6.0"
Drill. Method	: Mud Rotary
	:

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
	:
WELL SCREENING	: 0.010" Slotted

NOTES

Attempt Shelby Tube at 36.0' BLS/ No Penetration - No Sample

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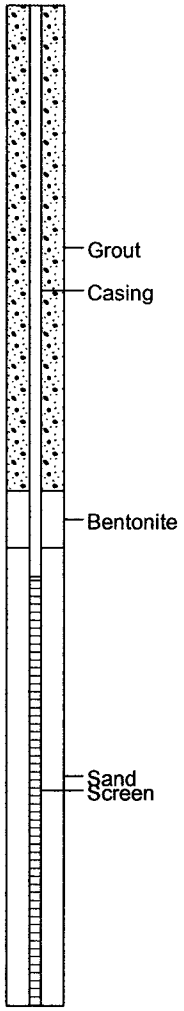
LOG OF BORING WRB-4S

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/10/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/10/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25'Hollow Stem Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND; Very Fine to Fine, Subangular, Non-Plastic to Low Plasticity, Loose, Moist to Very Moist, Light Brown.
5	SC	SAND WITH CLAY; Very Fine to Medium, Subangular, ~ 10% Fines, Non Plastic, Very Firm, Very Moist to Very Wet, Light Brown and Purple, Pea Gravel and Fe Nodules Noted.
10		
15		
20	SM	SILTY SAND ; Very Fine to Very Coarse, Subangular ~ 20% Fines Non-Plastic, Firm, White and Purple, Pea Gravel Noted.
25	SC	CLAYEY, SILTY SAND ; Very Fine to Medium, Subangular, ~ 40% to Fines, Medium Plasticity, Very firm to Very Dense, Gray.
30		
35	ML	SANDY SILT WITH CLAY ; 85% Fines, Medium Plasticity, Hard, Wet , Gray
40		
45		

Well: WRB-4S
Elev.:



Samples	Blow Count
1	4 4 4 5
2	7 9 13 15
3	6 5 9 14
4	11 28 32 39
5	9 11 13 17
6	8 6 30 34
7	11 20 29

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/10/03
Hole Dia.	: 9.0"
Drill. Method	: HSA

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in.
WELL SCREENING	: 0.010" Slotted

NOTES

Shelby Tube Removed 25.0 to 27.5' BLS

Shelby Tube Removed 31.5 to 34.0' BLS

Bentonite Plug 35.5 to 30.0 BLS

09-25-2003 K:\02\02-330\02334.01\Boring Plan\WRB-4S.bor

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LOG OF BORING WRB-4D

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/9/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/9/03	Northing Coord.	:
Hole Diameter	: 6.0"	Easting Coord.	:
Drilling Method	: Mud Rotary	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND ; Very Fine to Fine, Subangular, Non-Plastic, Loose to Firm, Dry to Wet, Light Brown.
5	SC	SAND WITH CLAY ; Very Fine to Clayey Silt, Subangular, ~10% Fines, Non-Plastic, Very Firm to Dense, Very Wet, White and Purple and Light Brown, Fe Nodules and Zones of Clean Sands and Very Coarse Sands Noted.
10		
15		
20		
25	SC	CLAYEY, SITLY SAND; Very Fine to Medium, Subangular, ~40% Fines, Mediium Plasticity, Dense, Wet to Very Wet, Gray and Orange/ Brown, Minor Sandy Zones Noted.
30		
35	CH	SILTY CLAY ; ~95 % Fines, High Plasticity, Very Stiff, Wet, Gray.
40	ML	SANDY SILT ; ~60% Fines, Very Fine Sand, Medium Plasticity, Very Stiff, Very Wet, Gray
	CH	SILTY CLAY ; ~ 90% Fines, High Plasticity, Very Stiff, Wet, Gray.
45	SC	CLAYEY SILTY SAND ; Very Fine to Fine, Subangular, ~40% Fines, Medium Plasticity, Firm, Wet, Gray.
50		
55	CH	SANDY, SILTY CLAY ; 80% Fines, High Plasticity, Hard, Wet, Gray and Burgundy.

Well: WRB-4D
Elev.:

Samples	Blow Count
1	9 8 5 5
2	6 10 13 13
3	9 14 17 21
4	9 18 18 19
5	15 25 25 22
6	7 10 17 16
7	10 14 15 22
8	9 11 14 27
9	4 8 15 32
10	50/3
11	49 42

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/15/03
Hole Dia.	: 6.0"
Drill. Method	: HSA
	:

WELL CASING

Material	: Sch 40 PVC
Diameter	: 2"
Joints	: threaded

WELL SCREEN

Material	: Sch 40 PVC
	:
Joints	: threaded

NOTES

62.5' BLS Roller-Bit Refusal (No Sample Exists Beyond 62.5' BLS)

09-11-2003 k:\02\02-330\02334.01\Boring Plan\WRB-4D.bor

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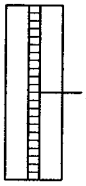
LOG OF BORING WRB-4D

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/9/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/9/03	Northing Coord.	:
Hole Diameter	: 6.0"	Easting Coord.	:
Drilling Method	: Mud Rotary	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
55	CH	
60	DRY	PWR; (DRY) Gray Mudstone
65		
70		
75		
80		
85		
90		
95		
100		
105		
110		

Well: WRB-4D
Elev.:



Samples	Blow Count
11	50/4
12	23 35 50/4

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/15/03
Hole Dia.	: 6.0"
Drill. Method	: HSA
	:

WELL CASING

Material	: Sch 40 PVC
Diameter	: 2"
Joints	: threaded

WELL SCREEN

Material	: Sch 40 PVC
	:
Joints	: threaded

NOTES

62.5' BLS Roller-Bit Refusal (No Sample Exists Beyond 62.5' BLS)

09-11-2003 K:\02\02-330\02334.01\Boring Plan\WRB-4D.bor

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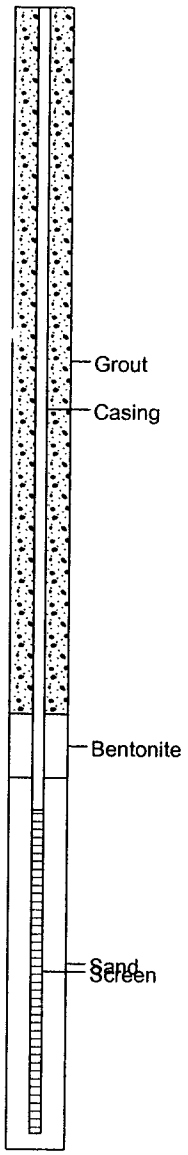
LOG OF BORING WRB-5

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/10/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/10/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25" Hollow Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND; Very Fine to Fine, Subangular, Non-Plastic, Loose, Dry to Moist, Light Brown.
10	SC	SAND WITH CLAY; Very Fine to Medium, Subangular, ~10% Fines, Non-Plastic, Lose to Firm, Very Moist to Very Wet, Orange/Brown.
20	SW	SAND; Fine to Medium, Subangular, Non-Plastic, Very Firm to Dense, Very Wet, White and Burgundy, Minor Clay-Rich Zones Noted.
30	CH	SILTY CLAY WITH SAND; ~95% Fines, High Plastic, Hard, Wet, Gray.
40		

Well: WRB-5
Elev.:



Samples	Blow Count
1	3 3 4 5
2	4 4 4 3
3	5 5 6 8
4	7 7 9 12
5	6 10 13 16
6	2 11 28 44
7	18 25 39 50/5

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/10/03
Hole Dia.	: 9.0"
Drill. Method	: 4.25" Hollow Stem Auger
	:

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
	:
WELL SCREENING	: 0.010" Slotted

NOTES

09-10-2003 k:\02\02-330\02334.01\Boring Plan\WRB-5.bor

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Engineering & Surveying, Inc.
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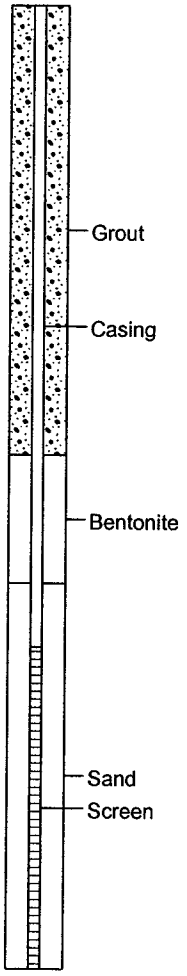
LOG OF BORING WRB-6S

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/1/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/1/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25'Hollow Stem Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Well: WRB-6S
Elev.:

Depth in Feet	USCS	DESCRIPTION
0	SP	SAND; Very Fine to Medium, Soft to Medium, Dry to Very Wet, Light Brown.
5		
10	SC	SAND WITH CLAY; Medium, Very Wet, Light Brown.
15		
20		



Samples	Blow Count
1	1
	3
	5
	6
2	7
	8
	9
	12
3	3
	5
	8

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/10/03
Hole Dia.	: 9.0"
Drill. Method	: HSA

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
WELL SCREENING	: 0.010" Slotted

NOTES

Shelby Tube Removed 13.5 to 15.5' BLS

09-10-2003 ...\02\02-330\02334.01\Boring Plan\WRB-6S.bor

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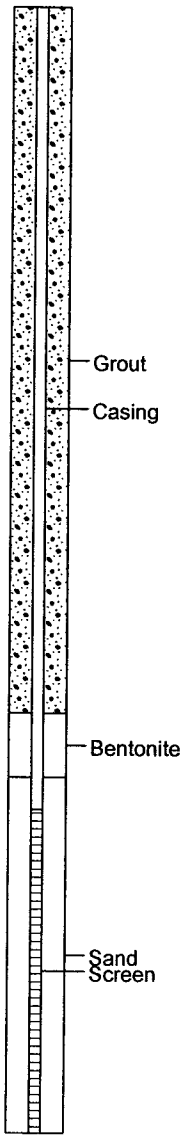
LOG OF BORING WRB-6D

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/1/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/1/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25'Hollow Stem Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SP	SAND; Very Fine to Medium, Soft to Medium, Dry to Very Wet, Light Brown.
5		
10	SC	CLAYEY SAND; Very Fine to Fine, Medium, Very Wet, Light Brown.
15	CL	SAND WITH CLAY;Very Fine to Medium, Very Soft, Very Wet, Beige.
20	SW	CLAYEY SNAD; Fine to Medium, Beige and Purple, Very Soft to Soft, Very Wet, Beige.
25	CL	SANDY CLAY; Very Stiff, Very Wet, Beige and Purple.
30	CH	SILTY CLAY WITH SAND; Very Stiff to Hard, Wet, Gray
35		
40		



Samples	Blow Count
1	2 2 2 3
2	7 11 11 11
3	1 2 1 1
4	1 3 4 3
5	18 25 33 35
6	13 28 33 46
7	16 19 29

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/10/03
Hole Dia.	: 9.0"
Drill. Method	: HSA

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
WELL SCREENING	: 0.010" Slotted

NOTES

Shelby Tube Removed 13.5 to 15.5' BLS

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LOG OF BORING WRB-7

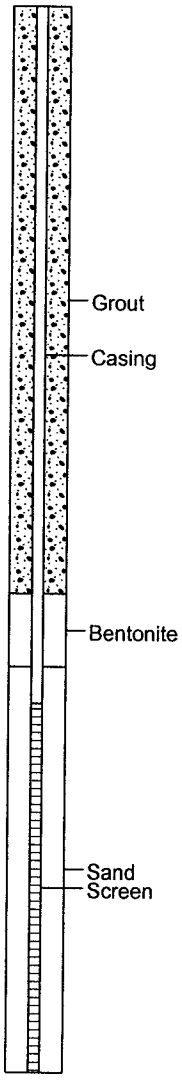
(Page 1 of 1)

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/9/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/9/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25" Hollow Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND; Very Fine to Fine; Subangular, Non-Plastic, Loose, Dry to Moist, Light Brown.
5	SC	SAND WITH CLAY; Very Fine to Fine, Subangular, ~10 % Fines, Low Plasticity, Very Stiff, Moist, Light Brown.
10	SC	CLAYEY SAND; Fine to Medium, Subangular, ~20% Fines, Low Plasticity, Very Moist to Very Wet, Orange/ Brown.
15	CH	SILTY CLAY; ~95% Fines, High Plasticity, Very Stiff, Very Moist to Wet, Gray.
20	SC	CLAYEY,SILTY SAND; Very Fine to Medium, Subangular, ~45% Fines, Medium Plasticity, Very Firm, Wet, Gray and Orange/ Brown.
25	SC	CLAYEY SAND; Fine to Medium, Subangular, ~25% Fines, Low Plasticity, Very Firm, Very Wet, Orange/ Brown.
	CH	SILTY, SANDY CLAY; ~90% Fines, High Plasticity, Hard, Wet, Gray.
30		
35		

Well: WRB-7
Elev.:



Samples	Blow Count
1	8 16 24 19
2	14 12 11 13
3	4 8 18 32
4	15 13 29 29
5	7 10 17
6	7 13 27

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/9/03
Hole Dia.	: 9.0"
Drill. Method	: 4.25" Hollow Stem Auger
	:

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
	:
WELL SCREENING	: 0.010" Slotted

NOTES

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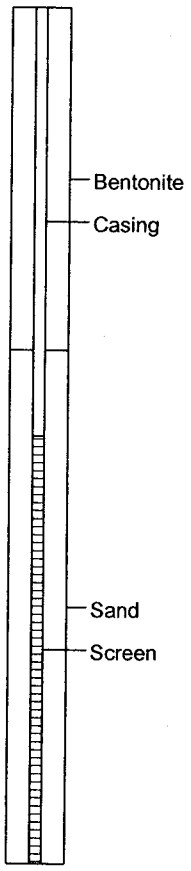
LOG OF BORING WRB-8S

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/16/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/16/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25'Hollow Stem Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SC	CLAYEY SAND (SC); Very Fine, Subangular, ~15 to 25 % Fines, Firm, Very Moist to Very Wet, Orange/Brown.
5	MH	SANDY, CLAYEY SILT (MH); ~ 80 % Fines, Medium Plasticity, Very Stiff, Wet, Gray.
10		
15		

Well: WRB-8S
Elev.:



Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/16/03
Hole Dia.	: 9.0"
Drill. Method	: HSA
	:

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
	:
WELL SCREENING	: 0.010" Slotted

NOTES

No SPT/ No Samples Exist

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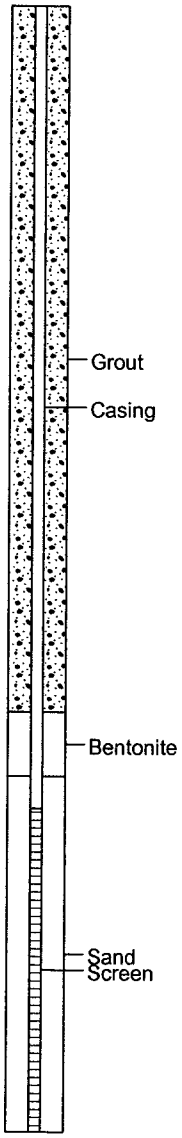
LOG OF BORING WRB-8D

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/16/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/16/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: Hollow Stem Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SC	CLAYEY SAND ; Very Fine to Fine, Subangular ~ 15 to 25 % Fines, Non-Plastic, Firm, Very Moist to Very Wet, Orange/Brown.
5	MH	SANDY, CLAYEY SILT (MH); ~ 80 %, Fines, Medium Plasticity, Very Stiff, Wet, Gray.
10	SC	SILTY SAND WITH CLAY ; Very Fine, ~45 % Fines, Medium Plasticity, Dense, Wet, Gray.
	SC	CLAYEY, SILTY SAND; Very Fine to Fine, ~20 to 30 % Fine, Low to Medium Plasticity, Dense, Wet, Gray.
15		
20	CH	SANDY, SILTY CLAY; ~80 % Fines, High Plasticity, Very Stiff, Wet, Gray.
25	SC	CLAYEY SAND; Very Fine to Fine, Subangular, ~ 15 to 35 % Fines, Low to Medium Plasticity, Loose to Very Firm, Very Wet, Gray.
30		
35		
40		

Well: WRB-8D
Elev.:



Samples	Blow Count
1	4 9 10 12
2	12 14 23 23
3	24 19 22 30
4	6 13 21 28
5	9 14 14 16
6	6 9 16 15
7	4 5 6

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/16/03
Hole Dia.	: 9.0"
Drill. Method	: HSA
	:

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
	:
WELL SCREENING	: 0.010" Slotted

NOTES

Shelby Tube Removed 7.5 to 8.5' BLS (Limited Sample)

Shelby Tube Removed 11.5 to 12.5 BLS (Limited Sample)

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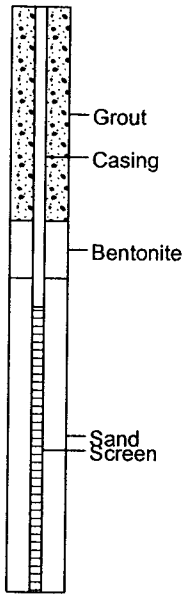
LOG OF BORING WRB-9

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/15-16/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/16/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25'Hollow Stem Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND ; Very Fine to Fine, Subangular, Non-Plastic, Loose, Moist, Light Brown.
5		
10	SC	SAND WITH CLAY ; Very Fine to Fine, Subangular, ~5 % Fines, Non-Plastic, Firm to Very Firm, Very Moist to Very Wet, Orange/Brown.
15	SC	CLAYEY SAND ; Medium, Subangular, ~ 30 % Fines, Medium Plasticity, Very Firm, Very Wet, Beige and Purple, Fe Nodules Noted.
20	MH	CLAYEY SILT WITH SAND ; ~ 85% Fines, High Plasticity, Hard, Wet, Beige and Purple, Fe Nodules Noted.
25	CH	CLAY WITH SAND ; ~ 95% Fines, High Plasticity, Hard, Moist, Gray.
30		
35	SC	CLAYEY SAND ; Very Fine to Fine, Subangular, ~20 % Fines, Low Plasticity, Dense, Very Wet, Gray, Minor Sandy Zones Noted
40	MH	CLAYEY SILT WITH (V. FN) SAND; ~ 80 % Fines, Medium Plasticity, Very Stiff , Wet, Gray.
45		

Well: WRB-9
Elev.:



Samples	Blow Count
1	4 3 3 4
2	8 12 16 22
3	7 6 5 11
4	9 11 25 40
5	12 23 50/5.5
6	12 16 26 35
7	10 16 21
8	5 8 12

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/16/03
Hole Dia.	: 9.0"
Drill. Method	: HSA
	:

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
	:
WELL SCREENING	: 0.010" Slotted

NOTES

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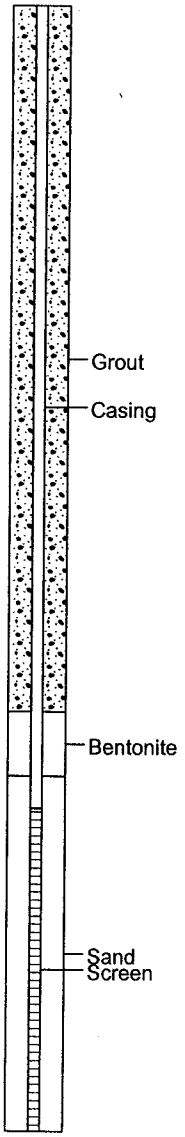
LOG OF BORING WRB-10

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/8/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/8/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25" Hollow Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND; Very Fine to Fine; Subangular, Non-Plastic, Loose to Firm, Dry to Very Moist, Light Brown.
10	SC	SAND WITH CLAY; Very Fine to Fine, Subangular, ~10 % Fines, Low Plasticity, Very Firm, Very Moist to Wet, Light Brown.
15	SC	SILTY CLAYEY SAND; Very Fine, Subangular, ~45% Fines, Medium Plasticity, Wet to Very Wet, Beige
20	SC	SAND W/ CLAY; Very Fine to Medium, Subangular, ~15% Fines, Low Plasticity, Firm , Very Wet, Orange and Brown,Caly Rich Zones Noted.
25	SC	CLAYEY SAND; Very Fine to Medium, Subangular, ~40% Fines, Low to Medium Plasticity, Loose to Firm, Very Wet, Gray Clay Interlayers Noted
35	SC	SANDY , SILTY CLAY; ~70% Fines, High Plasitcity, Hard, Wet, Gray.
40		

Well: WRB-10
Elev.:



Samples	Blow Count
1	3 3 4 5
2	9 13 13 14
3	5 4 3 5
4	3 3 6 4
5	9 7 7 7
6	4 3 3 5
7	10 22 35

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/8/03
Hole Dia.	: 9.0"
Drill. Method	: 4.25" Hollow Stem Auger

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
WELL SCREENING	: 0.010" Slotted

NOTES

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LOG OF BORING WRB-11S

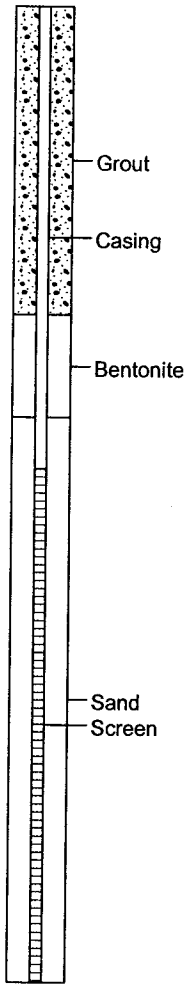
(Page 1 of 1)

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/15/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/15/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25'Hollow Stem Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SP	SAND ; Very Fine to Medium, Subangular, Non-Plastic, Firm, Moist, Light Brown.
5	SC	SAND WITH CLAY ; Fine to Coarse, Subangular, ~ 10% Fines, Non-Plastic, Firm, Very Moist, Very Wet , Light Brown.
10	CH	SILTY SANDY CLAY ; ~85 % Fines, High Plasticity, Very Stiff, Very Wet, Gray.
15	MH	SILTY CLAYEY SAND; Very Fine to Coarse, Subangular, ~30% Fines, Low to Medium Plasticity, Loose to Firm, Very Wet, Gray, Sandy Zones Noted.
20		
25		

Well: WRB-11S
Elev.:



Samples	Blow Count
1	7
	10
	13
	11
2	3
	7
	15
	16
3	4
	5
	12
	11
4	4
	4
	5
	7

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/15/03
Hole Dia.	: 9.0"
Drill. Method	: HSA

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
WELL SCREENING	: 0.010" Slotted

NOTES

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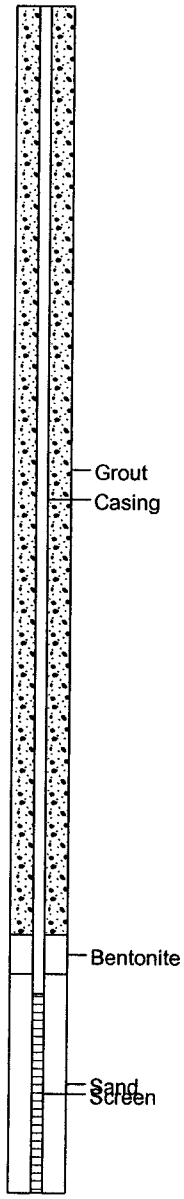
LOG OF BORING WRB-11D

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/14-15/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/15/03	Northing Coord.	:
Hole Diameter	: 6.0"	Easting Coord.	:
Drilling Method	: Mud Rotary	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Well: WRB-11D
Elev.:

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND; Very Fine to Fine, Subangular, Non-Plastic, Firm, Moist, Light Brown.
	SC	SAND WITH CLAY; Fine to Medium, Subangular, ~ 10% Fines, Non-Plastic, Very Moist to Very Wet, Light Brown.
5	SP	SAND ; Fine to Coarse, Subangular, Non-Plastic, Firm, Very Wet, Light Brown
10	CH	SILTY, SANDY CLAY ; ~ 85 % Fines, High Plasticity, Stiff, Very Wet, Gray.
	SC	SILTY CLAYEY SAND ; Very Fine to Very Coarse, Subangular, ~ 30 % Fines, Low to Medium Plasticity, Loose, Very Firm, Very Wet, Gray and Orange/ Brown, Minor Clay-Rich Zones Noted.
15		
20	SC	CLAYEY SILTY SAND ; Very Fine to Coarse, Subangular, ~45 % Fines, Low to Medium Plasitcity, Very Firm to Hard, Wet to Very Wet, Gray, Minor Sandy Zones Noted.
25	CH	SILTY CLAY WITH SAND ; ~95% Fines, High Plasticity, Stiff to Very Stiff, Wet, Gray and Burgundy.
	SC	CLAYEY, SILTY SAND ; Very Fine to Medium, Subangular, ~35% Fines, Medium Plasticity, Very Dense, Wet, Gray.
30		
35	SS	PWR; (Very Moist) Gray, Silty Sandstone
	CH	SILTY CLAY WITH SAND ; ~95 % Fines High Plasticity, Hard, Wet, Gray.
40	SC	CLAYEY, SILTY SAND ; Very Fine to Medium, Subangular, ~35% Fines, Medium Plasticity, Firm to Very Firm, Wet, Gray.
45		
50	CH	SILTY CLAY ; ~ 95% Fines, High Plasticity, Very Stiff, Wet, Gray.
55	CH	SANDY, SILTY CLAY ; ~ 55% Fines, High Plasticity, Very Stiff, Hard, Wet, Gray
60		
65		



Samples	Blow Count
1	11 12 13 14
2	9 7 7 8
3	8 11 12 13
4	4 6 19 23
5	
6	34 50/5
7	28 50/55
8	18 25 35
9	11 28 33
10	6 10 16
11	13 25 29
12	13 16

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/15/03
Hole Dia.	: 6.0"
Drill. Method	: HSA
	:

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
	:
WELL SCREENING	: 0.010" Slotted

NOTES
Shelby Tube Removed 23.5 to 25.5' BLS

09-25-2003 w:\202-330\02334.01\Boring Plan\WRB-11D.bor

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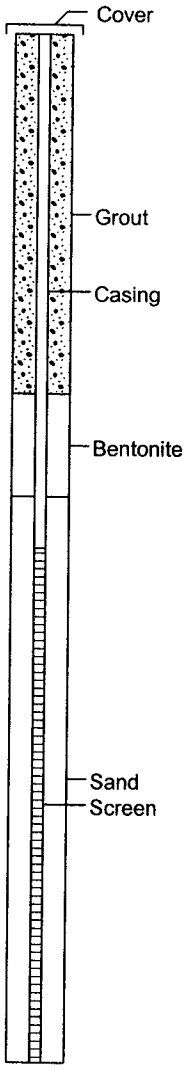
LOG OF BORING WRB-12S

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/17/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/17/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25'Hollow Stem Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND ; Fine to Medium, Subangular, Non-Plastic, Loose to Firm, Moist to Very Wet, Light Brown and Gray and Purple.
15	SP	SAND WITH CLAY ; Very Fine to Medium, Subangular, ~ 5 to 15% Fines Non to Low Plasticity, Loose to Very Dense, Very Wet, Beige and Gray.
20		
25		

Well: WRB-12S
Elev.:



Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/17/03
Hole Dia.	: 9.0"
Drill. Method	: HSA
	:

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
	:
WELL SCREENING	: 0.010" Slotted

NOTES

No SPT/No Samples Exist

Piezometer is Completed with Well Pad and Locking Standup Cover

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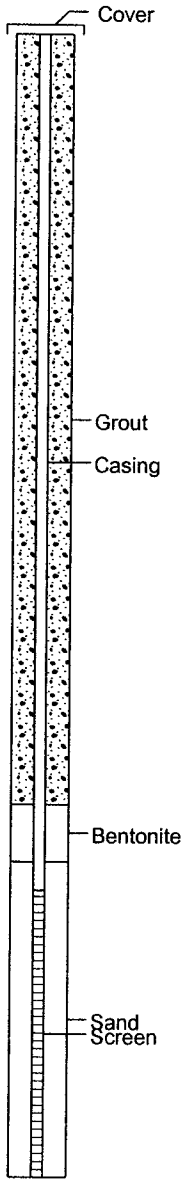
LOG OF BORING WRB-12D

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/17/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/17/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25'Hollow Stem Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND ; Fine to Medium, Subangular, Non-Plastic, Loose to Firm, Moist to Very Wet, Light Brown and Gray and Purple.
15	SP	SAND WITH CLAY ; Very Fine to Medium Subangular, ~5 to 15% Fines, Non-Plastic to Low Plasticity, Loose to Very Dense, Very Wet, Beige and Gray.
20	CH	SANDY CLAY ; ~60 % Fines, Medium to High Plasticity, Very Stiff to Hard, Wet, Gray.
25	SC	CLAYEY, SILTY SAND ; Very Fine to Medium, Subangular, ~40 % Fines, Medium Plasticity, Very Firm, Wet, Gray.
		SILTY CLAY WITH SAND; ~95% Fines, High Plasticity, Very Stiff to Hard, Moist, Gray.
40	SW	CLAYEY, SILTY SAND ; Very Fine to Fine, Subangular, ~40% Fines, Medium Plasticity, Hard, Moist, Gray.
45		

Well: WRB-12D
Elev.:



Blow Count	Samples
12	1
5	
4	2
4	
6	
10	
2	3
3	
3	
4	
12	4
29	
41	
50/5	
8	5
11	
15	
16	
13	6
33	
36	
50/4	
12	7
15	
22	
19	8
36	
47	

Well Construction Information

WELL CONSTRUCTION
Date Compl. : 7/17/03
Hole Dia. : 9.0"
Drill. Method : HSA

WELL CASING
Joints : Threaded
Material : Sch 40 PVC
Diameter : 2 in

WELL SCREEN : 10" Slotted

NOTES
Piezometer is Completed with Well Pad and Locking Standup Cover.

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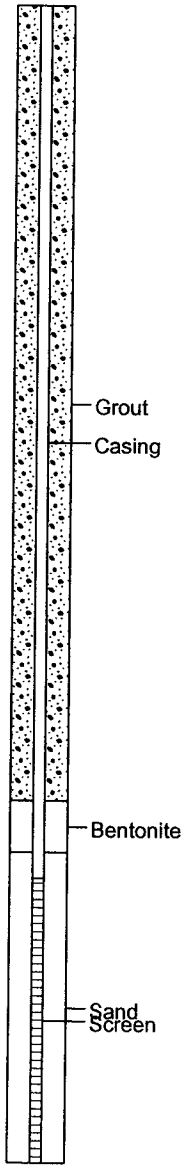
LOG OF BORING WRB-13

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/3/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/3/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25'Hollow Stem Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SP	SAND ; Very Fine to Medium, Subangular, Non-Plastic, Loose, Dry to Very Moist, Light Brown.
10	SC	SAND WITH CLAY ; Very Fine to Medium, Subangular, ~15 % Fines, Low Plasticity, Very Moist, Light Brown.
	CL	SANDY CLAY ; ~60 % Fines, Medium Plasticity, Firm, Very Moist, Gray
15	SC	SAND WITH CLAY ; Fine to Medium, Subangular, ~ 15 % Fines, Low Plasticity, Firm, Very Moist to Very Wet, White and Gray and Orange/ Brown, Sandy/Clayey Interlayers Noted.
25		
30		
35		
40	CL	SANDY CLAY ; ~55 % Fines, Medium Plasticity, Very Soft, Very Wet, Gray.
	SC	SAND WITH CLAY ; Very Fine to Fine, Subangular, ~10% Fines, Low Plasticity, Very Wet, Gray, Shell Fragments Noted.
45	CH	CLAY WITH SAND ; ~90% Fines, High Plasticity, Soft to Firm, Very Wet, Gray
50		

Well: WRB-13
Elev.:



Samples	Blow Count
1	3 3 4 5
2	5 7 11 17
3	7 7 14 11
4	6 8 10 13
5	6 11 12 9
6	7 6 10 13
7	4 6 8 9
8	
9	3 x x x

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/3/03
Hole Dia.	: 9.0"
Drill. Method	: HSA
WELL CASING	
Joint	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
WELL SCREENING	: 0.010" Slotted

NOTES

Shelby Tube Removed 40.5 to 44.0' BLS

Bentonite Plug 45.0 to 44.0' BLS

09-10-2003 k:\02\02-330\02334.01\Boring Plan\WRB-13.bor

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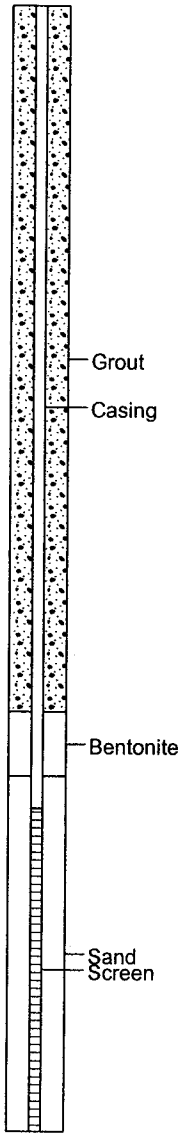
LOG OF BORING WRB-14

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/8/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/8/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25" Hollow Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND; Very Fine to Fine, Subangular, Non-Plastic, Loose, Dry to Moist, Light Brown.
10	SC	SAND WITH CLAY; Very Fine to Medium, Subangular, ~10% Fines, Low Plasticity, Dense, Very Moist to Very Wet, Light Brown.
13	ML	SANDY SILT WITH CLAY; 65% Fines, Medium Plasticity, Very Stiff, Very Wet, Orange and Gray.
15	SW	SAND; Fine to Medium, Subangular, Non-Plastic, Firm, Very Wet, Orange/Brown.
20	SC	CLAYEY SAND; Very Fine to Medium, Subangular, ~40% Fines, Low to Medium Plasticity, Firm, Very Wet, Gray, Clay Interlayers Noted.
25	SC	CLAYEY, SILTY SAND; Very Fine to Medium, Subangular, ~45% Fines, Medium Plasticity, Very Dense, Wet, Gray, Clay Interlayers Noted.
35	CH	SANDY, SILTY CLAY; ~75% Fines, High Plasticity, Very Dense, Wet , Gray.
40		

Well: WRB-14
Elev.:



Samples	Blow Count
1	5 3 4 3
2	6 18 20 16
3	9 8 12 12
4	5 7 8 15
5	3 5 6 6
6	10 15 24 36
7	7 15 25

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/8/03
Hole Dia.	: 9.0"
Drill. Method	: 4.25" Hollow Stem Auger
WELL CASING	
Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
WELL SCREENING	: 0.010" Slotted

NOTES

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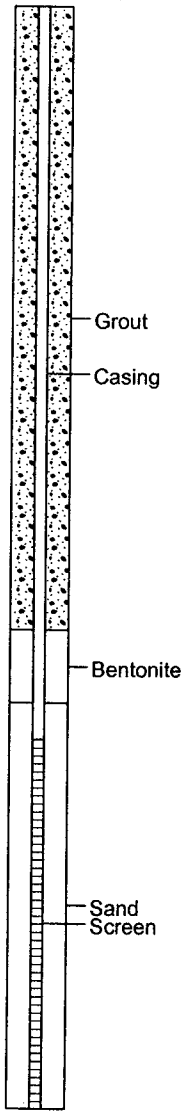
LOG OF BORING WRB-15

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/14/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/14/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25'Hollow Stem Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND ; Very Fine to Fine, Subangular, Non-Plastic, Firm, Moist, Light Brown.
5	SC	CLAYEY SAND ; Very Fine to Fine, Subangular, ~20 % Fines, Low Plasticity, Firm, Very Moist, Wet, Beige.
10	SC	SILTY, CLAYEY SAND WITH GRAVEL ; Very Fine, Subangular ~45% Fines , Medium Plasticity, Loose, Wet, Beige and Gray.
15		
20	SC	CLAYEY SILTY SAND ; Very Fine to Fine, Subangular, ~35 % Fines, Medium Plasticity, Firm, Wet to Very Wet, Gray
25	DRY	PWR; (DRY) Gray, Silty Sandstone.
30		
35		

Well: WRB-15
Elev.:



Samples	Blow Count
1	3 6 9 16
2	12 11 3 4
3	2 3 4 6
4	5 7 11 16
5	5 6 6 9
6	31 50/4

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/15/03
Hole Dia.	: 9.0"
Drill. Method	: HSA
	:

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
	:
WELL SCREENING	: 0.010" Slotted

NOTES

Attempted Shelby Tube @ 11.5 to 13.5 ' BLS / No Sample

09-10-2003 k:\02\02-330\02334.01\Boring Plan\WRB-15.bor

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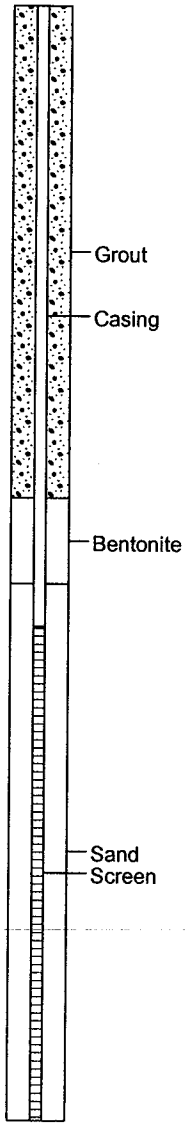
LOG OF BORING WRB-16S

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/7/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/7/03	Northing Coord.	:
Hole Diameter	: 9.0"	Easting Coord.	:
Drilling Method	: 4.25'Hollow Stem Auger	Survey By	:
Sampling Method	: SPT	Logged By	: John Palmer

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND ; Very Fine to Fine, Subangular, Non-Plastic, Loose, Dry to Moist, Light Brown.
10	SC	SAND WITH CLAY ; Very Fine to Medium, Subangular, ~ 15% Fines, Low Plasticity, Firm, Very Moist, Light Brown.
15	SC	CLAYEY SAND ; Very Fine to Fine, Subangular, ~20 % Fines, Low Plasticity, Firm, Wet to Very Wet, Beige.
	SC	CLAYEY, SLITY SAND ; Very Fine, Subangular, ~ 45 % Fines, Medium Plasticity, Firm, Very Wet, Biege and Gray.
	SC	CLAYEY SAND ; Fine to Medium, Subangular, ~20 % Fines, Low Plasticity, Firm, Very Wet , Gray.
20	CH	SANDY, SILTY CLAY ; ~65 % Fines, High Plasticity, Stiff, Very Wet, Gray.
	SC	CLAYEY SAND ; Very Fine to Medium, Subangular, ~30 % Fines, Low Plasticity, Firm, Beige.
25	CL	SANDY, SILTY CLAY ; 60% Fines, Medium Plasticity, Firm, Very Wet, Gray.
30		

Well: WRB-16S
Elev.:



Samples	Blow Count
1	3 3 6 6
2	12 14 14 15
3	5 8 9 10
4	8 8 4 3
5	3 5 3 6

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/3/03
Hole Dia.	: 9.0"
Drill. Method	: HSA

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
WELL SCREENING	: 0.010" Slotted

NOTES
Bentonite Plug 25.5 to 24.5' BLS

09-10-2003 R:\02\02-330\02334.01\Boring Plan\WRB-16S.bor

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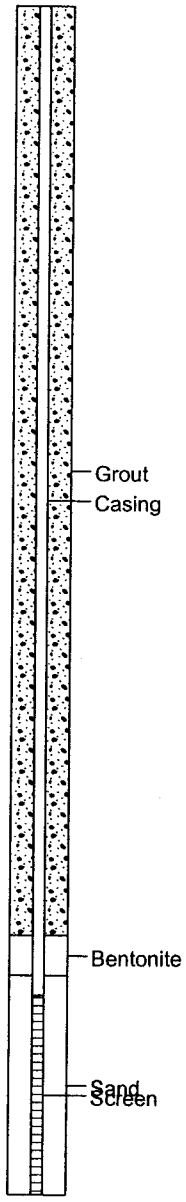
LOG OF BORING WRB-16D

Central Carolina Tire
Project No. 202334.01

Date Started	: 7/7/03	Drilling Company	: Titian Atlantic Co.
Date Completed	: 7/7/03	Northing Coord.	:
Hole Diameter	: 6.0"	Easting Coord.	:
Drilling Method	: Mud Rotary	Survey By	:
Sampling Method	: SPT	Logged By	: John Ihnatolya

Well: WRB-16D
Elev.:

Depth in Feet	USCS	DESCRIPTION
0	SW	SAND; Very Fine to Fine, Subangular, Non-Plastic, Moist, Firm, Light Brown.
5	SC	SAND WITH CLAY; Very Fine to Medium, Subangular, ~15% Fines, Very Firm, Very Moist, Light Brown.
20	CH	SANDY CLAY; ~90% Fines, High Plasticity, Firm, Very Wet, Gray.
30	CH	SANDY, SILTY CLAY; ~75% Fines, High Plasticity, Very Stiff to Hard, Wet, Gray
35	SC	CLAYEY SILTY SAND; Very Fine to Medium Sand, Subangular, ~45% Fines, Medium Plasitcity, Hard, Wet, Gray. Clay Interlayers, Fe Nodules and Purple Coloration at ~ 50.0' BLS.
65		



Samples	Blow Count
1	19 21 21
2	5 10 12 11
3	7 14 17 21
4	WOH 5 4 4
5	
6	12 20 21 19
7	27 26 21 43
8	45 50/5
9	16 19 20 18
10	15 24 27 32
11	20 32 36 40
12	19 24 20

Well Construction Information

WELL CONSTRUCTION

Date Compl.	: 7/7/03
Hole Dia.	: 6.0"
Drill. Method	: Mud Rotary
	:

WELL CASING

Joints	: Threaded
Material	: Sch 40 PVC
Diameter	: 2 in
	:
WELL SCREENING	: 0.010" Slotted

NOTES

21.5-24.0 Shelby Tube Removed

09-25-2003 k:\02\02-330\02334.01\Boring Plan\WRB-16D.bor

APPENDIX 4B

Laboratory Reports

202334.01

Geotechnics

.....GEOTECHNICAL, GEOENVIRONMENTAL, AND GEOSYNTHETIC LABORATORIES

LABORATORY TEST REPORT

August 31, 2003

Project No. 202334.01

RECEIVED
SEP 03 2003
WITHERS & RAVENEL

Mr. Stefan Bray
Withers & Ravenel
111 MacKenan Dr
Cary, NC 27511

RE: Soils Testing – CENTRAL CAROLINA TIRE MONOFILL Geotechnics No. 2003-558-01

Transmitted herein are the results of the soils testing performed for the above referenced project verified on the Project Verification Form, submitted August 13, 2003. The testing was performed in accordance with the ASTM methods listed on the enclosed data sheets. The remaining sample materials for this project will be retained for a minimum of 90 days as directed by the Geotechnics' Quality Program.

Disclaimer

The test results are believed to be representative of the samples submitted but are indicative only of the specimens which were evaluated. Geotechnics has no direct knowledge of the origin of the samples, implies no position with regard to the disposition of the test results, i.e. pass/fail, and makes no claims as to the suitability of the material for its intended use.

The test data and all associated project information provided shall be held in strict confidence and disclosed to other parties only with authorization of the Client and Geotechnics. The test data submitted herein is considered integral with this report and is not to be reproduced except in whole and only with the authorization of the Client and Geotechnics.

We are pleased to provide these testing services. Should you have any questions or if we may be of further assistance, please do not hesitate to contact our office.

Respectively submitted,

Dave A. Jenks
Laboratory Manager

Geotechnics

MOISTURE CONTENT

ASTM D 2216 (SOP-S1)

Client	WITHERS & RAVENEL
Client Reference	CENTRAL CAROLINA TIRE MONOFILL
Project No.	2003-558-01

Lab ID	.01	.02	.03	.04	.05
Boring No.	WRB-16D	WRB-11D	WRB-4S	WRB-15	WRB-8D
Depth (ft)	23.0 - 23.1	24.5 - 24.6	33.4 - 33.5	16.0 - 16.1	7.8 - 7.9
Sample No.	1	2	3	4	5
Tare Number	Y-13	Y-6	SS-1	B-2	ZZ-1
Wt. of Tare & WS (gm)	381.63	413.4	460.4	435.9	484.8
Wt. of Tare & DS (gm)	297.45	364.02	409.4	385.49	424.2
Wt. of Tare (gm)	99.17	100.47	100.47	98.14	100.06
Wt. of Water (gm)	84.18	49.38	51	50.41	60.6
Wt. of DS (gm)	198.28	263.55	308.93	287.35	324.14
Water Content (%)	**42.5**	**18.7**	**16.5**	**17.5**	**18.7**
UNIT WEIGHT (Dry Density)	**78.2**	**108.1**	**114.2**	**113.0**	**100.9**

Lab ID	.06	.07	.08
Boring No.	WRB-14	WRB-6D	WRB-13
Depth (ft)	3.5 - 5.5	14.9 - 15.3	42.0 - 42.4
Sample No.	6	7	8
Tare Number	C	Z-12	Y-6
Wt. of Tare & WS (gm)	28.86	415.4	713.1
Wt. of Tare & DS (gm)	28.45	361.61	617.2
Wt. of Tare (gm)	15.21	99.83	100.48
Wt. of Water (gm)	0.41	53.79	95.9
Wt. of DS (gm)	13.24	261.78	516.72
Water Content (%)	**3.1**	**20.5**	**18.6**
UNIT WEIGHT (Dry Density)	**NA**	**100.1**	**107.2**

Notes : *NA*

Tested By DAJ *Date* 08/31/03 *Checked By* MDS *Date* 8-31-03

DCN: CT-S1 DATE 6-30-98 REVISION: 2

C:\2003 Projects\2003-558 W&R\[2003-558-01 %M&UNIT WT..XLS]Sheet1

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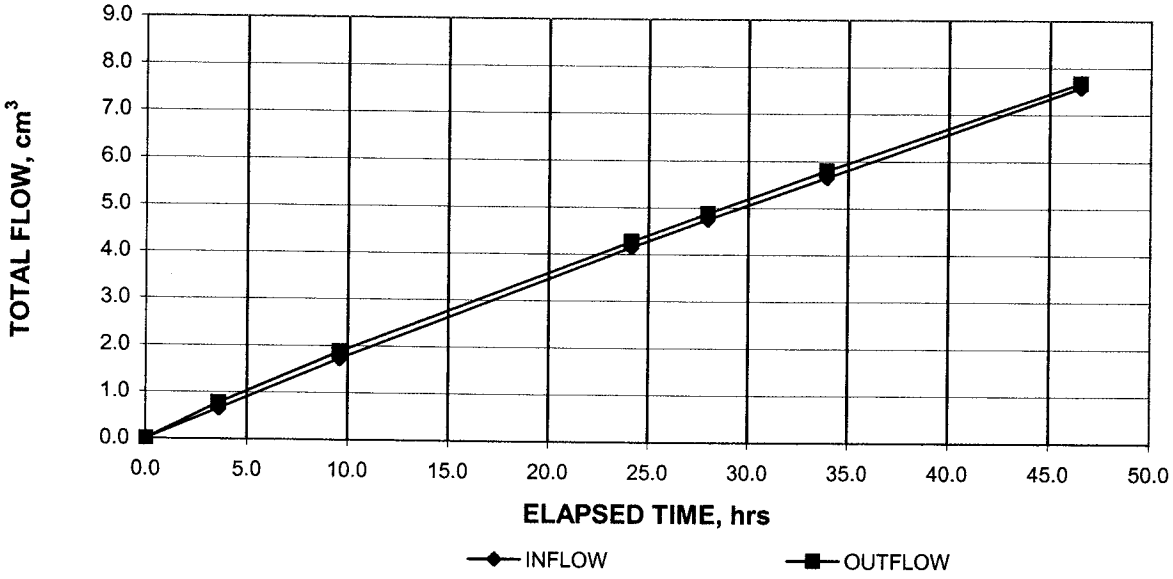
PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

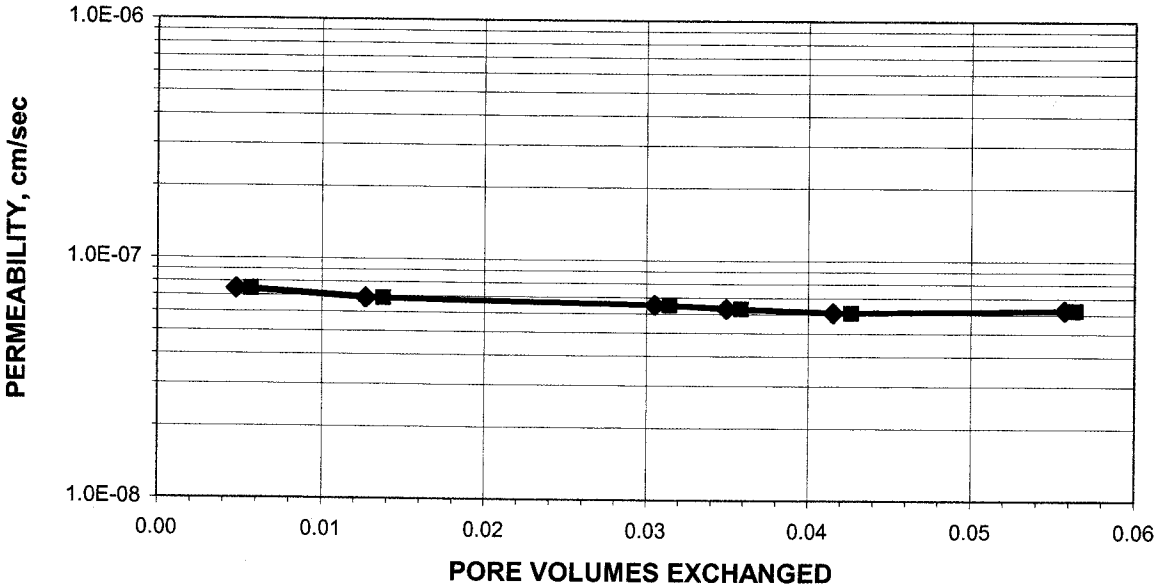
Client	WITHERS & RAVENEL	Boring No.	WRB-4S
Client Project	Central Carolina Tire Monofill	Depth (ft.)	33.55 - 33.9
Project No.	2003-558-01	Sample No.	3
Lab ID No.	2003-558-01-03		

AVERAGE PERMEABILITY = 6.3E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 6.3E-10 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



Tested By: DAJ Date: 08/19/03 Checked By: MPS Date: 8-30-03

DCN: CT-22 DATE: 01/06/99 REVISION: 2 C:\Documents and Settings\DAVE JENKS\Desktop\Running Perms\[2003-558-01-03 W&R.xls]Sheet1

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

Geotechnics

Client	WITHERS & RAVENEL	Boring No.	WRB-4S
Client Project	Central Carolina Tire Monofill	Depth (ft.)	33.55 - 33.9
Project No.	2003-558-01	Sample No.	3
Lab ID No.	2003-558-01-03		
		Specific Gravity	2.63 Measured
		Sample Condition	Undisturbed

Visual Description: LIGHT ORANGE-LIGHT GRAY SANDY CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	SS-1	H-1
Wt. of Tare & WS (gm.)	460.40	1128.00
Wt. of Tare & DS (gm.)	409.40	988.10
Wt. of Tare (gm.)	100.47	151.51
Wt. of Water (gm.)	51.00	139.90
Wt. of DS (gm.)	308.93	836.59
Moisture Content (%)	**16.5**	**16.7**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	1274.30	NA
Wt. of Tube (gm.)	291.35	NA
Wt. of WS (gm.)	982.95	984.76
Length 1 (in.)	4.303	4.349
Length 2 (in.)	4.287	4.361
Length 3 (in.)	4.393	4.362
Top Diameter (in.)	2.876	2.857
Middle Diameter (in.)	2.873	2.844
Bottom Diameter (in.)	2.885	2.861
Average Length (in.)	4.33	4.36
Average Area ($in.^2$)	6.51	6.40
Sample Volume (cm^3)	461.35	456.79
Unit Wet Wt. ($gm./cm^3$)	2.13	2.16
Unit Wet Wt. (pcf)	133.0	134.6
Unit Dry Wt. (pcf)	114.2	115.3
Unit Dry Wt. ($gm./cm^3$)	1.83	1.85
Void Ratio, e	0.44	0.42
Porosity, n	0.30	0.30
Pore Volume (cm^3)	140.6	136.0

Tested By: DAJ Date: 08/19/03 Checked By: MPS Date: 8-30-03

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

Geotechnics

Client	WITHERS & RAVENEL	Boring No.	WRB-4S
Client Project	Central Carolina Tire Monofill	Depth (ft.)	33.55 - 33.9
Project No.	2003-558-01	Sample No.	3
Lab ID No.	2003-558-01-03		

Pressure Heads (Constant)	
Top Cap (psi)	57.5
Bottom Cap (psi)	60.0
Cell (psi)	76.5
Total Pressure Head (cm)	175.8
Hydraulic Gradient	15.88

Final Sample Dimensions	
Sample Length (cm), L	11.07
Sample Diameter (cm)	7.25
Sample Area (cm^2), A	41.27
Inflow Burette Area (cm^2), a-in	0.882
Outflow Burette Area (cm^2), a-out	0.880
B Parameter (%)	96

AVERAGE PERMEABILITY = 6.3E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 6.3E-10 m/sec @ 20°C

DATE	TIME		ELAPSED TIME t	TOTAL INFLOW	TOTAL OUTFLOW	TOTAL HEAD h	FLOW (0 flow)	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(hr)	(cm^3)	(cm^3)	(cm)	(1 stop)	(°C)	(cm/sec)
08/25/03	8	31	0.0	0.0	0.0	183.2	0	22.7	NA
08/25/03	12	7	3.6	0.6	0.8	181.6	0	23.3	7.4E-08
08/25/03	18	6	9.6	1.7	1.9	179.1	0	23.6	6.9E-08
08/26/03	8	40	24.2	4.2	4.3	173.6	0	22.9	6.5E-08
08/26/03	12	29	28.0	4.8	4.9	172.3	0	22.9	6.3E-08
08/26/03	18	27	33.9	5.7	5.8	170.2	0	23.8	6.1E-08
08/27/03	7	3	46.5	7.6	7.7	165.9	1	22.8	6.2E-08

Tested By: DAJ Date: 08/19/03 Checked By: MPS Date: 8-30-03

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Geotechnics

SPECIFIC GRAVITY

ASTM D 854-00 (SOP - S5)

Client	WITHERS & RAVENEL	Boring No.	WRB-4S
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	32.9 - 33
Project No.	2003-558-01	Sample No.	3
Lab ID	2003-558-01-03	Visual Description	**GRAY-LIGHT ORANGE CLAYEY SAND** (MInus No.4 sieve material, airdried)

Replicate Number	**1**	**2**
Pycnometer ID	R 27	R 29
Weight of Pycnometer + Soil + Water (gm)	722.7	724.9
Temperature, T (°Celsius)	23.6	24.0
Weight of Pycnometer + Water (gm)	687.93	692.30
Tare Number	C-2	C-4
Weight of Tare + Dry Soil (gm)	280.75	277.66
Weight of Tare (gm)	224.4	225.22
Weight of Dry Soil (gm)	56.35	52.44
Specific Gravity of Soil @ T	2.612	2.643
Specific Gravity of Water @ T	0.9974	0.9973
Conversion Factor for Temperature T	0.9992	0.9991
Specific Gravity @ 20° Celsius	2.614	2.646

Average Specific Gravity @ 20° Celsius	2.63

Tested By DJK *Date* 08/25/03 *Checked By* DAJ *Date* 8-30-03

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Geotechnics

ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	WITHERS & RAVENEL	Boring No.	WRB-4S
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	33.0 - 33.2
Project No.	2003-558-01	Sample No.	3
Lab ID	2003-558-01-03	Soil Description	**LIGHT ORANGE-GRAY FAT CLAY**

Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Wet method)

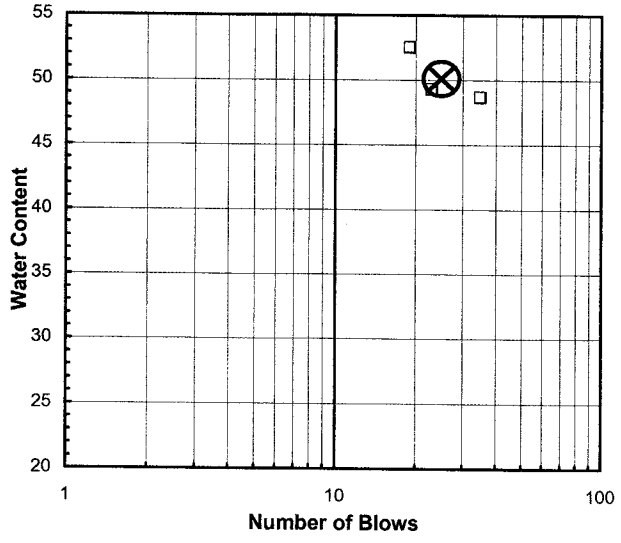
Liquid Limit Test	**1**	**2**	**3**	MULTIPOINT
Tare Number	A-I	M	A-T	
Wt. of Tare & WS (gm)	29.21	25.40	26.58	
Wt. of Tare & DS (gm)	24.49	22.00	22.98	
Wt. of Tare (gm)	15.50	15.10	15.58	
Wt. of Water (gm)	4.7	3.4	3.6	
Wt. of DS (gm)	9.0	6.9	7.4	
Moisture Content (%)	**52.5**	**49.3**	**48.6**	
Number of Blows	**19**	**23**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	H	N	
Wt. of Tare & WS (gm)	22.22	21.42	
Wt. of Tare & DS (gm)	20.90	20.33	
Wt. of Tare (gm)	15.10	15.26	
Wt. of Water (gm)	1.3	1.1	
Wt. of DS (gm)	5.8	5.1	
Moisture Content (%)	**22.8**	**21.5**	**1.3**

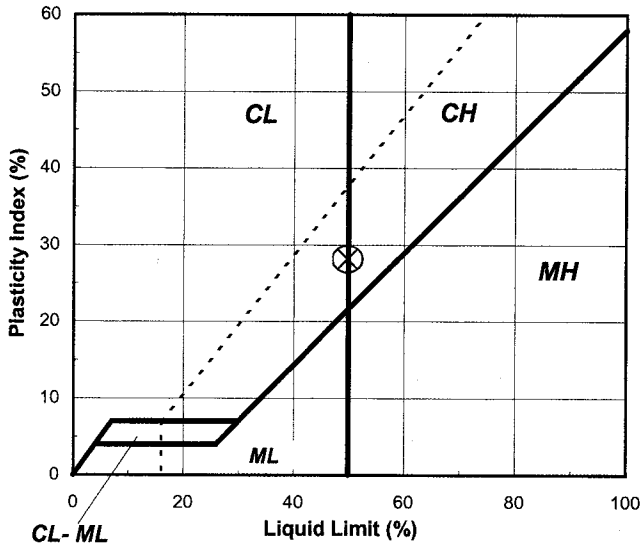
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**50**
Plastic Limit (%)	**22**
Plasticity Index (%)	**28**
USCS Symbol	**CH**

Flow Curve



Plasticity Chart



Tested By DJK *Date* 08/21/03 *Checked By* DAJ *Date* 8-31-03

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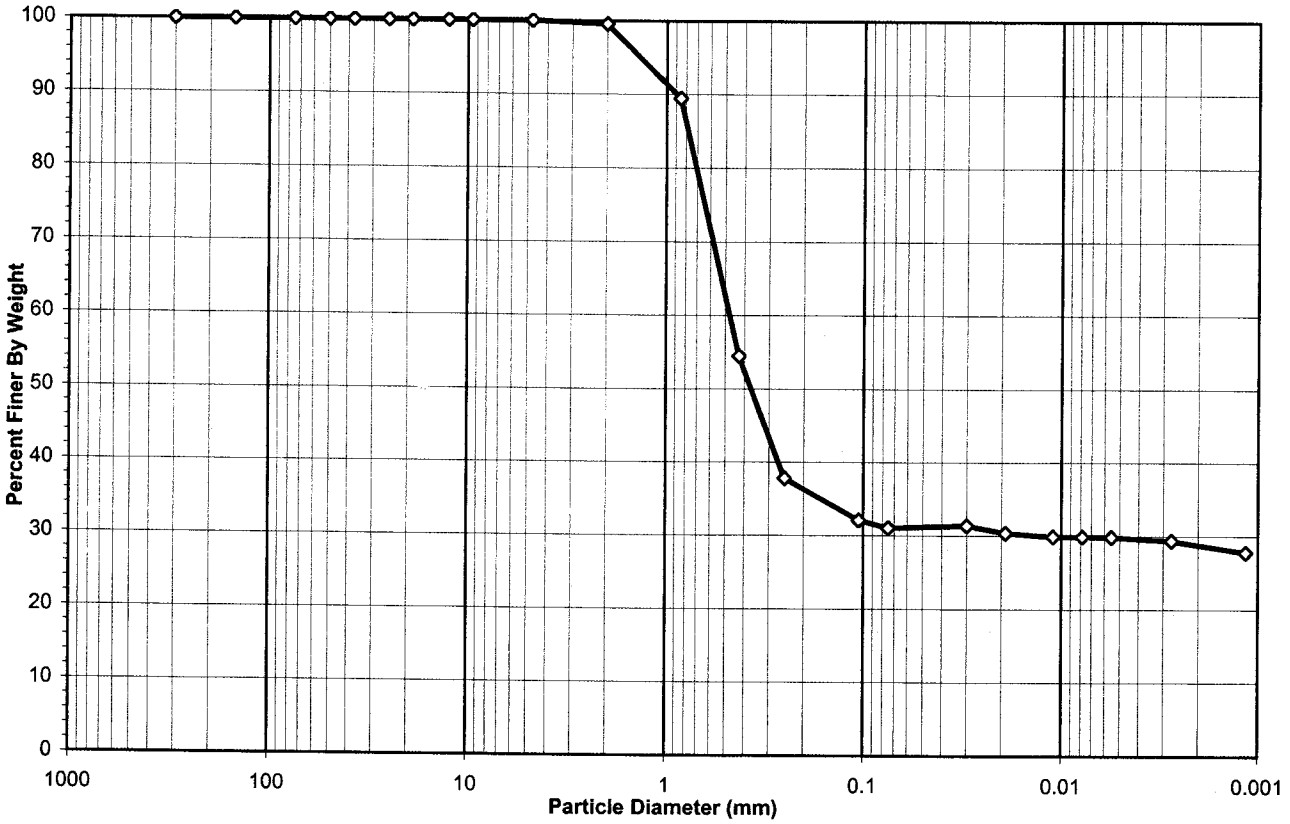
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-4S
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	33.2 - 33.4
Project No.	2003-558-01	Sample No.	3
Lab ID	2003-558-01-03	Soil Color	**GRAY-LIGHT ORANGE**

	SIEVE ANALYSIS				HYDROMETER	
USCS	cobbles	gravel	sand		silt and clay fraction	
USDA	cobbles	gravel	sand		silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	68.97
Finer Than #200	*Silt & Clay*	31.03

USCS Symbol ***SC, TESTED***

USCS Classification ***CLAYEY SAND***

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

C:\2003 Projects\2003-558 W&R\[2003-558-01-03 Sieve-H.xls]Sheet1

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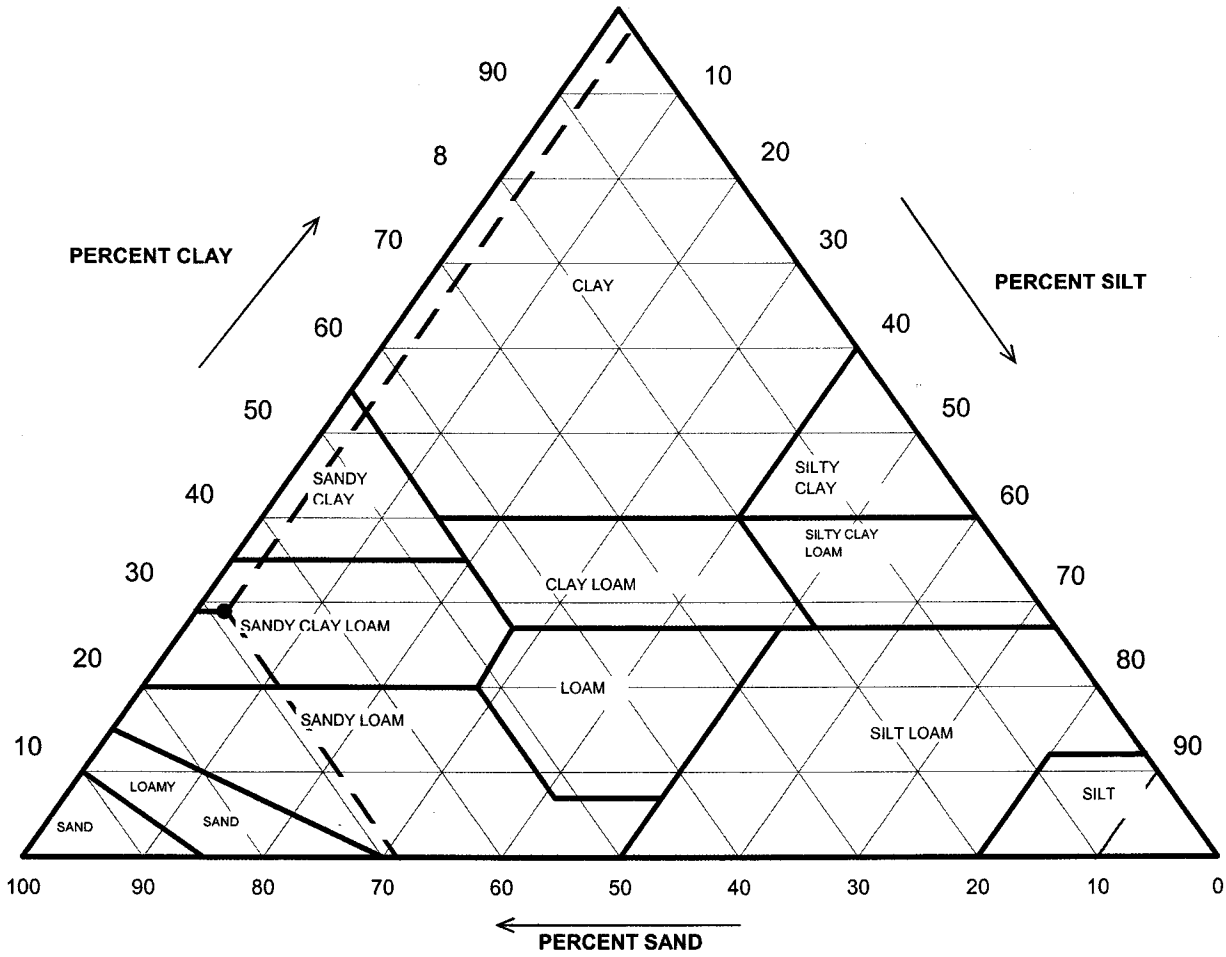
Geotechnics

USDA CLASSIFICATION CHART

Client	WITHERS & RAVENEL	Boring No.	WRB-4S
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	33.2 - 33.4
Project No.	2003-558-01	Sample No.	3
Lab ID	2003-558-01-03	Soil Color	GRAY-LIGHT ORANGE



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.44	**0.00**
2	99.56	*Sand*	68.38	**68.68**
0.05	31.18	*Silt*	2.39	**2.40**
0.002	28.80	*Clay*	28.80	**28.92**

USDA Classification: ***SANDY CLAY LOAM***

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-4S
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	33.2 - 33.4
Project No.	2003-558-01	Sample No.	3
Lab ID	2003-558-01-03	Soil Color	**GRAY-LIGHT ORANGE**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	H-5	Tare No.	A-A
Wgt.Tare + Wet Soil (gm)	560.20	Wgt.Tare + Wet Soil (gm)	25.69
Wgt.Tare + Dry Soil (gm)	500.10	Wgt.Tare + Dry Soil (gm)	25.65
Weight of Tare (gm)	152.90	Weight of Tare (gm)	15.47
Weight of Water (gm)	60.10	Weight of Water (gm)	0.04
Weight of Dry Soil (gm)	347.20	Weight of Dry Soil (gm)	10.18
Moisture Content (%)	**17.3**	**Moisture Content (%)**	**0.4**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	407.30	Weight of the Dry Sample (gm)	446.10
Dry Weight +#10 Material(gm)	347.2	Weight of minus #200 material (gm)	30.82
Wet Weight Hydro. Material.(gm)	99.29	Weight of plus #200 material (gm)	415.28
Dry Weight Hydro. Material (gm)	98.90		
Total Dry Weight Sample (gm)	446.10	**J-FACTOR (%FINER THAN #10)**	**0.9956**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.00	0.0	0.0	100.0	**100.0**
#10	2.00	1.54	0.4	0.4	99.6	**99.6**
#20	0.85	10.07	10.2	10.2	89.8	**89.4**
#40	0.425	34.71	35.1	45.3	54.7	**54.5**
#60	0.250	16.56	16.7	62.0	38.0	**37.8**
#140	0.106	5.71	5.8	67.8	32.2	**32.1**
#200	0.075	1.03	1.0	68.8	31.2	**31.0**
Pan	-	30.82	31.2	100.0	-	-

Notes :

Tested By DAJ Date 08/26/03 Checked By mps Date 8-30-03

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

C:\2003 Projects\2003-558 W&R\[2003-558-01-03 Sieve-H.xls]Sheet1

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Geotechnics

HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-4S
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	33.2 - 33.4
Project No.	2003-558-01	Sample No.	3
Lab ID	2003-558-01-03	Soil Color	**GRAY-LIGHT ORANGE**

Bulb Ser.# **667986**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	37.0	37.0	22.9	5.95	31.0	31.5	0.01326	0.0300	**31.4**
5		36.0	22.8	5.96	30.0	30.5	0.01328	0.0191	**30.4**
15		35.5	23.0	5.94	29.6	30.0	0.01325	0.0111	**29.9**
30		35.5	23.0	5.94	29.6	30.0	0.01325	0.0078	**29.9**
60		35.5	22.8	5.96	29.5	30.0	0.01328	0.0055	**29.9**
250		35.0	22.9	5.95	29.0	29.5	0.01326	0.0027	**29.4**
1440		33.5	22.5	5.99	27.5	27.9	0.01333	0.0012	**27.8**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	98.90	a - Factor	1.004
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	99.56
Weight of Dry Material (gm)	98.90		
		Specific Gravity	2.63 Measured

Note:

Tested By JDR Date 08/21/03 Checked By MPS Date 8-30-03

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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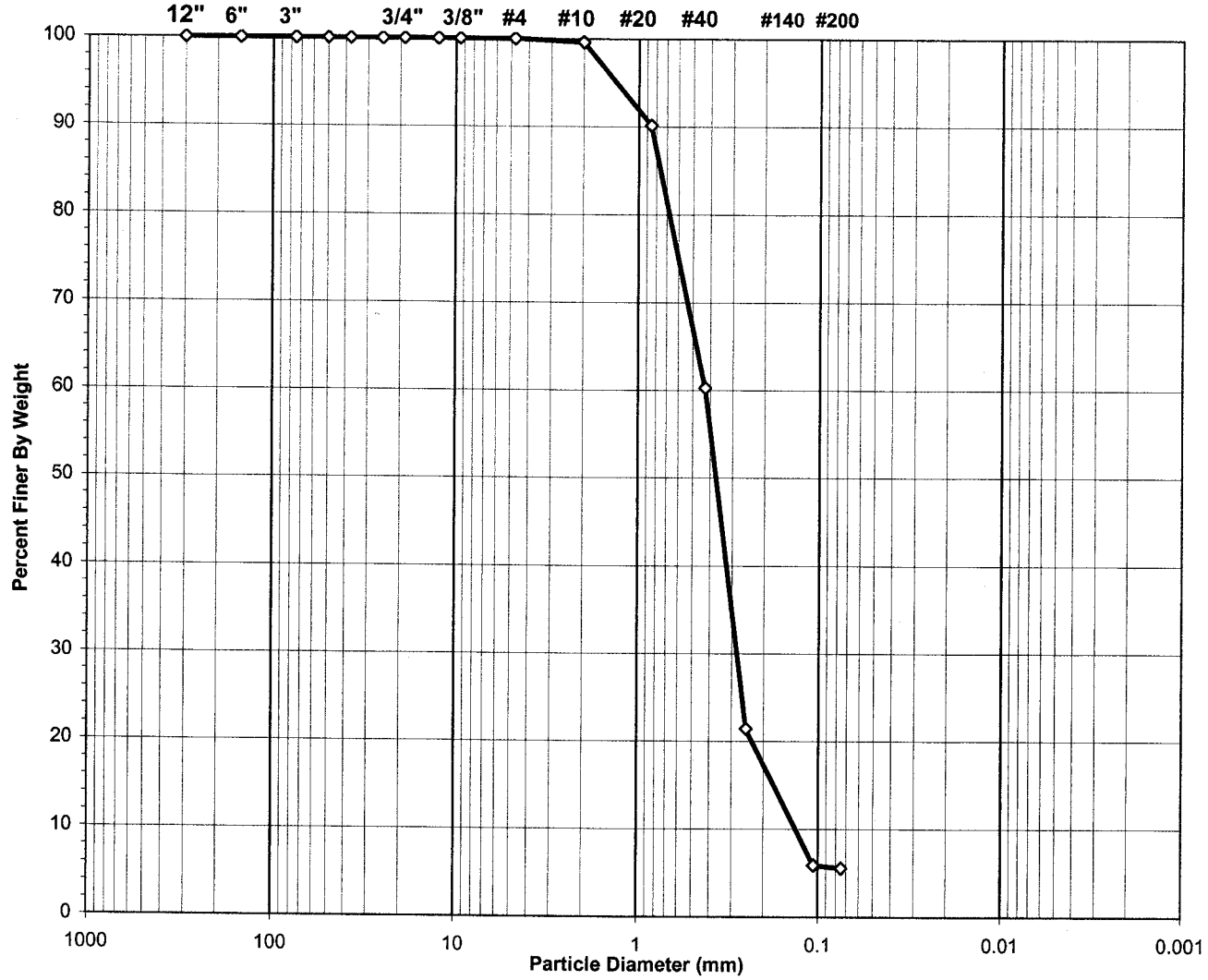
Geotechnics

SIEVE ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-6D
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	14.9 - 15.3
Project No.	2003-558-01	Sample No.	7
Lab ID	2003-558-01-07	Soil Color	**WHITE-PINK**

USCS	SIEVE ANALYSIS		HYDROMETER
	gravel	sand	silt and clay



USCS Symbol ***sp-sm, ASSUMED*** **D60 = 0.4** **CC = 1.4**

USCS Classification ***POORLY GRADED SAND WITH SILT*** **D30 = 0.3** **CU = 3.2**

D10 = 0.1

Tested By DJK Date 08/25/03 Checked By DAJ Date 8-30-03

DCN: CT-S3C DATE 6-25-98 REVISION: 2

C:\2003 Projects\2003-558 W&R\[2003-558-01-07 Sieve.XLS]Sheet1

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WASH SIEVE ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-6D
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	14.9 - 15.3
Project No.	2003-558-01	Sample No.	7
Lab ID	2003-558-01-07	Soil Color	**WHITE-PINK**

Moisture Content of Passing 3/4" Material		Water Content of Retained 3/4" Material	
Tare No.	G-5	Tare No.	NA
Wgt.Tare + Wet Specimen (gm)	667.90	Wgt.Tare + Wet Specimen (gm)	NA
Wgt.Tare + Dry Specimen (gm)	576.80	Wgt.Tare + Dry Specimen (gm)	NA
Weight of Tare (gm)	149.65	Weight of Tare (gm)	NA
Weight of Water (gm)	91.10	Weight of Water (gm)	NA
Weight of Dry Soil (gm)	427.15	Weight of Dry Soil (gm)	NA
Moisture Content (%)	**21.3**	**Moisture Content (%)**	**NA**

Wet Weight -3/4" Sample (gm)	NA	Weight of the Dry Specimen (gm)	427.15
Dry Weight - 3/4" Sample (gm)	403.4	Weight of minus #200 material (gm)	23.76
Wet Weight +3/4" Sample (gm)	NA	Weight of plus #200 material (gm)	403.39
Dry Weight + 3/4" Sample (gm)	0.00		
Total Dry Weight Sample (gm)	NA		

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.50	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.00	0.0	0.0	100.0	**100.0**
#10	2.00	1.64	0.4	0.4	99.6	**99.6**
#20	0.850	40.56	9.5	9.9	90.1	**90.1**
#40	0.425	127.58	29.9	39.7	60.3	**60.3**
#60	0.250	165.92	38.8	78.6	21.4	**21.4**
#140	0.106	66.39	15.5	94.1	5.9	**5.9**
#200	0.075	1.30	0.3	94.4	5.6	**5.6**
Pan	-	23.76	5.6	100.0	-	**-**

Tested By DJK Date 08/25/03 Checked By DAJ Date 8-30-03

DCN: CT-S3C DATE 6-25-98 REVISION: 2

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PERMEABILITY TEST

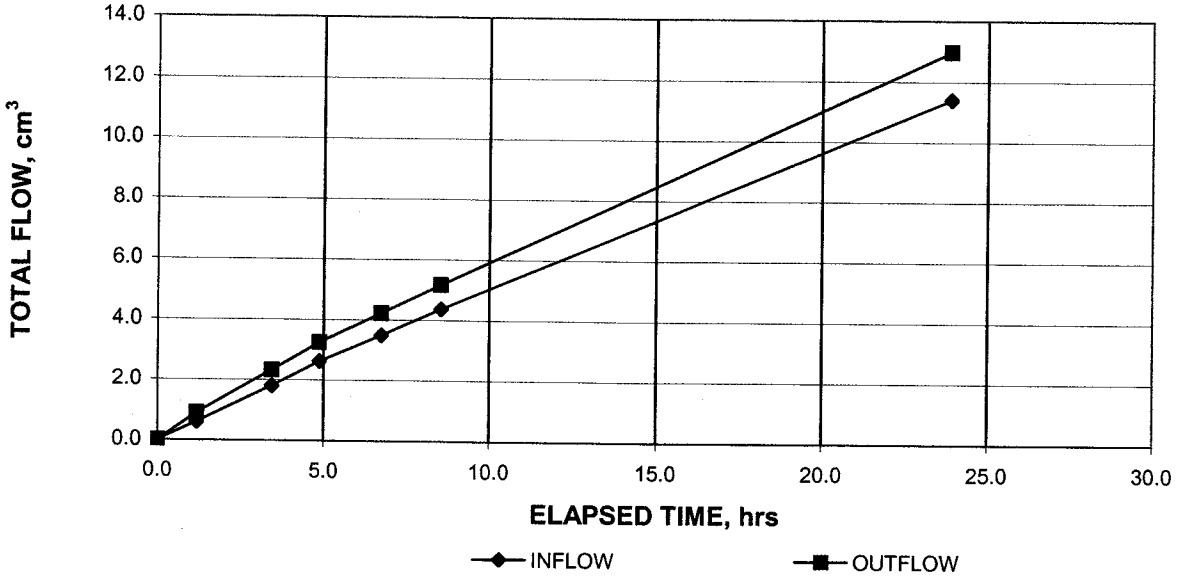
ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

geotechnics

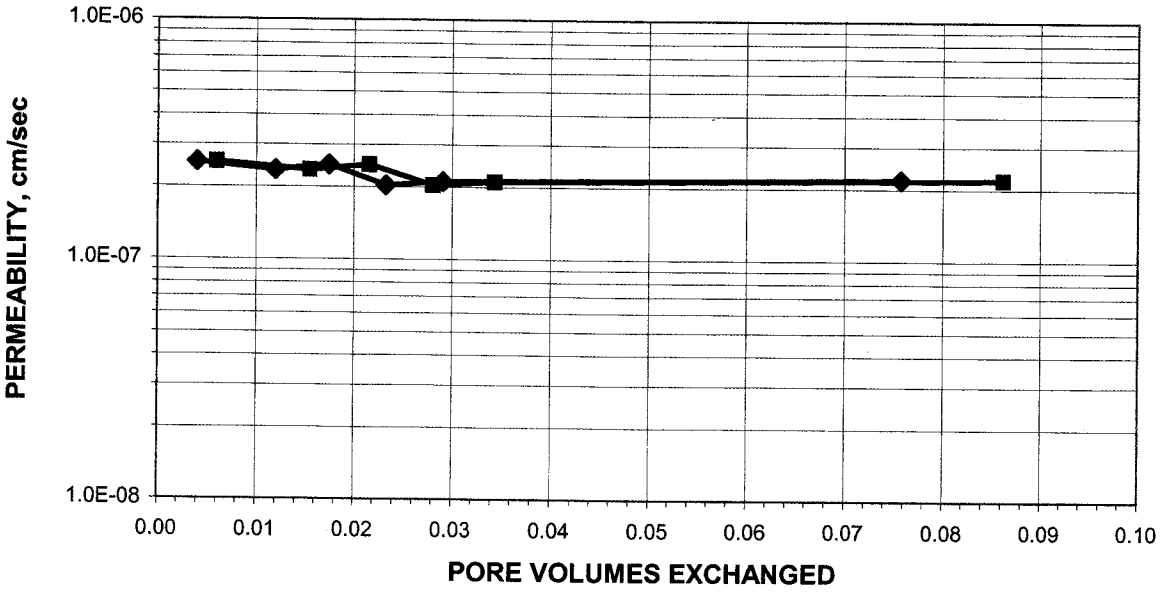
Client	WITHERS & RAVENEL	Boring No.	WRB-8D
Client Project	Central Carolina Tire Monofill	Depth (ft.)	7.4 - 7.8
Project No.	2003-558-01	Sample No.	5
Lab ID No.	2003-558-01-05		

AVERAGE PERMEABILITY = 2.2E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 2.2E-09 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



Tested By: DAJ Date: 08/19/03 Checked By: MPS Date: 8-30-03

DCN: CT-22 DATE: 01/06/03 REVISION 2 C:\Documents and Settings\DAVE JENKS\Desktop\Running Perms\[2003-558-01-05 W&R.xls]Sheet1

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

Geotechnics

Client	WITHERS & RAVENEL	Boring No.	WRB-8D
Client Project	Central Carolina Tire Monofill	Depth (ft.)	7.4 - 7.8
Project No.	2003-558-01	Sample No.	5
Lab ID No.	2003-558-01-05		
		Specific Gravity	2.64 Measured
		Sample Condition	Undisturbed

Visual Description: LIGHT GRAY SANDY CLAY (LOWER), DARK BROWN SAND (UPPER)

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	ZZ-1	G-7
Wt. of Tare & WS (gm.)	484.80	1040.20
Wt. of Tare & DS (gm.)	424.20	888.90
Wt. of Tare (gm.)	100.06	150.89
Wt. of Water (gm.)	60.60	151.30
Wt. of DS (gm.)	324.14	738.01
Moisture Content (%)	**18.7**	**20.5**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	1169.30	NA
Wt. of Tube (gm.)	293.43	NA
Wt. of WS (gm.)	875.87	889.19
Length 1 (in.)	4.284	4.187
Length 2 (in.)	4.314	4.181
Length 3 (in.)	4.335	4.085
Top Diameter (in.)	2.873	2.865
Middle Diameter (in.)	2.869	2.844
Bottom Diameter (in.)	2.865	2.803
Average Length (in.)	4.31	4.15
Average Area ($in.^2$)	6.46	6.32
Sample Volume (cm^3)	456.70	430.10
Unit Wet Wt. ($gm./cm^3$)	1.92	2.07
Unit Wet Wt. (pcf)	119.7	129.1
Unit Dry Wt. (pcf)	100.9	107.1
Unit Dry Wt. ($gm./cm^3$)	1.62	1.72
Void Ratio, e	0.63	0.54
Porosity, n	0.39	0.35
Pore Volume (cm^3)	177.2	150.6

Tested By: DAJ Date: 08/19/03 Checked By: MPS Date: 8-30-03

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

Geotechnics

Client	WITHERS & RAVENEL	Boring No.	WRB-8D
Client Project	Central Carolina Tire Monofill	Depth (ft.)	7.4 - 7.8
Project No.	2003-558-01	Sample No.	5
Lab ID No.	2003-558-01-05		

Pressure Heads (Constant)

Top Cap (psi)	58.0
Bottom Cap (psi)	60.0
Cell (psi)	65.9
Total Pressure Head (cm)	140.6
Hydraulic Gradient	13.34

Final Sample Dimensions

Sample Length (cm), L	10.54
Sample Diameter (cm)	7.21
Sample Area (cm^2), A	40.79
Inflow Burette Area (cm^2), a-in	0.888
Outflow Burette Area (cm^2), a-out	0.872
B Parameter (%)	96

AVERAGE PERMEABILITY = 2.2E-07 cm/sec @ 20°C
AVERAGE PERMEABILITY = 2.2E-09 m/sec @ 20°C

DATE	TIME		ELAPSED TIME t	TOTAL INFLOW	TOTAL OUTFLOW	TOTAL HEAD h	FLOW (0 flow)	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(hr)	(cm^3)	(cm^3)	(cm)	(1 stop)	(°C)	(cm/sec)
08/21/03	9	2	0.0	0.0	0.0	165.0	0	23.0	NA
08/21/03	10	13	1.2	0.6	0.9	163.3	0	23.2	2.5E-07
08/21/03	12	28	3.4	1.8	2.3	160.4	0	23.5	2.3E-07
08/21/03	13	54	4.9	2.6	3.3	158.4	0	23.9	2.5E-07
08/21/03	15	46	6.7	3.5	4.2	156.3	0	23.9	2.0E-07
08/21/03	17	34	8.5	4.4	5.2	154.3	0	23.9	2.1E-07
08/22/03	8	55	23.9	11.4	13.0	137.7	1	22.9	2.2E-07

Tested By: DAJ Date: 08/19/03 Checked By: mps Date: 8-30-03

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Geotechnics

SPECIFIC GRAVITY

ASTM D 854-00 (SOP - S5)

Client	WITHERS & RAVENEL	Boring No.	WRB-8D
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	8.3 - 8.4
Project No.	2003-558-01	Sample No.	5
Lab ID	2003-558-01-05	Visual Description	**LIGHT GRAY LEAN CLAY WITH SAND** (MInus No.4 sieve material, airdried)

Replicate Number	**1**	**2**
Pycnometer ID	R 27	R 29
Weight of Pycnometer + Soil + Water (gm)	718.7	722.2
Temperature, T (°Celsius)	23.2	23.4
Weight of Pycnometer + Water (gm)	687.98	692.37
Tare Number	C-6	C-1
Weight of Tare + Dry Soil (gm)	273.72	271.39
Weight of Tare (gm)	224.21	223.48
Weight of Dry Soil (gm)	49.51	47.91
Specific Gravity of Soil @ T	2.636	2.650
Specific Gravity of Water @ T	0.9975	0.9975
Conversion Factor for Temperature T	0.9993	0.9992
Specific Gravity @ 20° Celsius	2.637	2.652

Average Specific Gravity @ 20° Celsius	2.64

Tested By DAJ *Date* 08/23/03 *Checked By* MPS *Date* 8-30-03

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Geotechnics

ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	WITHERS & RAVENEL	Boring No.	WRB-8D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	7.9 - 8.1
Project No.	2003-558-01	Sample No.	5
Lab ID	2003-558-01-05	Soil Description	**LIGHT GRAY LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Wet method)

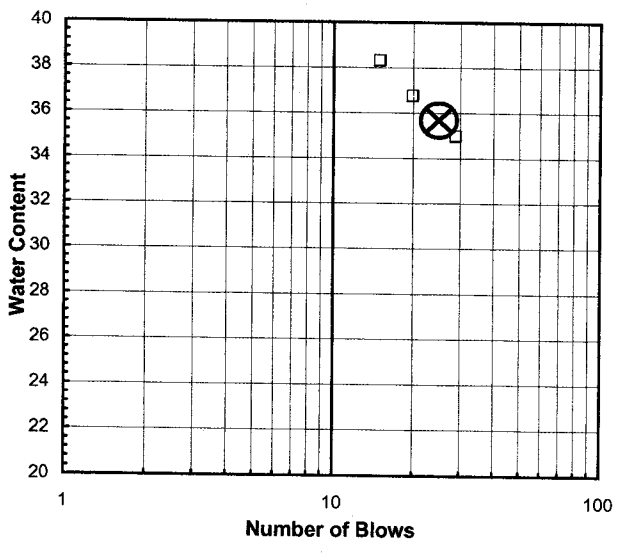
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-B	K	B	MULTIPOINT
Wt. of Tare & WS (gm)	30.44	29.94	31.47	
Wt. of Tare & DS (gm)	26.58	25.99	26.96	
Wt. of Tare (gm)	15.54	15.24	15.18	
Wt. of Water (gm)	3.9	4.0	4.5	
Wt. of DS (gm)	11.0	10.8	11.8	
Moisture Content (%)	**35.0**	**36.7**	**38.3**	
Number of Blows	**29**	**20**	**15**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	A-P	T	
Wt. of Tare & WS (gm)	23.32	22.29	
Wt. of Tare & DS (gm)	22.21	21.26	
Wt. of Tare (gm)	15.57	15.18	
Wt. of Water (gm)	1.1	1.0	
Wt. of DS (gm)	6.6	6.1	
Moisture Content (%)	**16.7**	**16.9**	**-0.2**

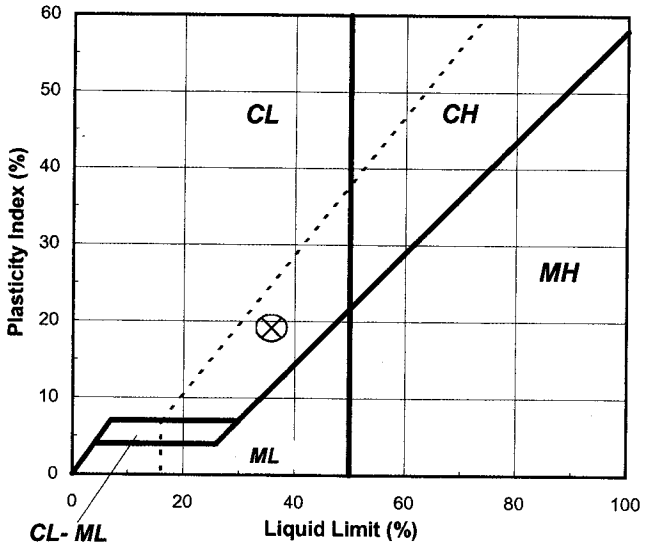
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**36**
Plastic Limit (%)	**17**
Plasticity Index (%)	**19**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



Tested By MPS *Date* 08/28/03 *Checked By* DAJ *Date* 8-30-03

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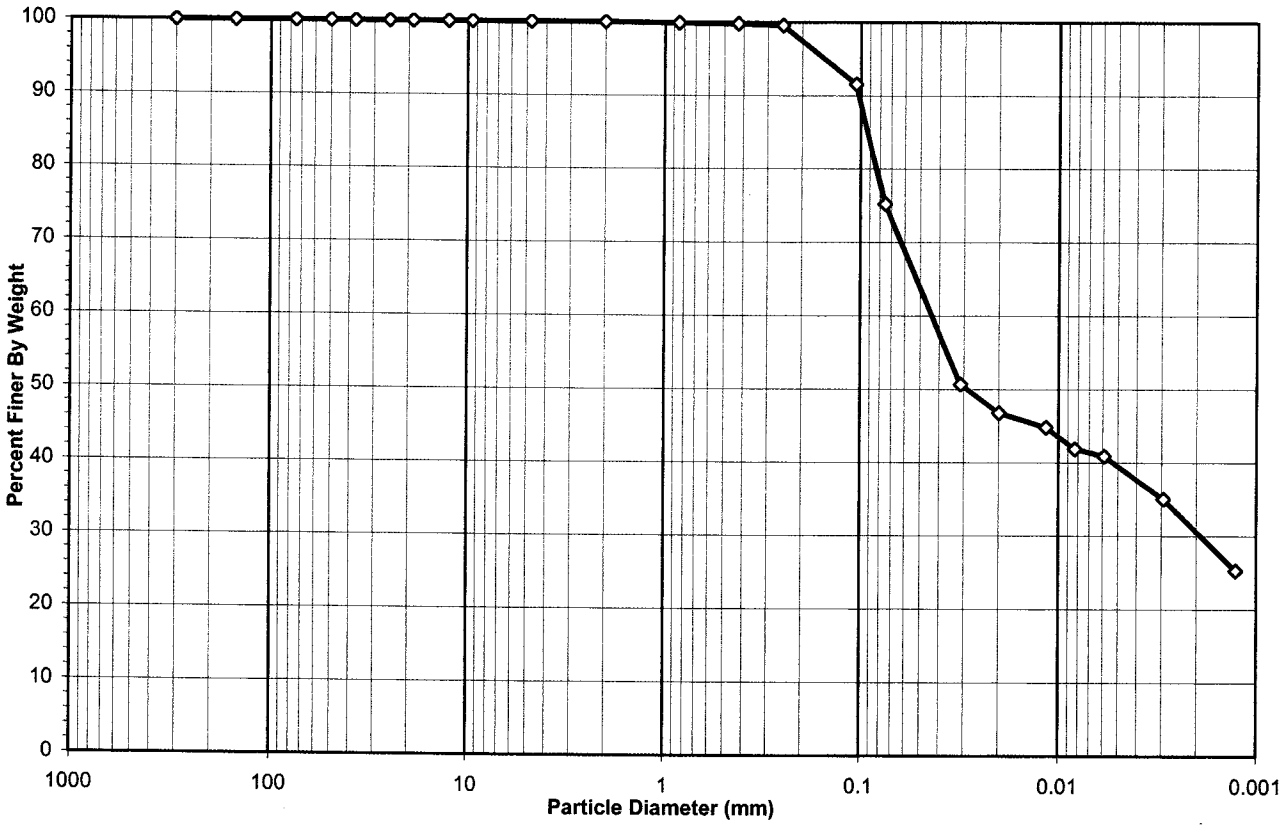
Geotechnics

SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-8D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	8.1 - 8.3
Project No.	2003-558-01	Sample No.	5
Lab ID	2003-558-01-05	Soil Color	**LIGHT GRAY**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	24.82
Finer Than #200	*Silt & Clay*	75.18

USCS Symbol ***CL, TESTED***

USCS Classification ***LEAN CLAY WITH SAND***

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

C:\2003 Projects\2003-558 W&R\[2003-558-01-05 Sieve-H.xls]Sheet1

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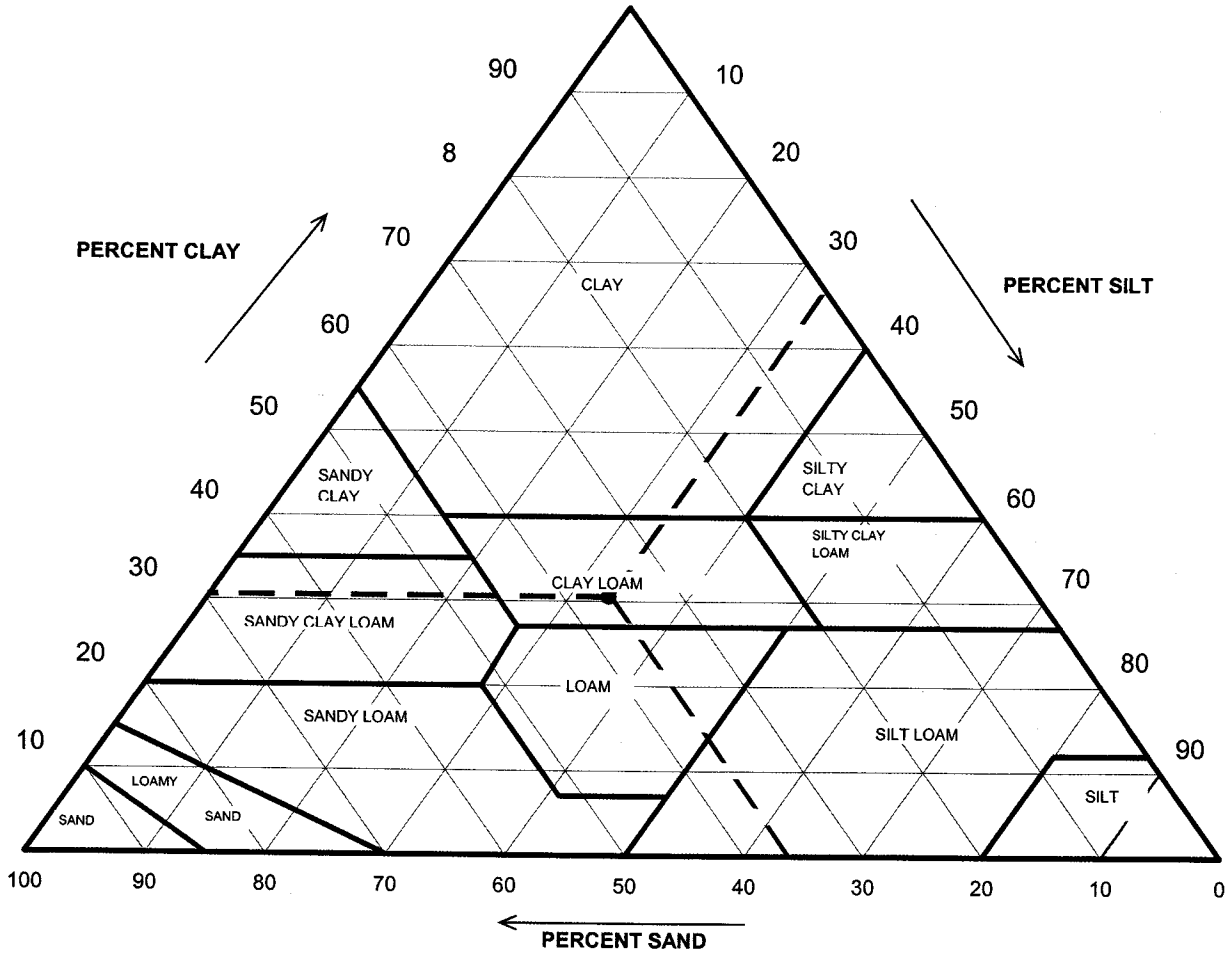
USDA CLASSIFICATION CHART

Client	WITHERS & RAVENEL	Boring No.	WRB-8D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	8.1 - 8.3
Project No.	2003-558-01	Sample No.	5
Lab ID	2003-558-01-05	Soil Color	LIGHT GRAY



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.00	**0.00**
2	100.00	*Sand*	36.13	**36.13**
0.05	63.87	*Silt*	33.30	**33.30**
0.002	30.57	*Clay*	30.57	**30.57**

USDA Classification: ***CLAY LOAM***

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Geotechnics

WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-8D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	8.1 - 8.3
Project No.	2003-558-01	Sample No.	5
Lab ID	2003-558-01-05	Soil Color	**LIGHT GRAY**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	G-15	Tare No.	C
Wgt.Tare + Wet Soil (gm)	548.30	Wgt.Tare + Wet Soil (gm)	26.87
Wgt.Tare + Dry Soil (gm)	501.20	Wgt.Tare + Dry Soil (gm)	26.79
Weight of Tare (gm)	152.76	Weight of Tare (gm)	15.20
Weight of Water (gm)	47.10	Weight of Water (gm)	0.08
Weight of Dry Soil (gm)	348.44	Weight of Dry Soil (gm)	11.59
Moisture Content (%)	**13.5**	**Moisture Content (%)**	**0.7**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	395.54	Weight of the Dry Sample (gm)	400.00
Dry Weight +#10 Material(gm)	348.4	Weight of minus #200 material (gm)	38.76
Wet Weight Hydro. Material.(gm)	51.92	Weight of plus #200 material (gm)	361.24
Dry Weight Hydro. Material (gm)	51.56		
Total Dry Weight Sample (gm)	400.00	**J-FACTOR (% FINER THAN #10)**	**1.0000**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.00	0.0	0.0	100.0	**100.0**
#10	2.00	0.00	0.0	0.0	100.0	**100.0**
#20	0.85	0.06	0.1	0.1	99.9	**99.9**
#40	0.425	0.06	0.1	0.2	99.8	**99.8**
#60	0.250	0.10	0.2	0.4	99.6	**99.6**
#140	0.106	4.14	8.0	8.5	91.5	**91.5**
#200	0.075	8.44	16.4	24.8	75.2	**75.2**
Pan	-	38.76	75.2	100.0	-	-

Notes :

Tested By DAJ Date 08/26/03 Checked By mps Date 8-30-03

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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Geotechnics

HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-8D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	8.1 - 8.3
Project No.	2003-558-01	Sample No.	5
Lab ID	2003-558-01-05	Soil Color	**LIGHT GRAY**

Bulb Ser.# **667986**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	32.0	32.0	22.9	5.95	26.0	50.6	0.01322	0.0311	**50.6**
5		30.0	23.0	5.94	24.1	46.7	0.01321	0.0199	**46.7**
15		29.0	23.0	5.94	23.1	44.8	0.01321	0.0116	**44.8**
30		27.5	23.0	5.94	21.6	41.9	0.01321	0.0083	**41.9**
60		27.0	22.9	5.95	21.0	40.9	0.01322	0.0059	**40.9**
250		24.0	22.9	5.95	18.0	35.1	0.01322	0.0029	**35.1**
1440		19.0	22.5	5.99	13.0	25.3	0.01329	0.0013	**25.3**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	51.56	a - Factor	1.002
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	100.00
Weight of Dry Material (gm)	51.56		
		Specific Gravity	2.64 Measured

Note:

Tested By JDR Date 08/21/03 Checked By DAJ Date 8-30-03

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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PERMEABILITY TEST

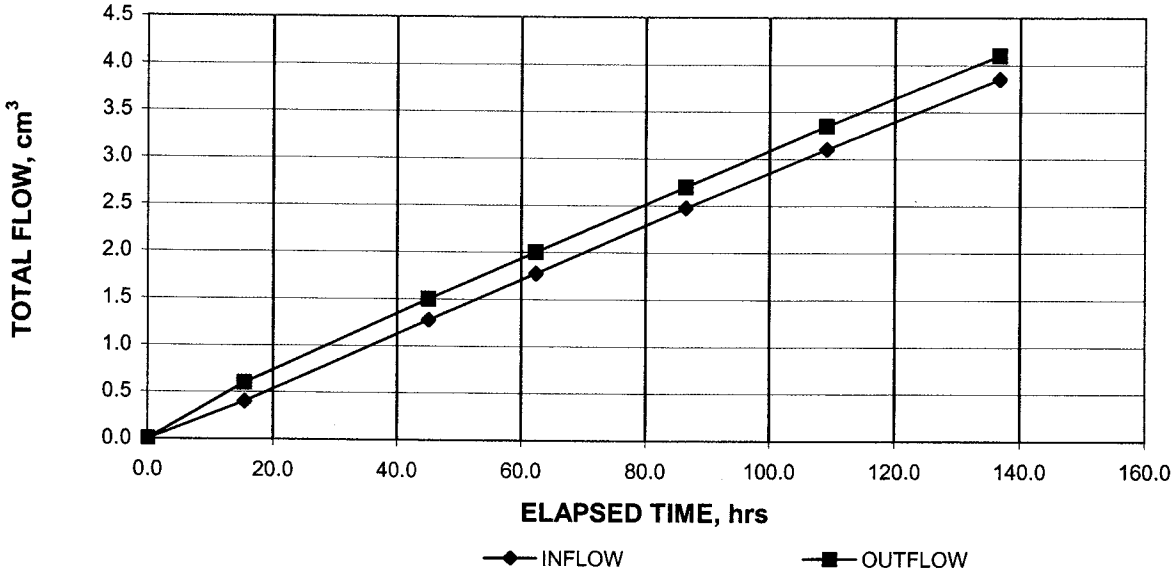
ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

geotechnics

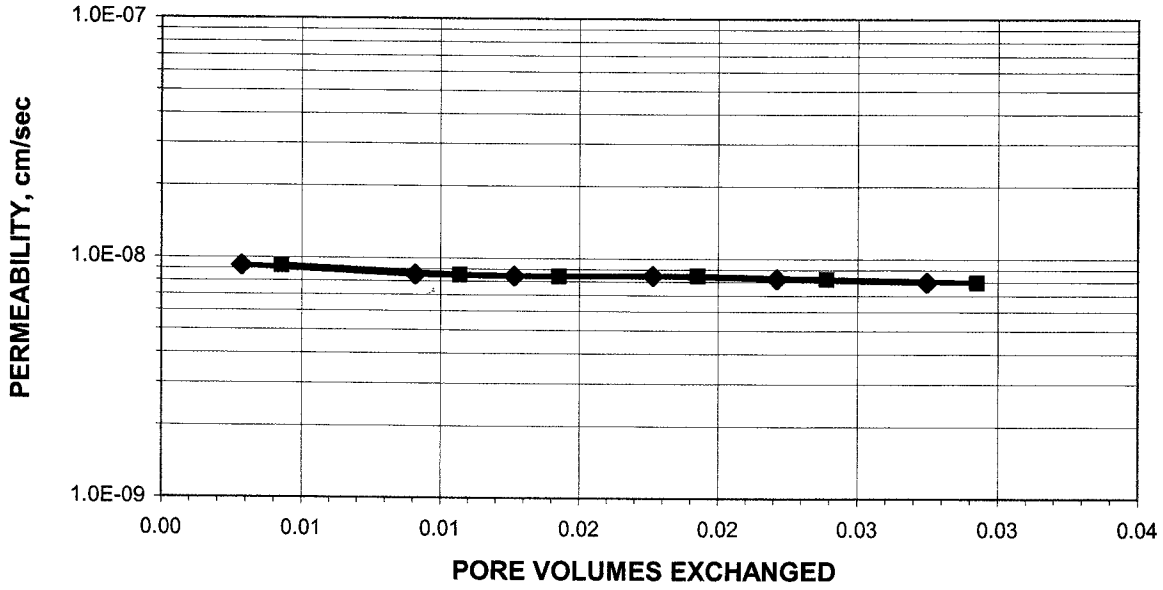
Client	WITHERS & RAVENEL	Boring No.	WRB-11D
Client Project	Central Carolina Tire Monofill	Depth (ft.)	24.6 - 25.0
Project No.	2003-558-01	Sample No.	2
Lab ID No.	2003-558-01-02		

AVERAGE PERMEABILITY = 8.3E-09 cm/sec @ 20°C
AVERAGE PERMEABILITY = 8.3E-11 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



Tested By: DAJ Date: 08/20/03 Checked By: MPS Date: 8-30-03

DCN: CT-22 DATE: 01/08/99 REVISION 2 C:\Documents and Settings\DAVE JENKS\Desktop\Running Perms\[2003-558-01-02 W&R.xls]Sheet1

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

Geotechnics

Client	WITHERS & RAVENEL	Boring No.	WRB-11D
Client Project	Central Carolina Tire Monofill	Depth (ft.)	24.6 - 25.0
Project No.	2003-558-01	Sample No.	2
Lab ID No.	2003-558-01-02		
		Specific Gravity	2.66 Measured
		Sample Condition	Undisturbed

Visual Description: GRAY-PURPLE FAT CLAY WITH SAND

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	Y-6	K-8
Wt. of Tare & WS (gm.)	413.40	1060.20
Wt. of Tare & DS (gm.)	364.02	909.40
Wt. of Tare (gm.)	100.47	155.27
Wt. of Water (gm.)	49.38	150.80
Wt. of DS (gm.)	263.55	754.13
Moisture Content (%)	**18.7**	**20.0**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	1209.30	NA
Wt. of Tube (gm.)	308.08	NA
Wt. of WS (gm.)	901.22	910.78
Length 1 (in.)	4.145	4.132
Length 2 (in.)	4.151	4.088
Length 3 (in.)	4.133	4.135
Top Diameter (in.)	2.870	2.835
Middle Diameter (in.)	2.870	2.839
Bottom Diameter (in.)	2.862	2.826
Average Length (in.)	4.14	4.12
Average Area ($in.^2$)	6.46	6.31
Sample Volume (cm^3)	438.39	425.51
Unit Wet Wt. ($gm./cm^3$)	2.06	2.14
Unit Wet Wt. (pcf)	128.3	133.6
Unit Dry Wt. (pcf)	108.1	111.3
Unit Dry Wt. ($gm./cm^3$)	1.73	1.78
Void Ratio, e	0.54	0.49
Porosity, n	0.35	0.33
Pore Volume (cm^3)	153.1	140.2

Tested By: DAJ Date: 08/20/03 Checked By: MPS Date: 8-30-03

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

Geotechnics

Client	WITHERS & RAVENEL	Boring No.	WRB-11D
Client Project	Central Carolina Tire Monofill	Depth (ft.)	24.6 - 25.0
Project No.	2003-558-01	Sample No.	2
Lab ID No.	2003-558-01-02		

Pressure Heads (Constant)	
Top Cap (psi)	57.0
Bottom Cap (psi)	60.0
Cell (psi)	79.9
Total Pressure Head (cm)	210.9
Hydraulic Gradient	20.16

Final Sample Dimensions	
Sample Length (cm), L	10.46
Sample Diameter (cm)	7.20
Sample Area (cm^2), A	40.68
Inflow Burette Area (cm^2), a-in	0.967
Outflow Burette Area (cm^2), a-out	0.973
B Parameter (%)	98

AVERAGE PERMEABILITY = 8.3E-09 cm/sec @ 20°C
AVERAGE PERMEABILITY = 8.3E-11 m/sec @ 20°C

DATE	TIME		ELAPSED TIME t	TOTAL INFLOW	TOTAL OUTFLOW	TOTAL HEAD h	FLOW (0 flow)	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(hr)	(cm^3)	(cm^3)	(cm)	(1 stop)	(°C)	(cm/sec)
08/21/03	17	43	0.0	0.0	0.0	233.6	0	23.9	NA
08/22/03	9	9	15.4	0.4	0.6	232.6	1	22.9	9.2E-09
08/23/03	9	41	15.4	0.4	0.6	232.2	0	22.7	NA
08/24/03	15	17	45.0	1.3	1.5	230.4	0	23.5	8.5E-09
08/25/03	8	36	62.4	1.8	2.0	229.3	0	22.7	8.4E-09
08/26/03	8	43	86.5	2.5	2.7	227.9	0	22.9	8.4E-09
08/27/03	7	23	109.1	3.1	3.4	226.6	0	22.9	8.2E-09
08/28/03	10	56	136.7	3.9	4.1	225.0	1	23.1	8.0E-09

Tested By: DAJ Date: 08/20/03 Checked By: MPS Date: 8-30-03

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Geotechnics

SPECIFIC GRAVITY

ASTM D 854-00 (SOP - S5)

Client	WITHERS & RAVENEL	Boring No.	WRB-11
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	24.4 - 24.5
Project No.	2003-558-01	Sample No.	2
Lab ID	2003-558-01-02	Visual Description	**GRAY FAT CLAY WITH SAND**
			(Minus No.4 sieve material, airdried)

Replicate Number	**1**	**2**
Pycnometer ID	R 30	R 28
Weight of Pycnometer + Soil + Water (gm)	720	722.8
Temperature, T (°Celsius)	26.2	26.3
Weight of Pycnometer + Water (gm)	686.73	690.38
Tare Number	C-6	C-2
Weight of Tare + Dry Soil (gm)	277.71	276.28
Weight of Tare (gm)	224.2	224.36
Weight of Dry Soil (gm)	53.51	51.92
Specific Gravity of Soil @ T	2.644	2.662
Specific Gravity of Water @ T	0.9968	0.9967
Conversion Factor for Temperature T	0.9985	0.9985
Specific Gravity @ 20° Celsius	2.648	2.666

Average Specific Gravity @ 20° Celsius	2.66

Tested By DAJ *Date* 08/26/03 *Checked By* MPS *Date* 8-30-03

DCN: CT-S5 Date 09-07-00 Revision: 7

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Geotechnics

ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	WITHERS & RAVENEL	Boring No.	WRB-11D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	25.0 - 25.3
Project No.	2003-558-01	Sample No.	2
Lab ID	2003-558-01-02	Soil Description	**GRAY-PURPLE FAT CLAY**

Note: The* USCS *symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Wet method)

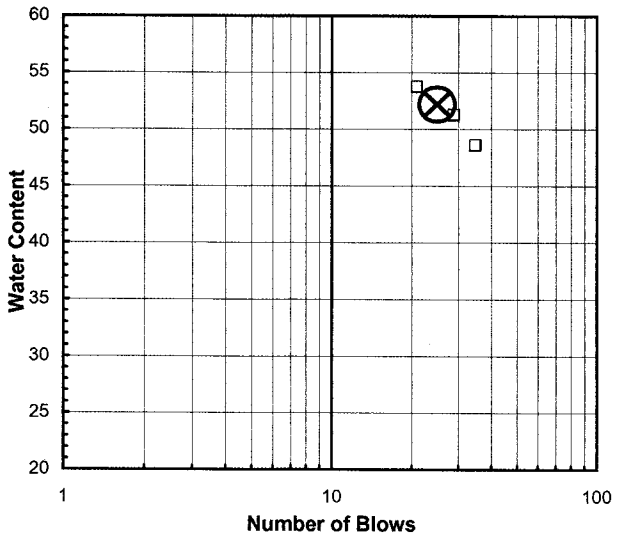
Liquid Limit Test	**1**	**2**	**3**	MULTIPOINT
Tare Number	A-D	F	A-U	
Wt. of Tare & WS (gm)	26.29	27.14	29.20	
Wt. of Tare & DS (gm)	22.72	22.94	24.60	
Wt. of Tare (gm)	15.37	15.12	15.62	
Wt. of Water (gm)	3.6	4.2	4.6	
Wt. of DS (gm)	7.4	7.8	9.0	
Moisture Content (%)	**48.6**	**53.7**	**51.2**	
Number of Blows	**35**	**21**	**29**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	Q	A-R	
Wt. of Tare & WS (gm)	22.46	22.79	
Wt. of Tare & DS (gm)	21.19	21.53	
Wt. of Tare (gm)	15.18	15.61	
Wt. of Water (gm)	1.3	1.3	
Wt. of DS (gm)	6.0	5.9	
Moisture Content (%)	**21.1**	**21.3**	**-0.2**

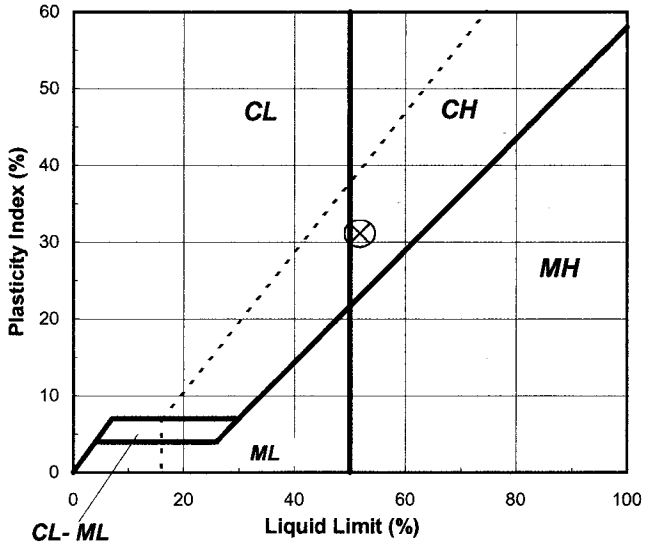
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**52**
Plastic Limit (%)	**21**
Plasticity Index (%)	**31**
USCS Symbol	**CH**

Flow Curve



Plasticity Chart



Tested By DJK *Date* 08/25/03 *Checked By* DAJ *Date* 8-30-03

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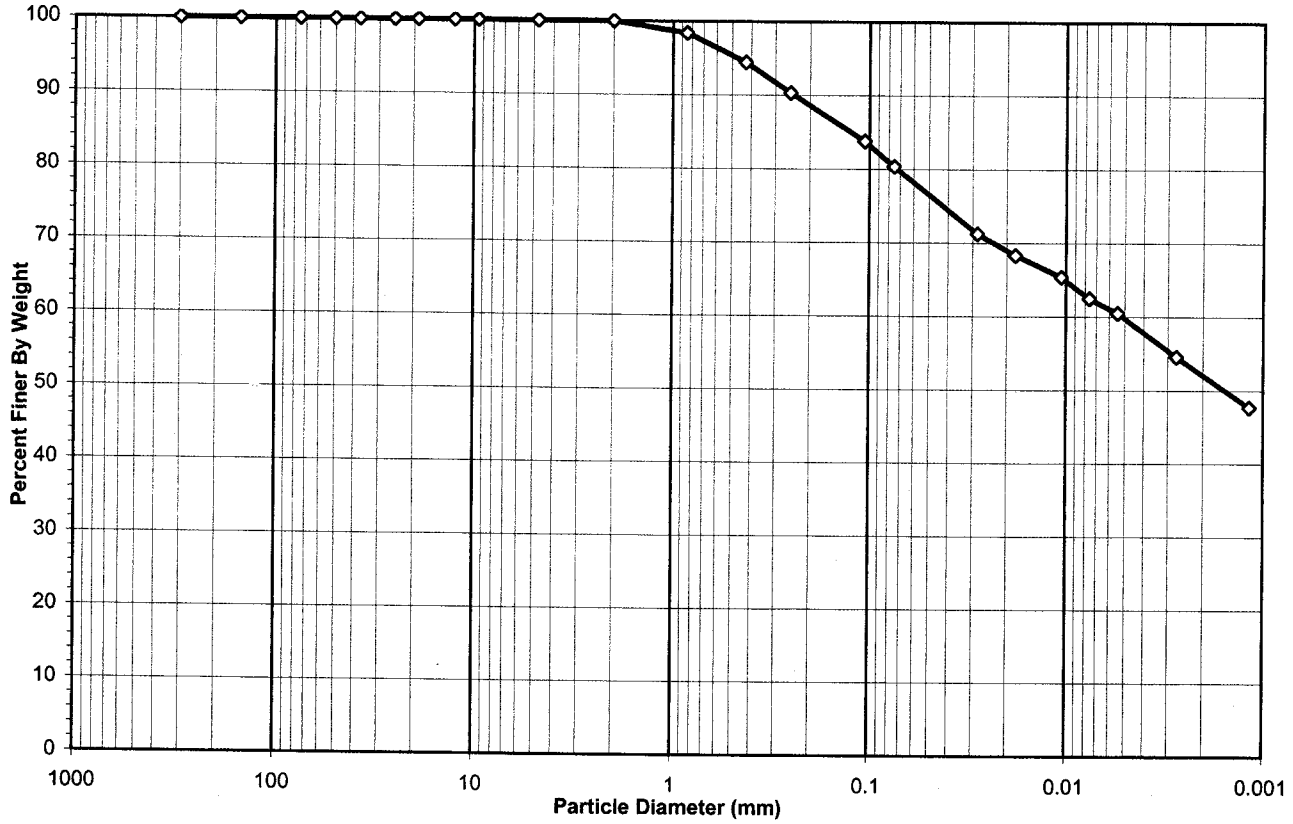
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-11D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	25.2 - 25.4
Project No.	2003-558-01	Sample No.	2
Lab ID	2003-558-01-02	Soil Color	**GRAY-PURPLE**

	SIEVE ANALYSIS				HYDROMETER	
USCS	cobbles	gravel	sand		silt and clay fraction	
USDA	cobbles	gravel	sand		silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	19.67
Finer Than #200	*Silt & Clay*	80.33

USCS Symbol ***CH, TESTED***

USCS Classification ***FAT CLAY WITH SAND***

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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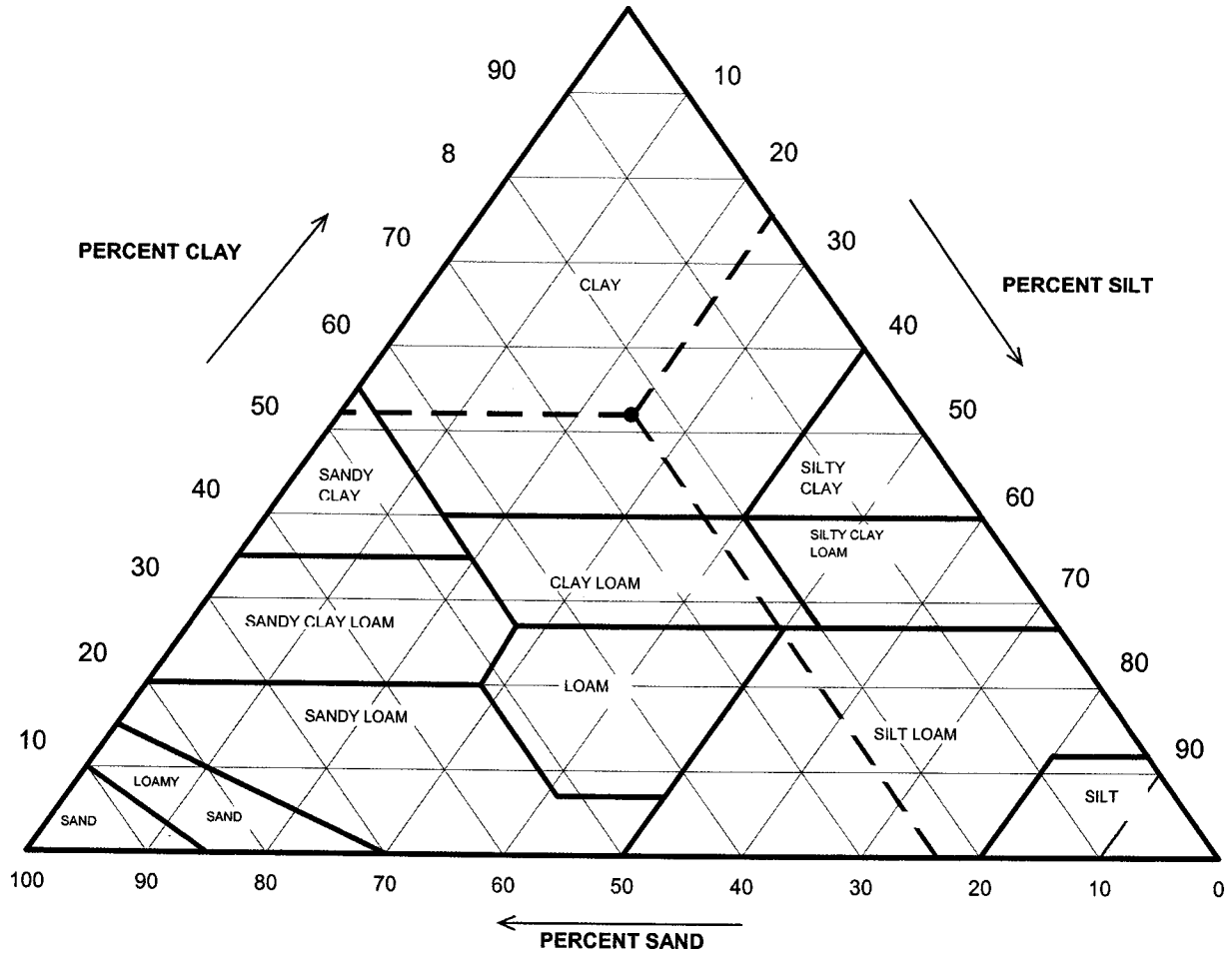
USDA CLASSIFICATION CHART

Client	WITHERS & RAVENEL	Boring No.	WRB-11D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	25.2 - 25.4
Project No.	2003-558-01	Sample No.	2
Lab ID	2003-558-01-02	Soil Color	GRAY-PURPLE



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.00	**0.00**
2	100.00	*Sand*	23.47	**23.47**
0.05	76.53	*Silt*	24.48	**24.48**
0.002	52.05	*Clay*	52.05	**52.05**

USDA Classification: ***CLAY***

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-11D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	25.2 - 25.4
Project No.	2003-558-01	Sample No.	2
Lab ID	2003-558-01-02	Soil Color	**GRAY-PURPLE**

Bulb Ser.# **667986**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	42.5	42.5	23.1	5.94	36.6	71.2	0.01311	0.0283	**71.2**
5		41.0	23.1	5.94	35.1	68.3	0.01311	0.0181	**68.3**
15		39.5	23.0	5.94	33.6	65.3	0.01313	0.0106	**65.3**
30		38.0	22.9	5.95	32.0	62.4	0.01314	0.0076	**62.4**
60		37.0	22.8	5.96	31.0	60.4	0.01316	0.0054	**60.4**
252		34.0	22.6	5.98	28.0	54.6	0.01319	0.0027	**54.6**
1440		30.5	22.3	6.01	24.5	47.7	0.01324	0.0012	**47.7**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	51.25	a - Factor	0.998
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	100.00
Weight of Dry Material (gm)	51.25		
		Specific Gravity	2.66 Measured

Note:

Tested By DAJ Date 08/26/03 Checked By mps Date 8-30-03

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-11D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	25.2 - 25.4
Project No.	2003-558-01	Sample No.	2
Lab ID	2003-558-01-02	Soil Color	**GRAY-PURPLE**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	K-4	Tare No.	C
Wgt.Tare + Wet Soil (gm)	488.80	Wgt.Tare + Wet Soil (gm)	29.13
Wgt.Tare + Dry Soil (gm)	434.30	Wgt.Tare + Dry Soil (gm)	28.91
Weight of Tare (gm)	154.61	Weight of Tare (gm)	15.21
Weight of Water (gm)	54.50	Weight of Water (gm)	0.22
Weight of Dry Soil (gm)	279.69	Weight of Dry Soil (gm)	13.70
Moisture Content (%)	**19.5**	**Moisture Content (%)**	**1.6**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	334.19	Weight of the Dry Sample (gm)	330.94
Dry Weight +#10 Material(gm)	279.7	Weight of minus #200 material (gm)	41.17
Wet Weight Hydro. Material.(gm)	52.07	Weight of plus #200 material (gm)	289.77
Dry Weight Hydro. Material (gm)	51.25		
Total Dry Weight Sample (gm)	330.94	**J-FACTOR (%FINER THAN #10)**	**1.0000**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.00	0.0	0.0	100.0	**100.0**
#10	2.00	0.00	0.0	0.0	100.0	**100.0**
#20	0.85	0.83	1.6	1.6	98.4	**98.4**
#40	0.425	2.02	3.9	5.6	94.4	**94.4**
#60	0.250	2.12	4.1	9.7	90.3	**90.3**
#140	0.106	3.34	6.5	16.2	83.8	**83.8**
#200	0.075	1.77	3.5	19.7	80.3	**80.3**
Pan	-	41.17	80.3	100.0	-	-

Notes :

Tested By DAJ Date 08/29/03 Checked By MPS Date 8-30-03

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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Geotechnics

ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	WITHERS & RAVENEL	Boring No.	WRB-13
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	42.4 - 42.6
Project No.	2003-558-01	Sample No.	8
Lab ID	2003-558-01-08	Soil Description	**LIGHT GRAY-WHITE LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.

(Minus No. 40 sieve material, Wet method)

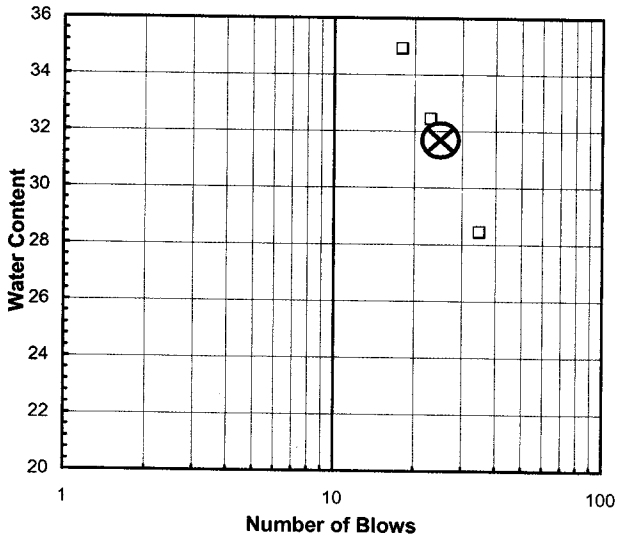
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	N	A-N	A-M	M U L T I P O I N T
Wt. of Tare & WS (gm)	29.00	29.37	28.66	
Wt. of Tare & DS (gm)	25.46	25.96	25.72	
Wt. of Tare (gm)	15.32	15.44	15.38	
Wt. of Water (gm)	3.5	3.4	2.9	
Wt. of DS (gm)	10.1	10.5	10.3	
Moisture Content (%)	**34.9**	**32.4**	**28.4**	
Number of Blows	**18**	**23**	**35**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	H	R	
Wt. of Tare & WS (gm)	22.83	23.07	
Wt. of Tare & DS (gm)	21.81	22.03	
Wt. of Tare (gm)	15.11	15.14	
Wt. of Water (gm)	1.0	1.0	
Wt. of DS (gm)	6.7	6.9	
Moisture Content (%)	**15.2**	**15.1**	**0.1**

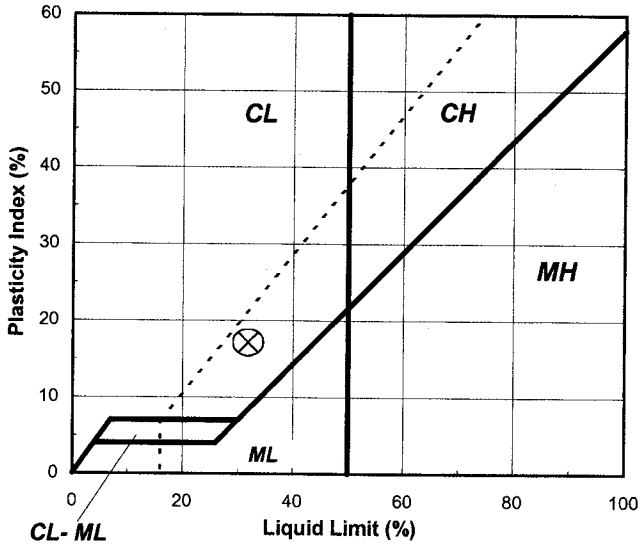
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**32**
Plastic Limit (%)	**15**
Plasticity Index (%)	**17**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



Tested By MPS *Date* 08/28/03 *Checked By* DAJ *Date* 8-31-03

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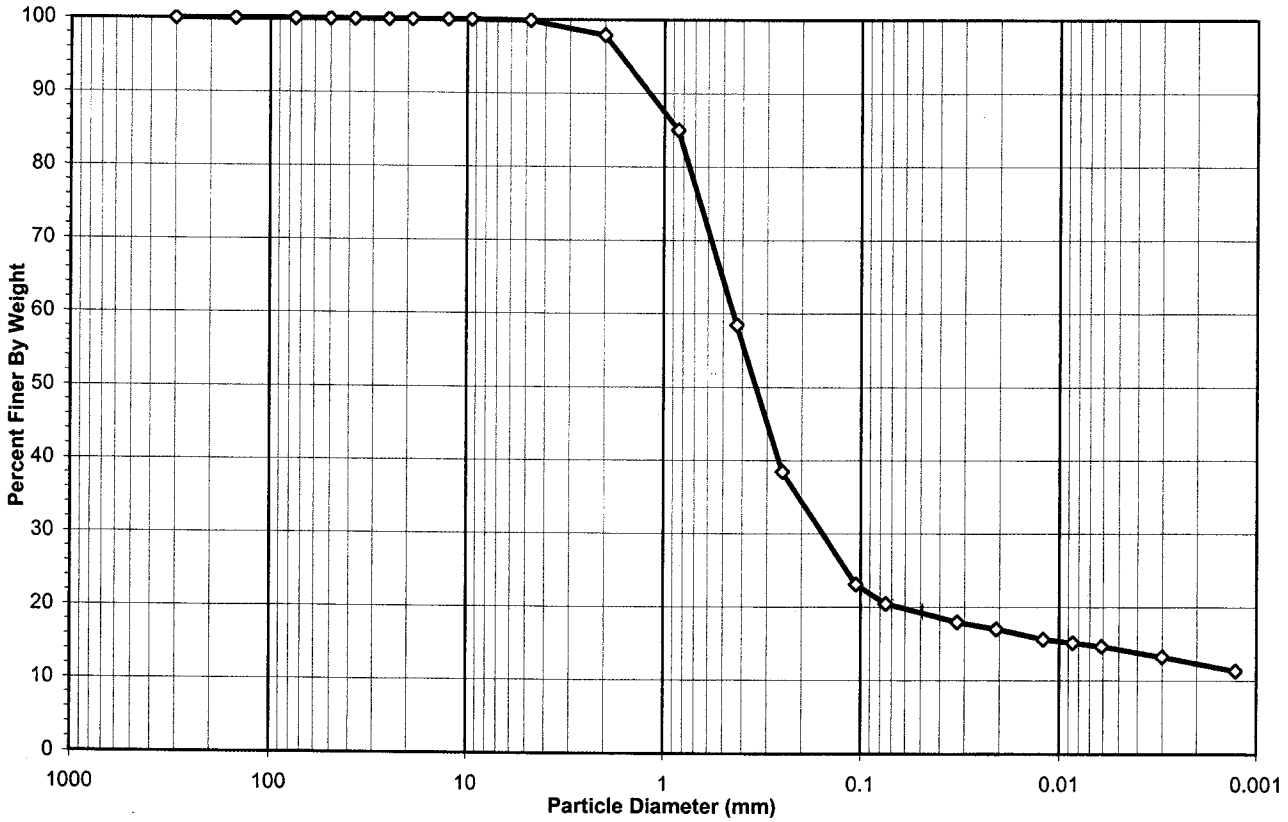
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-13
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	42.6 - 42.8
Project No.	2003-558-01	Sample No.	8
Lab ID	2003-558-01-08	Soil Color	**LIGHT GRAY-WHITE**

	SIEVE ANALYSIS			HYDROMETER	
USCS	**cobbles**	**gravel**	**sand**	**silt and clay fraction**	
USDA	**cobbles**	**gravel**	**sand**	**silt**	**clay**

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



Sieve Sizes (mm)	USCS Summary	Percentage
Greater Than #4	*Gravel*	0.12
#4 To #200	*Sand*	79.44
Finer Than #200	*Silt & Clay*	20.44

USCS Symbol ***SC, TESTED***

USCS Classification ***CLAYEY SAND***

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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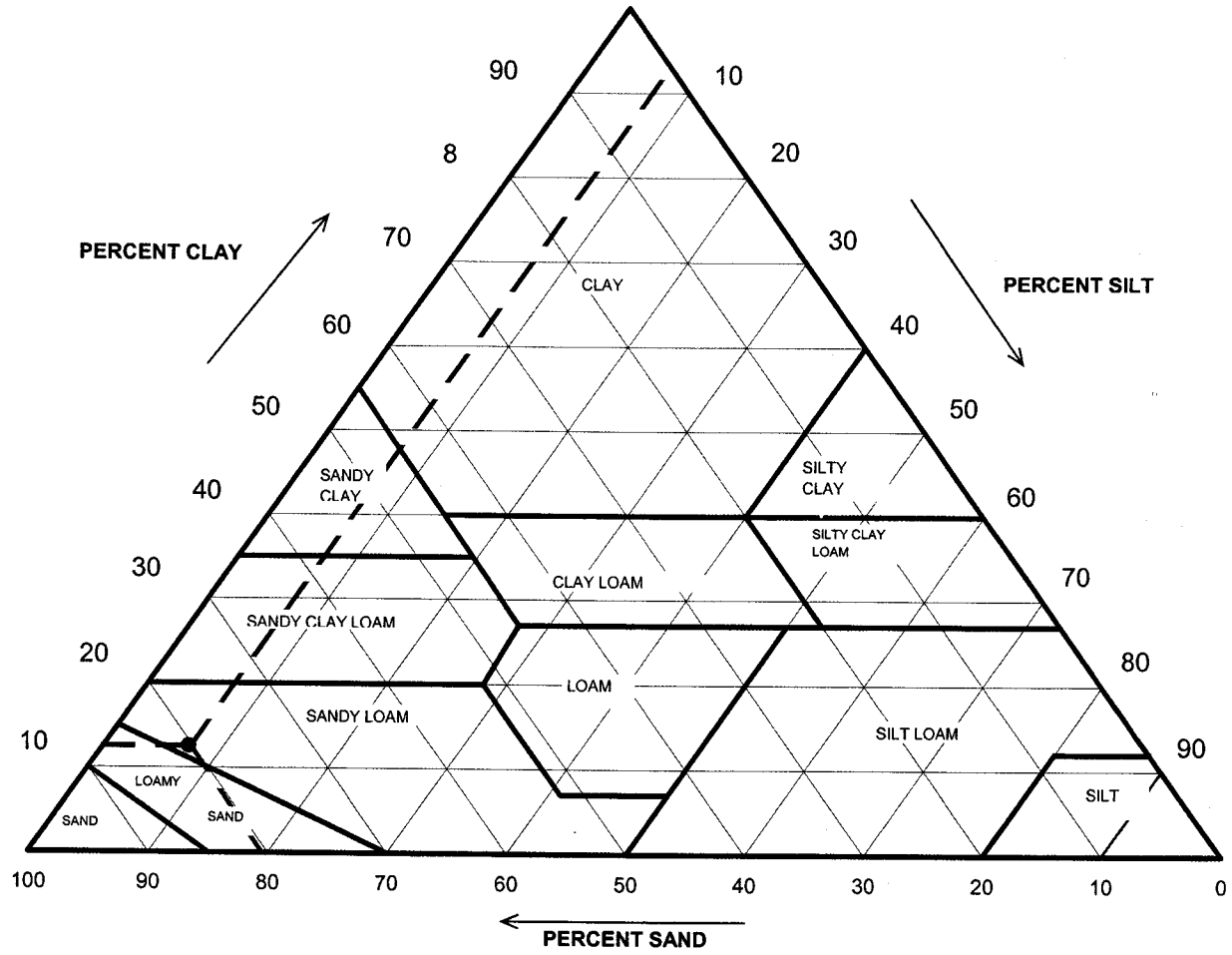
USDA CLASSIFICATION CHART

Client	WITHERS & RAVENEL	Boring No.	WRB-13
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	42.6 - 42.8
Project No.	2003-558-01	Sample No.	8
Lab ID	2003-558-01-08	Soil Color	LIGHT GRAY-WHITE



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	2.07	**0.00**
2	97.93	*Sand*	78.70	**80.36**
0.05	19.23	*Silt*	6.92	**7.07**
0.002	12.31	*Clay*	12.31	**12.57**

USDA Classification: ***SANDY LOAM***

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WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-13
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	42.6 - 42.8
Project No.	2003-558-01	Sample No.	8
Lab ID	2003-558-01-08	Soil Color	**LIGHT GRAY-WHITE**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	G-7	Tare No.	P
Wgt.Tare + Wet Soil (gm)	581.60	Wgt.Tare + Wet Soil (gm)	34.41
Wgt.Tare + Dry Soil (gm)	527.70	Wgt.Tare + Dry Soil (gm)	34.38
Weight of Tare (gm)	151.70	Weight of Tare (gm)	15.19
Weight of Water (gm)	53.90	Weight of Water (gm)	0.03
Weight of Dry Soil (gm)	376.00	Weight of Dry Soil (gm)	19.19
Moisture Content (%)	**14.3**	**Moisture Content (%)**	**0.2**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	429.90	Weight of the Dry Sample (gm)	479.82
Dry Weight +#10 Material(gm)	376.0	Weight of minus #200 material (gm)	21.67
Wet Weight Hydro. Material.(gm)	103.98	Weight of plus #200 material (gm)	458.15
Dry Weight Hydro. Material (gm)	103.82		
Total Dry Weight Sample (gm)	479.82	**J-FACTOR (%FINER THAN #10)**	**0.9793**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.44	0.1	0.1	99.9	**99.9**
#10	2.00	7.33	1.9	2.1	97.9	**97.9**
#20	0.85	13.72	13.2	13.2	86.8	**85.0**
#40	0.425	28.17	27.1	40.3	59.7	**58.4**
#60	0.250	21.15	20.4	60.7	39.3	**38.5**
#140	0.106	16.28	15.7	76.4	23.6	**23.1**
#200	0.075	2.83	2.7	79.1	20.9	**20.4**
Pan	-	21.67	20.9	100.0	-	-

Notes :

Tested By DAJ Date 08/29/03 Checked By MPS Date 8-30-03

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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Geotechnics

HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-13
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	42.6 - 42.8
Project No.	2003-558-01	Sample No.	8
Lab ID	2003-558-01-08	Soil Color	**LIGHT GRAY-WHITE**

Bulb Ser.# **667986**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	25.0	25.0	22.8	5.96	19.0	18.3	0.01320	0.0326	**18.0**
5		24.0	22.8	5.96	18.0	17.4	0.01320	0.0208	**17.0**
15		22.5	22.8	5.96	16.5	15.9	0.01320	0.0121	**15.6**
30		22.0	22.8	5.96	16.0	15.4	0.01320	0.0086	**15.1**
60		21.5	22.7	5.97	15.5	15.0	0.01321	0.0061	**14.6**
250		20.0	22.6	5.98	14.0	13.5	0.01323	0.0030	**13.2**
1440		18.0	22.4	6.00	12.0	11.6	0.01326	0.0013	**11.3**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	103.82	a - Factor	1
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	97.93
Weight of Dry Material (gm)	103.82		
		Specific Gravity	2.65 Assumed

Note:

Tested By DAJ Date 08/26/03 Checked By MPS Date 8-30-03

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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ATTERBERG LIMIT

ASTM D 4318-00 (SOP - S4)

Client	WITHERS & RAVENEL	Boring No.	WRB-14
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	3.5 - 5.5
Project No.	2003-558-01	Sample No.	6
Lab ID	2003-558-01-06	Visual Description	**BROWN SILT**
			(Minus No. 40 sieve material, Wet Method)

NON - PLASTIC MATERIAL

Tested By DJK *Date* 08/19/03 *Checked By* DAJ *Date* 8-30-03

DCN: CT-S4C DATE: 7-11-97 REVISION : 2

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SPECIFIC GRAVITY

ASTM D 854-00 (SOP - S5)

Client	WITHERS & RAVENEL	Boring No.	WRB-14
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	3.5 - 5.5
Project No.	2003-558-01	Sample No.	6
Lab ID	2003-558-01-06	Visual Description	**BROWN POORLY GRADED SAND**
			(MInus No.4 sieve material, airdried)

Replicate Number		**1**		**2**
Pycnometer ID	R	27	R	29
Weight of Pycnometer + Soil + Water (gm)		718.1		722.8
Temperature, T (°Celsius)		26.1		25.9
Weight of Pycnometer + Water (gm)		687.61		692.06
Tare Number		C-6		C-1
Weight of Tare + Dry Soil (gm)		273.68		273.3
Weight of Tare (gm)		224.38		223.74
Weight of Dry Soil (gm)		49.30		49.56
Specific Gravity of Soil @ T		2.621		2.634
Specific Gravity of Water @ T		0.9968		0.9968
Conversion Factor for Temperature T		0.9986		0.9986
Specific Gravity @ 20° Celsius		2.625		2.638

Average Specific Gravity @ 20° Celsius	2.63

Tested By DJK *Date* 08/15/03 *Checked By* DAJ *Date* 8-30-03

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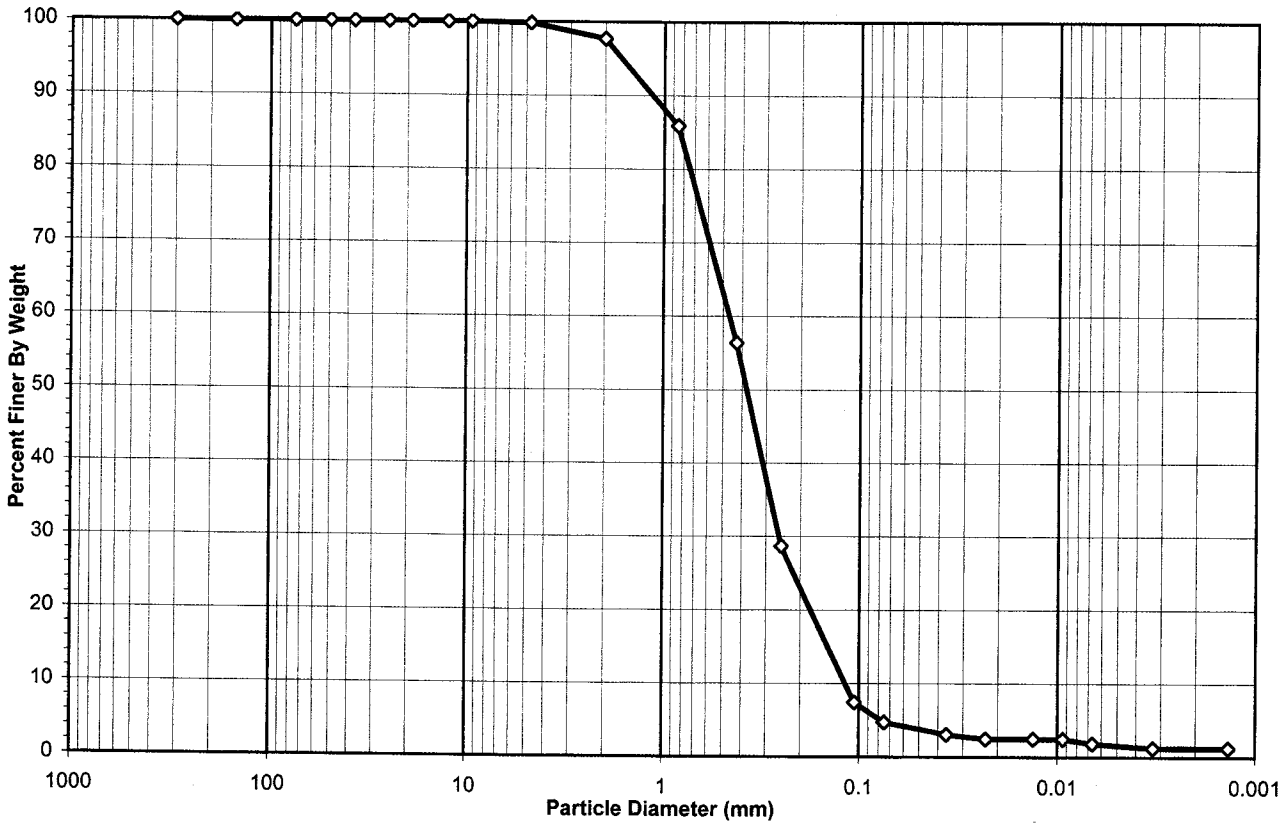
SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-14
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	3.5 - 5.5
Project No.	2003-558-01	Sample No.	6
Lab ID	2003-558-01-06	Soil Color	**BROWN**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



USCS Summary					
Sieve Sizes (mm)		**Percentage**			
Greater Than #4	*Gravel*	0.17			
#4 To #200	*Sand*	95.13			
Finer Than #200	*Silt & Clay*	4.70			
			D60 =	**0.463**	
USCS Symbol	***SP, TESTED (NON-PLASTIC FINES)***		**D30 =**	**0.257**	**CC =** **1.21**
USCS Classification	***POORLY GRADED SAND***		**D10 =**	**0.118**	**CU =** **3.93**

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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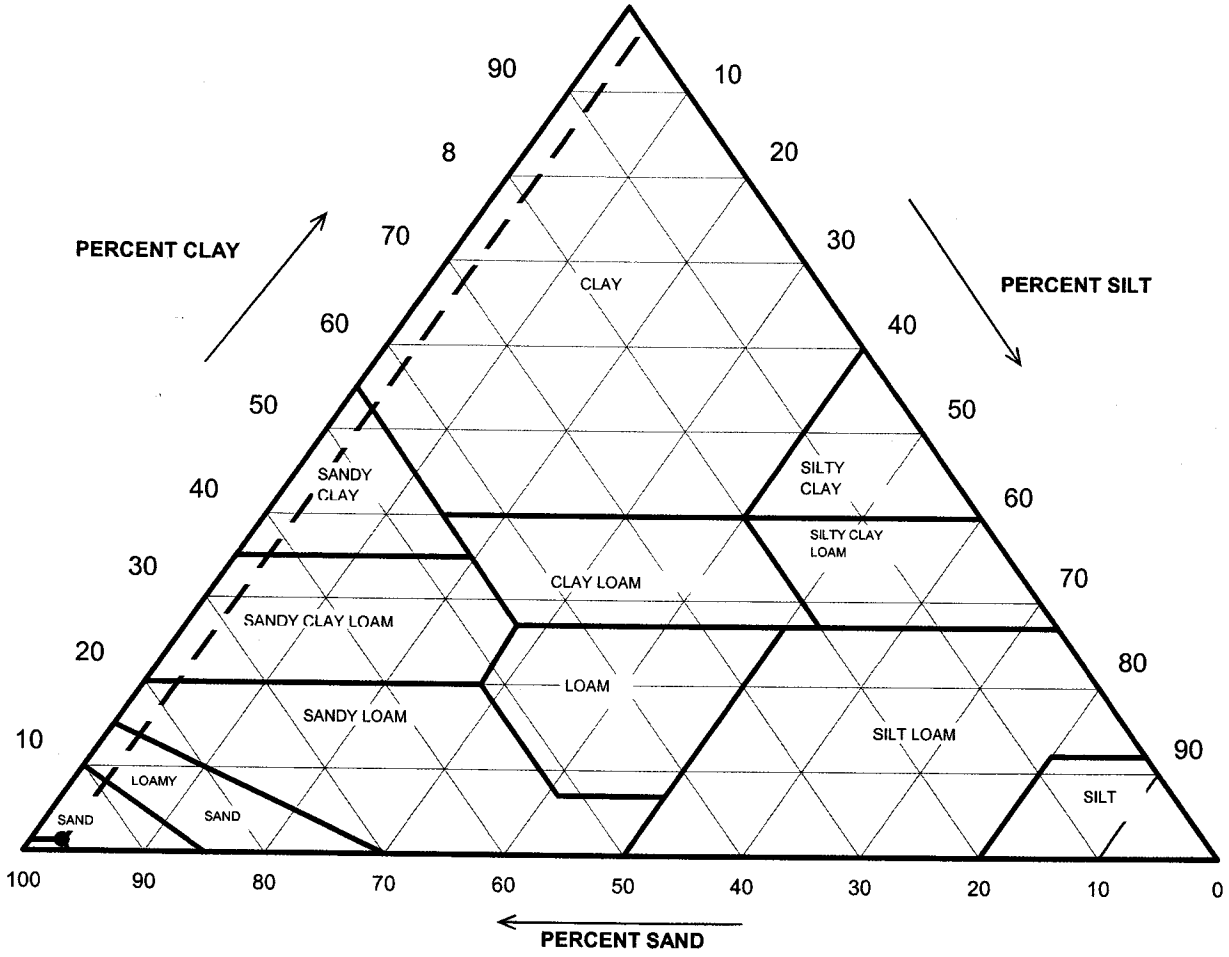
USDA CLASSIFICATION CHART

Client	WITHERS & RAVENEL	Boring No.	WRB-14
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	3.5 - 5.5
Project No.	2003-558-01	Sample No.	6
Lab ID	2003-558-01-06	Soil Color	BROWN



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	2.30	**0.00**
2	97.70	*Sand*	93.92	**96.13**
0.05	3.78	*Silt*	2.58	**2.64**
0.002	1.20	*Clay*	1.20	**1.23**

USDA Classification: ***SAND***

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Geotechnics

WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-14
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	3.5 - 5.5
Project No.	2003-558-01	Sample No.	6
Lab ID	2003-558-01-06	Soil Color	**BROWN**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	H-3	Tare No.	A
Wgt.Tare + Wet Soil (gm)	439.96	Wgt.Tare + Wet Soil (gm)	25.47
Wgt.Tare + Dry Soil (gm)	431.30	Wgt.Tare + Dry Soil (gm)	25.47
Weight of Tare (gm)	153.92	Weight of Tare (gm)	15.22
Weight of Water (gm)	8.66	Weight of Water (gm)	0.00
Weight of Dry Soil (gm)	277.38	Weight of Dry Soil (gm)	10.25
Moisture Content (%)	**3.1**	**Moisture Content (%)**	**0.0**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	286.04	Weight of the Dry Sample (gm)	358.08
Dry Weight +#10 Material(gm)	277.4	Weight of minus #200 material (gm)	3.88
Wet Weight Hydro. Material.(gm)	80.70	Weight of plus #200 material (gm)	354.20
Dry Weight Hydro. Material (gm)	80.70		
Total Dry Weight Sample (gm)	358.08	**-FACTOR (%FINER THAN #10)**	**0.9770**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.47	0.2	0.2	99.8	**99.8**
#10	2.00	5.91	2.1	2.3	97.7	**97.7**
#20	0.85	9.74	12.1	12.1	87.9	**85.9**
#40	0.425	24.43	30.3	42.3	57.7	**56.3**
#60	0.250	22.86	28.3	70.7	29.3	**28.7**
#140	0.106	17.58	21.8	92.5	7.5	**7.4**
#200	0.075	2.21	2.7	95.2	4.8	**4.7**
Pan	-	3.88	4.8	100.0	-	**-**

Notes :

Tested By JDR Date 08/19/03 Checked By DAJ Date 8-30-03

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-14
Client Reference	CENTRAL CAROLINA TIRE MONOFILL	Depth (ft)	3.5 - 5.5
Project No.	2003-558-01	Sample No.	6
Lab ID	2003-558-01-06	Soil Color	**BROWN**

Bulb Ser.#
667986

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	8.5	8.5	22.6	5.98	2.5	3.1	0.01331	0.0363	**3.1**
5		8.0	22.6	5.98	2.0	2.5	0.01331	0.0230	**2.5**
15		8.0	22.6	5.98	2.0	2.5	0.01331	0.0133	**2.5**
30		8.0	22.6	5.98	2.0	2.5	0.01331	0.0094	**2.5**
60		7.5	22.5	5.99	1.5	1.9	0.01333	0.0067	**1.8**
250		7.0	22.3	6.01	1.0	1.2	0.01336	0.0033	**1.2**
1440		7.0	22.3	6.01	1.0	1.2	0.01336	0.0014	**1.2**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	80.70	a - Factor	1.004
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	97.70
Weight of Dry Material (gm)	80.70		
		Specific Gravity	2.63 Measured

Note:

Tested By JDR Date 08/19/03 Checked By DAJ Date 8-30-03

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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PERMEABILITY TEST

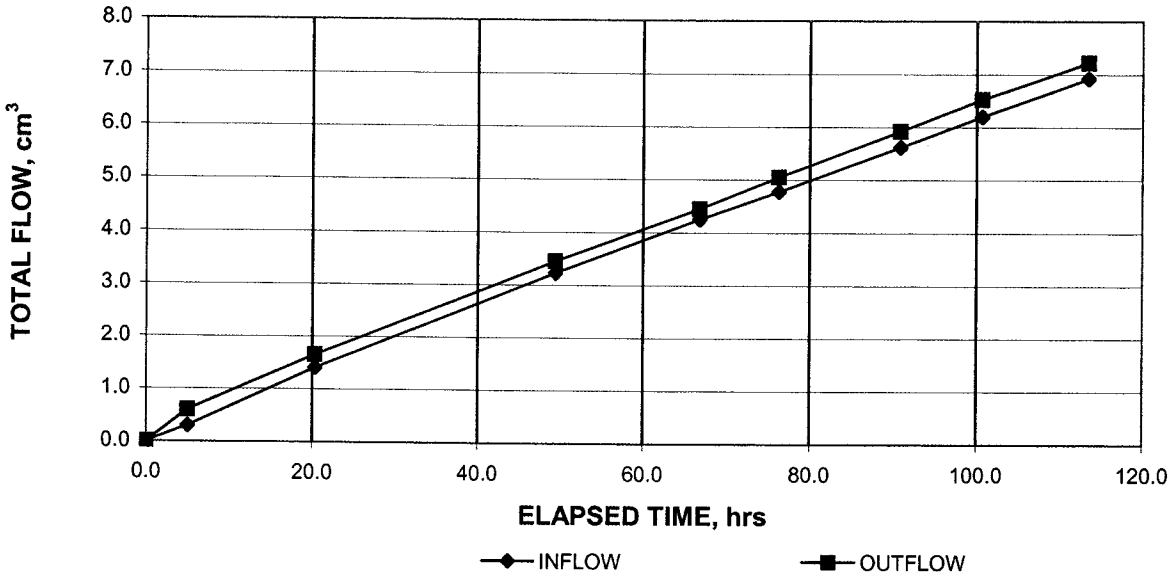
ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

geotechnics

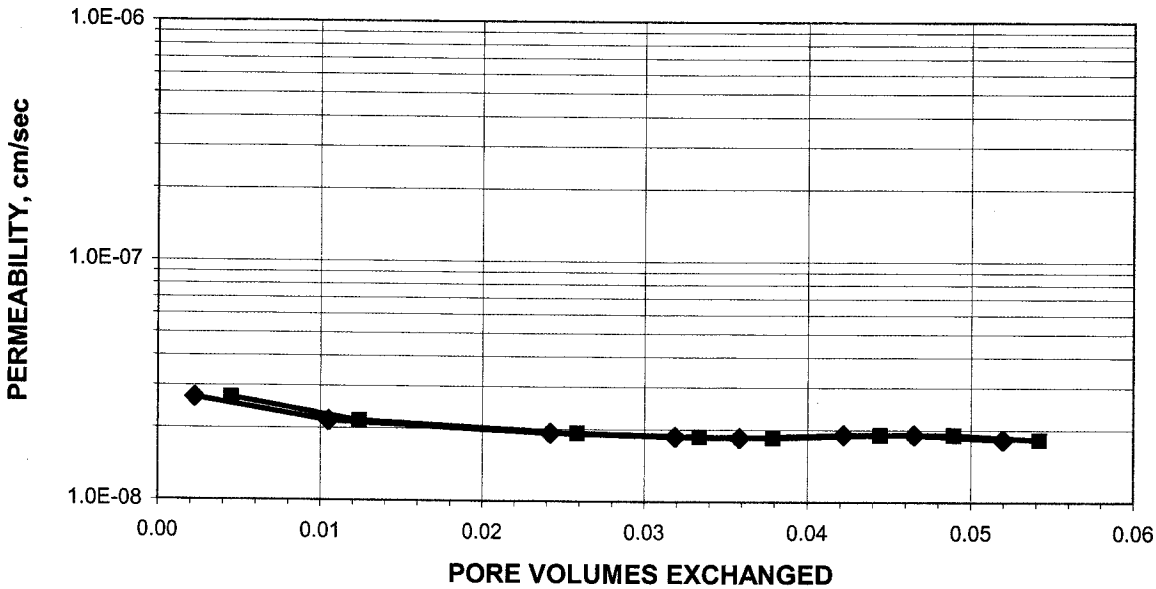
Client	WITHERS & RAVENEL	Boring No.	WRB-15
Client Project	Central Carolina Tire Monofill	Depth (ft.)	16.1 - 16.5
Project No.	2003-558-01	Sample No.	4
Lab ID No.	2003-558-01-04		

AVERAGE PERMEABILITY = 1.9E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 1.9E-10 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



Tested By: DAJ Date: 08/19/03 Checked By: MPS Date: 8-30-03

DCN: CT-22 DATE: 01/08/99 REVISION 2 C:\Documents and Settings\DAVE JENKS\Desktop\Running Perms\[2003-558-01-04 W&R.xls]Sheet1

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

Geotechnics

Client	WITHERS & RAVENEL	Boring No.	WRB-15
Client Project	Central Carolina Tire Monofill	Depth (ft.)	16.1 - 16.5
Project No.	2003-558-01	Sample No.	4
Lab ID No.	2003-558-01-04		
		Specific Gravity	2.64 Measured
		Sample Condition	Undisturbed

Visual Description: LIGHT GRAY, SOME RED SANDY LEAN CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	B-2	G-12
Wt. of Tare & WS (gm.)	435.90	1092.00
Wt. of Tare & DS (gm.)	385.49	953.80
Wt. of Tare (gm.)	98.14	153.90
Wt. of Water (gm.)	50.41	138.20
Wt. of DS (gm.)	287.35	799.90
Moisture Content (%)	**17.5**	**17.3**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	1223.90	NA
Wt. of Tube (gm.)	284.68	NA
Wt. of WS (gm.)	939.22	937.10
Length 1 (in.)	4.159	4.164
Length 2 (in.)	4.159	4.199
Length 3 (in.)	4.165	4.169
Top Diameter (in.)	2.872	2.858
Middle Diameter (in.)	2.867	2.842
Bottom Diameter (in.)	2.874	2.843
Average Length (in.)	4.16	4.18
Average Area (in.^{2})	6.47	6.37
Sample Volume (cm^3)	441.42	435.98
Unit Wet Wt. (gm./ cm^3)	2.13	2.15
Unit Wet Wt. (pcf)	132.8	134.2
Unit Dry Wt. (pcf)	113.0	114.4
Unit Dry Wt. (gm./ cm^3)	1.81	1.83
Void Ratio, e	0.46	0.44
Porosity, n	0.31	0.31
Pore Volume (cm^3)	138.8	133.3

Tested By: DAJ Date: 08/19/03 Checked By: MPS Date: 8-30-03

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

Geotechnics

Client	WITHERS & RAVENEL	Boring No.	WRB-15
Client Project	Central Carolina Tire Monofill	Depth (ft.)	16.1 - 16.5
Project No.	2003-558-01	Sample No.	4
Lab ID No.	2003-558-01-04		

Pressure Heads (Constant)

Top Cap (psi)	62.2
Bottom Cap (psi)	65.0
Cell (psi)	75.1
Total Pressure Head (cm)	196.8
Hydraulic Gradient	18.55

Final Sample Dimensions

Sample Length (cm), L	10.61
Sample Diameter (cm)	7.23
Sample Area (cm^2), A	41.09
Inflow Burette Area (cm^2), a-in	0.956
Outflow Burette Area (cm^2), a-out	0.975
B Parameter (%)	98

AVERAGE PERMEABILITY = 1.9E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 1.9E-10 m/sec @ 20°C

DATE	TIME		ELAPSED TIME t	TOTAL INFLOW	TOTAL OUTFLOW	TOTAL HEAD h	FLOW (0 flow)	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(hr)	(cm^3)	(cm^3)	(cm)	(1 stop)	(°C)	(cm/sec)
08/21/03	12	43	0.0	0.0	0.0	220.3	0	23.5	NA
08/21/03	17	42	5.0	0.3	0.6	219.3	0	23.9	2.7E-08
08/22/03	9	5	20.4	1.4	1.7	217.1	1	22.9	2.1E-08
08/23/03	10	13	20.4	1.4	1.7	216.2	0	22.9	NA
08/24/03	15	16	49.4	3.2	3.5	212.4	0	23.5	1.9E-08
08/25/03	8	35	66.7	4.3	4.5	210.3	0	22.7	1.9E-08
08/25/03	18	8	76.3	4.8	5.1	209.1	0	23.6	1.8E-08
08/26/03	8	42	90.9	5.6	5.9	207.4	0	22.9	1.9E-08
08/26/03	18	29	100.6	6.2	6.5	206.1	0	23.8	1.9E-08
08/27/03	7	18	113.5	6.9	7.2	204.7	1	22.8	1.8E-08

Tested By: DAJ Date: 08/19/03 Checked By: MPS Date: 8-30-03

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Geotechnics

SPECIFIC GRAVITY

ASTM D 854-00 (SOP - S5)

Client	WITHERS & RAVENEL	Boring No.	WRB-15
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	15.9 - 16.0
Project No.	2003-558-01	Sample No.	4
Lab ID	2003-558-01-04	Visual Description	**LIGHT GRAY-LIGHT BROWN SANDY LEAN CLAY** (Minus No.4 sieve material, airdried)

Replicate Number	**1**	**2**
Pycnometer ID	R 27	R 29
Weight of Pycnometer + Soil + Water (gm)	735.5	742.2
Temperature, T (°Celsius)	25.0	24.9
Weight of Pycnometer + Water (gm)	687.75	692.19
Tare Number	C-1	C-6
Weight of Tare + Dry Soil (gm)	300.34	304.64
Weight of Tare (gm)	223.4	224.2
Weight of Dry Soil (gm)	76.94	80.44
Specific Gravity of Soil @ T	2.636	2.644
Specific Gravity of Water @ T	0.9971	0.9971
Conversion Factor for Temperature T	0.9988	0.9989
Specific Gravity @ 20° Celsius	2.639	2.647

Average Specific Gravity @ 20° Celsius	2.64

Tested By DJK *Date* 08/21/03 *Checked By* DAJ *Date* 8-30-03

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ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	WITHERS & RAVENEL	Boring No.	WRB-15
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	16.5 - 16.7
Project No.	2003-558-01	Sample No.	4
Lab ID	2003-558-01-04	Soil Description	**LIGHT GRAY LEAN CLAY**

Note: The USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description. (Minus No. 40 sieve material, Wet method)

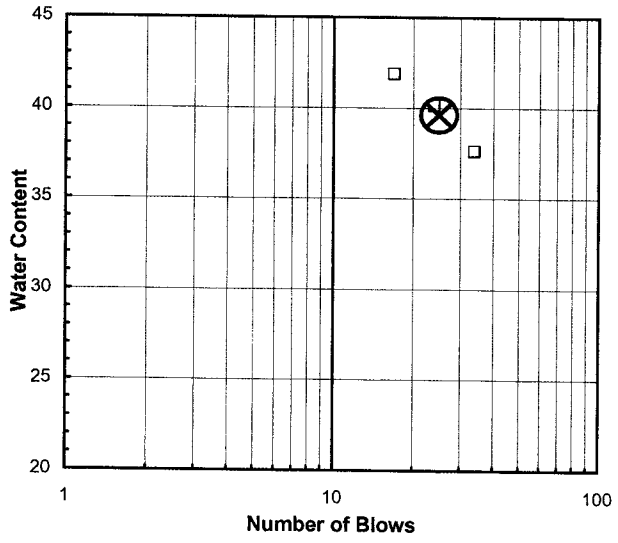
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-T	A-R	A-A	M U L T I P O I N T
Wt. of Tare & WS (gm)	29.85	28.19	26.54	
Wt. of Tare & DS (gm)	25.95	24.59	23.28	
Wt. of Tare (gm)	15.58	15.62	15.49	
Wt. of Water (gm)	3.9	3.6	3.3	
Wt. of DS (gm)	10.4	9.0	7.8	
Moisture Content (%)	**37.6**	**40.1**	**41.8**	
Number of Blows	**34**	**24**	**17**	

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	O	I	
Wt. of Tare & WS (gm)	21.59	22.34	
Wt. of Tare & DS (gm)	20.73	21.35	
Wt. of Tare (gm)	15.18	15.24	
Wt. of Water (gm)	0.9	1.0	
Wt. of DS (gm)	5.6	6.1	
Moisture Content (%)	**15.5**	**16.2**	**-0.7**

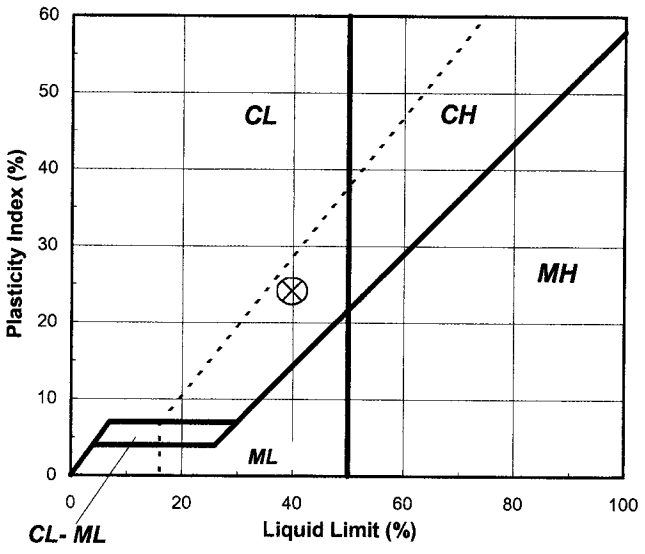
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**40**
Plastic Limit (%)	**16**
Plasticity Index (%)	**24**
USCS Symbol	**CL**

Flow Curve



Plasticity Chart



Tested By DAJ *Date* 08/29/03 *Checked By* mps *Date* 8-30-03

page 1 of 1 **DCN:** CT-S4B **DATE:** 10/08/01 **REVISION:** 2

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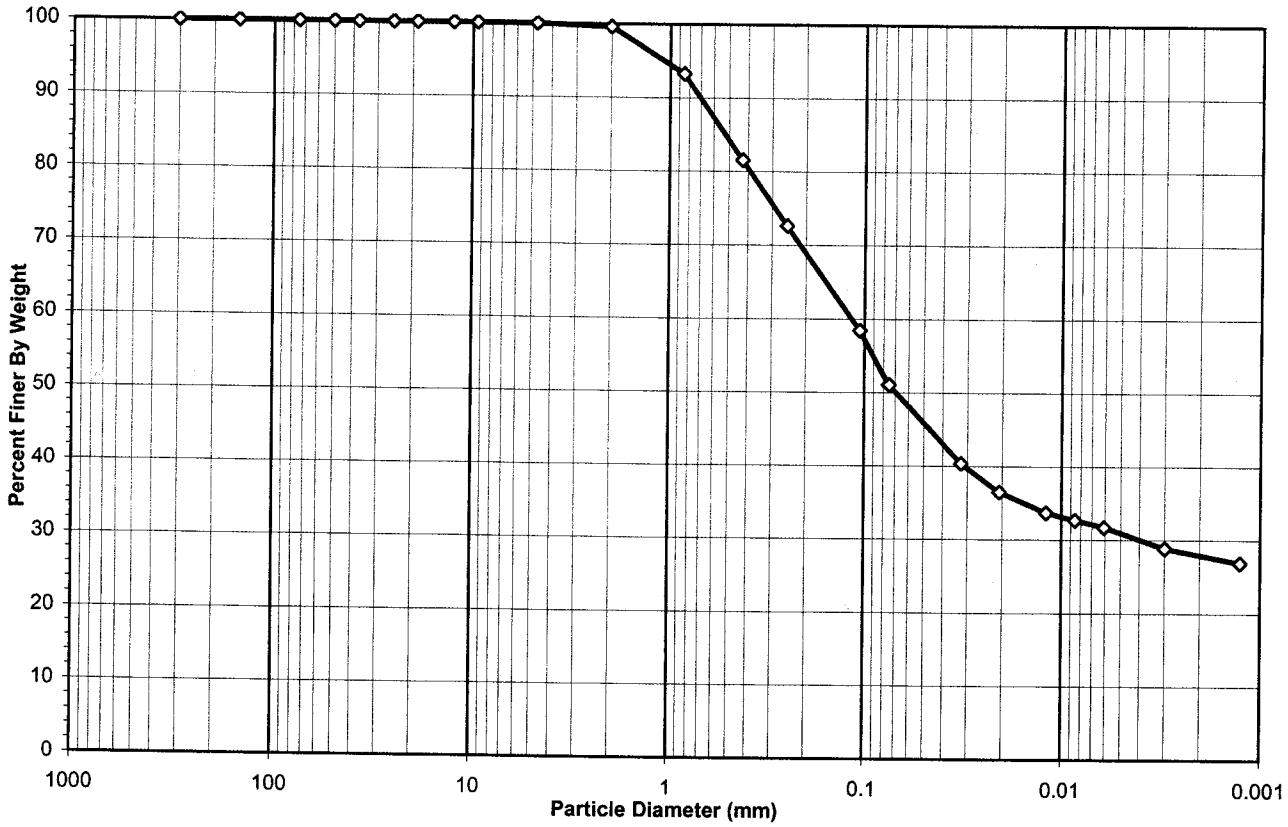
Geotechnics

SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-15
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	16.7 - 16.9
Project No.	2003-558-01	Sample No.	4
Lab ID	2003-558-01-04	Soil Color	**LIGHT GRAY**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



USCS Summary		
Sieve Sizes (mm)		**Percentage**
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	48.99
Finer Than #200	*Silt & Clay*	51.01

USCS Symbol ***CL, TESTED***

USCS Classification ***SANDY LEAN CLAY***

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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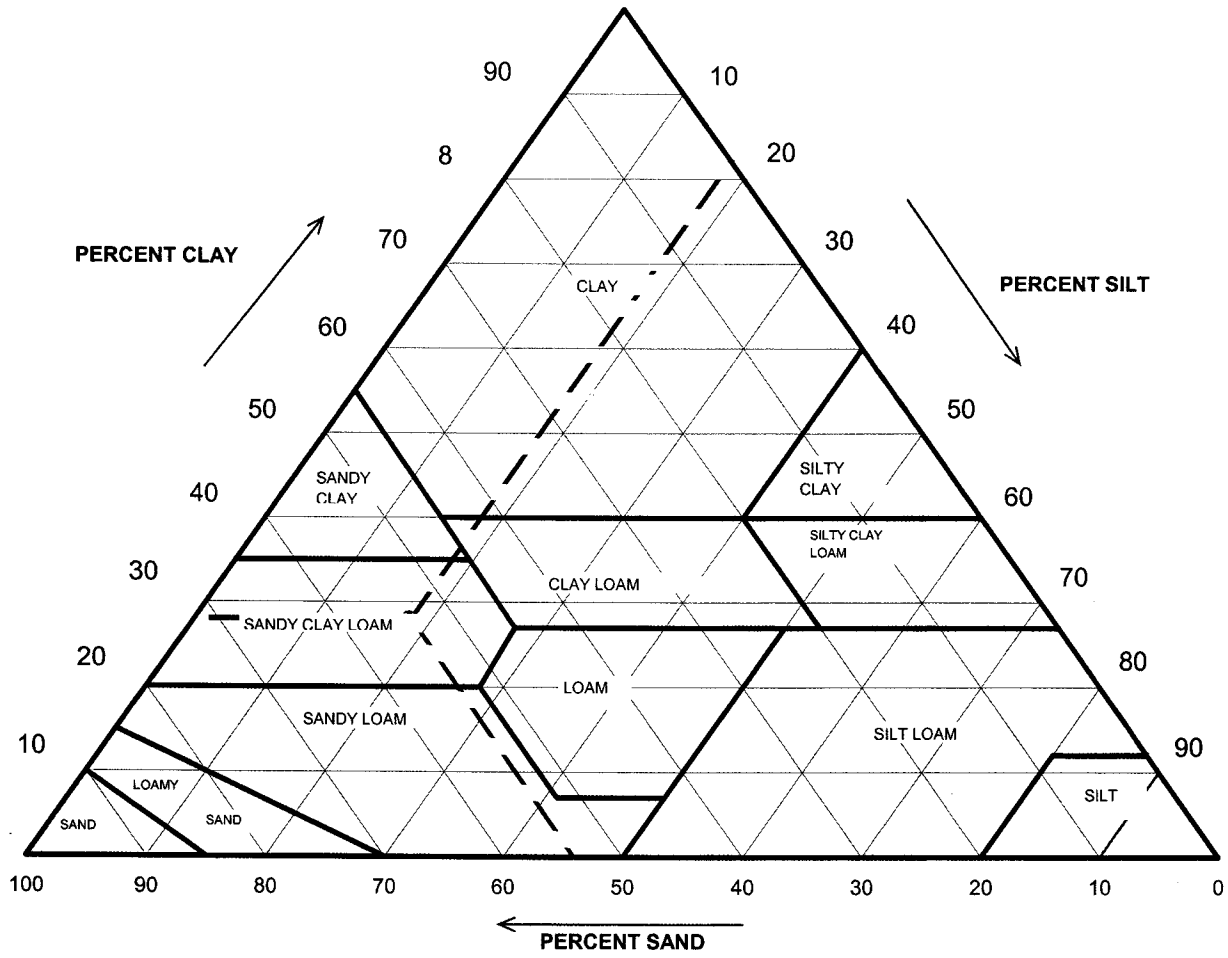
USDA CLASSIFICATION CHART

Client	WITHERS & RAVENEL	Boring No.	WRB-15
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	16.7 - 16.9
Project No.	2003-558-01	Sample No.	4
Lab ID	2003-558-01-04	Soil Color	LIGHT GRAY



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.37	**0.00**
2	99.63	*Sand*	53.74	**53.94**
0.05	45.89	*Silt*	17.96	**18.03**
0.002	27.92	*Clay*	27.92	**28.03**

USDA Classification: ***SANDY CLAY LOAM***

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Geotechnics

WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-15
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	16.7 - 16.9
Project No.	2003-558-01	Sample No.	4
Lab ID	2003-558-01-04	Soil Color	**LIGHT GRAY**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	A-A	Tare No.	A
Wgt.Tare + Wet Soil (gm)	560.60	Wgt.Tare + Wet Soil (gm)	26.70
Wgt.Tare + Dry Soil (gm)	507.70	Wgt.Tare + Dry Soil (gm)	26.60
Weight of Tare (gm)	152.62	Weight of Tare (gm)	15.22
Weight of Water (gm)	52.90	Weight of Water (gm)	0.10
Weight of Dry Soil (gm)	355.08	Weight of Dry Soil (gm)	11.38
Moisture Content (%)	**14.9**	**Moisture Content (%)**	**0.9**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	407.98	Weight of the Dry Sample (gm)	407.13
Dry Weight +#10 Material(gm)	355.1	Weight of minus #200 material (gm)	26.65
Wet Weight Hydro. Material.(gm)	52.51	Weight of plus #200 material (gm)	380.48
Dry Weight Hydro. Material (gm)	52.05		
Total Dry Weight Sample (gm)	407.13	**J-FACTOR (%FINER THAN #10)**	**0.9963**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.00	0.0	0.0	100.0	**100.0**
#10	2.00	1.32	0.4	0.4	99.6	**99.6**
#20	0.85	3.32	6.4	6.4	93.6	**93.3**
#40	0.425	6.14	11.8	18.2	81.8	**81.5**
#60	0.250	4.67	9.0	27.1	72.9	**72.6**
#140	0.106	7.40	14.2	41.4	58.6	**58.4**
#200	0.075	3.87	7.4	48.8	51.2	**51.0**
Pan	-	26.65	51.2	100.0	-	-

Notes :

Tested By DAJ Date 08/25/03 Checked By MJS Date 8-30-03

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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Geotechnics

HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-15
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	16.7 - 16.9
Project No.	2003-558-01	Sample No.	4
Lab ID	2003-558-01-04	Soil Color	**LIGHT GRAY**

Bulb Ser.# **667986**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	27.0	27.0	22.8	5.96	21.0	40.5	0.01324	0.0323	**40.3**
5		25.0	22.8	5.96	19.0	36.6	0.01324	0.0207	**36.5**
15		23.5	23.0	5.94	17.6	33.8	0.01321	0.0120	**33.7**
30		23.0	22.8	5.96	17.0	32.8	0.01324	0.0086	**32.7**
60		22.5	22.8	5.96	16.5	31.8	0.01324	0.0061	**31.7**
250		21.0	22.9	5.95	15.0	29.0	0.01322	0.0030	**28.9**
1440		20.0	22.5	5.99	14.0	27.0	0.01329	0.0013	**26.9**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	52.05	a - Factor	1.002
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	99.63
Weight of Dry Material (gm)	52.05		
		Specific Gravity	2.64 Measured

Note:

Tested By JDR Date 08/21/03 Checked By MPS Date 8-30-03

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

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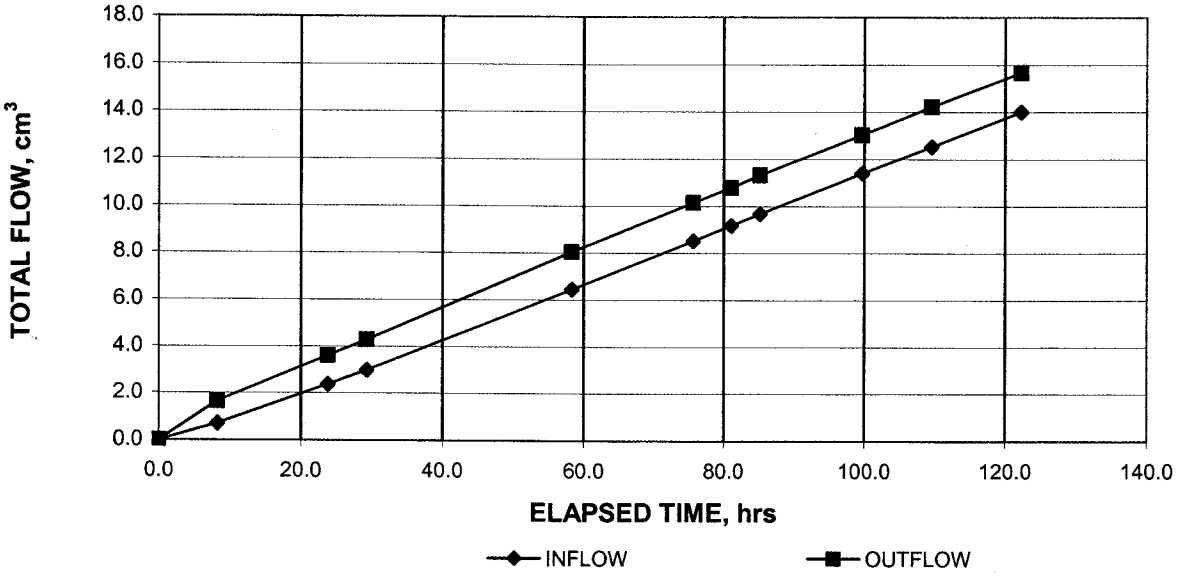
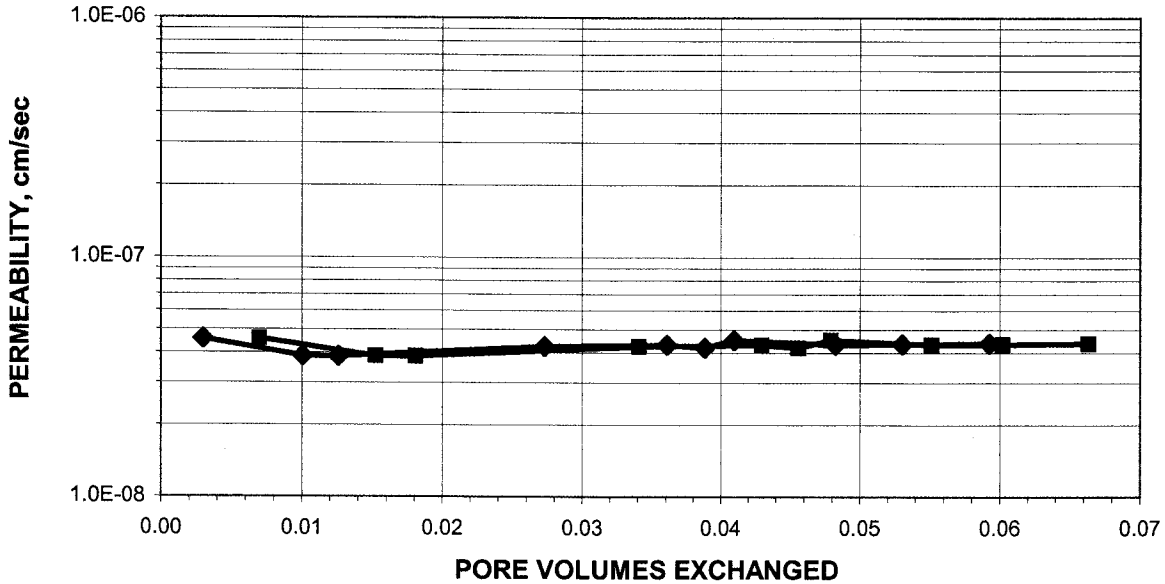
Client	WITHERS & RAVENEL	Boring No.	WRB-16D
Client Project	Central Carolina Tire Monofill	Depth (ft.)	23.1 - 23.5
Project No.	2003-558-01	Sample No.	1
Lab ID No.	2003-558-01-01		

AVERAGE PERMEABILITY = 4.4E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 4.4E-10 m/sec @ 20°C

TOTAL FLOW vs. ELAPSED TIME



PORE VOLUMES EXCHANGED vs. PERMEABILITY



Tested By: DAJ Date: 08/19/03 Checked By: MPS Date: 8-30-03

DCN: CT-22 DATE: 01/08/09 REVISION 2 C:\Documents and Settings\DAVE JENKS\Desktop\Running Perms\[2003-558-01-01 W&R.xls]Sheet1

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

Geotechnics

Client	WITHERS & RAVENEL	Boring No.	WRB-16D
Client Project	Central Carolina Tire Monofill	Depth (ft.)	23.1 - 23.5
Project No.	2003-558-01	Sample No.	1
Lab ID No.	2003-558-01-01		
		Specific Gravity	2.66 Measured
		Sample Condition	Undisturbed

Visual Description: LIGHT GRAY-PINK FAT CLAY

MOISTURE CONTENT:	BEFORE TEST	AFTER TEST
Tare Number	Y-13	K-8
Wt. of Tare & WS (gm.)	381.63	1003.50
Wt. of Tare & DS (gm.)	297.45	767.80
Wt. of Tare (gm.)	99.17	155.38
Wt. of Water (gm.)	84.18	235.70
Wt. of DS (gm.)	198.28	612.42
Moisture Content (%)	**42.5**	**38.5**

SPECIMEN:	BEFORE TEST	AFTER TEST
Wt. of Tube & WS (gm.)	1182.80	NA
Wt. of Tube (gm.)	313.22	NA
Wt. of WS (gm.)	869.58	845.36
Length 1 (in.)	4.549	4.564
Length 2 (in.)	4.600	4.605
Length 3 (in.)	4.579	4.562
Top Diameter (in.)	2.871	2.816
Middle Diameter (in.)	2.881	2.812
Bottom Diameter (in.)	2.877	2.807
Average Length (in.)	4.58	4.58
Average Area ($in.^2$)	6.50	6.21
Sample Volume (cm^3)	487.25	465.73
Unit Wet Wt. ($gm./cm^3$)	1.78	1.82
Unit Wet Wt. (pcf)	111.4	113.3
Unit Dry Wt. (pcf)	78.2	81.8
Unit Dry Wt. ($gm./cm^3$)	1.25	1.31
Void Ratio, e	1.12	1.03
Porosity, n	0.53	0.51
Pore Volume (cm^3)	257.8	236.2

Tested By: DAJ Date: 08/19/03 Checked By: MPS Date: 8-30-03

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PERMEABILITY TEST

ASTM D 5084-90(Reapproved 1997)
(SOP-S22A & S22B)

Geotechnics

Client	WITHERS & RAVENEL	Boring No.	WRB-16D
Client Project	Central Carolina Tire Monofill	Depth (ft.)	23.1 - 23.5
Project No.	2003-558-01	Sample No.	1
Lab ID No.	2003-558-01-01		

Pressure Heads (Constant)

Top Cap (psi)	57.1
Bottom Cap (psi)	60.0
Cell (psi)	78.6
Total Pressure Head (cm)	203.9
Hydraulic Gradient	17.54

Final Sample Dimensions

Sample Length (cm), L	11.63
Sample Diameter (cm)	7.14
Sample Area (cm^2), A	40.06
Inflow Burette Area (cm^2), a-in	0.888
Outflow Burette Area (cm^2), a-out	0.892
B Parameter (%)	100

AVERAGE PERMEABILITY = 4.4E-08 cm/sec @ 20°C
AVERAGE PERMEABILITY = 4.4E-10 m/sec @ 20°C

DATE	TIME		ELAPSED TIME t	TOTAL INFLOW	TOTAL OUTFLOW	TOTAL HEAD h	FLOW (0 flow)	TEMP.	INCREMENTAL PERMEABILITY @ 20°C
(mm/dd/yy)	(hr)	(min)	(hr)	(cm^3)	(cm^3)	(cm)	(1 stop)	(°C)	(cm/sec)
08/21/03	9	15	0.0	0.0	0.0	230.1	0	23.0	NA
08/21/03	17	29	8.2	0.7	1.7	227.5	0	23.9	4.6E-08
08/22/03	9	3	23.8	2.4	3.6	223.4	0	22.9	3.9E-08
08/22/03	14	32	29.3	3.0	4.3	222.0	1	23.5	3.9E-08
08/23/03	10	13	29.3	3.0	4.3	221.7	0	22.9	NA
08/24/03	15	15	58.3	6.5	8.1	213.6	0	23.5	4.2E-08
08/25/03	8	34	75.6	8.5	10.2	208.9	0	22.7	4.3E-08
08/25/03	13	58	81.0	9.2	10.8	207.5	0	23.6	4.2E-08
08/25/03	18	7	85.2	9.7	11.3	206.3	0	23.6	4.5E-08
08/26/03	8	41	99.8	11.4	13.0	202.4	0	22.9	4.3E-08
08/26/03	18	28	109.5	12.5	14.2	199.8	0	23.8	4.3E-08
08/27/03	7	10	122.2	14.0	15.7	196.6	1	22.8	4.4E-08

Tested By: DAJ Date: 08/19/03 Checked By: MPS Date: 8-30-03

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Geotechnics

SPECIFIC GRAVITY

ASTM D 854-00 (SOP - S5)

Client	WITHERS & RAVENEL	Boring No.	WRB-16D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	22.9 - 23.0
Project No.	2003-558-01	Sample No.	1
Lab ID	2003-558-01-01	Visual Description	**LIGHT GRAY-PINK FAT CLAY** (MInus No.4 sieve material, airdried)

Replicate Number	**1**	**2**
Pycnometer ID	R 28	R 30
Weight of Pycnometer + Soil + Water (gm)	717.5	713
Temperature, T (°Celsius)	23.5	23.4
Weight of Pycnometer + Water (gm)	690.74	687.07
Tare Number	C-6	C-1
Weight of Tare + Dry Soil (gm)	267.27	265.08
Weight of Tare (gm)	224.28	223.52
Weight of Dry Soil (gm)	42.99	41.56
Specific Gravity of Soil @ T	2.649	2.659
Specific Gravity of Water @ T	0.9974	0.9975
Conversion Factor for Temperature T	0.9992	0.9992
Specific Gravity @ 20° Celsius	2.651	2.661

Average Specific Gravity @ 20° Celsius	2.66

Tested By DAJ *Date* 08/25/03 *Checked By* MPS *Date* 8-30-03

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ATTERBERG LIMITS

ASTM D 4318-98 / AASHTO T89 (SOP - S4A)

Client	WITHERS & RAVENEL	Boring No.	WRB-16D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	23.5 - 23.7
Project No.	2003-558-01	Sample No.	1
Lab ID	2003-558-01-01	Soil Description	**LIGHT GRAY-PINK FAT CLAY**

***Note: The* USCS symbol used with this test refers only to the minus No. 40 sieve material. See the "Sieve and Hydrometer Analysis" graph page for the complete material description.**

(Minus No. 40 sieve material, Wet method)

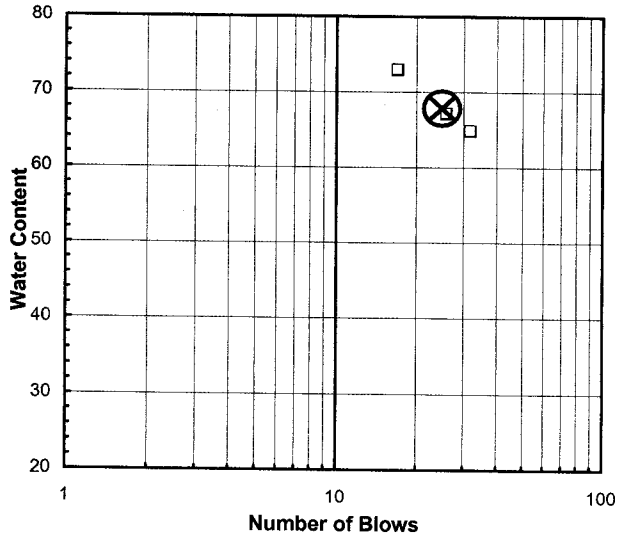
Liquid Limit Test	**1**	**2**	**3**	
Tare Number	A-C	A-Q	A-T	M
Wt. of Tare & WS (gm)	24.91	26.08	26.85	U
Wt. of Tare & DS (gm)	21.23	21.84	22.09	L
Wt. of Tare (gm)	15.55	15.52	15.56	T
Wt. of Water (gm)	3.7	4.2	4.8	I
Wt. of DS (gm)	5.7	6.3	6.5	P
				O
Moisture Content (%)	**64.8**	**67.1**	**72.9**	I
Number of Blows	**32**	**26**	**17**	N
				T

Plastic Limit Test	**1**	**2**	**Range**
Tare Number	U	W	
Wt. of Tare & WS (gm)	22.39	22.37	
Wt. of Tare & DS (gm)	20.73	20.76	
Wt. of Tare (gm)	15.17	15.13	
Wt. of Water (gm)	1.7	1.6	
Wt. of DS (gm)	5.6	5.6	
Moisture Content (%)	**29.9**	**28.6**	**1.3**

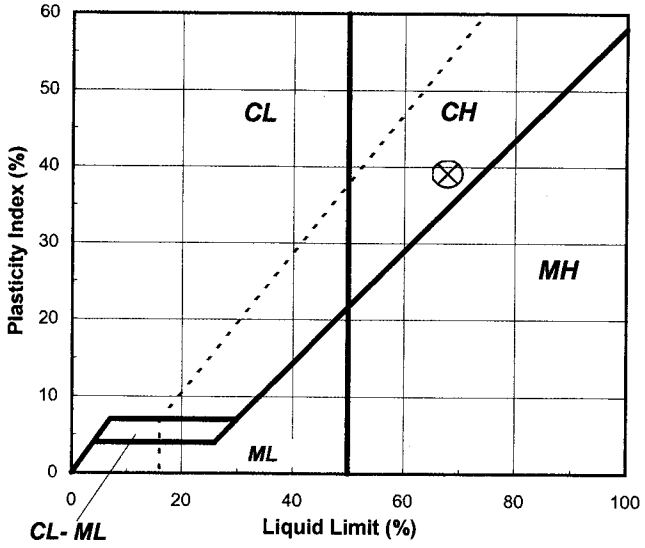
Note: The acceptable range of the two Moisture contents is ± 2.6

Test Results	
Liquid Limit (%)	**68**
Plastic Limit (%)	**29**
Plasticity Index (%)	**39**
USCS Symbol	**CH**

Flow Curve



Plasticity Chart



Tested By DJK *Date* 08/25/03 *Checked By* DAJ *Date* 8-30-03

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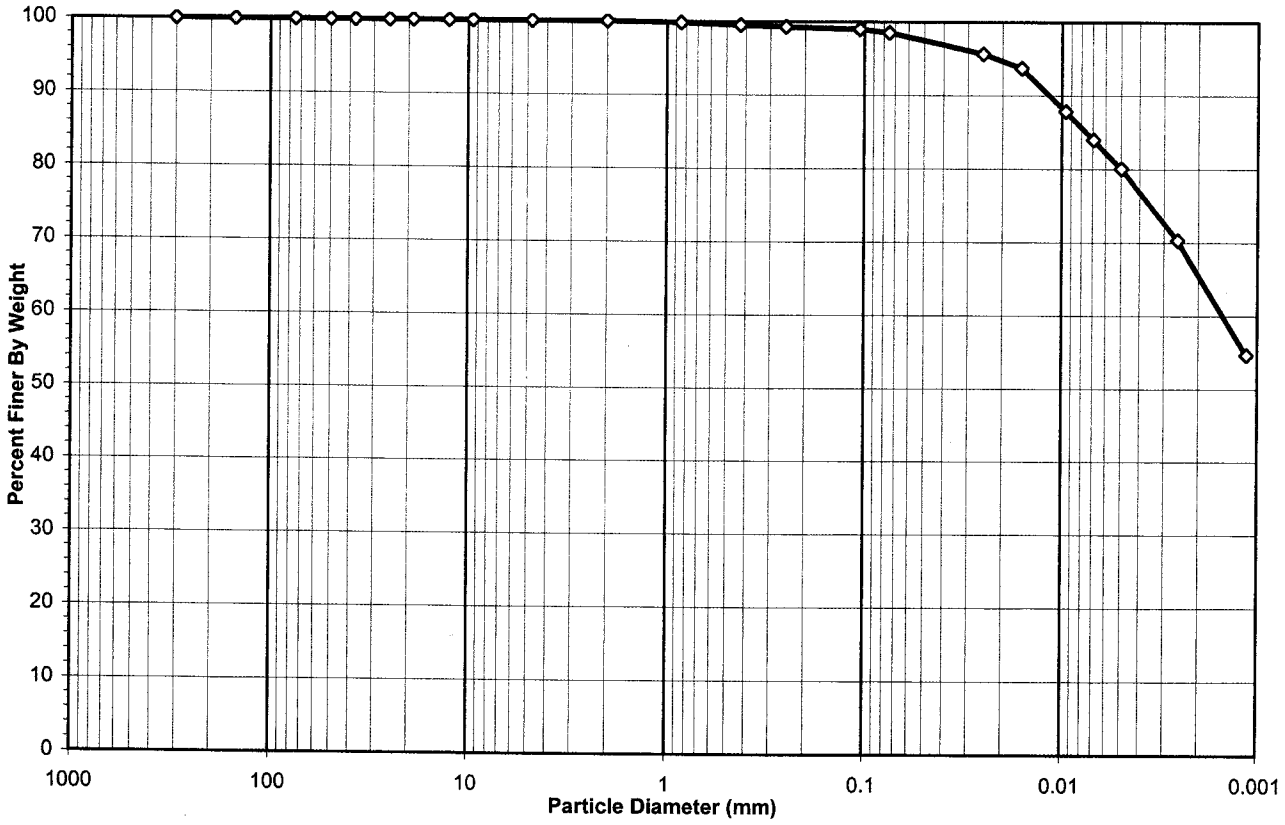
Geotechnics

SIEVE AND HYDROMETER ANALYSIS
ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-16D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	23.7 - 23.9
Project No.	2003-558-01	Sample No.	1
Lab ID	2003-558-01-01	Soil Color	**LIGHT GRAY-PINK**

	SIEVE ANALYSIS			HYDROMETER	
USCS	cobbles	gravel	sand	silt and clay fraction	
USDA	cobbles	gravel	sand	silt	clay

12" 6" 3" 3/4" 3/8" #4 #10 #20 #40 #140 #200



USCS Summary

Sieve Sizes (mm)		Percentage
Greater Than #4	*Gravel*	0.00
#4 To #200	*Sand*	1.49
Finer Than #200	*Silt & Clay*	98.51

USCS Symbol ***CH, TESTED***

USCS Classification ***FAT CLAY***

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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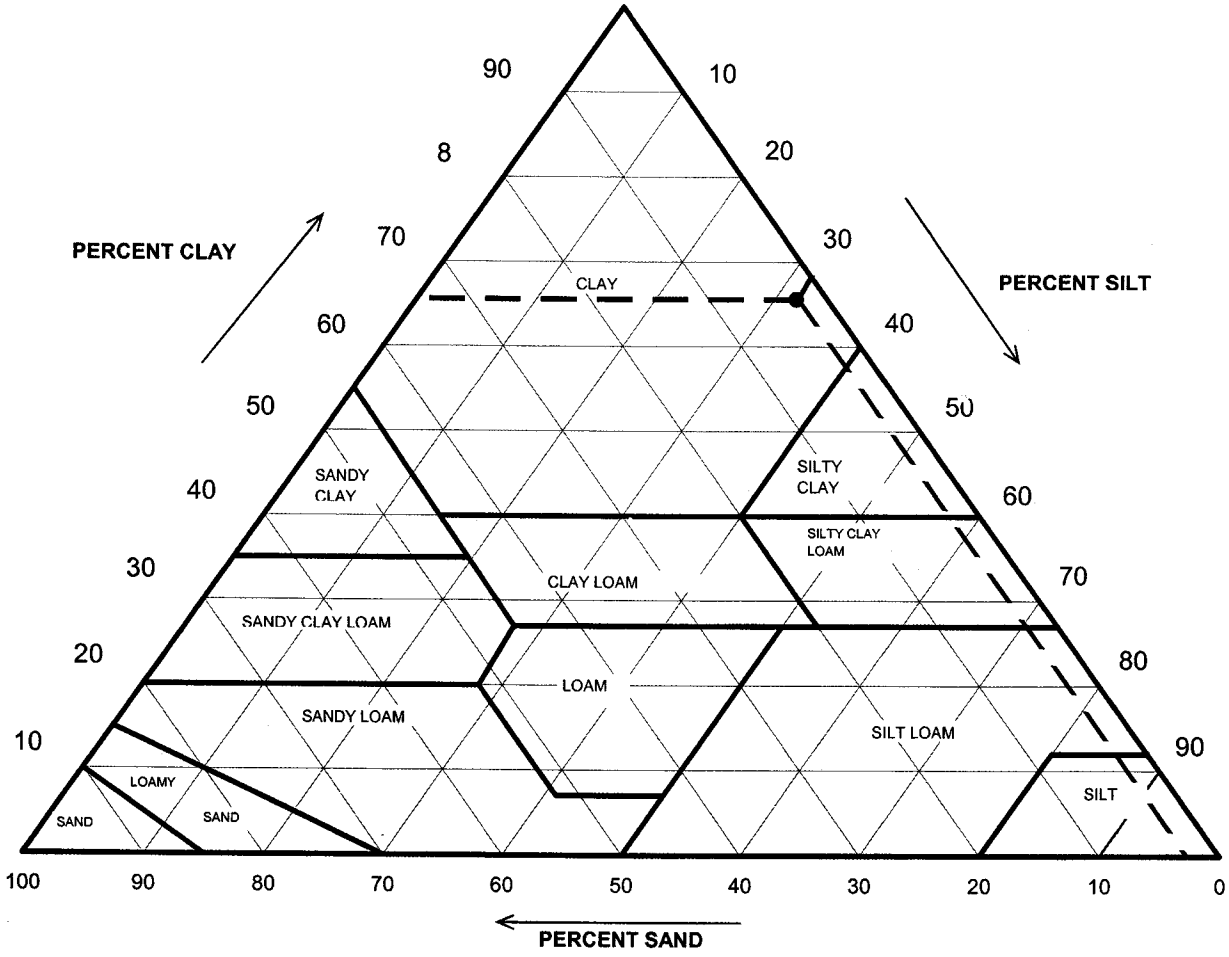
USDA CLASSIFICATION CHART

Client	WITHERS & RAVENEL	Boring No.	WRB-16D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	23.7 - 23.9
Project No.	2003-558-01	Sample No.	1
Lab ID	2003-558-01-01	Soil Color	LIGHT GRAY-PINK



Particle Size (mm)	Percent Finer	USDA SUMMARY	Actual Percentage	Corrected % of Minus 2.0 mm material for USDA Classificat.
		Gravel	0.00	**0.00**
2	100.00	*Sand*	2.55	**2.55**
0.05	97.45	*Silt*	31.88	**31.88**
0.002	65.57	*Clay*	65.57	**65.57**

USDA Classification: ***CLAY***

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Geotechnics

WASH SIEVE ANALYSIS #10 SPLIT

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-16D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	23.7 - 23.9
Project No.	2003-558-01	Sample No.	1
Lab ID	2003-558-01-01	Soil Color	**LIGHT GRAY-PINK**

Moisture Content/sieve +10 Material		Moisture Content for Hydrometer Portion	
Tare No.	G-6	Tare No.	P
Wgt.Tare + Wet Soil (gm)	482.00	Wgt.Tare + Wet Soil (gm)	26.43
Wgt.Tare + Dry Soil (gm)	385.20	Wgt.Tare + Dry Soil (gm)	26.25
Weight of Tare (gm)	155.30	Weight of Tare (gm)	15.22
Weight of Water (gm)	96.80	Weight of Water (gm)	0.18
Weight of Dry Soil (gm)	229.90	Weight of Dry Soil (gm)	11.03
Moisture Content (%)	**42.1**	**Moisture Content (%)**	**1.6**

Soil Specimen Data			
Wet Weight +#10 Material (gm)	326.70	Weight of the Dry Sample (gm)	281.07
Dry Weight +#10 Material(gm)	229.9	Weight of minus #200 material (gm)	50.41
Wet Weight Hydro. Material.(gm)	52.01	Weight of plus #200 material (gm)	230.66
Dry Weight Hydro. Material (gm)	51.17		
Total Dry Weight Sample (gm)	281.07	**J-FACTOR (%FINER THAN #10)**	**1.0000**

Sieve Size	Sieve Opening (mm)	Wgt.of Soil Retained (gm)	Percent Retained (%)	Accumulated Percent Retained (%)	Percent Finer (%)	**Accumulated Percent Finer (%)**
12"	300	0.00	0.0	0.0	100.0	**100.0**
6"	150	0.00	0.0	0.0	100.0	**100.0**
3"	75	0.00	0.0	0.0	100.0	**100.0**
2"	50	0.00	0.0	0.0	100.0	**100.0**
1 1/2"	37.5	0.00	0.0	0.0	100.0	**100.0**
1"	25.0	0.00	0.0	0.0	100.0	**100.0**
3/4"	19.0	0.00	0.0	0.0	100.0	**100.0**
1/2"	12.5	0.00	0.0	0.0	100.0	**100.0**
3/8"	9.50	0.00	0.0	0.0	100.0	**100.0**
#4	4.75	0.00	0.0	0.0	100.0	**100.0**
#10	2.00	0.00	0.0	0.0	100.0	**100.0**
#20	0.85	0.09	0.2	0.2	99.8	**99.8**
#40	0.425	0.16	0.3	0.5	99.5	**99.5**
#60	0.250	0.11	0.2	0.7	99.3	**99.3**
#140	0.106	0.16	0.3	1.0	99.0	**99.0**
#200	0.075	0.24	0.5	1.5	98.5	**98.5**
Pan	-	50.41	98.5	100.0	-	-

Notes :

Tested By DAJ Date 08/26/03 Checked By mps Date 8-30-03

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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Geotechnics

HYDROMETER ANALYSIS

ASTM D 422-63 (SOP-S3)

Client	WITHERS & RAVENEL	Boring No.	WRB-16D
Client Reference	CENTRAL CAROLINA TIRE MONOFIL	Depth (ft)	23.7 - 23.9
Project No.	2003-558-01	Sample No.	1
Lab ID	2003-558-01-01	Soil Color	**LIGHT GRAY-PINK**

Bulb Ser.# **667986**

Elapsed Time (min)		R Measured	Temp. (°C)	Composite Correction	R Corrected	N (%)	K Factor	Diameter (mm)	N' (%)
0	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	55.0	55.0	22.8	5.96	49.0	95.6	0.01316	0.0251	**95.6**
5		54.0	22.8	5.96	48.0	93.7	0.01316	0.0161	**93.7**
15		51.0	22.8	5.96	45.0	87.8	0.01316	0.0096	**87.8**
30		49.0	22.8	5.96	43.0	83.9	0.01316	0.0069	**83.9**
60		47.0	22.8	5.96	41.0	80.0	0.01316	0.0050	**80.0**
250		42.0	22.9	5.95	36.0	70.3	0.01314	0.0026	**70.3**
1440		34.0	22.5	5.99	28.0	54.6	0.01321	0.0011	**54.6**

Soil Specimen Data		**Other Corrections**	
Tare + Dry Material (gm)	51.17	a - Factor	0.998
Weight of Tare (gm)	0		
Weight of Deflocculant (gm)	5.0	Percent Finer than # 10	100.00
Weight of Dry Material (gm)	51.17		
		Specific Gravity	2.66 Measured

Note:

Tested By JDR Date 08/21/03 Checked By MPS Date 8-30-03

DCN: CT-S3P DATE: 03/07/01 REVISION: 5

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APPENDIX 4C

In-Situ Hydraulic Conductivity Test Data and Calculations

Carolina Central Tire Siting Study
Hydraulic Conductivity (K) Calculation Worksheet
W&R Project Number: 202334.01

Well: **WRB-1**
Test Date: 8/20/2003
Test Type: Falling Head (Slug in)

Conducted by: Ihnatolya
Entered/date: Bellis -8-25-03
Checked/date: Ihnatolya -8-26-03

WELL DATA

SWL =	12.41	(ft BTOC)
WD =	31.79	(ft BTOC)
WD =	29.00	(ft BGS)
DTSP =	19.79	(ft BTOC)
rc =	0.083	(ft)
n =	0.30	
rw =	0.38	(ft)
rc (adjusted) =	0.08	(ft)
Le =	12	(ft)
Lw =	19.38	(ft)
Le/rw =	32.00	
H =	75.00	(ft)

CALCULATION OF K

K = [(rc^2 ln(Re/rw))/2Le]*(1/t)ln(yo/yt)

yo =	0.926	(ft) from plot
yt =	0.345	(ft) from plot
t =	0.348	(minutes) from plot
ln(Re/rw) =	2.38	
K =	3	(ft/day)
K =	1.0E-03	(cm/sec)

Calculation of ln(Re/rw)

Where: Lw < H;

ln(Re/rw) = [{1.1/(ln(Lw/rw))}+{A+Bln((H-Lw)/rw)}/(Le/rw)]^-1= 2.38

Where: Lw = H;

ln(Re/rw) = [{1.1/(ln(Lw/rw))}+{C/(Le/rw)}]^-1 = 2.86

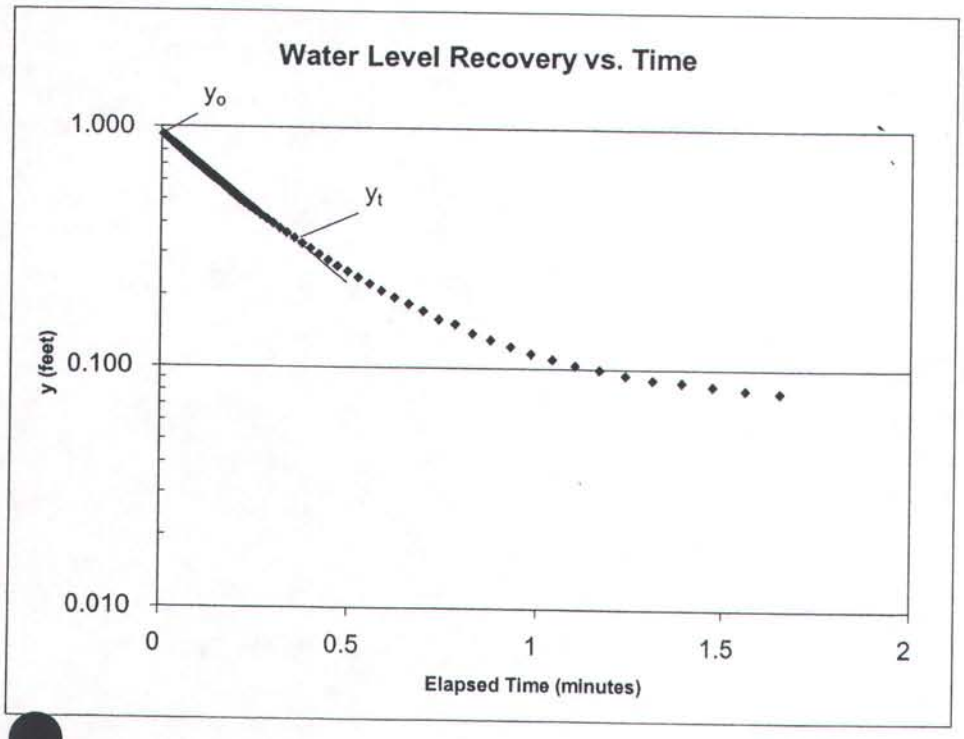
Calculation of Coefficients
Value range for Le/rw from Table of Coefficients

Le/rw	A	B	C
30	2.5	0.35	2.1
40	2.75	0.45	2.45

Interpolated values of A, B and C for Le/rw

32.00	2.55	0.37	2.17

Reference: Bouwer(1989), Bouwer and Rice(1976)



TEST DATA

Elapsed time (min)	Log y	y (ft)	WL (ft BTOC)
0.005	-0.03	0.926	11.484
0.01	-0.04	0.912	11.498
0.015	-0.05	0.897	11.513
0.02	-0.05	0.885	11.525
0.025	-0.06	0.871	11.539
0.03	-0.07	0.856	11.554
0.035	-0.07	0.842	11.568
0.04	-0.08	0.830	11.58
0.045	-0.09	0.817	11.593
0.05	-0.10	0.803	11.607
0.055	-0.10	0.791	11.619
0.06	-0.11	0.776	11.634
0.065	-0.12	0.766	11.644
0.07	-0.12	0.754	11.656
0.075	-0.13	0.742	11.668
0.08	-0.14	0.730	11.68
0.085	-0.14	0.719	11.691
0.09	-0.15	0.709	11.701
0.095	-0.16	0.699	11.711
0.1	-0.16	0.689	11.721
0.1058	-0.17	0.676	11.734
0.112	-0.18	0.662	11.748
0.1185	-0.19	0.650	11.76
0.1255	-0.20	0.637	11.773
0.1328	-0.21	0.623	11.787
0.1407	-0.22	0.609	11.801
0.149	-0.23	0.594	11.816
0.1578	-0.24	0.582	11.828
0.167	-0.25	0.562	11.848
0.177	-0.26	0.547	11.863
0.1875	-0.28	0.529	11.881
0.1985	-0.29	0.513	11.897
0.2102	-0.31	0.494	11.916
0.2227	-0.32	0.480	11.93
0.2358	-0.33	0.464	11.946
0.2498	-0.35	0.445	11.965
0.2647	-0.37	0.429	11.981
0.2803	-0.38	0.413	11.997
0.297	-0.40	0.396	12.014
0.3147	-0.42	0.378	12.032
0.3333	-0.44	0.362	12.048
0.3532	-0.46	0.345	12.065
0.3742	-0.49	0.327	12.083
0.3963	-0.50	0.313	12.097
0.4198	-0.53	0.296	12.114
0.4447	-0.55	0.280	12.13
0.4697	-0.58	0.264	12.146
0.4963	-0.60	0.251	12.159
0.5247	-0.63	0.237	12.173
0.5547	-0.65	0.223	12.187
0.5863	-0.68	0.209	12.201
0.6213	-0.71	0.196	12.214
0.658	-0.74	0.184	12.226
0.6963	-0.76	0.172	12.238
0.738	-0.80	0.159	12.251
0.7813	-0.82	0.152	12.258
0.828	-0.86	0.139	12.271
0.8763	-0.88	0.131	12.279
0.928	-0.91	0.123	12.287
0.983	-0.94	0.115	12.295
1.0413	-0.96	0.109	12.301
1.103	-0.99	0.103	12.307
1.168	-1.00	0.099	12.311
1.238	-1.03	0.094	12.316
1.3113	-1.05	0.090	12.32
1.3897	-1.06	0.088	12.322
1.473	-1.07	0.085	12.325
1.5613	-1.09	0.082	12.328
1.6547	-1.10	0.080	12.33

Carolina Central Tire Siting Study
Hydraulic Conductivity (K) Calculation Worksheet
W&R Project Number: 202334.01

Well: **WRB-1**
Test Date: 8/20/2003
Test Type: Rising Head (Slug out)

Conducted by: Ihnatolya
Entered/date: Bellis -8-25-03 BJB
Checked/date: Ihnatolya -8-26-03

WELL DATA

SWL =	12.41	(ft BTOC)
WD =	31.79	(ft BTOC)
WD =	29.00	(ft BGS)
DTSP =	19.79	(ft BTOC)
rc =	0.083	(ft)
n =	0.30	
rw =	0.38	(ft)
rc (adjusted) =	0.08	(ft)
Le =	12	(ft)
Lw =	19.38	(ft)
Le/rw =	32.00	
H =	75.00	(ft)

CALCULATION OF K

K = [(rc^2 ln(Re/rw))/2Le]*(1/t)ln(yo/yt)

yo =	1.300	(ft) from plot
yt =	0.136	(ft) from plot
t =	0.776	(minutes) from plot
ln(Re/rw) =	2.38	
K =	3	(ft/day)
K =	1.0E-03	(cm/sec)

Calculation of ln(Re/rw)

Where: Lw < H;

ln(Re/rw) = [{1.1/(ln(Lw/rw))}+(A+Bln((H-Lw)/rw))/(Le/rw)]^-1= 2.38

Where: Lw = H;

ln(Re/rw) = [{1.1/(ln(Lw/rw))}+{C/(Le/rw)}]^-1 = 2.86

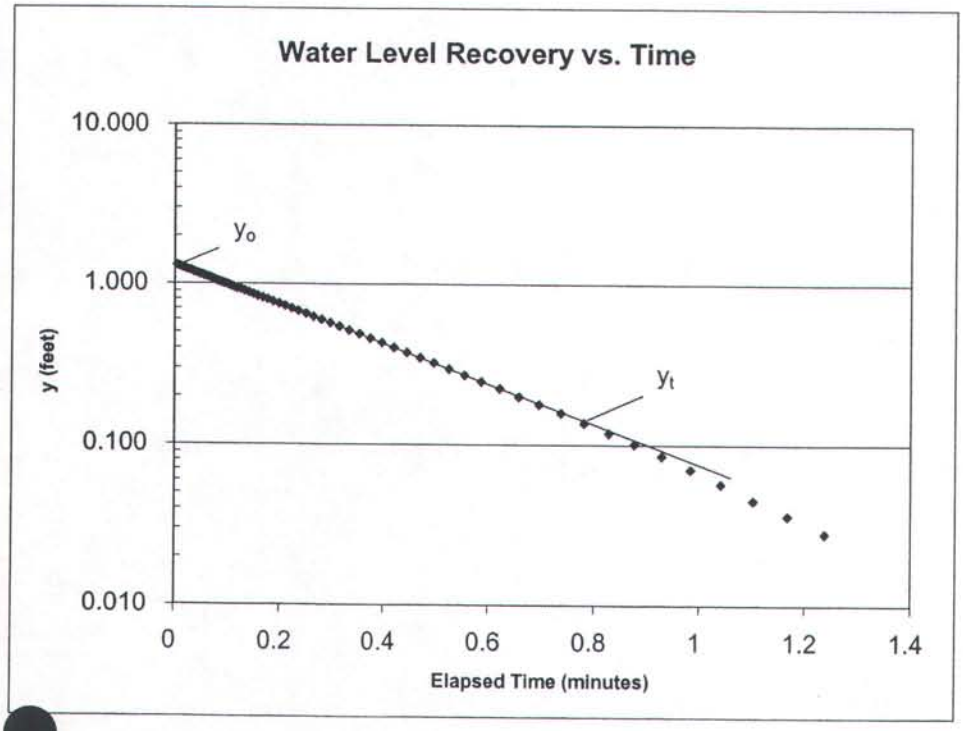
Calculation of Coefficients
Value range for Le/rw from Table of Coefficients

Le/rw	A	B	C
30	2.5	0.35	2.1
40	2.75	0.45	2.45

Interpolated values of A, B and C for Le/rw

32.00	2.55	0.37	2.17

Reference: Bouwer(1989), Bouwer and Rice(1976)



TEST DATA

Elapsed time (min)	Log y	y (ft)	WL (ft BTOC)
0.005	0.11	1.300	13.71
0.01	0.11	1.279	13.689
0.015	0.10	1.261	13.671
0.02	0.09	1.243	13.653
0.025	0.09	1.222	13.632
0.03	0.08	1.206	13.616
0.035	0.07	1.187	13.597
0.04	0.07	1.171	13.581
0.045	0.06	1.154	13.564
0.05	0.06	1.138	13.548
0.055	0.05	1.122	13.532
0.06	0.04	1.105	13.515
0.065	0.04	1.091	13.501
0.07	0.03	1.075	13.485
0.075	0.02	1.058	13.468
0.08	0.02	1.044	13.454
0.085	0.01	1.030	13.44
0.09	0.01	1.015	13.425
0.095	0.00	1.001	13.411
0.1	-0.01	0.987	13.397
0.1058	-0.01	0.970	13.38
0.112	-0.02	0.952	13.362
0.1185	-0.03	0.935	13.345
0.1255	-0.04	0.919	13.329
0.1328	-0.05	0.898	13.308
0.1407	-0.06	0.878	13.288
0.149	-0.07	0.857	13.267
0.1578	-0.08	0.837	13.247
0.167	-0.09	0.816	13.226
0.177	-0.10	0.796	13.206
0.1875	-0.11	0.771	13.181
0.1985	-0.12	0.751	13.161
0.2102	-0.14	0.726	13.136
0.2227	-0.15	0.701	13.111
0.2358	-0.17	0.676	13.086
0.2498	-0.19	0.650	13.06
0.2647	-0.21	0.623	13.033
0.2803	-0.22	0.597	13.007
0.297	-0.24	0.570	12.98
0.3147	-0.27	0.541	12.951
0.3333	-0.29	0.512	12.922
0.3532	-0.31	0.486	12.896
0.3742	-0.34	0.457	12.867
0.3963	-0.37	0.430	12.84
0.4198	-0.40	0.401	12.811
0.4447	-0.43	0.374	12.784
0.4697	-0.46	0.348	12.758
0.4963	-0.49	0.323	12.733
0.5247	-0.53	0.296	12.706
0.5547	-0.57	0.271	12.681
0.5863	-0.61	0.247	12.657
0.6213	-0.65	0.224	12.634
0.658	-0.70	0.199	12.609
0.6963	-0.75	0.178	12.588
0.738	-0.80	0.157	12.567
0.7813	-0.87	0.136	12.546
0.828	-0.93	0.118	12.528
0.8763	-1.00	0.101	12.511
0.928	-1.07	0.085	12.495
0.983	-1.15	0.070	12.48
1.0413	-1.24	0.057	12.467
1.103	-1.35	0.045	12.455
1.168	-1.44	0.036	12.446
1.238	-1.55	0.028	12.438

Carolina Central Tire Siting Study
Hydraulic Conductivity (K) Calculation Worksheet
W&R Project Number: 202334.01

Well: **WRB-2**
Test Date: 8/20/2003
Test Type: Falling Head (Slug in)

Conducted by: Ihnatolya
Entered/date: Bellis -8-25-03
Checked/date: Ihnatolya -8-26-03

WELL DATA

SWL =	13.49	(ft BTOC)
WD =	32.94	(ft BTOC)
WD =	30.00	(ft BGS)
DTSP =	21.94	(ft BTOC)
rc =	0.083	(ft)
n =	0.30	
rw =	0.38	(ft)
rc (adjusted) =	0.08	(ft)
Le =	11	(ft)
Lw =	19.45	(ft)
Le/rw =	29.33	
H =	75.00	(ft)

CALCULATION OF K

K = [(rc^2 ln(Re/rw))/2Le]*(1/t)ln(yo/yt)

yo =	0.294	(ft) from plot
yt =	0.106	(ft) from plot
t =	0.275	(minutes) from plot
ln(Re/rw) =	2.38	
K =	4	(ft/day)
K =	1.5E-03	(cm/sec)

Calculation of ln(Re/rw)

Where: Lw < H;

ln(Re/rw) = [{1.1/(ln(Lw/rw))}+(A+Bln((H-Lw)/rw))/(Le/rw)]^-1= 2.38

Where: Lw = H;

ln(Re/rw) = [{1.1/(ln(Lw/rw))}+{C/(Le/rw)}]^-1 = 2.86

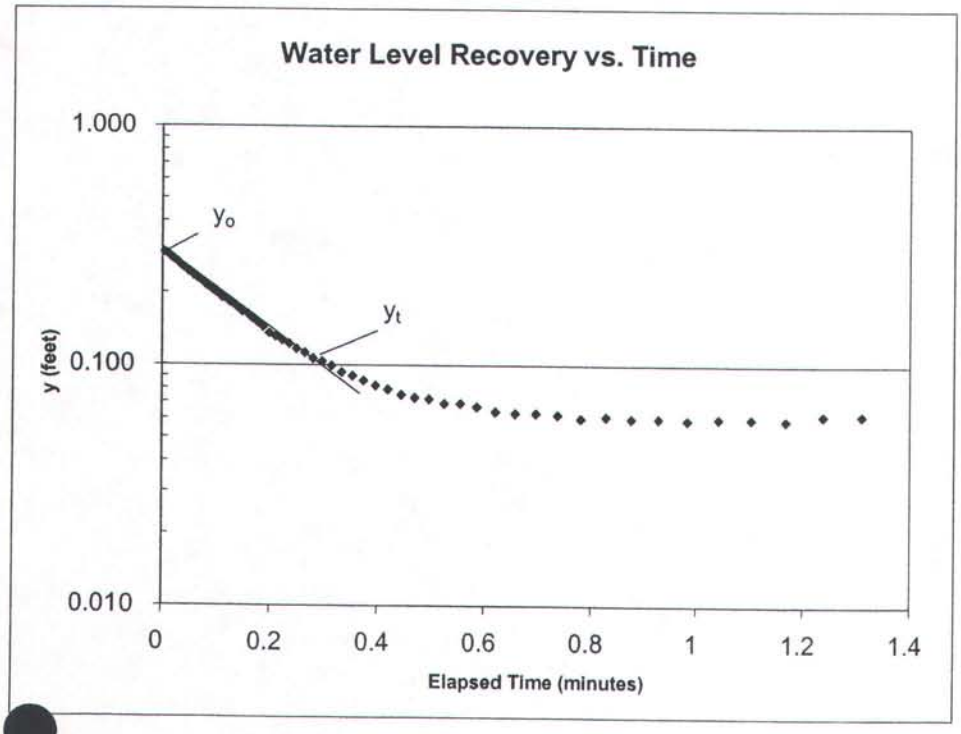
Calculation of Coefficients
Value range for Le/rw from Table of Coefficients

Le/rw	A	B	C
25	2.4	0.31	1.9
30	2.5	0.35	2.1

Interpolated values of A, B and C for Le/rw

29.33	2.49	0.34	2.07

Reference: Bouwer(1989), Bouwer and Rice(1976)



TEST DATA

Elapsed time (min)	Log y	y (ft)	WL (ft BTOC)
0.005	-0.53	0.294	13.196
0.01	-0.54	0.290	13.2
0.015	-0.55	0.284	13.206
0.02	-0.56	0.276	13.214
0.025	-0.57	0.272	13.218
0.03	-0.58	0.266	13.224
0.035	-0.59	0.260	13.23
0.04	-0.60	0.254	13.236
0.045	-0.60	0.250	13.24
0.05	-0.61	0.244	13.246
0.055	-0.62	0.240	13.25
0.06	-0.63	0.234	13.256
0.065	-0.64	0.230	13.26
0.07	-0.65	0.226	13.264
0.075	-0.65	0.222	13.268
0.08	-0.67	0.216	13.274
0.085	-0.67	0.212	13.278
0.09	-0.68	0.208	13.282
0.095	-0.69	0.204	13.286
0.1	-0.70	0.200	13.29
0.1058	-0.71	0.196	13.294
0.112	-0.72	0.190	13.3
0.1185	-0.73	0.188	13.302
0.1255	-0.74	0.182	13.308
0.1328	-0.75	0.178	13.312
0.1407	-0.76	0.172	13.318
0.149	-0.78	0.166	13.324
0.1578	-0.79	0.163	13.327
0.167	-0.81	0.155	13.335
0.177	-0.83	0.149	13.341
0.1875	-0.84	0.143	13.347
0.1985	-0.87	0.135	13.355
0.2102	-0.88	0.131	13.359
0.2227	-0.90	0.126	13.364
0.2358	-0.91	0.122	13.368
0.2498	-0.94	0.116	13.374
0.2647	-0.95	0.112	13.378
0.2803	-0.97	0.106	13.384
0.297	-0.99	0.103	13.387
0.3147	-1.00	0.099	13.391
0.3333	-1.03	0.093	13.397
0.3532	-1.05	0.090	13.4
0.3742	-1.07	0.086	13.404
0.3963	-1.09	0.082	13.408
0.4198	-1.10	0.079	13.411
0.4447	-1.12	0.075	13.415
0.4697	-1.14	0.073	13.417
0.4963	-1.14	0.072	13.418
0.5247	-1.16	0.069	13.421
0.5547	-1.16	0.069	13.421
0.5863	-1.17	0.067	13.423
0.6213	-1.19	0.064	13.426
0.658	-1.20	0.063	13.427
0.6963	-1.20	0.063	13.427
0.738	-1.21	0.062	13.428
0.7813	-1.22	0.060	13.43
0.828	-1.21	0.061	13.429
0.8763	-1.22	0.060	13.43
0.928	-1.22	0.060	13.43
0.983	-1.23	0.059	13.431
1.0413	-1.22	0.060	13.43
1.103	-1.22	0.060	13.43
1.168	-1.23	0.059	13.431
1.238	-1.21	0.062	13.428
1.3113	-1.21	0.062	13.428

Carolina Central Tire Siting Study
Hydraulic Conductivity (K) Calculation Worksheet
W&R Project Number: 202334.01

Well: **WRB-2**
Test Date: 8/20/2003
Test Type: Rising Head (Slug out)

Conducted by: Ihnatolya
Entered/date: Bellis -8-25-03 BJB
Checked/date: Ihnatolya -8-26-03

WELL DATA

SWL =	13.49	(ft BTOC)
WD =	32.94	(ft BTOC)
WD =	30.00	(ft BGS)
DTSP =	21.94	(ft BTOC)
rc =	0.083	(ft)
n =	0.30	
rw =	0.38	(ft)
rc (adjusted) =	0.08	(ft)
Le =	11	(ft)
Lw =	19.45	(ft)
Le/rw =	29.33	
H =	75.00	(ft)

CALCULATION OF K

K = [(rc^2 ln(Re/rw))/2Le]*(1/t)ln(yo/yt)

yo =	0.683	(ft) from plot
yt =	0.026	(ft) from plot
t =	0.520	(minutes) from plot
ln(Re/rw) =	2.38	
K =	7	(ft/day)
K =	2.6E-03	(cm/sec)

Calculation of ln(Re/rw)

Where: Lw < H;

ln(Re/rw) = [{1.1/(ln(Lw/rw))}+{A+Bln((H-Lw)/rw)}/(Le/rw)]^-1= 2.38

Where: Lw = H;

ln(Re/rw) = [{1.1/(ln(Lw/rw))}+{C/(Le/rw)}]^-1 = 2.86

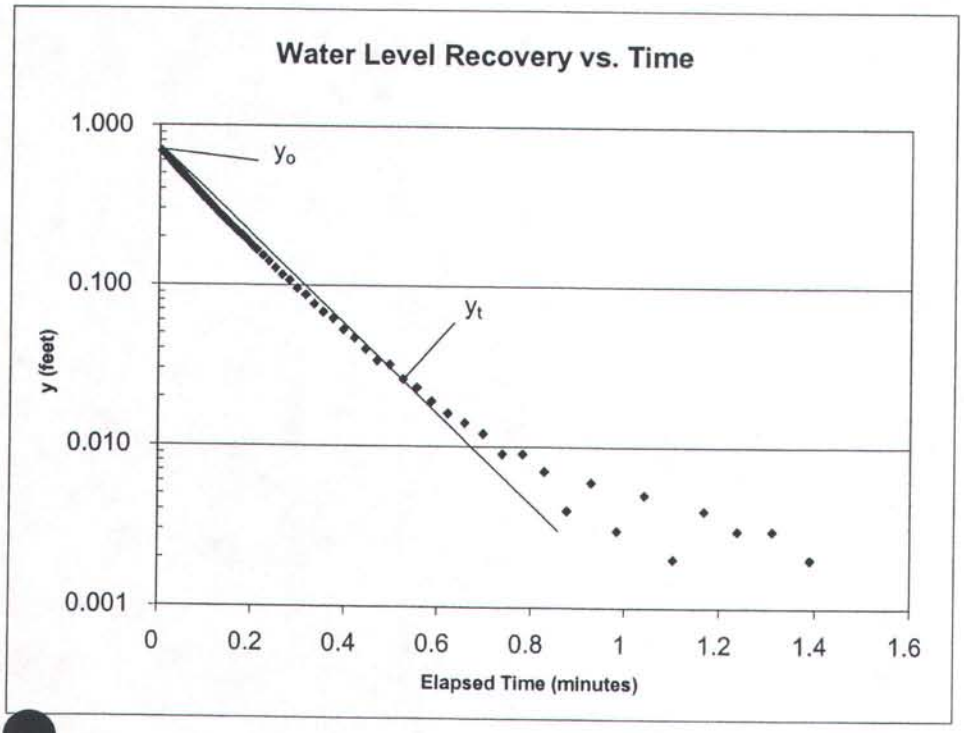
Calculation of Coefficients
Value range for Le/rw from Table of Coefficients

Le/rw	A	B	C
25	2.4	0.31	1.9
30	2.5	0.35	2.1

Interpolated values of A, B and C for Le/rw

29.33	2.49	0.34	2.07

Reference: Bouwer(1989), Bouwer and Rice(1976)



TEST DATA

Elapsed time (min)	Log y	y (ft)	WL (ft BTOC)
0.005	-0.17	0.683	14.173
0.01	-0.18	0.658	14.148
0.015	-0.20	0.632	14.122
0.02	-0.22	0.609	14.099
0.025	-0.23	0.587	14.077
0.03	-0.25	0.566	14.056
0.035	-0.26	0.544	14.034
0.04	-0.28	0.525	14.015
0.045	-0.30	0.505	13.995
0.05	-0.31	0.491	13.981
0.055	-0.33	0.472	13.962
0.06	-0.34	0.454	13.944
0.065	-0.36	0.439	13.929
0.07	-0.37	0.425	13.915
0.075	-0.39	0.408	13.898
0.08	-0.40	0.394	13.884
0.085	-0.42	0.380	13.87
0.09	-0.44	0.367	13.857
0.095	-0.45	0.353	13.843
0.1	-0.47	0.341	13.831
0.1058	-0.48	0.328	13.818
0.112	-0.50	0.314	13.804
0.1185	-0.52	0.300	13.79
0.1255	-0.55	0.285	13.775
0.1328	-0.57	0.271	13.761
0.1407	-0.59	0.257	13.747
0.149	-0.62	0.242	13.732
0.1578	-0.64	0.230	13.72
0.167	-0.66	0.217	13.707
0.177	-0.69	0.205	13.695
0.1875	-0.72	0.192	13.682
0.1985	-0.75	0.178	13.668
0.2102	-0.78	0.166	13.656
0.2227	-0.82	0.153	13.643
0.2358	-0.85	0.141	13.631
0.2498	-0.89	0.128	13.618
0.2647	-0.94	0.116	13.606
0.2803	-0.97	0.107	13.597
0.297	-1.02	0.095	13.585
0.3147	-1.06	0.087	13.577
0.3333	-1.12	0.076	13.566
0.3532	-1.17	0.068	13.558
0.3742	-1.21	0.062	13.552
0.3963	-1.28	0.053	13.543
0.4198	-1.33	0.047	13.537
0.4447	-1.40	0.040	13.53
0.4697	-1.47	0.034	13.524
0.4963	-1.49	0.032	13.522
0.5247	-1.59	0.026	13.516
0.5547	-1.64	0.023	13.513
0.5863	-1.72	0.019	13.509
0.6213	-1.80	0.016	13.506
0.658	-1.85	0.014	13.504
0.6963	-1.92	0.012	13.502
0.738	-2.05	0.009	13.499
0.7813	-2.05	0.009	13.499
0.828	-2.15	0.007	13.497
0.8763	-2.40	0.004	13.494
0.928	-2.22	0.006	13.496
0.983	-2.52	0.003	13.493
1.0413	-2.30	0.005	13.495
1.103	-2.70	0.002	13.492
1.168	-2.40	0.004	13.494
1.238	-2.52	0.003	13.493
1.3113	-2.52	0.003	13.493
1.3897	-2.70	0.002	13.492

Carolina Central Tire Siting Study
Hydraulic Conductivity (K) Calculation Worksheet
W&R Project Number: 202334.01

Well: **WRB-4S**
Test Date: 8/20/2003
Test Type: Falling Head (Slug in)

Conducted by: Ihnatolya
Entered/date: Bellis -8-25-03
Checked/date: Ihnatolya -8-26-03

WELL DATA

SWL =	9.29	(ft BTOC)
WD =	37.51	(ft BTOC)
WD =	35.00	(ft BGS)
DTSP =	21.51	(ft BTOC)
rc =	0.083	(ft)
n =	0.30	
rw =	0.38	(ft)
rc (adjusted) =	0.08	(ft)
Le =	16	(ft)
Lw =	28.22	(ft)
Le/rw =	42.67	
H =	75.00	(ft)

CALCULATION OF K

K = [(rc^2 ln(Re/rw))/2Le]*(1/t)ln(yo/yt)

yo =	1.871	(ft) from plot
yt =	0.384	(ft) from plot
t =	35.406	(minutes) from plot
ln(Re/rw) =	2.70	
K =	0.04	(ft/day)
K =	1.4E-05	(cm/sec)

Calculation of ln(Re/rw)

Where: Lw < H;

ln(Re/rw) = [(1.1/(ln(Lw/rw)))+(A+Bln((H-Lw)/rw))/(Le/rw)]^-1= 2.70

Where: Lw = H;

ln(Re/rw) = [(1.1/(ln(Lw/rw)))+(C/(Le/rw))]^-1 = 3.23

Calculation of Coefficients

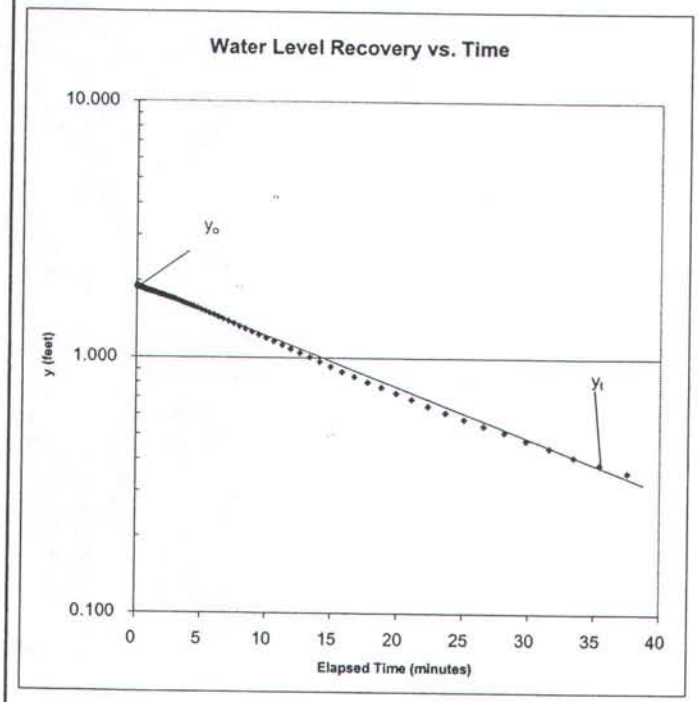
Value range for Le/rw from Table of Coefficients

Le/rw	A	B	C
40	2.75	0.45	2.45
50	3	0.5	2.7

Interpolated values of A, B and C for Le/rw

42.67	2.82	0.46	2.52

Reference: Bouwer(1969), Bouwer and Rice(1976)



Coefficients Table

Le/rw	A	Le/rw	B	Le/rw	C
4	1.75	4	0.25	4	0.75
5	1.76	5	0.25	5	0.85
6	1.77	6	0.25	6	0.90
7	1.80	7	0.25	7	1.00
8	1.83	8	0.25	8	1.10
9	1.90	9	0.25	9	1.20
10	1.95	10	0.25	10	1.30
15	2.10	15	0.27	15	1.50
20	2.23	20	0.29	20	1.75
25	2.40	25	0.31	25	1.90
30	2.50	30	0.35	30	2.10
40	2.75	40	0.45	40	2.45
50	3.00	50	0.50	50	2.70
60	3.45	60	0.52	60	3.00
70	3.70	70	0.60	70	3.40
80	3.90	80	0.65	80	3.60
90	4.20	90	0.70	90	3.85
100	4.50	100	0.75	100	4.20
150	5.45	150	0.98	150	5.70
200	6.10	200	1.20	200	7.00
250	6.70	250	1.30	250	8.00
300	7.10	300	1.50	300	8.80
400	7.75	400	1.90	400	9.90
500	8.20	500	2.20	500	10.60
600	8.50	600	2.33	600	11.10
700	8.70	700	2.50	700	11.50
800	8.90	800	2.70	800	11.80
900	9.00	900	2.75	900	12.00
1000	9.20	1000	2.83	1000	12.40
1500	9.50	1500	3.18	1500	12.90

TEST DATA

Elapsed time (min)	Log y	y (ft)	WL (ft BTOC)
0.005	0.27	1.871	7.419
0.01	0.28	1.898	7.392
0.015	0.28	1.912	7.378
0.02	0.28	1.885	7.405
0.025	0.28	1.885	7.405
0.03	0.28	1.905	7.385
0.035	0.28	1.895	7.395
0.04	0.27	1.883	7.407
0.045	0.28	1.897	7.393
0.05	0.28	1.899	7.391
0.055	0.28	1.887	7.403
0.06	0.28	1.889	7.401
0.065	0.28	1.898	7.392
0.07	0.28	1.891	7.399
0.075	0.28	1.887	7.403
0.08	0.28	1.893	7.397
0.085	0.28	1.893	7.397
0.09	0.28	1.887	7.403
0.095	0.28	1.889	7.401
0.1	0.28	1.891	7.399
0.1058	0.28	1.887	7.403
0.112	0.28	1.887	7.403
0.1185	0.28	1.889	7.401
0.1255	0.28	1.885	7.405
0.1328	0.28	1.887	7.403
0.1407	0.28	1.888	7.402
0.149	0.27	1.883	7.407
0.1578	0.27	1.883	7.407
0.167	0.27	1.881	7.409
0.177	0.27	1.877	7.413
0.1875	0.27	1.878	7.412
0.1985	0.27	1.876	7.414
0.2102	0.27	1.874	7.416
0.2227	0.27	1.874	7.416
0.2358	0.27	1.874	7.416
0.2498	0.27	1.872	7.418
0.2647	0.27	1.870	7.42
0.2803	0.27	1.868	7.422
0.297	0.27	1.868	7.422
0.3147	0.27	1.866	7.424
0.3333	0.27	1.864	7.426
0.3532	0.27	1.862	7.428
0.3742	0.27	1.862	7.428
0.3963	0.27	1.859	7.431
0.4198	0.27	1.857	7.433
0.4447	0.27	1.857	7.433
0.4697	0.27	1.853	7.437
0.4963	0.27	1.853	7.437
0.5247	0.27	1.849	7.441
0.5547	0.27	1.847	7.443
0.5863	0.27	1.845	7.445
0.6213	0.27	1.843	7.447
0.658	0.27	1.841	7.449
0.6963	0.26	1.837	7.453
0.738	0.26	1.835	7.455
0.7813	0.26	1.832	7.458
0.828	0.26	1.828	7.462
0.8763	0.26	1.824	7.466
0.928	0.26	1.820	7.47
0.983	0.26	1.818	7.472
1.0413	0.26	1.812	7.478
1.103	0.26	1.808	7.482
1.168	0.26	1.804	7.486
1.238	0.26	1.800	7.49
1.3113	0.25	1.797	7.493
1.3897	0.25	1.791	7.499
1.473	0.25	1.785	7.505
1.5613	0.25	1.779	7.511
1.6547	0.25	1.773	7.517
1.753	0.25	1.763	7.527
1.858	0.25	1.759	7.531
1.968	0.24	1.751	7.539
2.0847	0.24	1.743	7.547
2.2097	0.24	1.735	7.555
2.3412	0.24	1.727	7.563
2.4813	0.23	1.717	7.573
2.6297	0.23	1.707	7.583
2.7863	0.23	1.696	7.594
2.953	0.23	1.684	7.606
3.1297	0.22	1.672	7.618
3.3163	0.22	1.658	7.632
3.5147	0.22	1.842	7.648
3.7247	0.21	1.625	7.665
3.9463	0.21	1.609	7.681
4.1813	0.20	1.590	7.7
4.4297	0.20	1.574	7.716
4.693	0.19	1.554	7.736
4.973	0.19	1.533	7.757
5.2697	0.18	1.510	7.78
5.583	0.17	1.488	7.802
5.9147	0.17	1.465	7.825
6.2683	0.16	1.438	7.852
6.6397	0.15	1.412	7.878
7.0347	0.14	1.385	7.905
7.453	0.13	1.354	7.936
7.8963	0.12	1.323	7.967
8.3663	0.11	1.292	7.998
8.8647	0.10	1.261	8.029
9.3913	0.09	1.226	8.064
9.9497	0.08	1.193	8.097
10.5413	0.06	1.156	8.134
11.168	0.05	1.118	8.172
11.8313	0.03	1.082	8.208
12.5347	0.02	1.042	8.248
13.2797	0.00	1.003	8.287
14.0697	-0.02	0.962	8.328
14.9063	-0.03	0.923	8.367
15.7913	-0.05	0.882	8.408
16.7297	-0.07	0.845	8.445
17.723	-0.10	0.802	8.488
18.7763	-0.12	0.766	8.524
19.8913	-0.14	0.727	8.563
21.073	-0.16	0.688	8.602
22.3247	-0.19	0.649	8.641
23.6497	-0.21	0.612	8.678
25.0547	-0.24	0.576	8.714
26.543	-0.27	0.543	8.747
28.118	-0.29	0.512	8.778
29.7863	-0.32	0.477	8.813
31.5547	-0.35	0.445	8.845
33.428	-0.39	0.412	8.878
35.4112	-0.42	0.384	8.906
37.513	-0.45	0.358	8.932

Carolina Central Tire Siting Study
Hydraulic Conductivity (K) Calculation Worksheet
W&R Project Number: 202334.01

Well: WRB-4S
Test Data: 8/20/2003
Test Type: Rising Head (Slug out)

Conducted by: Ihnatolya
Entered/date: Bellis -8-25-03
Checked/date: Ihnatolya -8-26-03

WELL DATA

SWL =	9.29	(ft BTOC)
WD =	37.51	(ft BTOC)
WD =	35.00	(ft BGS)
DTSP =	21.51	(ft BTOC)
rc =	0.083	(ft)
n =	0.30	
rw =	0.38	(ft)
rc (adjusted) =	0.08	(ft)
La =	15	(ft)
Lw =	28.22	(ft)
La/rw =	42.67	
H =	75.00	(ft)

CALCULATION OF K

K = [(rc^2 ln(Re/rw))/2LeI*(1/t)ln(vo/vt)

vo =	1.493	(ft) from plot
vt =	0.949	(ft) from plot
t =	74.905	(minutes) from plot
ln(Re/rw) =	2.70	
K =	0.01	(ft/day)
K =	1.8E-06	(cm/sec)

Calculation of ln(Re/rw)

Where: Lw < H;

ln(Re/rw) = [(1.1/(ln(Lw/rw)))+(A+Bln((H-Lw)/rw))/(La/rw)]^-1 = 2.70

Where: Lw = H;

ln(Re/rw) = [(1.1/(ln(Lw/rw)))+(C/(La/rw))]^-1 = 3.23

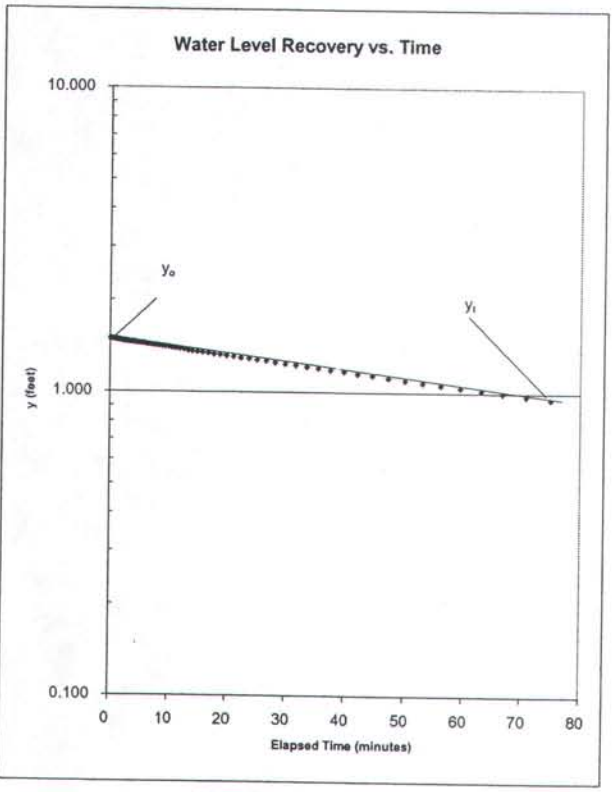
Calculation of Coefficients
Value range for La/rw from Table of Coefficients

La/rw	A	B	C
40	2.75	0.45	2.45
50	3	0.5	2.7

Interpolated values of A, B and C for La/rw

42.67	2.82	0.46	2.52

Reference: Bouwer(1989), Bouwer and Rice(1976)



Coefficients Table

La/rw	A	La/rw	B	La/rw	C
4	1.75	4	0.25	4	0.75
5	1.76	5	0.25	5	0.85
6	1.77	6	0.25	6	0.90
7	1.80	7	0.25	7	1.00
8	1.83	8	0.25	8	1.10
9	1.90	9	0.25	9	1.20
10	1.95	10	0.25	10	1.30
15	2.10	15	0.27	15	1.50
20	2.23	20	0.29	20	1.75
25	2.40	25	0.31	25	1.90
30	2.50	30	0.35	30	2.10
40	2.75	40	0.45	40	2.45
50	3.00	50	0.50	50	2.70
60	3.45	60	0.52	60	3.00
70	3.70	70	0.60	70	3.40
80	3.90	80	0.65	80	3.60
90	4.20	90	0.70	90	3.85
100	4.50	100	0.75	100	4.20
150	5.45	150	0.98	150	5.70
200	6.10	200	1.20	200	7.00
250	6.70	250	1.30	250	8.00
300	7.10	300	1.50	300	8.80
400	7.75	400	1.90	400	9.90
500	8.20	500	2.20	500	10.60
600	8.50	600	2.33	600	11.10
700	8.70	700	2.50	700	11.50
800	8.90	800	2.70	800	11.90
900	9.00	900	2.75	900	12.00
1000	9.20	1000	2.83	1000	12.40
1500	9.50	1500	3.18	1500	12.90

TEST DATA

Elapsed time (min)	Log v	v (ft)	WL (ft BTOC)
0.005	0.17	1.493	10.783
0.01	0.17	1.491	10.781
0.015	0.17	1.489	10.779
0.02	0.17	1.489	10.779
0.025	0.17	1.489	10.779
0.03	0.17	1.487	10.777
0.035	0.17	1.489	10.779
0.04	0.17	1.489	10.779
0.045	0.17	1.487	10.777
0.05	0.17	1.487	10.777
0.055	0.17	1.487	10.777
0.06	0.17	1.485	10.775
0.065	0.17	1.487	10.777
0.07	0.17	1.485	10.775
0.075	0.17	1.487	10.777
0.08	0.17	1.487	10.777
0.085	0.17	1.487	10.777
0.09	0.17	1.485	10.775
0.095	0.17	1.487	10.777
0.1	0.17	1.487	10.777
0.1058	0.17	1.485	10.775
0.112	0.17	1.485	10.775
0.1185	0.17	1.486	10.776
0.1255	0.17	1.486	10.776
0.1328	0.17	1.486	10.776
0.1407	0.17	1.486	10.776
0.149	0.17	1.486	10.776
0.1578	0.17	1.486	10.776
0.167	0.17	1.487	10.777
0.177	0.17	1.489	10.779
0.1875	0.17	1.489	10.779
0.1985	0.17	1.489	10.779
0.2102	0.17	1.489	10.779
0.2227	0.17	1.489	10.779
0.2358	0.17	1.489	10.779
0.2498	0.17	1.489	10.779
0.2647	0.17	1.489	10.779
0.2803	0.17	1.491	10.781
0.297	0.17	1.489	10.779
0.3147	0.17	1.489	10.779
0.3333	0.17	1.489	10.779
0.3532	0.17	1.487	10.777
0.3742	0.17	1.487	10.777
0.3963	0.17	1.487	10.777
0.4198	0.17	1.487	10.777
0.4447	0.17	1.485	10.775
0.4697	0.17	1.485	10.775
0.4963	0.17	1.485	10.775
0.5247	0.17	1.485	10.775
0.5547	0.17	1.485	10.775
0.5863	0.17	1.483	10.773
0.6213	0.17	1.483	10.773
0.658	0.17	1.483	10.773
0.6963	0.17	1.483	10.773
0.738	0.17	1.483	10.773
0.7813	0.17	1.481	10.771
0.828	0.17	1.481	10.771
0.8763	0.17	1.481	10.771
0.928	0.17	1.479	10.769
0.983	0.17	1.479	10.769
1.0413	0.17	1.479	10.769
1.103	0.17	1.477	10.767
1.168	0.17	1.479	10.769
1.238	0.17	1.477	10.767
1.3113	0.17	1.475	10.765
1.3897	0.17	1.474	10.764
1.473	0.17	1.472	10.762
1.5613	0.17	1.472	10.762
1.6547	0.17	1.472	10.762
1.753	0.17	1.470	10.76
1.858	0.17	1.468	10.758
1.968	0.17	1.466	10.756
2.0847	0.17	1.466	10.756
2.2097	0.17	1.466	10.756
2.3412	0.17	1.464	10.754
2.4813	0.16	1.462	10.752
2.6297	0.16	1.459	10.749
2.7863	0.16	1.459	10.749
2.953	0.16	1.457	10.747
3.1297	0.16	1.455	10.745
3.3163	0.16	1.453	10.743
3.5147	0.16	1.451	10.741
3.7247	0.16	1.451	10.741
3.9463	0.16	1.447	10.737
4.1813	0.16	1.447	10.737
4.4297	0.16	1.443	10.733
4.693	0.16	1.442	10.732
4.973	0.16	1.438	10.728
5.2697	0.16	1.436	10.726
5.583	0.16	1.434	10.724
5.9147	0.16	1.430	10.72
6.2663	0.15	1.426	10.716
6.6397	0.15	1.424	10.714
7.0347	0.15	1.419	10.709
7.453	0.15	1.415	10.705
7.8963	0.15	1.413	10.703
8.3663	0.15	1.411	10.701
8.8647	0.15	1.405	10.695
9.3913	0.15	1.400	10.69
9.9497	0.14	1.396	10.686
10.5413	0.14	1.388	10.678
11.168	0.14	1.384	10.674
11.8313	0.14	1.378	10.668
12.5347	0.14	1.369	10.659
13.2797	0.13	1.361	10.651
14.0697	0.13	1.355	10.645
14.9063	0.13	1.348	10.638
15.7913	0.13	1.340	10.63
16.7297	0.13	1.334	10.624
17.723	0.12	1.325	10.615
18.7763	0.12	1.317	10.607
19.8913	0.12	1.309	10.599
21.073	0.11	1.299	10.589
22.3247	0.11	1.288	10.578
23.6497	0.11	1.280	10.57
25.0547	0.10	1.269	10.559
26.543	0.10	1.259	10.549
28.118	0.09	1.244	10.534
29.7863	0.09	1.232	10.522
31.5547	0.09	1.219	10.509
33.428	0.08	1.207	10.497
35.4112	0.08	1.195	10.485
37.513	0.07	1.176	10.466
39.7397	0.07	1.166	10.456
42.098	0.06	1.145	10.435
44.5963	0.05	1.132	10.422
47.243	0.05	1.112	10.402
50.0463	0.04	1.093	10.383
53.0147	0.03	1.075	10.365
56.1597	0.02	1.056	10.346
59.4913	0.02	1.036	10.326
63.0197	0.01	1.017	10.307
66.758	0.00	0.994	10.284
70.718	-0.01	0.972	10.262
74.9113	-0.02	0.949	10.239

Carolina Central Tire Siting Study
Hydraulic Conductivity (K) Calculation Worksheet
W&R Project Number: 202334.01

Well: **WRB-5**
Test Date: 8/20/2003
Test Type: Falling Head (Slug in)

Conducted by: lhnatolya
Entered/date: Bellis -8-25-03 B/B
Checked/date: lhnatolya -8-26-03

WELL DATA

SWL =	17.45	(ft BTOC)
WD =	37.87	(ft BTOC)
WD =	35.00	(ft BGS)
DTSP =	26.87	(ft BTOC)
rc =	0.083	(ft)
n =	0.30	
rw =	0.38	(ft)
rc (adjusted) =	0.08	(ft)
Le =	11	(ft)
Lw =	20.42	(ft)
Le/rw =	29.33	
H =	75.00	(ft)

CALCULATION OF K

K = [(rc^2 ln(Re/rw))/2Le]*(1/t)ln(yo/yt)

yo =	0.841	(ft) from plot
yt =	0.241	(ft) from plot
t =	0.369	(minutes) from plot
ln(Re/rw) =	2.38	
K =	4	(ft/day)
K =	1.4E-03	(cm/sec)

Calculation of ln(Re/rw)

Where: Lw < H;

ln(Re/rw) = [{1.1/(ln(Lw/rw))}+{A+Bln((H-Lw)/rw)}/(Le/rw)]^-1= 2.38

Where: Lw = H;

ln(Re/rw) = [{1.1/(ln(Lw/rw))}+{C/(Le/rw)}]^-1 = 2.86

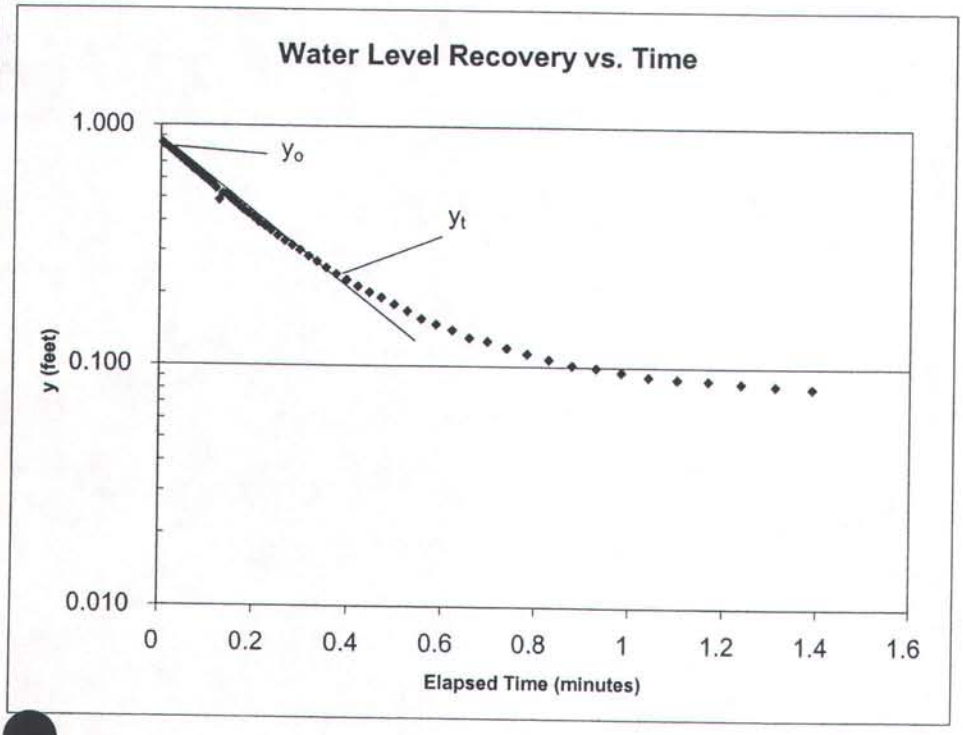
Calculation of Coefficients
Value range for Le/rw from Table of Coefficients

Le/rw	A	B	C
25	2.4	0.31	1.9
30	2.5	0.35	2.1

Interpolated values of A, B and C for Le/rw

29.33	2.49	0.34	2.07

Reference: Bouwer(1989), Bouwer and Rice(1976)



TEST DATA

Elapsed time (min)	Log y	y (ft)	WL (ft BTOC)
0.005	-0.08	0.841	16.609
0.01	-0.08	0.827	16.623
0.015	-0.09	0.812	16.638
0.02	-0.10	0.796	16.654
0.025	-0.11	0.782	16.668
0.03	-0.12	0.767	16.683
0.035	-0.12	0.751	16.699
0.04	-0.13	0.737	16.713
0.045	-0.14	0.724	16.726
0.05	-0.15	0.708	16.742
0.055	-0.16	0.696	16.754
0.06	-0.17	0.683	16.767
0.065	-0.17	0.671	16.779
0.07	-0.18	0.657	16.793
0.075	-0.19	0.647	16.803
0.08	-0.20	0.634	16.816
0.085	-0.21	0.622	16.828
0.09	-0.21	0.610	16.84
0.095	-0.22	0.600	16.85
0.1	-0.23	0.589	16.861
0.1058	-0.24	0.575	16.875
0.112	-0.25	0.565	16.885
0.1185	-0.26	0.544	16.906
0.1255	-0.31	0.487	16.963
0.1328	-0.29	0.518	16.932
0.1407	-0.29	0.512	16.938
0.149	-0.31	0.493	16.957
0.1578	-0.32	0.477	16.973
0.167	-0.34	0.460	16.99
0.177	-0.35	0.444	17.006
0.1875	-0.37	0.428	17.022
0.1985	-0.39	0.412	17.038
0.2102	-0.40	0.395	17.055
0.2227	-0.42	0.379	17.071
0.2358	-0.44	0.365	17.085
0.2498	-0.46	0.347	17.103
0.2647	-0.48	0.330	17.12
0.2803	-0.50	0.316	17.134
0.297	-0.52	0.302	17.148
0.3147	-0.55	0.285	17.165
0.3333	-0.57	0.271	17.179
0.3532	-0.59	0.255	17.195
0.3742	-0.62	0.241	17.209
0.3963	-0.64	0.228	17.222
0.4198	-0.67	0.214	17.236
0.4447	-0.69	0.202	17.248
0.4697	-0.72	0.192	17.258
0.4963	-0.74	0.180	17.27
0.5247	-0.77	0.169	17.281
0.5547	-0.80	0.157	17.293
0.5863	-0.83	0.149	17.301
0.6213	-0.85	0.141	17.309
0.658	-0.88	0.131	17.319
0.6963	-0.90	0.127	17.323
0.738	-0.92	0.119	17.331
0.7813	-0.95	0.113	17.337
0.828	-0.97	0.107	17.343
0.8763	-1.00	0.101	17.349
0.928	-1.00	0.099	17.351
0.983	-1.02	0.095	17.355
1.0413	-1.04	0.091	17.359
1.103	-1.05	0.089	17.361
1.168	-1.06	0.088	17.362
1.238	-1.07	0.086	17.364
1.3113	-1.08	0.084	17.366
1.3897	-1.09	0.082	17.368

Carolina Central Tire Siting Study
Hydraulic Conductivity (K) Calculation Worksheet
W&R Project Number: 202334.01

Well: **WRB-5**
Test Date: 8/20/2003
Test Type: Rising Head (Slug out)

Conducted by: Ihnatolya
Entered/date: Bellis -8-25-03 BJB
Checked/date: Ihnatolya -8-26-03

WELL DATA

SWL =	17.45	(ft BTOC)
WD =	37.87	(ft BTOC)
WD =	35.00	(ft BGS)
DTSP =	26.87	(ft BTOC)
rc =	0.083	(ft)
n =	0.30	
rw =	0.38	(ft)
rc (adjusted) =	0.08	(ft)
Le =	11	(ft)
Lw =	20.42	(ft)
Le/rw =	29.33	
H =	75.00	(ft)

CALCULATION OF K

K = [(rc^2 ln(Re/rw))/2Le]*(1/t)ln(yo/yt)

yo =	1.482	(ft) from plot
yt =	0.026	(ft) from plot
t =	0.978	(minutes) from plot
ln(Re/rw) =	2.38	
K =	5	(ft/day)
K =	1.7E-03	(cm/sec)

Calculation of ln(Re/rw)

Where: Lw < H;

ln(Re/rw) = [{1.1/(ln(Lw/rw))}+{A+Bln((H-Lw)/rw)}/(Le/rw)]^-1= 2.38

Where: Lw = H;

ln(Re/rw) = [{1.1/(ln(Lw/rw))}+(C/(Le/rw))]^-1 = 2.86

Calculation of Coefficients
Value range for Le/rw from Table of Coefficients

Le/rw	A	B	C
25	2.4	0.31	1.9
30	2.5	0.35	2.1

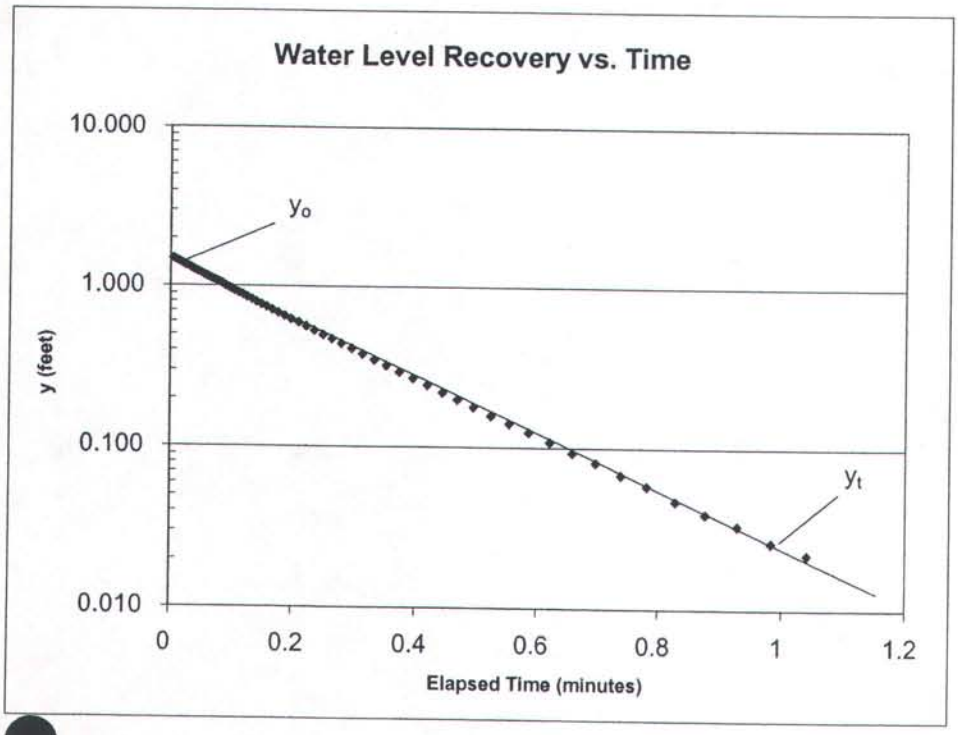
Interpolated values of A, B and C for Le/rw

29.33	2.49	0.34	2.07

Reference: Bouwer(1989), Bouwer and Rice(1976)

TEST DATA

Elapsed time (min)	Log y	y (ft)	WL (ft BTOC)
0.005	0.17	1.482	18.932
0.01	0.16	1.448	18.898
0.015	0.15	1.411	18.861
0.02	0.14	1.376	18.826
0.025	0.13	1.345	18.795
0.03	0.12	1.316	18.766
0.035	0.11	1.282	18.732
0.04	0.10	1.255	18.705
0.045	0.09	1.224	18.674
0.05	0.08	1.196	18.646
0.055	0.07	1.171	18.621
0.06	0.06	1.142	18.592
0.065	0.05	1.118	18.568
0.07	0.04	1.091	18.541
0.075	0.03	1.071	18.521
0.08	0.02	1.054	18.504
0.085	0.01	1.026	18.476
0.09	0.00	0.997	18.447
0.095	-0.01	0.974	18.424
0.1	-0.02	0.954	18.404
0.1058	-0.03	0.929	18.379
0.112	-0.04	0.903	18.353
0.1185	-0.06	0.878	18.328
0.1255	-0.07	0.851	18.301
0.1328	-0.08	0.823	18.273
0.1407	-0.10	0.794	18.244
0.149	-0.12	0.765	18.215
0.1578	-0.13	0.736	18.186
0.167	-0.15	0.708	18.158
0.177	-0.17	0.679	18.129
0.1875	-0.19	0.650	18.1
0.1985	-0.21	0.619	18.069
0.2102	-0.23	0.591	18.041
0.2227	-0.25	0.558	18.008
0.2358	-0.28	0.527	17.977
0.2498	-0.30	0.496	17.946
0.2647	-0.33	0.468	17.918
0.2803	-0.36	0.437	17.887
0.297	-0.39	0.408	17.858
0.3147	-0.42	0.377	17.827
0.3333	-0.46	0.348	17.798
0.3532	-0.49	0.322	17.772
0.3742	-0.53	0.293	17.743
0.3963	-0.57	0.269	17.719
0.4198	-0.61	0.244	17.694
0.4447	-0.66	0.219	17.669
0.4697	-0.70	0.198	17.648
0.4963	-0.75	0.178	17.628
0.5247	-0.80	0.157	17.607
0.5547	-0.85	0.141	17.591
0.5863	-0.91	0.124	17.574
0.6213	-0.97	0.108	17.558
0.658	-1.03	0.093	17.543
0.6963	-1.09	0.081	17.531
0.738	-1.17	0.068	17.518
0.7813	-1.24	0.058	17.508
0.828	-1.33	0.047	17.497
0.8763	-1.41	0.039	17.489
0.928	-1.48	0.033	17.483
0.983	-1.59	0.026	17.476
1.0413	-1.66	0.022	17.472



Carolina Central Tire Siting Study
Hydraulic Conductivity (K) Calculation Worksheet
W&R Project Number: 202334.01

Well: **WRB-6S**
Test Date: 8/20/2003
Test Type: Falling Head (Slug in)

Conducted by: Ihnatolya
Entered/date: Bellis -8-25-03 BJB
Checked/date: Ihnatolya -8-26-03

WELL DATA

SWL =	7.84	(ft BTOC)
WD =	17.86	(ft BTOC)
WD =	15.00	(ft BGS)
DTSP =	11.86	(ft BTOC)
rc =	0.083	(ft)
n =	0.30	
rw =	0.38	(ft)
rc (adjusted) =	0.08	(ft)
Le =	6	(ft)
Lw =	10.02	(ft)
Le/rw =	16.00	
H =	75.00	(ft)

CALCULATION OF K

K = [(rc^2 ln(Re/rw))/2Le]*(1/t)ln(yo/yt)

yo =	1.138	(ft) from plot
yt =	0.237	(ft) from plot
t =	2.205	(minutes) from plot
ln(Re/rw) =	1.82	
K =	1	(ft/day)
K =	4.0E-04	(cm/sec)

Calculation of ln(Re/rw)

Where: Lw < H;

ln(Re/rw) = [{1.1/(ln(Lw/rw))}+{A+Bln((H-Lw)/rw)}/(Le/rw)]^-1= 1.82

Where: Lw = H;

ln(Re/rw) = [{1.1/(ln(Lw/rw))}+{C/(Le/rw)}]^-1 = 2.33

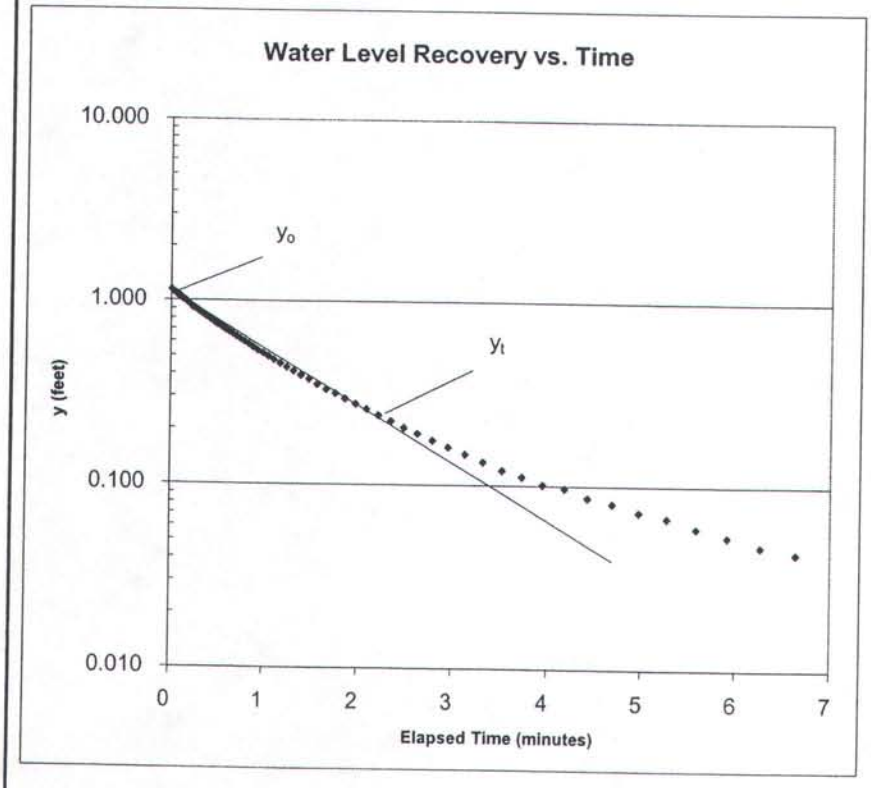
Calculation of Coefficients
Value range for Le/rw from Table of Coefficients

Le/rw	A	B	C
15	2.1	0.27	1.5
25	2.4	0.31	1.9

Interpolated values of A, B and C for Le/rw

16.00	2.13	0.27	1.54

Reference: Bouwer(1989), Bouwer and Rice(1976)



TEST DATA

Elapsed time (min)	Log y	y (ft)	WL (ft BTOC)
0.005	0.06	1.138	6.702
0.01	0.05	1.134	6.706
0.015	0.05	1.129	6.711
0.02	0.05	1.121	6.719
0.025	0.05	1.117	6.723
0.03	0.05	1.110	6.73
0.035	0.04	1.106	6.734
0.04	0.04	1.099	6.741
0.045	0.04	1.093	6.747
0.05	0.04	1.089	6.751
0.055	0.03	1.083	6.757
0.06	0.03	1.078	6.762
0.065	0.03	1.072	6.768
0.07	0.03	1.066	6.774
0.075	0.03	1.062	6.778
0.08	0.02	1.057	6.783
0.085	0.02	1.049	6.791
0.09	0.02	1.051	6.789
0.095	0.02	1.040	6.8
0.1	0.02	1.038	6.802
0.1058	0.01	1.030	6.81
0.112	0.01	1.023	6.817
0.1185	0.01	1.017	6.823
0.1255	0.01	1.013	6.827
0.1328	0.00	1.007	6.833
0.1407	0.00	0.998	6.842
0.149	0.00	0.992	6.848
0.1578	-0.01	0.983	6.857
0.167	-0.01	0.975	6.865
0.177	-0.02	0.964	6.876
0.1875	-0.02	0.956	6.884
0.1985	-0.02	0.945	6.895
0.2102	-0.03	0.935	6.905
0.2227	-0.04	0.918	6.922
0.2358	-0.04	0.914	6.926
0.2498	-0.04	0.903	6.937
0.2647	-0.05	0.895	6.945
0.2803	-0.05	0.882	6.958
0.297	-0.06	0.870	6.97
0.3147	-0.07	0.857	6.983
0.3333	-0.07	0.844	6.996
0.3532	-0.08	0.829	7.011
0.3742	-0.09	0.817	7.023
0.3963	-0.09	0.804	7.036
0.4198	-0.10	0.789	7.051
0.4447	-0.11	0.772	7.068
0.4697	-0.12	0.755	7.085
0.4963	-0.13	0.740	7.1
0.5247	-0.14	0.726	7.114
0.5547	-0.15	0.707	7.133
0.5863	-0.16	0.689	7.151
0.6213	-0.17	0.673	7.167
0.658	-0.18	0.654	7.186
0.6963	-0.20	0.634	7.206
0.738	-0.21	0.615	7.225
0.7813	-0.22	0.597	7.243
0.828	-0.24	0.578	7.262
0.8763	-0.25	0.556	7.284
0.928	-0.27	0.535	7.305
0.983	-0.29	0.516	7.324
1.0413	-0.31	0.495	7.345
1.103	-0.32	0.474	7.366
1.168	-0.34	0.453	7.387
1.238	-0.36	0.432	7.408
1.3113	-0.39	0.411	7.429
1.3897	-0.41	0.390	7.45
1.473	-0.43	0.371	7.469
1.5613	-0.46	0.349	7.491
1.6547	-0.49	0.326	7.514
1.753	-0.51	0.311	7.529
1.858	-0.53	0.292	7.548
1.968	-0.56	0.273	7.567
2.0847	-0.59	0.256	7.584
2.2097	-0.63	0.237	7.603
2.3412	-0.66	0.221	7.619
2.4813	-0.69	0.204	7.636
2.6297	-0.72	0.189	7.651
2.7863	-0.76	0.174	7.666
2.953	-0.80	0.160	7.68
3.1297	-0.83	0.147	7.693
3.3163	-0.88	0.133	7.707
3.5147	-0.92	0.120	7.72
3.7247	-0.95	0.111	7.729
3.9463	-1.00	0.101	7.739
4.1813	-1.01	0.097	7.743
4.4297	-1.07	0.086	7.754
4.693	-1.10	0.080	7.76
4.973	-1.14	0.072	7.768
5.2697	-1.17	0.067	7.773
5.583	-1.23	0.059	7.781
5.9147	-1.28	0.053	7.787
6.2663	-1.33	0.047	7.793
6.6397	-1.37	0.043	7.797

Carolina Central Tire Siting Study
Hydraulic Conductivity (K) Calculation Worksheet
W&R Project Number: 202334.01

Well: **WRB-6S**
Test Date: 8/20/2003
Test Type: Rising Head (Slug out)

Conducted by: Ihnatolya
Entered/date: Bellis -8-25-03
Checked/date: Ihnatolya -8-26-03

WELL DATA

SWL =	7.84	(ft BTOC)
WD =	17.86	(ft BTOC)
WD =	15.00	(ft BGS)
DTSP =	11.86	(ft BTOC)
rc =	0.083	(ft)
n =	0.30	
rw =	0.38	(ft)
rc (adjusted) =	0.08	(ft)
Le =	6	(ft)
Lw =	10.02	(ft)
Le/rw =	16.00	
H =	75.00	(ft)

CALCULATION OF K

K = [(rc^2 ln(Re/rw))/2Le]*(1/t)ln(yo/yt)

yo =	1.406	(ft) from plot
yt =	0.161	(ft) from plot
t =	2.948	(minutes) from plot
ln(Re/rw) =	1.82	
K =	1	(ft/day)
K =	4.1E-04	(cm/sec)

Calculation of ln(Re/rw)

Where: Lw < H;

ln(Re/rw) = [(1.1/(ln(Lw/rw)))+(A+Bln((H-Lw)/rw))/(Le/rw)]^-1= 1.82

Where: Lw = H;

ln(Re/rw) = [(1.1/(ln(Lw/rw)))+(C/(Le/rw))]^-1 = 2.33

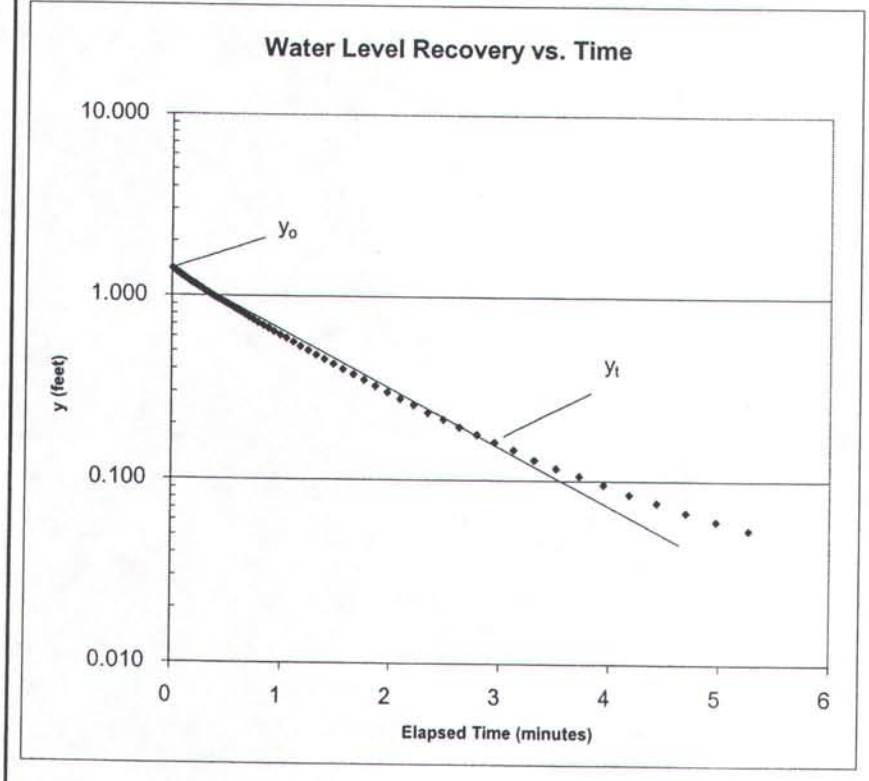
Calculation of Coefficients
Value range for Le/rw from Table of Coefficients

Le/rw	A	B	C
15	2.1	0.27	1.5
25	2.4	0.31	1.9

Interpolated values of A, B and C for Le/rw

16.00	2.13	0.27	1.54

Reference: Bouwer(1989), Bouwer and Rice(1976)



TEST DATA

Elapsed time (min)	Log y	y (ft)	WL (ft BTOC)
0.005	0.15	1.406	9.246
0.01	0.15	1.398	9.238
0.015	0.14	1.389	9.229
0.02	0.14	1.381	9.221
0.025	0.14	1.375	9.215
0.03	0.14	1.366	9.206
0.035	0.13	1.358	9.198
0.04	0.13	1.349	9.189
0.045	0.13	1.343	9.183
0.05	0.13	1.337	9.177
0.055	0.12	1.328	9.168
0.06	0.12	1.320	9.16
0.065	0.12	1.314	9.154
0.07	0.12	1.307	9.147
0.075	0.11	1.301	9.141
0.08	0.11	1.295	9.135
0.085	0.11	1.286	9.126
0.09	0.11	1.280	9.12
0.095	0.11	1.274	9.114
0.1	0.10	1.267	9.107
0.1058	0.10	1.261	9.101
0.112	0.10	1.253	9.093
0.1185	0.09	1.244	9.084
0.1255	0.09	1.238	9.078
0.1328	0.09	1.229	9.069
0.1407	0.09	1.219	9.059
0.149	0.08	1.208	9.048
0.1578	0.08	1.198	9.038
0.167	0.08	1.189	9.029
0.177	0.07	1.181	9.021
0.1875	0.07	1.168	9.008
0.1985	0.06	1.158	8.998
0.2102	0.06	1.145	8.985
0.2227	0.05	1.132	8.972
0.2358	0.05	1.117	8.957
0.2498	0.04	1.105	8.945
0.2647	0.04	1.092	8.932
0.2803	0.03	1.077	8.917
0.297	0.03	1.060	8.9
0.3147	0.02	1.045	8.885
0.3333	0.01	1.029	8.869
0.3532	0.01	1.012	8.852
0.3742	0.00	0.993	8.833
0.3963	-0.01	0.974	8.814
0.4198	-0.02	0.957	8.797
0.4447	-0.03	0.938	8.778
0.4697	-0.04	0.916	8.756
0.4963	-0.05	0.897	8.737
0.5247	-0.06	0.878	8.718
0.5547	-0.07	0.857	8.697
0.5863	-0.08	0.834	8.674
0.6213	-0.09	0.811	8.651
0.658	-0.10	0.787	8.627
0.6963	-0.12	0.764	8.604
0.738	-0.13	0.739	8.579
0.7813	-0.15	0.713	8.553
0.828	-0.16	0.688	8.528
0.8763	-0.18	0.665	8.505
0.928	-0.20	0.637	8.477
0.983	-0.21	0.612	8.452
1.0413	-0.23	0.586	8.426
1.103	-0.25	0.559	8.399
1.168	-0.27	0.531	8.371
1.238	-0.30	0.504	8.344
1.3113	-0.32	0.476	8.316
1.3897	-0.35	0.451	8.291
1.473	-0.37	0.424	8.264
1.5613	-0.40	0.398	8.238
1.6547	-0.43	0.373	8.213
1.753	-0.46	0.348	8.188
1.858	-0.49	0.323	8.163
1.968	-0.52	0.299	8.139
2.0847	-0.56	0.276	8.116
2.2097	-0.59	0.255	8.095
2.3412	-0.63	0.232	8.072
2.4813	-0.67	0.213	8.053
2.6297	-0.71	0.194	8.034
2.7863	-0.75	0.177	8.017
2.953	-0.79	0.161	8.001
3.1297	-0.84	0.146	7.986
3.3163	-0.89	0.129	7.969
3.5147	-0.94	0.116	7.956
3.7247	-0.97	0.106	7.946
3.9463	-1.02	0.095	7.935
4.1813	-1.08	0.084	7.924
4.4297	-1.12	0.076	7.916
4.693	-1.17	0.067	7.907
4.973	-1.22	0.060	7.9
5.2897	-1.27	0.054	7.894

Carolina Central Tire Siting Study
Hydraulic Conductivity (K) Calculation Worksheet
W&R Project Number: 202334.01

Well: **WRB-10**
Test Date: 8/20/2003
Test Type: Falling Head (Slug in)

Conducted by: Ihnatolya
Entered/date: Bellis -8-25-03
Checked/date: Ihnatolya -8-26-03

WELL DATA

SWL =	13.00	(ft BTOC)
WD =	38.00	(ft BTOC)
WD =	35.00	(ft BGS)
DTSP =	27.00	(ft BTOC)
rc =	0.083	(ft)
n =	0.30	
rw =	0.38	(ft)
rc (adjusted) =	0.08	(ft)
Le =	11	(ft)
Lw =	25.00	(ft)
Le/rw =	29.33	
H =	75.00	(ft)

CALCULATION OF K

$K = [(rc^2 \ln(Re/rw))/2Le]*(1/t)\ln(yo/yt)$

yo =	1.170	(ft) from plot
yt =	0.139	(ft) from plot
t =	3.477	(minutes) from plot
ln(Re/rw) =	2.50	
K =	**1**	**(ft/day)**
K =	**2.5E-04**	**(cm/sec)**

Calculation of ln(Re/rw)

Where: Lw < H;

$\ln(Re/rw) = [\{1.1/(\ln(Lw/rw))\}+\{A+B\ln((H-Lw)/rw)\}/(Le/rw)]^{-1} =$ 2.50

Where: Lw = H;

$\ln(Re/rw) = [\{1.1/(\ln(Lw/rw))\}+\{C/(Le/rw)\}]^{-1} =$ 3.03

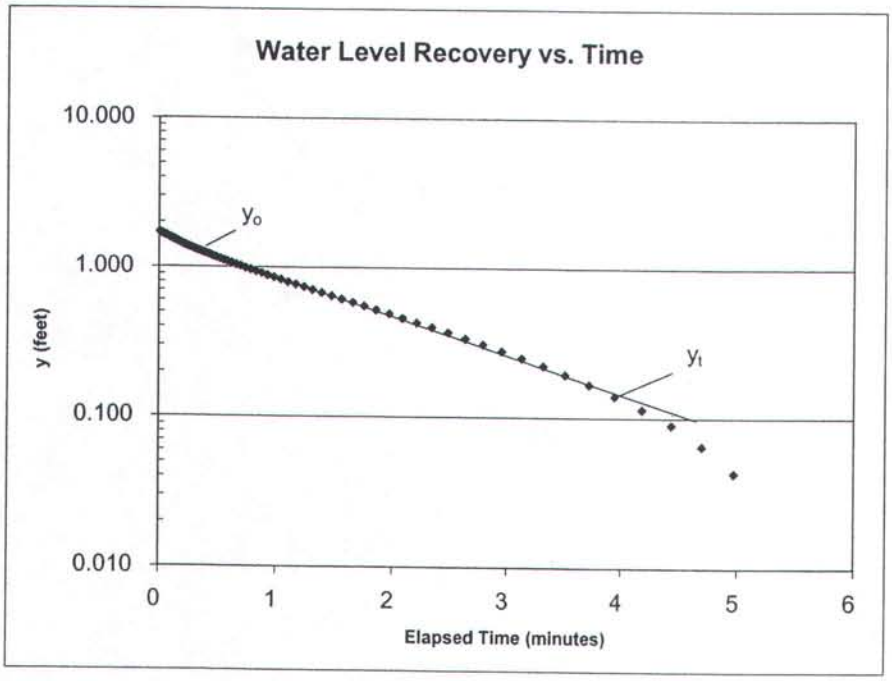
Calculation of Coefficients
Value range for Le/rw from Table of Coefficients

Le/rw	A	B	C
25	2.4	0.31	1.9
30	2.5	0.35	2.1

Interpolated values of A, B and C for Le/rw

29.33	2.49	0.34	2.07

Reference: Bouwer(1989), Bouwer and Rice(1976)



TEST DATA

Elapsed time (min)	Log y	y (ft)	WL (ft BTOC)
0.005	0.23	1.704	11.296
0.01	0.23	1.696	11.304
0.015	0.23	1.690	11.31
0.02	0.23	1.684	11.316
0.025	0.22	1.673	11.327
0.03	0.22	1.667	11.333
0.035	0.22	1.659	11.341
0.04	0.22	1.651	11.349
0.045	0.22	1.645	11.355
0.05	0.21	1.637	11.363
0.055	0.21	1.628	11.372
0.06	0.21	1.620	11.38
0.065	0.21	1.614	11.386
0.07	0.21	1.606	11.394
0.075	0.20	1.600	11.4
0.08	0.20	1.592	11.408
0.085	0.20	1.585	11.415
0.09	0.20	1.577	11.423
0.095	0.20	1.569	11.431
0.1	0.19	1.563	11.437
0.1058	0.19	1.557	11.443
0.112	0.19	1.547	11.453
0.1185	0.19	1.541	11.459
0.1255	0.18	1.528	11.472
0.1328	0.18	1.520	11.48
0.1407	0.18	1.510	11.49
0.149	0.18	1.500	11.5
0.1578	0.17	1.488	11.512
0.167	0.17	1.473	11.527
0.177	0.16	1.459	11.541
0.1875	0.16	1.447	11.553
0.1985	0.16	1.433	11.567
0.2102	0.15	1.419	11.581
0.2227	0.15	1.404	11.596
0.2358	0.14	1.390	11.61
0.2498	0.14	1.374	11.626
0.2647	0.13	1.357	11.643
0.2803	0.13	1.343	11.657
0.297	0.12	1.325	11.675
0.3147	0.12	1.308	11.692
0.3333	0.11	1.290	11.71
0.3532	0.10	1.272	11.728
0.3742	0.10	1.251	11.749
0.3963	0.09	1.233	11.767
0.4198	0.08	1.213	11.787
0.4447	0.08	1.190	11.81
0.4697	0.07	1.170	11.83
0.4963	0.06	1.149	11.851
0.5247	0.05	1.129	11.871
0.5547	0.04	1.107	11.893
0.5863	0.04	1.084	11.916
0.6213	0.03	1.060	11.94
0.658	0.01	1.035	11.965
0.6963	0.00	1.011	11.989
0.738	-0.01	0.986	12.014
0.7813	-0.02	0.960	12.04
0.828	-0.03	0.933	12.067
0.8763	-0.04	0.907	12.093
0.928	-0.06	0.878	12.122
0.983	-0.07	0.852	12.148
1.0413	-0.08	0.823	12.177
1.103	-0.10	0.793	12.207
1.168	-0.12	0.764	12.236
1.238	-0.13	0.735	12.265
1.3113	-0.15	0.703	12.297
1.3897	-0.17	0.674	12.326
1.473	-0.19	0.641	12.359
1.5613	-0.21	0.611	12.389
1.6547	-0.24	0.580	12.42
1.753	-0.26	0.550	12.45
1.858	-0.28	0.519	12.481
1.968	-0.31	0.488	12.512
2.0847	-0.34	0.456	12.544
2.2097	-0.37	0.427	12.573
2.3412	-0.40	0.397	12.603
2.4813	-0.43	0.368	12.632
2.6297	-0.47	0.335	12.665
2.7863	-0.51	0.306	12.694
2.953	-0.56	0.276	12.724
3.1297	-0.60	0.249	12.751
3.3163	-0.66	0.221	12.779
3.5147	-0.71	0.194	12.806
3.7247	-0.78	0.166	12.834
3.9463	-0.86	0.139	12.861
4.1813	-0.94	0.114	12.886
4.4297	-1.05	0.090	12.91
4.693	-1.19	0.065	12.935
4.973	-1.37	0.043	12.957

Carolina Central Tire Siting Study
Hydraulic Conductivity (K) Calculation Worksheet
W&R Project Number: 202334.01

Well: **WRB-10**
Test Date: 8/20/2003
Test Type: Rising Head (Slug out)

Conducted by: Ihnatolya
Entered/date: Bellis -8-25-03
Checked/date: Ihnatolya -8-26-03

WELL DATA

SWL =	13.00	(ft BTOC)
WD =	38.00	(ft BTOC)
WD =	35.00	(ft BGS)
DTSP =	27.00	(ft BTOC)
rc =	0.083	(ft)
n =	0.30	
rw =	0.38	(ft)
rc (adjusted) =	0.08	(ft)
Le =	11	(ft)
Lw =	25.00	(ft)
Le/rw =	29.33	
H =	75.00	(ft)

CALCULATION OF K

K = [(rc^2 ln(Re/rw))/2Le]*(1/t)ln(yo/yt)

yo =	1.876	(ft) from plot
yt =	0.459	(ft) from plot
t =	4.425	(minutes) from plot
ln(Re/rw) =	2.50	
K =	0.4	(ft/day)
K =	1.3E-04	(cm/sec)

Calculation of ln(Re/rw)

Where: Lw < H;

ln(Re/rw) = [(1.1/(ln(Lw/rw)))+(A+Bln((H-Lw)/rw))/(Le/rw)]^-1= 2.50

Where: Lw = H;

ln(Re/rw) = [(1.1/(ln(Lw/rw)))+(C/(Le/rw))]^-1 = 3.03

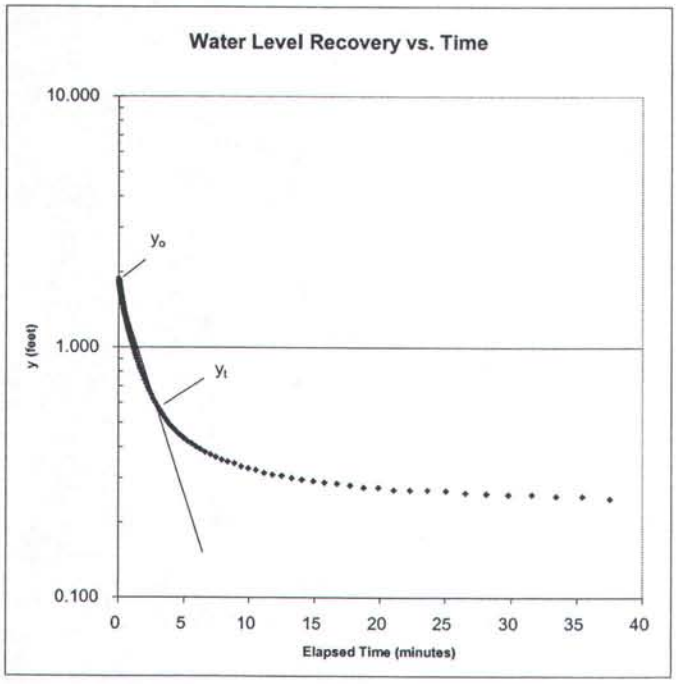
Calculation of Coefficients
Value range for Le/rw from Table of Coefficients

Le/rw	A	B	C
25	2.4	0.31	1.9
30	2.5	0.35	2.1

Interpolated values of A, B and C for Le/rw

29.33	2.49	0.34	2.07

Reference: Bouwer(1989), Bouwer and Rice(1976)



Coefficients Table

Le/rw	A	Le/rw	B	Le/rw	C
4	1.75	4	0.25	4	0.75
5	1.76	5	0.25	5	0.85
6	1.77	6	0.25	6	0.90
7	1.80	7	0.25	7	1.00
8	1.83	8	0.25	8	1.10
9	1.90	9	0.25	9	1.20
10	1.95	10	0.25	10	1.30
15	2.10	15	0.27	15	1.50
20	2.23	20	0.29	20	1.75
25	2.40	25	0.31	25	1.90
30	2.50	30	0.35	30	2.10
40	2.75	40	0.45	40	2.45
50	3.00	50	0.50	50	2.70
60	3.45	60	0.52	60	3.00
70	3.70	70	0.60	70	3.40
80	3.90	80	0.65	80	3.60
90	4.20	90	0.70	90	3.85
100	4.50	100	0.75	100	4.20
150	5.45	150	0.98	150	5.70
200	6.10	200	1.20	200	7.00
250	6.70	250	1.30	250	8.00
300	7.10	300	1.50	300	8.80
400	7.75	400	1.90	400	9.90
500	8.20	500	2.20	500	10.60
600	8.50	600	2.33	600	11.10
700	8.70	700	2.50	700	11.50
800	8.90	800	2.70	800	11.80
900	9.00	900	2.75	900	12.00
1000	9.20	1000	2.83	1000	12.40
1500	9.50	1500	3.18	1500	12.90

TEST DATA

Elapsed time (min)	Log y	y (ft)	WL (ft BTOC)
0.005	0.27	1.876	14.876
0.01	0.27	1.866	14.866
0.015	0.27	1.856	14.856
0.02	0.27	1.845	14.845
0.025	0.26	1.835	14.835
0.03	0.26	1.827	14.827
0.035	0.26	1.819	14.819
0.04	0.26	1.811	14.811
0.045	0.26	1.803	14.803
0.05	0.25	1.794	14.794
0.055	0.25	1.786	14.786
0.06	0.25	1.778	14.778
0.065	0.25	1.770	14.77
0.07	0.25	1.762	14.762
0.075	0.24	1.753	14.753
0.08	0.24	1.747	14.747
0.085	0.24	1.739	14.739
0.09	0.24	1.733	14.733
0.095	0.24	1.727	14.727
0.1	0.24	1.718	14.718
0.1058	0.23	1.710	14.71
0.112	0.23	1.702	14.702
0.1185	0.23	1.694	14.694
0.1255	0.23	1.684	14.684
0.1328	0.22	1.675	14.675
0.1407	0.22	1.665	14.665
0.149	0.22	1.653	14.653
0.1578	0.22	1.645	14.645
0.167	0.21	1.635	14.635
0.177	0.21	1.624	14.624
0.1875	0.21	1.612	14.612
0.1985	0.20	1.600	14.6
0.2102	0.20	1.587	14.587
0.2227	0.20	1.575	14.575
0.2358	0.19	1.561	14.561
0.2498	0.19	1.546	14.546
0.2647	0.19	1.532	14.532
0.2803	0.18	1.516	14.516
0.297	0.18	1.501	14.501
0.3147	0.17	1.484	14.484
0.3333	0.17	1.468	14.468
0.3532	0.16	1.450	14.45
0.3742	0.16	1.431	14.431
0.3963	0.15	1.415	14.415
0.4198	0.14	1.394	14.394
0.4447	0.14	1.376	14.376
0.4697	0.13	1.355	14.355
0.4963	0.13	1.335	14.335
0.5247	0.12	1.316	14.316
0.5547	0.11	1.294	14.294
0.5863	0.10	1.273	14.273
0.6213	0.10	1.250	14.25
0.658	0.09	1.228	14.228
0.6963	0.08	1.205	14.205
0.738	0.07	1.180	14.18
0.7813	0.06	1.156	14.156
0.828	0.05	1.131	14.131
0.8763	0.04	1.104	14.104
0.928	0.03	1.081	14.081
0.983	0.02	1.057	14.057
1.0413	0.01	1.030	14.03
1.103	0.00	1.003	14.003
1.168	-0.01	0.976	13.976
1.238	-0.02	0.949	13.949
1.3113	-0.03	0.924	13.924
1.3897	-0.05	0.897	13.897
1.473	-0.06	0.871	13.871
1.5613	-0.07	0.844	13.844
1.6547	-0.09	0.819	13.819
1.753	-0.10	0.792	13.792
1.858	-0.12	0.767	13.767
1.968	-0.13	0.742	13.742
2.0847	-0.15	0.715	13.715
2.2097	-0.16	0.692	13.692
2.3412	-0.17	0.669	13.669
2.4813	-0.19	0.645	13.645
2.6297	-0.21	0.622	13.622
2.7863	-0.22	0.601	13.601
2.953	-0.24	0.580	13.58
3.1297	-0.25	0.559	13.559
3.3163	-0.27	0.540	13.54
3.5147	-0.28	0.522	13.522
3.7247	-0.30	0.505	13.505
3.9463	-0.31	0.488	13.488
4.1813	-0.33	0.473	13.473
4.4297	-0.34	0.459	13.459
4.693	-0.35	0.446	13.446
4.973	-0.36	0.433	13.433
5.2697	-0.38	0.421	13.421
5.583	-0.39	0.412	13.412
5.9147	-0.40	0.400	13.4
6.2663	-0.41	0.391	13.391
6.6397	-0.42	0.381	13.381
7.0347	-0.43	0.372	13.372
7.453	-0.44	0.364	13.364
7.8963	-0.45	0.355	13.355
8.3663	-0.46	0.349	13.349
8.8647	-0.46	0.344	13.344
9.3913	-0.48	0.334	13.334
9.9497	-0.48	0.328	13.328
10.5413	-0.49	0.323	13.323
11.168	-0.50	0.315	13.315
11.8313	-0.51	0.309	13.309
12.5347	-0.51	0.307	13.307
13.2797	-0.52	0.300	13.3
14.0697	-0.53	0.296	13.296
14.9063	-0.53	0.292	13.292
15.7913	-0.54	0.288	13.288
16.7297	-0.54	0.286	13.286
17.723	-0.55	0.281	13.281
18.7763	-0.56	0.275	13.275
19.8913	-0.56	0.275	13.275
21.073	-0.57	0.269	13.269
22.3247	-0.57	0.269	13.269
23.6497	-0.57	0.269	13.269
25.0547	-0.57	0.267	13.267
26.543	-0.58	0.262	13.262
28.118	-0.59	0.260	13.26
29.7863	-0.59	0.258	13.258
31.5547	-0.59	0.258	13.258
33.428	-0.60	0.254	13.254
35.4112	-0.60	0.254	13.254
37.513	-0.61	0.248	13.248

Carolina Central Tire Siting Study
Hydraulic Conductivity (K) Calculation Worksheet
W&R Project Number: 202334.01

Well: **WRB-3D**
Test Date: 8/20/2003
Test Type: Falling Head (Slug in)

Conducted by: Ihnatolya
Entered/data: Bellis -8-25-03
Checked/data: Ihnatolya -8-26-03

No change in water level observed. Test data can't be used to define K. K < 10^{-8} cm/s ~~FAO~~ B/B

WELL DATA

SWL =	40.41	(ft BTOC)
WD =	57.86	(ft BTOC)
WD =	55.00	(ft BGS)
DTSP =	46.86	(ft BTOC)
rc =	0.083	(ft)
n =	0.30	
rw =	0.38	(ft)
rc (adjusted) =	0.08	(ft)
Le =	11	(ft)
Lw =	17.45	(ft)
Le/rw =	29.33	
H =	75.00	(ft)

CALCULATION OF K

K = [(rc^2 ln(Re/rw))/2Le]*(1/t)ln(yo/yt)

yo =	2.259	(ft) from plot
yt =	2.235	(ft) from plot
t =	50.041	(minutes) from plot
ln(Re/rw) =	2.33	
K =	0.0002	(ft/day)
K =	7.1E-08	(cm/sec)

Calculation of ln(Re/rw)

Where: Lw < H;

ln(Re/rw) = [(1.1/(ln(Lw/rw)))+(A+Bln((H-Lw)/rw))/(Le/rw)]^-1 = 2.33

Where: Lw = H;

ln(Re/rw) = [(1.1/(ln(Lw/rw)))+(C/(Le/rw))]^-1 = 2.78

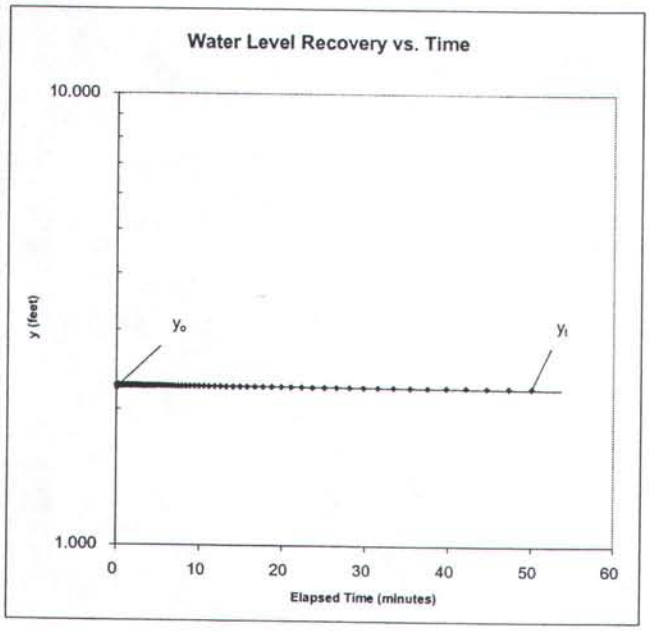
Calculation of Coefficients
Value range for Le/rw from Table of Coefficients

Le/rw	A	B	C
25	2.4	0.31	1.9
30	2.5	0.35	2.1

Interpolated values of A, B and C for Le/rw

29.33	2.49	0.34	2.07

Reference: Bouwer(1989), Bouwer and Rice(1976)



Coefficients Table

Le/rw	A	Le/rw	B	Le/rw	C
4	1.75	4	0.25	4	0.75
5	1.76	5	0.25	5	0.85
6	1.77	6	0.25	6	0.90
7	1.80	7	0.25	7	1.00
8	1.83	8	0.25	8	1.10
9	1.90	9	0.25	9	1.20
10	1.95	10	0.25	10	1.30
15	2.10	15	0.27	15	1.50
20	2.23	20	0.29	20	1.75
25	2.40	25	0.31	25	1.90
30	2.50	30	0.35	30	2.10
40	2.75	40	0.45	40	2.45
50	3.00	50	0.50	50	2.70
60	3.45	60	0.52	60	3.00
70	3.70	70	0.60	70	3.40
80	3.90	80	0.65	80	3.60
90	4.20	90	0.70	90	3.85
100	4.50	100	0.75	100	4.20
150	5.45	150	0.98	150	5.70
200	6.10	200	1.20	200	7.00
250	6.70	250	1.30	250	8.00
300	7.10	300	1.50	300	8.80
400	7.75	400	1.90	400	9.90
500	8.20	500	2.20	500	10.60
600	8.50	600	2.33	600	11.10
700	8.70	700	2.50	700	11.50
800	8.90	800	2.70	800	11.80
900	9.00	900	2.75	900	12.00
1000	9.20	1000	2.83	1000	12.40
1500	9.50	1500	3.18	1500	12.90

TEST DATA

Elapsed time (min)	Log y	y (ft)	WL (ft BTOC)
0.005	0.3539	2.259	38.151
0.01	0.3539	2.259	38.151
0.015	0.3543	2.261	38.149
0.02	0.3547	2.263	38.147
0.025	0.3547	2.263	38.147
0.03	0.3543	2.261	38.149
0.035	0.3547	2.263	38.147
0.04	0.3547	2.263	38.147
0.045	0.3547	2.263	38.147
0.05	0.3547	2.263	38.147
0.055	0.3547	2.263	38.147
0.06	0.3547	2.263	38.147
0.065	0.3543	2.261	38.149
0.07	0.3547	2.263	38.147
0.075	0.3547	2.263	38.147
0.08	0.3547	2.263	38.147
0.085	0.3547	2.263	38.147
0.09	0.3547	2.263	38.147
0.095	0.3473	2.225	38.185
0.1	0.3531	2.255	38.155
0.1058	0.3487	2.232	38.178
0.112	0.3499	2.238	38.172
0.1185	0.3539	2.259	38.151
0.1255	0.3531	2.255	38.155
0.1328	0.3535	2.257	38.153
0.1407	0.3539	2.259	38.151
0.149	0.3547	2.263	38.147
0.1578	0.3547	2.263	38.147
0.167	0.3543	2.261	38.149
0.177	0.3539	2.259	38.151
0.1875	0.3539	2.259	38.151
0.1985	0.3539	2.259	38.151
0.2102	0.3539	2.259	38.151
0.2227	0.3535	2.257	38.153
0.2358	0.3535	2.257	38.153
0.2498	0.3535	2.257	38.153
0.2647	0.3535	2.257	38.153
0.2803	0.3535	2.257	38.153
0.297	0.3535	2.257	38.153
0.3147	0.3531	2.255	38.155
0.3333	0.3535	2.257	38.153
0.3532	0.3535	2.257	38.153
0.3742	0.3531	2.255	38.155
0.3963	0.3531	2.255	38.155
0.4198	0.3528	2.253	38.157
0.4447	0.3533	2.256	38.154
0.4697	0.3528	2.253	38.157
0.4963	0.3528	2.253	38.157
0.5247	0.3533	2.256	38.154
0.5547	0.3528	2.253	38.157
0.5863	0.3530	2.254	38.156
0.6213	0.3530	2.254	38.156
0.658	0.3530	2.254	38.156
0.6963	0.3526	2.252	38.158
0.738	0.3530	2.254	38.156
0.7813	0.3530	2.254	38.156
0.828	0.3526	2.252	38.158
0.8763	0.3530	2.254	38.156
0.928	0.3533	2.256	38.154
0.983	0.3533	2.256	38.154
1.0413	0.3533	2.256	38.154
1.103	0.3533	2.256	38.154
1.168	0.3535	2.257	38.153
1.238	0.3531	2.255	38.155
1.3113	0.3531	2.255	38.155
1.3897	0.3535	2.257	38.153
1.473	0.3531	2.255	38.155
1.5613	0.3531	2.255	38.155
1.6547	0.3531	2.255	38.155
1.753	0.3531	2.255	38.155
1.858	0.3531	2.255	38.155
1.968	0.3531	2.255	38.155
2.0847	0.3528	2.253	38.157
2.2097	0.3528	2.253	38.157
2.3412	0.3528	2.253	38.157
2.4813	0.3530	2.254	38.156
2.6297	0.3530	2.254	38.156
2.7863	0.3530	2.254	38.156
2.953	0.3526	2.252	38.158
3.1297	0.3526	2.252	38.158
3.3163	0.3526	2.252	38.158
3.5147	0.3526	2.252	38.158
3.7247	0.3526	2.252	38.158
3.9463	0.3526	2.252	38.158
4.1813	0.3526	2.252	38.158
4.4297	0.3522	2.250	38.16
4.693	0.3526	2.252	38.158
4.973	0.3528	2.253	38.157
5.2697	0.3524	2.251	38.159
5.583	0.3524	2.251	38.159
5.9147	0.3524	2.251	38.159
6.2663	0.3524	2.251	38.159
6.6397	0.3520	2.249	38.161
7.0347	0.3520	2.249	38.161
7.453	0.3516	2.247	38.163
7.8963	0.3520	2.249	38.161
8.3663	0.3520	2.249	38.161
8.8647	0.3520	2.249	38.161
9.3913	0.3516	2.247	38.163
9.9497	0.3516	2.247	38.163
10.5413	0.3516	2.247	38.163
11.168	0.3512	2.245	38.165
11.8313	0.3516	2.247	38.163
12.5347	0.3516	2.247	38.163
13.2797	0.3512	2.245	38.165
14.0697	0.3512	2.245	38.165
14.9063	0.3512	2.245	38.165
15.7913	0.3512	2.245	38.165
16.7297	0.3508	2.243	38.167
17.723	0.3508	2.243	38.167
18.7763	0.3512	2.245	38.165
19.8913	0.3508	2.243	38.167
21.073	0.3508	2.243	38.167
22.3247	0.3508	2.243	38.167
23.6497	0.3504	2.241	38.169
25.0547	0.3504	2.241	38.169
26.543	0.3504	2.241	38.169
28.118	0.3504	2.241	38.169
29.7863	0.3501	2.239	38.171
31.5547	0.3501	2.239	38.171
33.428	0.3501	2.239	38.171
35.4112	0.3497	2.237	38.173
37.513	0.3497	2.237	38.173
39.7397	0.3501	2.239	38.171
42.098	0.3501	2.239	38.171
44.5963	0.3497	2.237	38.173
47.243	0.3497	2.237	38.173
50.0463	0.3493	2.235	38.175

Carolina Central Tire Siting Study
Hydraulic Conductivity (K) Calculation Worksheet
W&R Project Number: 202334.01

Well: WRB-8D
Test Date: 8/20/2003
Test Type: Falling Head (Slug in)

Conducted by: Ihnatolya
Entered/date: Betts -8-25-03
Checked/date: Ihnatolya -8-28-03 BJB

WELL DATA

SWL =	6.36	(ft BTOC)
WD =	37.75	(ft BTOC)
WD =	35.00	(ft BGS)
DTSP =	26.75	(ft BTOC)
rc =	0.083	(ft)
n =	0.30	
rw =	0.35	(ft)
rc (adjusted) =	0.08	(ft)
Le =	11	(ft)
Lw =	29.39	(ft)
Le/rw =	29.33	
H =	75.00	(ft)

CALCULATION OF K

K = [(rc^2 ln(Re/rw))/2Le]*[1/t]ln(yo/yt)

yo =	1.935	(ft) from plot
yt =	1.746	(ft) from plot
t =	72.430	(minutes) from plot
ln(Re/rw) =	2.56	
K =	0.0016	(ft/day)
K =	5.6E-07	(cm/sec)

Calculation of ln(Re/rw)

Where: Lw < H;

ln(Re/rw) = [(1.1/(ln(Lw/rw)))+(A+B*ln((H-Lw)/rw))/(Le/rw)]^-1 = 2.56

Where: Lw = H;

ln(Re/rw) = [(1.1/(ln(Lw/rw)))+(C/(Le/rw))]^-1 = 3.13

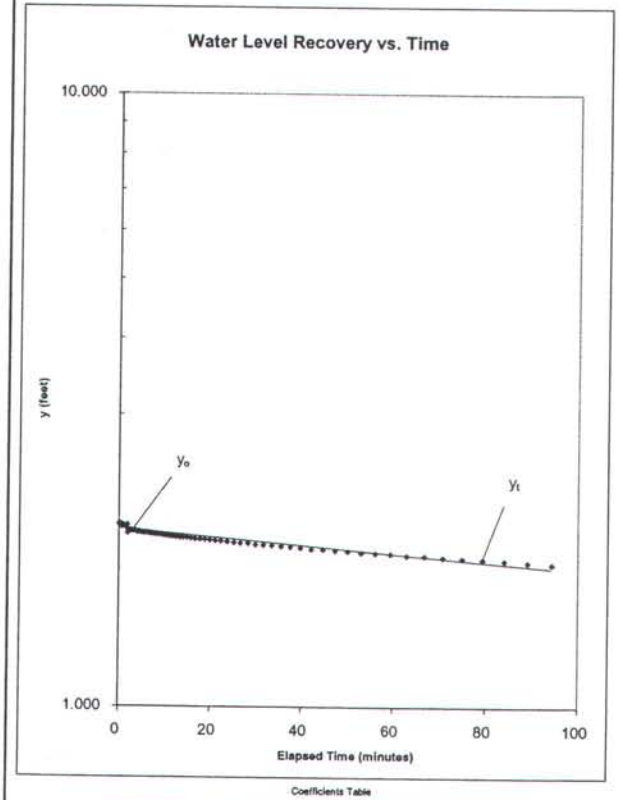
Calculation of Coefficients
Value range for Le/rw from Table of Coefficients

Le/rw	A	B	C
25	2.4	0.31	1.9
30	2.5	0.35	2.1

Interpolated values of A, B and C for Le/rw

29.33	2.49	0.34	2.07

Reference: Bouwer(1969), Bouwer and Rice(1976)



Coefficients Table

Le/rw	A	Le/rw	B	Le/rw	C
4	1.75	4	0.25	4	0.75
5	1.78	5	0.25	5	0.85
6	1.77	6	0.25	6	0.90
7	1.80	7	0.25	7	1.00
8	1.83	8	0.25	8	1.10
9	1.90	9	0.25	9	1.20
10	1.95	10	0.25	10	1.30
15	2.10	15	0.27	15	1.50
20	2.23	20	0.29	20	1.75
25	2.40	25	0.31	25	1.90
30	2.50	30	0.35	30	2.10
40	2.75	40	0.45	40	2.45
50	3.00	50	0.50	50	2.70
60	3.45	60	0.52	60	3.00
70	3.70	70	0.60	70	3.40
80	3.90	80	0.65	80	3.60
90	4.20	90	0.70	90	3.85
100	4.50	100	0.75	100	4.20
150	5.45	150	0.98	150	5.70
200	6.10	200	1.20	200	7.00
250	6.70	250	1.30	250	8.00
300	7.10	300	1.50	300	8.80
400	7.75	400	1.90	400	9.90
500	8.20	500	2.20	500	10.60
600	8.50	600	2.33	600	11.10
700	8.70	700	2.50	700	11.50
800	8.90	800	2.70	800	11.80
900	9.00	900	2.75	900	12.00
1000	9.20	1000	2.83	1000	12.40
1500	9.50	1500	3.18	1500	12.90

TEST DATA

Elapsed time (min)	Log y	y (ft)	WL (ft BTOC)
0.005	0.2984	1.979	6.381
0.01	0.2984	1.979	6.381
0.015	0.2969	1.981	6.379
0.02	0.2969	1.981	6.379
0.025	0.2969	1.981	6.379
0.03	0.2971	1.982	6.378
0.035	0.2971	1.982	6.378
0.04	0.2971	1.982	6.378
0.045	0.2975	1.984	6.376
0.05	0.2971	1.982	6.378
0.055	0.2971	1.982	6.378
0.06	0.2971	1.982	6.378
0.065	0.2971	1.982	6.378
0.07	0.2971	1.982	6.378
0.075	0.2971	1.982	6.378
0.08	0.2971	1.982	6.378
0.085	0.2971	1.982	6.378
0.09	0.2971	1.982	6.378
0.095	0.2971	1.982	6.378
0.1	0.2971	1.982	6.378
0.1058	0.2967	1.980	6.38
0.112	0.2967	1.980	6.38
0.1185	0.2967	1.980	6.38
0.1255	0.2969	1.981	6.379
0.1328	0.2969	1.981	6.379
0.1407	0.2973	1.983	6.377
0.149	0.2969	1.981	6.379
0.1578	0.2969	1.981	6.379
0.167	0.2964	1.979	6.381
0.177	0.2960	1.977	6.383
0.1875	0.2960	1.977	6.383
0.1985	0.2962	1.978	6.382
0.2102	0.2958	1.976	6.384
0.2227	0.2958	1.976	6.384
0.2358	0.2958	1.976	6.384
0.2498	0.2953	1.974	6.386
0.2647	0.2958	1.975	6.385
0.2803	0.2958	1.975	6.385
0.297	0.2956	1.975	6.385
0.3147	0.2956	1.975	6.385
0.3333	0.2951	1.973	6.387
0.3532	0.2953	1.974	6.386
0.3742	0.2953	1.974	6.386
0.3963	0.2953	1.974	6.386
0.4196	0.2945	1.970	6.39
0.4447	0.2951	1.973	6.387
0.4697	0.2951	1.973	6.387
0.4963	0.2951	1.973	6.387
0.5247	0.2947	1.971	6.389
0.5547	0.2949	1.972	6.388
0.5863	0.2945	1.970	6.39
0.6213	0.2945	1.970	6.39
0.656	0.2927	1.962	6.398
0.6963	0.2947	1.971	6.389
0.738	0.2942	1.969	6.391
0.7813	0.2945	1.970	6.39
0.828	0.2945	1.970	6.39
0.8763	0.2940	1.968	6.392
0.928	0.2942	1.969	6.391
0.983	0.2942	1.969	6.391
1.0413	0.2940	1.968	6.392
1.103	0.2940	1.968	6.392
1.168	0.2938	1.967	6.393
1.238	0.2938	1.967	6.393
1.3113	0.2940	1.968	6.392
1.3897	0.2931	1.964	6.396
1.473	0.2938	1.967	6.393
1.5613	0.2920	1.959	6.401
1.6547	0.2938	1.966	6.394
1.753	0.2940	1.968	6.392
1.858	0.2951	1.973	6.387
1.968	0.2922	1.915	6.445
2.0847	0.2862	1.933	6.427
2.2097	0.2865	1.934	6.426
2.3412	0.2865	1.934	6.426
2.4813	0.2867	1.935	6.425
2.6297	0.2858	1.931	6.429
2.7863	0.2858	1.931	6.429
2.953	0.2858	1.931	6.429
3.1297	0.2856	1.930	6.43
3.3163	0.2856	1.930	6.43
3.5147	0.2856	1.930	6.43
3.7247	0.2847	1.928	6.434
3.9463	0.2842	1.924	6.436
4.1813	0.2842	1.924	6.436
4.4297	0.2842	1.924	6.436
4.693	0.2838	1.922	6.438
4.973	0.2833	1.920	6.44
5.2697	0.2833	1.920	6.44
5.583	0.2828	1.918	6.442
5.9147	0.2831	1.919	6.441
6.2663	0.2826	1.917	6.443
6.6397	0.2822	1.915	6.445
7.0347	0.2817	1.913	6.447
7.453	0.2813	1.911	6.449
7.8963	0.2808	1.909	6.451
8.3663	0.2804	1.907	6.453
8.8647	0.2799	1.905	6.455
9.3913	0.2794	1.903	6.457
9.9497	0.2790	1.901	6.459
10.5413	0.2778	1.896	6.464
11.168	0.2774	1.894	6.466
11.8313	0.2769	1.892	6.468
12.5347	0.2765	1.890	6.47
13.2797	0.2755	1.886	6.474
14.0697	0.2755	1.886	6.474
14.9063	0.2751	1.884	6.476
15.7913	0.2742	1.880	6.48
16.7297	0.2732	1.876	6.484
17.723	0.2725	1.873	6.487
18.7783	0.2721	1.871	6.489
19.8913	0.2711	1.867	6.493
21.073	0.2702	1.863	6.497
22.3247	0.2697	1.861	6.499
23.6497	0.2688	1.857	6.503
25.0547	0.2672	1.850	6.51
26.543	0.2662	1.846	6.514
28.118	0.2656	1.844	6.516
29.7863	0.2639	1.836	6.524
31.5547	0.2634	1.834	6.526
33.428	0.2622	1.829	6.531
35.4112	0.2613	1.825	6.535
37.513	0.2603	1.821	6.539
39.7397	0.2589	1.815	6.545
42.098	0.2567	1.806	6.554
44.5963	0.2562	1.804	6.556
47.243	0.2548	1.798	6.562
50.0463	0.2533	1.792	6.568
53.0147	0.2518	1.785	6.575
56.1597	0.2502	1.779	6.581
59.4913	0.2492	1.775	6.585
63.0197	0.2470	1.766	6.594
66.758	0.2460	1.762	6.598
70.718	0.2435	1.752	6.608
74.9113	0.2420	1.746	6.614
79.3547	0.2403	1.739	6.621
84.0613	0.2383	1.731	6.629
89.0463	0.2360	1.722	6.638
94.3263	0.2325	1.708	6.652

Section 5
Local Government Approval

5.1 Introduction

Rule .0504(1)(e) of the North Carolina Solid Waste Management Rules require:

(1) the approval of the Board of Commissioners of the county in which the site is located. Approval may be in the form of either a resolution or a vote on a motion; and

(2) a letter from the unit of government having zoning jurisdiction over the site which states that the proposal meets all requirements of the local zoning ordinance, or that the site is not zoned.

A Franchise Agreement was entered into on August 5, 2002 between Harnett County and Central Carolina Holdings, LLC d/b/a Central Carolina Tire Disposal (CCTD). The franchise grants CCTD "a non-exclusive franchise to operate the Facility at its current location, as the same may be expanded from time to time pursuant to permits issued by the State of North Carolina". A copy of the resolution by the Board of Commissioners for the subject Agreement is provided in Attachment 5.1.

The site is currently zoned "I" (Industrial). In a letter dated January 20, 2004, the Harnett County Planning Department confirms the subject property "is properly zoned for a tire disposal and recycling center and for any for future expansions no conditional use permit is needed". The January 20, 2004 letter adds, "All future expansions will be required to obtain a Land Use Permit with Site Plan approval". A copy of the January 20, 2004 letter from the Harnett County planning office is provided in Attachment 5.2.

Central Carolina Tire submitted a Land Use/Site Plan application to the Harnett County Planning Department on February 4, 2004. The Plan was prepared in general accordance with the Zoning Ordinance of Harnett County (as amended through August 18, 2003). In a letter dated February 5, 2004, the Harnett County Planning Department approved the site plan for the expansion of the facility. A copy of the February 5, 2004 letter from the Harnett County planning office is provided in Attachment 5.3.

ATTACHMENT 5.1

HARNETT COUNTY BOARD OF COMMISSIONERS
RESOLUTION

Prepared by Dwight W. Snow, Attorney at Law, P.O. Box 397, Dunn NC 28335

STATE OF NORTH CAROLINA

COUNTY OF HARNETT

FRANCHISE AGREEMENT
CENTRAL CAROLINA TIRE DISPOSAL

This Franchise Agreement ("Agreement") is made and entered into as of the 5TH day of August, 2002 by and between Harnett County, a body corporate and politic existing under the laws of the State of North Carolina ("County") and Central Carolina Holdings, LLC, a North Carolina limited liability company d/b/a Central Carolina Tire Disposal (collectively "CCTD").

WHEREAS, the Division of Solid Waste Management of the State of North Carolina Department of Environment, Health, and Natural Resources issued CCTD a Solid Waste Permit (#43-04) for the operation of a tire landfill facility on March 16, 1992 (as amended February 20, 1996, September 26, 1996 and August 21, 2001) and a Solid Waste Permit (#43-08) for the operation of a scrap tire collection and processing facility site on February 18, 1993 (as amended January 4, 1995, March 7, 1995, February 17, 2000, August 24, 2000 and August 21, 2001); and

WHEREAS, pursuant to such Permits CCTD has vested rights to operate a tire landfill facility and scrap tire collection and processing facility sited at the end of dead-end SR 1105 in Harnett County, North Carolina (the "Facility") and is currently operating such Facility; and

WHEREAS, CCTD is required to obtain a franchise to operate the Facility from the County and the County wishes to grant CCTD such franchise.

NOW, THEREFORE, in consideration of the mutual covenants contained herein, County and CCTD, intending to be legally bound hereby, agree as follows:

1. Grant of Franchise. Pursuant to N.C.G.S. 130A-294, County hereby grants CCTD a non-exclusive franchise to operate the Facility at its current location, as the same may be expanded from time to time pursuant to permits issued by the State of North Carolina.

2. Term of Franchise. The franchise granted hereunder shall have an initial term of twenty (20) years.

3. Waste Stream. The waste stream that may be accepted by the Facility shall be comprised of waste or debris resulting from rubber vehicle tires. The annual tonnage accepted shall not exceed 300,000.

4.a. Facility Life. The useful life of the existing landfill and proposed expansion to this landfill, consisting of a total footprint of 240 acres, will have a remaining life of 60 years, based on assumed growth to the above annual tonnage from the service area specified below translating to annual landfill volume consumption of approximately 727,000 cubic yards per year.

4.b. Service Area. The population to be served by the Facility shall consist of commercial, industrial, corporate, and individual users of rubber tires primarily from North Carolina's 8,049,000 residents (2000 Census). However, the Facility shall be available to users from South Carolina, Virginia, West Virginia, Georgia, and Tennessee as well.

5. Compliance with Law. CCTD shall operate the Facility in accordance with all applicable laws and regulations including any Harnett County land use regulations ,and shall further comply in all material respects with any Permit issued by the State of North Carolina.

6. Assignability. The franchise granted hereunder shall not be assigned without the prior written authorization from the County.

IN WITNESS WHEREOF, County and CCTD have executed this Franchise Agreement as of the day and year first written.

CENTRAL CAROLINA HOLDINGS, LLC

By: Thomas Womble
Name: Thomas Womble
Title: Manager

BOARD OF COMMISSIONERS
FOR THE COUNTY OF HARNETT

By: Teddy J. Byrd
Name: Teddy J. Byrd
Title: Chairman

ATTEST:

Kay S. Blanchard
Kay S. Blanchard
Clerk to the Board of Commissioners

ATTACHMENT 5.2

LETTER FROM
HARNETT COUNTY PLANNING DEPARTMENT
DATED JANUARY 20, 2004

Harnett COUNTY
NORTH CAROLINA

Planning Department

www.harnett.org

PO Box 65
102 East Front Street
Lillington, NC 27546

ph: 910-893-7525
fax: 910-893-2793

January 20, 2004

Pope & Tart
403 West Broad Street
PO Box 928
Dunn, NC 28334

Re: Central Carolina Tire Disposal

Dear Mr. Pope;

In accordance with the Harnett County Zoning Ordinance staff has determined that the Central Carolina Tire Disposal is a permitted use within the Industrial Zoning District. The property is properly zoned for a tire disposal and recycling center and for any future expansions no conditional use permit is needed. All future expansions will be required to obtain a Land Use Permit with Site Plan approval, both are administrative reviews.

For any additional information you may contact the Harnett County Planning Department at (910) 893-7525.

Sincerely,

Joseph D. Jeffries
Manager of Planning Services

ATTACHMENT 5.3

LETTER FROM
HARNETT COUNTY PLANNING DEPARTMENT
DATED FEBRUARY 5, 2004

Harnett
COUNTY
NORTH CAROLINA

Planning Department

www.harnett.org

PO Box 65
102 East Front Street
Lillington, NC 27546

ph: 910-893-7525
fax: 910-893-2793

February 5, 2004

Thomas Womble
Central Carolina Tire
1616 McKoy Town Road
Cameron, NC 28326

Re: Site Plan Approval on 02/04/04
Central Carolina Tire collection & processing facility, Phase III
HTE 04-5-8693

Dear Sir or Madam:

This is to inform you that the Harnett County Planning Department has approved the site plan for the expansion of the above referenced plan on February 4, 2004, with the following conditions:

- Receive approval from NCDENR (Erosion Control Plan and Solid Waste)
- Maintain buffers as required by DENR around perimeter of parcel

If you have any questions, please contact me at (910) 893-7525. Thank you in advance for your cooperation in this matter.

Sincerely,

Joseph D. Jeffries
Manager of Planning Services

Section 6
Location Restrictions

6.1 Introduction

Rule .0504(1)(F) of the North Carolina Solid Waste Management Rules requires that a report be prepared and submitted demonstrating compliance with the criteria in Rule .0503(1). Rule .0503 requires documentation or approvals by agencies other than the Division of Solid Waste Management that demonstrate compliance with specific location criteria. The location criteria include:

- Floodplains;
- Endangered and threatened species;
- Cultural resources;
- State Nature and Historic Preserves;
- Airport Safety; and,
- Cover Material.

6.2 Floodplains

Rule 0503(1)(a) states that a site located in 100-year floodplain unless the owner/operator demonstrates the following:

1) The unit will not restrict the flow from a 100-year flood, and,

2) The unit will not reduce the temporary storage capacity of the floodplain, and,

3) The 100-year flood will not result in washout of solid waste so as to pose a hazard to human life, wildlife or land or water resources.

W&R reviewed the Federal Emergency Management Agency's (FEMA) Flood Insurance Risk Map, which identifies 100-year floodplain areas. As shown in Figure 3-1, no portion of the proposed landfill property lies within the 100-year floodplain. A copy of the effective FEMA Flood Insurance Risk Map is attached to this section as Appendix 6.1.

6.3 Endangered and Threatened Species

Rule 0503(1)(b)(i)&(ii) state that a site shall not cause or contribute to the taking of any endangered or threatened species of plants, fish or wildlife; and the site shall not result in the destruction or adverse modification of the critical habitat of endangered or threatened species.

W&R contracted The Brigman Company, Inc. to perform a Biological Assessment for the proposed tire monofill landfill site. The purpose this Biological Assessment was to provide a professional opinion as to whether any federally threatened, endangered, or proposed species existing on-site.

Based on a literature review and communication with various federal agencies, the following list of federally threatened or endangered species occurring in Harnett County was prepared. The list was acquired from the USFWS website on April 7, 2003. The list was last updated February 24, 2003 by USFWS. (E = Federally Endangered)

		Certainty of
Birds	Status	Occurrence
Red-cockaded woodpecker (Picoides borealis)	E	Known
Fish		
Cape Fear shiner (Notropis mekistocholas)	E	Known
Plants		
Rough-leaved loosestrife (Lysimachia asperulaefollia)	E	Known
Small whorled pogonia (lostria medeoloides)	E	Known

Based on the Biological Assessment performed by The Brigman Company, Inc. on June 16, 2003 the proposed Phase III tire monofill site held no suitable habitat for any of the federally threatened, endangered or proposed species of concern; therefore a no effect determination has been made for the proposed tire monofill site.

The Biological Assessment performed by the Brigman Company, Inc. is attached to this section as Attachment 6.1.

6.4 Cultural Resources

Rule .0503(1)(b)(iii) states that a site shall not damage or destroy an archaeological or historical site.

W&R contracted with Brockingham and Associates, Inc. to conduct a cultural resources investigation of a 200-acre tract of the Central Carolina Tire Disposal facility. This investigation was undertaken pursuant to Section 106 of the Natural Historic Preservations Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified as 36 CFR Part 800.

Background research at the North Carolina Office of State Archaeology identified no previously recorded archaeological sites within the study tract. Four site are located just southeast of the tract. These sites are not eligible for the National Register of Historic Places (NHRP). Background research at the North Carolina Department of Historic Resources (Survey and Planning Branch) did not identify any historic architectural resources in or near the tract.

During the investigation, Brockington & Associates identified eight archaeological site and six isolated finds. Brockington & Associates recommend the archaeological site and isolated finds identified with the tract no eligible for the NRHP.

In summary, no historic properties will be affected by the proposed development of the landfill. Brockington & Associates recommended no further management of cultural resources with the project tract.

The results of Brockington & Associates' Cultural Resources Investigation are located in Attachment 6.2.

6.5 State Nature and Historic Preserves

Rule .0503(1)(b)(iv) states that a site shall not cause an adverse impact on a state park, recreation or scenic area, or any other lands included in the state nature and historic preserve.

There are no state or federal parks or lands in the vicinity of the site. The proposed Phase III tire monofill landfill shall not have an adverse impact on any lands included in a state nature of historic preserve.

6.6 Airport Safety

Rule .0503(1)(c) states that a new site disposing of putrescible wastes shall not be located within 10,000 feet of an airport runway used by turbojet aircraft or within 5,000 feet of an airport runway used by piston-type aircraft.

Since scrap tire waste is not a putrescible waste, W&R assumes that tire monofill landfill will not be required to comply with this rule.

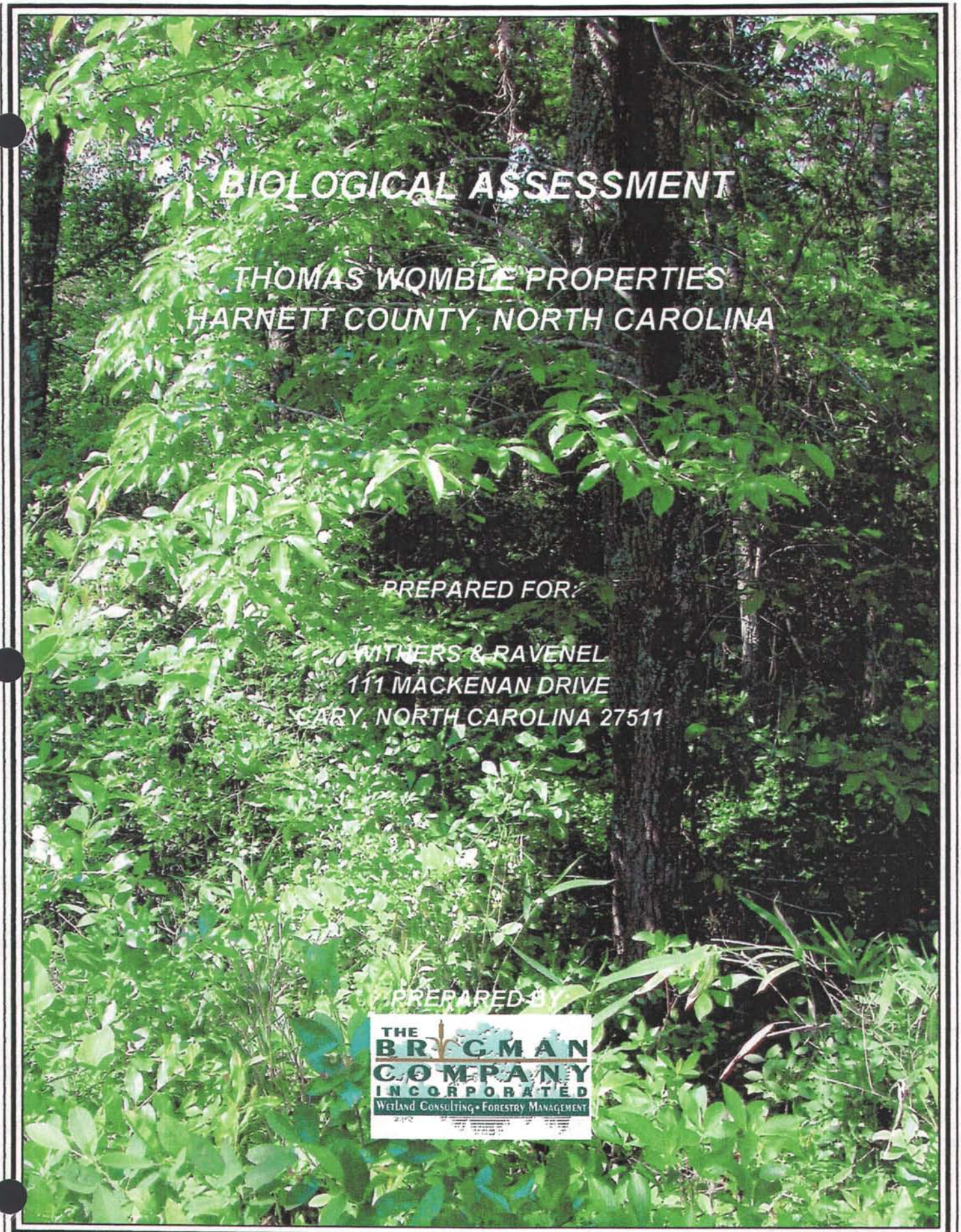
6.7 Cover Material

Rule .0503(1)(d) states that a site shall have available adequate suitable soils for cover either on-site or from off-site.

W&R has determined that an adequate supply of cover soils exists on-site and off-site. A detailed cover volume calculation will be included in the Construction Plan Application.

ATTACHMENT 6.1

ENDANGERED AND THREATENED SPECIES
BIOLOGICAL ASSESSMENT
BY THE
BRIGMAN COMPANY, INC.



BIOLOGICAL ASSESSMENT

THOMAS WOMBLE PROPERTIES
HARNETT COUNTY, NORTH CAROLINA

PREPARED FOR:

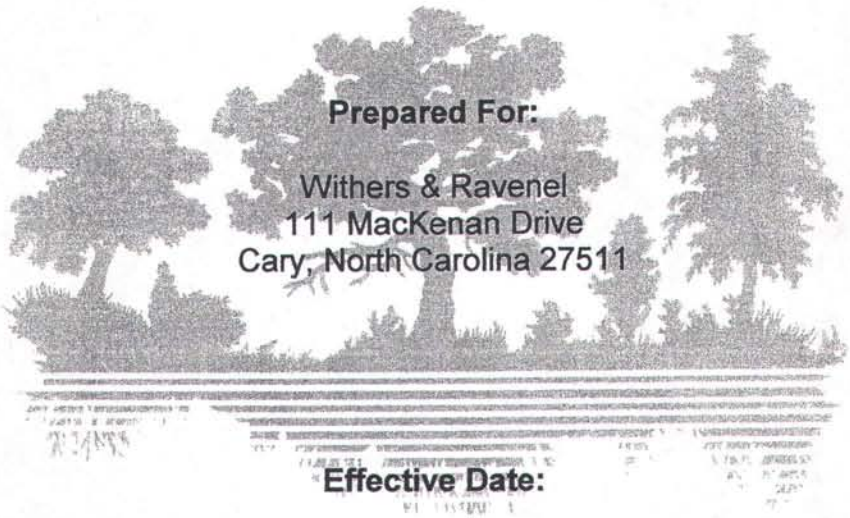
WITHERS & RAVENEL
111 MACKENAN DRIVE
CARY, NORTH CAROLINA 27511

PREPARED BY:

THE BRYCMAN COMPANY INCORPORATED
Wetland Consulting • Forestry Management

BIOLOGICAL ASSESSMENT

Thomas Womble Property
Harnett County, North Carolina



Prepared For:

Withers & Ravenel
111 MacKenan Drive
Cary, North Carolina 27511

Effective Date:

June 16, 2003

Prepared By:

THE BRIGMAN COMPANY, INC.
PO BOX 1532
CONWAY, SC 29528

INTRODUCTION

The Brigman Company, Inc. has completed a Biological Assessment on the Thomas Womble Tract in Harnett County, North Carolina (see figure 1). The purpose of this Biological Assessment was to provide a professional opinion as to whether any federally threatened, endangered, or proposed species existed on-site. Work was authorized and site access was granted by Mr. Vance Moore of Withers & Ravenel.
There is no federal nexus that applies to this project at the time of this assessment. However, the client is aware of the required compliance to Section 7 of the Endangered Species Act of 1973, as amended (ESA). Therefore, to access the feasibility of future development, The Brigman Company, Inc. was assigned the task of completing a Biological Assessment.

PROJECT SITE DESCRIPTION

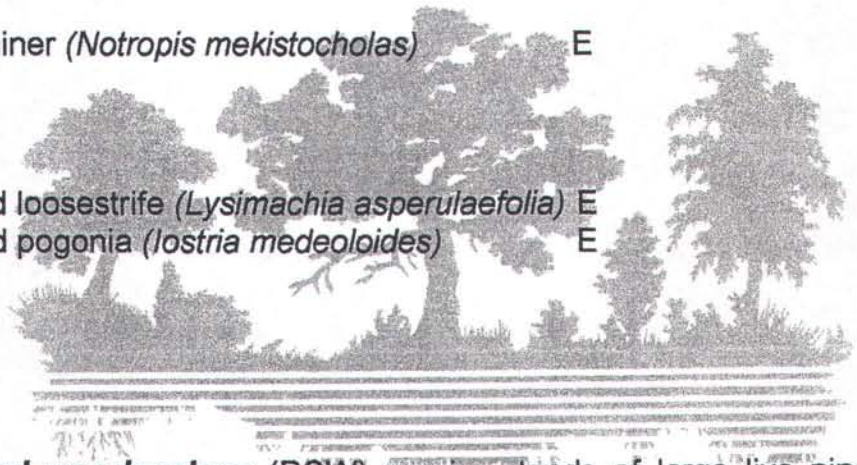
The project site is situated in the southwestern corner of Harnett County, North Carolina. The site is located between NC Highway 24-27 and NC Highway 1107 (Cypress Church Road). Specifically, the site is 8500 feet South of the intersection of NC Highway 24-27 and NC Highway 1105 (McKoy Town Road), on McKoy Town Road. The project study area is approximately 175 acres.

The subject site contains two distinct habitat types: Pine/Scrub Oak Sand hills and Streamhead Pocosins. The Pine/Scrub Oak Sandhills surrounding the wetland systems onsite make up 140.64 acres of the project site. This area consists of young pines and mixed hardwoods not over 10 years of age. Vegetation in this area consists mostly of Longleaf pine (Pinus palustris), Loblolly pine (Pinus teada), Southern red oak (Quercus falcata), Turkey oak (Quercus laevis), Black cherry (Prunus serotina), Flowering dogwood (Cornus florida), Broom-sedge (Andropogon virginicus), Pineland three-awn grass (Aristida stricta) and Bracken fern (Pteridium aquilinum). Fire has been absent from this portion of the site for several years. The majority of the wetlands onsite can be classified as streamhead pocosins. These wetlands are saturated during most of the year and are mapped as Bibb soil unit. This area consists of semi-mature mixed hardwoods with a very dense understory of shrubs. The dominant species present include: Pond pine (Pinus serotina), Swamp tupelo (Nyssa biflora), Yellow poplar (Liriodendron tulipifera), Red maple (Acer rubrum) Ti ti (Cyrilla racemiflora), Fetterbush (Lyonia lucida), Sweet pepper-bush (Clethra alnifolia), Large gall berry (Ilex glabra), Small gall berry (Ilex coriacea) and Laurel-leaf greenbriar (Smillax laurifolia). The Streamhead Pocosin wetlands occupy approximately 34.36 acres of the site. This area of the site also lacks the presence of fire within the past several years.

FEDERALLY LISTED SPECIES

Based on the literature review and communication with various federal agencies, the following list of federally threatened or endangered species occurring in Harnett County was prepared. The list was acquired from the USFWS website on April 7, 2003. The list was last updated February 24, 2003 by USFWS. (E=Federal Endangered, T= Federal Threatened, P= Proposed in the Federal Register).

	Status	Certainty of Occurrence
Birds		
Red-cockaded woodpecker *(Picoides borealis)*	E	Known
Fish		
Cape Fear shiner *(Notropis mekistocholas)*	E	Known
Plants		
Rough-leaved loosestrife *(Lysimachia asperulaefolia)*	E	Known
Small whorled pogonia *(Iostria medeoloides)*	E	Known



Birds

Red-cockaded woodpeckers (RCW) require stands of large live pines (preferably longleaf pines which are 60 years or older) with no hardwood under story. Foraging habitat is provided by surrounding pine and pine hardwood stands of 30 years old or more. Most foraging occurs for pine trees 10 inches or larger in diameter (USFWS 2003).
The Pine/Shrub Oak Sandhills- located on the tract were clearcut approximately seven to ten years ago. These areas now contain very dense understory vegetation. These areas consist mostly of: Longleaf pine (Pinus palustris), Loblolly pine (Pinus taeda), Southern red oak (Quercus falcata), Turkey oak (Quercus laevis), Black cherry (Prunus serotina), Common persimmon (Diospyros virginiana), Broom-sedge (Andropogon virginicus), Pineland three-awn grass (Aristida stricta), Poison oak (Toxicodendron quercifolia) and Bracken fern (Pteridium aquilinum).

Due to the lack of age and extreme density of these areas they were found to contain no suitable habitat for RCW's. Furthermore, no birds or nest cavity trees were observed upon site inspection.

Fish

The ***Cape Fear shiner*** is a small fish that rarely exceeds 2 inches in length. The fish's body is flushed with a pale silvery yellow and black band runs along its sides (Snelson 1971). The fins are yellowish and somewhat pointed. The upper lip is black, and the lower lip bears a thin black bar along its margin. The Cape Fear shiner feeds extensively on plant material, thus its digestive tract is modified by having an elongated, convoluted intestine. Plant material forms the primary part of the shiner's diet. No information is presently available on the species' breeding behavior, fecundity, or longevity. (USFWS 2003).

The species is generally associated with gravel, cobble, and boulder substrates and has been observed to inhabit slow pools, riffles, and slow runs (Snelson 1971, Pottern and Huish 1985). In these habitats, the species is typically associated with schools of other related species, but it is never the numerically dominant species. Juveniles are often found in slackwater, among large rock outcrops in midstream, and in flooded side channels and pools (Pottern and Huish 1985). Most of the streams located on-site are not deep enough to sustain aquatic life. Most are very small in size approximately two to four feet in width. Since this site is not bordered by any contiguous deep water aquatic bodies no suitable habitat for the species is present.

Plants

Small whorled pogonia is a perennial with long, pubescent roots and a smooth, hollow stem 9.5 to 25 centimeters (cm) tall terminating in a whorl of 5 or 6 light green, elliptical leaves that are somewhat pointed and measure up to 8 by 4 cm. A flower, or occasionally two flowers, is produced at the top of the stem. Flowering occurs from about mid-May to mid-June, with the flowers apparently lasting only a few days to a week or so. Also, this plant doesn't necessarily flower annually. Individual plants may not flower every year; and extended dormancy, although not scientifically documented, is purported to occur under certain conditions (USFWS 2003). This species is generally known from open, dry, deciduous woods with acid soil. It occurs in habitat where there is relatively high shrub coverage or high sapling density, flowering appears to be inhibited. No suitable habitat or species were observed during survey.

Rough-leaved loosestrife has slender stems, which grow from a rhizome and reach heights of 3 to 6 decimeters (1 to 2 feet). Whorls of 3 to 4 leaves encircle the stem at intervals beneath the showy yellow flowers. Flowering occurs from mid-May through June, with fruits present from July through October (Kral 1983, Radford et al. 1968). This species is easily distinguished from the one other similar southeastern species of Lysimachia, Lysimachia loomisii Torrey, by its broader, glandular leaves and much larger flowers (Kral

1983).
This species generally occurs in the ecotones or edges between longleaf pine uplands and pond pine pocosins (areas of dense shrub and vine growth usually on a wet, peaty, poorly drained soil) (Barry 1980), on moist to seasonally saturated sands and on shallow organic soils overlaying sand. Rough-leaved loosestrife has also been found on deep peat in the low shrub community of large Carolina bays (shallow, elliptical, poorly drained depressions of unknown origin) (Matthews et al., 1980). The grass-shrub ecotone, where rough-leaved loosestrife is found, is fire-maintained, as are the adjacent plant communities (longleaf pine - scrub oak, savanna, flatwoods, and pocosin). Suppression of naturally-occurring fire in these ecotones results in shrubs increasing in density and height and expanding to eliminate the open edges required by this plant. See determination of effect for further details.

SURVEY METHODOLOGY

Aerial photographs were used to locate any areas of potential habitat for federally threatened or endangered species (See attached maps). The US Fish and Wildlife Service's database was cited for occurrences of any Threatened, Endangered or Proposed Species in Harnett County. Transect surveys of the site were conducted on May 28, 2003 to give a professional opinion as to the presence or absence of any federally endangered, threatened or proposed species (see survey map). The transect survey was more specifically conducted in the marginally suitable areas of the site for the presence of Rough-leaved loosestrife. The identification of these species was facilitated by use of various field guides and by previous experience.

DETERMINATION OF EFFECT

The only marginally suitable habitat present onsite is located within the transition of the Pine/Shrub Oak Sandhills and streamhead pocosins. This area was surveyed intensively for the presence of Rough-leaved loosestrife and found to be void of the species due to the suppression of natural fire in the area. The transition area was very dense with shrubs, thus eliminating the open edges required by this plant. The remainder of the site held no suitable habitat for any other federally threatened, endangered or proposed species of concern; therefore a **no effect** determination has been made.

LIMITATIONS

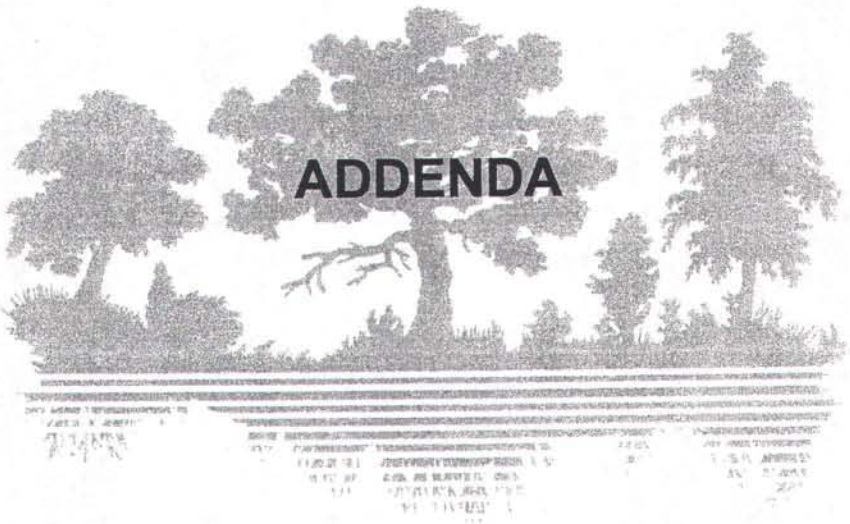
This report has been prepared for the exclusive use of Withers & Ravenel and its designees for specific application to the subject tract. Copies of our report may be distributed provided their use is consistent with the scope and intent of our services. Our findings have been developed in accordance with generally accepted standards of practice. No other warranty is expressed or implied. The client recognizes that future changes in regulations and guidelines may affect the findings presented in this report.

ACKNOWLEDGMENT

The Brigman Company, Inc. appreciates the opportunity to be of service to you by performing this Biological Assessment on the project site and preparing this report.

Respectfully submitted,

Britt A. Feldner
Wetland Ecologist


ADDENDA

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SCALE IN FEET 8000' 0 8000'

SITE

FORT BRAGG

MILITARY

POPE AIR FORCE BASE

82nd Airborne

HOKE CO

CUMBERLAND CO

HARNETT CO

MOORE CO

Little River

Big Ridge

Wooldake

SEABOARD

Cameron

Overhills

Gibsons

Buffalo

Smith Lake

FIGURE 1

THE BRIGMAN COMPANY INCORPORATED
Wetland Consulting • Forestry Management

LOCATION MAP

PREPARED FOR:
THOMAS WOMBLE PROPERTIES
LOCATED IN:
HARNETT COUNTY, NORTH CAROLINA

SCALE: 1" = 8000'
3-1-2003
TWSP: JOHNSONVILLE
JOB NO.: 03027
DWG. NO.: 03027SOILS
PROJECT MGR.: BAF

AGENT: THE BRIGMAN COMPANY, INC., P.O. BOX 1532, CONWAY SC 29526 (843) 248-9388 FAX: (843) 248-9596

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FIGURE 2

THE BRIGMAN COMPANY INCORPORATED
Wetland Consulting • Forestry Management

USGS 7.5 MINUTE QUADRANGLE

PREPARED FOR:
THOMAS WOMBLE PROPERTIES
LOCATED IN:
HARNETT COUNTY, NORTH CAROLINA

SCALE: 1" = 1000'
3-1-2003
TWSP: JOHNSONVILLE
JOB NO.: 03027
DWG. NO.: 03027SOILS
PROJECT MGR.: BAF

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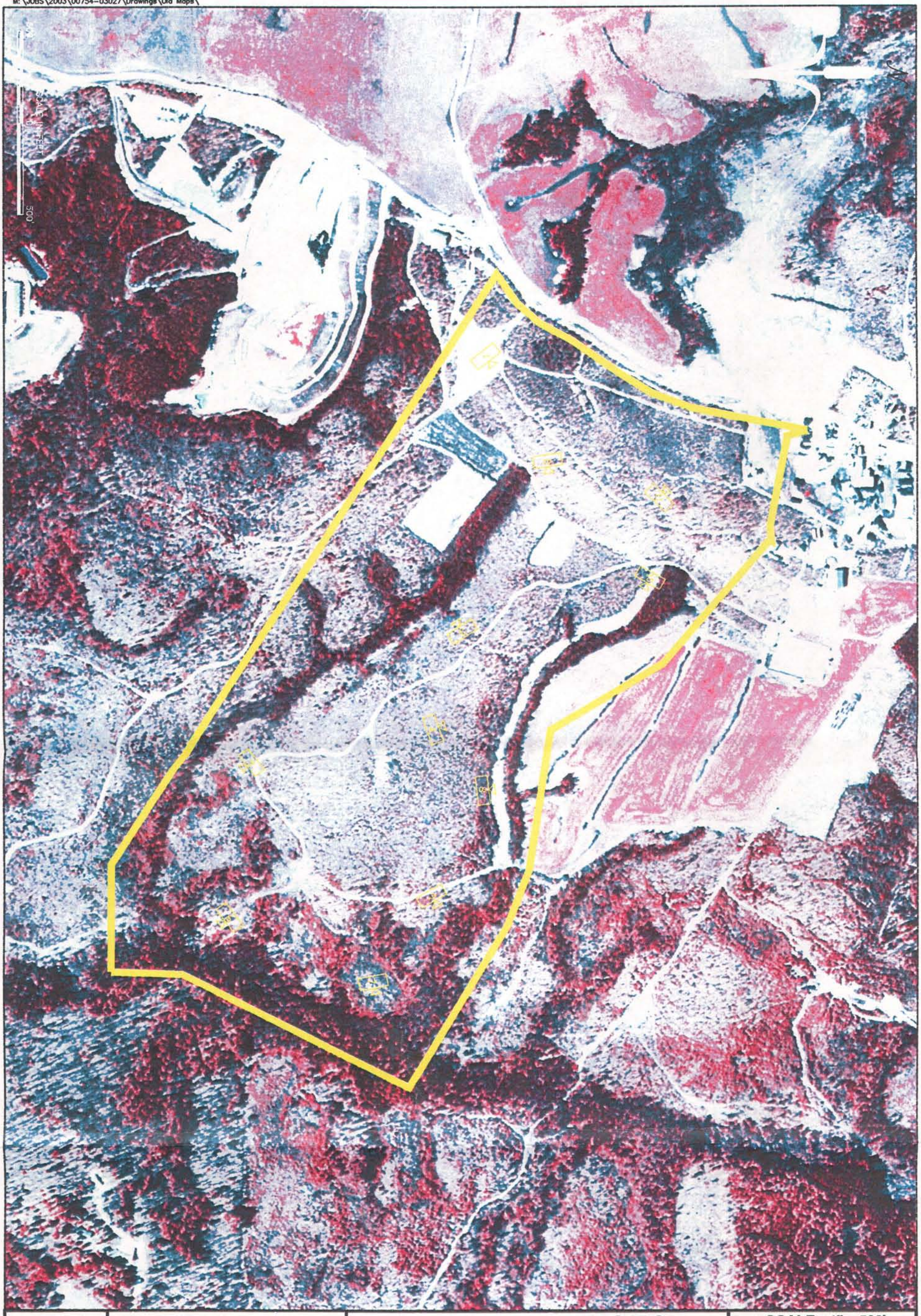

FIGURE 3	THE BRIGMAN COMPANY INCORPORATED Wetland Consulting • Forestry Management	*1999 C.I.R. PHOTO* PREPARED FOR: THOMAS WOMBLE PROPERTIES LOCATED IN: HARNETT COUNTY, NORTH CAROLINA	SCALE: 1" = 500'
			3-1-2003
			TWSP: JOHNSONVILLE
			JOB NO.: 03027
			DWG. NO.: 03027SOILS
			PROJECT MGR.: BAF

AGENT: THE BRIGMAN COMPANY, INC., P.O. BOX 1532, CONWAY SC 29526 (843) 248-9388 FAX: (843) 248-9596

Photo Point #1

Photo Point #2 (Upland Forest)

Sandhills milkvetch	*Astragalus michauxii*	FSC
Sandhills pyxie-moss	*Pyxidanthera barbulata var. brevifolia*	FSC
Savanna cowbane	*Oxypolis ternata*	FSC
Small-whorled pogonia	*Isotria medeoloides*	Threatened*
Spring-flowering goldenrod	*Solidago verna*	FSC
Sun-facing coneflower	*Rudbeckia heliopsidis*	FSC

KEY:

Status	Definition
Endangered -	A taxon "in danger of extinction throughout all or a significant portion of its range."
Threatened -	A taxon "likely to become endangered within the foreseeable future throughout all or a significant portion of its range."
Proposed -	A taxon proposed for official listing as endangered or threatened.
C1 -	A taxon under consideration for official listing for which there is sufficient information to support listing.
FSC -	A Federal species of concern--a species that may or may not be listed in the future (formerly C2 candidate species or species under consideration for listing for which there is insufficient information to support listing).
T(S/A) -	Threatened due to similarity of appearance (e.g., American alligator)--a species that is threatened due to similarity of appearance with other rare species and is listed for its protection. These species are not biologically endangered or threatened and are not subject to Section 7 consultation.
EXP -	A taxon that is listed as experimental (either essential or nonessential). Experimental, nonessential endangered species (e.g., red wolf) are treated as threatened on public land, for consultation purposes, and as species proposed for listing on private land.

Species with 1, 2, 3, or 4 asterisks behind them indicate historic, obscure, or incidental records.

*Historic record - the species was last observed in the county more than 50 years ago.

**Obscure record - the date and/or location of observation is uncertain.

***Incidental/migrant record - the species was observed outside of its normal range or habitat.

****Historic record - obscure and incidental record.

Photo Point #3 (Wetland Edge)

Photo Point #4 (Upland Forest)

Photo Point #5 (Wetland Edge)

Photo Point #6 (Wetland)

Photo Point #7 (Wetland Edge)

Photo Point #8 (Wetland Upland Transition)

Photo Point #9 (Wetland)

Photo Point #10 (Wetland Upland Transition)

Photo Point #11

RED-COCKADED WOODPECKER

Picoides (=Dendrocopos) borealis

FAMILY: Picidae

STATUS: Endangered, *Federal Register*, October 13, 197O

DESCRIPTION: The red-cockaded woodpecker is 18 to 2O centimeters long with a wing span of 35 to 38 centimeters. There are black and white horizontal stripes on its back, and its cheeks and underparts are white. Its flanks are black streaked. The cap and stripe on the side of the neck and the throat are black. The male has a small red spot on each side of the black cap. After the first post fledgling molt, fledgling males have a red crown patch. This woodpecker's diet is composed mainly of insects which include ants, beetles, wood-boring insects, caterpilars, and corn ear worms if available. About 16 to 18 percent of the diet includes seasonal wild fruit.

REPRODUCTION AND DEVELOPMENT: Egg laying occurs during April, May, and June with the female utilizing her mate's roosting cavity for a nest. Maximum clutch size is seven eggs with the average being three to five eggs. From egg laying to fledging requires about 38 days, and then another several weeks are needed before the young become completely independent. Most often, the parent birds and some of their male offspring from previous years form a family unit called a group. A group may include one breeding pair and as many as seven other birds. Commonly, these groups are comprised of three to five birds. Rearing the young birds becomes a shared responsibility of the group. However, a single pair can breed successfully without the benefit of the helpers.

RANGE AND POPULATION LEVEL: This bird's range is closely tied to the distribution of southern pines. Historically, the red-cockaded woodpecker occurred from East Texas and Oklahoma, to Florida, and North to New Jersey. The present distribution is similar, except the species has been extirpated from Missouri, Maryland, and New Jersey. The remaining populations are fragmented into isolated, island populations. Current population level is estimated at 4,5OO groups or 1O,OOO to 12,OOO birds.

HABITAT: Open stands of pines with a minimum age of 8O to 12O years, depending on the site, provide suitable nesting habitat. Longleaf pines (*Pinus palustris*) are most commonly used, but other species of southern pine are also acceptable. Dense stands (stands that are primarily hardwoods, or that have a dense hardwood understory) are avoided. Foraging habitat is provided in pine and pine hardwood stands 3O years old or older with foraging preference for pine trees 1O inches or larger in diameter. In good, well-stocked, pine habitat, sufficient foraging substrate can be provided on 8O to 125 acres.

Roosting cavities are excavated in living pines, and usually in those which are infected with a fungus producing what is known as red-heart disease. The cavity tree ages range from 63 to 3OO plus years for longleaf, and 62 to 2OO plus years for loblolly and other pines. The aggregate of cavity trees is called a cluster and may include 1 to 2O or more cavity trees on 3 to 6O acres. The average cluster is about 1O acres. Completed cavities in active use have numerous, small resin wells which exude sap. The birds keep the sap flowing apparently as a cavity defense mechanism against rat snakes and possibly other predators. The territory for a group averages about 2OO acres, but observers have reported territories running from a low of around 6O acres, to an upper extreme of more than 6OO acres. The expanse of territories is related to both habitat suitability and population density.

REASONS FOR CURRENT STATUS: The red-cockaded woodpecker was described by Audubon as being abundant in 1839, but it received little study until around 197O, when investigations began to indicate that the species could be headed for extinction. The decline is attributed primarily to the reduction of pine forest with trees 8O years old and older and to the encroachment of hardwood midstory due to fire supression in clusters. Living pines in this age group, infected with red-heart disease, generally provide the specialized nesting sites which these woodpeckers require.

MANAGEMENT AND PROTECTION: Some of the recommendations included in the species' recovery plan are: (1) Survey, monitor, and assess the status of individual populations and the species; (2) Implement protection and management of nesting and foraging habitat on Federal lands; (3) Encourage protection and management on private lands; (4) Conduct research on habitat needs and management, population dynamics, and genetic variation, and (5) Inform and involve the public.

The U.S. Forest Service, the U.S. Fish and Wildlife Service, and the U.S. Army are all working on comprehensive management and recovery guidelines for their respective federal properties (national forests, national wildlife refuges, and army installations)

where the bird will be recovered. Additionally, the issues surrounding protection and management of red-cockaded woodpeckers on private lands are being addressed through a three-part private lands strategy which includes a procedural manual for private landowners, Statewide Habitat Conservation Plans, and Memorandums of Agreement with industrial forest landowners.

In January 1993, the third annual red-cockaded woodpecker symposium was held. Proceedings will be available through the Fish and Wildlife Service in 1994.

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ROUGH-LEAVED LOOSESTRIFE

(*Lysimachia asperulaefolia*)

FAMILY: Primulaceae

STATUS: Endangered, *Federal Register*, June 12, 1987

DESCRIPTION: The slender stems of this perennial herb grow from a rhizome and reach heights of 3 to 6 decimeters (1 to 2 feet). Whorls of 3 to 4 leaves encircle the stem at intervals beneath the showy yellow flowers. Flowering occurs from mid-May through June, with fruits present from July through October (Kral 1983, Radford *et al.* 1968). This species is easily distinguished from the one other similar southeastern species of *Lysimachia*, *Lysimachia loomisii* Torrey, by its broader, glandular leaves and much larger flowers (Kral 1983).

RANGE AND POPULATION LEVEL: Rough-leaved loosestrife is a species endemic to the coastal plain and sandhills of North Carolina and South Carolina. It is currently known from 35 populations in North Carolina and one in South Carolina. The single extant site in South Carolina is in Richland County. North Carolina's extant populations are in the following counties: Brunswick (8 populations); Pender (1 population); Bladen (1 population); Carteret (8 populations); Scotland (3 populations); Cumberland (5 populations); Onslow (3 populations); Hoke (5 populations); and Pamlico (1 population). Historically, Rough-leaved loosestrife was known from 15 other sites in Brunswick, Pender, Cumberland, Onslow, Beaufort, Columbus, Pamlico, and Richmond Counties,

North Carolina, and Darlington County, South Carolina. Most of the populations are small, both in area covered and in number of stems.

HABITAT: This species generally occurs in the ecotones or edges between longleaf pine uplands and pond pine pocosins (areas of dense shrub and vine growth usually on a wet, peaty, poorly drained soil) (Barry 1980), on moist to seasonally saturated sands and on shallow organic soils overlaying sand. Rough-leaved loosestrife has also been found on deep peat in the low shrub community of large Carolina bays (shallow, elliptical, poorly drained depressions of unknown origin) (Matthews *et al.*, 1980). The grass-shrub ecotone, where rough-leaved loosestrife is found, is fire-maintained, as are the adjacent plant communities (longleaf pine - scrub oak, savanna, flatwoods, and pocosin). Suppression of naturally-occurring fire in these ecotones results in shrubs increasing in density and height and expanding to eliminate the open edges required by this plant.

REASONS FOR CURRENT STATUS: Fire suppression, drainage, and, to a lesser extent, residential and industrial development have altered and eliminated habitat for this species and continue to be the most significant threats to the species' continued existence (Carter 1985; Kral 1983).

MANAGEMENT AND PROTECTION EFFORTS: Many of the remaining populations are on public lands owned by the Department of Defense (Fort Bragg, Camp Lejeune, Fort Jackson, and Sunny Point Military Ocean Terminal), the North Carolina Wildlife Resources Commission, the U.S. Forest Service, and the North Carolina Department of Environment, Health, and Natural Resources. Most of these populations are being managed with controlled burning and are protected from adverse habitat alterations by the land managers. The Nature Conservancy owns and manages one of the North Carolina sites. Another of North Carolina's privately-owned sites is registered as a natural area with the Natural Heritage Program. The North Carolina Natural Heritage Program has also negotiated management agreements with power companies that maintain powerline rights-of-way adjacent to populations. The remaining sites on private land are suffering from fire suppression. Collection and storage of seeds and plant material is planned in cooperation with the Center for Plant Conservation and its member gardens.

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SMALL WHORLED POGONIA

(*Isotria medeoloides*)

FAMILY: Orchidaceae

STATUS: Threatened, *Federal Register*, October 6, 1994

DESCRIPTION AND REPRODUCTION: Small whorled pogonia is a perennial with long, pubescent roots and a smooth, hollow stem 9.5 to 25 centimeters (cm) tall terminating in a whorl of 5 or 6 light green, elliptical leaves that are somewhat pointed and measure up to 8 by 4 cm. A flower, or occasionally two flowers, is produced at the top of the stem. Small whorled pogonia's nearest relative is *I. verticillata*, which is similar looking but can be distinguished by its purplish stem and by differences in the flower structure. *I. verticillata* is much more common and widespread than the small-whorled pogonia. When not in flower, young plants of Indian cucumber-root (*Medeola virginiana*) also resemble small whorled pogonia. However, the hollow stout stem of *Isotria* will separate it from the genus *Medeola*, which has a solid, more slender stem.

Flowering occurs from about mid-May to mid-June, with the flowers apparently lasting only a few days to a week or so. Also, this plant doesn't necessarily flower annually. Usually only one flower is produced per plant. If pollination occurs, a capsule may be formed which can contain several thousand minute seeds. No evidence of insect pollination has been observed. This plant is believed to be self-pollinating by mechanical processes. The flower lacks both nectar guides and fragrance. There is no evidence for asexual reproduction. Individual plants may not flower every year; and extended dormancy, although not scientifically documented, is purported to occur under certain conditions.

RANGE AND POPULATION LEVEL: This plant formerly occurred in 48 counties in 16 eastern states and Canada, but when listed as endangered in 1982 it was known to exist in only 16 counties in 1O states, and one county in Ontario, Canada. By 1991, a total of 86 sites in 15 states were known, and by 1993, there was a known total of 104 sites in 15 states. Most populations are centered in the foothills of the Appalachian Mountains in New England and northern coastal Massachusetts The 23 populations in the Southeast Region occur in North Carolina (5 populations); South Carolina (4 populations); Georgia (13 populations); and Tennessee (1 population). Most Southeastern populations number less than 25 plants. South Carolina has one population of over 25 plants, and Georgia has two populations numbering about 100 plants. Small whorled pogonia is also known from Virginia, Delaware, and New Jersey, Pennsylvania, Ohio, Michigan, Illinois, and Ontario, Canada.

This plant was reclassified from endangered to threatened because the number of known populations increased from 34 in 1985 to 104 in 1993. Also, the species' 1992 revised recovery plan stipulates that at least 25 percent of the plant's self-sustaining populations were protected through public ownership or private landowner management agreement. According to the October 6, 1994 *Federal Register* notice which officially downlisted the species, a total of 46 small whorled pogonia sites are currently protected rangewide, 24 of which have self-sustaining populations. In the Southeast, North Carolina has two protected sites, both of which are viable; South Carolina has four protected sites, two of which are viable; and Georgia has seven protected sites, four of which are viable.

HABITAT: This species is generally known from open, dry, deciduous woods with acid soil. It occurs in habitat where there is relatively high shrub coverage or high sapling density, flowering appears to be inhibited.

REASONS FOR CURRENT STATUS: The current status of small whorled pogonia is attributed to loss of habitat and overutilization for scientific and private collections. However, some populations observed for a number of years have also declined for unknown reasons.

MANAGEMENT AND PROTECTION: Management needs are unknown, but some habitat manipulation, as determined by future research, may be necessary to maintain certain populations. Effective management will require more information on the method of pollination, identification of pollen vectors, pollen and seed viability, seed dispersal mechanisms, competing vegetation, and abiotic factors such as light, soil, moisture, and disturbance effects, including fire.

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(Small Whorled Pogonia) From Endangered to Threatened. *Federal Register* 59:193. p. 50852-50857.

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U.S. Fish and Wildlife Service. 1985. Small Whorled Pogonia Recovery Plan. Prepared by Peter G. Poulos for U.S. Fish and Wildlife Service, Newton Corner, Massachussetts. 45 pp.

CAPE FEAR SHINER

(*Notropis mekistocholas*)

STATUS: Endangered, *Federal Register*, September 25, 1987

DESCRIPTION: The Cape Fear shiner is small, rarely exceeding 2 inches in length. The fish's body is flushed with a pale silvery yellow, and a black band runs along its sides (Snelson 1971). The fins are yellowish and somewhat pointed. The upper lip is black, and the lower lip bears a thin black bar along its margin. The Cape Fear shiner, unlike most other members of the large genus *Notropis*, feeds extensively on plant material, and its digestive tract is modified for this diet by having an elongated, convoluted intestine. Plant material forms the primary part of the shiner's diet. No information is presently available on the species' breeding behavior, fecundity, or longevity.

RANGE AND POPULATION LEVEL: The Cape Fear shiner is known from four small populations in the Cape Fear drainage in Randolph, Moore, Lee, Harnett, and Chatham Counties, North Carolina. Total numbers are unknown, but all populations appear to be small. Surveys conducted in 1984 and 1985 yielded 1O1 individuals from the population located around the junction of the Rocky River and Deer River in Chatham and Lee Counties, one specimen from the Rocky River near State Highway Bridge 9O2 in Chatham County, and six specimens from the Deep River system in Randolph and Moore Counties.

The strongest population is located around the junction of the Rocky River and Deep River in Chatham and Lee Counties where the fish inhabits the Deep River from the upstream limits of the backwaters of Locksville Dam upstream to the Rocky River; then upstream from the Rocky River to Bear Creek, and upstream from Bear Creek to the Chatham County Road 2156 Bridge. A few individuals have been collected just downstream of the Locksville Dam, but because of the limited extent of Cape Fear shiner habitat at this site, it is not believed this is a separate population. Instead, it is thought

these fish represent a small number of individuals that periodically drop down from the population above Locksville Dam pool.

The second population is located above the Rocky River Hydroelectric Dam. This population was historically the best, but the area yielded only one specimen after extensive surveys by Pottern and Huish (1985). The third population is found in the Deep River system in Randolph and Moore Counties. This population is believed to be small (Pottern and Huish 1985, 1986). In a 1985 survey, three individuals were found above the Highfalls Hydroelectric Reservoir; one in Fork Creek, Randolph County, and two in the Deep River, Moore County. The species was also found downstream of the Highfalls Dam. However, the extent of suitable habitat in this stream reach is limited, and it is thought that these individuals likely result from downstream movement from above the reservoir where Cape Fear shiner habitat is more extensive. The fourth population is found in Neal Creek, which flows into the Cape Fear River near Lillington in Harnett County.

Three historic populations have apparently been extirpated one in Robeson Creek, Chatham County, believed lost when Jordan Lake flooded part of the creek; and one each in Parkers Creek and Kenneth Creek in Harnett County, which disappeared for unknown reasons. Other undiscovered populations or population segments have likely been lost due to reservoir construction in the Deep, Haw, and Cape Fear Rivers.

HABITAT: The species is generally associated with gravel, cobble, and boulder substrates and has been observed to inhabit slow pools, riffles, and slow runs (Snelson 1971, Pottern and Huish 1985). In these habitats, the species is typically associated with schools of other related species, but it is never the numerically dominant species. Juveniles are often found in slackwater, among large rock outcrops in midstream, and in flooded side channels and pools (Pottern and Huish 1985).

CRITICAL HABITAT: (1) North Carolina, Chatham County. Approximately 4.1 miles of the Rocky River from North Carolina State Highway 9O2 Bridge downstream to Chatham County Road 1O1O Bridge; (2) North Carolina, Chatham and Lee Counties. Approximately O.5 river mile of Bear Creek, from Chatham County Road 2156 Bridge downstream to the Rocky River, then downstream in the Rocky River (approximately 4.2 river miles) to the Deep River, then downstream in the Deep River (approximately 2.6 river miles) to a point O.3 river mile below the Moncure, North Carolina, U.S. Geological Survey Gaging Station; and (3) North Carolina. Randolph and Moore Counties. Approximately 1.5 miles of Fork Creek, from a point 0.1 river mile upstream of Randolph County Road 2873 Bridge downstream to the Deep River then downstream approximately 4.1 river miles of the Deep River in Randolph and Moore Counties, North Carolina, to a point 2.5 river miles below Moore County Road 1456 Bridge.

Constituent elements include clean streams with gravel, cobble, and boulder substrates with pools, riffles, shallow runs and slackwater areas with large rock outcrops and side channels and pools with water of good quality with relatively low silt loads.

REASONS FOR CURRENT STATUS: The Cape Fear shiner may always have existed in low numbers. However, its recent reduction in range and its small population size (Pottern and Huish 1985, 1986) increases the species' vulnerability to a catastrophic event, such as a toxic chemical spill. Dam construction in the Cape Fear system has probably had the most serious impact on the species by inundating the species' rocky riverine habitat. Changes in flow regulation at existing hydroelectric facilities could further threaten the species.

The deterioration of water quality has likely been another factor in the species' decline. The North Carolina Department of Natural Resources and Community Development (1983) classified water quality in the Deep River, Rocky River, and Bear Creek as good to fair, and referred to the Rocky River below Silver City as an area where their sampling indicates degradation. That report also stated "Within the Cape Fear Basin, estimated average annual soil losses from cropland ranged from 3 tons per acre in the lower basin to 12 tons in the headwaters." The North Carolina State Division of Soil and Water Conservation considers 5 tons of soil loss per acre as the maximum allowable.

Potential threats to the species and its habitat could come from such activities as road construction, stream channel modification, changes in stream flows for hydroelectric power, impoundments, land use changes, wastewater discharges, and other projects in the watershed if such activities are not planned and implemented with the survival of the species and protection of its habitat in mind.

MANAGEMENT AND PROTECTION: Assuring survival of the Cape Fear shiner will require, at a minimum, maintaining good water quality and the natural conditions of the remaining habitat. Providing for a higher level of security will necessitate determining limiting factors and reestablishing additional populations into suitable waters within the historic range.

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ATTACHMENT 6.2

CULTURAL RESOURCES INVESTIGATION
BY
BROCKINGHAM AND ASSOCIATES, INC.

Cultural Resources Investigation of the Central Tire Disposal Tract Harnett County, North Carolina

Final Report

Brockington and Associates, Inc.
Atlanta Charleston Raleigh
2004

Cultural Resources Investigation of the Central Carolina Tire Disposal Tract Harnett County, North Carolina

Final Report

Prepared for

Withers & Ravenel, Inc.
Cary, North Carolina

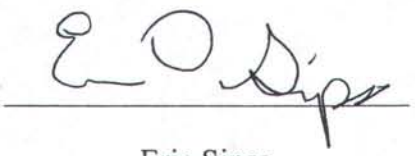
Prepared by

Michael Keith O'Neal
Archaeologist

and

Carrie E. Collins
Laboratory Supervisor

under the supervision of



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January 2004

Management Summary

On behalf of Withers & Ravenel, Inc., Brockington and Associates, Inc., conducted a cultural resources investigation of the 81 hectare (200 acre) Central Carolina Tire Disposal Tract in Harnett County, North Carolina in July, 2003. This investigation was undertaken pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified as 36 CFR Part 800.

Background research at the North Carolina Office of State Archaeology indicated no previously recorded archaeological sites within the study tract. Four sites, 31HT172, 31HT173, 31HT174, and 31HT175, are located just southeast of the tract. These sites are not eligible for the National Register of Historic Places (NRHP). Background research at the North Carolina Department of Historic Resources (Survey and Planning Branch) did not identify any historic architectural resources in or near the tract.

During the present investigations, we identified eight archaeological sites (38HT954, 38HT955, 38HT956, 38HT957, 38HT958, 38HT959, 38HT960, and 38HT961) and six isolated finds (38HT948, 38HT949, 38HT050, 38HT051, 38HT952, and 389HT953). We recommend the archaeological sites and isolated finds identified within the Central Carolina Tire Disposal Tract not eligible for the NRHP. No additional work is recommended at any of these sites.

In summary, no historic properties will be affected by the development of the Central Carolina Tire Disposal tract. We recommend no further management of cultural resources within the project tract.

Acknowledgments

The project crew was Joseph Sanders and Carrie E. Collins. Michael Keith O'Neal served as the Field Director. Field work was conducted in July 2003. Laboratory analysis was conducted by Carrie E. Collins. Report graphics were produced by Joseph Sanders and report documents were edited and produced by Carol Poplin.

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Chapter I. Introduction

In July 2003, Brockington and Associates, Inc., conducted a cultural resources survey of the 81 hectare (200 acre) Central Carolina Tire Disposal tract, in Harnett County, North Carolina. The project tract is located in southwestern Harnett County, near the Moore County line. McKoy Town Road forms the western boundary of the survey tract, while the northern, eastern, and southern boundaries cut across cleared fields and wooded countryside. Figure 1 presents the location of the project tract and all identified cultural resources on the USGS *Murchistown, NC* quadrangle.

This investigation was undertaken on behalf of Withers and Ravenel, Inc., as partial compliance with state and federal permit regulations addressing the identification and management of significant cultural resources. These regulations include:

- Section 404 of the Clean Water Act of 1994 (33USC 1344), as amended;
- Section 106 of the National Historic Preservation Act of 1966 (16 USC 470), as amended and administered buy the regulatory programs of the U.S. Army Corps of Engineers (33 CFR 325);
- 36 CFR Part 800: Protection of Historic Properties.

This investigation consisted of several tasks, including background research, field survey, and laboratory analysis. All cultural resources identified within the project tract were assessed for eligibility to the National Register of Historic Places (NRHP). In summary, the goals of this investigation are:

- To identify all archaeological and historic architectural resources, if present, within the project tract;
- To assess any identified archaeological and historic architectural resources relative to their research potential and NRHP eligibility; and
- To recommend management options for any identified historic properties, as applicable.

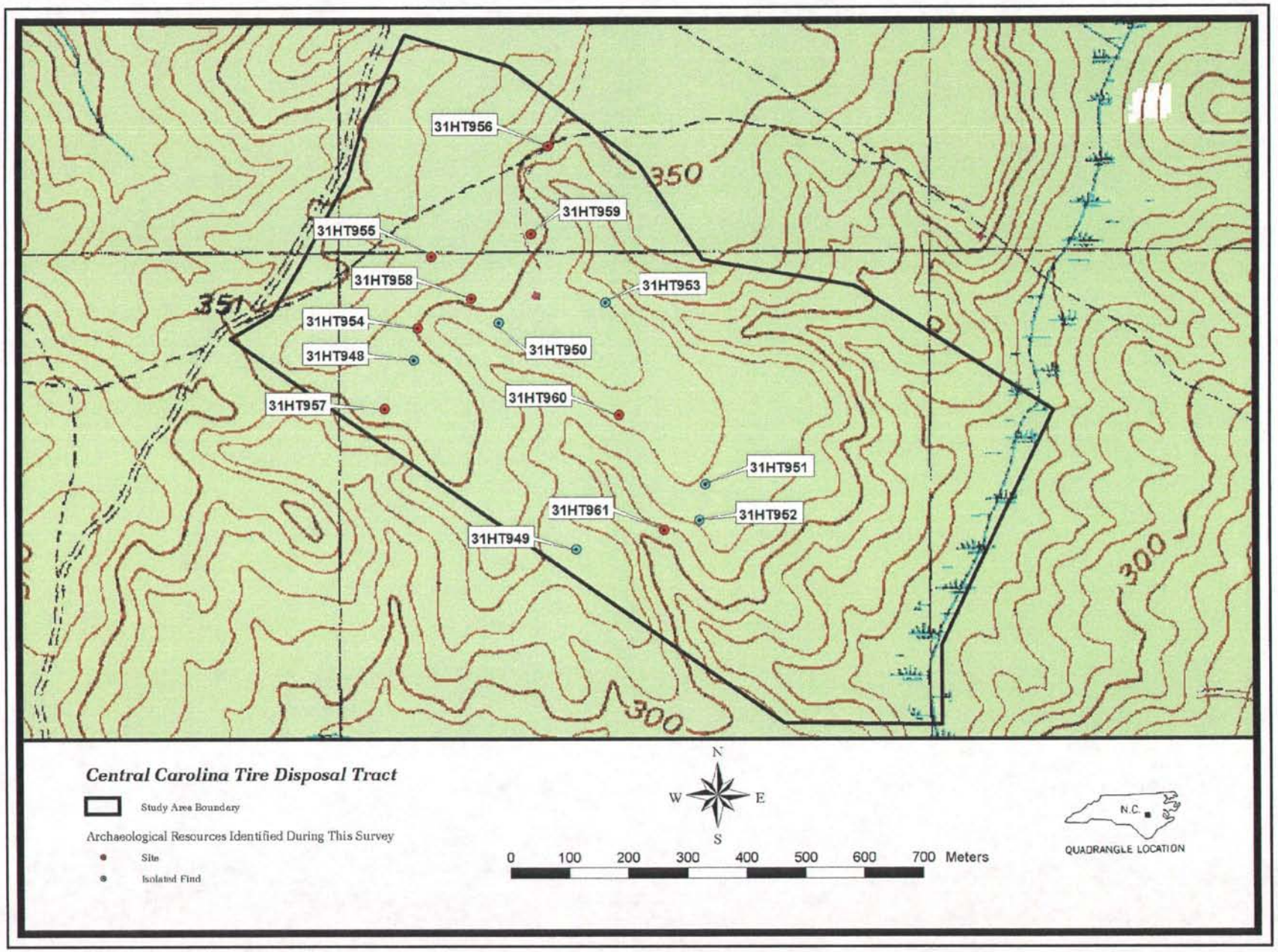

Figure 1. The location of the Central Carolina Tire Disposal tract and identified cultural resources (USGS 1981 *Murchistown, NC* quadrangle).

Chapter II describes the methods employed during this investigation. Chapter III provides an overview of the environmental and cultural contexts for the project area. Chapter IV contains the results of the background research and field investigations and provides a brief summary with management recommendations.

Chapter II. Methods of Investigation

Background Research

Background research helps to establish the types and locations of cultural resources that may occur in the project tract. Published and unpublished sources relating to the archaeology, geography, history, and prehistory of Harnett County and central North Carolina were examined.

To identify previously recorded archaeological sites within 1.6 kilometers (1.0 mile) of the project tract, we reviewed the North Carolina archaeological site files, located at the North Carolina Office of State Archaeology (OSA) in Raleigh. In addition to a review of maps and site forms, reports on file documenting previous archaeological investigations in the region were examined.

The files concerning previously recorded historic architectural resources in Harnett County, located at the North Carolina Department of Cultural Resources, also were examined. Maps, survey forms, and file photographs of previously recorded architectural resources were examined.

Archaeological Survey

Archaeological field survey consisted of systematic coverage of the project tract through the pedestrian traversing of transects spaced across the tract. Transects were spaced at 30 meter (100 ft) intervals, and were generally aligned in cardinal directions. Shovel tests were excavated every 30 meters (100 ft) along the transects. Shovel tests were not excavated in areas judged (through initial shovel testing) to be highly disturbed, and were augmented by visual inspection in areas with good surface visibility. In addition to the initial 30 meter (100 ft) interval coverage, selected landforms (i.e., ridge toes, saddles, etc.) deemed to have good potential to contain archaeological sites were specifically targeted for examination.

Shovel tests measured approximately 0.3 meters (1 ft) in diameter, and were excavated into sterile subsoil (i.e., generally yellowish brown loamy sand at a depth of 0.6 meters [1.8 ft]). Fill from the shovel tests was screened through 1/4 inch mesh hardware cloth. Records of each shovel test were kept in field notebooks, including information on content (e.g., presence or absence of artifacts, artifact descriptions) and context (i.e., soil colors and texture descriptions, depth of definable levels, observed features). All excavations were backfilled on completion. At least one photograph (35 mm format) was taken of the setting at each site recorded.

For this project, an archaeological site is an area containing three or more artifacts of a possible single occupation in a 30 meter (100 ft) or less diameter of surface exposure; or where at least two shovel tests within 30 meters (100 ft) are positive (containing one or more artifacts); or where surface or subsurface cultural features are present. Artifacts of recent age (less than 50 years) typically do not define a site without a compelling research or management justification.

Generally, site boundaries were established by the absence of artifacts or features moving outward in cardinal directions from a defined site center. In areas with poor surface visibility, two negative shovel tests excavated at short intervals (15 meters [50 ft]) were used to establish a site boundary. The definition of archaeological site boundaries also takes into account natural features and/or boundaries (e.g., streams, bluffs, swamps).

Architectural Survey

Architectural survey is part of a comprehensive examination of cultural resources. In the case of this project, as no historic architecture is present in the tract or its immediate vicinity, the architectural survey was not warranted. However, the following outlines the steps that would be taken during an architectural survey.

An architectural survey is conducted by an architectural historian. The project tract boundary constitutes the survey universe. This survey is designed to record and evaluate all historic architectural resources (buildings, structures, objects, designed landscapes, and/or sites with above-ground components) in the project corridor. Field survey methods complied with the *National Register Bulletin 24, Guidelines For Local Surveys: A Basis For Preservation Planning* (Parker 1985). In accordance with the scope of work, the Architectural Historian would drive every street and road in the survey universe, and conduct a pedestrian inspection of all potential historic architectural resources.

The principal criterion used to define historic architectural resources is the 50 year minimum age which is recommended for inclusion on the NRHP. In addition, certain other classes of architectural resources are eligible for intensive survey:

- buildings, sites, structures, and objects constructed after 1950 with architectural significance or historical associations;
- natural landscape features that have cultural associations–mountains, rock formations, rivers, river crossings (fords), trees, springs, and caves–and man-

made landscape features–rice fields, designed landscapes (e.g., parks, gardens), landings, railroad rights-of-way, oak alleys, roads, and Indian mounds; and

- properties already listed on the National Register of Historic Places.

The integrity of a historic architectural resource is a primary consideration for inclusion in the NRHP. In order to have integrity, the resource must retain the physical identity from its historic period. This requires few alterations, or if alterations have been made, they must have used construction materials and methods that are consistent with the original.

While in the field, the Architectural Historian would evaluate the integrity of each potential historic architectural resource. Resources exhibiting poor integrity are not recorded. Four levels of architectural integrity are employed. These include:

Excellent - All original construction materials and design remain intact and unchanged.

Good - The majority of original construction materials remain intact and unchanged except for roofing and other renewable elements.

Fair - A substantial number of original architectural elements have been altered, such as the installation of aluminum, asbestos, or vinyl siding, the substitution of historic doors and windows with non-historic replacements, and the construction of non-historic additions.

Poor - Has been radically altered from its original design by non-historic renovations and/or additions.

References consulted for architectural style and architectural type descriptions included Blumenson (1977), Longstreth (1987), McAlester and McAlester (1984), Poppeliers et al. (1983), and Whiffen (1981).

Laboratory Analysis and Curation

All recovered artifacts were transported to the Raleigh laboratory facilities of Brockington and Associates, Inc., where they were washed, cataloged, and analyzed. Distinct provenience numbers were assigned to each surface scatter and/or shovel test. Artifacts from each provenience were subsequently divided by class/type, and assigned a catalog number.

Typological identification, as manifested by technological and stylistic attributes, served as the basis for prehistoric artifact analysis. Initially, all lithic material was separated by raw material type and cataloged on the basis of attributes indicating their stage in a lithic reduction sequence. These attributes have been identified by a number of researchers (e.g. Bordes 1961; Crabtree 1982; Semenov 1964). These reduction attributes are intended to convey the various phases or aspects of the reduction of lithic raw materials to useable forms by prehistoric tool makers, and the techniques employed during each phase.

Tools were identified within presumed functional categories. These include projectile points (shaped biface or unifaces presumably hafted for a variety of cutting and piercing tasks) and bifaces (roughly shaped fragments that lack regular attributes permitting association with known types of points), as well as flaked and cobble tools. Where possible, formal tools (i.e., projectile points) were identified by known types. Sources for identifying these types include Cambron and Hulse (1975), Coe (1964), and Justice (1987).

The artifact catalog was entered into a Microsoft Access 2000 database; a computer generated artifact catalog is provided in Appendix A. The catalog is arranged by site number and provenience number; report graphics include provenience numbers for each shovel test and subsurface find to facilitate the review of the findings.

Artifacts, project maps, field notes, and photographs presently are stored at the Raleigh facilities of Brockington and Associates, Inc. Artifacts were bagged in resealable polyethylene bags with catalog tags and bag information enclosed. For final curation, artifact bags will be placed in archivally stable acid-free boxes. Following submittal of the final report of investigations, these materials will be submitted to the OSA for permanent curation.

Assessing NRHP Eligibility

All cultural resources encountered in the project tract are assessed as to their significance based on the criteria of the NRHP. As per 36 CFR Part 60.4, there are four broad evaluative criteria for determining the significance of a particular resource and its eligibility to the NRHP. Any resource (building, structure, site, object, or district) may be eligible for the NRHP that:

A. is associated with events that have made a significant contribution to the broad pattern of history;

B. is associated with the lives of persons significant in the past;

C. embodies the distinctive characteristics of a type, period, or method of construction, or represents the work of a master, possesses high artistic value, or represents a significant and distinguishable entity whose components may lack individual distinction; or

D. has yielded, or is likely to yield, information important to history or prehistory.

A resource may be eligible under one or more of these criteria. Criteria A, B, and C are most frequently applied to historic buildings, structures, objects, non-archaeological sites (e.g., battlefields, natural features, designed landscapes, or cemeteries), or districts. The eligibility of archaeological sites is most frequently considered with respect to Criterion D. Also, a general guide of 50 years of age is employed to define "historic" in the NRHP evaluation process. That is, all resources greater than 50 years of age may be considered. However, more recent resources may be considered if they display "exceptional" significance (Sherfy and Luce n.d.).

Following *National Register Bulletin*: *How to Apply the National Register Criteria for Evaluation* (Savage and Pope 1998), evaluation of any resource requires a twofold process. First, the resource must be associated with an important historic context. If this association is demonstrated, the integrity of the resource must be evaluated to ensure that it conveys the significance of its context. The applications of both of these steps are discussed in more detail below.

Determining the association of a resource with a historic context involves five steps (Savage and Pope 1998). First, the resource must be associated with a particular facet of local, regional (state), or national history. Secondly, one must determine the significance of the identified historical facet/context with respect to the resource under evaluation. A lack of Native American archaeological sites within a project area would preclude the use of contexts associated with the prehistoric use of a region.

The third step is to demonstrate the ability of a particular resource to illustrate the context. A resource should be a component of the locales and features created or used during the historical period in question. For example, early nineteenth century farm houses, the ruins of African-American slave settlements from 1820s, and/or field systems associated with particular antebellum plantations in the region would illustrate various aspects of the agricultural development of the region prior to the Civil War. Conversely, contemporary churches or road networks may have been used during this time period but do not reflect the agricultural practices suggested by the other kinds of resources.

The fourth step involves determining the specific association of a resource with aspects of the significant historic context. Savage and Pope (1998) define how one should consider a resource under each of the four criteria of significance. Under Criterion A, a property must have existed at the time that a particular event or pattern of events occurred and activities associated with the event(s) must have occurred at the site. In addition, this association must be of a significant nature, not just a casual occurrence (Savage and Pope 1998). Under Criterion B, the resource must be associated with historically important individuals. Again, this association must relate to the period or events that convey historical significance to the individual, not just that this person was present at this locale (Savage and Pope 1998). Under Criterion C, a resource must possess physical features or traits that reflect a style, type, period, or method of construction; display high artistic value; or, represent the work of a master (an individual whose work can be distinguished from others and possesses recognizable greatness [Savage and Pope 1998]). Under Criterion D, a resource must possess sources of information that can address specific important research questions (Savage and Pope 1998). These questions must generate information that is important in reconstructing or interpreting the past (Butler 1987; Townsend et al. 1993). For archaeological sites, recoverable data must be able to address specific research questions.

After a resource is associated with a specific significant historic context, one must determine which physical features of the resource reflect its significance. One should consider the types of resources that may be associated with the context, how these resources represent the theme, and which aspects of integrity apply to the resource in question (Savage and Pope 1998). As in the antebellum agriculture example given above, a variety of resources may reflect this context (farm houses, ruins of slave settlements, field systems, etc.). One must demonstrate how these resources reflect the context. The farm houses represent the residences of the principal landowners who were responsible for implementing the agricultural practices that drove the economy of the North Carolina area during the antebellum period. The slave settlements housed the workers who conducted the vast majority of the daily activities necessary to plant, harvest, process, and market crops.

Once the above steps are completed and the association with a historically significant context is demonstrated, one must consider the aspects of integrity applicable to a resource. Integrity is defined in seven aspects of a resource; one or more may be applicable depending on the nature of the resource under evaluation. These aspects are *location, design, setting, materials, workmanship, feeling, and association* (36 Part CFR 60.4; Savage and Pope 1998). If a resource does not possess integrity with respect to these aspects, it cannot adequately reflect or represent its associated historically significant context. Therefore, it cannot be eligible for the NRHP. To be considered eligible under Criteria A and B, a resource must retain its essential physical characteristics that were present during the event(s) with which it is associated. Under Criterion C, a resource must retain

enough of its physical characteristics to reflect the style, type, etc., or work of the artisan that it represents. Under Criterion D, a resource must be able to generate data that can address specific research questions that are important in reconstructing or interpreting the past.

Chapter III. Environmental and Cultural Background

Environmental Background

Since the arrival of humans in the region we now call North Carolina, the natural landscape has undergone considerable change as a result of both natural and man-induced processes. In this section, data about the natural setting (past and present) in the project vicinity are presented to better understand interactions between humans and their surrounding physical environment.

Past Environment

Profound changes in climate and dependent biophysical aspects of the regional environment have occurred over the last 20,000 years (Delcourt and Delcourt 1981; Delcourt and Delcourt 1986). Major changes include a general warming trend, melting of the large ice sheets of the Wisconsin glaciation in northern North America, and an associated rise in sea level. This general warming trend also greatly affected vegetative communities. During the Late Wisconsin glacial period, which ended about 12,000 years ago, a boreal forest dominated by pine and spruce covered most of the Southeast. By about 10,000 years ago, this forest was changing from coniferous to deciduous species. The new deciduous forest was dominated by northern hardwoods such as beech, hemlock, and alder, with oak and hickory beginning to increase in number. With continuation of the general warming and drying trend, oak and hickory dominated the forest, along with southern species of pine. Pollen data suggest oak and hickory appear to have reached a peak at 7,000 to 5,000 years ago (Delcourt and Delcourt 1981; Delcourt and Delcourt 1986; Watts 1970, 1980; Whitehead 1965, 1973). Since that time, the general climatic trend in the Southeast has been toward slightly cooler and moister conditions, and the present southern mixed hardwood forest has become established.

Faunal communities also changed dramatically during this time. A number of megafauna mammal species (e.g., mammoth, mastodon, horse, camel, giant sloth) became extinct at the end of the glacial period 12,000 to 10,000 years ago. There is abundant evidence that during the Paleoindian period humans in the Southeast incorporated some of the now extinct fauna into their subsistence strategies. However, modern Holocene adaptions reflect a marked shift to exploitation of white-tail deer and smaller mammal species, as well as fish, shellfish, turtles, and birds.

Current Environment

The climate for Harnett County is characterized by mild winters and hot summers. Daily average temperatures range between a high of 77° Fahrenheit (F) a low of 43° F (Spangler 1994). Average yearly precipitation is about 1.2 meters (3.9 feet); the majority of rainfall occurs between the months of April and September (Spangler 1994). The average relative humidity ranges from 60 percent during the day to 85 percent overnight (Spangler 1994).

The general area surrounding the project tract can be characterized as a typical rural setting in the North Carolina Sandhills District. Residences are common, but tend to be scattered across the countryside. However, since the arrival of Europeans and enslaved Africans over 200 years ago, profound changes to the landscape have occurred. The woodland landscape, only slightly modified over thousands of years by Native Americans, underwent dramatic changes after the arrival of settlers of European and African descent. Large areas of woodlands were cleared to make way for domesticated plants and animals imported from the Old World. The transition to an agricultural landscape proceeded rapidly, as large fields and pastures were developed. The loss of the woodlands also brought about significant changes in faunal species, as cattle and other domesticated animals were introduced.

The eastern boundary of the Central Carolina Tire Disposal tract roughly parallels the main road heading southwest through the disposal plant. The remaining boundaries are arbitrary lines without any physical barrier defining them. The project tract has undergone clear cutting activities within the past several years. The majority of the tract is covered with immature hardwoods and pines. Some mature trees still stand primarily near the drainages running through the tract. There are, however, a few grassy fields within the project boundaries. A network of dirt roads traverse the project tract allowing access to most of the areas within the tract. A borrow area is located in the southwest corner of the tract. The northwestern corner of the tract is being used to store shredded rubber.

The Cape Fear River is the main drainage in Harnett County. The Cape Fear River has a general southeastward flow, emptying into the Atlantic Ocean near Wilmington. Several small unnamed creeks and intermittent streams drain the survey tract, and ultimately flow into the Cape Fear River.

Geology and Soils

The project tract is located in the northwestern edge of the Sandhills District of North Carolina, which is situated immediately east of the Piedmont Slate belt, and is part of the Atlantic Coastal Plain that extends to the coastline. The area features broad, sandy ridges and long, less sandy side slopes (Spangler 1994). Elevation in the Sandhills District ranges from approximately 82 - 152 meters (270-500 ft) amsl (Spangler 1994). Elevations within the study tract range between 75 - 111 meters (250 - 370 ft) amsl.

This portion of the extreme western coastal plain consists mainly of the Middendorf Formation, featuring Cretaceous sandstones and mudstones (North Carolina Geological Survey 1996). Above these lies the Tuscaloosa or Barnwell Formation, which occurs throughout the Sandhills District. Parent materials of Harnett County soils are formed from bedrock and sediments derived from unconsolidated materials (Spangler 1994). All soils in the study tract fall within the Gilead-Blaney-Candor soil association mapping unit (Spangler 1994). These soils tend to be well drained, gently sloping to moderately steep, and are associated with uplands. Five specific soil series occur within the project tract and are summarized in Table 1. Their distributions are shown in Figure 2.

Table 1. Summary of Soil Types within the Project Tract (Spangler 1994).

Soil Name	Map Symbol	Soil Characteristics
Bibb	Bb	Frequently flooded loam
Blaney	BnB	Well drained loamy sand, 2-8 % slope
Blaney	BnD	Well drained loamy sand, 8-15 % slope
Candor	CaB	Excessively drained sand, 0-8 % slope
Gilead	GaB	Well drained loamy sand, 2-8 % slope

Cultural Background

Native American Context

The following discussion summarizes the various periods of Native American occupation in the Coastal Plain of North Carolina, emphasizing cultural change, settlement, and site function

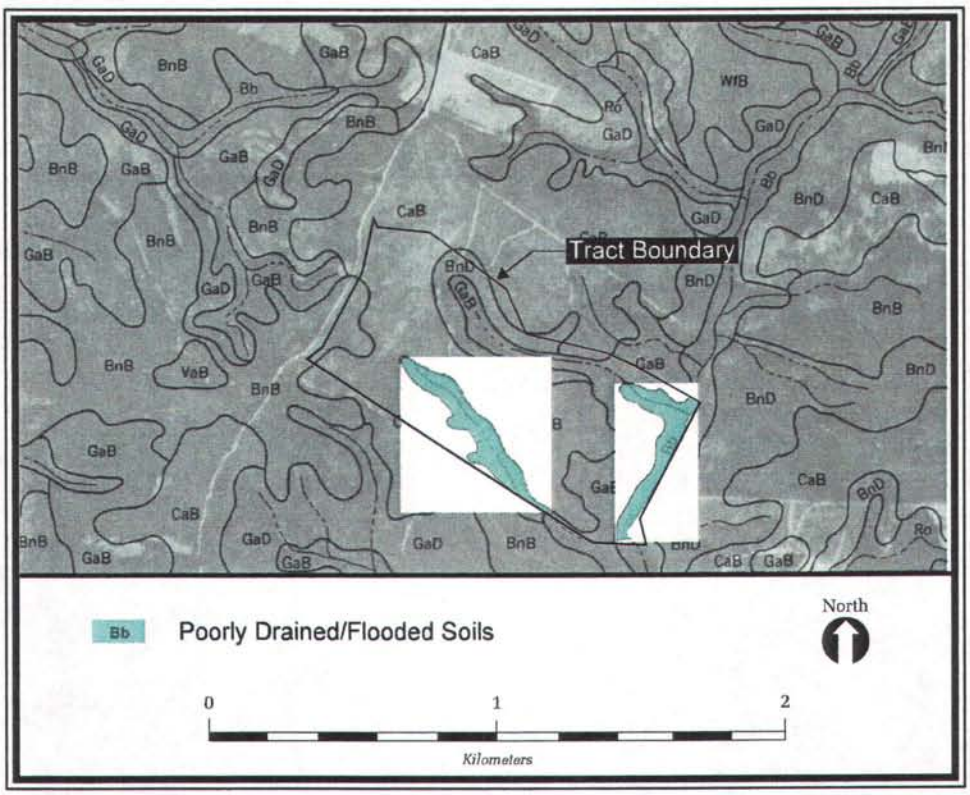

Figure 2. Map showing soil types in the project tract (Spangler 1994).

throughout prehistory. The Coastal Plain is divided into two sections, the Northern and Southern Coastal Plain, starting in the Ceramic Late Archaic.

Paleoindian Period (12000 - 8000 BC). The actual dates applied to the Paleoindian period are currently being debated. The accepted theory about the peopling of North America dates the influx of migrant bands of hunter-gatherers to approximately 12,000 years ago. This date corresponds with the exposure of a land bridge linking Siberia to the North American continent (Driver 1998; Jackson et al. 1997). Recently, however, researchers have suggested that this migration occurred as much as 15,000 to 20,000 years ago and was led by seagoing travelers (see Green et al. 1998; Steele and Powell 1993, 1994). These recent theories are supported by such discoveries as Kennewick Man, a skeleton recovered in Washington, and the Gordon Creek Woman, who was recovered from a site in northern Colorado. The Kennewick Man skeleton determined to be over 11,000 years old (Morell 1998; Preston 1997; and Slayman 1997). The Gordon Creek Woman has been dated to 9700 years BC or nearly 11,700 years old (Swedlund and Anderson 1999). Other discoveries, such as the Monte Verde site in South America that dates to 12,500 years before present (BP) (Dillehay 1997; Meltzer et al. 1997) continue to fuel this controversy.

The earliest recognized artifact marker for this period is the Clovis lanceolate fluted spear point (Gardner 1974, 1989; Griffin 1967). Smaller fluted and nonfluted lanceolate spear points, such as Dalton and Hardaway point types, are characteristic of the later portion of the period (Goodyear 1982). The Hardaway point, first described by Coe (1964), is seen as a regional variant of Dalton (Oliver 1985; Ward 1983). Perkinson (1971, 1973) recorded Paleoindian fluted points in North Carolina. Fluted Clovis points have been recovered from surface contexts, but no intact Clovis sites have been reported in the Piedmont region of North Carolina.

The Piedmont of North Carolina appears to have been more intensively occupied by Paleoindian peoples than the Coastal Plain. This is in contrast to distribution studies in South Carolina, which show more fluted points in the Coastal Plain than in the Piedmont (Goodyear et al. 1989). Williams and Stoltman (1965) mapped the occurrence of fluted point finds in the eastern United States and noted that these had a high correlation with reports of extinct mastodon finds in the region. They concluded that Paleoindian hunters were focusing on mastodon. Other researchers (Anderson and Joseph 1988; Michie 1977; Steponaitis 1986) have noted that fluted points are most common near major rivers at areas where river valleys are constricted providing ease in fording the waterways, such as the Fall Line Zone (where mastodon and other Pleistocene game animals would be concentrated).

Most Paleoindian materials occur as isolated surface finds in the eastern United States; this indicates to many scholars that population density was extremely low during this period, and that groups were small and highly mobile (Meltzer 1988). It has been noted that group movements were probably well scheduled and that some semblance of territories was probably maintained to ensure adequate arrangements for procuring mates and maintaining population levels (Anderson and Hanson 1988). O'Steen et al. (1986) analyzed Paleoindian settlement patterns in the Oconee River Valley in northeastern Georgia. They noted a pattern of decreasing mobility throughout the Paleoindian period. Sites of the earliest portion of the period seem to be restricted to the flood plains, while later sites are distributed widely in the uplands, showing what O'Steen, et al. (1986) interpret as "settling in" and exploitation of a wider range of environmental subsistence resources. If this pattern holds true for the Southeast in general, it may be a result of changing environments trending toward increased deciduous forest and small mammal resources, and decreasing availability of Pleistocene megafauna; population growth could be another factor.

Early Archaic Period (8000-6000 BC). The Early Archaic corresponds to the adaptation of native groups to Holocene conditions. The climate in coastal North Carolina during this period was still colder and moister than at present, but an oak-hickory forest was establishing itself on the

Coastal Plain (Watts 1970, 1980; Whitehead 1965, 1973). The Early Archaic adaptation in the North Carolina Lower Coastal Plain is not clear, as Anderson and Logan (1981:13) report:

> At the present, very little is known about Early Archaic site distribution, although there is some suggestion that sites tend to occur along river terraces, with a decrease in occurrence away from this zone.

Early Archaic finds in the Lower Coastal Plain typically are corner- or side-notched projectile points, which have been determined to be Early Archaic through comparison with materials excavated at sites in other areas of the Southeast (Claggett and Cable 1982; Coe 1964).

Anderson and Hanson (1988) offer a model of seasonal mobility for Early Archaic groups in the Southeast that posits bands of 50 to 150 people along major drainage systems. Anderson and Hanson (1988) hypothesize that Early Archaic use of the Lower Coastal Plain was limited to seasonal (springtime) foraging camps and logistical camps; aggregation camps and winter base camps are hypothesized to have been near the Fall Line. Given the low overall population density, limited evidence of Early Archaic occupation is expected in the region.

Middle Archaic and Preceramic Late Archaic Periods (6000-2500 BC). The trends initiated in the Early Archaic, i.e., increased population and adaptation to local environments, continue through the Middle Archaic and Preceramic Late Archaic. Climatically, the study area was still warming and an oak-hickory forest dominated the coast until circa 2000 BC, when pine became more prevalent (Watts 1970, 1980). Sites increased in size and density through the period. Stemmed projectile points and ground stone tools are characteristic artifacts.

Blanton and Sassaman (1989) recently reviewed the archaeological literature on the Middle Archaic period. They document an increased simplification of lithic technology through this period, with increased use of expedient, situational tools. Furthermore, they argue that the use of local lithic raw materials is characteristic of the Middle and Late Archaic. Blanton and Sassaman (1989:68) conclude that "the data at hand suggest that Middle Archaic populations resorted to a pattern of adaptive flexibility as a response to" mid-Holocene environmental conditions such as "variable precipitation, sea level rise, and differential vegetational succession." These processes resulted in changes in the types of resources available changing from year to year.

Ceramic Late Archaic Period (2500-1500 BC). By the end of the Late Archaic period, two developments occurred that changed the prehistoric lifeways on the North Carolina Coastal Plain. First, sea level rose to within one meter (3.3 feet) of present levels, and the extensive estuaries now present were established (Colquhoun et al. 1981). These estuaries were a reliable source of shellfish,

and the Ceramic Late Archaic period saw the first documented emphasis on shellfish exploitation. The second major development was the invention or adoption of pottery on the North Carolina coast. It should be noted that the temporal/cultural border between the Ceramic Late Archaic and the Early Woodland is subject to much discussion.

Trinkley (1989, 1990) argues that the subsequent Woodland period begins with pottery production, and that there is no Ceramic Late Archaic. Anderson et al. (1982) and Sassaman and Anderson (1995) argue that the Ceramic Late Archaic is recognizable by either Stallings or Thom's Creek pottery. Around 1500 BC production of fiber tempered pottery (Stallings) ceases, and coastal midden sites change from large shell rings to smaller, dispersed middens. Thom's Creek was a long-lived tradition that spanned a period of major cultural and environmental change. When Thom's Creek pottery was produced within a generally Archaic system (Stallings and Thom's Creek I phases), it is considered a Ceramic Late Archaic manifestation. Subsequently, when Thom's Creek ware was produced within a more typically Woodland system, it entered the Early Woodland period. It has been speculated that the extent of Stallings ceramics is directly related to the availability of Spanish moss for use in tempering (David Phelps as quoted by Sanborn and Abbott 1999). Thoms' Creek and New River wares contain sand as a tempering agent, which Sassaman (1983) suggests indicates a transition from indirect to direct cooking technologies.

Early Woodland Period (1500 - 200 BC). The Early Woodland period was a time when sea level climbed slowly and irregularly to within 1.0 meter of current levels. The period effectively begins and ends with significant low stands within the general rising trend; the 1300 BC low stand was 4.0 meters (12.8 feet) below present high marsh surface (bphms), and the 400 BC low stand was 3.0 meters (10.0 feet) bphms (Brooks et al. 1989). The subsistence and settlement pattern of the Early Woodland period suggests population expansion, and the movement of groups into areas that were only minimally used in earlier periods. It appears that group organization during this period was based on the semipermanent occupation of shell midden sites, with the short-term use of interior Coastal Strand sites. Site location patterns suggest a dispersed, highly mobile lifeway that continued from the Late Archaic into the Woodland period.

Trinkley (1990) established a series of site type categories for the Woodland period. Site types for the Early Woodland Period in the North Carolina Coastal Plain include seasonal camps located in upland settings at spring heads or at the confluence of small streams, small seasonal campsites located on swamp edges, and large semipermanent camps on swamp edges. Jones et al. (1997) hypothesize that, based on site location data, Early Woodland people along the North Carolina coast practiced a highly mobile dispersed pattern of settlement similar to that of the Late Archaic.

The ceramic typology for the southern North Carolina coastal region is currently being debated. On the northern South Carolina coast, the ceramic typology allows the definition of two phases within the Early Woodland period: the Thom's Creek II phase and the Deptford I phase. The Thom's Creek II phase (1500-800 BC) is recognized by the presence of a wide variety of Thom's Creek (untempered or fine-to-medium sand tempered) and Refuge (coarse sand tempered) types. Thom's Creek ceramics have been recovered from archaeological sites in southern North Carolina (Hargrove 1993; Phelps 1983; South 1976). However, on the coast of North Carolina the Deptford ceramic series is known as Deep Creek in the southern portion of the state and New River in the northern portion of the state. Both Deep Creek and New River ceramics are characterized by coarse sand temper and a variety of surface decorations including fabric and net impressions (Loftfield 1979). Some researchers subsume New River under the Deep Creek series (Phelps 1983), while others prefer to utilize both series' (Herbert and Mathis 1996). Based on recent research, simple stamping and net impression surface modifications appear to be confined to the Early Woodland (Mathis 1999).

Recently, a previously undefined ceramic type was identified during data recovery at the Hamp's Landing site (Hargrove 1993; Hargrove and Eastman 1997) in Columbus County. The key defining characteristic of Hamp's Landing ceramics is limestone or marl temper. Based on stratigraphy, Hamp's Landing ceramics appear either to succeed or be contemporary with Thom's Creek ceramics (Hargrove 1993; Hargrove and Eastman 1997:92). Radiocarbon dates obtained from 31CB114, in Columbus County, suggests that Hamp's Landing ceramics occur in the Late Archaic through Early Woodland periods (Abbott et al. 1999).

Middle Woodland Period (200 BC - AD 1000). The extreme sea level fluctuations that marked the Ceramic Late Archaic and Early Woodland periods ceased during the Middle Woodland period. The Middle Woodland period began as sea level was rising from a significant low stand at 400 BC, and for the majority of the period the sea level remained within 1.0 meter of current levels (Brooks et al. 1989). The comments of Brooks et al. (1989:95) are pertinent in describing the changes in settlement:

> It is apparent that a generally rising sea level, and corresponding estuarine expansion, caused an increased dispersion of some resources (e.g., small inter-tidal oyster beds in the expanding tidal creek network). This hypothesized change in the structure of the subsistence resource base may partially explain why these sites tend to be correspondingly smaller, more numerous, and more dispersed through time.

Survey and testing data from a number of sites in the region clearly indicate that Middle Woodland period sites are frequently encountered throughout the region. Coastal sites include small

single house shell middens, more significant shell middens, and a wide variety of shell-less sites of varying size and density in the interior. Trinkley's (1990) site types for the Middle Woodland in the North Carolina Coastal Plain include the same seasonal camps, and semipermanent campsites, as well as the addition of sand burial mounds. Such low, sand burial mounds have been identified at a number of archaeological sites in the southern coastal area (Holmes 1916).

The present data from the region suggest seasonal mobility, with certain locations revisited on a regular basis (Reid 1998). Subsistence remains indicate that oysters and estuarine fish were major faunal contributors, while hickory nut and acorn have been recovered from ethnobotanical samples (Drucker and Jackson 1984; Espenshade and Brockington 1989; Trinkley 1976, 1980). Loftfield (1987) suggests that a pattern of adaptation to coastal settings evolved based on exploitation of estuarine resources.

The Middle Woodland period witnessed increased regional interaction, and saw the incorporation of extralocal ceramic decorative modes into the established technological tradition. As Caldwell (1958) first suggested, the period apparently saw the expansion and subsequent interaction between groups from different regional traditions (Espenshade 1986, 1990).

The published radiocarbon dates (as summarized in Blanton et al. 1986) for Hanover wares recovered from sites on the northern South Carolina coast range from 180 BC to 250 AD, with most clustering around 150 BC. On the southern North Carolina coast, radiocarbon dates of 300 to 400 AD for Hanover wares have been obtained by Eastman (1994) and Wilde-Ramsing (1984). Hanover pottery characteristically has a lumpy interior, with cracks common as the general ceramic body separated from the large fragments of grog temper.

Late Woodland Period (AD 1000-1524). The Late Woodland represents the most stable prehistoric period in terms of sea level change, with sea level for the entire period between 0.4 and 0.6 meters (1.3-2.0 feet) bphms (Brooks et al. 1989). Perhaps as a consequence of this stability, Late Woodland occupation along the North Carolina coast reflects a purely estuarine focus.

Utilizing ethnohistoric and linguistic data, three phases have been advanced for the Late Woodland period. These phases are the Colington phase, the Cashie phase, and the Oak Island phase. The Colington phase is associated with Algonquian speakers in the northern coastal area. Archaeological evidence indicates that these Algonquian speakers occupied coastal areas as far south as Onslow County (Bogdan and Weaver 1989; Jones 1990; Loftfield 1990; Loftfield and Jones 1995; and Mathis 1995); however, Loftfield (1990) and Mathis (1995) suggest that the Algonquin groups ranged as far south as the Cape Fear River.

Colington ceramics are shell tempered and often exhibit fabric impressions, incising, and simple stamping (Phelps 1983). These shell-tempered wares are the most common ceramics recovered from archaeological sites along the southern North Carolina coast and are frequently associated with shell middens located along estuaries (Mathis 1999).

The Cashie phase is associated with Iroquoian speakers in the interior Coastal Plain. Cashie ceramics (also known as White Oak) have similar surface decorations as Colington wares but are tempered with extremely coarse sand or small pebbles (Phelps 1983).

The Oak Island phase represents Siouan speakers and is confined to the southern coast of North Carolina. Oak Island ceramics are shell tempered. The identification of Hamp's Landing ceramics has called into question the prevalence of Oak Island ceramics. Researchers suggest that a re-analysis of Oak Island wares may result in many being recategorized as the earlier Hamp's Landing wares (Hargrove 1993; Hargrove and Eastman 1997; Herbert and Mathis 1996; Mathis 1999).

As in the Middle Woodland, the Siouan people in the southern coastal area buried their dead in sand mounds or on top of sand ridges. These burials are generally secondary and bundled and cremations or charred remains are common (Jones et al. 1997). Jones and his colleagues (Jones et al. 1997) suggest that burials appear to be placed away from village sites but stress the need for this view to be further investigated.

Structural patterns noted at several Late Woodland sites suggest that both circular and rectangular structures were constructed, perhaps during different seasons. Perhaps the two structure types identified at some Late Woodland sites supports the contention that Algonquin speakers inhabited the area (Loftfield 1990; Mathis 1995).

In much of the Southeast, AD 900 through approximately 1600 is classified as the Mississippian Period. The Mississippian period was a time of major mound ceremonialism, regional redistribution of goods, chiefdoms, and maize horticulture as a major subsistence activity elsewhere. The Mississippian period is not recognized as a distinct temporal/cultural delineation in coastal North Carolina.

Historic Period

In the decades following the expedition of Christopher Columbus, the coast and interior portions of what would become North Carolina were explored. Much of this activity was initiated by Spain in the hope of preserving its hegemony over North America. Hernando de Soto (1539-1543) and Juan Pardo (1566-1568) led military expeditions into the western Piedmont and mountains of North Carolina during the mid-sixteenth century (Hudson 1990, 1994). Despite these military incursions and the establishment of minor outposts, the Spanish presence in the Carolinas could not be sustained. Mounting pressure from hostile Native Americans and English privateers resulted in the withdrawal of Spanish forces to St. Augustine in 1587 (South 1980).

England's interest in the New World was heavily promoted by Sir Walter Raleigh. A courtier in the court of Queen Elizabeth I, Raleigh secured the financial and political support necessary to attempt the first permanent settlement of the New World by English colonists (Powell 1989). Although his efforts failed, Raleigh's single minded ambition ultimately led to the establishment of the Jamestown colony in 1607 by the Virginia Company (Noël Hume 1994). However, the disastrous mismanagement and resulting loss of life in Virginia during the first two decades of the colony's existence resulted in the revocation of the Virginia Company's charter in 1624 (Noël Hume 1994).

Preoccupied with the civil war between Royalist and Parliamentarian forces in the 1640s, the authorities in Virginia showed little interest in North Carolina until the 1650s. During this period the area around Albemarle Sound in northeastern North Carolina was inhabited by traders, hunters, trappers, rogues, and tax evaders (Powell 1989). Even then, North Carolina was becoming notorious as a refuge for the independent and self-reliant.

The restoration of Charles II to the throne in 1660 resulted in the distribution of rewards to those who had supported the Royalist cause during the interregnum (Powell 1989). This initiated the Proprietary colonial period in the Carolinas, which lasted from 1663 until 1729. Years of turmoil brought about by an unstable system of government culminated in war with the Tuscarora Indians. Severe fighting broke out in 1711, triggered by the death of the colony's Surveyor General (John Lawson) at the hands of the Tuscarora (Powell 1989). After the loss of much life and property, the war ended in 1712 leaving the Carolina colonies in dire financial straights. These conditions persisted until the Lords Proprietors were forced to sell their holdings in the Carolinas to the Crown in 1729 (Powell 1989).

The acquisition of North Carolina by the Crown initiated a period of relatively stable government and increased settlement. During this time, immigration into the colony was along three major routes (Powell 1989): western North Carolina was settled by German and Scots-Irish immigrants arriving from Pennsylvania and Virginia via the Great Wagon Road; new arrivals at the important towns of New Bern and Brunswick pushed west up the Cape Fear and Neuse River valleys; and colonists from South Carolina advanced up the Pee Dee and Catawba rivers in search of new land.

The first English and Scots-Irish settlers arrived in the Sandhills District during the 1740s. Scottish highlanders represented the largest national group of Europeans immigrating into the area. Their land holdings were typically located along the floodplains of the Cape Fear River and nearby smaller rivers and creeks. These areas were fertile and ideal for plant cultivation. Although the population in the Sandhills District remained small and widely scattered, it was large enough to form Cumberland County out of Anson County in 1754 (Corbitt 1996). During the 1750s, the area now known as Johnsonville (northeast of the project tract) was called "Mount Pleasant," a Scottish Highlander settlement (Powell 1968). Like other settlements in the region, "Mount Pleasant" was primarily an agricultural community that also relied upon their free-ranging herds of cattle, horses, and pigs, which were driven to larger markets (Meyer 1957).

During the Revolutionary War, the Sandhills District experienced fighting, guerilla warfare, lawlessness, and looting due to its Scottish Loyalist and Tory populations. In early 1776, Highlanders marched with other Loyalists towards Wilmington in order to join Cornwallis and his soldiers. Before arriving, they were stopped on 27 February 1776 by Colonel James Moore and his Patriot army. The Battle of Moore's Creek Bridge ensued, and the Patriots were victorious. The battle has been referred to as "the Lexington and Concord" of the South because it kept the British from occupying the region (Powell 1989). At the end of the war, the Loyalists suffered punishment through the confiscation of their land, property, and expulsion from North Carolina (Meyer 1957). A mass execution of Loyalists occurred near Lillington (Harnett County 2003).

Conditions remained unsettled in the region after the Revolutionary War. Paper money lost its value, agricultural pursuits were no longer profitable, and commerce slowed to almost a stop. Lack of adequate transportation and communication made improvements nearly impossible. Large numbers of Highlanders left North Carolina, returning to Great Britain or emigrating to Canada, Florida, and the West Indies (Powell 1989). It was not until the beginning of the nineteenth century that gains were made in repairing these economic and social damages. The production of tar, turpentine, and lumber from the vast pine forests in the Sandhills District soon became a major cash

industry. Cotton was also grown on a small scale, but it would not be a major commercial activity until after the Civil War.

Harnett County was formed from a portion of Cumberland County in 1855 (Corbitt 1996). It was named after Cornelius Harnett, a Revolutionary War patriot and delegate to the Continental Congress (Corbitt 1996). Originally, the county seat was established at Toomer, but was moved to the more desirable location of Lillington in 1859 (Corbitt 1996). Lillington was named after Alexander Lillington, who served as a colonel with the Wilmington District militia in the Revolutionary War (Powell 1989).

North Carolina seceded from the Union on 20 May 1861, at approximately 5:30 in the afternoon (Murray 1983). Minutes later the Secession Convention ratified the provisional constitution of the Confederate States of America. Within a few weeks, North Carolinians were arriving at regimental training camps throughout the state (Barrett 1963).

General William T. Sherman arrived in the Sandhills District in early 1865. In his passing, his soldiers burned countless acres of longleaf pines that were used for the turpentine industry (Powell 1989). Sherman engaged in the battle at Averasboro, located in southeast Harnett County, against General Hardee in mid-March (Powell 1989). Hardee's forces did little to stop his movement towards Goldsboro. Figure 3 shows a map of the project area circa 1865.

The post war period was a time of distress for many of the farmers in Harnett County. The end of slavery resulted in the collapse of the plantation economic system. It was replaced by a new labor system based on sharecropping and cash rents (Powell 1989). Under the sharecropping system, the landowner retained ownership of the crop. The sharecropper provided the labor and some of the fertilizer needed to work the land. The tools, seeds, housing, fuel, draft animals and other essentials were supplied by the landowner. Typically, the crop was split equitably between both parties. Most small farmers preferred the rent system since it left control of the crop in their hands.

This system resulted in the intensification of cash cropping (Powell 1989). The tenant was encouraged to squeeze production out of marginal lands which led to erosion and soil depletion across the south including Harnett County. The act of "settling up" at the end of the harvest season often left the tenant cash poor leading to a cycle of debt peonage, that was difficult to escape. The cultural geography of the county changed in response to the demands of this new agricultural system. During the postwar decades farms became smaller and more dispersed (Powell 1989).

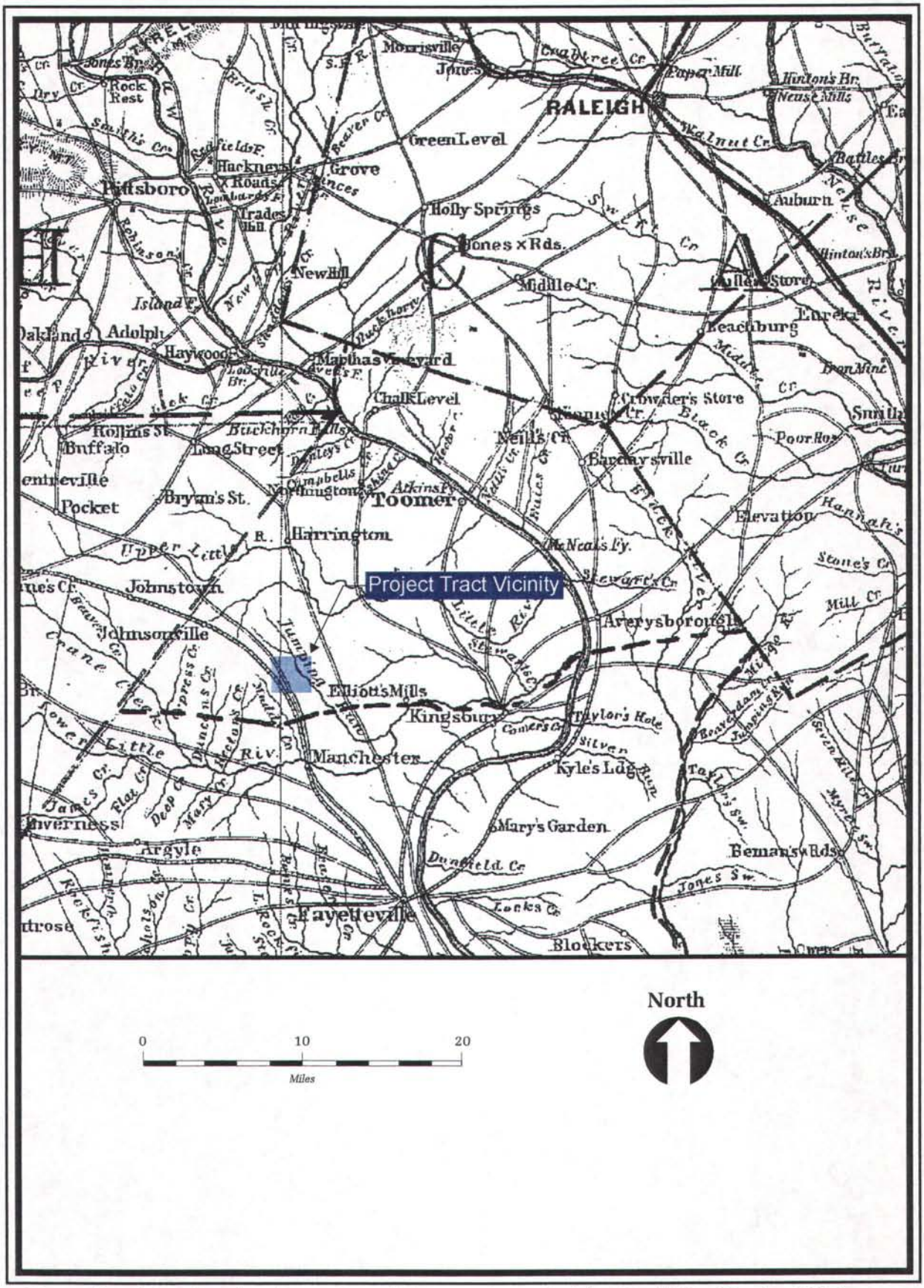

Figure 3. Map showing the project vicinity at the end of the Civil War (Bache 1865).

Significant advances in the development of North Carolina's industrial base occurred after 1870. For example, by 1880 there were 49 textile mills operating in the state (Powell 1989). This represents a substantial increase in industrial capacity over that which existed in 1860. By the 1890s, furniture and tobacco factories dotted the Piedmont landscape. It is during this time that populations shifted from rural to urban areas in Harnett County. The cities of Lillington, Dunn, Coats, Angier, and Erwin became commercial trade centers (Harnett County 2003). In comparison to other North Carolina counties, however, Harnett County remained sparsely populated through out the early twentieth century.

Currently, one-fifth of the population in Harnett County is concentrated in cities and towns. Due to the proximity of Fort Bragg and Pope Field Air Base in Cumberland County, southwestern Harnett County has experienced population growth (Spangler 1994). Agriculture still provides the majority of the county's income (Harnett County 2003). Toward the end of the 1980s, there were close to 900 farms in the county, each averaging 160 acres (Spangler 1994). Industrial development, however, is beginning to occur through community planning under new leadership.

Chapter 4. Results of Investigation

Background Research Results

We conducted a review of files at the Office of State Archaeology (OSA) in Raleigh to determine if any previously recorded archaeological sites are located in the project tract. The site file check included the area within a 1.6 kilometers (1.0 mile) radius of the Central Carolina Tire Disposal tract. No previously recorded sites are located in the tract. However, four sites, 31HT172, 31HT173, 31HT174, and 31HT175, are located just southeast of the tract. These resources were identified in 1991 by Archaeological Research Consultants, Inc., during their survey of the Central Carolina Tire Monofill (Hargrove 1991). These four prehistoric sites were all surface scatter, and they are not eligible for the National Register of Historic Places (NRHP) due to damage caused by logging and erosion.

We also reviewed files at the North Carolina Survey and Planning Branch of the North Carolina Department of Archives and History to identify previously recorded historic architectural resources in the area. No historic architectural resources were identified in the project vicinity.

Archaeological Survey Results

The Central Carolina Tire Disposal tract consists of approximately 81 hectares (200 acres) in Harnett County, North Carolina. The project tract was clear cut approximately a decade ago and is now covered predominantly by immature hardwoods and pines. Three drainages run through the tract. Two run northwest to southeast draining into a larger unnamed creek located at the eastern end of the project area. Figure 4 presents a general view of the tract (top) and a view of the smaller creek at the northern end of the tract (bottom). The larger creek at the eastern end of the project tract drains into Buffalo Creek, a tributary of the Little River. A small borrow area and a severely disturbed area adjacent to it are located in the southwestern corner of the tract. Figure 5 presents views of these disturbed areas. The northwestern corner of the project tract is used as part of the tire disposal complex. A view of the tire disposal area is presented in Figure 6.

We excavated approximately 810 shovel tests at 30 meter (100 ft) intervals along transects spaced 30 meters (100 ft) apart across the project tract. We identified eight archaeological sites and six isolated finds during this investigation. Table 2 presents a summary of the identified sites. The location of the sites and isolated finds are shown in Figure 7 on an aerial view of the project tract.

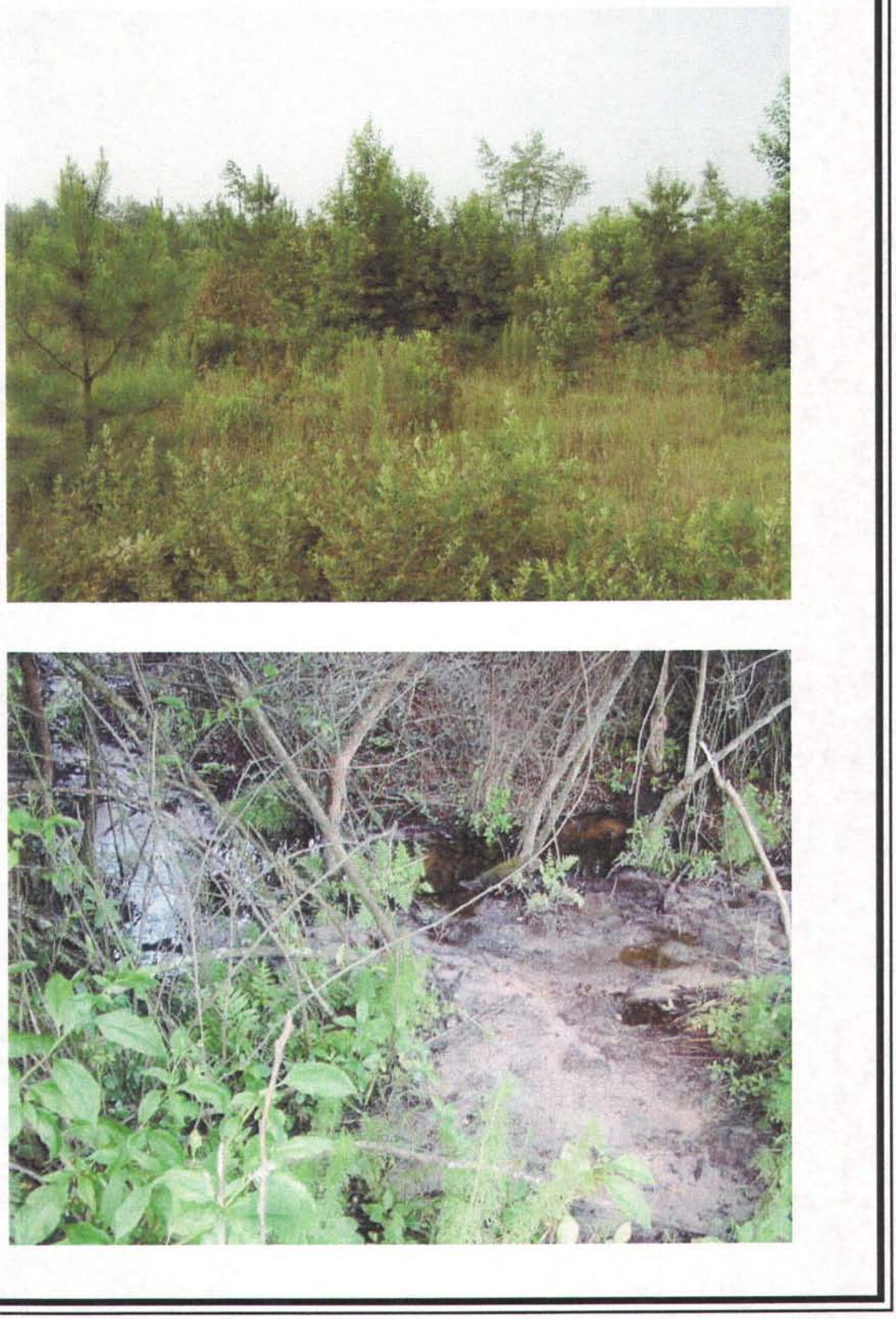

Figure 4. A general view of the tract (top) and a view of the northern drainage, looking south (bottom).

Figure 5. Views of the borrow area in the southwest corner of the project tract, looking northwest (top) and an adjacent disturbed area, mlloking north (bottom).

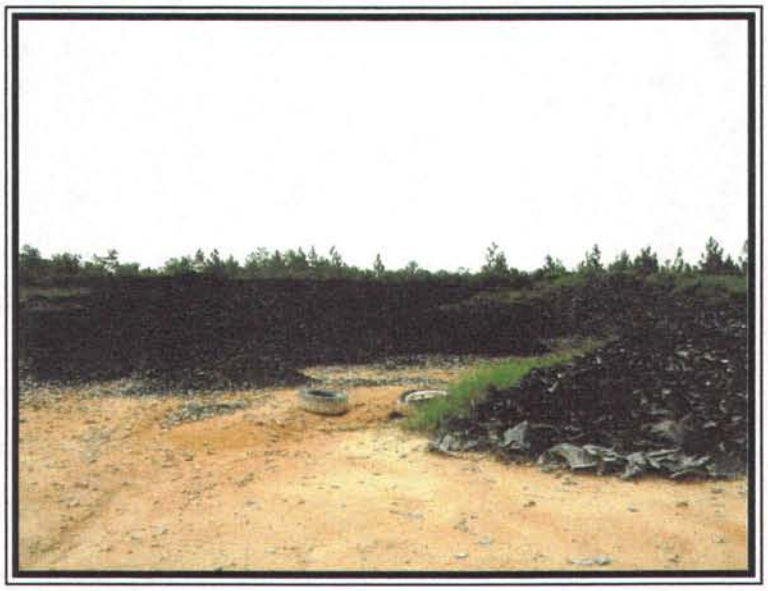

Figure 6. The shredded rubber piles in the northwest portion of the tract, looking northeast.

Table 2. Summary of Archaeological Resources Identified in the Tract.

Site Number	Site Type	Comments	NRHP Eligibility
31HT954	Unknown prehistoric	Surface scatter of quartz debitage	Not Eligible
31HT955	Late Woodland	Surface scatter of quartz and chert debitage, 1 Caraway point, and 1 eroded sherd	Not Eligible
31HT956	Unknown prehistoric	Surface scatter of quartz debitage	Not Eligible
31HT957	Unknown prehistoric	Surface scatter of quartz debitage	Not Eligible
31HT958	Unknown prehistoric	Surface scatter of quartz debitage	Not Eligible
31HT959	Middle Woodland	Surface scatter of 4 Hanover Cord Marked Sherds	Not Eligible
31HT960	Unknown prehistoric	Surface scatter of residual sherds and quartz debitage	Not Eligible
31HT961	Middle/Late Woodland	Surface scatter of 5 Hanover Fabric Impressed sherds	Not Eligible
31HT948 (Isolate 1)	Unknown prehistoric	1 quartz flake, on surface	Not Eligible
31HT949 (Isolate 2)	Unknown prehistoric	1 quartz flake fragment	Not Eligible
31HT950 (Isolate 3)	Unknown prehistoric	1 chert flake, on surface	Not Eligible
31HT951 (Isolate 4)	Unknown prehistoric	1 quartz flake fragment, on surface	Not Eligible
31HT952 (Isolate 5)	Unknown prehistoric	1 quartz flake fragment	Not Eligible
31HT953 (Isolate 6)	Unknown prehistoric	1 unidentifiable sherd	Not Eligible

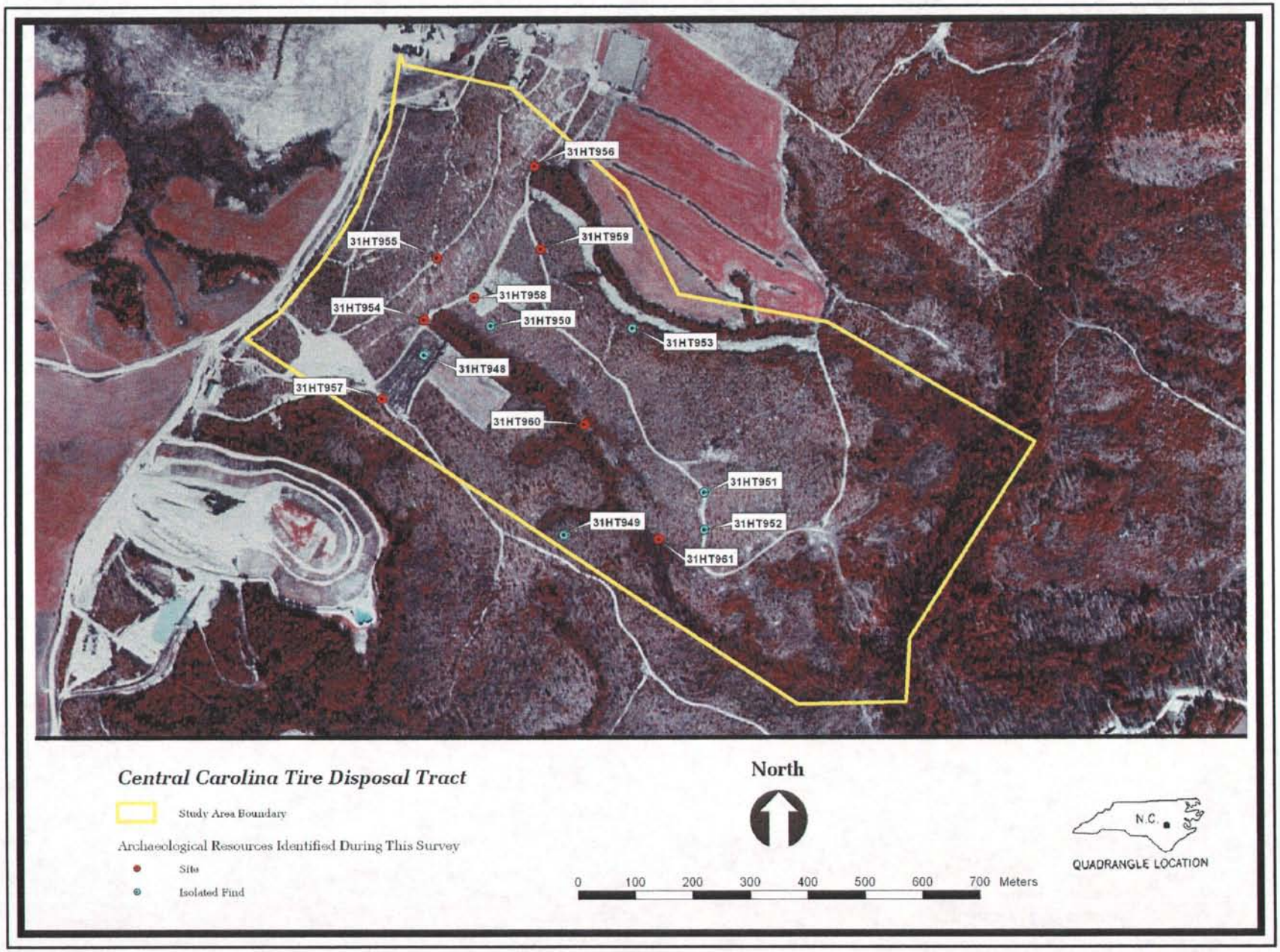

Figure 7. An aerial view of the project tract showing the location of identified sites and isolated finds.

Site 31HT954

Cultural Affiliation - Unknown prehistoric
Site Type - Pre-Contact lithic scatter
Site Dimensions - 11 meters North-South by 15 meters East-West
Soil Type - Candor Sand
Nearest Water Source - Unnamed intermittent stream
Present Vegetation - Mixed immature hardwood and pine forest, light to moderate undergrowth
UTM Coordinates - N 3902872 E 668133
NRHP/Management Recommendation: Not eligible, no further work

Site 31HT1954 is a prehistoric lithic debitage surface scatter located on a ridge top in the western portion of the project tract (see Figure 1). This site is situated along the edge of an access road adjacent to young planted pines. Figure 8 presents a plan and view of the site.

Nine shovel tests were excavated at 15 meter (50 foot) intervals in and around the site. None of the shovel tests was positive. Soil in the shovel tests consisted of of dark grayish brown sand (0.0-0.08 meters [0-0.25 ft] below surface [bs]) overlaying yellowish brown sand to a depth of 0.08-0.6 meters (0.25-2.0 ft) bs. The surrounding area was surface inspected for artifacts. Site boundaries of 11 by 15 meters (36 by 49 ft) were established based upon the extent of artifacts recovered from the ground surface (see Figure 8).

A total of eleven artifacts was recovered from the road surface and the area betwen the road and the tree line. The artifacts include one translucent quartz projectile point base, one piece of translucent quartz shatter, one translucent quartz thinning flake, and eight translucent quartz flake fragments. These artifacts cannot be associated with any specific prehistoric cultural period. No subsurface features or artifact concentrations indicative of activity areas were identified at the site. However the site may have been used as a small camp occupied during resource procurement activities.

We assessed 31HT954 for eligibility to the NRHP with respect to Criterion D. This site has suffered extensive damage from erosion and past clear cutting activities. None of the artifacts was recovered from subsurface deposits. No soil features were encountered. The artifacts cannot be associated with a particular prehistoric period. Therefore, site 31HT954 cannot address research issues concerning Native Americans in Harnett County or the Coastal Plain of North Carolina. We recommend 31HT954 not eligible for the NRHP. The site warrants no further management.

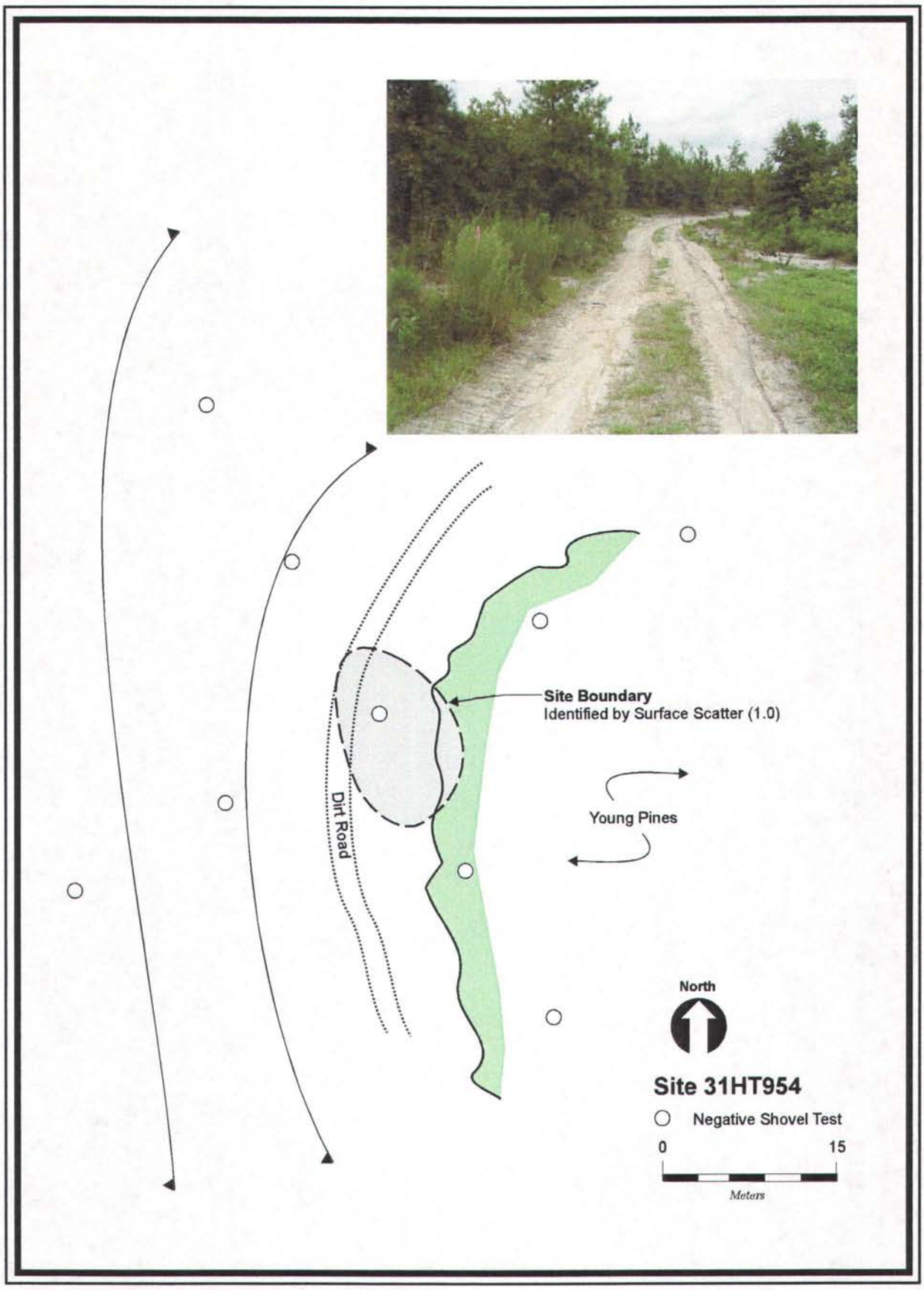

Figure 8. Plan and view of site 31HT954.

Site 31HT955

Cultural Affiliation - Late Woodland
Site Type - Pre-Contact artifact scatter
Site Dimensions - 12 meters North-South by 24 meters East-West
Soil Type - Candor Sand
Nearest Water Source - Unnamed intermittent stream
Present Vegetation - Mixed immature hardwood and pine forest, light to moderate undergrowth
UTM Coordinates - N 3902995 E 668656
NRHP/Management Recommendation: Not eligible, no further work

Site 31HT955 is a surface scatter of prehistoric artifacts located on a ridge top in the western portion of the project tract (see Figure 1). This site is situated within an access road surrounded by a predominately immature hardwood forest. Figure 9 presents a plan and view of the site.

Nine shovel tests were excavated at 15 meter (50 ft) intervals in and around an the site. None of the shovel tests produced artifacts. Soil in the shovel tests consisted of dark grayish brown (0.0-0.8 meters [0.0-0.25 ft] bs) sand overlaying yellowish brown sand to a depth of 0.08-0.6 meters (0.25-2.0 ft). The surrounding area was surface inspected for artifacts. Site boundaries of 12 by 24 meters (39 by 79 ft) were established based upon the extent of artifacts recovered from the ground surface.

A total of six artifacts was collected from or near the road surface. The artifacts include two chert flake fragments, two translucent quartz flake fragments, one translucent quartz Carraway Point, and one eroded body sherd. The Carraway projectile point is associated with a Late Woodland occupation.

We assessed 31HT955 for eligibility to the NRHP with respect to Criterion D. This site has suffered damage from erosion and past clear cutting activities. This site may be a small camp occupied during resource procurement activities. The flakes and flake fragments are indicative of tool maintenance or production.

None of the artifacts was recovered from subsurface deposits. No soil features or artifact concentrations indicative of activity areas were identified. Although a Carraway projectile point was recovered from the site, it is not associated with a particular soil horizon or feature. In general, the paucity of artifacts and their poor condition precludes any potential for 31HT955 to address research issues concerning Native Americans and the Late Woodland period in the Coastal Plain of North Carolina. Therefore, we recommend 31HT955 not eligible for the NRHP. The site warrants no further management.

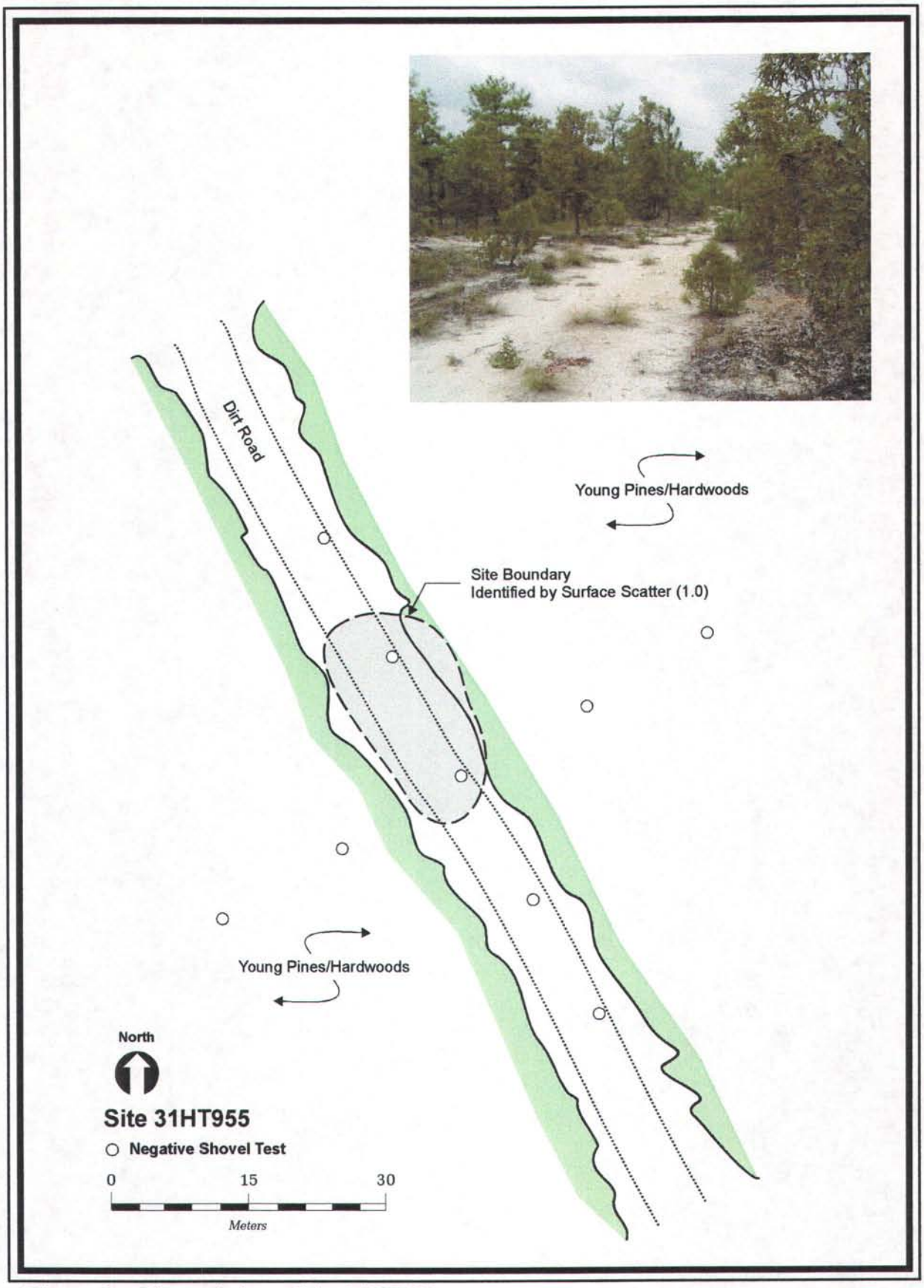

Figure 9. Plan and view of site 31HT955.

Site 31HT956

Cultural Affiliation - Unknown prehistoric
Site Type - Pre-Contact lithic scatter
Site Dimensions - 10 meters North-South by 10 meters East-West
Soil Type - Candor Sand
Nearest Water Source - Unnamed intermittent stream
Present Vegetation - Mixed immature hardwood and pine forest, light to moderate undergrowth
UTM Coordinates - N 3903184 E 668353
NRHP/Management Recommendation: Not eligible, no further work

Site 38HT956 is a surface scatter of prehistoric lithic debitage located on a ridge top in the western portion of the project tract (see Figure 1). This site is situated along the edge of an access road adjacent to young planted pines. Figure 10 presents a plan and view of the site.

Nine shovel tests were excavated at 15 meter (50 ft) intervals in and around the site. No artifacts were recovered from any of the shovel tests. Soil in the shovel tests consisted of dark grayish brown sand (0.0-0.2 meters [0.0-0.67 ft] bs) overlaying yellowish brown sand to a depth of 0.2-0.6 meters (0.67-2.0 ft) bs. The surrounding area was surface inspected for artifacts. Site boundaries of 10 by 10 meters (33 by 33 ft) were established based upon the extent of artifacts recovered from the ground surface.

A total of five artifacts was collected from the road surface. The artifacts include one translucent quartz flake and four translucent quartz flake fragments. None of these artifacts can be associated with a particular prehistoric cultural period. No subsurface features or artifact concentrations were identified. The recovered artifacts are indicative of tool maintenance or production. Therefore, the site may be a small camp occupied during resource procurement activities.

We assessed 31HT956 for eligibility to the NRHP with respect to criterion D. This site has suffered damage from erosion and past clear cutting activities. None of the artifacts was recovered from subsurface deposits. No soil features or artifact concentrations indicative of activity areas were identified. The artifacts cannot be associated with a particular prehistoric period. Therefore, Site 31HT956 cannot address research issues concerning Native Americans in Harnett County or the Coastal Plain of North Carolina. We recommend 31HT956 not eligible for the NRHP. The site warrants no further management.

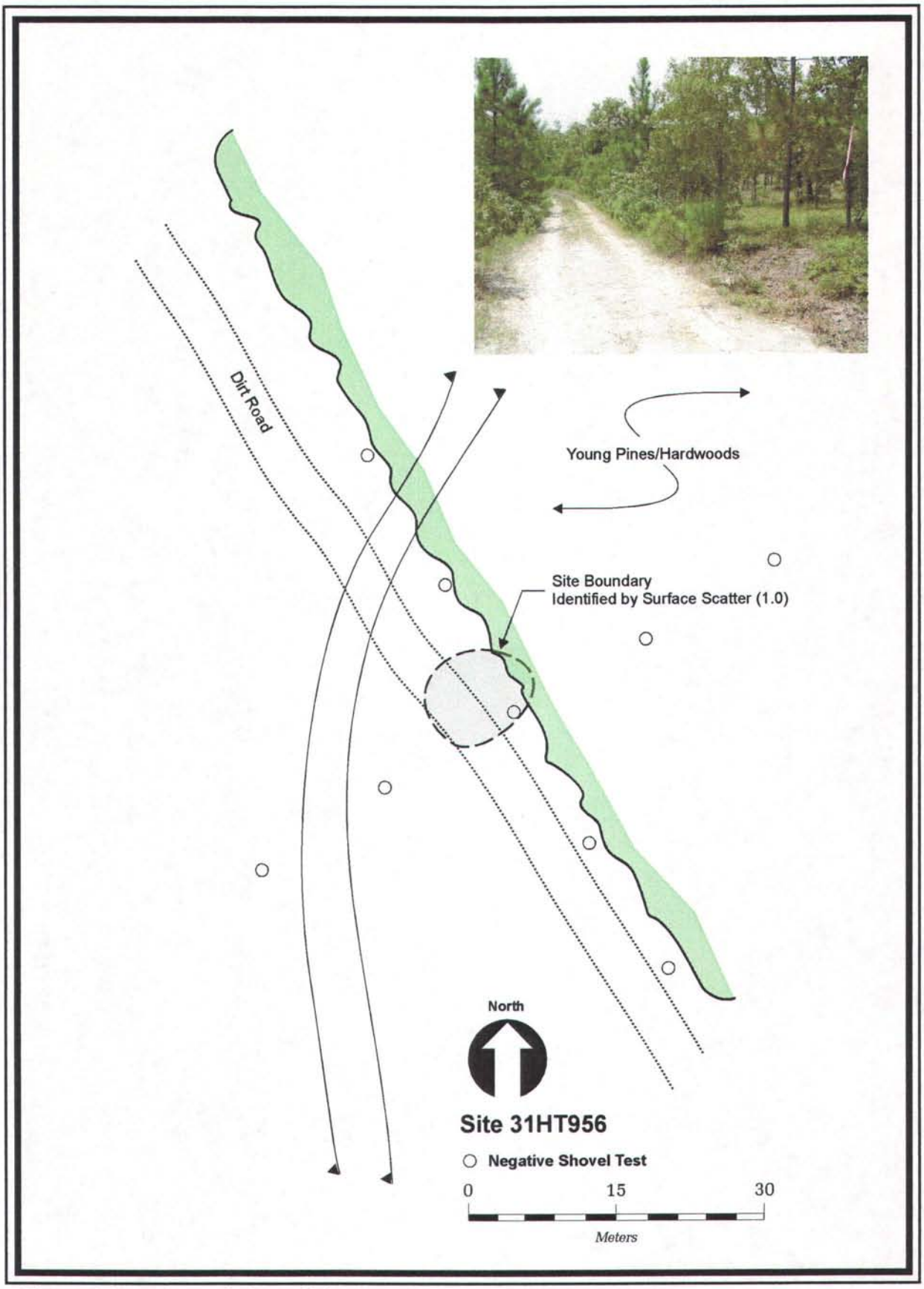

Figure 10. Plan and view of site 31HT956.

Site 31HT957

Cultural Affiliation - Unknown prehistoric
Site Type - Pre-Contact lithic scatter
Site Dimensions - 8 meters North-South by 8 meters East-West
Soil Type - Candor Sand
Nearest Water Source - Unnamed intermittent stream
Present Vegetation - Mixed immature hardwood and pine forest, light to moderate undergrowth
UTM Coordinates - N 3902735 E 668077
NRHP/Management Recommendation: Not eligible, no further work

Site 31HT957 is a prehistoric artifact scatter located on a ridge top in the western portion of the project tract (see Figure 1). This site is located along the edge of an access road adjacent to a grassy field. Figure 11 presents a plan and view of the site.

Nine shovel tests were excavated at 15 meter (50 ft) intervals in and around the site. No artifacts were recovered from any of the shovel tests. Soil within these shovel tests consisted of of dark grayish brown sand (0.0-0.1 meters [0.0-0.33 ft] bs) overlaying brown sand to a depth of 0.1-0.6 meters (0.3-2.0 ft) bs. The surrounding road surface was inspected for artifacts. Site boundaries of 8 by 8 meters (26 by 26 ft) were established based upon the extent of artifacts recovered from the ground surface. No evidence of subsurface soil features or artifact concentrations indicative of activity areas were encountered.

A total of five artifacts was recovered from the road surface. These artifacts include three translucent quartz flakes and two translucent quartz flake fragments. These artifacts cannot be associated with any specific cultural period. It is likely they are associated with a small camp or resource procurement activities.

We assessed 31HT957 for eligibility to the NRHP with respect to criterion D. This site has suffered damage from erosion and past clear cutting activities. None of the artifacts was recovered from subsurface deposits. No soil features or artifact concentrations indicative of activity areas were identified. The artifacts cannot be associated with a particular prehistoric period. Therefore, Site 31HT957 cannot address research issues concerning Native Americans in Harnett County or the Coastal Plain of North Carolina. We recommend 31HT956 not eligible for the NRHP. The site warrants no further management.

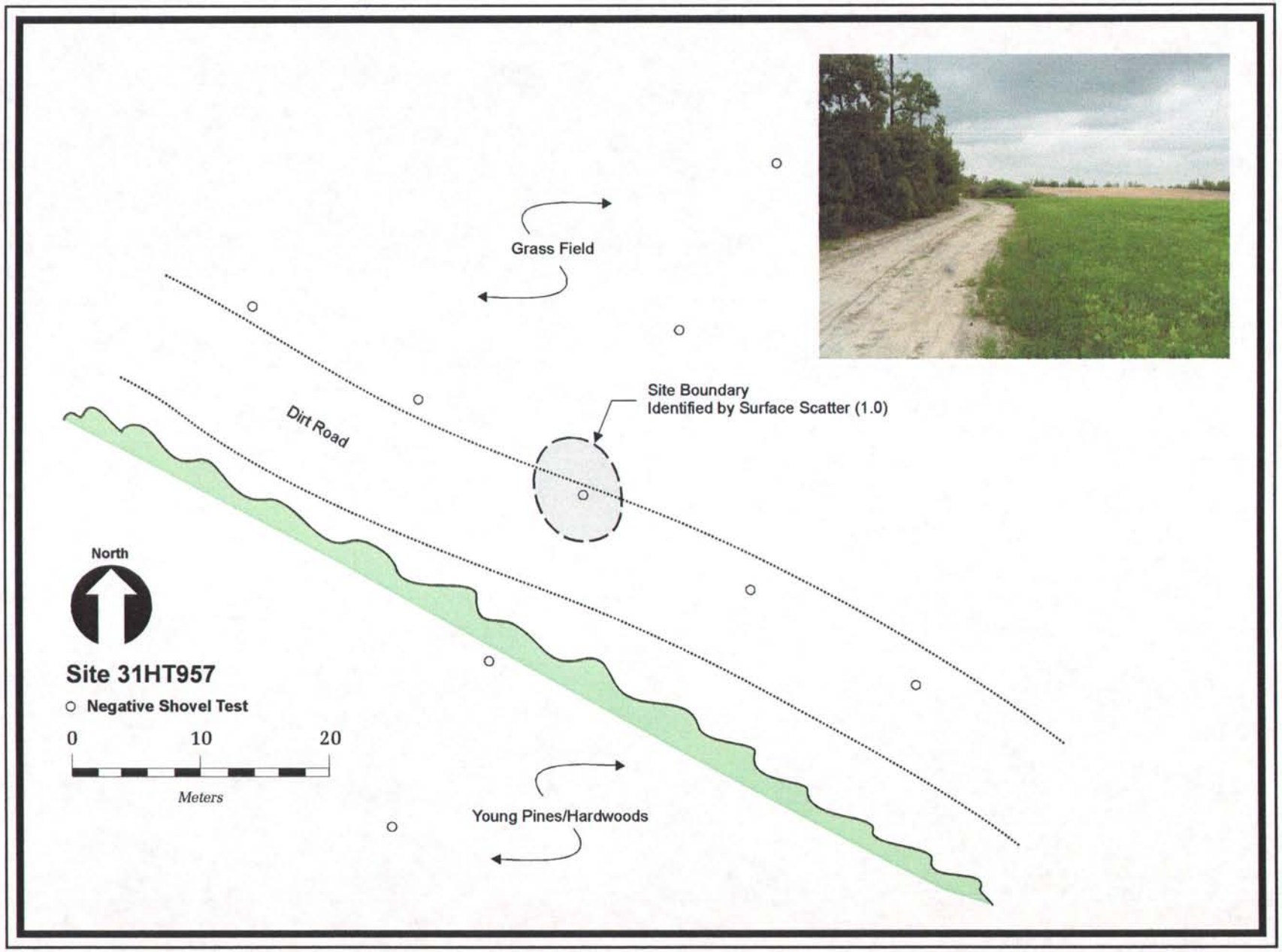

Figure 11. Plan of site 31HT957.

Site 31HT958

Cultural Affiliation - Unknown prehistoric
Site Type - Pre-Contact lithic scatter
Site Dimensions - 10 meters North-South by 8 meters East-West
Soil Type - Candor Sand
Nearest Water Source - Unnamed intermittent stream
Present Vegetation - Mixed immature hardwood and pine forest, light to moderate undergrowth
UTM Coordinates - N 3902923 E 668223
NRHP/Management Recommendation: Not eligible, no further work

Site 31HT958 is a prehistoric artifact surface scatter located on a ridge top in the western portion of the project tract (see Figure 1). This site is located in an open area adjacent to an access road and areas with immature pines and hardwoods. Figure 12 presents a plan and view of the site.

Nine shovel tests were excavated at 15 meter (50 foot) intervals in and around the site. None of the shovel tests produced artifacts. The soil observed in each shovel test consisted of dark grayish brown sand (0.0-0.1 meters [0.0-0.33 feet] bs) overlaying a yellowish brown sand to a depth of 0.1-0.6 meters (0.33-2.0 feet) bs. The surrounding area was surface inspected for artifacts. Site boundaries of 10 by 8 meters (33 by 26 feet) were established based upon the extent of artifacts recovered from the ground surface. No evidence of subsurface soil features or artifact concentrations indicative of activity areas were encountered.

A total of five artifacts was recovered from the ground surface. These artifacts include one quartzite flake and four translucent quartz flake fragments. These artifacts cannot be associated with a specific cultural period. However, they are indicative of tool maintenance or production and may be associated with a former camp site. Native peoples may have used the site during resource procurement activities.

We assessed 31HT958 for eligibility to the NRHP with respect to criterion D. This site has suffered damage from erosion and past clear cutting activities. None of the artifacts was recovered from subsurface deposits. No soil features or artifact concentrations indicative of activity areas were identified. The artifacts cannot be associated with a particular prehistoric period. Therefore, Site 31HT958 cannot address research issues concerning Native Americans in Harnett County or the Coastal Plain of North Carolina. We recommend 31HT958 not eligible for the NRHP. The site warrants no further management.

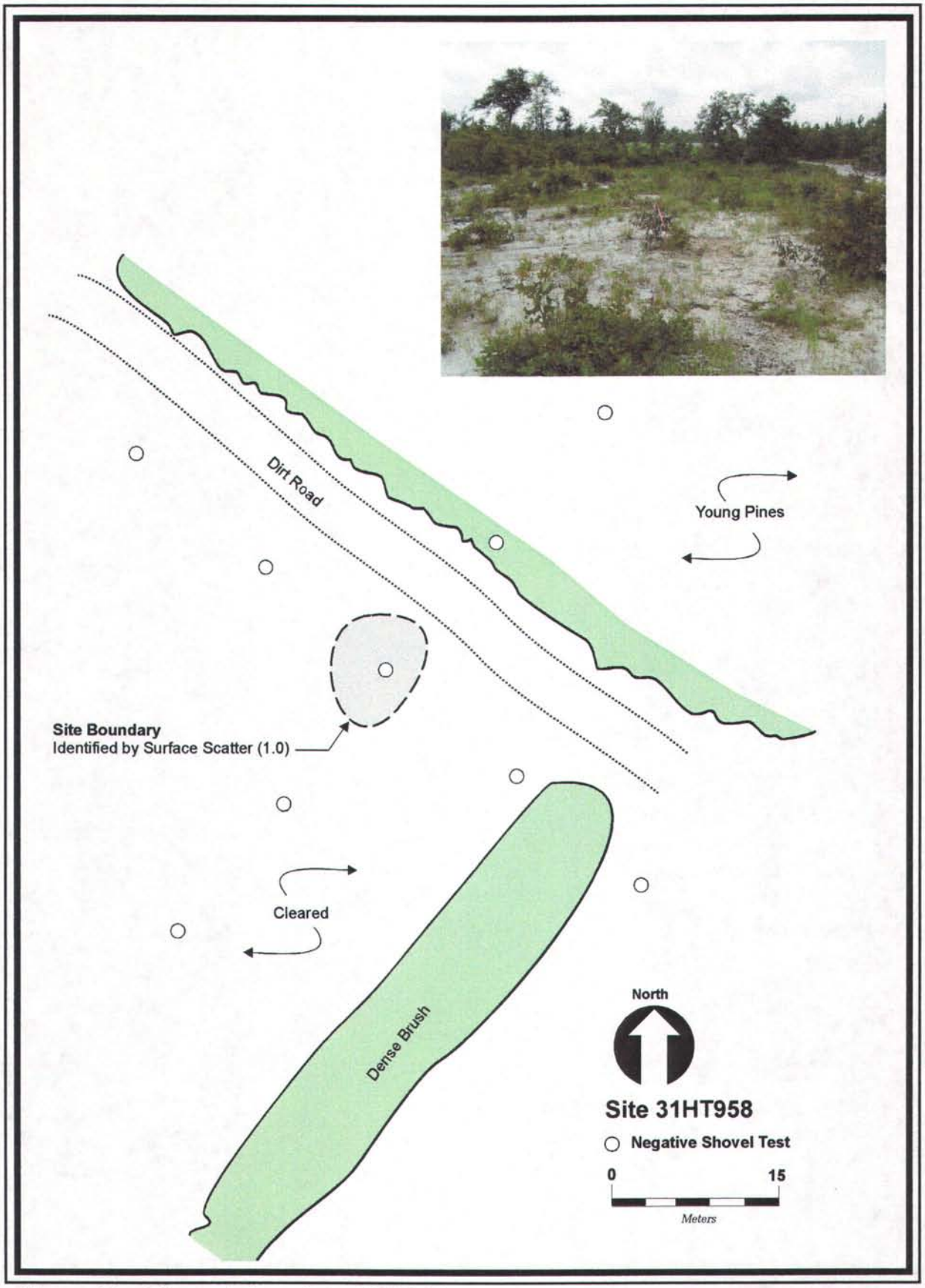

Figure 12. Plan and view of site 31HT958.

Site 31HT959

Cultural Affiliation - Middle Woodland
Site Type - Pre-Contact ceramic scatter
Site Dimensions - 8 meters North-South by 8 meters East-West
Soil Type - Candor Sand
Nearest Water Source - Unnamed intermittent stream
Present Vegetation - Mixed immature hardwood and pine forest, light to moderate undergrowth
UTM Coordinates - N 3903033 E 668325
NRHP/Management Recommendation: Not eligible, no further work

Site 31HT959 is a prehistoric ceramic surface scatter located on a ridge top in the northern portion of the project tract (see Figure 1). This site is located near an intersection of two access roads surrounded by immature hardwoods and pines. Figure 13 presents a plan and view of 31HT959.

Shovel tests were excavated at 15 meter (50 ft) intervals in and around the site. None of the shovel tests produced artifacts. The soil observed in each shovel test consisted of of dark grayish brown sand 0.0-0.1 cm [0.0-0.33 ft] bs) overlaying a yellowish brown sand to a depth of 0.1-0.6 meters (0.33-2.0 ft) bs. The surrounding area was surface inspected for artifacts. Site boundaries of 8 by 8 meters (26 by 26 ft) were established based upon the extent of artifacts recovered from the ground surface.

A total of four artifacts was recovered from the ground surface. These artifacts include four Hanover cord marked sherds. These sherds are associated with a Middle Woodland occupation. No evidence of subsurface soil features or artifact concentrations indicative of activity areas was encountered. It is possible these artifacts were redeposited from another location.

We assessed 31HT959 for eligibility to the NRHP with respect to criterion D. This site has suffered damage from erosion and past clear cutting activities. None of the artifacts was recovered from subsurface deposits. No soil features or artifact concentrations indicative of activity areas were identified. Although Hanover cord marked sherds were recovered from the site, it is not associated with a particular soil horizon or feature. Therefore, Site 31HT959 cannot address research issues concerning Native Americans in Harnett County or the Coastal Plain of North Carolina. We recommend 31HT959 not eligible for the NRHP. The site warrants no further management.

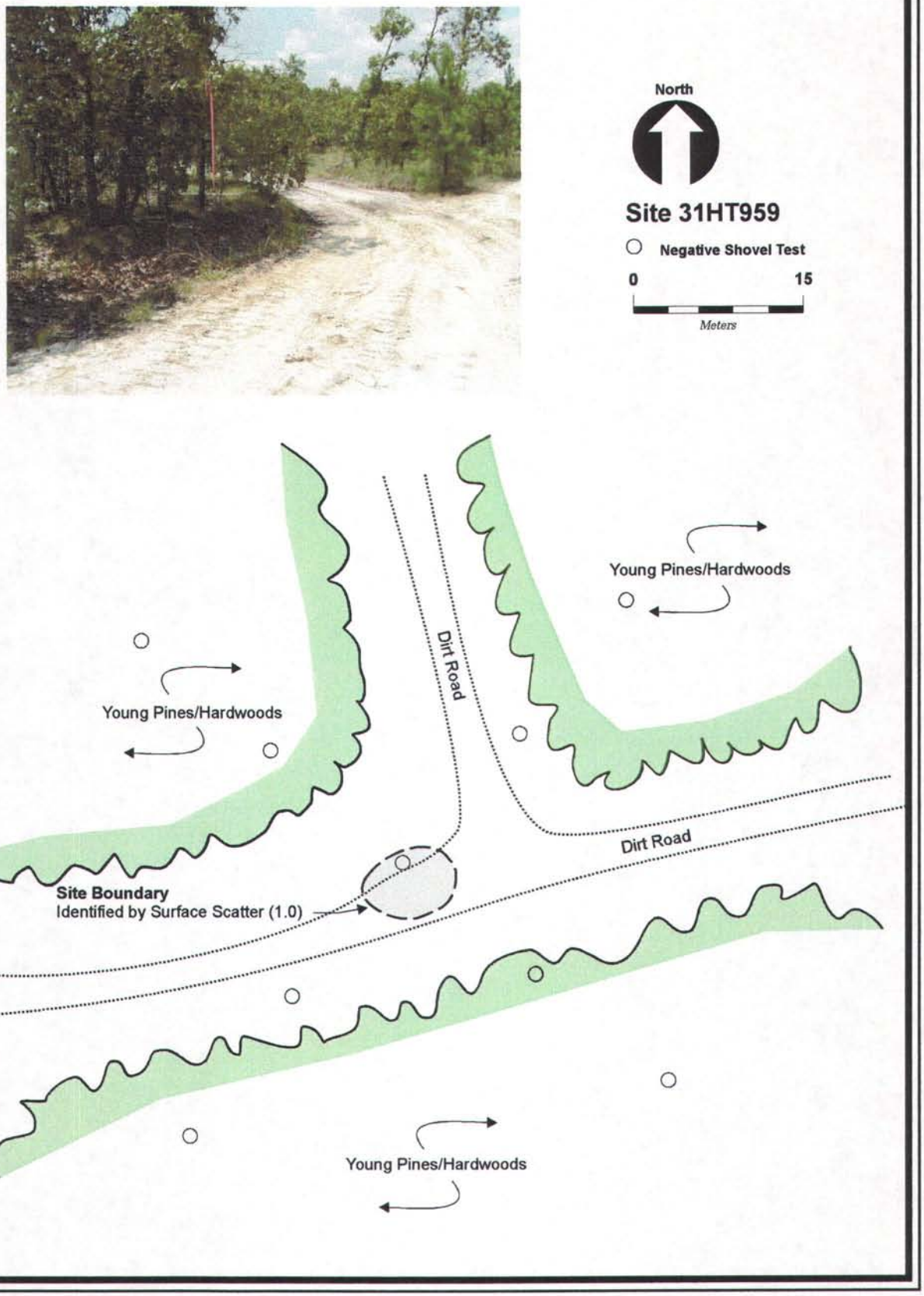

Figure 13. Plan and view of site 31HT959.

Site 31HT960

Cultural Affiliation - Unknown prehistoric
Site Type - Pre-Contact artifact scatter
Site Dimensions - 15 meters North-South by 8 meters East-West
Soil Type - Candor Sand
Nearest Water Source - Unnamed intermittent stream
Present Vegetation - Mixed immature hardwood and pine forest, light to moderate undergrowth
UTM Coordinates - N 3902725 E 668474
NRHP/Management Recommendation: Not eligible, no further work

Site 31HT960 is a prehistoric artifact surface scatter located on a ridge top in the central port ion of the project survey tract (see Figure 1). This site is located along an access road surrounded by immature pines and hardwoods close to a drainage. Figure 14 presents a plan and view of the site.

Nine shovel tests were excavated at 15 meter (50 ft) intervals in and around the site. None of the shovel tests produced artifacts. The soil observed in each shovel test consisted of dark grayish brown sand overlaying (0.0-0.1 meters [0.0-0.33 ft] bs)a yellowish brown sand to a depth of 0.1-0.6 cm (0.33-2.0 ft) bs. The surrounding area was surface inspected for artifacts. Site boundaries of 15 by 8 meters (49 by 26 ft) were established based upon the extent of artifacts recovered from the ground surface.

A total of five artifacts was recovered from the ground surface. These artifacts include two translucent quartz flake fragments and three residual sherds. These artifacts are non-diagnostic and cannot be associated with any specific cultural period. No evidence of subsurface soil features or artifact concentrations indicative of activity areas was encountered. Native Americans may have used 31HT960 as a small camp during resource procurement activities.

We assessed 31HT960 for eligibility to the NRHP with respect to criterion D. This site has suffered damage from erosion and past clear cutting activities. None of the artifacts was recovered from subsurface deposits. No soil features or artifact concentrations indicative of activity areas were identified. The artifacts cannot be associated with a particular prehistoric period. Therefore, Site 31HT960 cannot address research issues concerning Native Americans in Harnett County or the Coastal Plain of North Carolina. We recommend 31HT956 not eligible for the NRHP. The site warrants no further management.

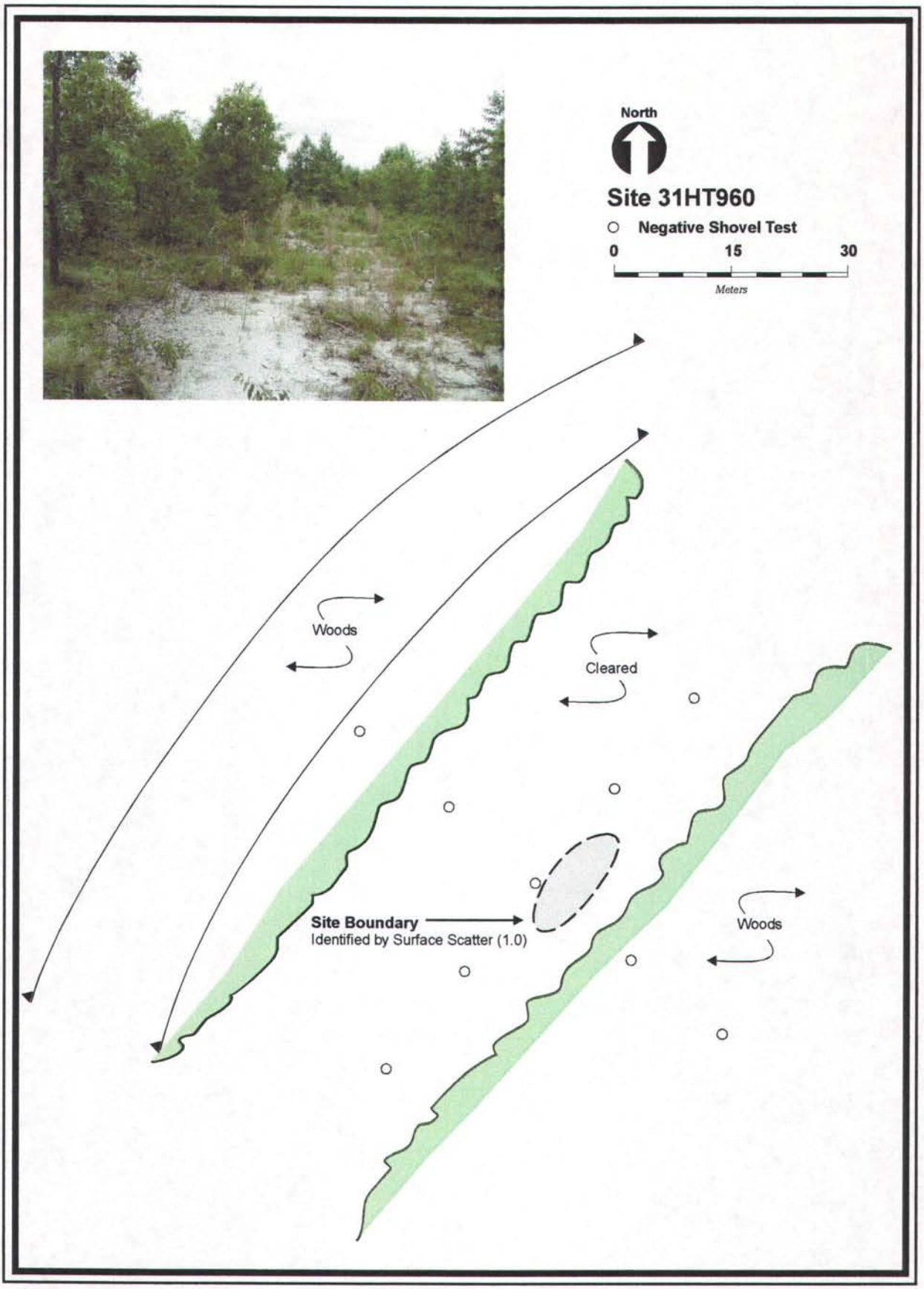

Figure 14. Plan and view of site 31HT960.

Site 31HT961

Cultural Affiliation - Middle/Late Woodland
Site Type - Pre-Contact lithic scatter
Site Dimensions - 24 meters North-South by 7 meters East-West
Soil Type - Candor Sand
Nearest Water Source - Unnamed intermittent stream
Present Vegetation - Mixed immature hardwood and pine forest, light to moderate undergrowth
UTM Coordinates - N 39025257 E 668550
NRHP/Management Recommendation: Not eligible, no further work

Site 31HT961 is a prehistoric artifact scatter located on a ridge top in the central portion of the project tract (see Figure 1). This site is located along an access road surrounded by immature pines and hardwoods close to a drainage. Figure 15 presents a plan and view of the site.

Shovel tests were excavated at 15 meter (50 ft) intervals in and around the site. None of the shovel tests produced artifacts. The soil observed in each shovel test consisted of dark grayish brown sand (0.0-0.1 meters [0.0-0.33 ft] bs) overlaying a yellowish brown sand to a depth of 0.1-0.6 meters (0.33-2.0 ft) bs . The surrounding areas was surface inspected for artifacts. Site boundaries of 24 by 7 meters (79 by 23 ft) were established based upon the extent of artifacts recovered from the ground surface.

A total of five artifacts was recovered from the ground surface. These artifacts include five Hanover Fabric Impressed sherds. These artifacts are associated with a Middle/Late Woodland occupation. No evidence of subsurface soil features or artifact concentrations indicative of activity areas was encountered. It is possible the sherds were redeposited from another location.

None of the artifacts was recovered from subsurface deposits. No soil features or artifact concentrations indicative of activity areas were identified. Although Hanover fabric impressed sherds were recovered from the site, it is not associated with a particular soil horizon or feature. In general, the paucity of artifacts and their poor condition precludes any potential for 31HT960 to address research issues concerning Native Americans and the Middle/Late Woodland period in the Coastal Plain of North Carolina. Therefore, we recommend 31HT961 not eligible for the NRHP. The site warrants no further management.

Isolated Finds

Isolated find 1 (31HT948) consists of a single translucent quartz flake recovered on the ground surface of a grassy field in the southwestern portion of the project tract (see Figure 1). Shovel tests were excavated in cardinal direction from the surface occurring artifact to determine the

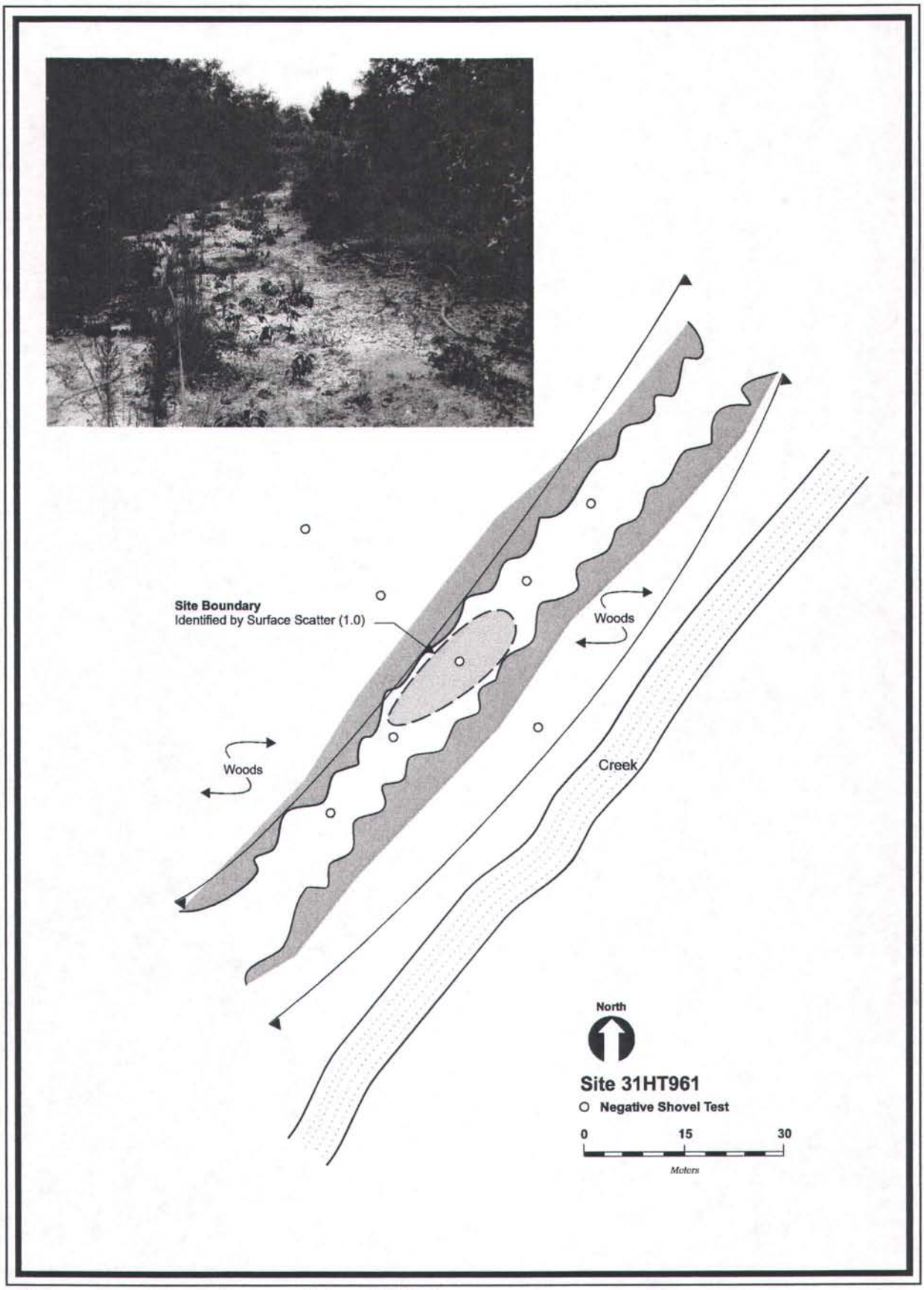

Figure 15. Plan and view of site 31HT961.

extent and nature of this resource. No additional artifacts were recovered from the shovel tests and surface inspections. The surrounding area has undergone considerable erosion due to past clear cutting activities and cultivation and there is no evidence of intact cultural deposits. This resource is considered to have poor research potential and is recommended not eligible for the NRHP.

Isolated find 2 (31HT949) consists of a single translucent quartz flake fragment recovered in a shovel test located within a young mixed pine and hardwood forest in the south-central portion of the project tract (see Figure 1). Shovel tests were excavated in cardinal directions from the initial positive shovel test determine the extent and nature of this resource. No additional artifacts were recovered from the shovel tests and surface inspections. The surrounding area has undergone considerable erosion to due past clear cutting activities and there is no evidence of intact cultural deposits. As a result, this resource is considered to have poor research potential and is recommended not eligible for the NRHP.

Isolated find 3 (31HT950) consists of a single chert flake recovered on the ground surface in a cleared area within a young mixed pine and hardwood forest in the western half of the project tract (see Figure 1). Shovel tests were excavated in cardinal directions from the initial positive shovel test to determine the extent and nature of this resource. No additional artifacts were recovered from the shovel tests and surface inspections. The surrounding area has undergone considerable erosion due to past clear cutting activities and there is no evidence of intact deposits. This resource is considered to have poor research potential and is recommended not eligible for the NRHP.

Isolated find 4 (31HT951) consists of a single translucent quartz flake fragment recovered on an existing dirt road in the eastern portion of the project tract (see Figure 1). Shovel tests were excavated in cardinal directions from the initial surface location to determine the extent and nature of this resource. No additional artifacts were recovered from the shovel tests and surface inspections. The surrounding area has undergone considerable erosion due to road construction and past clear cutting activities. There is no evidence of intact cultural deposits. This resource is considered to have poor research potential and is recommended not eligible for the NRHP.

Isolated find 5 (31HT952) consists of a single translucent quartz flake fragment recovered on the ground surface in a young mixed pine and hardwood forest in the eastern half of the project tract (see Figure 1). Shovel tests were excavated in cardinal directions from the initial surface location to determine the extent and nature of this resource. No additional artifacts were recovered from the shovel tests and surface inspections. The surrounding area has undergone considerable

erosion due to past clear cutting activities and there is no evidence of intact deposits. This resource is considered to have poor research potential and is recommended not eligible for the NRHP.

Isolated find 6 (31HT953) consists of a single eroded body sherd recovered from a shovel test in a young mixed pine and hardwood forest in the north-central portion of the project tract (see Figure 1). Shovel tests were excavated in cardinal direction from the initial positive shovel test to determine the extent and nature of this resource. No additional artifacts were recovered from the shovel tests and surface inspections. The surrounding area has undergone considerable erosion due to past clear cutting activities and there is no evidence of intact cultural deposits. This resource is considered to have poor research potential and is recommended not eligible for the NRHP.

Architectural Survey Results

The architectural survey consisted of a pedestrian survey of the entire project tract. A vehicular survey of the areas surrounding the project tract was also conducted. The architectural historian did not identify any historic architectural resources within, or in the vicinity of, the project tract.

Chapter V. Summary and Recommendations

In July 2003, Brockington and Associates, Inc., under contract with Withers and Ravenel, Inc., conducted a cultural resources survey of the 81 hectare (200 acre) Central Carolina Tire Disposal tract in Harnett County, North Carolina. This investigation was undertaken in compliance with federal and state regulations concerning the identification and management of cultural resources.

The objective of our survey was to identify all cultural resources in the project tract and vicinity and to assess their eligibility for inclusion on the National Register of Historic Places (NRHP). Background research indicated that no archaeological sites or significant cultural resources were recorded within the tract. Four previously recorded archaeological sites were identified within 1.6 kilometers (1.0 mile) of the project tract. All resources are recommended not eligible for the NRHP.

We recorded eight archaeological sites (31HT954-961) and six isolated finds (31HT948-953) during these investigations. The eight archaeological sites have poor integrity and low artifact frequencies. No subsurface archaeological deposits were identified at any of these sites. These sites and isolated finds do not meet the criteria for inclusion on the NRHP, and we recommend them not eligible for the NRHP. We did not identify any historic architectural resources during these investigations

In conclusion, development activities on the Central Carolina Tire Disposal tract will not affect any historic properties. We recommend no further management of cultural resources in the project tract.

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Appendix A.

Artifact Catalog

Artifact Catalog

Brockington and Associates, Inc. uses the following proveniencing system. Provenience 1 designates general surface collections. Numbers after the decimal point designate subsequent surface collections, or trenches. Proveniences 2 to 200 designate shovel tests. Controlled surface collections and 50 by 50 cm units are also designated by this provenience range. Proveniences 201 to 400 designate 1 by 1 m units done for testing purposes. Proveniences 401 to 600 designate excavation units (1 by 2 m, 2 by 2 m, or larger). Provenience numbers over 600 designate features. For all provenience numbers except 1, the numbers after the decimal point designate levels. Provenience X.0 is a surface collection at a shovel test or unit. X.1 designates level one, and X.2 designates level two. For example, 401.2 is Excavation Unit 401, level 2. Flotation samples are designated by a 01 added after the level. For example, 401.201 is the flotation material from Excavation Unit 401, level 2.

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31HT949	**A - 1**	**31HT956**	**A - 3**
31HT950	**A - 1**	**31HT957**	**A - 3**
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31HT952	**A - 2**	**31HT959**	**A - 4**
31HT953	**A - 2**	**31HT960**	**A - 4**
31HT954	**A - 2**	**31HT961**	**A - 4**

SITE NUMBER: 31HT948 **ACCESSION NUMBER:** 230694

PROVENIENCE NUMBER: 2 . 0 Transect 16, shovel test 4, surface

Spec. #	*Catalog #*	*Count*	*Weight (in g)*	*Artifact Description*	*Comments*
ml	1	1	0.60	translucent quartz flake	

SITE NUMBER: 31HT949 **ACCESSION NUMBER:** 230695

PROVENIENCE NUMBER: 2 . 1 Transect 34, shovel test 1, 0-70cm

Spec. #	*Catalog #*	*Count*	*Weight (in g)*	*Artifact Description*	*Comments*
ml	1	1	0.10	translucent quartz flake	

SITE NUMBER: 31HT950 **ACCESSION NUMBER:** 230696

PROVENIENCE NUMBER: 2 . 0 Transect 38, shovel test 5, surface

Spec. #	*Catalog #*	*Count*	*Weight (in g)*	*Artifact Description*	*Comments*
ml	1	1	1.00	chert flake	

Site Number: 31HT951

SITE NUMBER: 31HT951 **ACCESSION NUMBER:** 230697

PROVENIENCE NUMBER: 2 . 0 Transect 53, shovel test 4, surface

Spec. #	*Catalog #*	*Count*	*Weight (in g)*	*Artifact Description*	*Comments*
m1	1	1	1.10	translucent quartz flake fragment	

SITE NUMBER: 31HT952 **ACCESSION NUMBER:** 230698

PROVENIENCE NUMBER: 2 . 0 Transect 54, shovel test 2, surface

Spec. #	*Catalog #*	*Count*	*Weight (in g)*	*Artifact Description*	*Comments*
m1	1	1	0.70	translucent quartz flake fragment	

SITE NUMBER: 31HT953 **ACCESSION NUMBER:** 230699

PROVENIENCE NUMBER: 2 . 1 Transect 65, shovel test 2, 0-20cm

Spec. #	*Catalog #*	*Count*	*Weight (in g)*	*Artifact Description*	*Comments*
p1	1	1	10.50	body sherd with unidentifiable decoration, grog temper	

SITE NUMBER: 31HT954 **ACCESSION NUMBER:** 230700

PROVENIENCE NUMBER: 2 . 0 Transect 1, shovel test 1, surface

Spec. #	*Catalog #*	*Count*	*Weight (in g)*	*Artifact Description*	*Comments*
m1	1	1	1.30	translucent quartz projectile point base	
m2	2	1	10.40	translucent quartz shatter	
m3	3	1	0.30	translucent quartz small circular tertiary reduction flake	
m4	4	8	4.80	translucent quartz flake fragment	

SITE NUMBER: 31HT955 **ACCESSION NUMBER:** 230701

PROVENIENCE NUMBER: 2 . 0 Transect 5, shovel test 4, surface

Spec. #	*Catalog #*	*Count*	*Weight (in g)*	*Artifact Description*	*Comments*
m1	1	2	2.20	chert flake fragment	
m2	2	2	8.00	translucent quartz flake fragment	
a3	3	1	0.50	translucent quartz projectile point	Caraway, Late Woodland
p4	4	1	6.40	eroded body sherd, fine/medium sand temper	

SITE NUMBER: 31HT956 **ACCESSION NUMBER:** 230702

PROVENIENCE NUMBER: 2 . 0 Transect 13, shovel test 1, surface

Spec. #	*Catalog #*	*Count*	*Weight (in g)*	*Artifact Description*	*Comments*
m1	1	1	1.20	translucent quartz flake	
m2	2	4	1.60	translucent quartz flake fragment	

SITE NUMBER: 31HT957 **ACCESSION NUMBER:** 230703

PROVENIENCE NUMBER: 2 . 0 Transect 17, shovel test 1, surface

Spec. #	*Catalog #*	*Count*	*Weight (in g)*	*Artifact Description*	*Comments*
m1	1	3	2.10	translucent quartz flake	
m2	2	2	0.40	translucent quartz flake fragment	

Site Number: 31HT958

SITE NUMBER: 31HT958 **ACCESSION NUMBER:** 230704

PROVENIENCE NUMBER: 2 . 0 Transect 36, shovel test 6, surface

Spec. #	*Catalog #*	*Count*	*Weight (in g)*	*Artifact Description*	*Comments*
m1	1	1	0.50	quartzite flake	
m2	2	4	2.00	translucent quartz flake fragment	

SITE NUMBER: 31HT959 **ACCESSION NUMBER:** 230705

PROVENIENCE NUMBER: 2 . 0 Transect 36, shovel test 1, surface

Spec. #	*Catalog #*	*Count*	*Weight (in g)*	*Artifact Description*	*Comments*
p1	1	4	12.60	cord marked body sherd, coarse sand temper	2 mend

SITE NUMBER: 31HT960 **ACCESSION NUMBER:** 230706

PROVENIENCE NUMBER: 2 . 0 Transect 47, shovel test 2, surface

Spec. #	*Catalog #*	*Count*	*Weight (in g)*	*Artifact Description*	*Comments*
m1	1	2	1.70	translucent quartz flake fragment	
p2	2	3	3.00	residual sherd	

SITE NUMBER: 31HT961 **ACCESSION NUMBER:** 230707

PROVENIENCE NUMBER: 2 . 0 Transect 53, shovel test 2, surface

Spec. #	*Catalog #*	*Count*	*Weight (in g)*	*Artifact Description*	*Comments*
p1	1	5	8.20	fabric impressed rim sherd, grog temper	Hanover, 4 mend

Appendix B.

Resume of Primary Author

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EDUCATION

M.A. in Anthropology, University of Arkansas, Fayetteville, 2001.
B.A. in Anthropology, Appalachian State University, Boone, NC, 1999.

PROFESSIONAL MEMBERSHIPS

Society for American Archaeology
Southeastern Archaeological Society

AREAS OF SPECIALIZATION

Ground Stone Technology

EMPLOYMENT HISTORY

June 2002-present	Archaeologist I. Brockington and Associates, Inc., Raleigh.
July 2001-May 2002	Archaeological Technician. Brockington and Associates, Inc., Raleigh.
August 2000-May 2001	Archaeological Research Assistant, Department of Anthropology, University of Arkansas, Fayetteville.
August2000-September 2000	Archaeological Technician, Department of Anthropology, University of Arkansas, Fayetteville.
July 2000	Archaeological Field Technician, SPEARS Inc., West Fork, Arkansas.

EXPERIENCE (a more detailed list of project and reports are available upon request)

Project Manager - *Archaeological Survey of the Proposed Aiken Combustion Turbine Plant Tract, Aiken County, South Carolina.* This project was a Phase I cultural resources survey of an 80 acre tract. This project was conducted for Duke Engineering and Services.

Project Manager - *Cultural Resources Survey of Three Proposed Intersection Improvements, Spartanburg County, South Carolina.* This was Phase I cultural resources survey of three proposed intersection improvements. This project was conducted for the TranSystems Corporation.

Project Manager- *Cultural Resources Survey of the Georgetown Industrial Park Tract, Georgetown County, South Carolina.* This project was a Phase I cultural resources survey of a 600 acre tract. This project was conducted for Davis and Floyd.

Project Manager- *Cultural Resources Evaluation of the Grace Chapel Substation and 115 kV Transmission Line, Caldwell County, North Carolina.* This project was a Phase I cultural resources survey of 4 acre substation tract and an associated 4.5 mile transmission line corridor. The project was conducted for Framatome ANP.

Project Manager- *Archaeological Survey of the Heavenly Mountain Resort Golf Course, Watauga County, North Carolina.* This project was a Phase I archaeological survey of 200 acres, divided between three tracts of land. This project was conducted for E'nV Environmental Consulting.

Project Manager- *Cultural Resources Survey of the Jones-Mainland Tract, Beaufort County, South Carolina* . This project was a Phase I cultural resources survey of a 3,655 acre tract. The project was conducted for Palmetto Bluff, LLC.

Project Manager- *Cultural Resources Investigation of the Central Carolina Tire Disposal Tract, Harnett County, North Carolina.* This project was a Phase I cultural resources survey of a 200 acre tract. This project was conducted for Withers and Ravenel, Inc.

PUBLICATIONS AND PAPERS PRESENTED

1999 Cheryl Claassen, Michael O'Neal, Tamara Wilson, Elizabeth Arnold, and Brent Lansdell
Hearing and Reading Southeastern Archaeology: A Review of the Annual Meetings of SEAC from 1983 through 1995 and the Journal *Southeastern Archaeology. Southeastern Archaeology* 18(2): 85-97.

1998 Cheryl Claassen, Michael O'Neal, Tamara Wilson, Elizabeth Arnold, and Brent Lansdell
Hearing and Reading Southeastern Archaeology: A Review of the Annual Meetings of SEAC from 1983 through 1995 and the Journal Southeastern Archaeology. Paper presented at the Southeastern Archaeological Conference, Greenville, South Carolina.