STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

BEVERLY EAVES PERDUE
GOVERNOR

EUGENE A. CONTI, JR.
SECRETARY

May 4, 2012

U. S. Army Corps of Engineers
Regulatory Field Office
3331 Heritage Trade Drive, Suite 105
Wake Forest, NC 27587

ATTN: Mr. John Thomas
NCDOT Coordinator

SUBJECT: **Application for Section 404 Individual Permit and Section 401 Individual Water Quality Certification** for the proposed extension of SR 3000 (Idols Rd.) from SR 2999 (Hampton Rd.) to US 158 (Clemmons Rd.), Forsyth County. Federal Aid Project No. STP–3000 (1), State Project No. 8.2624101, T.I.P. Project No. U-2707.

Debit $570.00 from WBS Element No. 34845.1.1.

Dear Sir:

The North Carolina Department of Transportation (NCDOT) proposes to extend SR 3000 (Idols Rd.) from SR 2999 (Hampton Rd.) to US 158 (Clemmons Rd.) near Clemmons, Forsyth County. This project involves the construction of a 2.0 mile roadway on new location, as well as the replacement of bridge no. 109 over the Norfolk Southern Railroad and the reconfiguration of the intersection of Idols and Hampton Roads. The cross section of the proposed new location facility consists of two 12 ft. travel lanes, 4 ft. paved shoulders to accommodate bicycles, and 4 ft. grass shoulders.

In addition to this cover letter, the application packet for this project consists of the ENG Form 4345, Stream Mitigation Plan, North Carolina Ecosystem Enhancement Program (NCEEP) acceptance letter, 4A Concurrence Point Merger Packet, Interagency Hydraulic Review Meeting (4B) minutes, 4C Concurrence Point minutes, Stormwater Management Plan, permit drawings, and half-size roadway plan sheets.

PROJECT SCHEDULE

This project calls for a review date of October 2, 2012 and a letting date of November 20, 2012. However, these dates may advance as additional funds become available.

MAILING ADDRESS:
N.C. DEPARTMENT OF TRANSPORTATION
PDEA – NATURAL ENVIRONMENT SECTION
1598 MAIL SERVICE CENTER
RALEIGH NC 27699-1598

TELEPHONE: 919-707-6100

FAX: 919-212-5785

PHYSICAL ADDRESS:
CENTURY CENTER – BUILDING B
1020 BIRCH RIDGE DR.
RALEIGH, NC 27610-4328

WEBSITE: WWW.NCDOT.ORG

PURPOSE AND NEED

The stated purpose and need for this project is to:

- Improve the poor level of traffic service and connectivity between southern Clemmons and Winston-Salem;
- Improve the poor sight distance and restricted turning mobility along Hampton Road; and
- Provide an alternative route, other than Hampton Road (a residential street), to access a proposed industrial park, which is expected to increase truck traffic on the existing roadway network.

NEPA DOCUMENT STATUS

An Environmental Assessment (EA) was approved in February 2002 and distributed shortly thereafter. A Finding of No Significant Impact (FONSI) was signed July 2004 and distributed thereafter. These documents have been provided to the regulatory review agencies. Additional copies will be provided upon request.

INDEPENDENT UTILITY

The subject project is in compliance with 23 CFR Part 771.111(f), which lists the Federal Highway Administration (FHWA) characteristics of independent utility of a project:

(1) The project connects logical termini and is of sufficient length to address environmental matters on a broad scope;
(2) The project is usable and a reasonable expenditure, even if no additional transportation improvements are made in the area;
(3) The project does not restrict consideration of alternatives for other reasonably foreseeable transportation improvements.

RESOURCE STATUS

Wetland delineations within the U-2707 project area followed the field delineation method outlined in the *1987 Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory, 1987) and supplemented in the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region* (U.S. Army Corps of Engineers [USACE], 2010 [Interim]). Stream identification and classification followed the *Identification Methods for the Origins of Intermittent and Perennial Streams* (North Carolina Division of Water Quality [NCDWQ], 2005).

Within the U-2707 project area, nine streams and three wetlands were identified. Jurisdictional areas were verified by USACE Regulatory Specialist John Thomas and NCDWQ Regulatory Specialist Amy Euliss on April 20, 2011 and an approved Jurisdictional Determination (JD) was received on September 15, 2011 (USACE Action ID No. 199820439).

IMPACTS TO WATERS OF THE UNITED STATES

The project is located in the Yadkin-Pee Dee River Basin in Forsyth County. (U.S. Geological Survey [USGS] Hydrologic Unit [HUC] 03040101). A total of three jurisdictional streams will be impacted by this project. These include Muddy Creek (Class C; NCDWQ Index No. 12-94-[0.5]) and two unnamed tributaries of Muddy Creek (S-SE-C and S-JH-A). Additionally, two riparian wetlands, Wetland A-JP and Wetland JHC, will be impacted by the project.

There are no designated Outstanding Resource Waters (ORW), High Quality Waters (HQW), Water Supply I (WS-I), or Water Supply II (WS-II) waters within 1.0 mile of the project area. Additionally, none of the streams located within the project study area support trout or anadromous fish and no Primary Nursery Areas are present within the study area boundaries. In the project area, Muddy Creek is listed on the 2010 Final 303(d) List of Impaired Waters. This surface water is listed for increased levels of copper and zinc as well as compromised biological integrity.

Surface Waters

Total surface water impacts for U-2707 include 903 linear feet of permanent jurisdictional stream impacts, summarized below in Table 1.

Table 1. Impacts to Jurisdictional Streams

Site No.	Stream ID[a]	Stream Name	Stream Designation	Impact Type	Impact Length (linear ft.)
2	S-SE-C	UT to Muddy Creek	Intermittent	Permanent Fill	61
3	S-JH-A	UT to Muddy Creek	Perennial	Permanent Fill	831
6	Muddy Creek	Muddy Creek	Perennial	Bank Stabilization	11
Total Permanent Impacts					903

[a] These names were assigned during the 2011 JD process

Wetlands

There will be a total of 0.81 acre of permanent riparian wetland impacts associated with this project. Impacts are a result of mechanized clearing and permanent fill. Wetland impacts are summarized below in Table 2.

Table 2. Impacts to Jurisdictional Wetlands

Site	Wetland ID[a]	Impact Type	Impact (ac.)
1	Wetland A-JP	Mechanized Clearing	0.03
4	Wetland JHC	Permanent Fill	0.78
Total Permanent Impacts			0.81

[a] These names were assigned during the 2011 JD process

UTILITY IMPACTS

No impacts to Waters of the U.S. resulting from utilities are anticipated on this project.

FEDERALLY PROTECTED SPECIES

Plants and animals with a Federal classification of Endangered (E) or Threatened (T) are protected under provisions of Section 7 and Section 9 of the Endangered Species Act (ESA) of 1973, as amended. As of September 22, 2010 the U.S. Fish and Wildlife Service (USFWS) lists three federally protected species for Forsyth County: bog turtle (*Clemmys muhlenburgii*), red-cockaded woodpecker (*Picoides borealis*), and small-anthered bittercress (*Cardamine micranthera*). Biological conclusions of "No Effect" were stated in the EA for red-cockaded woodpecker and small-anthered bittercress and remain valid. No biological conclusion is required for bog turtle, as it is threatened due to the similarity of appearance to the threatened northern population of bog turtle.

As stated in the EA, no habitat is present for red-cockaded woodpecker in the project area; however habitat for the bittercress is listed as occurring in the project area, though no individuals were found. Since the EA was written, it has been determined that small-anthered bittercress is endemic to the Dan River drainage in the Roanoke River basin. Since this project is located in the Yadkin-Pee Dee River basin, no habitat for the bittercress is present. A search of the North Carolina Natural Heritage Database (NCNHP; updated February 2012) revealed no known occurrences of any federally protected species within 1.0 mile of the project limits.

CULTURAL RESOURCES

Archaeological Resources

Seven archaeological sites were identified within the four initial alternative alignments. However, none of these sites were deemed eligible for the National Register of Historic Places nor did they warrant preservation as a public exhibit. In a letter dated August 2, 1999, the North Carolina Department of Cultural Resources, State Historic Preservation Office (SHPO) concurred with these findings (see Appendix B in the EA).

Architectural Resources

In a concurrence form dated November 29, 2001, SHPO stated that this project would have an effect on Hanes House (Arden Farm), a National Register eligible property. However, it was determined that there would not be an adverse effect on this property if NCDOT agreed to minimize tree removal between the railroad right-of-way and the edge of pavement on the new alignment (see Appendix B in the EA). This requirement to achieve no adverse effect was incorporated into the project commitments in the EA.

FEMA COMPLIANCE

There are streams within the project limits that are within Federal Emergency Management Agency (FEMA)-designated flood zones. Coordination between the NCDOT Hydraulics Unit and FEMA will occur prior to Let to ensure that NCDOT is in full compliance with applicable floodplain ordinances.

INDIRECT AND CUMULATIVE EFFECTS

Although STIP Project U-2707 is expected to impart moderate indirect effects along the proposed project corridor northwest of the railroad at the planned industrial/employment site, minimal indirect effects are anticipated throughout the majority of the Future Land Use Study Area. The County planner indicated that although STIP Project U-2707 would provide industrial and employment development opportunities in Clemmons along the project corridor, additional growth or development other than along the project corridor as a result of STIP Project U-2707 is not anticipated. In addition, City-County sewer service is not currently available in the portions of the Future Land Use Study Area south of Idols Road, southeast of the proposed project corridor, or within Davidson County (except for the Peppertree Subdivision off Loop Road). The Winston-Salem County Utilities Commission does not have any plans to extend sewer service lines at this time. However, the wastewater treatment system is expected to reach 80% capacity in 2020.
The proposed partial control of access, in combination with the presence of the Norfolk Southern Railroad corridor and the lack of City-County sewer service, would temper any residential or commercial development southeast of the project corridor.

Although STIP Project U-2707 will be helpful in opening up industrial and employment opportunities along the project corridor in Clemmons, the County planner noted that the construction of the portion of the proposed Winston-Salem Northern Beltway between US 158 and I-40 (STIP Project R-2247) would ultimately make the Clemmons and southwestern Forsyth County area more accessible and attractive for industrial development. The project is only one of many factors affecting growth potential or potential for land use change in the Future Land Use Study Area (other factors include infrastructure, population growth and job growth, proximity to employment centers, etc.). The STIP Project is not the determining factor in how much, how fast, or how intense development is occurring or will occur in the study area. Taken in the context of other past, present and future actions, STIP Project U-2707 should not result in substantial cumulative effects.

Qualitative analyses of the probable development patterns in the Future Land Use Study Area suggest that STIP Project U-2707 will have little effect on water quality or future stormwater runoff in the watersheds encompassed by the project. Water quality concerns should be greatly mitigated by regulations covering watershed protection, floodplain protection, stream and river buffers and stormwater management.

No additional indirect and cumulative effects studies were recommended.

WILD AND SCENIC RIVERS

This project will not impact any designated Wild and Scenic Rivers or any rivers included in the list of study rivers (Public Law 90-542, as amended) or North Carolina Natural and Scenic Rivers.

ESSENTIAL FISH HABITAT

The project will not impact any essential fish habitat afforded protection under the Magnuson – Stevens Act of 1996 (16 U.S.C 1801 *et seq.*).

MITIGATION OPTIONS

The USACE has adopted, through the Council on Environmental Quality (CEQ), a wetland mitigation policy that embraces the concept of "no net loss of wetlands" and sequencing. The purpose of this policy is to restore and maintain the chemical, biological, and physical integrity of the waters of the United States. CEQ has defined mitigation of wetland and surface water impacts to include: avoiding impacts, minimizing impacts, rectifying impacts, reducing impacts over time, and compensating for impacts (40 CFR 1508.20).

The NCDOT is committed to incorporating all reasonable and practicable design features to avoid and minimize jurisdictional impacts, and to provide full compensatory mitigation of all remaining, unavoidable jurisdictional impacts. Avoidance measures were taken during the planning phase and minimization measures were incorporated as part of the project design. Minimization includes the examination of appropriate and practicable steps to reduce the adverse impacts.

Avoidance and Minimization

Avoidance and minimization has been employed in the project area to the maximum extent practicable. It must be noted that, in the FONSI, as no wetlands had been identified on the project, no wetland impacts were anticipated; however, wetlands were found during the re-verification process, leading to previously unidentified impacts.

The following avoidance and minimization measures were implemented for this project:

- NCDOT's Best Management Practices (BMPs) for the Protection of Surface Waters will be enforced;
- Stream impacts have been reduced from 1,362 linear feet in the EA to 903 linear feet;
- 2:1 fill slopes will be employed in areas where permanent fill will be placed in wetlands;
- The bridge placed over Muddy Creek will not require bents in the water and no deck drains will be allowed to discharge directly into the creek;
- Preformed scour holes will be placed throughout the project to diffuse storm drainage. See the Stormwater Management Plan (SMP) for station locations;
- Rip rap pads will be installed at pipe and ditch outlets into wetlands and streams to dissipate flow velocities throughout the project;

- Bank stabilization will reduce erosion without placing rip-rap in the streambed;
- Grassed swales will be employed to reduce flow velocities and filter pollutants from highway runoff. See the SMP for station locations; and
- Use of a corrugated aluminum arch pipe (CAAP) in the on-site stream mitigation to encourage fish passage.

In addition to the avoidance and minimization measures listed above, the chosen alternative (Alternative B) was preferred in part because it crosses Muddy Creek and its tributaries (S-JH-A and S-JH-B) at one location and would therefore require fewer structures (see the mitigation section below).

Compensatory Mitigation

NCDOT proposes mitigation for 892 linear feet of permanent stream impacts (not including bank stabilization) and 0.81 acre of permanent riparian wetland impacts. On-site stream restoration and enhancement will be performed by NCDOT to compensate for all 892 linear feet of permanent stream impacts at a 1:1 ratio. The USACE is requiring all 892 feet of mitigation. The remaining compensatory mitigation for 0.81 acre of permanent riparian wetland impacts will be provided by NCEEP.

On-Site Stream Restoration

Per the NCDOT Stream Mitigation Plan for U-2707, NCDOT proposes restoration and relocation of S-JH-A ('Reach 1') and enhancement of S-JH-B ('Reach 2'). The mitigation area will be constructed in conjunction with TIP U-2707. A total of 1,122 linear feet of S-JH-A will be restored and 863 feet relocated resulting in a proposed channel length of 678 feet. Using a 1:1 ratio, 1,800 feet of stream mitigation units (SMUs) will be generated by work on S-JH-A. In addition, a total of 153 linear feet of S-JH-B will receive enhancement, generating 76.5 feet of SMUs at a 2:1 ratio. In sum, a total of 1,876.5 linear feet of SMU's will be generated by this on-site stream mitigation project. Therefore, minus the 892 linear feet of compensatory mitigation required for U-2707, DOT will net 984.5 linear feet of bankable stream mitigation from this project.

Construction activities resulting from natural stream design on S-JH-A involve excavation, structure installation, pipe removal and replacement, utility marking, and vegetation installation. Enhancement activities on S-JH-B will consist of replacing a degraded corrugated metal pipe (CMP) with a corrugated aluminum arch pipe (CAAP) with a built in baffling system to encourage fish passage. Please see the attached Stream Mitigation Plan for a comprehensive description of the proposed mitigation activities.

REGULATORY APPROVALS

Application is hereby made for a Department of the Army Section 404 Individual Permit as required for the above-described activities for the proposed T.I.P. Project No. U-2707. We are also requesting a Section 401 Individual Water Quality Certification from NCDWQ. In compliance with Section 143-215.3D(e) of the NCAC, we will provide $570.00 to act as

payment for processing the Section 401 permit. We are providing five copies of this application to NCDWQ for their review and approval.

A copy of this application and its distribution list will be posted on the NCDOT website at http://www.ncdot.org/doh/preconstruct/pe/neu/Permit.html. Thank you for your time and assistance with this project. Please contact Amy James at either aejames@ncdot.gov or (919) 707-6129 if you have any questions or need additional information.

Sincerely,

E. R. Lusk

for Gregory J. Thorpe, Ph.D., Manager
Project Development and Environmental Analysis Unit

Cc: NCDOT Permit Application Standard Distribution List

U.S. ARMY CORPS OF ENGINEERS

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT

(33 CFR 325)

OMB APPROVAL NO. 0710-0003
EXPIRES: 31 AUGUST 2012

Public reporting for this collection of information is estimated to average 11 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of the collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters, Executive Services and Communications Directorate, Information Management Division and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. Please DO NOT RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research, and Sanctuaries Act, Section 103, 33 USC 1413; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public and may be made available as part of a public notice as required by Federal law. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued. One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and/or instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETE

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME	8. AUTHORIZED AGENT'S NAME AND TITLE (agent is not required)
First - Middle - Last -	First - Middle - Last -
Company - North Carolina Department of Transportation, PDEA	Company -
E-mail Address - aejames@ncdot.gov	E-mail Address -
6. APPLICANT'S ADDRESS:	9. AGENT'S ADDRESS:
Address- 1598 Mail Service Center	Address-
City - Raleigh State - NC Zip - 27699 Country - USA	City - State - Zip - Country -
7. APPLICANT'S PHONE NOs. w/AREA CODE	10. AGENTS PHONE NOs. w/AREA CODE
a. Residence b. Business 919-707-6129 c. Fax 919-212-5785	a. Residence b. Business c. Fax

STATEMENT OF AUTHORIZATION

11. I hereby authorize, _____ to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

_____ _____
SIGNATURE OF APPLICANT DATE

NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions)

U-2707, extension of SR 3000 (Idols Rd.) from SR 2999 (Hampton Rd.) to US 158 (Clemmons Rd.) near Clemmons, Forsyth Co.

13. NAME OF WATERBODY, IF KNOWN (if applicable)	14. PROJECT STREET ADDRESS (if applicable)
Muddy Creek and its unnamed tributaries	Address
15. LOCATION OF PROJECT Latitude: °N 36.014446 Longitude: °W -80.356643	City - State- Zip-

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)

State Tax Parcel ID Municipality Clemmons

Section - Township - Range -

17. DIRECTIONS TO THE SITE

Please see attached vicinity map and cover letter.

18. Nature of Activity (Description of project, include all features)

This project involves the construction of a 2.0 mile roadway on new location, as well as the replacement of bridge no. 109 over the Norfolk Southern Railroad and the re-configuration of the intersection of Idols and Hampton Roads. The cross section of the proposed new location facility consists of two 12-ft. travel lanes, 4-ft. paved shoulders to accommodate bicycles, and 4-ft. grass shoulders. This project will also involve a new bridge over Muddy Creek and on-site stream mitigation activities, which include excavation, structure installation, pipe removal and replacement, utility marking, and vegetation installation.

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

The main purpose of this project is to provide an improved connection from southern Clemmons and northern Davidson County to Winston-Salem. In addition, it will serve to improve access to a planned industrial park, which currently relies solely on a residential street (Hampton Rd.) as its main access point. To that end, the proposed project will route through- and truck traffic off Hampton Rd., which is projected to have a failing level of service in the design year (2025) if no changes are made.

USE BLOCKS 20-23 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

Both permanent stream and wetland impacts will result from the construction of the proposed project. Impacts will result from fill associated with construction of the Idols Rd. extension.

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards:

Type Amount in Cubic Yards	Type Amount in Cubic Yards	Type Amount in Cubic Yards
See attached cover letter.		

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Acres See attached cover letter.

or

Linear Feet

23. Description of Avoidance, Minimization, and Compensation (see instructions)

Avoidance and Minimization: Please see attached permit application cover letter and permit packet.

Compensation: NCDOT proposes mitigation for 892 linear feet of permanent stream impacts and 0.81 acre of permanent riparian wetland impacts. On-site stream restoration and enhancement will be performed by NCDOT to compensate for all 892 linear feet of permanent stream impacts at a 1:1 ratio. The remaining compensatory mitigation for 0.81 acre of permanent riparian wetland impacts will be provided by NCEEP.

24. Is Any Portion of the Work Already Complete? ☐ Yes ☒ No IF YES, DESCRIBE THE COMPLETED WORK

25. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (if more than can be entered here, please attach a supplemental list).

a. Address- See permit drawings

City - State - Zip -

b. Address-

City - State - Zip -

c. Address-

City - State - Zip -

d. Address-

City - State - Zip -

e. Address-

City - State - Zip -

26. List of Other Certificates or Approvals/Denials received from other Federal, State, or Local Agencies for Work Described in This Application.

AGENCY	TYPE APPROVAL*	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED

* Would include but is not restricted to zoning, building, and flood plain permits

27. Application is hereby made for permit or permits to authorize the work described in this application. I certify that this information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

E. L. Luck for Gregory J. Thaxe, PhD — May 1, 2012

SIGNATURE OF APPLICANT — DATE — SIGNATURE OF AGENT — DATE

The Application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

U-2707 STREAM MITIGATION PLAN

FORSYTH COUNTY, NORTH CAROLINA

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

DECEMBER 22, 2011

U-2707 Stream Mitigation Plan

Forsyth County, North Carolina

December 5, 2011

Prepared For:
North Carolina Department of Transportation

MULKEY
ENGINEERS & CONSULTANTS

Report Prepared by Mulkey, Inc.:

Emmett Perdue, P.E.
Design Engineer – Natural Resources

Wendee Smith
Project Manager – Natural Resources Group Manager

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U-2707 STREAM MITIGATION PLAN

FORSYTH COUNTY

WBS NO.: 34845.1.1

DECEMBER 22, 2011

1.0 BASELINE INFORMATION

1.1 Introduction

This U-2707 stream mitigation plan proposes improvements to be implemented by the North Carolina Department of Transportation (NCDOT) along two unnamed tributaries (UT's) to Muddy Creek. The plan is being completed to provide on-site mitigation for unavoidable stream impacts associated with the construction of Transportation Improvement Project (TIP) number U-2707, or the Idols Road Extension (SR 3000) in Forsyth County, North Carolina near the town of Clemmons. The project location is within the floodplain of Muddy Creek and consists of approximately 1,800 linear feet of restoration along Reach 1 (R1) coupled with the enhancement of bank conditions and reconnection of hydrology associated with the replacement of a culvert along Reach 2 (R2) (Figure 1).

1.2 General Watershed Information

The two unnamed tributaries are situated within the Yadkin-Pee Dee River Basin within the US Geological Survey (USGS) hydrological unit code (HUC) 03040101 and the NC Division of Water Quality (NCDWQ) sub-basin 03-07-04. R1 has an existing drainage area of 0.42 square miles (271 acres) at the culvert under Clouds Harbor Trail, the upstream limit of the project, increasing to 0.49 square miles (316 acres) at the point where the road alignment will fill the stream. R2 has an existing drainage area of 0.62 square miles (410 acres) at the culvert inlet. Both of these drainage areas are predominantly woodland/pasture areas with residential and commercial intermixed.

1.3 Project Site Description

1.3.1 Topography, Physiographic Providence, and Soils

The project site is situated entirely within the southwest portion of the Muddy Creek floodplain. A railway embankment and the future SR 3000 (Idols Road) form the southeastern boundary of the project site. The floodplain of Muddy Creek is relatively flat with minimal elevation change. There is a large levee on the western bank of Muddy Creek that separates it from R2. Elevation ranges on the project site from 700 feet above mean sea level (msl) along Clouds Harbor Trail to 679 feet msl at the confluence with Muddy Creek. The U-2707 mitigation site is within the Piedmont physiographic province: specifically, the Southern Outer Piedmont Ecoregion (Griffith et al., 2002). According to the Forsyth County Soil Survey, Chewacla soils dominate the project area.

1.3.2 Jurisdictional Wetlands

Jurisdictional wetland determinations were performed using the three-parameter approach as prescribed in the 1987 *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory, 1987). NCDOT personnel performed wetland delineations between December 1998 and November 2001 and reconfirmed any changes in June 2011. Four small wetlands occur within the entire U-2707 project area. Three of these areas were found to be non-jurisdictional due to a lack of hydric soils and are not within the work limits of the mitigation site. The fourth is contained within the stream banks of R1 approximately 165 feet downstream of Clouds Harbor Trail. This fourth wetland was deemed to be unimportant and non-mitigable because it was created by horses accessing the stream. The banks in this location are severely degraded and almost nonexistent therefore creating an inline channel pool/wetland area (NCDOT, 2002).

1.3.3 Existing Plant Communities

The vegetative communities found within the project area can be characterized by two major groupings. These groupings include pastureland (predominantly fescue) and the riparian fringe. The riparian fringe is a narrow band of vegetation found along each unnamed tributary. Common herbaceous species found include poison ivy (*Toxicondendron radicans*), jewelweed (*Impatiens capensis*), common violet (*Viola* sp.), common greenbrier (*Smilax rotundifolia*), Japanese honeysuckle (*Lonicera japonica*), multiflora rose (*Rosa multiflora)*, and giant cane (*Arundinaria gigantea*). Woody species located in the subcanopy primarily consist of silky dogwood (*Cornus amomum*), Chinese privet (*Ligustrum sinense*), river birch (*Betula nigra*), black willow (*Salix nigra*), and black cherry (*Prunus serotina)*. Common tree species occupying the canopy of the riparian fringe include boxelder (*Acer negundo)*, green ash (Fraxinus pennsylvanica), and tulip poplar (*Liriodendron tulipifera*).

1.3.4 Threatened and Endangered Species

According to the US Fish and Wildlife Service (USFWS), two endangered and one threatened species are known to occur in Forsyth County. The threatened species (bog turtle) is listed by similarity of appearance (S/A), but is neither biologically threatened nor endangered. Therefore, the bog turtle is not subject to Section 7 consultation (Endangered Species Act). Information regarding these federally listed species can be found in Table 1.

Table 1. Federally Listed Species for Forsyth County

Common Name	Scientific Name	Federal Status	Preferred Habitat	Habitat Availability	Biological Conclusion
Red-cockaded woodpecker	*Picoides borealis*	Endangered	Open park-like pine stands (live) w/ little undergrowth	No	No Effect
Small-anthered bittercress	*Cardamine microanthera*	Endangered [A]	Near seeps and wet rock crevices, moist woods near small streams, full to partial sun	No	No Effect
Bog Turtle	*Clemmys muhlenbergii*	Threatened (S/A) [B]	Shallow spring-fed fens, open and sunny muddy-bottomed streams	No	Not Applicable

[A] Denotes no specimen from Forsyth County found in the past twenty years.

[B] Threatened due to similarity of appearance (S/A) denotes 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.

2.0 SITE SELECTION

Both R1 and R2 were selected because of their proximity to the impact that they will offset and due to their degraded condition. As a part of the U-2707 right-of-way, these unnamed tributaries are part of the system being impacted by the construction of the Idols Road Extension. After analyzing all the impacted systems affected by the U-2707 project, R1 and R2 were identified as highly degraded systems offering the most potential ecological uplift. Therefore, the proximity to the impact being offset and the degraded nature of the streams offer an exemplary mitigation site.

2.1 Reach 1 (R1) Existing Conditions

The headwaters of R1 originate in a residential neighborhood approximately 0.3 miles south of the intersection of existing SR 3000 (Hampton Road) and US 158. The tributary flows in a southerly direction for approximately 0.3 miles before turning to the east/northeast and eventually connecting with R2 just upstream of Muddy Creek. The drainage area associated with R1 is 316 acres (0.49 mi^2) and is predominantly woodland/pasture with residential intermixed (Figure 2). The current location of the R1 stream channel (along the northeast toe of the Norfolk Southern railroad embankment) is a product of agricultural operations and railroad construction. Agriculture practices over the last century have played a major role in the destabilization of R1 by relocating, straightening, and channelizing the stream to provide for more active and accessible pastureland. In addition, vegetation removal throughout what should be the riparian buffer coupled with livestock access to the stream for watering purposes have created unstable banks contributing more sediment to the system. In addition to bank instability, Muddy Creek being actively dredged has increased the rate at which lower sections of R1 have become incised and entrenched. To combat this incision and the instability along the railroad, large boulders and concrete have been placed throughout the downstream section effectively removing any aquatic passage or hydrologic connection to Muddy Creek.

The vertical longitudinal profile of R1 indicates an altered system with fluctuating boundary conditions that is on the border of instability. Currently, the existing R1 channel flows approximately 2,000 linear feet within the limits of the U-2707 project area. The existing channel slope averages 0.00632 ft/ft over a representative 1100 feet of channel which is characteristic of E and C channels typical for this valley type. However, the upper 300 feet of the reach is characterized by a flat bed slope while the banks and bankfull channel are holding the average bankfull slope. This section of channel is actively being accessed by livestock and therefore the bed is being compressed into a uniform condition. The channel has also been straightened and channelized which is visible in the plan view of the channel and through the levees on both sides of the channel in cross sections 1 and 2. From station 300 to 600, the channel is not actively being accessed by livestock and maintains the best riparian buffer. This section of channel is the most stable with minimal incision occurring and consistent slope features across the banks, bankfull, water surface and bed. The lower 500 feet (station 600 to 1100), however, show the beginnings of incision as the channel bed deepens relative to the banks. This can be attributed to a downstream head cut moving through the channel as a result of the active dredging occurring in Muddy Creek. This corresponds to cross section 5 having a deep, narrow channel bottom as is the case with C streams moving towards G streams. These three scenarios depict a stream with instability on the upper and lower ends and altering

boundary conditions throughout. The tendency for streams in this situation is for the upper and lower conditions to migrate through the center and alter the channel conditions until equilibrium is reached. The complete data set for the existing profile information for R1 is presented in Appendix A.

Table 2. Summary of Existing Cross Sections –Reach 1 (R1)

Cross Section	Station No.	Morph. Feature	BKF Area (ft^2)	BKF Width (ft)	BKF Max Depth (ft)	W/D Ratio*	Ent. Ratio*	LBH Ratio*	Stream Class.*
1	88.5	Riffle	9.86	11.58	1.63	13.62	10.05	1.54	C5
2	136.5	Pool	18.73	14.22	2.47	10.77	9.46	--	--
3	465.5	Riffle	8.93	13.66	1.68	21.02	13.18	1.31	C5
4	538	Pool	16.55	17.87	2.08	19.22	8.95	--	--
5	1115	Riffle	14.00	8.86	2.37	5.61	14.66	1.33	E5
6	N/A	Riffle	13.35	14.82	1.41	16.47	3.29	1.73	C5

*Notes: Ent. Ratio is "Entrenchment Ratio"
W/D Ratio is "Width/Depth Ratio"
LB Ratio is "Low Bank Height Ratio"
Stream classification is only viable along riffle sections.

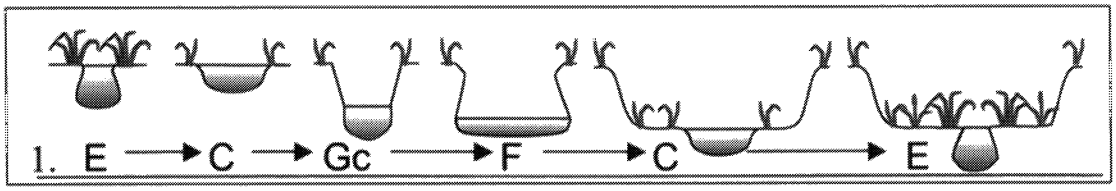
The cross section data is summarized in Table 2 above but graphs and the associated data can also be found in Appendix A. The cross section data suggests R1 is a stable C5 channel based on the Rosgen stream classification system (Rosgen, 1994). However, upon closer inspection of the riffle cross section graphs (pool cross sections are not used for evaluation), three trends toward instability can be spotted. The first, typical of most stream channels and not an indication of instability alone, is the bankfull area and width are both generally increasing as the riffle cross sections move downstream. The second is the degree of incision (Low Bank Height Ratio) remains consistent until cross section 6, where it increases slightly. And the third is the entrenchment ratio remains above 10 until the last cross section where it drops significantly to 3.29. These trends together indicate channel conditions that result in the floodplain being removed from the bankfull elevation as the bankfull elevation sinks lower into the stream channel on the downstream end. This situation is indicative of altered boundary conditions creating head cuts which travel upstream creating instability by producing steep, denuded, undercut banks; excessive in channel velocities; and overly widened channels.

A reach-wide modified Wolman Pebble Count was conducted to determine the average d_{50} (50% of the sampled population is equal to or finer than the representative particle diameter) to be approximately 0.13 mm for R1, which falls into the very fine sand size category. The wetted perimeter d_{50} was approximately 2.5mm. The bar sample was predominantly sand and therefore the d_{50} could not be determined. The particle size distribution data is presented in Appendix B. The results of the data suggest R1 is a sand dominated system with little grade control evidenced by the absence of a true pavement/subpavement stratum. These types of systems have a sensitive response to the alteration of boundary conditions since the channel is not well armored. Therefore these systems depend highly on bank vegetation and channel dimension, pattern and profile to maintain equilibrium.

The vertical longitudinal profile, corresponding cross sections, and material substrate of R1 exhibit conditions in which the channel is on the beginning path of instability. Taking into

account the typical stream types for this valley and the existing condition data, R1 is moving from a C to a Gc on a stream successional path of E→C→Gc→F→C→E (See Diagram 1 below). If allowed to fully develop, the channel's instability will lead to increased sediment supply through the mass wasting of banks, vertical instability, and channel widening.

Diagram 1. Stream Channel Succession



2.2 Reach 2 (R2) Existing Conditions

The R2 stream channel originates just north of the intersection of SR 3000 and US 158 and flows in an easterly direction for approximately 1.0 mile before turning south. R2 then flows south across the Muddy Creek floodplain for approximately 0.5 mile and eventually confluences with R1 just upstream of Muddy Creek. The existing drainage area associated with R2 is 0.64 square mile (410 acres.). R2 contains approximately 400 linear feet of existing channel within the project area and classifies as a G5 stream type. The average slope of this channel is 0.0023 ft/ft which is typical for streams in this valley type. The stream channel and banks associated with this tributary have been principally altered through channelization evidenced by the linear characteristics in the plan view (Figure 1 and 2). The stream section below the culvert has also seen increased entrenchment due to the dredging of Muddy Creek.

Agricultural access through the installation of a farm path and the associated stream crossing has exacerbated the degradation in R2. A high level analysis of R2 was not conducted because the farm path culvert was identified as the major obstacle inhibiting aquatic passage. R2 displays signs of stability upstream of the farm path culvert; however immediately downstream of the culvert the stream is severely entrenched and incised. Erosion around the culvert is causing the path to collapse into the stream channel. The severity in elevation drop from the inlet to the outlet of the culvert does not allow fish passage and minimizes any hydrologic connection of the upper part of R2 to Muddy Creek.

3.0 SITE PROTECTION INSTRUMENT

The Site will be located within the NCDOT right-of-way for the project and designated on the plan sheets as a mitigation area. The Site will be managed to prohibit all use inconsistent with its use as mitigation, including any activity that would materially alter the biological integrity or functional and educational value of the site, consistent with the mitigation plan. The Site will be recorded on the NEU mitigation geo-database (MGD). The MGD is distributed to the Divisions to designate the location and protected status of all onsite mitigation. After closeout, the Site will be placed in the NCDOT Stewardship Program for long term management and protection.

The Site will be managed according to the terms of this mitigation plan and the NCDOT Stewardship Process.

4.0 OBJECTIVES

The goal of the project is to improve water quality, to reduce bank erosion, to reestablish a floodplain along R1, and to improve the aquatic and terrestrial wildlife habitat. The functional restoration of the site will occur through a mixture of various treatments consistent with natural channel design techniques for 1800 linear feet of R1 and 153 linear feet of R2. Along R1, these techniques will include removing livestock from the stream through the implementation of a conservation easement; establishing a floodplain or reconnecting the stream back to its historic floodplain; increasing the amount of aquatic habitat through the addition of rock and wood structures; and reestablishing native plant communities throughout the conservation easement, whereby reintroducing shading, cover areas, and travel corridors. The restoration of R2 will be limited to the replacement of the existing culvert with a new arched pipe with baffles to allow functional fish passage, establish grade control, and minimize velocities therefore providing a more stable stream system.

5.0 MITIGATION WORK PLAN

The mitigation work plan will consist of construction activities associated with the implementation of the natural channel design set forth below.

5.1 Natural Channel Design

Natural channel design is the principle developed by Dave Rosgen of using stable reference reach streams to develop and project dimensionless variables onto unstable reaches with similar boundary conditions in order to superimpose a new stable system in low quality environments. The following section outlines the parameters necessary to undertake natural channel design and describes the fully developed mitigation plan.

5.1.1 Introduction

Based on existing condition data, the restoration of the U-2707 project was broken into two reaches, Reach 1 (R1) and Reach 2 (R2). R1 will undergo the most extensive restoration via priority I and II restoration techniques. Due to the nature of the valley and changing channel characteristics, explained further below, R1 was further divided into R1a (upstream 920ft) and R1b (downstream 880ft). R2 restoration is comprised of the removal and replacement of a nonfunctioning culvert and therefore some of the following analysis does not apply.

5.1.2 Reference Reach Analyses

One reference reach has been identified for use on the U-2707 stream restoration site. Spencer Creek was chosen as it represents a stable, rural, piedmont stream type and shares the same watershed size and characteristics as the project stream.

Spencer Creek is situated in Montgomery County, approximately 8.0 miles from Troy along the west side of SR 1134 (Figure 3). Spencer Creek is characterized as a second order stream and classifies as a rural E4/C4 stream type. Specific morphological data for this reference reach are given within the morphological table found in Appendix B. Its watershed is approximately 0.55 square mile (355 acres) and encompasses large tracts of undeveloped woodland within the Uwharrie National Forest. Common riparian species found along this stream corridor include

American holly (*Ilex opaca)*, red maple (*Acer rubrum*) , sweet gum (*Liqiudambar styraciflua*), mountain laurel (*Kalmia latifolia*), flowering dogwood (*Cornus florida*), water oak (*Quercus nigra*), willow oak (*Quercus phellos*), sourwood (*Oxydendrum arboreum*), and giant cane.

5.1.3 Sediment Transport Analysis

Sediment plays a major role in the influence of channel stability and morphology (Rosgen, 1996). A stable stream has the capacity to move its sediment load without aggrading or degrading.

The critical dimensionless shear stress (τ^*_{ci}) is the measure of force required to initiate general movement of particles in a bed of a given composition. Based on the d_i of 2.7 mm obtained from the active riffle sampling at cross section 3 and using a value of 0.1 mm for the bar sample d_{50} due to the composition of sand for R1, the critical dimensionless shear stress was calculated to be approximately 0.019 lbs/ft^2. Evaluating R1a and R1b with a consistent bankfull slopes, the differing channel geometries provide different bankfull shear stresses. R1a being classified a C5 channel has a smaller bankfull cross sectional area, but the geometry has a wider bankfull width and shallower depth resulting in a bankfull shear stress of 0.225 lbs/ft^2. R1b being classified an E5 channel has a larger bankfull area, but the smaller width and greater depth creates an environment where velocities are extremely high resulting in higher bankfull shear stress of 0.496 lbs/ft^2. These shear stresses result in the entrainment of particles a minimum of 16 mm in R1a and 38 mm in R1b. Entrainment and velocity calculation sheets used for this analysis are presented in Appendices C and D, respectively.

The bankfull shear stress for the proposed channel has to be sufficient to move the D_{84} of the bed material. The largest D_{84} particle determined within active riffles across the site was 4.87mm. Based on the entrainment calculations for the proposed R1a and R1b, the calculated bankfull shear stresses of 0.403 lbs/ft^2 and 0.284 lbs/ft^2 would move particles of 30 mm and 21 mm respectively. The proposed design provides the correct C5 channel geometry for both R1a and R1b, as seen in the design cross section overlays in Appendix E. However, due to valley conditions, R1a has an increased slope of 0.0080 ft/ft. This increase in slope increases velocities through the system with the same relative bankfull area and geometry which in turn creates a higher shear stress. Being further downstream and to match the existing conditions, R1b has a slightly larger bankfull cross sectional area than R1a but still retains the C5 channel geometry. This change in geometry coupled with the flattening of the slope through this section due to valley conditions allows the velocities and bankfull shear stress to be greatly reduced when compared to the existing conditions.

This analysis proves the system contains more than adequate bankfull shear stress to move the sediment through the system and raises concerns about degradation. The expected bankfull shear stress would move particles ranging from 21 mm to 30 mm. The largest particle found on depositional bars was 6 mm, while the D_{84} and D_{100} of the reach wide sampling of R1 was determined to be 8 mm and 32 mm, respectively. Therefore, the proposed design has sufficient shear stress to move the bedload associated with the project reach. However it will be extremely important that vegetation, grade control structures, and design plan form tolerances are strictly adhered to in construction as these will assist in maintaining the long term stability of the proposed channel, in particular in R1a.

5.1.4 Flood Analyses

The entire U-2707 mitigation site, including the channel of Muddy Creek and its immediate floodplain are located within the Federal Emergency Management Association's (FEMA) 100-year flood boundary, as depicted on Figure 4 (FEMA, 1991). These areas are inundated by the 100-year flood of Muddy Creek, where Base Flood Elevations (BFE) have been determined and a floodway established. However, the flood mapping only pertains to Muddy Creek proper. The unnamed tributaries are not a part of the flood study and are inundated by the floodwaters of Muddy Creek.

5.1.5 Proposed Design Reach 1 (R1)

The restoration of R1 has been divided into two sections, R1a and R1b, for design purposes. R1a, the upstream portion of R1 from Station 0+00 to 9+20, is characterized by a steeper valley slope and smaller bankfull channel. This area has been severely impacted by the agricultural practices of channelization and through livestock access. The stream channel has been straightened and deepened in locations while the banks have consistent levees on both sides of the channel except for where livestock is actively accessing the stream as a water supply. In the current condition, the channel classifies as a C5 stream, however as mentioned in Section 2 above, the system appears to be trending through the E→C→Gc→F→C→E stream succession. Therefore the design approach for R1a is to halt the succession at the first stage, E→C, through the design of a stable C channel; then reverse the trend, effectively jumping to the C→E stage, through the implementation of a vigorous vegetation plan.

R1a, being in the upstream steep valley scenario, will undergo Priority I restoration. This consists of raising the bed elevation such that the corresponding bankfull elevation matches the natural ground of the historic floodplain. In the case of R1a, performing this while keeping within the design ranges of the horizontal plan form variables of sinuosity, meander length, belt width, pool to pool spacing, and radius of curvature, the resulting bankfull slope was 0.0080 ft/ft (See Appendix F). The bankfull cross section was designed based on a cross sectional area of 10.0 ft^2 which matches the existing conditions and the NC Piedmont Regional Curve Data for a drainage area of 0.46 mi^2. The channel was then shaped based on a stable C5 dimension with a width to depth ratio of 14.4. This results in a bankfull width of 12.0 feet and a maximum bankfull depth of 1.37 feet. As depicted in the design overlays of cross section 1 and 3 in Appendix E, this geometry closely matches the existing conditions geometry at the bankfull stage therefore indicating a correct sizing. With the design of a stable C5 channel, the implementation of structures will provide vertical stability. Then a vigorous planting of the stream banks will facilitate bank stabilization and encourage a tightening of the bankfull width through sedimentation to form a stable E channel. This process will stabilize the system without moving through the complete E→C→Gc→F→C→E stream succession minimizing mass wasting of banks and down cutting of the channel.

R1b, the downstream section of R1, is characterized by a flatter valley slope, larger bankfull area and has the downstream elevation boundary condition at the confluence with R2. This channel encompasses the 863 feet of R1 being relocated due to the construction of SR3000. The current channel condition has been impacted by channelization and the creation of levees, but has also experienced inappropriate stabilization techniques along the section that abuts the railroad

alignment. In this area, concrete and large boulders have been introduced to the stream channel as vertical grade control. However, this technique has removed any hydrologic or aquatic connection to Muddy Creek by hardening large drops throughout the lower 300 feet. The disconnection to Muddy Creek coupled with the constraints imposed by the construction of SR3000 required R1b to be diverted to connect with R2 prior to connecting with Muddy Creek. This diversion resulted in a net loss of 185 linear feet of channel along R1 as R2 now makes the 185 foot connection to Muddy Creek.

Given the downstream elevation constraint imposed by the confluence with R2, R1b will undergo Priority II restoration. This type of restoration involves allowing the channel to drop through the natural valley ground level in an effort to meet other constraints. However, to ensure proper stability and flood capacity, a bankfull bench is excavated at the bankfull elevation to create the necessary floodplain. To achieve the required floodplain for a C5 channel, the entrenchment ratio (ratio of floodprone width to bankfull width) has to be greater than 2.2. Based on the NC Piedmont Regional Curve Data for a drainage area of 0.49 mi^2, the appropriate bankfull cross sectional area is 15.0 ft^2. Using a width to depth ratio of 13.0 provided a bankfull width of 14.0 feet and a maximum depth of 1.6 feet. Similar to R1a, design overlays of cross sections 5 and 6 in Appendix E confirm this geometry is suitable in comparison to the bankfull stage associated with the existing conditions. Using the entrenchment ratio of 2.2 and a bankfull width of 14.0 feet, the minimum floodprone width was calculated to be 30.8 feet. The design incorporates a 35.0 feet floodprone width to ensure this minimum is achieved. Adhering to the design variable ranges associated with sinuosity, meander length, belt width, pool to pool spacing, and radius of curvature (See Appendix F) while meeting the elevation constraints imposed by connecting R1a to R2; the design bankfull slope for R1b was determined to be 0.0044 ft/ft. These channel modifications in slope and geometry significantly lower the shear stress and velocities in this section creating a more stable system. As with R1a, the implementation of structures for grade control and vegetation for bank stability and channel tightening will significantly improve the long term stability of the channel. However, R1b was closer to the second stage of the E→C→Gc→F→C→E stream succession as indicated by the incision in cross section 5 and the entrenchment in cross section 6. The degradation processes in the lower portion of the reach were most likely tied to the dredging operation in Muddy Creek. Therefore, the decision to divert the channel to R2 now requires measures be taken to stabilize R2 as it now provides the hydrologic and aquatic connection to Muddy Creek.

5.1.6 Proposed Design Reach 2 (R2)

The work along R2 will consist of the replacement of a degraded culvert causing restrictive water passage effectively removing any hydrologic and aquatic connection to Muddy Creek while increasing erosive forces immediately downstream of the crossing. The existing pipe is an 18 inch corrugated metal pipe (CMP) with a buried inlet and a perched outlet approximately 3 feet above bed elevation. The downstream section of R2 is extremely incised and entrenched as a result of the perched pipe and active dredging occurring in Muddy Creek. Simply removing the degraded culvert would remove agricultural access and create an unstable transition in elevation which would result in a severe head cut moving upstream. Therefore the design must maintain agricultural access, provide vertical stability, and reconnect the aquatic passage of the upstream reach to Muddy Creek.

A 112 inch by 75 inch corrugated aluminum arch pipe (CAAP) was selected based on stream channel size and because this type of pipe can be easily modified to incorporate a baffling system. The baffling system is installed in such a manner as to create a sinuous low flow path through the pipe that encourages fish passage. The 75 inch height of the pipe coupled with a 1.15 foot headwall matches the existing grades of the surrounding banks allowing for easy path construction. The original drainage area of the culvert was 0.64 mi^2 before diverting R1 into R2 upstream of the culvert. Including R1, the new drainage area for the culvert is 1.13 mi^2 which based on an ungauged station analysis of that size produces a 2 year design discharge of 172 cfs and a 5 year design discharge of 319 cfs. Taking into account the baffling system, the flow path of this pipe is reduced to an equivalent pipe size of an 87 inch by 63 inch CAAP. The baffling system also effectively raised the invert elevation of the pipe to the invert of the first baffle. Accounting for these hydraulic changes, an analysis of the pipe determined the 5 year return interval caused the water to overtop the farm path by 2.41 feet whereas the 2 year return interval placed the water 1.5 feet below the road. As the pipe is installed to provide agricultural access, to allow for fish passage, and is completely contained within NCDOTs right of way; these hydraulic conditions were deemed acceptable for the purpose. The baffled pipe system will provide for the aquatic and hydrologic connection now missing throughout R1 and R2. Specific details of the pipe design can be found in Appendix G and in Appendix H within the details of the construction plans.

5.1.7 Stream Riparian Planting Plan

A protected riparian buffer will be established as part of the on-site mitigation and the entire conservation easement will be fenced to restrict access to the restored areas and the SR 3000 right-of-way. The planting plan for the riparian and upland buffers of the U-2707 site will provide post-construction erosion control and riparian habitat enhancement. The planting plan will also attempt to blend existing vegetative communities into recently restored areas. Plantings in the buffer areas will include native species appropriate for the Piedmont physiographic province. Plants within the floodplain will be flood tolerant species, which can accommodate periodic flooding events throughout the year. A variety of trees will be planted to provide cover and habitat for wildlife as well as soil stabilization. NCDOT Roadside Environmental Unit will develop the specific details and plant lists to be utilized on the U-2707 restoration site.

Trees with extensive, deep rooting systems will assist in stabilizing the banks in the long term. Colonization of local herbaceous vegetation will inevitably occur, which will provide additional soil stability. Tree species will be planted as bare root stock on random 8-foot centers at a frequency of 680 stems per acre. Planting stock will be culled to remove inferior specimens, so only healthy, viable stock will be planted at the U-2707 restoration site. Planting of species will utilize dormant plant stock and will be performed to the extent practicable between December 1st and March 15th.

A complete Plan and Profile (Sheets MIT-03 and MIT-04) of the design described above along with the Planting Plan (Sheets PLT-03 and PLT-04) can be found in Appendix I. Specific details regarding construction and typicals of the stream can be found in Appendix H.

5.2 Construction Implementation

Construction activities associated with the implementation of the natural channel design outlined above will include excavation, structure installation, pipe removal and replacement, utility marking, and vegetation installation. Prior to any work, the permittee will be responsible for the knowledge and implementation of appropriate erosion control practices that meet all local, county, and state regulations. The use of a pump around system will be incorporated and where possible work will be conducted offline to minimize sediment input. Work will continue in a fashion that allows for any land disturbance to be adequately treated by the end of each day. Prior to any work beginning, the permittee will be responsible for marking all utilities on-site and to confirm the elevations and locations shown on the plans. Excavation will be performed by qualified personnel using equipment suitable for the conditions. Excavation will include cutting the channel, bankfull bench, and any work necessary to remove the existing culvert. To stabilize the banks, seed and straw will be immediately applied to the newly cut channel and covered with coir fiber matting. Structure installation will include the installation of rock (or log if deemed acceptable on site) cross vanes and constructed riffles. These structures are installed to provide grade control and offer bank protection so it is important qualified personnel use equipment outfitted for stream restoration. Similar to the structure installation, the pipe removal and replacement will require specialized equipment and personnel familiar with the installation of CAAPs and baffling systems. The last phase of construction will consist of planting the conservation easement. As the vegetation is as important as the channel construction and structure installation, the vegetation should be installed by a qualified landscaper or person of similar background. This site will require the installation of bare root stock and live stake material, each of which requires particular handling and installation for manual installation.

6.0 PERFORMANCE STANDARDS

The NCDOT shall monitor stream channel stability and buffer vegetation survival on the site. Post-restoration monitoring will be conducted for a minimum of five years or until the success criteria are met following the completion of construction to document project success. Monitoring approaches follow those recommended by the Stream Mitigation Guidelines (USACE and NCDWQ 2003). These approaches are described below in Section 7.0.

7.0 MONITORING REQUIREMENTS

The stream mitigation site will be monitored for five years or until success criteria is satisfied. Monitoring protocols shall follow the Monitoring Level 1 outlined in the Stream Mitigation Guidelines, April 2003. NCDOT will evaluate the success of the stream restoration project based on guidance provided by the Stream Mitigation Guidelines disseminated by the United States Army Corps of Engineers- Wilmington District. The survey of the channel dimension will consist of permanent cross sections placed at equal number of pools and riffles. Annual photographs showing both banks and upstream and downstream views will be taken from permanent, mapped photo points. The survey of the longitudinal profile will represent distinct areas of the stream and cover a cumulative total of approximately 1,800 linear feet LF of channel. The entire restored length of stream will be investigated for channel stability and in-stream structure functionality. Any evidence of channel instability will be identified, mapped and photographed.

8.0 OTHER INFORMATION

No other information is available.

9.0 DETERMINATION OF CREDITS

Restoration						
Stream	**Station**	**Priority Level**	**Type**	**Existing Length of Channel (lf)**	**Proposed Length of Channel (lf)**	**Stream Mitigation Units (SMU)**
Reach 1	0+00 to 9+20	I	Perennial	920	920	920
Reach 1	9+20 to 11+22	II	Perennial	202	202	202
Relocation						
Stream	**Station**	**Priority Level**	**Type**	**Existing Length of Channel (lf)**	**Proposed Length of Channel (lf)**	**Stream Mitigation Units (SMU)**
Reach 1	11+22 to 18+00	II	Perennial	863	678	678
Enhancement						
Stream	**Station**	**Priority Level**	**Type**	**Existing Length of Channel (lf)**	**Proposed Length of Channel (lf)**	**Stream Mitigation Units (SMU)**
Reach 2	0+00 to 1+53	II	Perennial	153	153	76.5
			Total	2138	1953	1876.5

The site will be debited at the following ratios: 1:1 for stream restoration and 2:1 for stream enhancement to mitigate for the 903 linear feet of stream impacts associated with U-2707. An as-built report will be submitted within 60 days of completion of the project to verify final feet of mitigation. The success of the mitigation areas and determination of final credits will be based upon successful completion of the monitoring.

No wetland credit is currently proposed. However, there is potential for wetland restoration within the floodplain of Reach 1. Any wetland restoration will be documented during the monitoring phase and addressed with the agencies at a future time.

9.1 Credit Release Schedule

NCDOT proposes immediate, full release of the stream restoration and enhancement and the wetland restoration as on-site mitigation for the impacts associated with U-2707. Any mitigation not debited for U-2707 will be placed on the NCDOT debit ledger for future use on other projects.

10.0 GEOGRAPHIC SERVICE AREA

The U-2707 Mitigation Plan has been developed to provide on-site mitigation for unavoidable stream impacts associated with the construction of Transportation Improvement Project (TIP) number U-2707, or the Idols Road Extension (SR 3000) in Forsyth County, North Carolina near the town of Clemmons. The Site is situated within the Yadkin-Pee Dee River Basin within the US Geological Survey (USGS) hydrological unit code (HUC) 03040101 and the NC Division of Water Quality (NCDWQ) sub-basin 03-07-04. All stream and wetland mitigation assets not

compensate for impacts beyond the GSA may be considered by the Corps or the permitting agency on a case-by-case basis.

11.0 MAINTENANCE PLAN

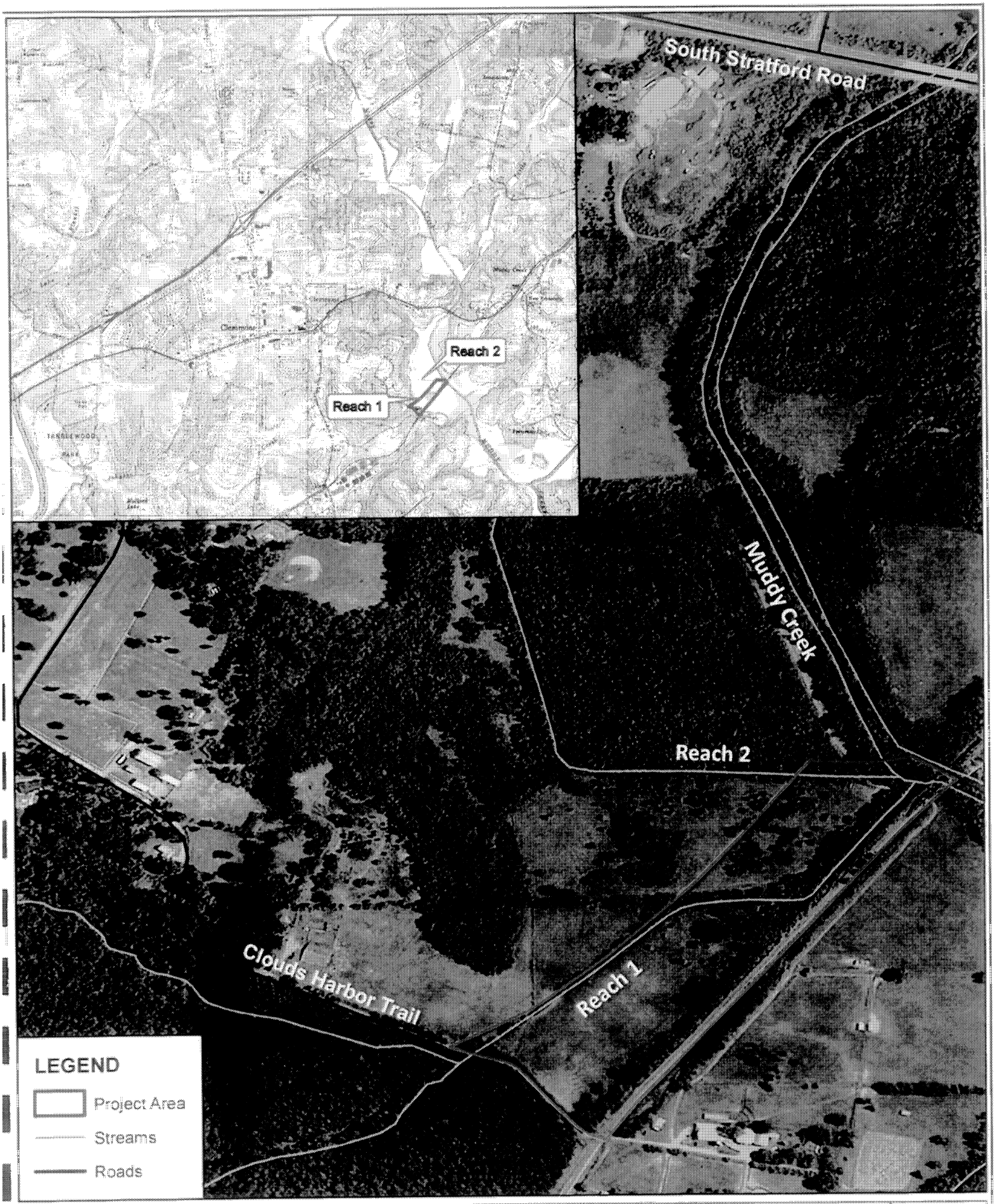
The Site will be held by NCDOT and placed on the NEU mitigation geodatabase. If an appropriate third party recipient is identified in the future, then the transfer of the property will include a conservation easement or other measure to protect the natural features and mitigation value of the site in perpetuity.

12.0 LONG TERM ADAPTIVE MANAGEMENT PLAN

The Site will be managed by the NCDOT according to the site plans. In the event that unforeseen issues arise that affect the management of the site, any remediation will be addressed by NCDOT in coordination with the Interagency Review Team.

13.0 FINANCIAL ASSURANCES

The Site is will be managed by NCDOT with its own distinct cost center number within the NCDOT budgeting and financial tracking system. Therefore, all accounting for revenues, contract encumbrances, fund transfers, and expenses will be performed and reported independent from other capital budget or operating budget accounting.



PREPARED FOR:

VICINITY MAP

J-2707 STREAM RESTORATION

FORSYTH COUNTY, NORTH CAROLINA

GRAPHIC SCALE

0 0.25 0.5 0.75 Miles

Top Figure Scale

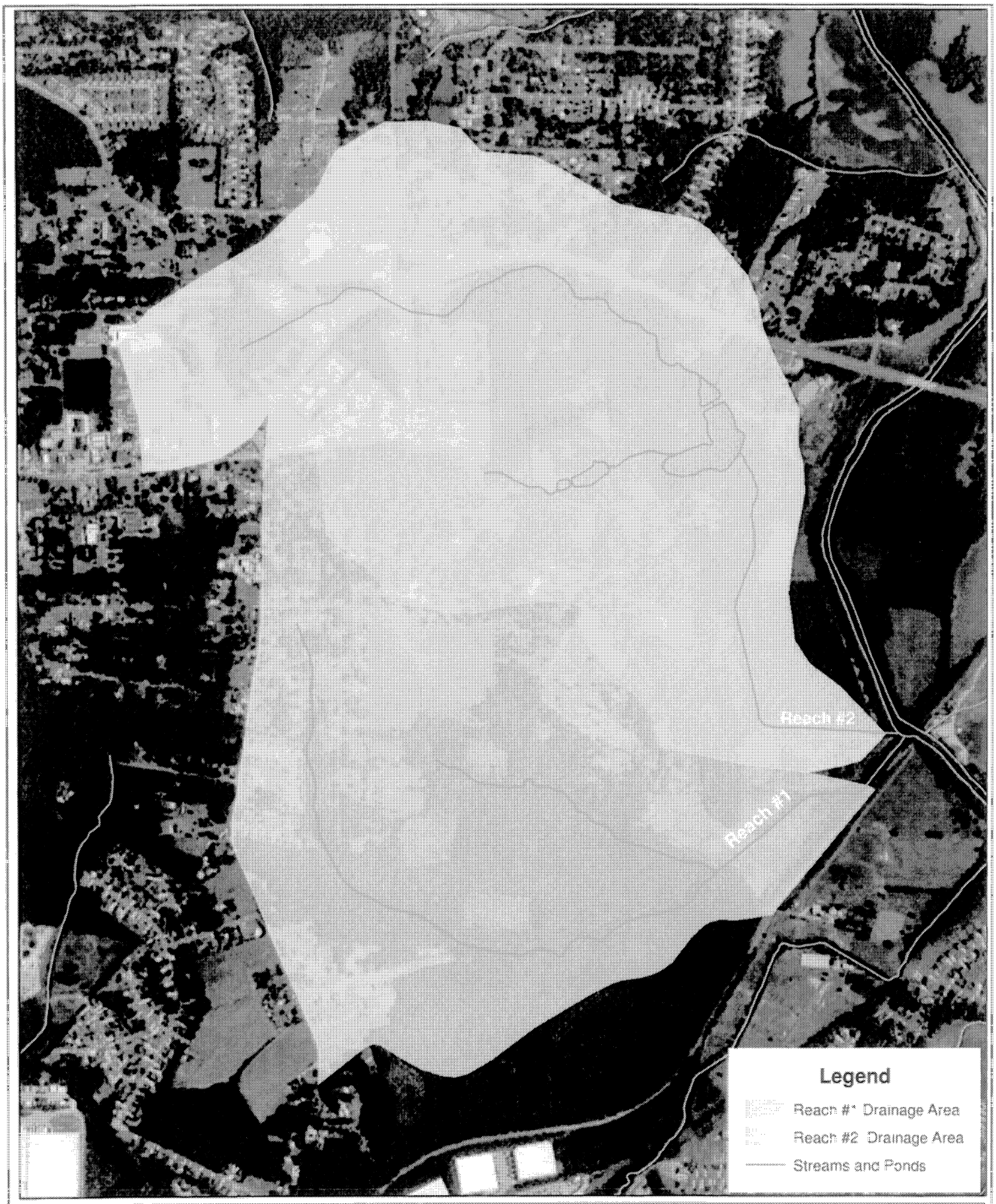
Bottom Figure Scale

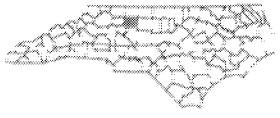
0 250 500 Feet

Sources

FIGURE

1





PREPARED FOR:

DRAINAGE AREA MAP

U-2707 STREAM RESTORATION

FORSYTH COUNTY NORTH CAROLINA

1 inch = 1,000 feet

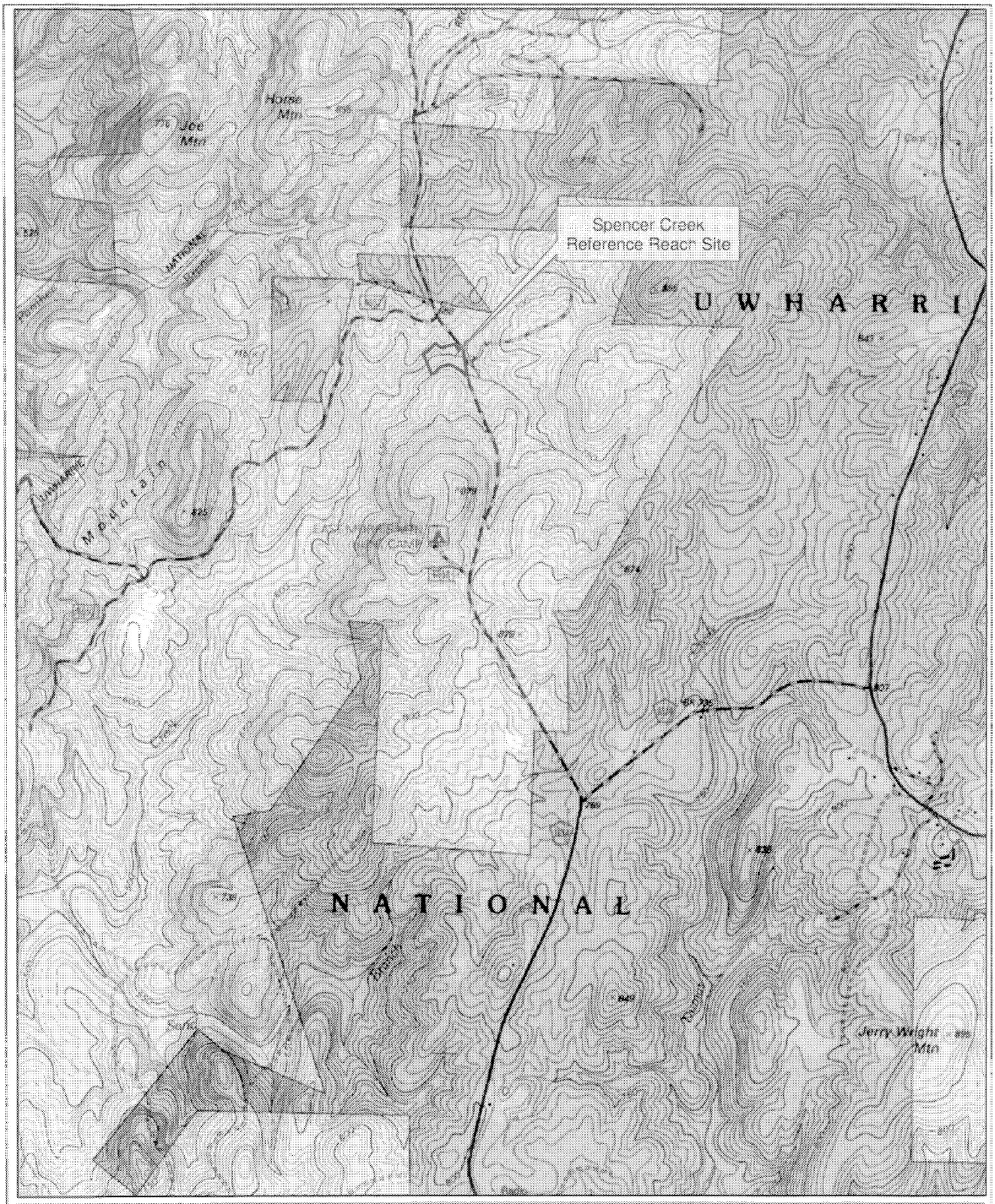
GRAPHIC SCALE

0 250 500 1,000 Feet

Sources:
Aerial Photography: ESRI imagery Prime World 80

FIGURE

2



PREPARED FOR:

REFERENCE REACH VICINITY MAP

SPENCER CREEK

MONTGOMERY COUNTY, NORTH CAROLINA

1 inch = 2,000 feet

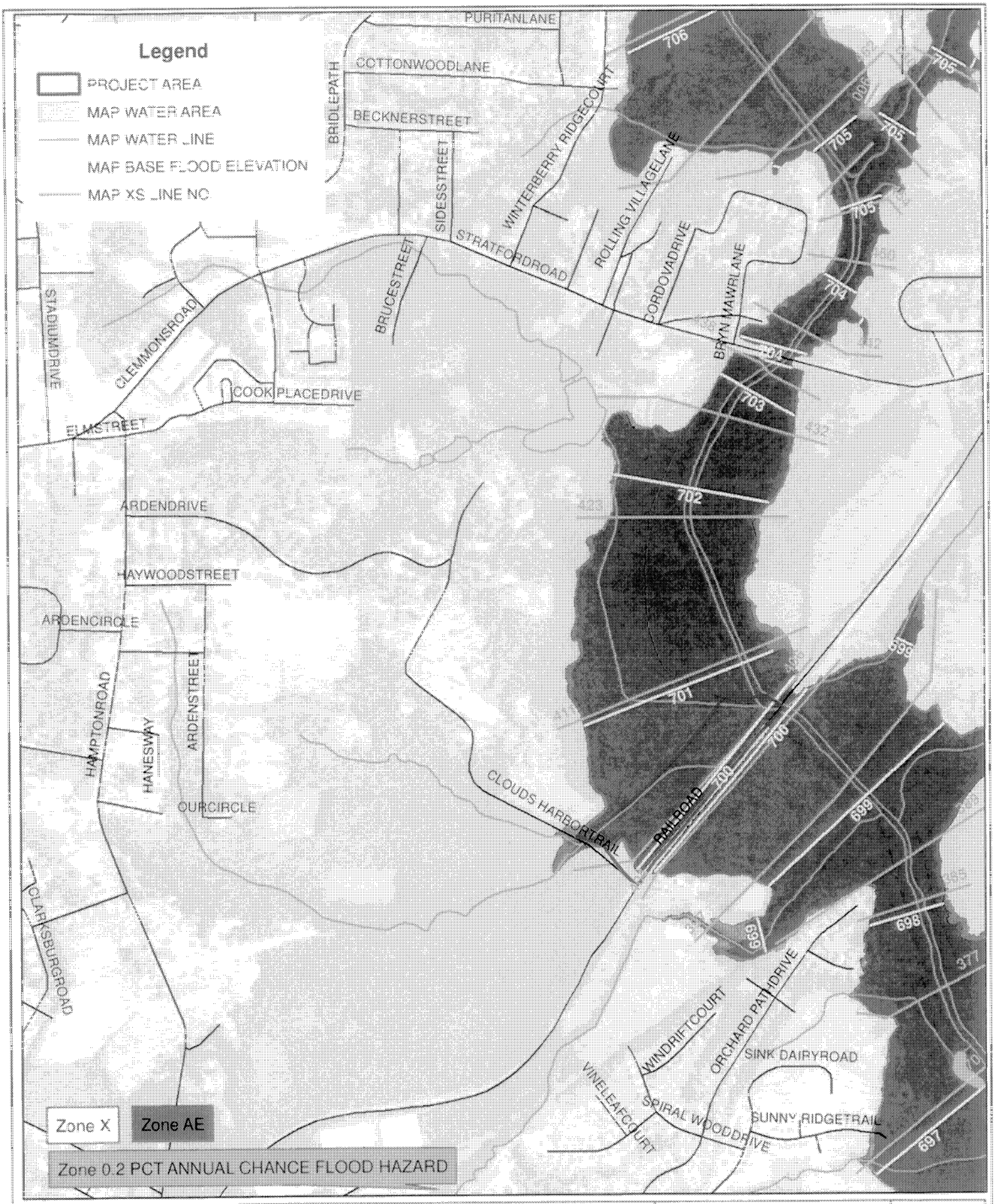
GRAPHIC SCALE

0 500 1,000 2,000 Feet

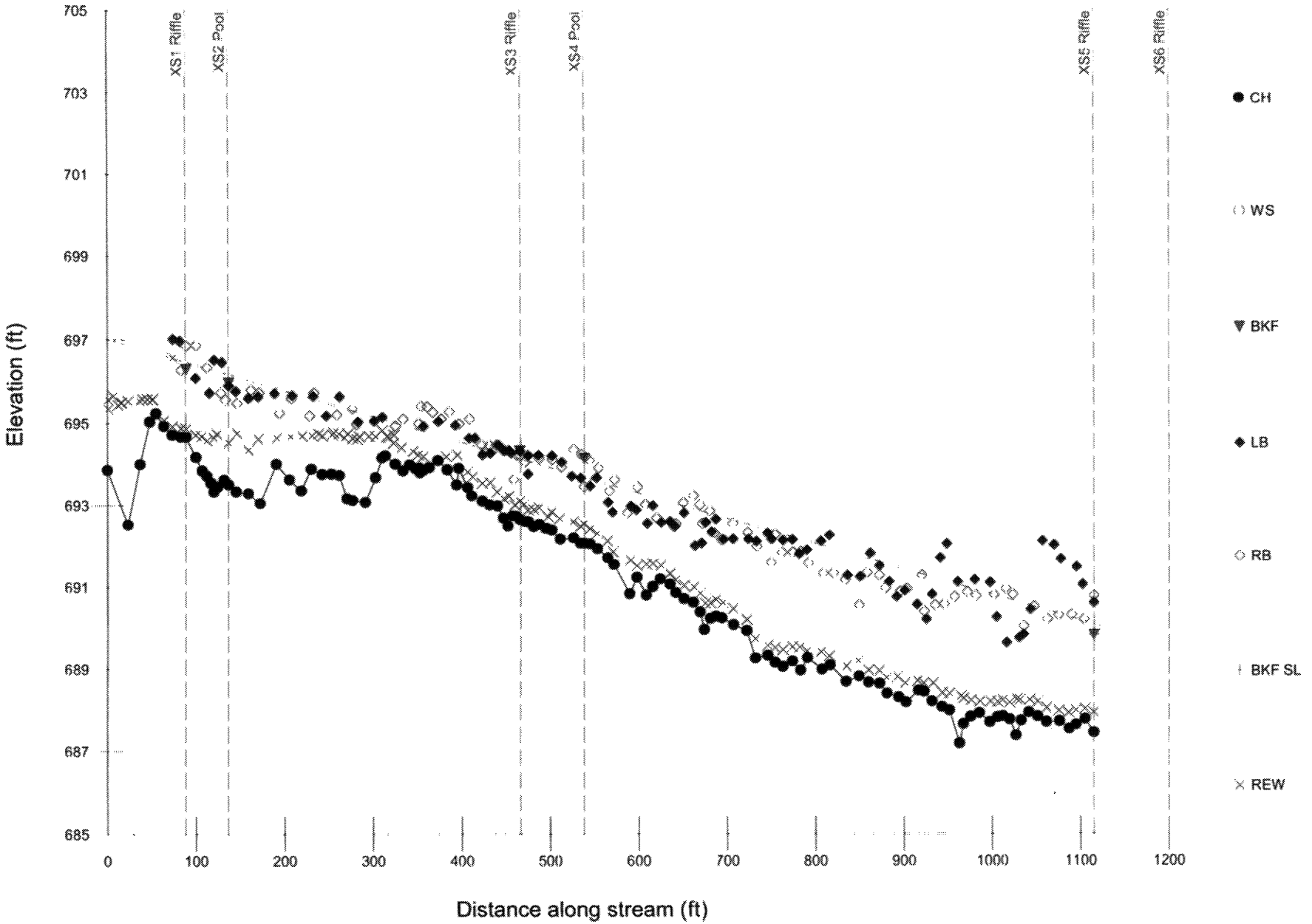
Sources:
Topographic Data: Terrain Navigator Pro Newworx

FIGURE

3


Legend
PROJECT AREA
MAP WATER AREA
MAP WATER LINE
MAP BASE FLOOD ELEVATION
MAP XS LINE NO
PURITANLANE
COTTONWOODLANE
BECKNERSTREET
BRIDLEPATH
SIDESTREET
WINTERBERRY RIDGECOURT
ROLLING VILLAGELANE
STRATFORDROAD
BRUCESTREET
CORDOVADRIVE
BRYN MAWRLANE
STADIUMDRIVE
CLEMMONSROAD
COOK PLACEDRIVE
ELMSTREET
ARDENDRIVE
HAYWOODSTREET
ARDENCIRCLE
HAMPTONROAD
HANESWAY
ARDENSTREET
OURCIRCLE
CLARKSBURGROAD
CLOUDS HARBOR TRAIL
RAILROAD
WINDRIFTCOURT
ORCHARD PATHDRIVE
SINK DAIRYROAD
VINELEAFCOURT
SPIRAL WOODDRIVE
SUNNY RIDGETRAIL
705
704
703
702
701
700
699
698
697
Zone X
Zone AE
Zone 0.2 PCT ANNUAL CHANCE FLOOD HAZARD
PREPARED FOR:
FEMA FLOOD MAP
U-2707 STREAM RESTORATION
FORSYTH COUNTY, NORTH CAROLINA
1 inch = 1,000 feet
GRAPHIC SCALE
0 250 500 1,000 Feet
Sources:
Aerial Photography: ESRI Imagery Prime World 3D
FIGURE
4

U-2707 Existing Conditions Longitudinal Profile Reach 1



RIVERMORPH PROFILE SUMMARY

River Name: UT to Muddy Creek
Reach Name: Existing Conditions
Profile Name: Longitudinal Profile
Survey Date: 06/29/2011

Survey Data

DIST	CH	WS	BKF	LB	RB	BKF SL	REW
0	693.86						
0.625							695.585
0.795							695.353
6.222							695.661
11.832							695.451
15.196							695.501
15.91							695.508
23.074	692.516						
23.074							695.545
35.993							695.56
36.912	694.001						
39.507							695.59
44.881							695.587
47.663	695.034						
50.396							695.575
50.837							695.603
54.722	695.233						
63.645	694.927						
63.749							695.075
73.117							694.928
73.2	694.716						
73.794							696.585
74.078				697.024			
81.249				696.974			
82.706							694.882
82.877	694.668						
83.024					696.285		
88.5	694.665		696.299		696.869		694.87
99.124				696.086			
99.525							694.727
99.892	694.174						
99.892					696.881		
106.129							694.688
106.979	693.842						
111.923	693.713						
111.923							694.588
111.923					696.35		
114.753				695.735			
116.742	693.546						
120.095							694.643
120.095	693.327						
120.095				696.526			
123.141							694.746
124.212	693.447						
127.768					695.745		
128.982				696.468			

136.5 693.501 695.967 695.911 694.539
144.428 695.774
145.267 693.328
145.848 694.764
146.114 695.489
158.98 695.61
158.983 694.354
159.104 693.283
161.885 695.807
169.797 695.643
170.259 694.626
170.889 695.739
172.134 693.041
188.479 695.719
190.384 694.001
191.12 694.65
193.952 695.248
205.366 693.622
206.722 694.682
207.599 695.602
208.353 695.671
218.646 693.354
219.471 694.693
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232.972 695.729
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253.546 694.729
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258.813 695.206
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261.765 695.642
267.435 694.65
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271.218 694.746
276.332 695.354
276.651 694.639
276.651 693.113
281.13 694.975
281.795 694.609
282.523 695.035
284.179 694.679
291.088 693.067
294.804 694.69
300.754 695.052
302.661 693.672
302.661 694.68
310.044 695.145
310.044 694.825
310.044 694.153
313.517 694.202
315.386 694.689
317.356 694.66
322.478 694.519
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324.776 693.999

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333.534	693.833					
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351.841	693.909					
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360.804				695.4		
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396.542				694.983		
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461.541	692.719					
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997.44	687.703					
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1103.956				690.189		
1105.034						688.029
1105.204	687.774					
1115	687.445	689.806	690.588	690.765	689.806	687.945

Cross Section / Bank Profile Locations

XS1 Riffle	Riffle XS	88.5
XS2 Pool	Pool XS	136.5
XS3 Riffle	Riffle XS	465.5
XS4 Pool	Pool XS	538
XS5 Riffle	Riffle XS	1115
XS6 Riffle	Riffle XS	1200
XS1 Design	Riffle XS	0
XS6 Design	Riffle XS	0
XS5 Design	Riffle XS	0
XS3 Design	Riffle XS	0

Measurements from Graph

Bankfull Slope: 0.0063

Variable	Min	Avg	Max
S riffle	0.00794	0.01306	0.01981
S pool	0.00081	0.00606	0.01136
S run	0.00269	0.00996	0.01581
S glide	0.00257	0.00833	0.02236
P - P	29.34	61.22	78.63
Pool length	13.44	22.65	34.78
Riffle length	17.11	25.43	37.87
Dmax riffle	1.44	1.82	2.37
Dmax pool	0.92	2.31	3.59
Dmax run	1.57	2.13	2.86
Dmax glide	0.74	2.06	2.86
Low bank ht	0	0	0

Length and depth measurements in feet, slopes in ft/ft.

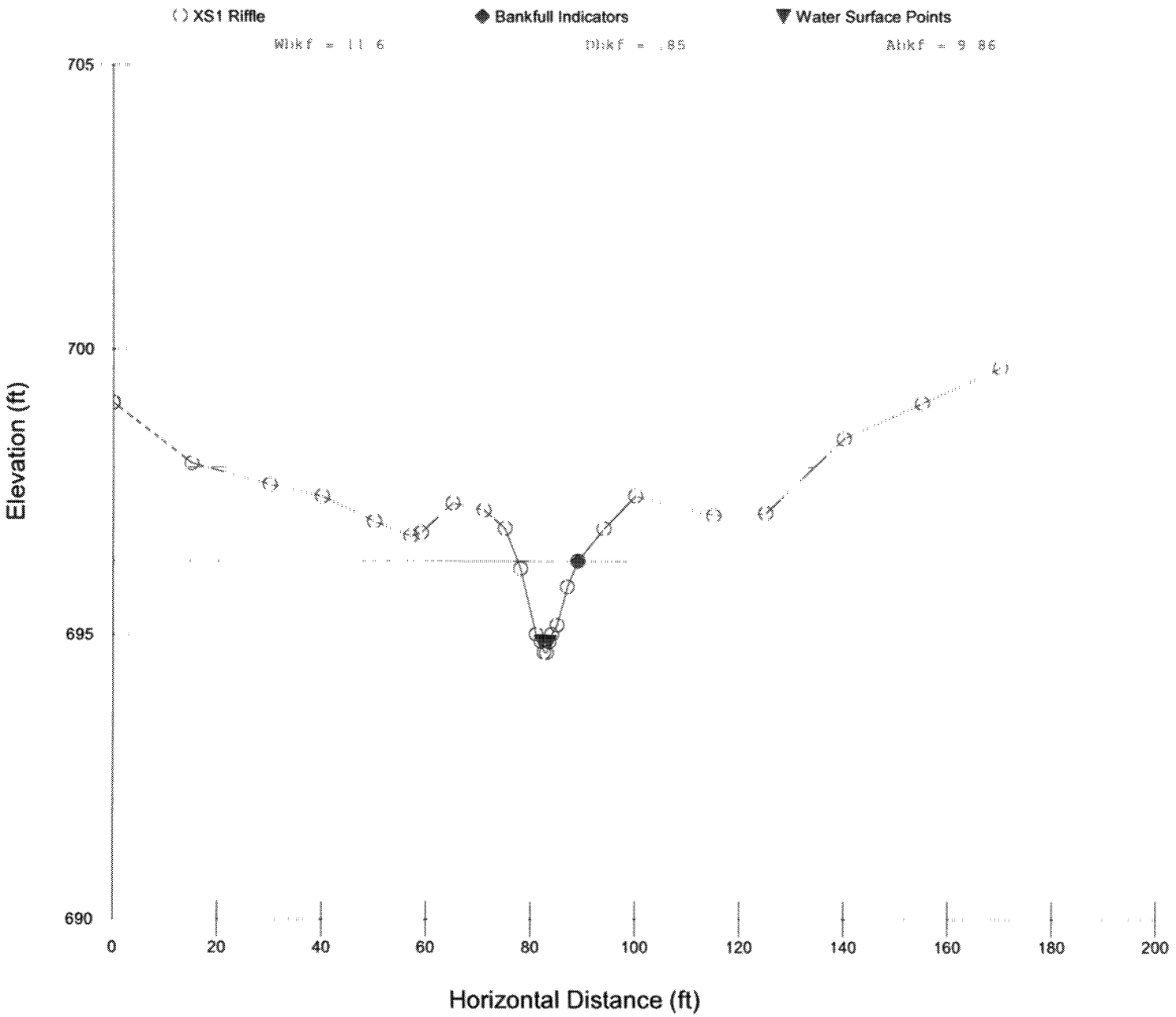
RIVERMORPH PROFILE SUMMARY

Notes

River Name: UT to Muddy Creek
Reach Name: Existing Conditions
Profile Name: Longitudinal Profile
Survey Date: 06/29/2011

DIST	Note
88.5	XS1 - TW Intersect @ station 88.5
136.5	XS2 - TW Intersect @ station 136.5
465.5	XS3 - TW Intersect @ station 465.5
538	XS4 - TW Intersect @ station 538
1115	XS5 - TW Intersect @ station 1115

U2707 R1 XS1 Riffle



RIVERMORPH CROSS SECTION SUMMARY

River Name: UT to Muddy Creek
Reach Name: Existing Conditions
Cross Section Name: XS1 Riffle
Survey Date: 06/14/2011

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	699.0642	GS
15	0	698.0063	GS
30	0	697.6342	GS
40	0	697.4325	GS
50	0	696.9929	GS
57	0	696.7344	GS
59	0	696.7981	GS
65	0	697.3121	GS
71	0	697.1896	LB
75	0	696.8689	GS
78	0	696.1681	GS
81	0	694.9963	GS
82	0	694.8701	LEW
82.5	0	694.6763	TW
83	0	694.665	SB
83.5	0	694.8619	REW
84	0	694.9972	GS
85	0	695.1601	GS
87	0	695.8468	GS
89	0	696.2988	BKF
94	0	696.8665	GS
100	0	697.4391	RB
115	0	697.0983	GS
125	0	697.1365	GS
140	0	698.434	GS
155	0	699.0594	GS
170	0	699.6787	GS

Cross Sectional Geometry

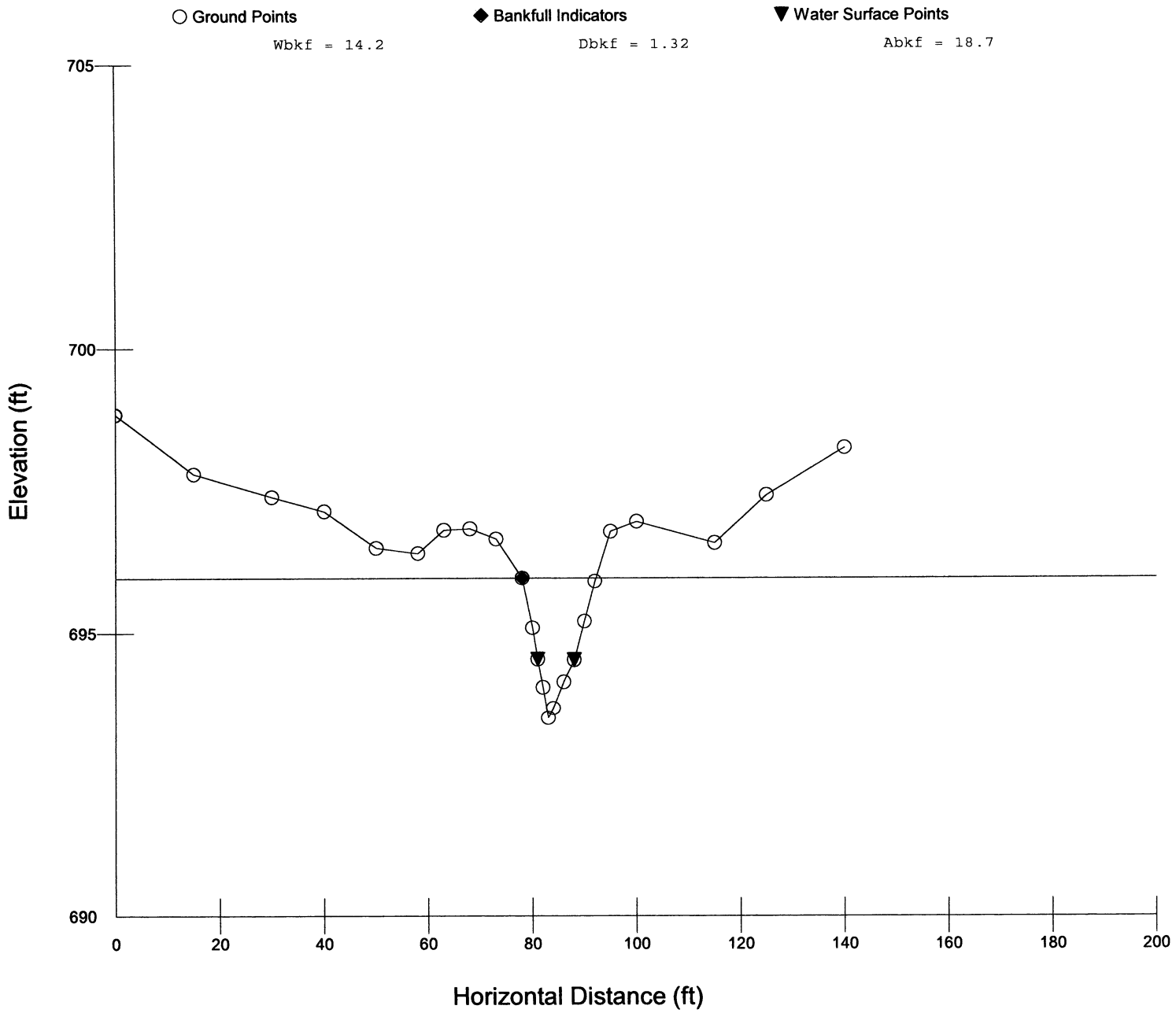
	Channel	Left	Right
Floodprone Elevation (ft)	697.94	697.94	697.94
Bankfull Elevation (ft)	696.3	696.3	696.3
Floodprone Width (ft)	116.36	-----	-----
Bankfull Width (ft)	11.58	5.35	6.22
Entrenchment Ratio	10.05	-----	-----
Mean Depth (ft)	0.85	0.9	0.81
Maximum Depth (ft)	1.63	1.63	1.63
Width/Depth Ratio	13.62	5.94	7.68
Bankfull Area (sq ft)	9.86	4.79	5.07
Wetted Perimeter (ft)	12.09	7.27	8.08

Entrainment Calculations

Entrainment Formula: Shields Curve

	Channel	Left Side	Right Side
Slope	0	0.0063	0
Shear Stress (lb/sq ft)		0.26	
Movable Particle (mm)		14.3	

U2707 R1 XS2 Pool



RIVERMORPH CROSS SECTION SUMMARY

River Name: UT to Muddy Creek
Reach Name: Existing Conditions
Cross Section Name: XS2 Pool
Survey Date: 06/14/2011

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

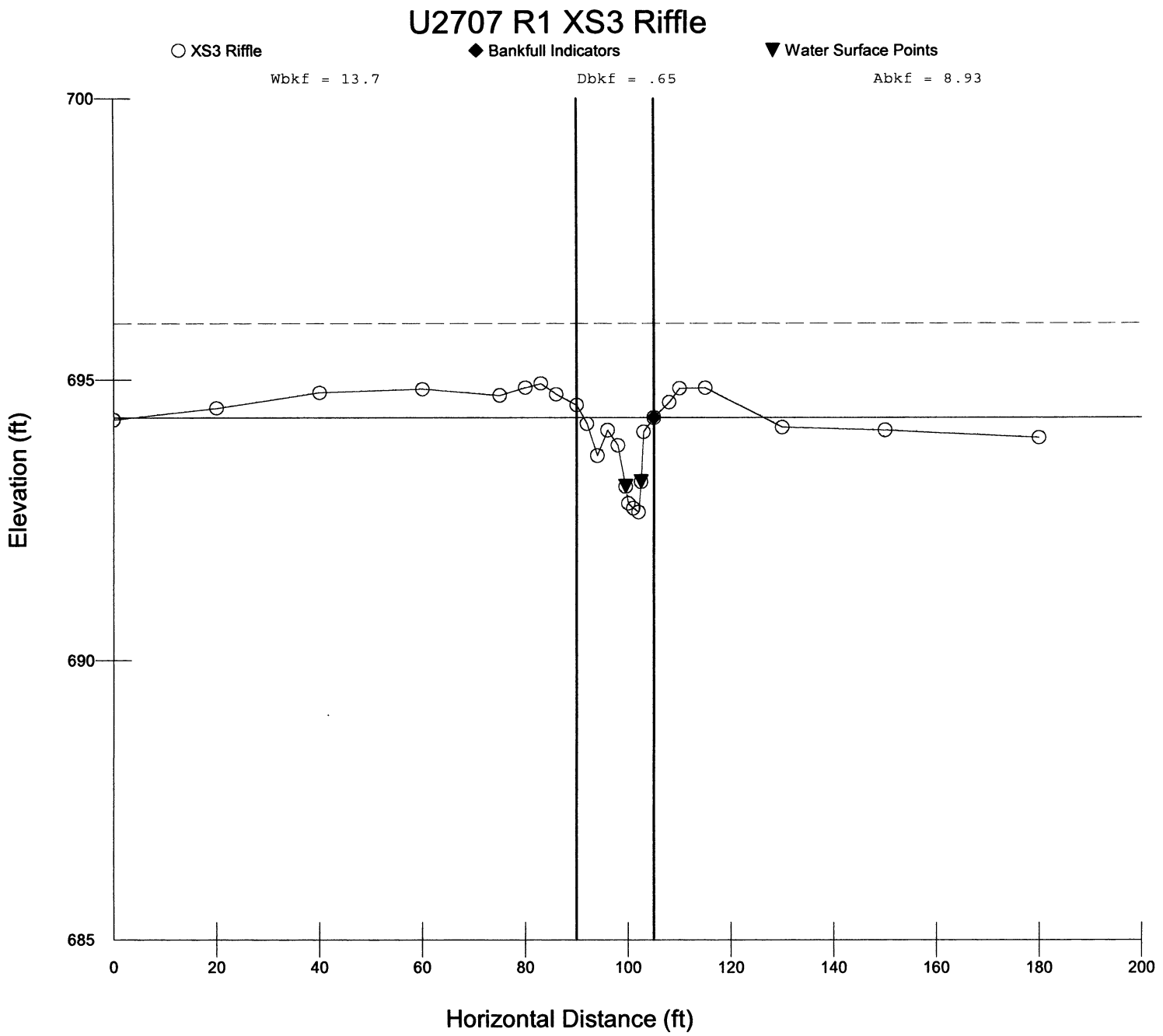
TAPE	FS	ELEV	NOTE
0	0	698.8197	GS
15	0	697.7803	GS
30	0	697.3835	GS
40	0	697.1321	GS
50	0	696.4967	GS
58	0	696.4032	GS
63	0	696.8045	GS
68	0	696.83	GS
73	0	696.6516	GS
78	0	695.9671	BKF
80	0	695.0878	GS
81	0	694.5389	LEW
82	0	694.0439	SB
83	0	693.5011	TW
84	0	693.6753	SB
86	0	694.1423	SB
88	0	694.5287	REW
90	0	695.2058	GS
92	0	695.9111	RB
95	0	696.7802	GS
100	0	696.951	GS
115	0	696.5771	GS
125	0	697.406	GS
140	0	698.2313	GS

Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	698.44	698.44	698.44
Bankfull Elevation (ft)	695.97	695.97	695.97
Floodprone Width (ft)	134.5	-----	-----
Bankfull Width (ft)	14.22	7.11	7.11
Entrenchment Ratio	9.46	-----	-----
Mean Depth (ft)	1.32	1.5	1.13
Maximum Depth (ft)	2.47	2.47	2.04
Width/Depth Ratio	10.77	4.74	6.29
Bankfull Area (sq ft)	18.73	10.66	8.06
Wetted Perimeter (ft)	15.15	9.78	9.45
Hydraulic Radius (ft)	1.24	1.09	0.85
Begin BKF Station	77.98	77.98	85.09
End BKF Station	92.2	85.09	92.2

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


U2707 R1 XS3 Riffle
XS3 Riffle
Bankfull Indicators
Water Surface Points
Wbkf = 13.7
Dbkf = .65
Abkf = 8.93
700
695
690
685
Elevation (ft)
0
20
40
60
80
100
120
140
160
180
200
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: UT to Muddy Creek
Reach Name: Existing Conditions
Cross Section Name: XS3 Riffle
Survey Date: 06/14/2011

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	694.281	GS
20	0	694.4926	GS
40	0	694.768	GS
60	0	694.8287	GS
75	0	694.7147	GS
80	0	694.8549	GS
83	0	694.9303	LB
86	0	694.7372	GS
90	0	694.5439	GS
92	0	694.2099	GS
94	0	693.6444	GS
96	0	694.098	GS
98	0	693.8268	GS
99.5	0	693.0932	LEW
100	0	692.7944	SB
101	0	692.7124	SB
102	0	692.6413	TW
102.5	0	693.1772	REW
103	0	694.0695	GS
105	0	694.318	BKF
108	0	694.5922	GS
110	0	694.843	RB
115	0	694.8506	GS
130	0	694.1478	GS
150	0	694.0967	GS
180	0	693.961	GS

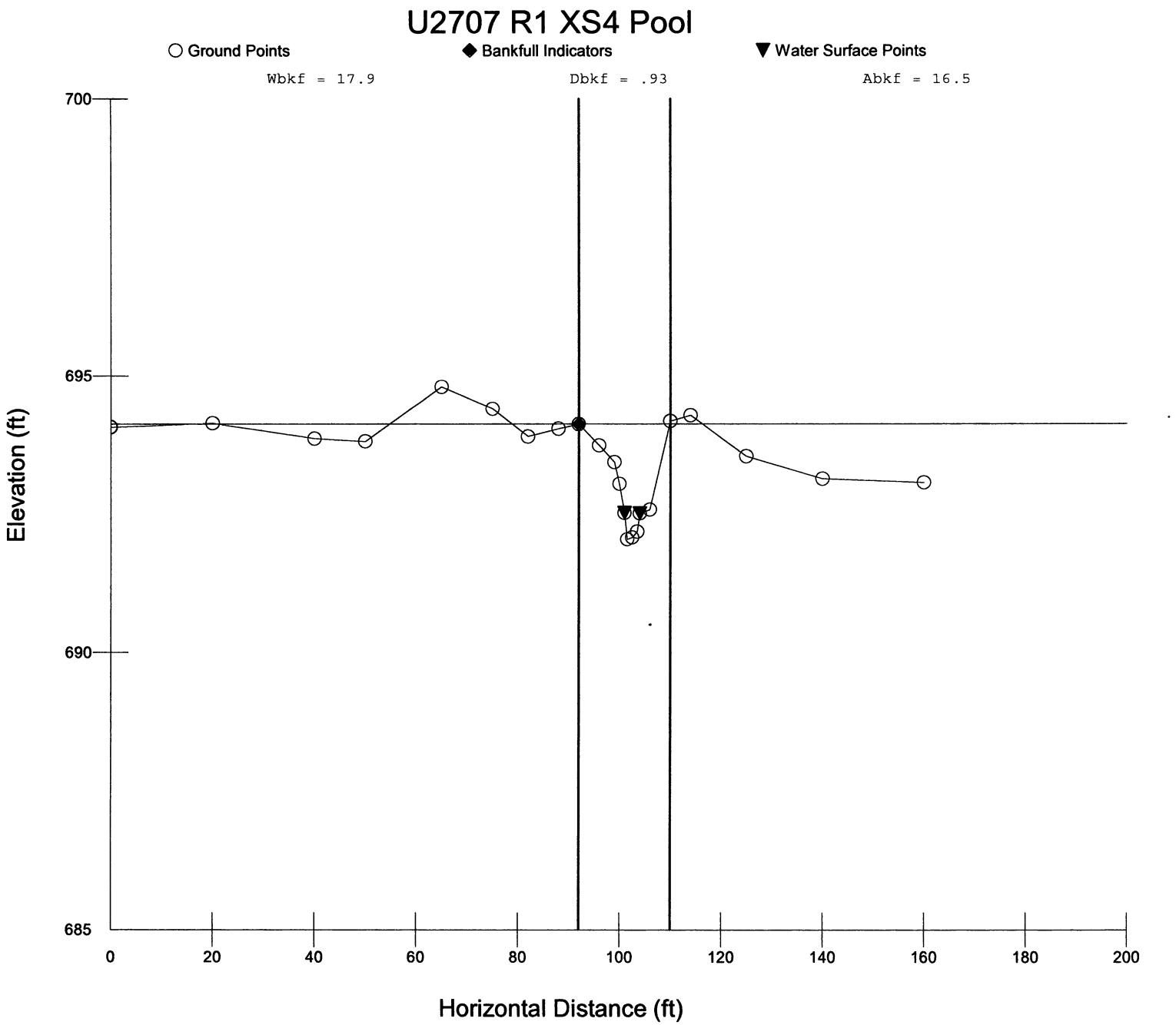
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	696	696	696
Bankfull Elevation (ft)	694.32	694.32	694.32
Floodprone Width (ft)	180	-----	-----
Bankfull Width (ft)	13.66	9.09	4.57
Entrenchment Ratio	13.18	-----	-----
Mean Depth (ft)	0.65	0.56	0.84
Maximum Depth (ft)	1.68	1.56	1.68
Width/Depth Ratio	21.02	16.23	5.44
Bankfull Area (sq ft)	8.93	5.08	3.85
Wetted Perimeter (ft)	14.85	11.06	6.91
Hydraulic Radius (ft)	0.6	0.46	0.56

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			


U2707 R1 XS4 Pool
Ground Points
Bankfull Indicators
Water Surface Points
Wbkf = 17.9
Dbkf = .93
Abkf = 16.5
700
695
690
685
Elevation (ft)
0
20
40
60
80
100
120
140
160
180
200
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

River Name: UT to Muddy Creek
Reach Name: Existing Conditions
Cross Section Name: XS4 Pool
Survey Date: 06/14/2011

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	694.0738	GS
20	0	694.1469	GS
40	0	693.8737	GS
50	0	693.8238	GS
65	0	694.796	GS
75	0	694.4041	GS
82	0	693.9102	GS
88	0	694.0461	GS
92	0	694.1282	BKF
96	0	693.7505	GS
99	0	693.4465	GS
100	0	693.057	GS
101	0	692.5303	LEW
101.5	0	692.0527	TW
102.5	0	692.086	SB
103.5	0	692.191	SB
104	0	692.522	REW
106	0	692.5926	GS
110	0	694.18253	RB
114	0	694.283555	GS
125	0	693.552789	GS
140	0	693.149204	GS
160	0	693.080396	GS

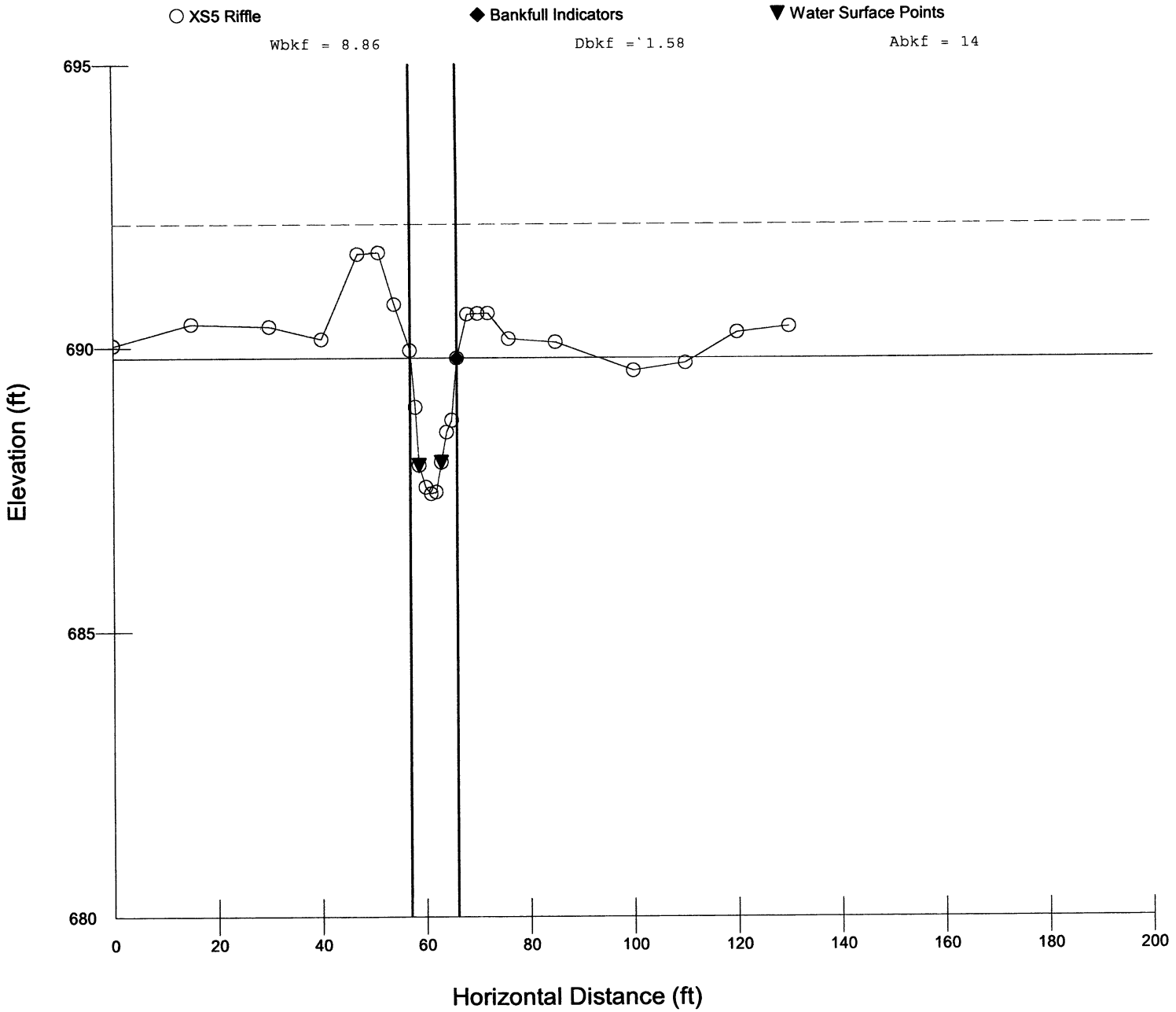
Cross Sectional Geometry

	Channel	Left	Right
Floodprone Elevation (ft)	696.21	696.21	696.21
Bankfull Elevation (ft)	694.13	694.13	694.13
Floodprone Width (ft)	160	-----	-----
Bankfull Width (ft)	17.87	11.58	6.29
Entrenchment Ratio	8.95	-----	-----
Mean Depth (ft)	0.93	0.84	1.09
Maximum Depth (ft)	2.08	2.08	1.89
Width/Depth Ratio	19.22	13.79	5.77
Bankfull Area (sq ft)	16.55	9.7	6.85
Wetted Perimeter (ft)	18.7	13.92	8.55
Hydraulic Radius (ft)	0.88	0.7	0.8
Begin BKF Station	92	92	103.58
End BKF Station	109.87	103.58	109.87

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

U2707 R1 XS5 Riffle



RIVERMORPH CROSS SECTION SUMMARY

River Name: UT to Muddy Creek
Reach Name: Existing Conditions
Cross Section Name: XS5 Riffle
Survey Date: 06/14/2011

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	690.032	GS
15	0	690.4106	GS
30	0	690.3663	GS
40	0	690.1402	GS
47	0	691.6543	GS
51	0	691.681	LB
54	0	690.765	GS
57	0	689.9441	GS
58	0	688.9531	GS
58.7	0	687.9453	LEW
60	0	687.5588	SB
61	0	687.4447	TW
62	0	687.4768	SB
63	0	687.9997	REW
64	0	688.5247	GS
65	0	688.7279	GS
66	0	689.8061	BKF
68	0	690.5877	RB
70	0	690.5979	GS
72	0	690.606	GS
76	0	690.1461	GS
85	0	690.0836	GS
100	0	689.5855	GS
110	0	689.7192	GS
120	0	690.2572	GS
130	0	690.3618	GS

Cross Sectional Geometry

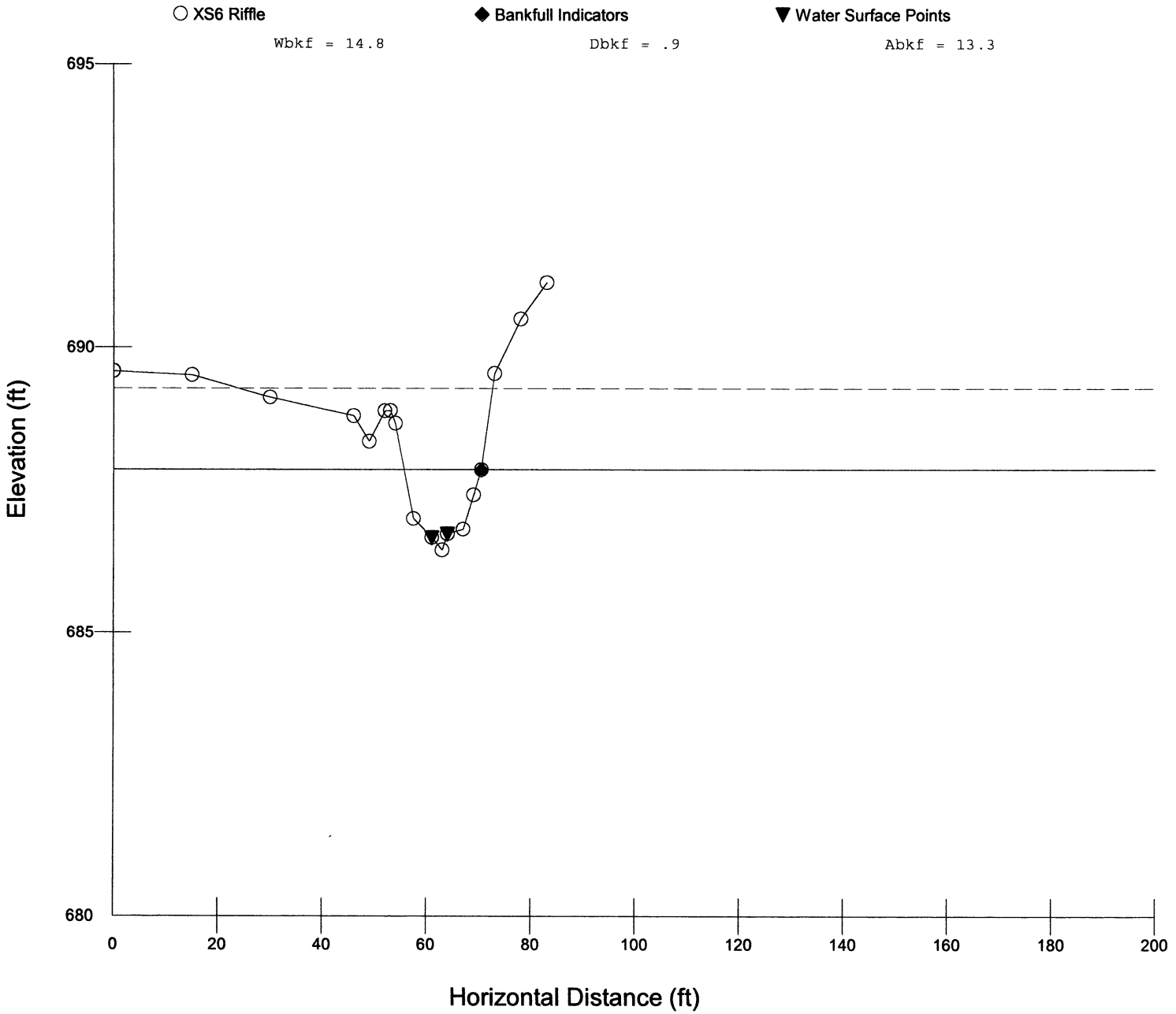
	Channel	Left	Right
Floodprone Elevation (ft)	692.18	692.18	692.18
Bankfull Elevation (ft)	689.81	689.81	689.81
Floodprone Width (ft)	130	-----	-----
Bankfull Width (ft)	8.86	1.93	6.93
Entrenchment Ratio	14.66	-----	-----
Mean Depth (ft)	1.58	1.05	1.73
Maximum Depth (ft)	2.37	1.97	2.37
Width/Depth Ratio	5.61	1.84	4.01
Bankfull Area (sq ft)	14	2.03	11.97
Wetted Perimeter (ft)	10.56	4.81	9.7
Hydraulic Radius (ft)	1.33	0.42	1.23

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

	Channel	Left Side	Right Side
Slope	0	0	0
Shear Stress (lb/sq ft)			
Movable Particle (mm)			

U2707 R1 XS6 Riffle



RIVERMORPH CROSS SECTION SUMMARY

River Name: UT to Muddy Creek
Reach Name: Existing Conditions
Cross Section Name: XS6 Riffle
Survey Date: 06/14/2011

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

TAPE	FS	ELEV	NOTE
0	0	689.5793	GS
15	0	689.5134	GS
30	0	689.1252	GS
46	0	688.8049	GS
49	0	688.3591	GS
52	0	688.8873	GS
53	0	688.8949	LB
54	0	688.6721	GS
57.5	0	687.0096	GS
61	0	686.678	LEW
63	0	686.4578	TW
64	0	686.7395	REW
67	0	686.8219	GS
69	0	687.4243	GS
70.5	0	687.866	BKF
73	0	689.537	GS
78	0	690.4895	GS
83	0	691.1334	GS

Cross Sectional Geometry

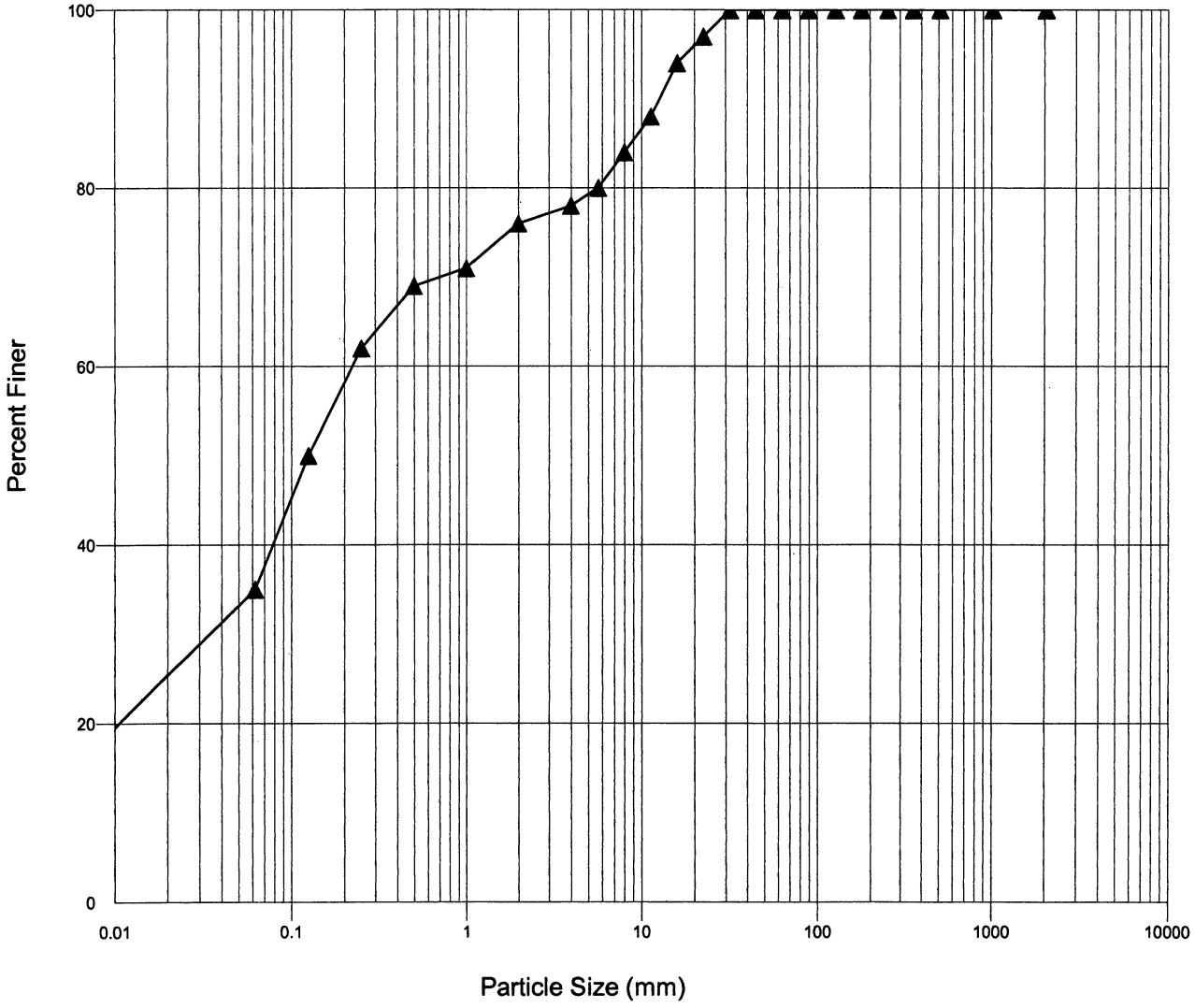
	Channel	Left	Right
Floodprone Elevation (ft)	689.28	689.28	689.28
Bankfull Elevation (ft)	687.87	687.87	687.87
Floodprone Width (ft)	48.69	-----	-----
Bankfull Width (ft)	14.82	7.12	7.7
Entrenchment Ratio	3.29	-----	-----
Mean Depth (ft)	0.9	0.94	0.86
Maximum Depth (ft)	1.41	1.39	1.41
Width/Depth Ratio	16.47	7.57	8.95
Bankfull Area (sq ft)	13.35	6.71	6.64
Wetted Perimeter (ft)	15.23	8.73	9.28
Hydraulic Radius (ft)	0.88	0.77	0.71
Begin BKF Station	55.69	55.69	62.81
End BKF Station	70.51	62.81	70.51

Entrainment Calculations

Entrainment Formula: Rosgen Modified Shields Curve

Shear Stress (lb/sq ft)
Movable Particle (mm)

U2707 R1 Reachwide Pebble Count



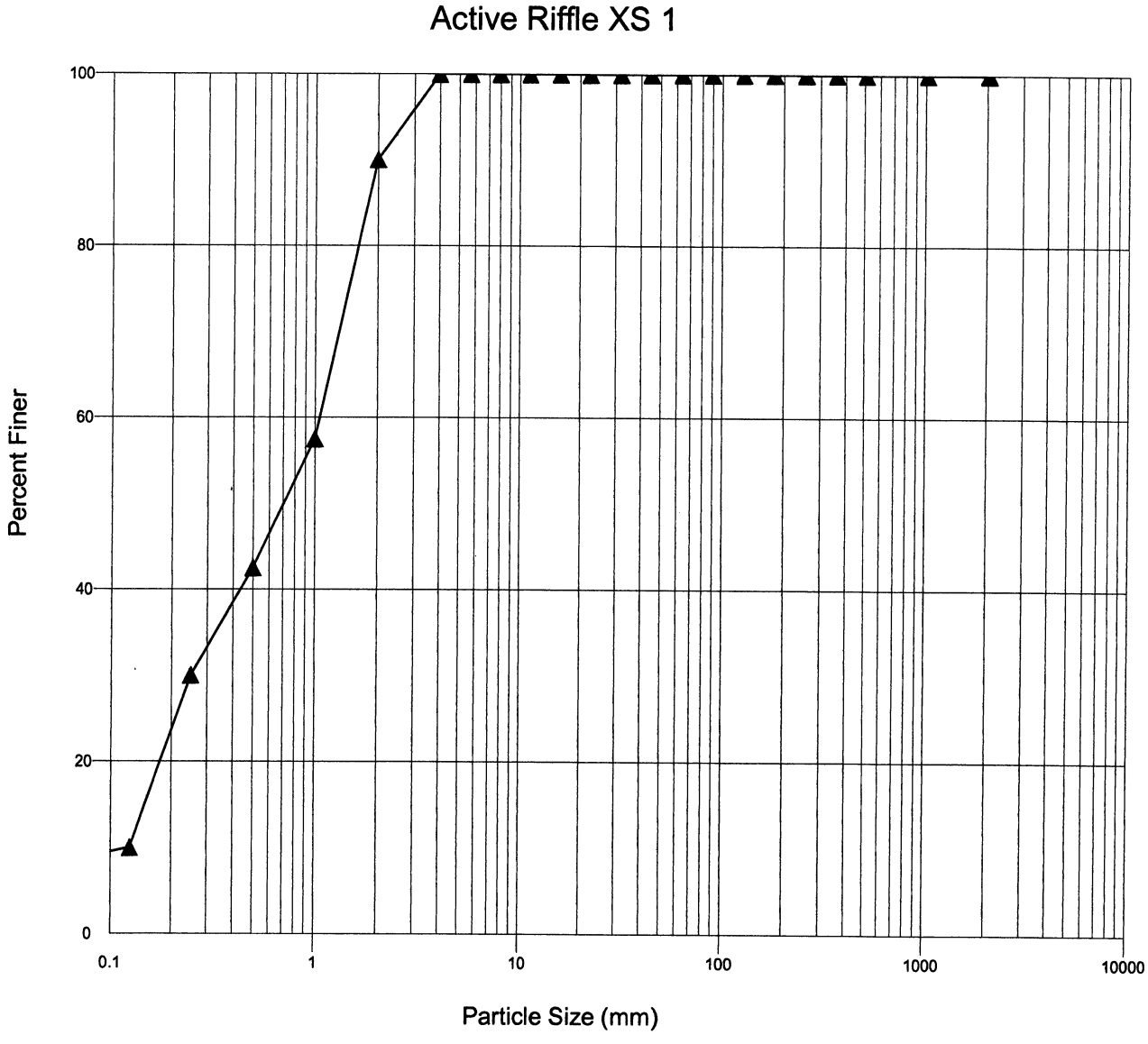
RIVERMORPH PARTICLE SUMMARY

River Name: UT to Muddy Creek
Reach Name: Existing Conditions
Sample Name: U2707 R1 Reachwide
Survey Date: 06/14/2011

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	35	35.00	35.00
0.062 - 0.125	15	15.00	50.00
0.125 - 0.25	12	12.00	62.00
0.25 - 0.50	7	7.00	69.00
0.50 - 1.0	2	2.00	71.00
1.0 - 2.0	5	5.00	76.00
2.0 - 4.0	2	2.00	78.00
4.0 - 5.7	2	2.00	80.00
5.7 - 8.0	4	4.00	84.00
8.0 - 11.3	4	4.00	88.00
11.3 - 16.0	6	6.00	94.00
16.0 - 22.6	3	3.00	97.00
22.6 - 32.0	3	3.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.03
D35 (mm)	0.06
D50 (mm)	0.13
D84 (mm)	8
D95 (mm)	18.2
D100 (mm)	32
Silt/Clay (%)	35
Sand (%)	41
Gravel (%)	24
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 100.


Active Riffle XS 1
Percent Finer
100
80
60
40
20
0
0.1
1
10
100
1000
10000
Particle Size (mm)

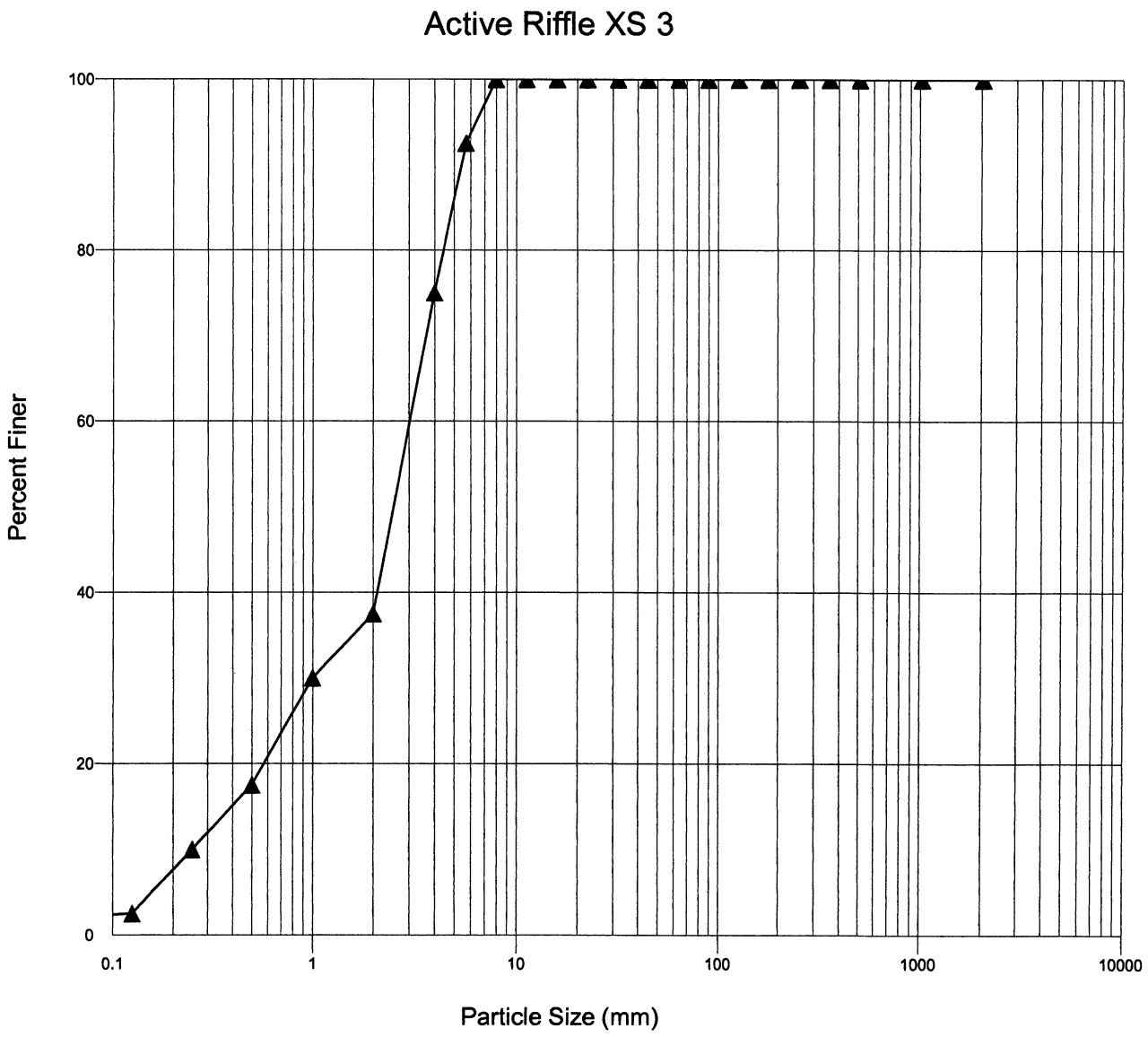
RIVERMORPH PARTICLE SUMMARY

River Name: UT to Muddy Creek
Reach Name: Existing Conditions
Sample Name: Active Riffle XS 1
Survey Date: 11/30/2011

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	4	10.00	10.00
0.125 - 0.25	8	20.00	30.00
0.25 - 0.50	5	12.50	42.50
0.50 - 1.0	6	15.00	57.50
1.0 - 2.0	13	32.50	90.00
2.0 - 4.0	4	10.00	100.00
4.0 - 5.7	0	0.00	100.00
5.7 - 8.0	0	0.00	100.00
8.0 - 11.3	0	0.00	100.00
11.3 - 16.0	0	0.00	100.00
16.0 - 22.6	0	0.00	100.00
22.6 - 32.0	0	0.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.16
D35 (mm)	0.35
D50 (mm)	0.75
D84 (mm)	1.82
D95 (mm)	3
D100 (mm)	4
Silt/Clay (%)	0
Sand (%)	90
Gravel (%)	10
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 40 (need at least 60).


Active Riffle XS 3
Percent Finer
100
80
60
40
20
0
0.1
1
10
100
1000
10000
Particle Size (mm)

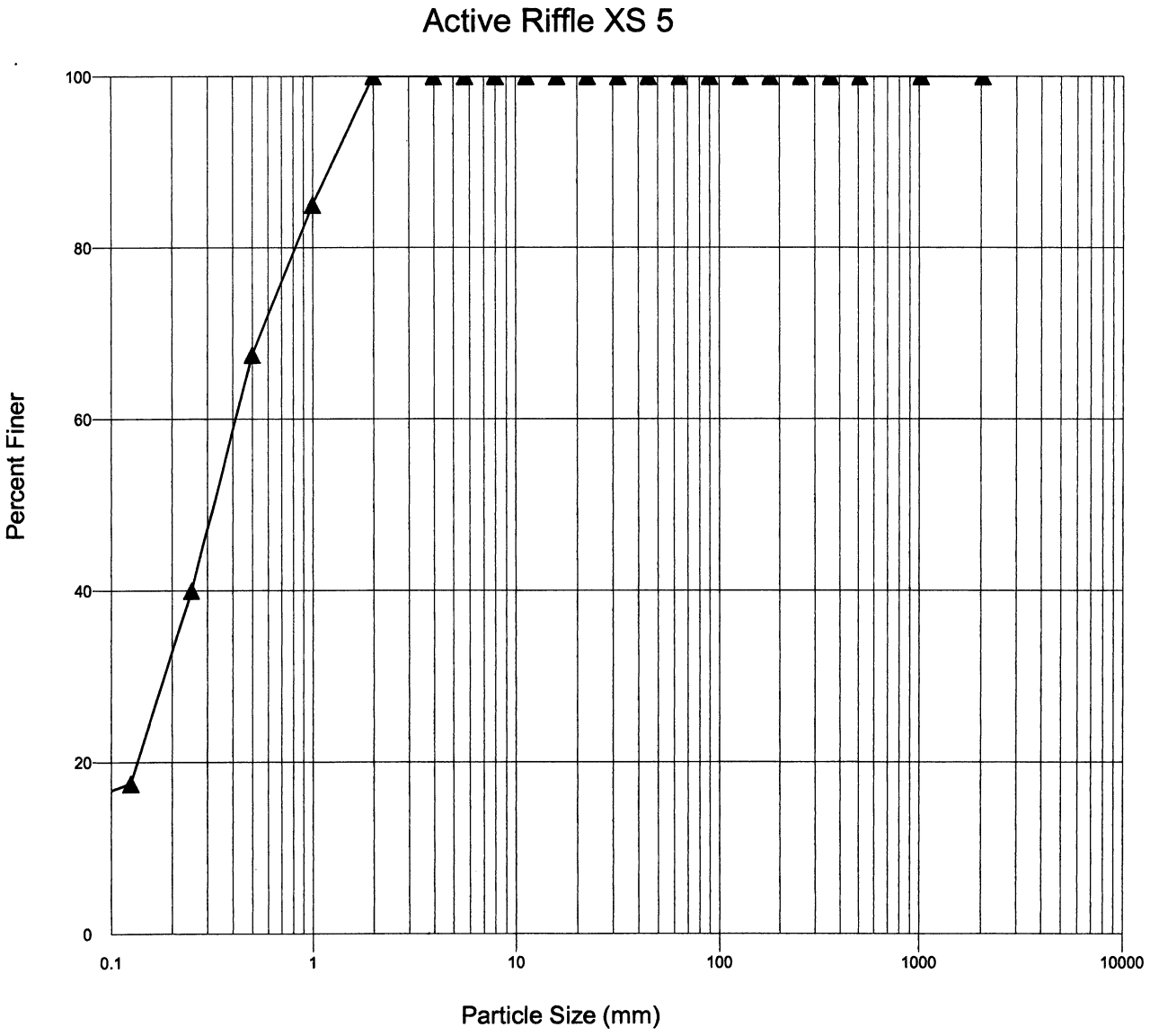
RIVERMORPH PARTICLE SUMMARY

River Name: UT to Muddy Creek
Reach Name: Existing Conditions
Sample Name: Active Riffle XS 3
Survey Date: 11/30/2011

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	1	2.50	2.50
0.125 - 0.25	3	7.50	10.00
0.25 - 0.50	3	7.50	17.50
0.50 - 1.0	5	12.50	30.00
1.0 - 2.0	3	7.50	37.50
2.0 - 4.0	15	37.50	75.00
4.0 - 5.7	7	17.50	92.50
5.7 - 8.0	3	7.50	100.00
8.0 - 11.3	0	0.00	100.00
11.3 - 16.0	0	0.00	100.00
16.0 - 22.6	0	0.00	100.00
22.6 - 32.0	0	0.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.45
D35 (mm)	1.67
D50 (mm)	2.67
D84 (mm)	4.87
D95 (mm)	6.47
D100 (mm)	8
Silt/Clay (%)	0
Sand (%)	37.5
Gravel (%)	62.5
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 40 (need at least 60).


Active Riffle XS 5
Percent Finer
100
80
60
40
20
0
0.1
1
10
100
1000
10000
Particle Size (mm)

RIVERMORPH PARTICLE SUMMARY

River Name: UT to Muddy Creek
Reach Name: Existing Conditions
Sample Name: Active Riffle XS 5
Survey Date: 11/30/2011

Size (mm)	TOT #	ITEM %	CUM %
0 - 0.062	0	0.00	0.00
0.062 - 0.125	7	17.50	17.50
0.125 - 0.25	9	22.50	40.00
0.25 - 0.50	11	27.50	67.50
0.50 - 1.0	7	17.50	85.00
1.0 - 2.0	6	15.00	100.00
2.0 - 4.0	0	0.00	100.00
4.0 - 5.7	0	0.00	100.00
5.7 - 8.0	0	0.00	100.00
8.0 - 11.3	0	0.00	100.00
11.3 - 16.0	0	0.00	100.00
16.0 - 22.6	0	0.00	100.00
22.6 - 32.0	0	0.00	100.00
32 - 45	0	0.00	100.00
45 - 64	0	0.00	100.00
64 - 90	0	0.00	100.00
90 - 128	0	0.00	100.00
128 - 180	0	0.00	100.00
180 - 256	0	0.00	100.00
256 - 362	0	0.00	100.00
362 - 512	0	0.00	100.00
512 - 1024	0	0.00	100.00
1024 - 2048	0	0.00	100.00
Bedrock	0	0.00	100.00

D16 (mm)	0.12
D35 (mm)	0.22
D50 (mm)	0.34
D84 (mm)	0.97
D95 (mm)	1.67
D100 (mm)	2
Silt/Clay (%)	0
Sand (%)	100
Gravel (%)	0
Cobble (%)	0
Boulder (%)	0
Bedrock (%)	0

Total Particles = 40 (need at least 60).

Entrainment Calculation Form

Status: **Existing Conditions**
Project: U-2707
Date: 7/22/2011

Location: Forsythe Co.
Reach: R1a, XS 3, Pebble Count Riffle 3
Observers: EMP

Value	Variable	Definition		
Required Information for Entrainment Analysis				
2.7	D_{50} (mm)	D_{50} from Riffle (1) or Pavement (2)	Riffle	Select Sample Type
0.1	D^*_{50} (mm)	D_{50} from Bar Sample (1) or Subpavement (2)	Bar Sample	
6	D_i (mm)	Largest Particle from Bar Sample (1) or Pavement (2)	Bar Sample	
0.020	D_i (ft)	D_i (mm) / 304.8 (mm/ft)		
0.006	S (ft/ft)	Bankfull Water Surface Slope		
0.65	d (ft)	Bankfull Mean Depth		
8.93	A (ft^2)	Bankfull Cross Sectional Area		
14.85	W_p (ft)	Wetted Perimeter		
1.65	γ_s	Submerged Specific Weight of Sediment (1.65)		
62.4	γ (lbs/ft^3)	Density of Water (62.4)		
Calculation of Critical Dimensionless Shear Stress				
27.00	D_{50}/D^*_{50}	Range 3-7	Use Equation 1: $\tau^*_{ci} = 0.0834(D_{50}/D^*_{50})^{-0.872}$	
2.22	D_i/D_{50}	Range 1.3-3.0	Use Equation 2: $\tau^*_{ci} = 0.0384(D_i/D^*_{50})^{-0.887}$	
0.019	τ^*_{ci}	Critical Dimensionless Shear Stress	Equation Used:	2
Caculate Bankfull Mean Depth Required for Entrainment of Largest Particle				
0.102	d_c	Required Bankfull Mean Depth (ft)	$d_c = \frac{\tau^*_{ci}\gamma_s D_i}{S}$	
6.349	d/d_c	**Stability:**	**Degrading**	
Calculate Bankfull Water Surface Slope Required for Entrainment of Largest Particle				
0.001	S_c	Required Bankfull Water Surface Slope (ft/ft)	$S_c = \frac{\tau^*_{ci}\gamma_s D_i}{d}$	
6.349	S/S_c	**Stability:**	**Degrading**	
Sediment Transport Validation - Bankfull Shear Stress				
0.60	R	Hydraulic Radius (ft)	$R = A/W_p$	
0.225	τ_c	Bankfull Shear Stress (lb/ft^2)	$\tau_c = \gamma RS$	
Y	Y or N	Is the Bed Material Homogeneous?		
		Determine from reach wide pebble count distribution (Use your best judgement). If homogeneous use "Leopold et. al" Curve Data, if heterogeneous use "Colorado" Curve Data.		
16	mm	Movable Particle Size (mm) At Bankfull Shear Stress predicted by the Leopold, Wolman, & Miller 1964 Power-trendline.		
0.085	lb/ft^2	Predicted Shear Stress (lbs/ft^2) Required To Move D_i predicted by the Leopold, Wolman, & Miller 1964 Power-trendline.		
N/A	mm	Movable Particle Size (mm) At Bankfull Shear Stress predicted by the Colorado Data Power-trendline.		
N/A	lb/ft^2	Predicted Shear Stress (lbs/ft^2) Required To Move D_i predicted by the Colorado Data Power-trendline.		

Taken from *The Reference Reach Field Book*, 2005 by Rosgen and Silvey

Entrainment Calculation Form

Status: **Proposed, iteration 1** Location: Forsythe Co.

Project: U-270 Reach: R1a, XS 3, Pebble Count Riffle 3

Date: 7/22/2011 Observers: EMP

Value	Variable	Definition		
Required Information for Entrainment Analysis				
2.7	D_{50} (mm)	D_{50} from Riffle (1) or Pavement (2)	Riffle	Select Sample Type
0.1	D_{50} (mm)	D_{50} from Bar Sample (1) or Subpavement (2)	Bar Sample	
6	D_i (mm)	Largest Particle from Bar Sample (1) or Pavement (2)	Bar Sample	
0.020	D_i (ft)	D_i (mm) / 304.8 (mm/ft)		
0.008	S (ft/ft)	Bankfull Water Surface Slope		
0.84	d (ft)	Bankfull Mean Depth		
10	A (ft^2)	Bankfull Cross Sectional Area		
12.39	W_p (ft)	Wetted Perimeter		
1.65	γ_s	Submerged Specific Weight of Sediment (1.65)		
62.4	γ (lbs/ft^3)	Density of Water (62.4)		
Calculation of Critical Dimensionless Shear Stress				
27.00	D_{50}/D^*_{50}	Range 3-7	Use Equation 1: $\tau^*_{ci} = 0.0834(D_{50}/D^*_{50})^{-0.872}$	
2.22	D_i/D_{50}	Range 1.3-3.0	Use Equation 2: $\tau^*_{ci} = 0.0384(D_i/D^*_{50})^{-0.887}$	
0.019	τ^*_{ci}	Critical Dimensionless Shear Stress	Equation Used:	2
Caculate Bankfull Mean Depth Required for Entrainment of Largest Particle				
0.077	d_c	Required Bankfull Mean Depth (ft) $d_c = \frac{\tau^*_{ci}\gamma_s D_i}{S}$		
10.940	d/d_c	**Stability:**	**Degrading**	
Calculate Bankfull Water Surface Slope Required for Entrainment of Largest Particle				
0.001	S_c	Required Bankfull Water Surface Slope (ft/ft) $S_c = \frac{\tau^*_{ci}\gamma_s D_i}{d}$		
10.940	S/S_c	**Stability:**	**Degrading**	
Sediment Transport Validation - Bankfull Shear Stress				
0.81	R	Hydraulic Radius (ft) $R = A/W_p$		
0.403	τ_c	Bankfull Shear Stress (lb/ft^2) $\tau_c = \gamma RS$		
Y	Y or N	Is the Bed Material Homogeneous? **Determine from reach wide pebble count distribution (Use your best judgement).** If homogeneous use "Leopold et. al" Curve Data, if heterogeneous use "Colorado" Curve Data.		
30	mm	Movable Particle Size (mm) At Bankfull Shear Stress predicted by the Leopold, Wolman, & Miller 1964 Power-trendline.		
0.085	lb/ft^2	Predicted Shear Stress (lbs/ft^2) Required To Move D_i predicted by the Leopold, Wolman, & Miller 1964 Power-trendline.		
N/A	mm	Movable Particle Size (mm) At Bankfull Shear Stress predicted by the Colorado Data Power-trendline.		
N/A	lb/ft^2	Predicted Shear Stress (lbs/ft^2) Required To Move D_i predicted by the Colorado Data Power-trendline.		

*Taken from *The Reference Reach Field Book*, 2005 by Rosgen and Silvey

Entrainment Calculation Form

Status: **Existing Conditions** Location: Forsythe Co.

Project: U-2707 Reach: R1b, XS 5, Pebble Count Riffle 3

Date: 7/22/2011 Observers: EMP

Value	Variable	Definition		
Required Information for Entrainment Analysis				
2.7	D_{50} (mm)	D_{50} from Riffle (1) or Pavement (2)	Riffle	Select Sample Type
0.1	D^*_{50} (mm)	D_{50} from Bar Sample (1) or Subpavement (2)	Bar Sample	
6	D_i (mm)	Largest Particle from Bar Sample (1) or Pavement (2)	Bar Sample	
0.020	D_i (ft)	D_i (mm) / 304.8 (mm/ft)		
0.006	S (ft/ft)	Bankfull Water Surface Slope		
1.58	d (ft)	Bankfull Mean Depth		
14	A (ft^2)	Bankfull Cross Sectional Area		
10.56	W_p (ft)	Wetted Perimeter		
1.65	γ_s	Submerged Specific Weight of Sediment (1.65)		
62.4	γ (lbs/ft^3)	Density of Water (62.4)		
Calculation of Critical Dimensionless Shear Stress				
27.00	D_{50}/D^*_{50}	Range 3-7	Use Equation 1:	
			$\tau^*_{ci} = 0.0834(D_{50}/D^*_{50})^{-0.872}$	
2.22	D_i/D_{50}	Range 1.3-3.0	Use Equation 2:	
			$\tau^*_{ci} = 0.0384(D_i/D^*_{50})^{-0.887}$	
0.019	τ^*_{ci}	Critical Dimensionless Shear Stress	Equation Used:	2
Caculate Bankfull Mean Depth Required for Entrainment of Largest Particle				
0.102	d_c	Required Bankfull Mean Depth (ft)		
		$d_c = \frac{\tau^*_{ci}\gamma_s D_i}{S}$		
15.433	d/d_c	**Stability:**	**Degrading**	
Calculate Bankfull Water Surface Slope Required for Entrainment of Largest Particle				
0.000	S_c	Required Bankfull Water Surface Slope (ft/ft)		
		$S_c = \frac{\tau^*_{ci}\gamma_s D_i}{d}$		
15.433	S/S_c	**Stability:**	**Degrading**	
Sediment Transport Validation - Bankfull Shear Stress				
1.33	R	Hydraulic Radius (ft)		
		$R = A/W_p$		
0.496	τ_c	Bankfull Shear Stress (lb/ft^2)		
		$\tau_c = \gamma RS$		
Y	Y or N	Is the Bed Material Homogeneous?		
		Determine from reach wide pebble count distribution (Use your best judgement).		
		If homogeneous use "Leopold et. al" Curve Data, if heterogeneous use "Colorado" Curve Data.		
38	mm	Movable Particle Size (mm) At Bankfull Shear Stress predicted by the Leopold, Wolman, & Miller 1964 Power-trendline.		
0.085	lb/ft^2	Predicted Shear Stress (lbs/ft^2) Required To Move D_i predicted by the Leopold, Wolman, & Miller 1964 Power-trendline.		
N/A	mm	Movable Particle Size (mm) At Bankfull Shear Stress predicted by the Colorado Data Power-trendline.		
N/A	lb/ft^2	Predicted Shear Stress (lbs/ft^2) Required To Move D_i predicted by the Colorado Data Power-trendline.		

Taken from *The Reference Reach Field Book*, 2005 by Rosgen and Silvey

Entrainment Calculation Form

Status: **Proposed, iteration 1** Location: Forsythe Co.

Project: U-270" Reach: R1b, XS 5, Pebble Count Riffle 3

Date: "/22/2011 Observers: EMP

Value	Variable	Definition		
Required Information for Entrainment Analysis				
2.7	D_{50} (mm)	D_{50} from Riffle (1) or Pavement (2)	Riffle	Select Sample Type
0.1	D^*_{50} (mm)	D_{50} from Bar Sample (1) or Subpavement (2)	Bar Sample	
6	D_i (mm)	Largest Particle from Bar Sample (1) or Pavement (2)	Bar Sample	
0.020	D_i (ft)	Di (mm) / 304.8 (mm/ft)		
0.0044	S (ft/ft)	Bankfull Water Surface Slope		
1.07	d (ft)	Bankfull Mean Depth		
15	A (ft^2)	Bankfull Cross Sectional Area		
14.52	W_p (ft)	Wetted Perimeter		
1.65	γ_s	Submerged Specific Weight of Sediment (1.65)		
62.4	γ (lbs/ft^3)	Density of Water (62.4)		

Calculation of Critical Dimensionless Shear Stress				
27.00	D_{50}/D^*_{50}	Range 3-"	Use Equation 1: $\tau^*_{ci} = 0.0834(D_{50}/D^*_{50})^{-0.872}$	
2.22	D_i/D_{50}	Range 1.3-3.0	Use Equation 2: $\tau^*_{ci} = 0.0384(D_i/D^*_{50})^{-0.887}$	
0.019	τ^*_{ci}	Critical Dimensionless Shear Stress	Equation Used:	2

Caculate Bankfull Mean Depth Required for Entrainment of Largest Particle			
0.140	d_r	Required Bankfull Mean Depth (ft)	$d_r = \frac{\tau^*_{ci}\gamma_s D_i}{S}$
7.665	d/d_r	**Stability:**	**Degrading**

Calculate Bankfull Water Surface Slope Required for Entrainment of Largest Particle			
0.001	S_r	Required Bankfull Water Surface Slope (ft/ft)	$S_r = \frac{\tau^*_{ci}\gamma_s D_i}{d}$
7.665	S/S_r	**Stability:**	**Degrading**

Sediment Transport Validation - Bankfull Shear Stress		
1.03	R	Hydraulic Radius (ft) $R = A/W_p$
0.284	τ_c	Bankfull Shear Stress (lb/ft^2) $\tau_c = \gamma RS$
Y	Y or N	Is the Bed Material Homogeneous? **Determine from reach wide pebble count distribution (Use your best judgement).** If homogeneous use "Leopold et. al" Curve Data, if heterogeneous use "Colorado" Curve Data.
21	mm*	Movable Particle Size (mm) At Bankfull Shear Stress predicted by the Leopold, Wolman, & Miller 1964 Power-trendline.
0.085	lb/ft^2	Predicted Shear Stress (lbs/ft^2) Required To Move D_i predicted by the Leopold, Wolman, & Miller 1964 Power-trendline.
N/A	mm*	Movable Particle Size (mm) At Bankfull Shear Stress predicted by the Colorado Data Power-trendline.
N/A	lb/ft^2	Predicted Shear Stress (lbs/ft^2) Required To Move D_i predicted by the Colorado Data Power-trendline.

*Taken from *The Reference Reach Field Book*, 2005 by Rosgen and Silvey

Velocity Comparison Form

Project:	U-2707	**Location:**	Forsyth County. NC
Stream:	UT to Muddy Creek	**Reach:**	R1 Existing XS1
Date:	8/16/2011	**Observers:**	Mulkey

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	9.86 sq ft	Bankfull Mean Depth (Dbkf)	0.85 ft
Bankfull Width (Wbkf)	11.58 ft	Wetted Perimeter (WP)	13.28 ft
D84 (Riffle or pavement)	1.82 mm	D84 (mm/304.8)	0.01 ft
Bankfull Slope (S)	0.0063 ft/ft	Hydraulic Radius (R)	0.74 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	142.35 ft/ft
Bankfull Maximum Depth	1.63 ft.	R/D84 (use D84 in ft)	124.34 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	13.5 ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	0.024
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	4.04 ft/s

u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.39 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	5.74 ft/s

Mannings n by StreamType		
Stream type		C5
Mannings n	(Red Book: p187; Blue :p237)	0.035
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	2.77 ft/s

Continuity Equation		
Qbkf	(cfs) original curve or stream gage hydraulic geometry	53 cfs
Velocity	(u=Q/A) or from stream gage hydraulic geometry	5.38 ft/s

Sandbed stream

Dr. Richard Hey Method		
Coefficient a	a = 11(R/dmax)^-0.314	14.2
Friction Factor - f	1/f^1/2 = 2.03 log (aR/3.5D84)	0.033
Velocity	(From D'Arcy Weisbach equation: u=(8*g*R S/f)^1/2)	6.03 ft/s

Velocity Comparison Form

Project:	U-2707	**Location:**	Forsyth County, NC
Stream:	UT to Muddy Creek	**Reach:**	R1 Existing XS3
Date:	8/16/2011	**Observers:**	Mulkey

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	8.93 sq ft	Bankfull Mean Depth (Dbkf)	0.65 ft
Bankfull Width (Wbkf)	13.66 ft	Wetted Perimeter (WP)	14.96 ft
D84 (Riffle or pavement)	4.887 mm	D84 (mm/304.8)	0.02 ft
Bankfull Slope (S)	0.0063 ft/ft	Hydraulic Radius (R)	0.60 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	40.54 ft/ft
Bankfull Maximum Depth	1.68 ft.	R/D84 (use D84 in ft)	37.23 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	11.2 ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	0.026
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	3.22 ft/s

u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.35 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	4.11 ft/s

Mannings n by StreamType		
Stream type		C5
Mannings n	(Red Book: p187; Blue :p237)	0.035
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	2.39 ft/s

Continuity Equation		
Qbkf	(cfs) original curve or stream gage hydraulic geometry	53 cfs
Velocity	(u=Q/A) or from stream gage hydraulic geometry	5.94 ft/s

Sandbed stream

Dr. Richard Hey Method		
Coefficient a	a = 11(R/dmax)^-0.314	15.4
Friction Factor - f	1/f^1/2 = 2.03 log (aR/3.5D84)	0.050
Velocity	(From D'Arcy Weisbach equation: u=(8*g*R S/f)^1/2)	4.43 ft/s

Velocity Comparison Form

Project:	U-2707	**Location:**	Forsyth County, NC
Stream:	UT to Muddy Creek	**Reach:**	R1 Existing XS5
Date:	8/16/2011	**Observers:**	Mulkey

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	14 sq ft	Bankfull Mean Depth (Dbkf)	1.58 ft
Bankfull Width (Wbkf)	8.86 ft	Wetted Perimeter (WP)	12.02 ft
D84 (Riffle or pavement)	0.97 mm	D84 (mm/304.8)	0.00 ft
Bankfull Slope (S)	0.0063 ft/ft	Hydraulic Radius (R)	1.16 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	496.48 ft/ft
Bankfull Maximum Depth	2.37 ft	R/D84 (use D84 in ft)	365.99 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	#DIV/0! ft/s

****UNABLE TO CALCULATE DUE TO LOW D84****

u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.49 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	8.49 ft/s

Mannings n by StreamType		
Stream type		C5
Mannings n	(Red Book: p187; Blue :p237)	0.035
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	3.74 ft/s

Continuity Equation		
Qbkf	(cfs) original curve or stream gage hydraulic geometry	53 cfs
Velocity	(u=Q/A) or from stream gage hydraulic geometry	3.79 ft/s

Sandbed stream

Dr. Richard Hey Method		
Coefficient a	a = 11(R/dmax)^-0.314	13.9
Friction Factor - f	1/f^1/2 = 2.03 log (aR/3.5D84)	0.024
Velocity	(From D'Arcy Weisbach equation: u=(8*g*R S/f)^1/2)	8.84 ft/s

Velocity Comparison Form

Project:	U-2707	**Location:**	Forsyth County, NC
Stream:	UT to Muddy Creek	**Reach:**	Proposed R1a
Date:	8/16/2011	**Observers:**	Mulkey

Based on Characteristics of Riffle Number 3

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	10 sq ft	Bankfull Mean Depth (Dbkf)	0.84 ft
Bankfull Width (Wbkf)	12 ft	Wetted Perimeter (WP)	13.68 ft
D84 (Riffle or pavement)	4.87 mm	D84 (mm/304.8)	0.02 ft
Bankfull Slope (S)	0.0075 ft/ft	Hydraulic Radius (R)	0.73 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	52.57 ft/ft
Bankfull Maximum Depth	1.4 ft	R/D84 (use D84 in ft)	45.75 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	12 ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	0.025
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	4.18 ft/s

u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.42 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	5.17 ft/s

Mannings n by StreamType		
Stream type		C5
Mannings n	(Red Book: p187; Blue :p237)	0.035
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	2.98 ft/s

Continuity Equation		
Qbkf	(cfs) original curve or stream gage hydraulic geometry	53 cfs
Velocity	(u=Q/A) or from stream gage hydraulic geometry	5.30 ft/s

Sandbed stream

Dr. Richard Hey Method		
Coefficient a	a = 11(R/dmax)^-0.314	13.6
Friction Factor - f	1/f^1/2 = 2.03 log (aR/3.5D84)	0.048
Velocity	(From D'Arcy Weisbach equation: u=(8*g*R S/f)^1/2)	5.43 ft/s

Velocity Comparison Form

Project:	U-2707	**Location:**	Forsyth County, NC
Stream:	UT to Muddy Creek	**Reach:**	Proposed R1b
Date:	8/16/2011	**Observers:**	Mulkey

Based on Characteristics of Riffle Number 5

Input Variables		Output Variables	
Bankfull X-Sec Area (Abkf)	15 sq ft	Bankfull Mean Depth (Dbkf)	1.07 ft
Bankfull Width (Wbkf)	14 ft	Wetted Perimeter (WP)	16.14 ft
D84 (Riffle or pavement)	0.97 mm	D84 (mm/304.8)	0.00 ft
Bankfull Slope (S)	0.0044 ft/ft	Hydraulic Radius (R)	0.93 ft
Gravitational Accleration (g)	32.2 ft/sq sec	Dbkf/D84 (use D84 in ft)	336.22 ft/ft
Bankfull Maximum Depth	1.76 ft.	R/D84 (use D84 in ft)	292.03 ft/ft

Dbkf/D84, u/u*, Mannings n		
u/u*	(Using Dbkf/D84 Red Book: p188; Blue p233)	ft/s/ft/s
Mannings n	(Red Book: p189; Blue :p236)	
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	#DIV/0! ft/s

****UNABLE TO CALCULATE DUE TO LOW D84****

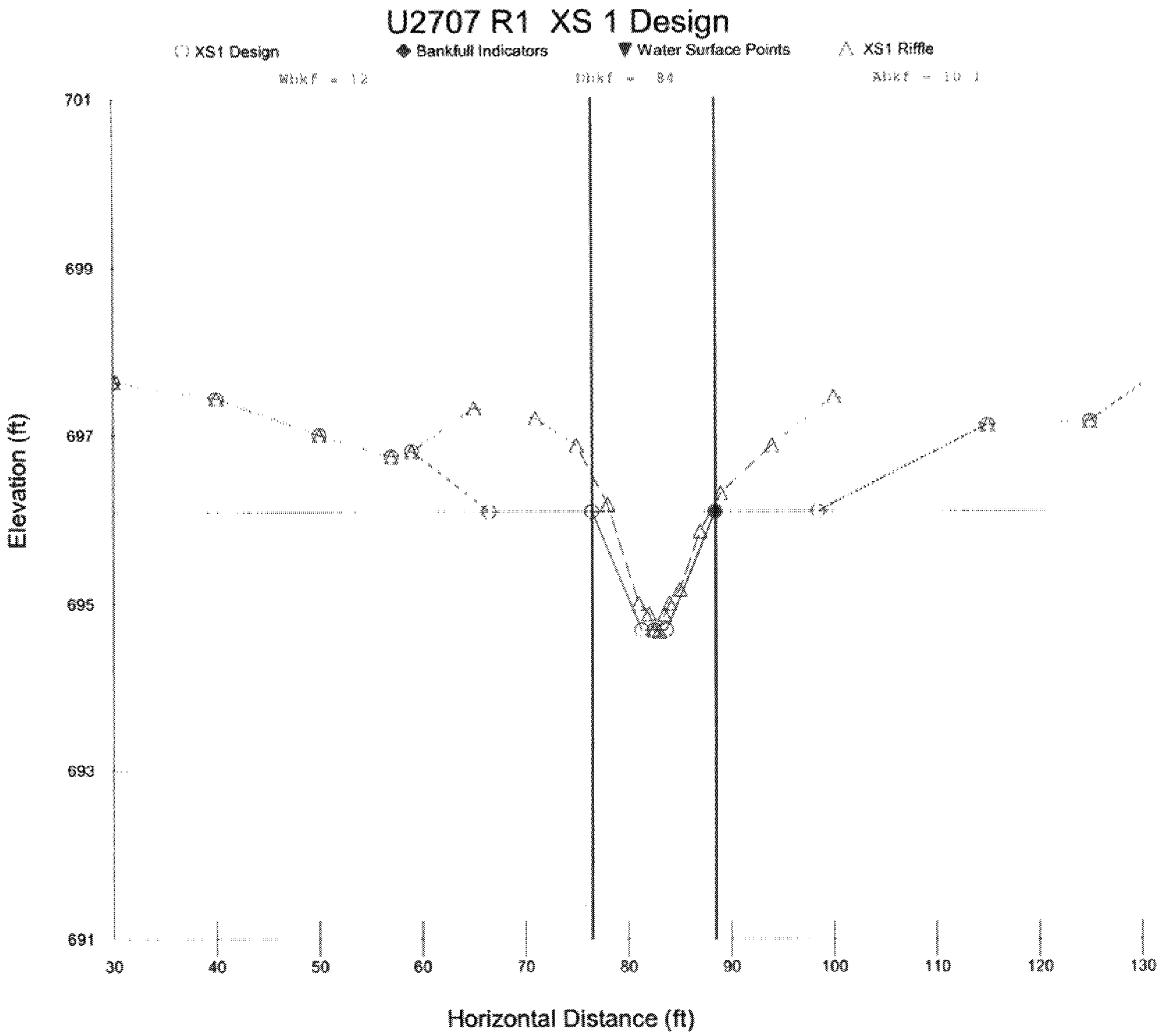
u/u*=2.83+5.7logR/D84		
u*	u* = (gRS)^.5	0.36 ft/s
Velocity:	u = u*(2.83+5.7log(R/D84))	6.13 ft/s

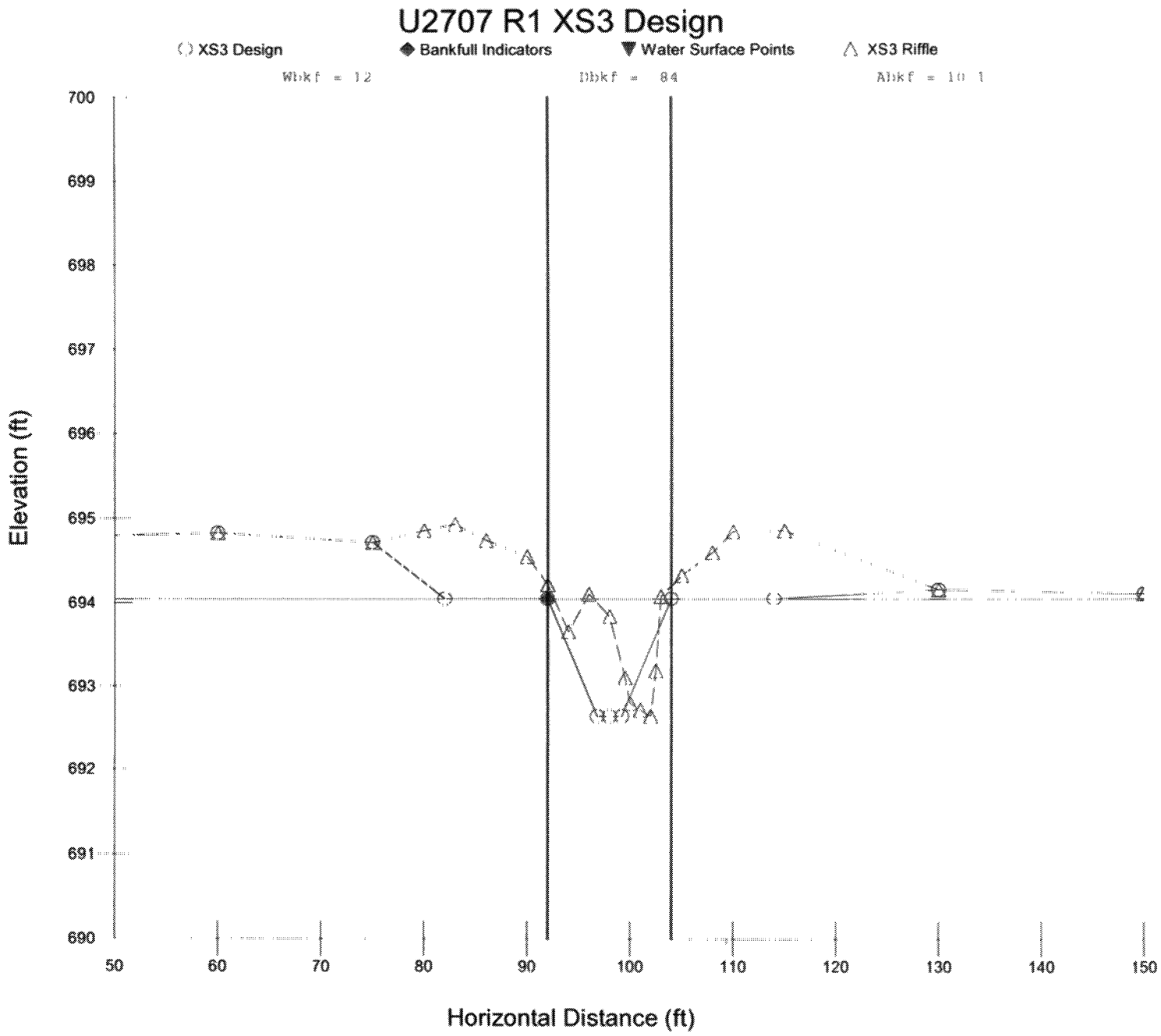
Mannings n by StreamType		
Stream type		C5
Mannings n	(Red Book: p187; Blue :p237)	0.035
Velocity	(From Mannings' equation: u=1.4865 * (R^2/3)(S^1/2)/n)	2.68 ft/s

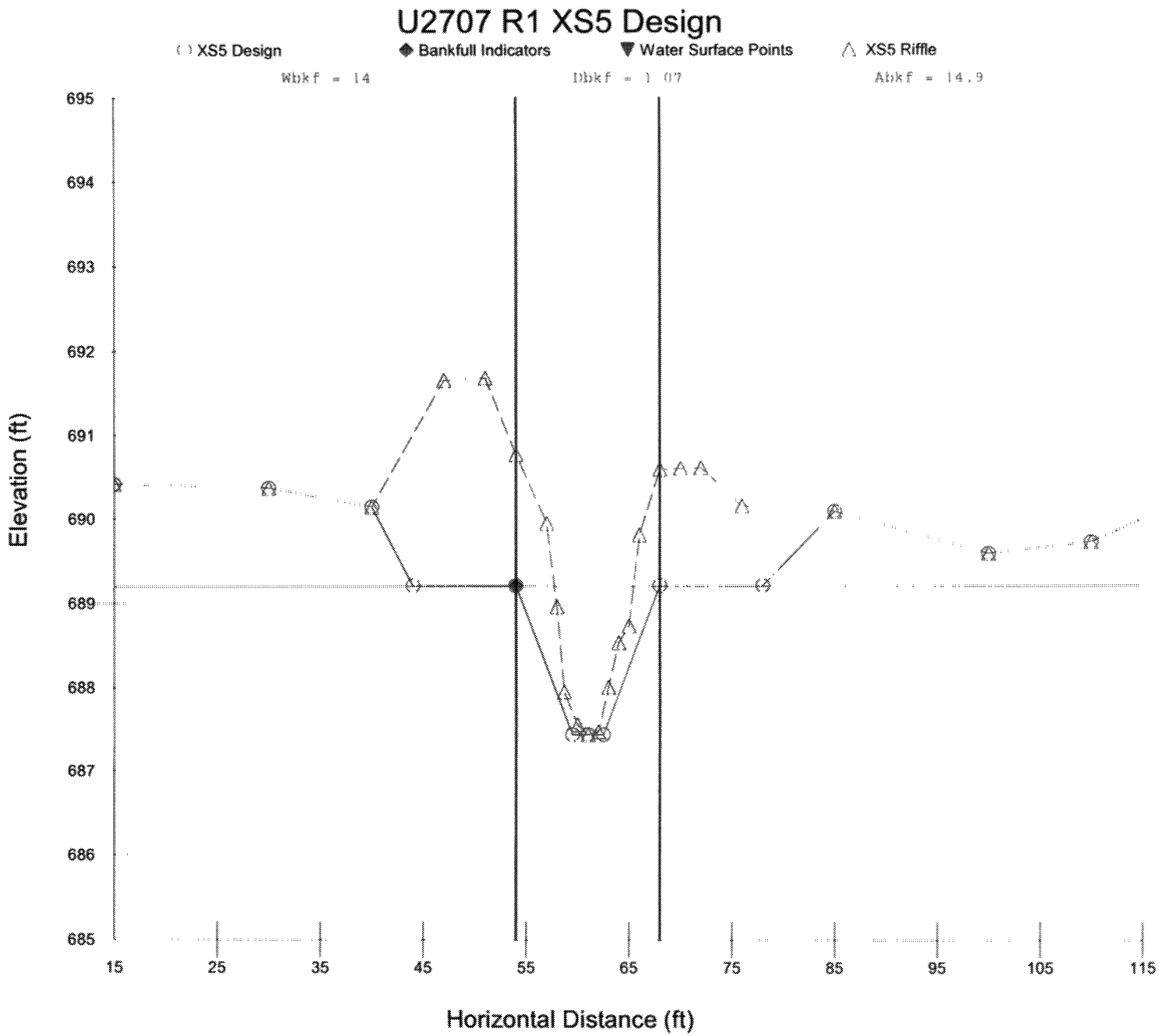
Continuity Equation		
Qbkf	(cfs) original curve or stream gage hydraulic geometry	53 cfs
Velocity	(u=Q/A) or from stream gage hydraulic geometry	3.53 ft/s

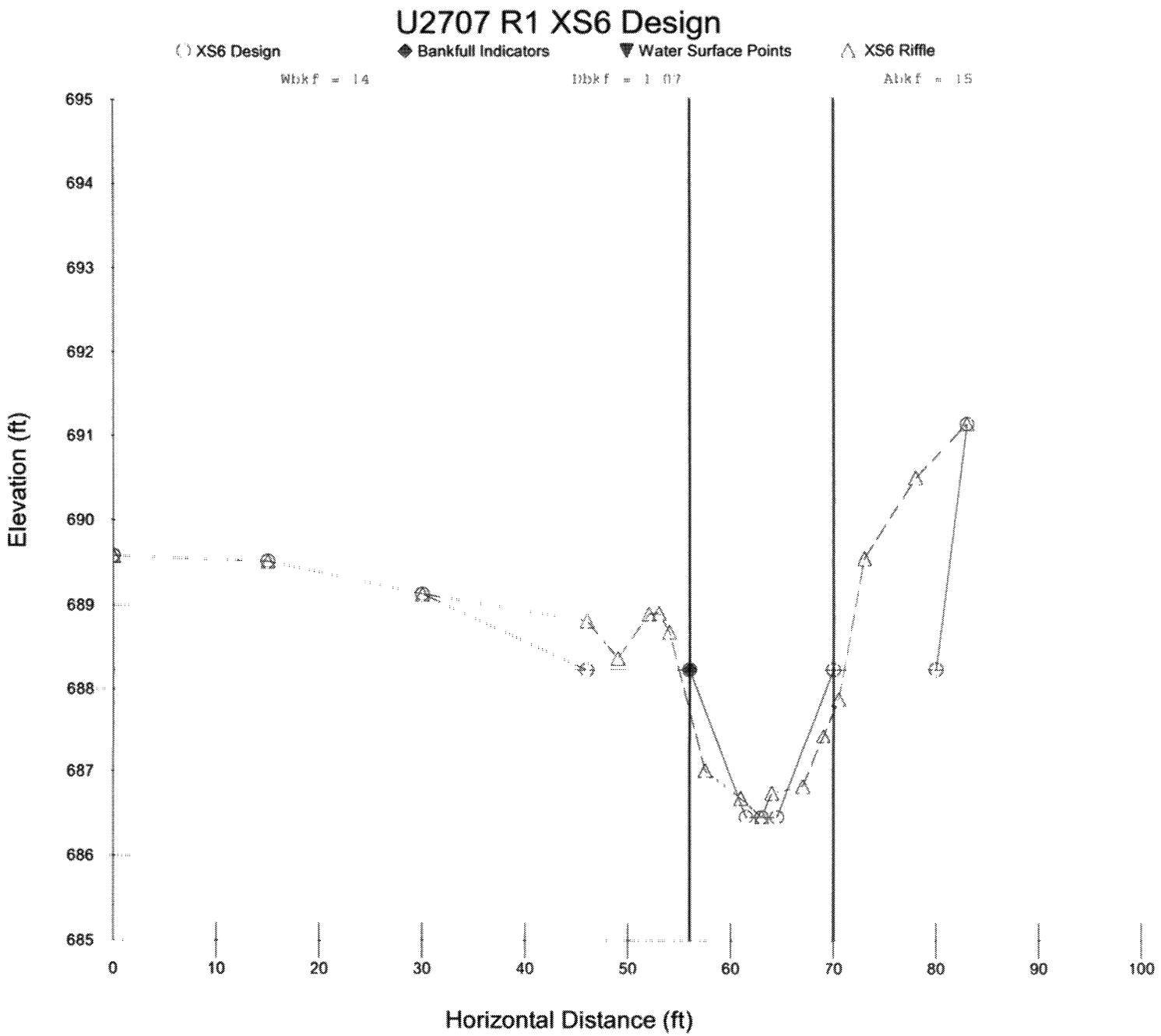
Sandbed stream

Dr. Richard Hey Method		
Coefficient a	a = 11(R/dmax)^-0.314	13.6
Friction Factor - f	1/f^1/2 = 2.03 log (aR/3.5D84)	0.026
Velocity	(From D'Arcy Weisbach equation: u=(8*g*R S/f)^1/2)	6.36 ft/s


U2707 R1 XS 1 Design
XS1 Design
Bankfull Indicators
Water Surface Points
XS1 Riffle
Wbkf = 12
Dbkf = 84
Abkf = 10 1
701
699
697
695
693
691
Elevation (ft)
30
40
50
60
70
80
90
100
110
120
130
Horizontal Distance (ft)


U2707 R1 XS3 Design
XS3 Design
Bankfull Indicators
Water Surface Points
XS3 Riffle
Wbkf = 12
Dbkf = 84
Abkf = 10.1
Elevation (ft)
700
699
698
697
696
695
694
693
692
691
690
50
60
70
80
90
100
110
120
130
140
150
Horizontal Distance (ft)


U2707 R1 XS5 Design
XS5 Design
Bankfull Indicators
Water Surface Points
XS5 Riffle
Wbkf = 14
Dbkf = 1.07
Abkf = 14.9
Elevation (ft)
695
694
693
692
691
690
689
688
687
686
685
15
25
35
45
55
65
75
85
95
105
115
Horizontal Distance (ft)


U2707 R1 XS6 Design
XS6 Design
Bankfull Indicators
Water Surface Points
XS6 Riffle
Wbkf = 14
Dbkf = 1.07
Abkf = 15
695
694
693
692
691
690
689
688
687
686
685
Elevation (ft)
0
10
20
30
40
50
60
70
80
90
100
Horizontal Distance (ft)

PROJECT REFERENCE NO.	SHEET NO.
U-2707	MORPH
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

5/28/99

REVISIONS

MORPHOLOGICAL MEASUREMENTS TABLE

UT TO MUDDY CREEK

-RI- Sta. 0+00.00 to Sta. 9+20.00

Variables	Existing Channel	Proposed Reach	USGS Station	Reference Reach
1. Stream type	C/E5	C5	--	C E 4/
2. Drainage area	0.49 SQ MI (316 ACRES)	0.45 SQ MI (288 ACRES)	----	0.55 SQ MI (355 ACRES)
3. Bankfull width	Mean: 11.36 Range: 8.86-14.80	Mean: 12.00 Range: ----	----	Mean: 15.48 Range: 11.90-17.70
4. Bankfull mean depth	Mean: 0.72 Range: 0.58-0.85	Mean: 0.83 Range: ----	----	Mean: 1.29 Range: 1.23-1.41
5. Width/depth ratio	Mean: 15.56 Range: 13.65-17.48	Mean: 14.4 Range: ----	----	Mean: 12.97 Range: 11.42-14.57
6. Bankfull cross-sectional area	Mean: 10.77 Range: 5.93-14.00	Mean: 10.00 Range: ----	----	Mean: 21.33 Range: 20.00-22.70
7. Bankfull mean velocity	Mean: 5.38 Range: ----	Mean: 5.30 Range: ----	----	Mean: 2.90 Range: ----
8. Bankfull discharge, cfs	Mean: 53 Range: ----	Mean: 53 Range: ----	----	Mean: 58 Range: ----
9. Bankfull max depth	Mean: 1.60 Range: 0.96-2.37	Mean: 1.40 Range: 1.40-1.40	----	Mean: 1.94 Range: 1.60-2.12
10. Width of floodprone area	Mean: 118.67 Range: 48.69-180.00	Mean: >100.00 Range: ----	----	Mean: 171.25 Range: 162.00-186.00
11. Entrenchment ratio	Mean: 11.41 Range: 3.29-17.68	Mean: >2.2 Range: ----	----	Mean: 11.30 Range: 10.06-14.45
12. Meander length	Mean: 50.92 Range: 31.09-73.07	Mean: 95.10 Range: 80.10-102.00	----	Mean: 80.30 Range: 64.32-114.00
13. Ratio of meander length to bankfull width	Mean: 4.48 Range: 2.47-6.43	Mean: 7.93 Range: 6.68-8.50	----	Mean: 5.19 Range: 4.16-7.37
14. Radius of curvature	Mean: 22.22 Range: 10.01-32.89	Mean: 33.47 Range: 28.00-49.00	----	Mean: 16.44 Range: 11.73-25.30
15. Ratio of radius of curvature to bankfull width	Mean: 1.96 Range: 0.88-2.90	Mean: 2.79 Range: 2.33-4.08	----	Mean: 1.19 Range: 0.76-1.63
16. Belt width	Mean: 6.38 Range: 1.28-14.48	Mean: 21.91 Range: 11.52-41.14	----	Mean: 31.92 Range: 12.54-54.25
17. Meander width ratio	Mean: 0.56 Range: 0.11-1.27	Mean: 1.83 Range: 0.96-3.43	----	Mean: 2.06 Range: 0.81-3.51
18. Sinuosity (stream length/valley length)	Mean: 1.06 Range: ----	Mean: 1.12 Range: ----	----	Mean: 1.41 Range: ----
19. Valley slope	Mean: 0.00675 Range: ----	Mean: 0.00899 Range: ----	----	Mean: 0.01230 Range: ----
20. Average slope	Mean: 0.00632 Range: ----	Mean: 0.0080 Range: 0.0080-0.0080	----	Mean: 0.00872 Range: ----
21. Pool slope	Mean: 0.00606 Range: 0.00081-0.01136	Mean: 0.00194 Range: 0.00120-0.00200	----	Mean: 0.00221 Range: 0.00175-0.00267
22. Ratio of pool slope to average slope	Mean: 0.96 Range: 0.13-1.80	Mean: 0.24 Range: 0.15-0.25	----	Mean: 0.25 Range: 0.20-0.31
23. Maximum pool depth	Mean: 1.94 Range: 1.40-2.47	Mean: 1.83 Range: 1.83-1.83	----	Mean: 2.87 Range: 2.85-2.89
24. Ratio of pool depth to average bankfull depth	Mean: 2.71 Range: 1.95-3.45	Mean: 2.20 Range: 2.20-2.20	----	Mean: 2.22 Range: 2.21-2.23
25. Pool width	Mean: 11.69 Range: 9.16-14.22	Mean: 12.00 Range: ----	----	Mean: 16.30 Range: 12.60-20.00
26. Ratio of pool width to bankfull width	Mean: 1.03 Range: 0.81-1.25	Mean: 1.0 Range: ----	----	Mean: 1.05 Range: 0.81-1.29
27. Pool to pool spacing	Mean: 61.22 Range: 29.34-78.63	Mean: 53.50 Range: 39.00-62.00	----	Mean: 51.98 Range: 35.73-68.22
28. Ratio of pool to pool spacing to bankfull width	Mean: 5.39 Range: 2.58-6.92	Mean: 4.46 Range: 3.25-5.17	----	Mean: 3.36 Range: 2.31-4.41
29. Ratio of lowest bank height to bankfull height (or max bankfull depth)1	Mean: N/A Range: N/A	Mean: 1.0 Range: ----	----	Mean: 1.06 Range: 1.0-1.15

PROJECT REFERENCE NO.	SHEET NO.
U-2707	MORPH
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

5/28/99

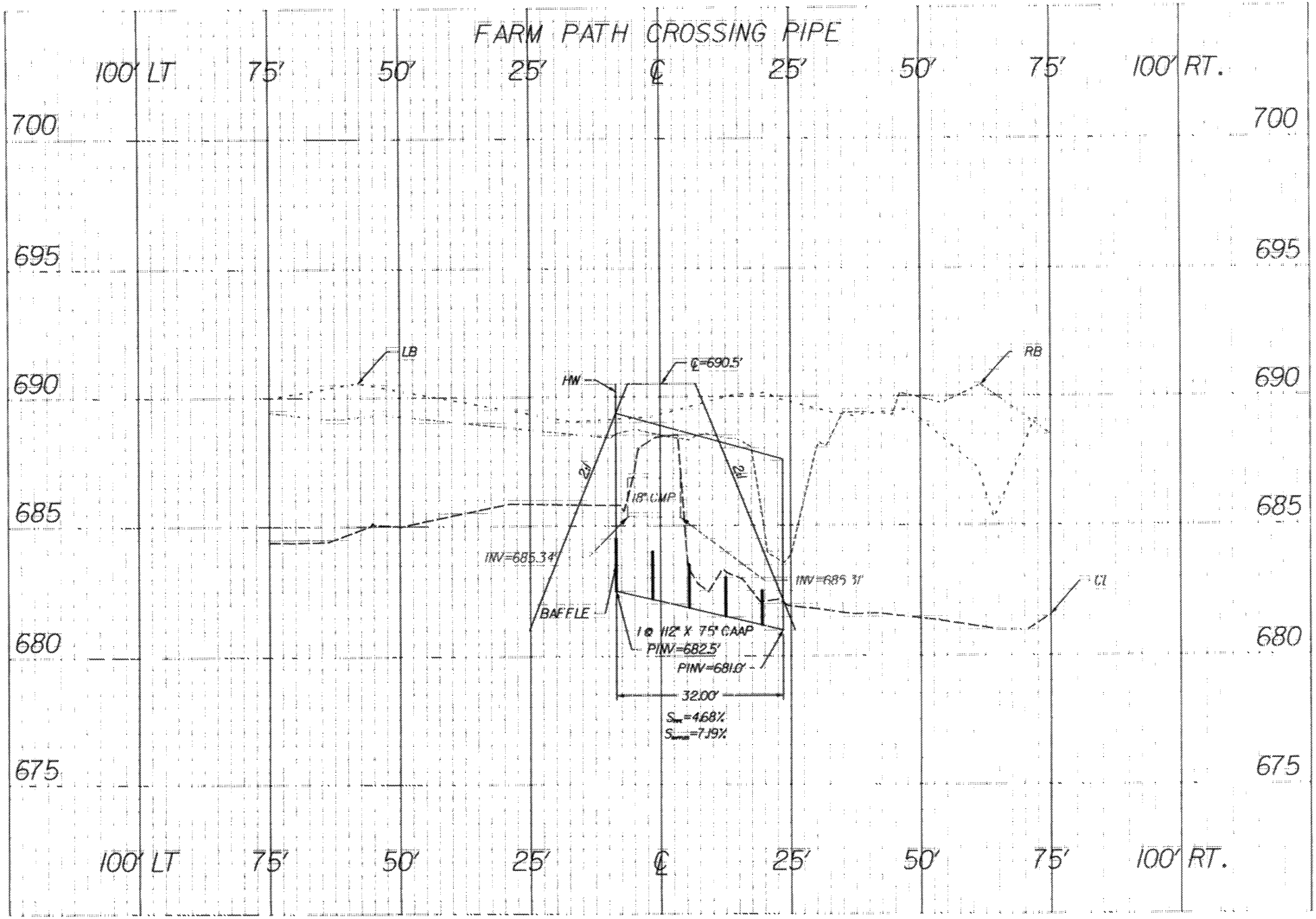
REVISIONS

MORPHOLOGICAL MEASUREMENTS TABLE

UT TO MUDDY CREEK

-R1- Sta. 9+20.00 to Sta. 18+00.00

Variables	Existing Channel	Proposed Reach	USGS Station	Reference Reach
1. Stream type	C/E5	E5	--	C/E 4/
2. Drainage area	0.49 SQ MI (316 ACRES)	0.49 SQ MI (316 ACRES)	----	0.55 SQ MI (355 ACRES)
3. Bankfull width	Mean: 11.36 Range: 8.86-14.80	Mean: 13.96 Range: ----	----	Mean: 15.48 Range: 11.90-17.70
4. Bankfull mean depth	Mean: 0.72 Range: 0.58-0.85	Mean: 1.07 Range: ----	----	Mean: 1.29 Range: 1.23-1.41
5. Width/depth ratio	Mean: 15.56 Range: 13.65-17.48	Mean: 13.00 Range: ----	----	Mean: 12.97 Range: 11.42-14.37
6. Bankfull cross-sectional area	Mean: 10.37 Range: 5.93-14.00	Mean: 15.00 Range: ----	----	Mean: 21.33 Range: 20.00-22.70
7. Bankfull mean velocity	Mean: 5.38 Range: ----	Mean: 3.53 Range: ----	----	Mean: 2.90 Range: ----
8. Bankfull discharge, cfs	Mean: 53 Range: ----	Mean: 53 Range: ----	----	Mean: 58 Range: ----
9. Bankfull max depth	Mean: 1.60 Range: 0.96-2.37	Mean: 1.75 Range: 1.61-1.76	----	Mean: 1.94 Range: 1.60-2.12
10. Width of floodprone area	Mean: 118.67 Range: 48.69-180.00	Mean: >100.00 Range: ----	----	Mean: 171.25 Range: 162.00-186.00
11. Entrenchment ratio	Mean: 11.41 Range: 3.29-17.68	Mean: >2.2 Range: ----	----	Mean: 11.30 Range: 10.06-14.45
12. Meander length	Mean: 50.92 Range: 31.09-73.07	Mean: 97.48 Range: 91.07-120.51	----	Mean: 80.30 Range: 64.32-114.00
13. Ratio of meander length to bankfull width	Mean: 4.48 Range: 2.47-6.43	Mean: 6.96 Range: 6.51-8.61	----	Mean: 5.19 Range: 4.16-7.37
14. Radius of curvature	Mean: 22.22 Range: 10.01-32.89	Mean: 33.88 Range: 28.00-49.00	----	Mean: 18.44 Range: 11.73-25.30
15. Ratio of radius of curvature to bankfull width	Mean: 1.96 Range: 0.88-2.90	Mean: 2.42 Range: 2.0-3.5	----	Mean: 1.19 Range: 0.76-1.63
16. Belt width	Mean: 6.38 Range: 1.28-14.48	Mean: 23.20 Range: 12.00-44.00	----	Mean: 31.92 Range: 12.54-54.25
17. Meander width ratio	Mean: 3.56 Range: 0.11-1.27	Mean: 1.66 Range: 0.86-3.14	----	Mean: 2.06 Range: 0.81-3.51
18. Sinuosity (stream length/valley length)	Mean: 1.06 Range: ----	Mean: 1.13 Range: ----	----	Mean: 1.41 Range: ----
19. Valley slope	Mean: 0.00670 Range: ----	Mean: 0.00498 Range: ----	----	Mean: 0.01230 Range: ----
20. Average slope	Mean: 0.00632 Range: ----	Mean: 0.0044 Range: 0.0044-0.0044	----	Mean: 0.00672 Range: ----
21. Pool slope	Mean: 0.00606 Range: 0.00081-0.01136	Mean: 0.00117 Range: 0.00110-0.00130	----	Mean: 0.00221 Range: 0.00175-0.00267
22. Ratio of pool slope to average slope	Mean: 0.96 Range: 0.13-1.80	Mean: 0.27 Range: 0.25-0.30	----	Mean: 0.25 Range: 0.20-0.31
23. Maximum pool depth	Mean: 1.94 Range: 1.40-2.47	Mean: 2.40 Range: 2.40-2.40	----	Mean: 2.87 Range: 2.85-2.89
24. Ratio of pool depth to average bankfull depth	Mean: 2.71 Range: 1.95-3.45	Mean: 2.40 Range: 2.40-2.40	----	Mean: 2.22 Range: 2.21-2.23
25. Pool width	Mean: 11.59 Range: 9.16-14.22	Mean: 14.00 Range: ----	----	Mean: 16.30 Range: 12.60-20.00
26. Ratio of pool width to bankfull width	Mean: 1.03 Range: 0.81-1.25	Mean: 1.0 Range: ----	----	Mean: 1.05 Range: 0.81-1.29
27. Pool to pool spacing	Mean: 61.22 Range: 29.34-78.63	Mean: 56.20 Range: 50.00-71.00	----	Mean: 51.98 Range: 35.73-68.22
28. Ratio of pool to pool spacing to bankfull width	Mean: 5.39 Range: 2.58-6.92	Mean: 4.01 Range: 3.57-5.07	----	Mean: 3.36 Range: 2.31-4.41
29. Ratio of lowest bank height to bankfull height (or max bankfull depth)1	Mean: N/A Range: N/A	Mean: 1.0 Range: ----	----	Mean: 1.06 Range: 1.0-1.15

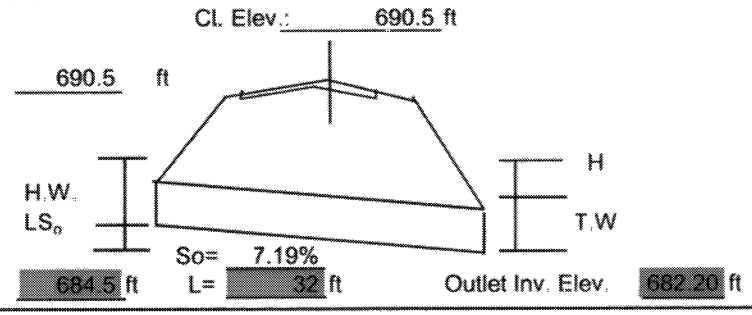

FARM PATH CROSSING PIPE
100' LT
75'
50'
25'
℄
25'
50'
75'
100' RT.
700
695
690
685
680
675
LB
RB
HW
℄=690.5'
2:1
2:1
18" CMP
INV=685.34'
INV=685.31'
CL
BAFFLE
1 @ 112" X 75" CAAP
PINV=682.5'
PINV=681.0'
32.00'
S=4.68%
S=7.19%

PIPE DATA SHEET

Date: 12/1/2011 Sheet 1 of 5

Project Number: 2003177.01 I.D. No. U-2707 County: Forsyth Designed By: EMP Checked By: JKS

Station: N/A
Skew: 90°
Size/Type Pipe: 1 @ 112x75 CAAP
Type Entrance: headwall
Direction of Flow: L-R
Hydrological Method: USGS
H.W. Control Elevation: 689.5



Plan Summary Data

Drainage Area:	1.13 sq. mi.
Design Freq.:	2 YR
Design Disch.:	172 cfs
Design H.W. Elev.:	688 98
Bankfull Disch.:	N/A
Bankfull H.W. Elev.:	N/A
Overtopping Freq.:	N/A
Overtopping Disch.:	N/A
Overtopping Elev.:	N/A

PIPE CULVERT ANALYSIS (English)

rcp=.012, cmp=.024
n= 0.024

Channel Specs. Slope: 0.01 Lt. Side Slope 2
Base= 8.5 n= 0.03 Rt. Side Slope 2

Size & Type			TW**	Q	Nat.	Allow.	Inlet Control		Outlet Control							HW	V_o	Remarks
SIZE	# Pipes	FREQ	ft	ft^3/s	H.W.	H.W.	HW/D	HW (ft)	Ke	d_c	$(d_c+D)/2$	h_o	H	$L*S_O$	HW	ELEV.		
67.25	1	5 YR	2.9	319		5.00	1.5	8.41	0.2	5.25	5.43	5.43	4.025	2.30	7.15	692.91		INLET CONTROL
67.25	1	2 YR	2.1	172		5.00	0.8	4.48	0.2	3.65	4.63	4.63	1.170	2.30	3.50	688.98		INLET CONTROL

**Pipe will be buried 2.5 feet at inlet and 1.2 feet at outlet, minimum 1 foot buried for fish passage
**Hydraulics takes into acount pipe is 112x75 CAAP with baffles reducing pipe size to an equivalent 87x63 CAAP
**Inlet Invert Elevation based on invert of first baffle, outlet invert elevation based on 1.2 foot buried
**HW Control Elevation equals 1 foot below shoulder
**Discharges based on USGS Rural Regression Equation with a drainage area of 1.13 sq mi

U-2707 FARM PATH
12/1/11

This spreadsheet computes the 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent chance exceedance flows for an ungaged site in Georgia, South Carolina, and North Carolina. The spreasheet also includes the 95-percent prediction intervals, the minus and plus standard error of prediction intervals, and the average standard error of prediction. To use the spreadsheet, enter requested information in the yellow cells below.

Enter a site-description name: Test site anywhere in GA, SC, or NC

Enter the explanatory variables:

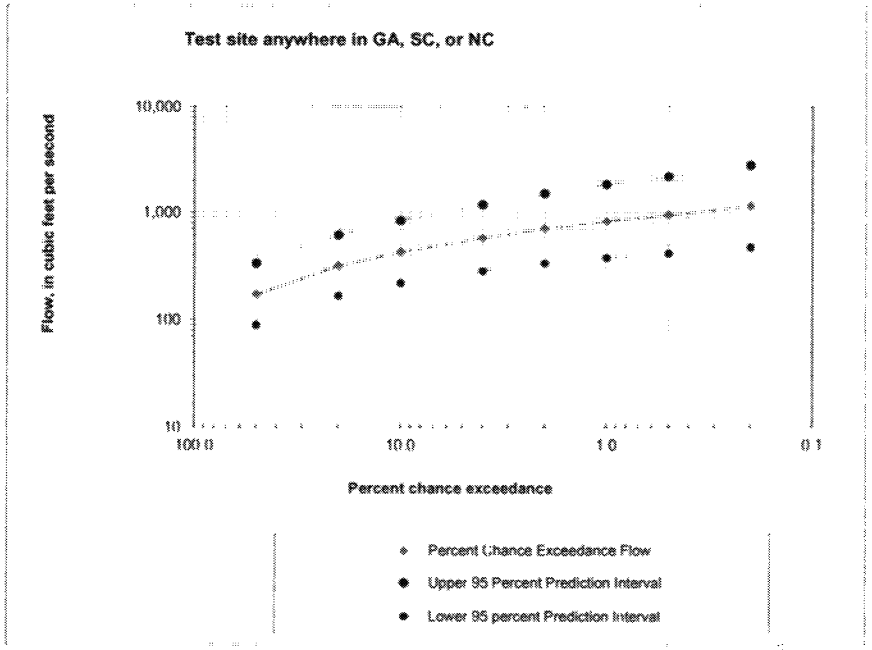
Drainage area, in square miles	1.13
Percent of basin in Hydrologic Region 1	100
Percent of basin in Hydrologic Region 2	0
Percent of basin in Hydrologic Region 3	0
Percent of basin in Hydrologic Region 4	0
Percent of basin in Hydrologic Region 5	0

Applicable range of draingage area is 1 to 9,000 square miles
Hydrologic Region 1 corresponds to the USEPA Level III Ridge and Valley and Piedmont ecoregions
Hydrologic Region 2 corresponds to the USEPA Level III Blue Ridge ecoregion
Hydrologic Region 3 corresponds to the USEPA Level IV Sand Hills ecoregion
Hydrologic Region 4 corresponds to the USEPA Level III Southeastern, Middle Atlantic Coastal, and Southern Coastal Plain ecoregions
Hydrologic Region 5 corresponds to the lower portion of the USEPA Level IV Tifton Uplands ecoregion

Sum of region percentages	100

Drainage area check
DRAINAGE AREA WITHIN APPLICABLE LIMITS

Percent chance exceedance	Percent chance exceedance flow, in ft^3/s	Lower 95 percent prediction interval flow, in ft^3/s	Upper 95 percent prediction interval flow, in ft^3/s	$-S_{p,i}$ (percent)	$+S_{p,i}$ (percent)	Average $S_{p,i}$ (percent)
50	172	88	333	-28.6	40.0	34.6
20	319	166	612	-28.3	39.4	34.2
10	429	219	839	-29.0	40.8	35.3
4	578	283	1,180	-30.5	43.9	37.6
2	711	335	1,510	-31.8	46.7	39.8
1	835	376	1,840	-33.2	49.8	42.1
0.5	968	416	2,250	-34.6	53.0	44.5
0.2	1,150	472	2,800	-36.5	57.6	47.9



U-2707 FARM PATH
12/1/11

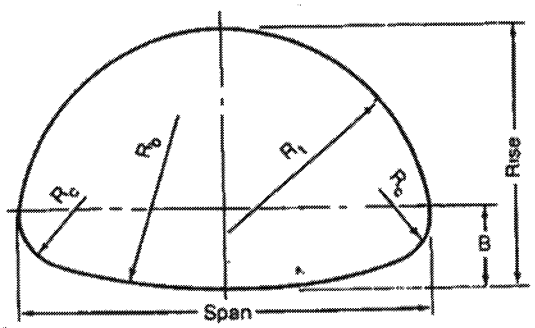


***Table 2.18 Sizes and Layout Details—CSP Pipe Arch. 2 ⅔ x ½ in. Corrugation**

Equiv. Diameter, in.	Span, in.	Rise, in.	Waterway Area, ft²	Layout Dimensions			
				B in.	R_c in.	R_t in.	R_b in.
15	17	13	1.1	4⅛	3½	8⅛	25⅝
18	21	15	1.6	4⅞	4⅛	10¾	33⅛
21	24	18	2.2	5⅝	4⅞	11⅞	34⅝
24	28	20	2.9	6½	5½	14	42¼
30	35	24	4.5	8⅛	6⅞	17⅞	55⅛
36	42	29	6.5	9¾	8¼	21½	66⅛
42	49	33	8.9	11⅜	9⅝	25⅛	77¼
48	57	38	11.6	13	11	28⅝	88¼
54	64	43	14.7	14⅝	12⅜	32¼	99¼
60	71	47	18.1	16¼	13¾	35¾	110¾
66	77	52	21.9	17⅞	15⅛	39⅝	121¼
72	83	57	26.0	19½	16½	43	132¼

***Table 2.19 Sizes and Layout Details—CSP Pipe-Arch 3 x 1 or 5 x 1 in. Corrugation**

Equiv. Diameter, in.	Nominal Size, in.	Design		Waterway Area, ft²	Layout Dimensions			
		Span, in.	Rise, in.		B in.	R_c in.	R_t in.	R_b in.
48	53 x 41	53	41	11.7	15¼	10¹⁵⁄₁₆	28¹⁄₁₆	73¹⁄₁₆
54	60 x 46	58½	46½	15.6	20½	18¾	29⅝	51⅛
60	66 x 51	65	54	19.3	22¾	20¾	32⅝	56¼
66	73 x 55	72½	58¼	23.2	25⅛	22⅞	36¾	63¾
72	81 x 59	79	62½	27.4	23¾	20⅞	39½	82⅝
78	87 x 63	86½	67¼	32.1	25¼	22⅝	43⅝	92⅛
84	95 x 67	93½	71¾	37.0	27¾	24⅝	47	100¼
90	103 x 71	101⅛	76	42.4	29¾	26¼	51¼	111⅝
96	112 x 75	108½	80½	48.0	31⅝	27¾	54⅞	120¼
102	117 x 79	116½	84¾	54.2	33⅝	29½	59⅛	131¼
108	128 x 83	123½	89¼	60.5	35⅝	31¼	63¼	139¾
114	137 x 87	131	93¾	67.4	37⅝	33	67⅝	148½
120	142 x 91	136½	98	74.5	39½	34¾	71⅝	162⅝
126	150 x 96	146	102	81	41	36	76	172
132	157 x 101	153	107	89	43	38	80	180
138	164 x 105	159	113	98	45	40	82	184
144	171 x 110	165	118½	107	47	41	85	190

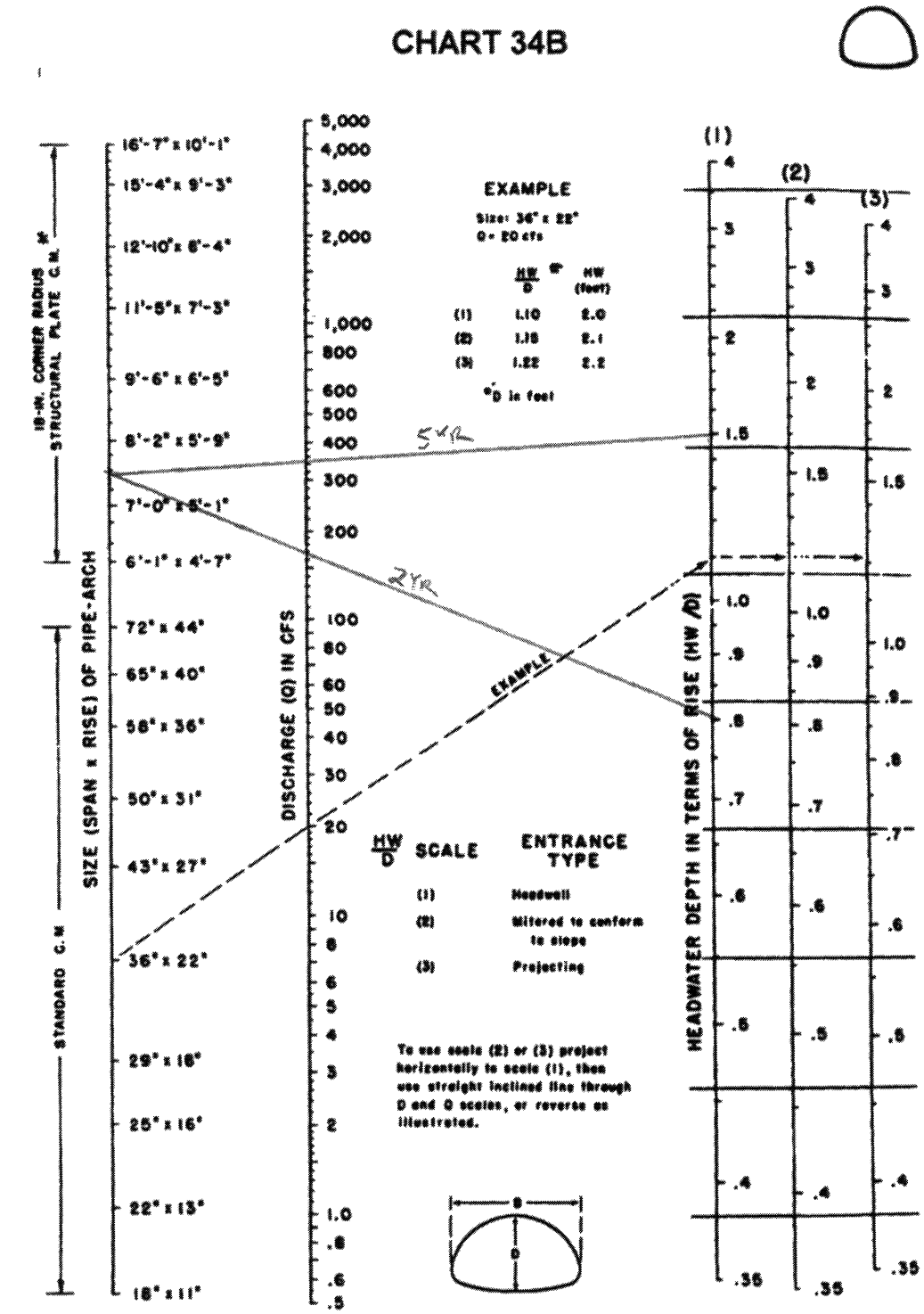
*Dimensions shown not for specification purposes, subject to manufacturing tolerances.

EQUIVALENT SIZE WITH BAFFLES IN PIPE

PIPE SIZE IN STREAM CHANNEL

U-2707 FARM PATH
12/1/11

CHART 34B



*ADDITIONAL SIZES NOT DIMENSIONED ARE LISTED IN FABRICATOR'S CATALOG

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR C. M. PIPE-ARCH CULVERTS WITH INLET CONTROL

PROJECT REFERENCE NO.	SHEET NO.
3-2707	TYP
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

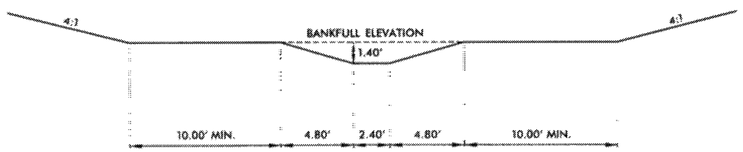
INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

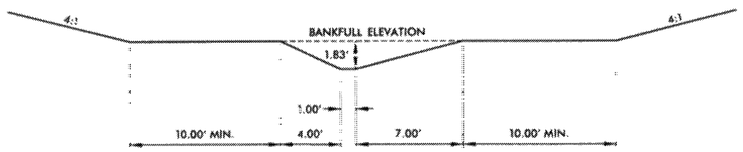
REVISIONS 5/28/99

R1
Sta. 0+00.00 to 9+20.00

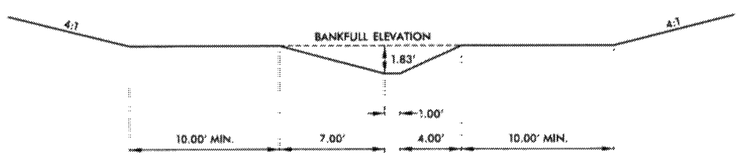
TYPICAL SECTION RIFFLE
BANKFULL AREA 10.0 SQ FT



TYPICAL SECTION POOL LEFT
BANKFULL AREA 11.9 SQ FT

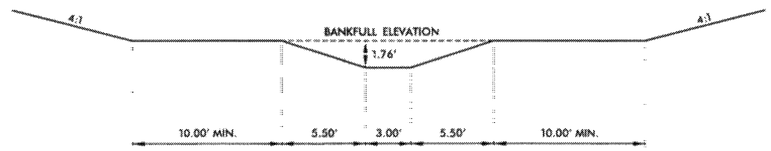


TYPICAL SECTION POOL RIGHT
BANKFULL AREA 11.9 SQ FT

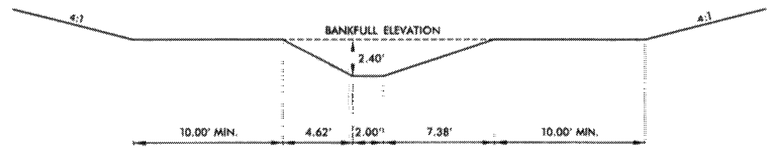


R1
Sta. 9+20.00 to 18+00.00

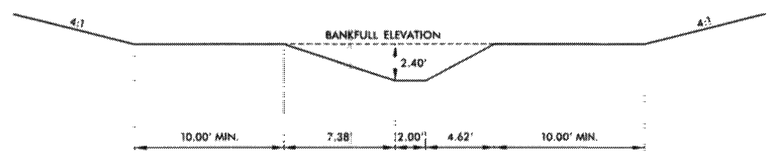
TYPICAL SECTION RIFFLE
BANKFULL AREA 15.0 SQ FT



TYPICAL SECTION POOL LEFT
BANKFULL AREA 19.2 SQ FT



TYPICAL SECTION POOL RIGHT
BANKFULL AREA 19.2 SQ FT



PROJECT REFERENCE NO.	SHEET NO.
U-2707	DET 4
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

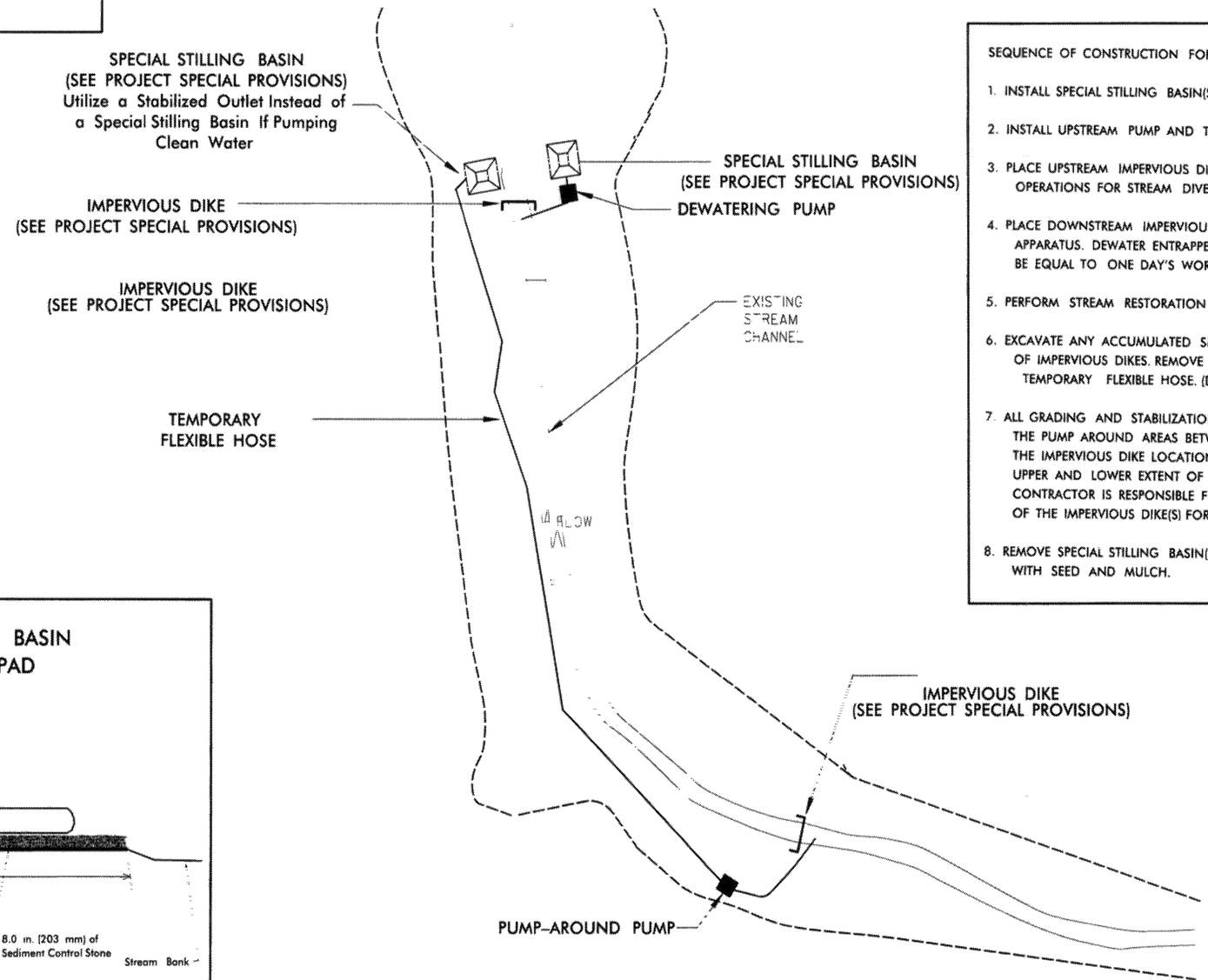
INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

5/28/99

REVISIONS

NOTES:
1) All excavation shall be performed in only dry or isolated sections of channel.
2) Impervious dikes are to be used to isolate work from stream flow when necessary.
3) All graded areas shall be stabilized within 24 hours.
4) Maintenance of stream flow operations shall be incidental to the work. This includes polyethylene sheeting, diversion pipes, pumps and hoses.
5) Pumps and hoses shall be of sufficicient size to dewater the work area.

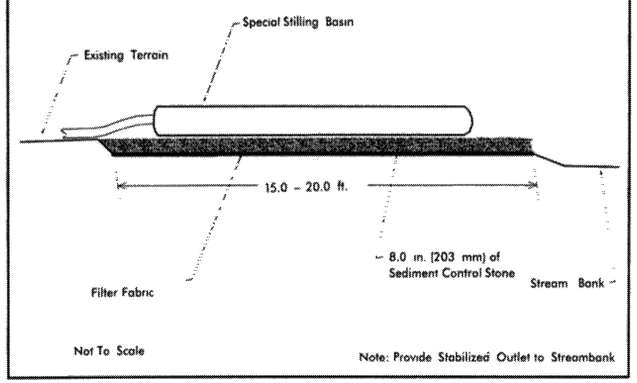
EXAMPLE OF PUMP-AROUND OPERATION



SEQUENCE OF CONSTRUCTION FOR TYPICAL WORK AREA

1. INSTALL SPECIAL STILLING BASIN(S)..
2. INSTALL UPSTREAM PUMP AND TEMPORARY FLEXIBLE HOSE.
3. PLACE UPSTREAM IMPERVIOUS DIKE AND BEGIN PUMPING OPERATIONS FOR STREAM DIVERSION.
4. PLACE DOWNSTREAM IMPERVIOUS DIKE AND PUMPING APPARATUS. DEWATER ENTRAPPED AREA. AREA TO BE DEWATERED SHALL BE EQUAL TO ONE DAY'S WORK.
5. PERFORM STREAM RESTORATION WORK IN ACCORDANCE WITH THE PLANS.
6. EXCAVATE ANY ACCUMULATED SILT AND DEWATER BEFORE REMOVAL OF IMPERVIOUS DIKES. REMOVE IMPERVIOUS DIKES, PUMPS, AND TEMPORARY FLEXIBLE HOSE. (DOWNSTREAM IMPERVIOUS DIKES FIRST).
7. ALL GRADING AND STABILIZATION MUST BE COMPLETED IN ONE DAY WITHIN THE PUMP AROUND AREAS BETWEEN THE IMPERVIOUS DIKES. THE IMPERVIOUS DIKE LOCATIONS AS SHOWN ON THIS SHEET ONLY SHOW THE UPPER AND LOWER EXTENT OF WORK FOR EACH STREAM SEGMENT. THE CONTRACTOR IS RESPONSIBLE FOR DETERMINING THE LOCATION OF THE IMPERVIOUS DIKE(S) FOR EACH DAY'S WORK.
8. REMOVE SPECIAL STILLING BASIN(S) AND BACKFILL. STABILIZE DISTURBED AREA WITH SEED AND MULCH.

SPECIAL STILLING BASIN WITH ROCK PAD



12/1/2011
H:\Eng\Environmental\Design\U2707 mst det dgn
mstaley

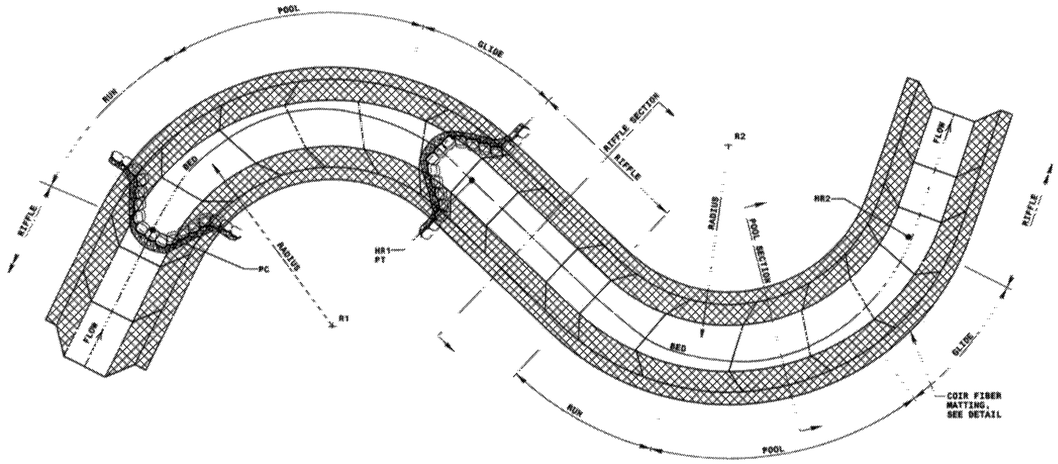
PROJECT REFERENCE NO.	SHEET NO.
3-2707	25 OF 25
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

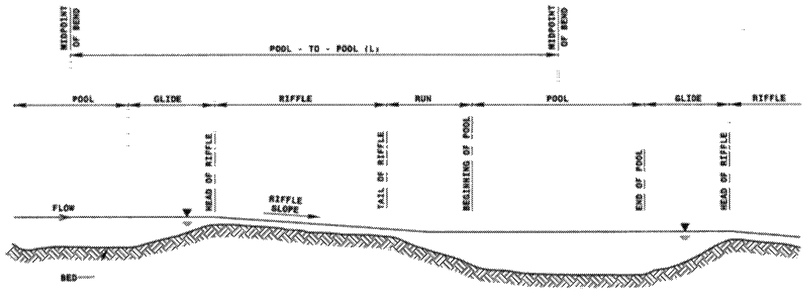
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS

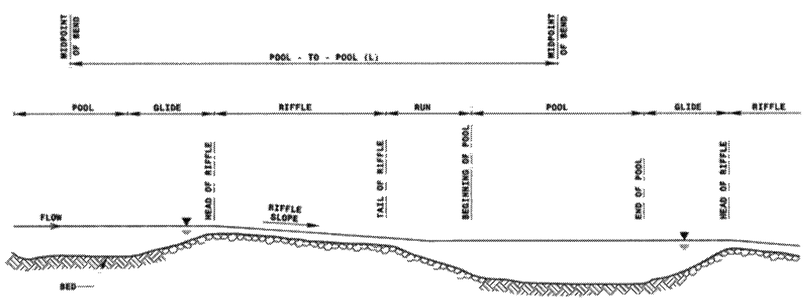
5/28/99



TYPICAL PLAN

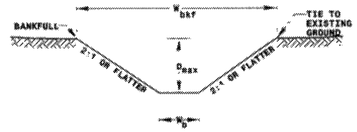


TYPICAL PROFILE

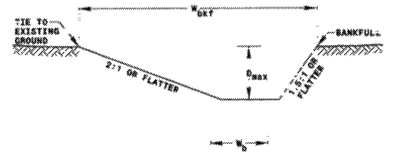


TYPICAL PROFILE FOR ARMORED RIFFLE SECTION

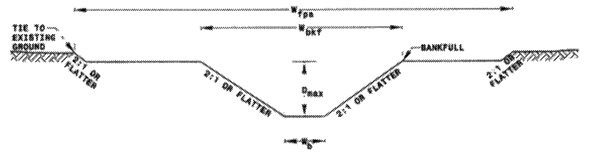
CHANNEL TYPICAL DETAIL
NOT TO SCALE



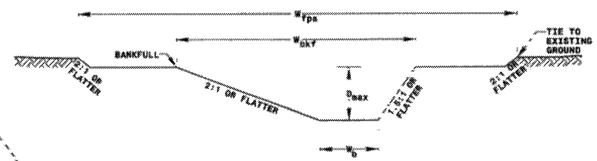
TYPICAL RIFFLE



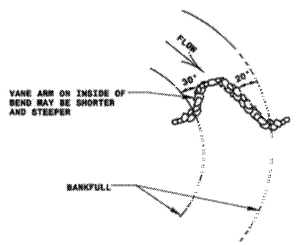
TYPICAL POOL



TYPICAL RIFFLE WITH BANKFULL BENCH



TYPICAL POOL WITH BANKFULL BENCH



CROSS VANE CONSTRUCTION IN MEANDER-BEND PLAN VIEW

W_{bkf} = BANKFULL WIDTH
D_{max} = MAXIMUM DEPTH
W_b = BOTTOM WIDTH
W_{fpa} = FLOOD PRONE AREA WIDTH

CROSS-SECTION DIMENSIONS

	RIFFLE				POOL				
REACH R1	W_{bkf}	D_{max}	W_b	W_{fpa}	W_{bkf}	D_{max}	W_b	W_{fpa}	Width/Depth Ratio
Sta. 0+00 - Sta. 9+20	12.0	1.40	2.40	>35	12.0	1.83	1.00	>35	14.4
Sta. 9+20 - Sta. 18+00	14.0	1.76	3.00	>35	14.0	2.40	2.00	>35	13.0

	RIFFLE				POOL				
REACH R2	W_{bkf}	D_{max}	W_b	W_{fpa}	W_{bkf}	D_{max}	W_b	W_{fpa}	Width/Depth Ratio
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
1. THE COORDINATES FOR EACH CENTER OF RADIUS (EX. "R1","R2"); AND EACH HEAD OF RIFFLE (EX. "HR1", "HR2") ARE INDICATED ON THE PLAN SHEETS.

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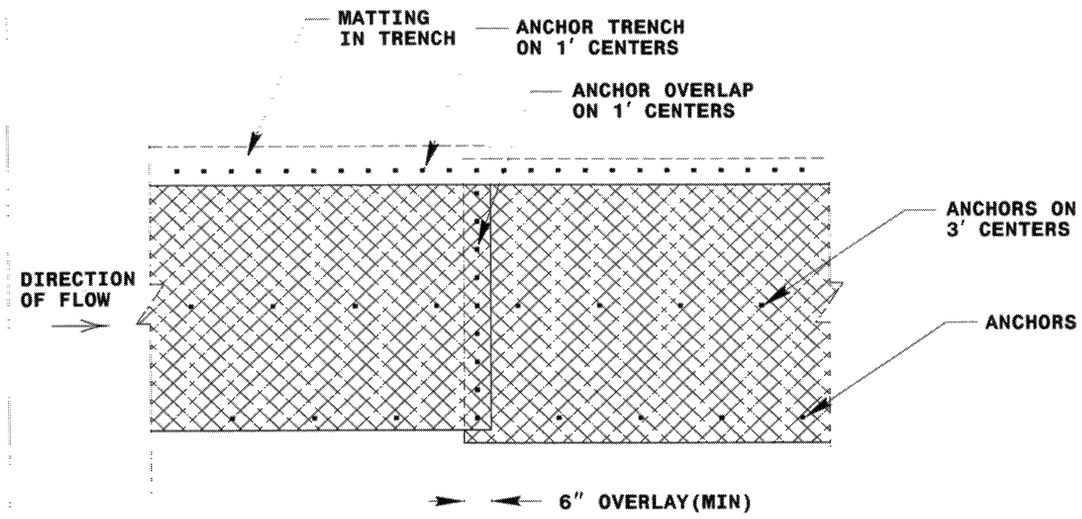
PROJECT REFERENCE NO.	SHEET NO.
3-270	25 OF 3
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

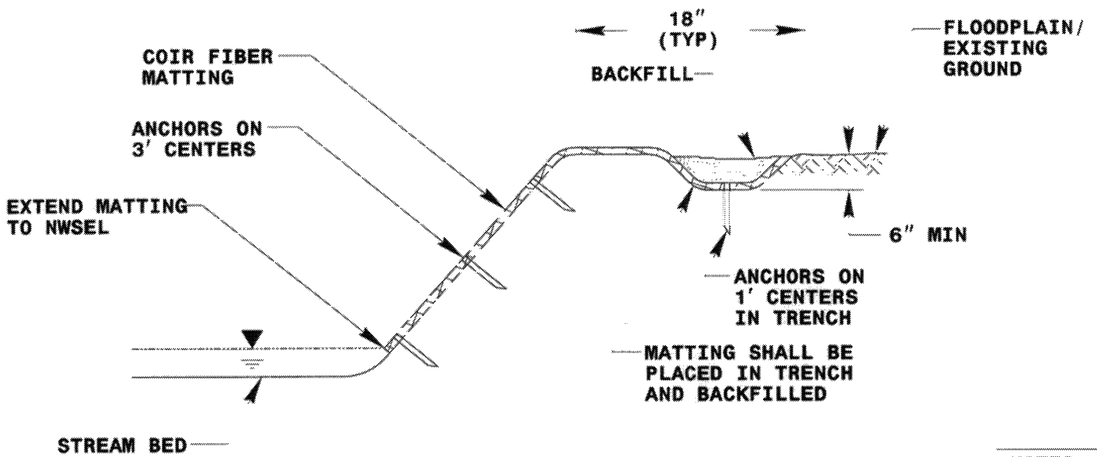
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS

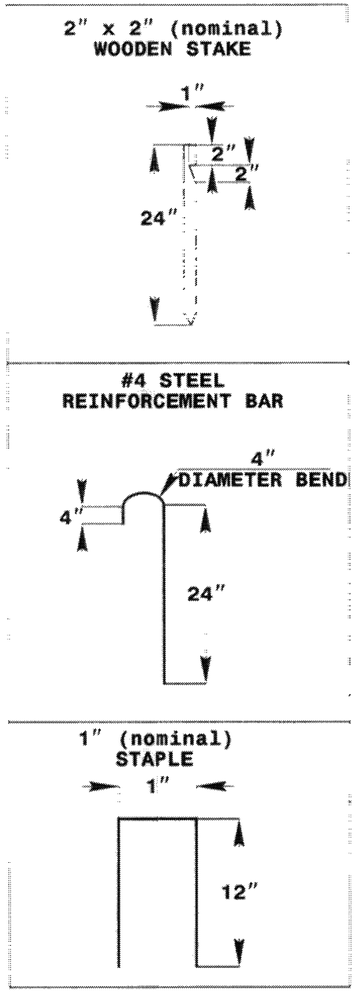
5/28/99



PLAN VIEW



TYPICAL CROSS SECTION



ANCHOR OPTIONS

NOTES:
1. IN AREAS TO BE MATTED, ALL SEEDING, SOIL AMENDMENTS, AND SOIL PREPARATION MUST BE COMPLETED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS PRIOR TO PLACEMENT OF COIR FIBER MATTING.
2. REBAR OR STAPLES MAY BE USED IN PLACE OF WOODEN STAKES AS DIRECTED BY THE ENGINEER.

COIR FIBER MATTING DETAIL

NOT TO SCALE

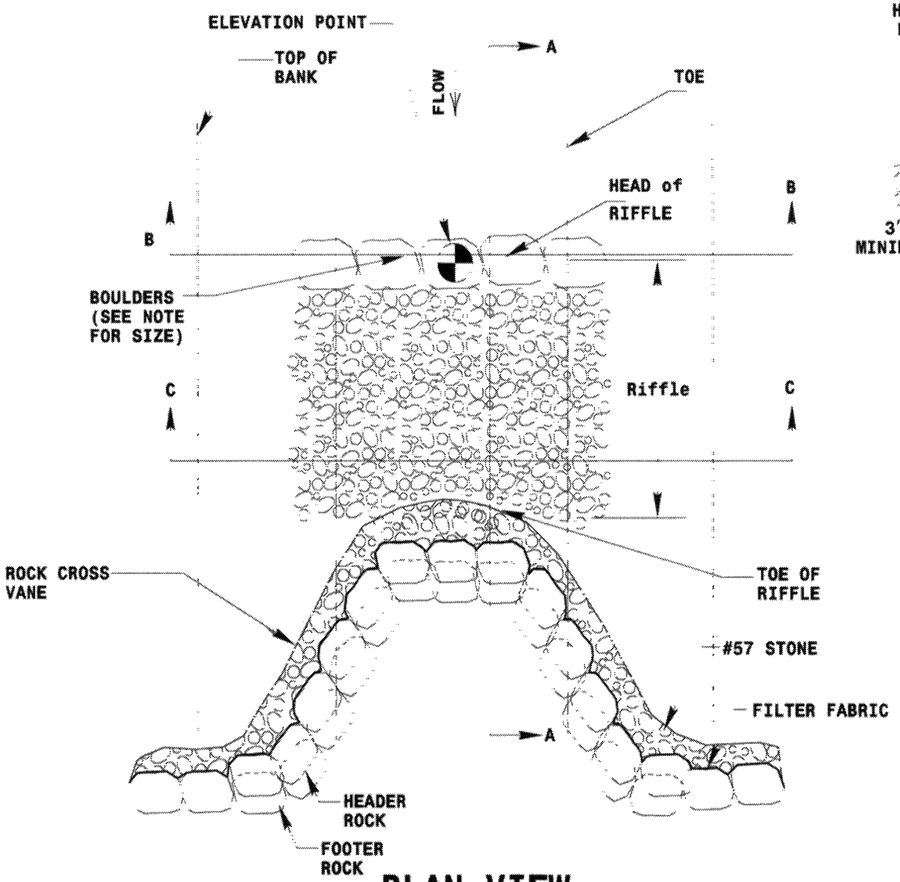
PROJECT REFERENCE NO.	SHEET NO.
U-2707	2E 5
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

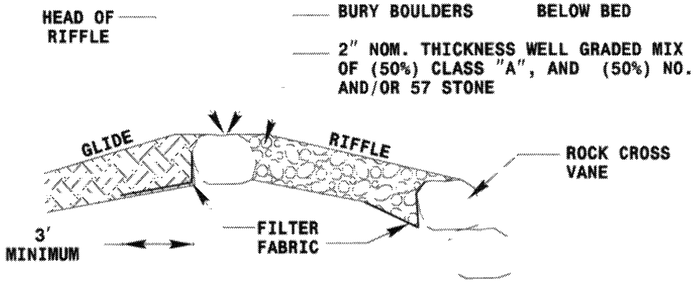
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

5/28/99

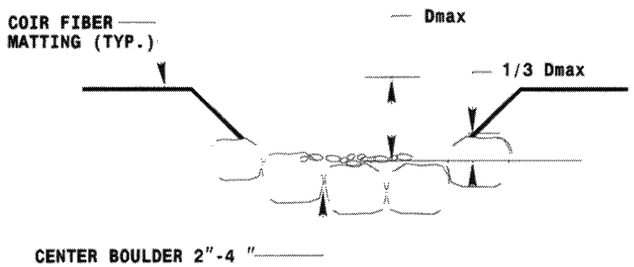
REVISIONS



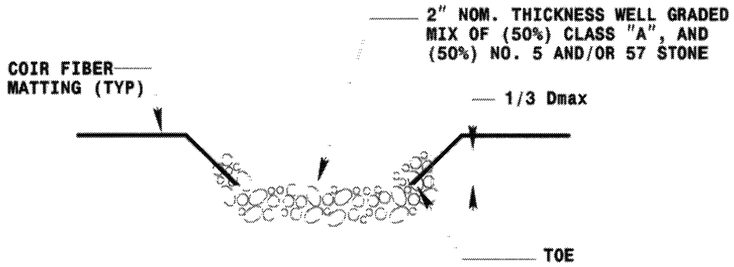
PLAN VIEW



SECTION A-A



SECTION B-B



SECTION C-C

REACH	R1
Wbkf (ft)	12.0
Dmax (ft)	1.40

REACH	R2
Wbkf (ft)	14.0
Dmax (ft)	1.76

NOTE:
1. BOULDERS SHOULD BE NATIVE STONES OR SHOT ROCK, ANGULAR AND OBLONG, WITH AN AXIS APPROXIMATELY
   Lx Wx D

CONSTRUCTED RIFFLE DETAIL

NOT TO SCALE

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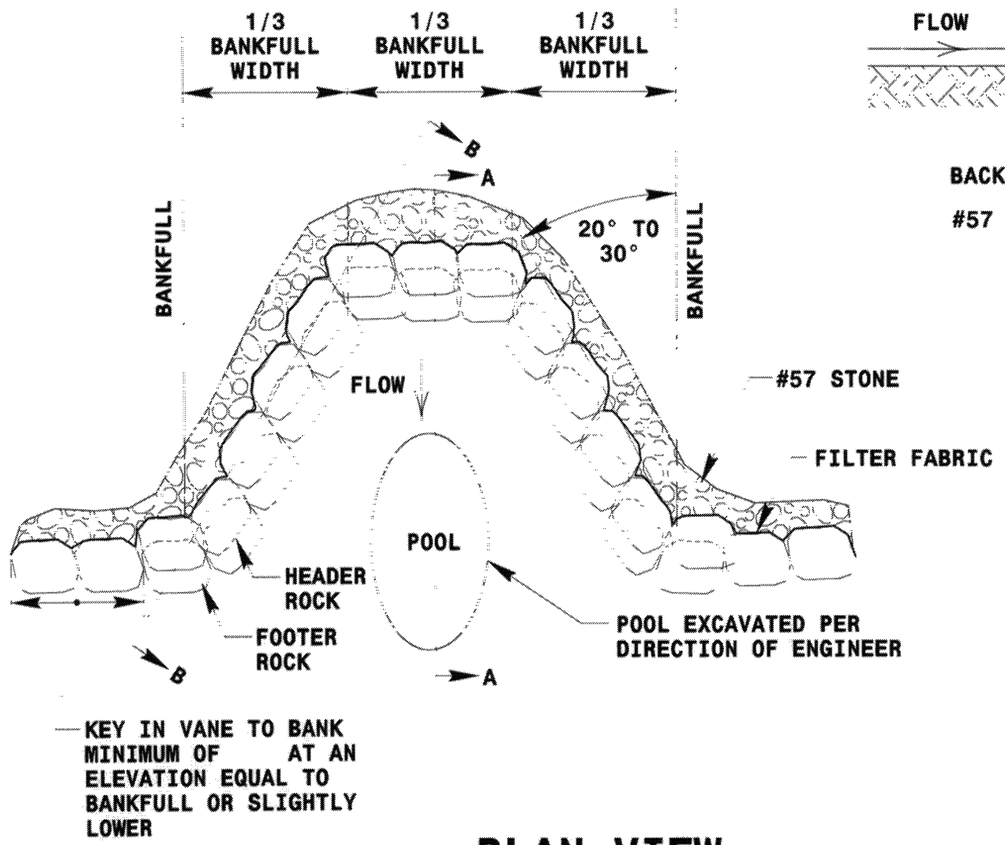
PROJECT REFERENCE NO.	SHEET NO.
U-2707	5E 5
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

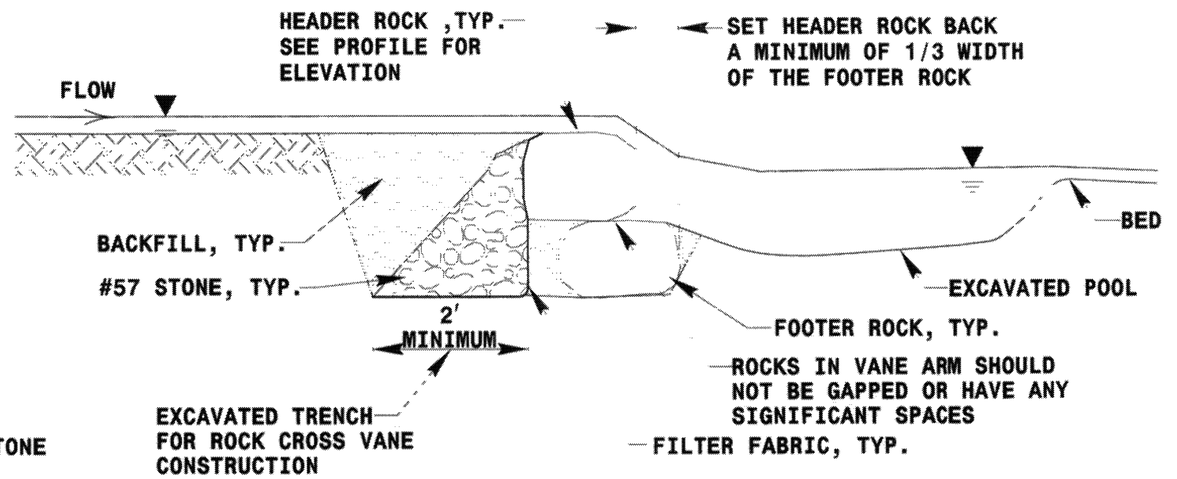
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

5/28/99

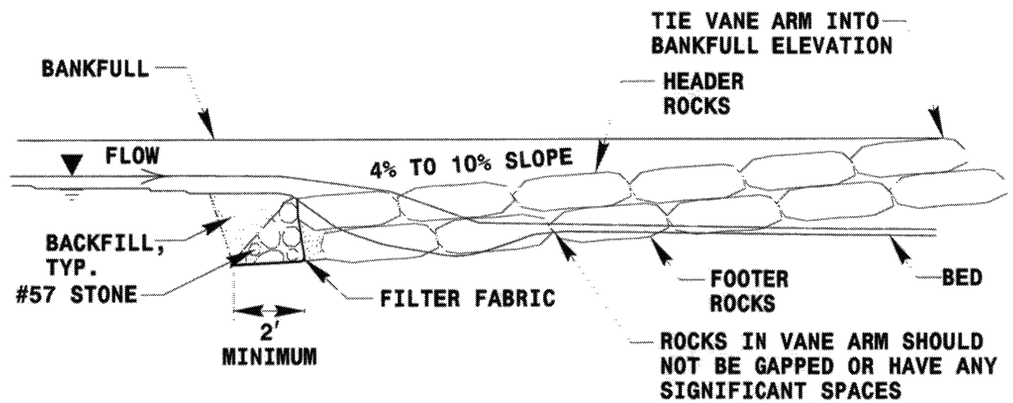
REVISIONS



PLAN VIEW



SECTION A-A



SECTION B-B

BOULDER DIMENSIONS (FT)			
REACH	HEIGHT	LENGTH	WIDTH
R1	3	5	4
R2	3	5	4

NOTES:
1. DEEPEST PART OF POOL TO BE IN LINE WITH WHERE VANE ARM TIES INTO BANKFULL.
2. DO NOT EXCAVATE POOL TOO CLOSE TO FOOTER BOULDERS.
3. CLASS "A" STONE CAN BE USED TO REDUCE VOIDS BETWEEN HEADERS AND FOOTERS.
4. COMPACT BACKFILL TO EXTENT POSSIBLE OR AT THE DIRECTION OF THE ENGINEER.
5. POOL DEPTH SHOULD BE 2 TO 3 TIMES BANKFULL DEPTH.

ROCK CROSS VANE DETAIL

NOT TO SCALE

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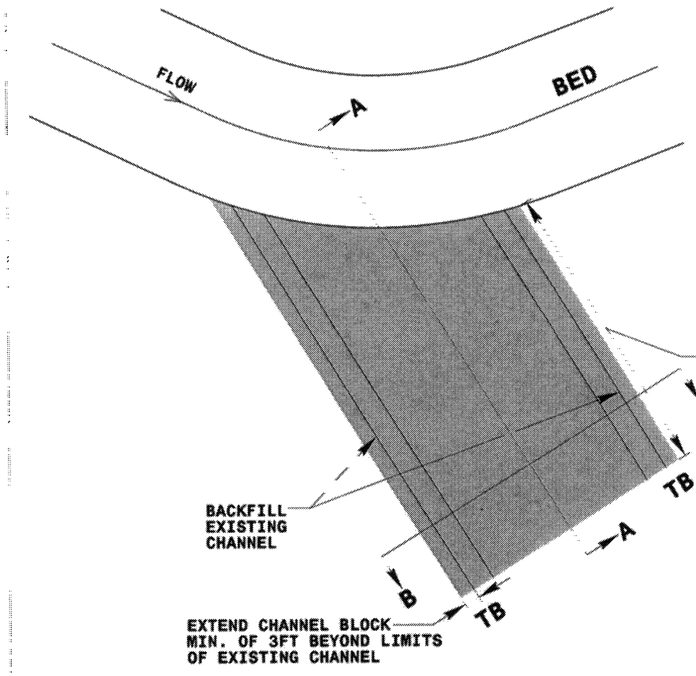
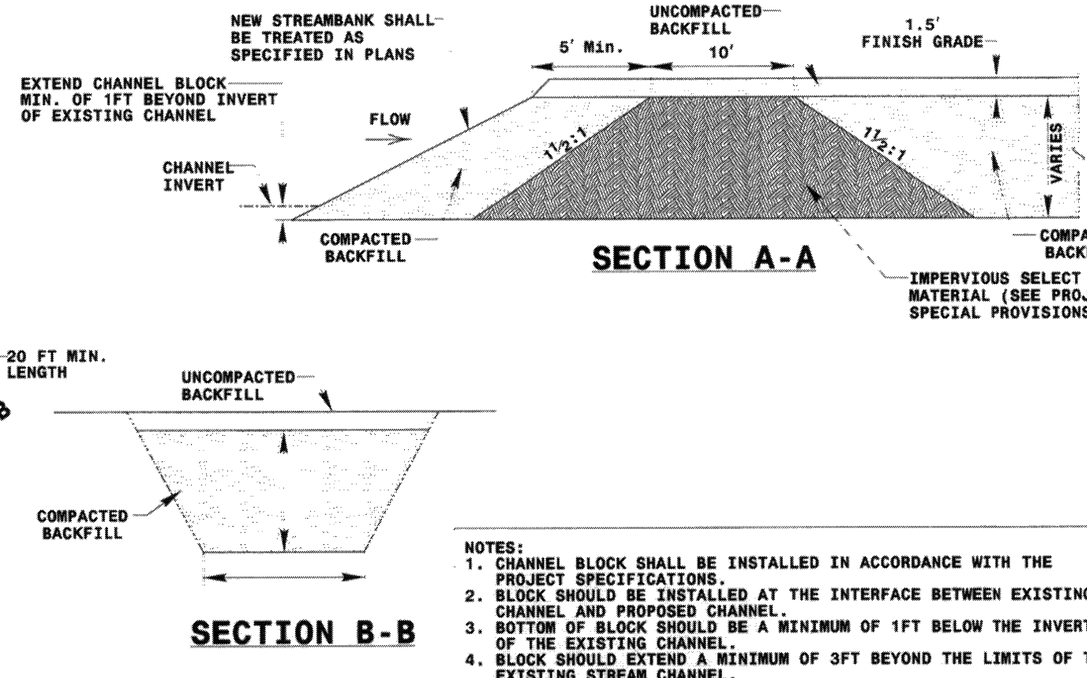
PROJECT REFERENCE NO.	SHEET NO.
1-2707	3E-2
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS 5/28/99



PLAN VIEW



SECTION A-A

SECTION B-B

STREAM PLUG

NOT TO SCALE

NOTES:
1. CHANNEL BLOCK SHALL BE INSTALLED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS.
2. BLOCK SHOULD BE INSTALLED AT THE INTERFACE BETWEEN EXISTING CHANNEL AND PROPOSED CHANNEL.
3. BOTTOM OF BLOCK SHOULD BE A MINIMUM OF 1FT BELOW THE INVERT OF THE EXISTING CHANNEL.
4. BLOCK SHOULD EXTEND A MINIMUM OF 3FT BEYOND THE LIMITS OF THE EXISTING STREAM CHANNEL.
5. INSTALL EROSION CONTROL MATTING AND SEED IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS IMMEDIATELY AFTER GRADING.
6. COMPACT BACKFILL TO EXTENT POSSIBLE OR AT THE DIRECTION OF THE ENGINEER.

PROJECT REFERENCE NO.	SHEET NO.
U-2707	35 OF 5
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

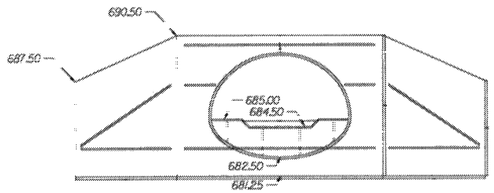
INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

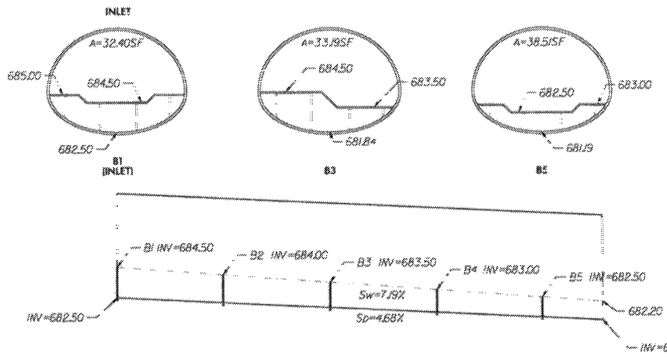
REVISIONS

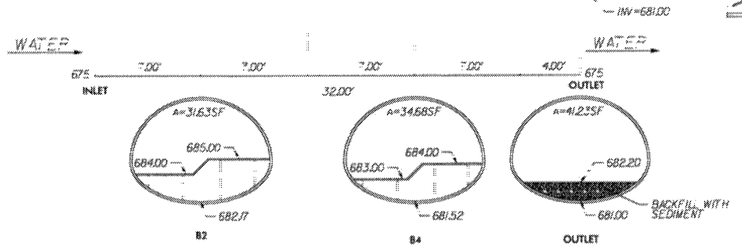
5/28/99

PIPE WITH BAFFLES
FARM PATH CROSSING
U-2707 CLEMMONS, NC

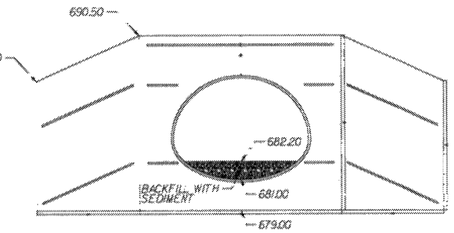


INLET WITH HEADWALL

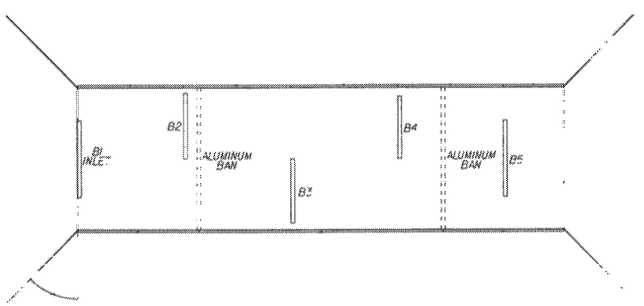




PROFILE WITH CROSS SECTIONS AT BAFFELS



OUTLET WITH HEADWALL



PLAN VIEW

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PROJECT REFERENCE NO.	SHEET NO.
I-237	2E
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

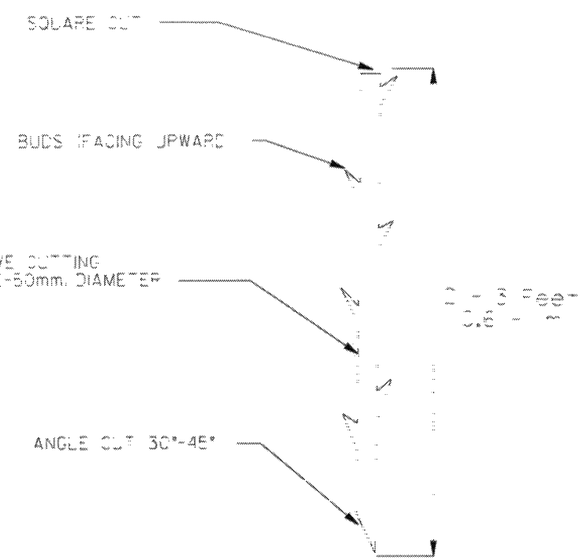
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

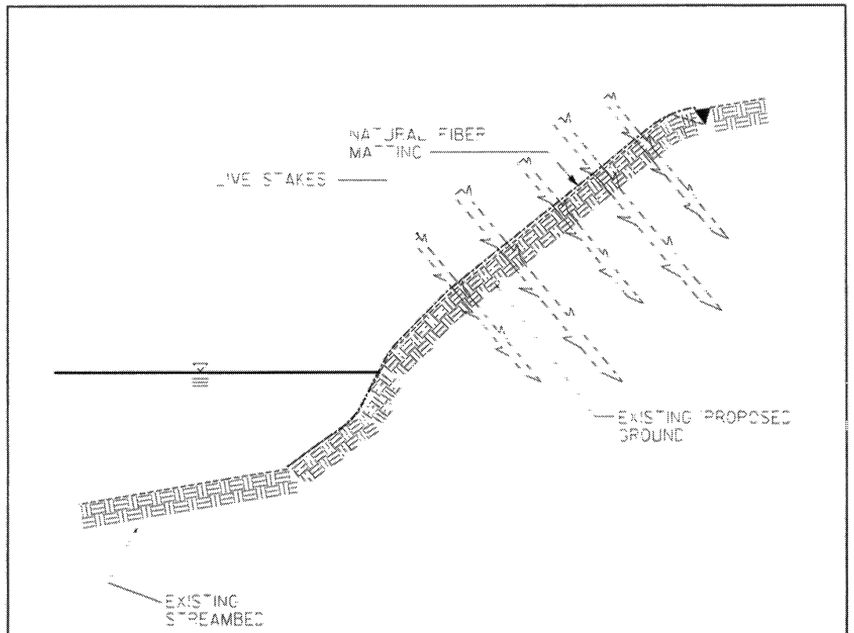
5/28/99

REVISIONS

LIVE STAKE DETAIL

LIVE STAKE





BANK STABILIZATION WITH LIVE STAKES

NOTE:
1. LIVE STAKES SHALL BE EVENLY SPACED 2' APART.
2. LIVE STAKES SHALL BE DRIVEN UNTIL APPROXIMATELY ¾ OF LIVE STAKE IS WITHIN GROUND

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PROJECT REFERENCE NO.	SHEET NO.
U-2707	2E
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

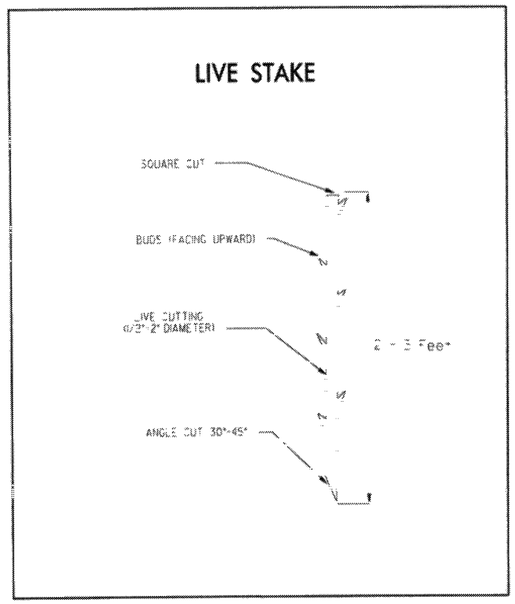
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

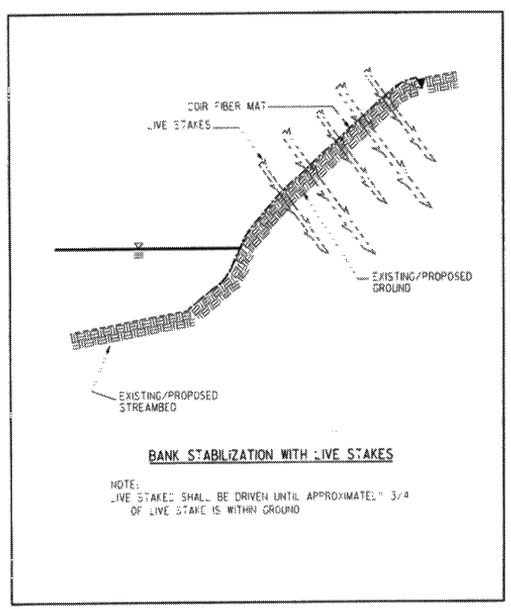
5/28/99

REVISIONS

PLANTING DETAILS

LIVE STAKES PLANTING DETAIL

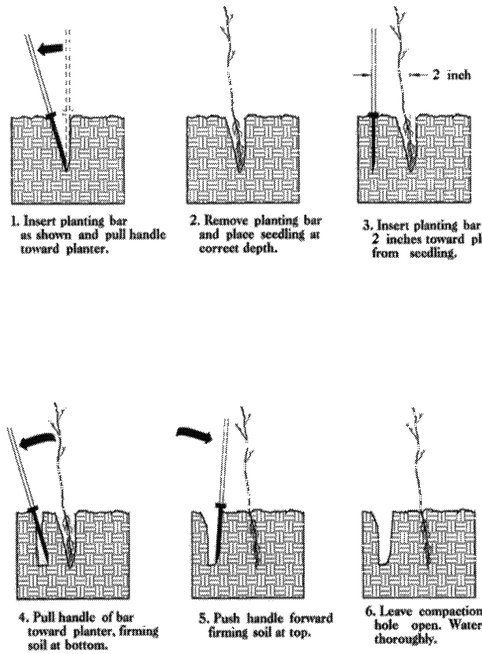




BANK STABILIZATION WITH LIVE STAKES

NOTE:
LIVE STAKES SHALL BE DRIVEN UNTIL APPROXIMATELY 3/4 OF LIVE STAKE IS WITHIN GROUND

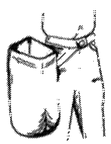
BAREROOT PLANTING DETAIL
DIBBLE PLANTING METHOD
USING THE KBC PLANTING BAR



1. Insert planting bar as shown and pull handle toward planter.
2. Remove planting bar and place seedling at correct depth.
3. Insert planting bar 2 inches toward planter from seedling.
4. Pull handle of bar toward planter, firming soil at bottom.
5. Push handle forward firming soil at top.
6. Leave compaction hole open. Water thoroughly.

PLANTING NOTES:

PLANTING BAG
During planting, seedlings shall be kept in a moist canvas bag or similar container to prevent the root systems from drying.

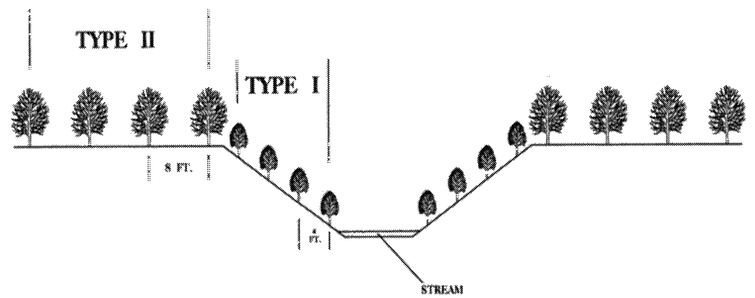


KBC PLANTING BAR
Planting bar shall have a blade with a triangular cross section, and shall be 12 inches long, 4 inches wide and 1 inch thick at center.

ROOT PRUNING
All seedlings shall be root pruned, if necessary, so that no roots extend more than 10 inches below the root collar.

- TYPE 1 STREAMBANK REFORESTATION SHALL BE PLANTED 3 FT. TO 5 FT. ON CENTER, RANDOM SPACING, AVERAGING 4 FT. ON CENTER, APPROXIMATELY 2724 PLANTS PER ACRE.
- TYPE 2 STREAMBANK REFORESTATION SHALL BE PLANTED 6 FT. TO 10 FT. ON CENTER, RANDOM SPACING, AVERAGING 8 FT. ON CENTER, APPROXIMATELY 680 PLANTS PER ACRE.
- NOTE: TYPE 1 AND TYPE 2 STREAMBANK REFORESTATION SHALL BE PAID FOR AS "STREAMBANK REFORESTATION"

STREAMBANK REFORESTATION TYPICAL



STREAMBANK REFORESTATION

MIXTURE, TYPE, SIZE, AND FURNISH SHALL CONFORM TO THE FOLLOWING:

TYPE 1			
50%	SALIX NIGRA	BLACK WILLOW	2 ft – 3 ft LIVE STAKES
50%	CORNUS AMOMUM	SILKY DOGWOOD	2 ft – 3 ft LIVE STAKES
TYPE 2			
25%	FRAXINUS PENNSYLVANICA	GREEN ASH	12 in – 18 in BR
25%	QUERCUS PHELLOS	WILLOW OAK	12 in – 18 in BR
25%	QUERCUS MICHAUXII	SWAMPCHESTNUT OAK	12 in – 18 in BR
25%	BETULA NIGRA	RIVER BIRCH	12 in – 18 in BR

- SEE PLAN SHEETS FOR AREAS TO BE PLANTED

STREAMBANK REFORESTATION DETAIL SHEET

N.C.D.O.T - ROADSIDE ENVIRONMENTAL UNIT

PROJECT REFERENCE NO.	SHEET NO.
U-2707	ALN
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

ALIGNMENT DATA
REACH 1

Beginning Point

Station	**00+00.00**
Northing	**826494.3736**
Easting	**1597877.6360**

Station	Curve/Tangent Number	Curve/Tangent Length (ft)	Chord/Tangent Bearing	Chord Length (ft)	Delta Angle	Radius (ft)
0+00.00	Point 45000					
	Point 45000 to PC R1-1	10.48	N 61° 41' 44.10" E			
0+10.48	Curve R1-1	21.11	N 74° 02' 24.49" E	20.95	24° 41' 20.78" (RT)	49.00
	PT R1-1 to PC R1-2	3.84	N 86° 23' 04.88" E			
0+35.43	Curve R1-2	42.82	N 51° 20' 15.67" E	40.20	70° 05' 38.42" (LT)	35.00
	PT R1-2 to PC R1-3	5.61	N 16° 17' 26.46" E			
0+83.86	Curve R1-3	48.84	N 61° 25' 29.75" E	43.94	90° 16' 06.57" (RT)	31.00
	PT R1-3 to PC R1-4	9.73	S 73° 26' 26.97" E			
1+42.42	Curve R1-4	54.40	N 62° 01' 43.35" E	49.09	89° 03' 39.37" (LT)	35.00
	PT R1-4 to PC R1-5	7.49	N 17° 29' 53.66" E			
2+04.32	Curve R1-5	44.23	N 59° 44' 12.89" E	40.33	84° 28' 38.45" (RT)	30.00
	PT R1-5 to PC R1-6	5.23	S 78° 01' 27.88" E			
2+53.79	Curve R1-6	46.76	N 60° 06' 55.79" E	42.71	83° 43' 12.66" (LT)	32.00
	PT R1-6 to PC R1-7	7.03	N 18° 15' 19.46" E			
3+07.57	Curve R1-7	47.16	N 56° 51' 09.79" E	43.67	77° 11' 40.66" (RT)	35.00
	PT R1-7 to PC R1-8	7.41	S 84° 32' 59.88" E			
3+62.14	Curve R1-8	52.42	N 54° 51' 46.39" E	48.14	81° 10' 27.46" (LT)	37.00
	PT R1-8 to PC R1-9	7.44	N 14° 16' 32.65" E			
4+22.00	Curve R1-9	50.33	N 63° 59' 44.48" E	44.25	99° 26' 23.64" (RT)	29.00
	PT R1-9 to PC R1-10	5.72	S 66° 17' 03.70" E			
4+78.05	Curve R1-10	49.84	N 62° 43' 03.65" E	43.52	101° 59' 45.29" (LT)	28.00
	PT R1-10 to PC R1-11	4.89	N 11° 43' 11.01" E			
5+32.78	Curve R1-11	52.74	N 50° 27' 47.72" E	48.82	77° 29' 13.42" (RT)	39.00
	PT R1-11 to PC R1-12	6.18	N 89° 12' 24.43" E			
5+91.70	Curve R1-12	39.46	N 51° 31' 45.40" E	36.67	75° 21' 18.07" (LT)	30.00
	PT R1-12 to PC R1-13	4.64	N 13° 51' 06.36" E			
6+35.80	Curve R1-13	47.52	N 60° 47' 33.87" E	42.38	93° 52' 55.01" (RT)	29.00
	PT R1-13 to PC R1-14	6.15	S 72° 15' 58.62" E			
6+89.48	Curve R1-14	59.25	N 60° 35' 07.59" E	52.78	94° 17' 47.57" (LT)	36.00
	PT R1-14 to PC R1-15	6.23	N 13° 26' 13.81" E			
7+54.95	Curve R1-15	34.19	N 48° 25' 14.01" E	32.11	69° 58' 00.40" (RT)	28.00
	PT R1-15 to PC R1-16	5.62	N 83° 24' 14.21" E			
7+94.77	Curve R1-16	45.15	N 41° 40' 42.92" E	41.26	83° 27' 02.58" (LT)	31.00
	PT R1-16 to PC R1-17	10.20	N 0° 02' 48.38" W			
8+50.12	Curve R1-17	49.30	N 40° 18' 30.95" E	45.33	80° 42' 38.65" (RT)	35.00
	PT R1-17 to PC R1-18	5.03	N 80° 39' 50.28" E			
9+04.46	Curve R1-18	51.70	N 31° 17' 40.66" E	45.54	98° 44' 19.23" (LT)	30.00
	PT R1-18 to PC R1-19	5.85	N 18° 04' 28.96" W			
9+62.01	Curve R1-19	49.02	N 30° 21' 01.43" E	43.39	96° 51' 00.77" (RT)	29.00
	PT R1-19 to PC R1-20	4.89	N 78° 46' 31.82" E			
10+15.92	Curve R1-20	53.31	N 38° 35' 21.06" E	49.04	80° 22' 21.52" (LT)	38.00
	PT R1-20 to PC R1-21	7.68	N 1° 35' 49.70" W			
10+76.91	Curve R1-21	39.93	N 39° 15' 33.94" E	36.63	81° 42' 47.28" (RT)	28.00
	PT R1-21 to PC R1-22	6.74	N 80° 06' 57.58" E			
11+23.58	Curve R1-22	52.12	N 28° 37' 28.08" E	45.39	102° 58' 59.00" (LT)	29.00
	PT R1-22 to PC R1-23	4.45	N 22° 52' 01.42" W			
11+80.16	Curve R1-23	56.65	N 27° 51' 09.41" E	49.54	101° 26' 21.65" (RT)	32.00
	PT R1-23 to PC R1-24	5.17	N 78° 34' 20.23" E			
12+41.98	Curve R1-24	43.64	N 36° 53' 51.67" E	39.89	83° 20' 57.13" (LT)	30.00
	PT R1-24 to PC R1-25	5.29	N 4° 46' 36.90" W			
12+90.92	Curve R1-25	51.80	N 36° 26' 53.31" E	47.45	82° 27' 00.41" (RT)	36.00
	PT R1-25 to PC R1-26	10.49	N 77° 40' 23.51" E			
13+53.21	Curve R1-26	39.24	N 41° 24' 49.79" E	36.67	72° 31' 07.44" (LT)	31.00

Station	Curve/Tangent Number	Curve/Tangent Length (ft)	Chord/Tangent Bearing	Chord Length (ft)	Delta Angle	Radius (ft)
	PT R1-26 to PC R1-27	8.81	N 5° 09' 16.07" E			
14+01.26	Curve R1-27	47.45	N 43° 59' 48.18" E	43.90	77° 41' 04.22" (RT)	35.00
	PT R1-27 to PC R1-28	9.08	N 82° 50' 20.29" E			
14+57.79	Curve R1-28	37.68	N 45° 37' 08.29" E	35.08	74° 26' 23.99" (LT)	29.00
	PT R1-28 to PC R1-29	8.64	N 8° 23' 56.30" E			
15+04.11	Curve R1-29	50.64	N 47° 36' 30.64" E	46.78	78° 25' 08.69" (RT)	37.00
	PT R1-29 to PC R1-30	6.20	N 86° 49' 04.99" E			
15+60.95	Curve R1-30	46.67	N 47° 29' 36.67" E	43.09	78° 38' 56.63" (LT)	34.00
	PT R1-30 to PC R1-31	7.87	N 8° 10' 08.36" E			
16+15.49	Curve R1-31	50.92	N 45° 34' 27.41" E	47.38	74° 48' 38.09" (RT)	39.00
	PT R1-31 to PC R1-32	8.06	N 82° 58' 46.45" E			
16+74.47	Curve R1-32	51.92	N 41° 39' 33.30" E	47.54	82° 38' 26.30" (LT)	36.00
	PT R1-32 to PC R1-33	11.79	N 0° 20' 20.15" E			
17+38.19	Curve R1-33	80.43	N 47° 21' 38.65" E	71.70	94° 02' 36.99" (RT)	49.00
	PC R1-33 to Point 45001	16.30	S 85° 37' 02.86" E			
18+34.93	Point 45001					

PROJECT REFERENCE NO.	SHEET NO.
U-2519	MT03
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS

5/28/09

MATCH TO SHEET MT-04
RT STA 12+15.00

NC 1
NAD 1983

STREAM PLUG

STREAM INV.=687.51'
SS TOP=685.76'

PROPOSED SLOPE STAKES

PROPOSED THALWEG

PROPOSED BANKFULL CHANNEL

PT Sta. 13+48.27

PC Sta. 11+91.08

PT Sta. 77+69.27

N 40° 08' 22.9" E

CAT "V" DITCH
EST. 187 CY DDE
SEE DETAIL BE

CLOUD HARBOR TRAIL

EDNA W. BINGHAM
DB 786 PG 441

GRAU-350

EXISTING GROUND

PROPOSED BANKFULL = 0.0080 ft/ft

PROPOSED BANKFULL = 0.0044 ft/ft

PROPOSED THALWEG

BEGIN RL
Sta. 2+00.00
Ele. 696.00

700
695
690
685
680
675

0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 9+00 10+00 11+00 12+00 13+00

PROJECT REFERENCE NO.	SHEET NO.
U-2707	MIT 04
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS

5/28/99

MATCH TO SHEET MIT-03
RT - STA 12+11.00

PROPOSED SLOPE STAKES

22
EDNA W. BINGHAM
DB 786 PG 441

PROPOSED BANKFULL CHANNEL

PROPOSED THALWEG

CLASS "I" RIP RAP SLOPE PROTECTION SEE DETAIL 9I

15" CSP W/ 2 ELBOWS

CY-9 RIP RAP W/FILTER FABRIC LINER EST. 96 TONS EST. 174 SY FABRIC

REMOVE EXISTING 18" CMP

P.S.H. SEE DETAIL 9H

ABANDON

PROP. 24" SS

N 40° 08' 22.9" E

TOP ELEV. = 680.15
INV. ELEV. = 681.85

ABANDON

PROP. 24" SS

RETAIN EXISTING CHANNEL

TOP ELEV. = 690.90
INV. ELEV. = 673.90

WILLOW CREEK

AT BASE DITCH W/CLASS "B" RIP RAP
EST. 281 TONS
EST. 449 S.Y. FABRIC
EST. 256 CY DDE
SEE DETAIL 9E

26
JOSEPH C. GOODMAN AND WIFE MARY ANN HARRIS GOODMAN
DB 2226 PG 4675
DB 1629 PG 3747

CLASS "I" RIP-RAP SLOPE PROTECTION SEE DETAIL 9I

STANDARD BASE DITCH W/CLASS "B" RIP RAP
EST. 40 TONS
EST. 75 S.Y. FABRIC
EST. 30 CY DDE
SEE DETAIL 9G

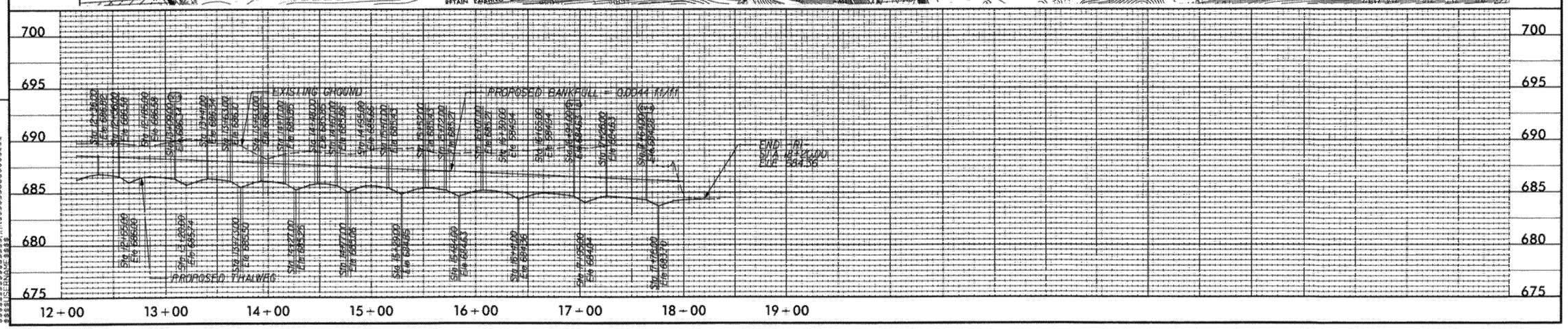
TYPE-III

N 40° 08' 22.9" E

GRAD-350

EXISTING R/W RIGHT OF WAY

NC GRID NAD 83



PROJECT REFERENCE NO.	SHEET NO.
U-2707	PLT03
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS

5/28/98

MATCH TO SHEET PLT-04
-RI- STA 12+15.00

NC GRID NAD 83

STREAM PLUG

STREAM INV.=687.51'
SS TOP=685.76'

PROPOSED SLOPE STAKES

TYPE II PLANTING ZONE

TYPE II PLANTING ZONE

PROPOSED THALWEG

PROPOSED BANKFULL CHANNEL

PT Sta 7+69.27

PT Sta. 13+18.27

PC Sta. 7+91.06

N 40° 08' 22.9" E

LAT 'V' DITCH
EST. 18 CY DDE
SEE DETAIL 8E

CLOUD HARBOR TRAIL

SONA B. BINGHAM
DB 186 PG 441

EXISTING GROUND

PROPOSED BANKFULL = 0.0080 ft/ft

PROPOSED BANKFULL = 0.0044 ft/ft

PROPOSED THALWEG

BEGIN -RI-
STA. 0+00.00
ELE. 695.00

700
695
690
685
680
675

0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 9+00 10+00 11+00 12+00 13+00

$$$$$$$SYSTIME$$$$$$$
$$$$$$$USERNAME$$$$$$$

PROJECT REFERENCE NO.	SHEET NO.
-2701	5L-24
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS

5/28/99

MATCH TO SHEET 5L-23
RT - STA 12+15.00

NC GRID NAD 1983

PROPOSED SLOPE STAKES

PROPOSED BANKFULL CHANNEL

TYPE II PLANTING ZONE

EDNA W. BINGHAM
DB 786 PG 441

TYPE 2

CLASS "II" RIP RAP SLOPE PROTECTION SEE DETAIL 9I

PROPOSED THALWEG

15" CSP W/ 2 ELBOWS

P-3HL SEE DETAIL 9H

TOP ELEV. = 691.15
INV. ELEV. = 681.85

ABANDON PROP. 24" SS

N 40° 08' 22.9" E

ABANDON PROP. 24" SS

MATCH EXISTING CHANNEL

TOP ELEV. = 691.36
INV. ELEV. = 674.42

TOP ELEV. = 690.90
INV. ELEV. = 673.90

CL 1" RIP RAP WINTER FABRIC LINER EST. 96 TONS EST. 124 SY FABRIC

REMOVE EXISTING 18" CMP

WILLOW CREEK

JOSEPH C. GOODMAN AND WIFE MARY ANN HARRIS GOODMAN
DB 2226 PG 4675
DB 1629 PG 3747

LAT GRASSED SWALE
EST. 256 CY DOE
SEE DETAIL 9E

CLASS "II" RIP RAP SLOPE PROTECTION SEE DETAIL 9I

STANDARD GRASSED SWALE
EST. 30 CY DOE
SEE DETAIL 9G

N 40° 08' 22.9" E

EXISTING R/W RIGHT OF WAY

EXISTING GROUND

PROPOSED BANKFULL = 0.0044 ft/ft

PROPOSED THALWEG

END PROPOSED DITCH
STA 18+12.00
ELEV 664.58

700
695
690
685
680
675

12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00

Ecosystem Enhancement PROGRAM

March 6, 2012

Mr. Gregory J. Thorpe, Ph.D.
Manager, Project Development and Environmental Analysis Branch
North Carolina Department of Transportation
1548 Mail Service Center
Raleigh, North Carolina 27699-1548

Dear Dr. Thorpe:

Subject: EEP Mitigation Acceptance Letter:

U-2707, Clemmons – SR 3000 (Idols Road) Extension from SR 2999 (Hampton Road) to US 158, Forsyth County

The purpose of this letter is to notify you that the Ecosystem Enhancement Program (EEP) will provide the compensatory stream and riparian wetland mitigation for the subject project. Based on the information supplied by you on March 2, 2012, the impacts are located in CU 03040101 of the Yadkin River basin in the Central Piedmont (CP) Eco-Region, and are as follows:

Yadkin 03040101 CP	Stream			Wetlands			Buffer (Sq. Ft.)	
	Cold	Cool	Warm	Riparian	Non-Riparian	Coastal Marsh	Zone 1	Zone 2
Impacts (feet/acres)	0	0	0	0.81	0	0	0	0

EEP commits to implementing sufficient compensatory stream and riparian wetland mitigation credits to offset the impacts associated with this project as determined by the regulatory agencies in accordance with the N.C. Department of Environment and Natural Resources' Ecosystem Enhancement Program In-Lieu Fee Instrument dated July 28, 2010. If the above referenced impact amounts are revised, then this mitigation acceptance letter will no longer be valid and a new mitigation acceptance letter will be required from EEP.

If you have any questions or need additional information, please contact Ms. Beth Harmon at 919-715-1929.

Sincerely,

James B Stanfill for

Michael Ellison
EEP Deputy Director

cc: Mr. John Thomas, USACE – Raleigh Regulatory Field Office
Mr. Brian Wrenn, Division of Water Quality, Wetlands/401 Unit
File: U-2707

May 20, 2004

Subject: Draft Minutes Interagency Hydraulic Review Meeting on May 19, 2004, for U2707, Forsyth County.

Team Members:		Participants:
Eric Alsmeyer – USACE	(Present)	Marshall Clawson – NCDOT Hydraulics
John Hennessy– NCDWQ	(Present)	Elizabeth Lusk – NCDOT PDEA ONE
Marla Chambers – NCWRC	(Absent)	Colista Freeman – NCDOT PDEA
Marella Buncick – USFWS	(Absent)	Rick Moore – Mulkey Engineers & Consultants
Christopher Militscher – USEPA-Raleigh	(Absent)	David Scheffel – NCDOT Design Services
Carla Dagnino – NCDOT PDEA	(Present)	Malcolm Watson – NCDOT Design Services
Brian Wrenn-NCDWQ	(Present)	Michael Bright – NCDOT Design Services Utilities
		Anne Gamber – NCDOT Hydraulic

The meeting began at 1:20. The project is located in the Yadkin – Pee Dee River basin which is not subject to the Buffer Rules. The project is a new location for Idols Road. The meeting began with a discussion as to the status of the project within the merger process. A meeting will be held on site to evaluate an on site mitigation location and to discuss the 4A and 4B concurrence points(separate meetings). We request that team members visit the project for review of on-site mitigation. Following is the comments:

Culverts under railroad: USACE has not verified the non-jurisdictional streams for this project.

River: The Bridge will span the creek and no deck drains will discharge directly into surface water. The bridge will also avoid impacts to the parallel sanitary sewer line. The relocated channel is to tie to the unnamed tributary. Capacity analysis will need to be performed for the tributary and the pipe under the farming path.

The meeting was adjourned.

Subject: Meeting Minutes from 4C Permit Drawings Review
September 14, 2011 for U-2707 in Forsyth County

Team Members:

John Thomas-USACE	(present)
Marella Buncick-USFWS	(present)
Marla Chambers-NCWRC	(present)
Chris Militscher-EPA	(present)
Amy Euliss-NCDWQ	(present)
Felix Davila-FHWA	(present)
David Harris-REU	(absent)
Ron McCollum-Roadway	(absent)
Mack Bailey-Structures	(absent)
Beverly Robinson-PDEA	(absent)
Rachelle Beauregard-NEU	(present)
Keith E. Raulston-Division 9	(absent)

Participants:
Marshall Clawson, NCDOT Hydraulics
Jonathan Scarce, Mulkey E & C
Matthew Harvey, Mulkey E & C
Emmett Perdue, Mulkey E & C
Felix Davila, FHWA
Mark Laugisch, NCDOT NEU
John Bailey, NCDOT TPB
Tris Ford, NCDOT PICS
Michael Penney, NCDOT PDEA
Chris Militscher, USEPA
Amy Euliss, DWQ
Kent Boyer, NCDOT Div. 9
Marla Chambers, NCWRC
John Thomas, USACE
Rachelle Beauregard, NCDOT NEU
Byron Moore, NCDOT NEU
Mike Stanley, NCDOT TIP
David Clodgo, NCDOT Roadway Design

Introductions were initiated by Marshall Clawson. Introductions were made by all in attendance. Jonathan Scarce proceeded with the review.

General

- The project is being constructed on new location.
- Muddy Creek and two Unnamed Tributaries to Muddy Creek are the major streams crossed within the project.
- All waters within the project are listed as class C, and are listed on the 303(d) list of impaired streams for copper, ecological/biological integrity benthos, and zinc.
- Project falls within the Yadkin Pee-Dee River Basin in which riparian buffer rules are not applicable.
- The project has one major structure, which is a bridge.
- Add Grass Swale information under the BMP list in the Stormwater Management Plan for all applicable permit sites

Sheet 6 (Site 1)

- Impacts in wetlands from mechanized clearing at the outlet of the 48" pipe under the Rail Road.

- The tail ditch at the outlet of the 48" smooth steel pipe will be flared for diffused flow.
- It will be investigated to see if the bore pit for the 48" smooth steel pipe can be located on the north side of the Rail Road in order to prevent further impacts to the wetland at the pipe outlet.
- Structure 13 will be revised to tie into Structure 12, due to Preformed Scour Hole at Structure 13 being inside the Rail Road Right of Way.

Sheet 8 (Site 2)

- Fill in surface water from roadway fill.
- The 48" pipe will be re-aligned to outlet at the inlet of the 48" smooth steel pipe. A bench will be installed at the inlet of the existing 24" pipe so that it will act as a high flow pipe.
- At the outlet of the 48" pipe under the Rail Road bank stabilization will need to be added along with the rip rap pad, in order to prevent scour in the stream.
- NEU is going to check on the status of the Jurisdictional Stream call at the outlet of the 24" and 48" pipes.
- Coordination with the Rail Road will be handled by others, not NCDOT Hydraulics.
- Rip rap needs to be added to the lateral base ditch from –L- Sta. 66+50 to Sta. 68+45 Lt.

Sheet 8 & 9 (Site 3)

- The wetland impacts shown at the beginning of stream mitigation will be removed.
- The stream impacts occurring at Site 3 will be removed up to the proposed fill slope on Sheet 9.
- The existing channel on the southeast side of the roadway alignment will be retained in order to serve as an outlet for the lateral ditches on the left and right sides of the roadway alignment. Due to the reduced drainage area from the stream mitigation no channel improvements will need to take place in the existing channel.
- The status of Right of Way for the stream mitigation is currently being investigated.

Sheet 8 & 9 (Site 4)

- Permanent fill in wetlands will occur over a large portion of wetland; therefore, the entire wetland will be shown as a total take.
- Due to the roadway super elevation the drainage cannot be re-routed to the other side of the road to prevent impacts to the wetlands.
- The lateral base ditch on the right side of the proposed road will be analyzed to see if it qualifies as a grass swale.

Sheet 9 (Site 5)

- The proposed site includes 2@66" RCP to incorporate a 5-yr design
- After discussions, it was determined the farm path would not require a 5-yr design and therefore modifications to the design to allow fish passage and to mitigate for a potential headcut upstream should be investigated.

- In the days after the meeting, NEU has investigated two alternatives to solve the fish passage and headcut problems. The first alternative is to replace the 2@66" RCP with a single aluminum pipe with baffles. The second alternative is to continue the proposed mitigation alignment straight ahead so that is ties directly into Muddy Creek. This solution would require a crossing in a different location where grade and channel size could be controlled.

Sheet 9 (Site 6)

- Bank stabilization at the outlet of the lateral base ditch is not in the stream bed, banks only.
- It will be investigated to see if a bio retention area can be integrated into the storm water design, in place of a portion of the standard base ditches. NEU was going to provide Mulkey E & C with a sample project showing a bio retention area in a similar situation.

Meeting Adjourned.

NEPA/404 Merger Team
TIP Project No. U-2707
Federal Aid No. STP-3000(1)
State Project No. 8.2624101
WBS Element 34845.1.1

Proposed Idols Road Extension
From SR 2999 (Hampton Road)
To US 158 (Clemmons Road)
Forsyth County

Purpose of Packet:

The purpose of this packet is to submit information to the Merger Team in order to reach concurrence on Point 4a, Avoidance and Minimization for TIP Project No. U-2707.

Contents:

I. Project Purpose and Need
II. Project Description
III. LEDPA
IV. Summary of Impacts
V. Bridging Review
VI. Avoidance and Minimization

Project Development Engineer: Colista S. Freeman, P.E.
(919) 733-7844 ext. 227
csfreeman@dot.state.nc.us

I. Project Purpose and Need

The purposes of the proposed project are:

- Provide an improved connection and upgrade level of traffic service from southern Clemmons and northern Davidson County to Winston-Salem.
- Route through traffic and truck traffic off of Hampton Road, which consists of residential development, poor sight distance, and inadequate turning radius at its intersection with Idols Road.
- Improve access to existing and planned development in the project area, which currently must rely solely on Hampton Road, a residential street, for transportation services.

Without the extension, Hampton Road will operate at a level of service (LOS) F in the design year 2025.

II. Project Description

The North Carolina Department of Transportation (NCDOT), Division of Highways, and the Federal Highway Administration (FHWA) propose to construct a two-lane facility with shoulders on an estimated 100-ft right of way on new location from SR 3000 (Idols Road)/SR 2999 (Hampton Road) to US 158 (Clemmons Road), in Forsyth County. The 2002-2008 NCDOT Transportation Improvement Program (TIP) includes a total funding of $8,490,000 for the project, including $7,000,000 for construction, $950,000 for right of way, and $540,000 for prior years' costs.

This proposed action also includes realignment of the Idols and Hampton Roads intersection, at the project's southern terminus. A new structure will replace Bridge Number 109 on Hampton Road to enable the intersection improvement and increase vertical clearance over the Norfolk Southern Railroad. New traffic signals will be installed at both project termini. It is also recommended that AASHTO standard 4-ft wide paved shoulders be provided to accommodate bicycle safety. In addition to roadway improvements, the replacement of Bridge No. 109 would include 4-ft offsets between the rails and the travel lanes and 1372-mm high rails for AASHTO standard bicycle safety accommodations.

III. LEDPA

Four new location alternatives were studied. Alternative B was selected as the Least Environmentally Damaging Practicable Alternative (LEDPA).

Alternative B

Alternative B begins at Idols Road/Hampton Road, just north of Bridge #109. Alternative B uses the same termini as Alternative A with a different alignment. This alternative parallels the Norfolk Southern rail lines, approximately 100 ft to the northwest, for the full length of 2.0 miles. The proposed alignment consists of a two-lane shoulder section, with 12-ft travel lanes on an estimated 100-ft right of way. Bicycle accommodations are recommended in the form of 4-ft paved shoulders. No sidewalks are recommended.

Construction of Alternative B will not impact jurisdictional wetlands. However, impacts to surface waters are anticipated. Alternative B will cross UT1, UT3, and Muddy Creek; however, a recommended 900 ft of stream rechannelization for UT3 results in one recommended bridge crossing all streams. The bridge would cross UT1 and Muddy Creek at the convergence. The estimated stream impacts are 1362 linear ft for Alternative B.

IV. Summary of Impacts

Table 1 summarizes the impacts associated with the recommended alternative, Alternative B.

Table 1: Impacts Associated with U-2707

Environmental Resource	Alternative B
Archaeological	No Resources
Architectural	No Adverse Effect
Natural • **Stream Impacts** • **Non-jurisdictional wetlands** • **Biotic Communities**	 1362 feet 0.07 acre 51.5 acres
Farmland	No Resources
Noise/Air	4 residential, 1 business noise impacts
GeoEnvironmental	1 underground storage tank site
Project Cost	$7,863,000
Socioeconomic	3 residential relocations

V. Bridging Review

Table 2: Hydraulic Recommendations

Stream/Wetland	Type of Structure	Proposed Structure Dimensions	Structure Cost	Stream Classification	Wetland Rating	Shading/Filling Impacts	Intermittent or Perennial (I or P)	Existing Channel Dimensions (width x depth)
Muddy Creek	Bridge	440'x 32'	$1,350,000	C	N/A	1920 ft²	P	35' x 2'
UT1				C	N/A	300 ft²	P	6' x 0.25'
UT3	Pipe	165'		C	N/A	660 ft²	P	5' x 0.25'

VI. Avoidance and Minimization

Alternative B, the recommended alternative, avoids impacts to UT2, one of three tributaries to Muddy Creek in the project area. Alternative B also minimizes impacts to Muddy Creek and UT1 by spanning the two streams at their convergence with a single bridge. Although stream rechannelization will be required for UT3 in the area of the proposed bridge, it has been noted by Merger Team members that the existing stream is degraded and would likely benefit from relocation with natural stream design.

Habitat fragmentation is also minimized by Alternative B, since the alignment runs close to and parallel to the existing railroad right of way for most of its proposed length.

As a project commitment, tree removal will be minimized between the railroad right of way and the edge of pavement in the area of the historic property, Hanes Farm. As a result, Alternative B was determined to have No Adverse Effect on the Hanes Farm.

Merger Project Team Agreement

Concurrence Point 4a: Avoidance and Minimization

Project Description: Proposed Idols Road Extension from SR 2999 (Hampton Road) To US 158 (Clemmons Road) in Forsyth County

TIP Project No.: U-2707

Federal Aid Project No.: STP-3000(1)

State Project No.: 8.2624101

WBS Element: 34845.1.1

The Project Team has concurred that avoidance and minimization has been adequately demonstrated for Alternative B for TIP Project U-2707.

USACE _____ **Date** _____

FHWA _____ **Date** _____

NCDOT _____ **Date** _____

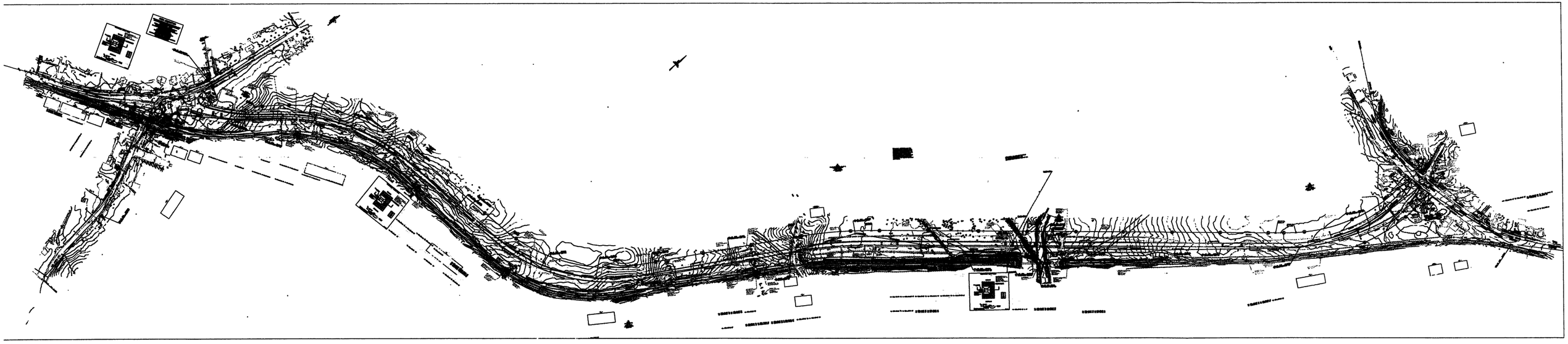
USFWS _____ **Date** _____

EPA _____ **Date** _____

NCWRC _____ **Date** _____

NCDCR _____ **Date** _____

NCDWQ _____ **Date** _____



Merger Project Team Agreement

Concurrence Point 4a: Avoidance and Minimization

Project Description: Proposed Idols Road Extension from SR 2999 (Hampton Road) To US 158 (Clemmons Road) in Forsyth County

TIP Project No.: U-2707

Federal Aid Project No.: STP-3000(1)

State Project No.: 8.2624101

WBS Element: 34845.1.1

The Project Team has concurred that avoidance and minimization has been adequately demonstrated for Alternative B for TIP Project U-2707.

USACE _____ **Date** _____

FHWA Filip Q Ilm **Date** 2/17/05

NCDOT _____ **Date** _____

USFWS _____ **Date** _____

EPA _____ **Date** _____

NCWRC _____ **Date** _____

NCDCR _____ **Date** _____

NCDWQ _____ **Date** _____

North Carolina Department of Cultural Resources

State Historic Preservation Office

Peter B. Sandbeck, Administrator

FAX COVER

Date: Feb 11th '05

TO: Colista Freeman (Name/Agency/City State) Fax. No. 919 733-9794

FROM: Sarah McBride (Fax. No. 919/715-4801)

___ Restoration Branch--telephone 919/733-6547

X Survey and Planning Branch--telephone 919/733-6545

NUMBER OF PAGES TRANSMITTED INCLUDING FAX COVER 2

Original to follow by mail ___yes ✓no Acknowledge receipt of fax by telephone ___yes ✓no

Comments:

Merger Project Team Agreement

Concurrence Point 4a: Avoidance and Minimization

Project Description: Proposed Idols Road Extension from SR 2999 (Hampton Road) To US 158 (Clemmons Road) in Forsyth County

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WBS Element: 34845.1.1

The Project Team has concurred that avoidance and minimization has been adequately demonstrated for Alternative B for TIP Project U-2707.

USACE _____ Date _____

FHWA _____ Date _____

NCDOT _____ Date _____

USFWS _____ Date _____

EPA _____ Date _____

NCWRC _____ Date _____

NCDCR _____ Date 2/16/05

NCDWQ _____ Date _____

Michael F. Easley, Governor

William G. Ross Jr., Secretary
North Carolina Department of Environment and Natural Resources

Alan W. Klimek, P.E. Director
Division of Water Quality

Division of Water Quality
Department of Environmental and Natural Resources
401 Oversight/Express Permit, Program Development and Transportation Permitting Units

Street Address: 2321 Crabtree Boulevard, Suite 250
Raleigh, NC 27604-2260

Mailing Address: 1650 Mail Service Center
Raleigh, NC 27699-1650

Contact Information: Phone #: 919-733-1786
Fax #: 919-733-6893

Fax To: Calista Freeman **Fax #:** 733-9794

Company: DOT **Date:** 2/24/05

Number of pages including cover sheet: _____

Notes or special instructions:

Merger Project Team Agreement

Concurrence Point 4a: Avoidance and Minimization

Project Description: Proposed Idols Road Extension from SR 2999 (Hampton Road) To US 158 (Clemmons Road) in Forsyth County

TIP Project No.: U-2707

Federal Aid Project No.: STP-3000(1)

State Project No.: 8.2624101

WBS Element: 34845.1.1

The Project Team has concurred that avoidance and minimization has been adequately demonstrated for Alternative B for TIP Project U-2707.

USACE _____ **Date** _____

FHWA _____ **Date** _____

NCDOT _____ **Date** _____

USFWS _____ **Date** _____

EPA _____ **Date** _____

NCWRC _____ **Date** _____

NCDCR _____ **Date** _____

NCDWQ _____ **Date** 2/24/05

STORMWATER MANAGEMENT PLAN

August 24, 2011

Project: 34845.1.1 (U-2707)
Forsyth County, North Carolina
Hydraulics Project Engineer: Jonathan Scarce, PE (Mulkey Engineers and Consultants)
NCDOT Hydraulics Project Engineer: Marshall W. Clawson, PE

Project Description:

This project consists of the construction of a two-lane shoulder facility on new location near Clemmons. The project begins at the intersection of SR 3000 and SR 2999 and ends at US 158. For safety purposes, the replacement of bridge #109 over the Norfolk Southern Railroad and the reconfiguration of the intersection of SR 3000 and SR 2999 and all approaches are proposed. The overall length of the project is 2.01 miles.

Environmental Description

This project is located in the Yadkin-Pee Dee River Basin, for which no buffer regulations have been implemented. Muddy Creek and two Unnamed Tributaries to Muddy Creek will each be crossed once by the proposed action. Muddy Creek is listed on the NCDENR classification list as Class C and is listed on the 303(d) list for impaired streams for copper, ecological/biological integrity benthos, and zinc. Neither High Quality Waters (HQW), Water Supplies (WS-I or WS-II) nor Outstanding Resource Waters (ORW) occur within 1.6 km (1.0 mi.) of project.

Roadway Description:

The proposed roadway cross section is a 2-lane facility, consisting of 12 foot travel lanes, 4 foot paved shoulders and 4 foot grass shoulders. The project drainage system consists mainly of ditches and cross pipes.

Shoulder berm gutter was utilized in areas of high fill and/or excessive runoff. In these instances, the runoff was collected in a 2GI and discharged into either a ditch or a pre-formed scour hole.

Curb and gutter was utilized at the end of the project to tie to existing curb and gutter. In this case, a storm system was used to collect the runoff and discharge at existing outfalls.

Best Management Practices and Major Structures:

The primary goal of Best Management Practices (BMP's) is to prevent degradation of the states surface waters by location, construction and operation of the highway system. The BMP's are activities, practices and procedures taken to prevent or reduce stormwater pollution. The BMP measures used on this project to reduce stormwater impacts are:

- ***Major Structure***

  A bridge will be placed from –L- Station 88+05 to –L- Station 92+45. There are no proposed bents in the channel. No deck drains will be allowed to discharge directly into Muddy Creek.

  A "No-Rise" Certification was obtained in the design of the Bridge Crossing of Muddy Creek on New Alignment of SR 3000. Technical data supports that there will not be an increase to the 100 year flood elevations, floodway elevations and floodway widths on Muddy Creek at any published or unpublished section in the Flood Insurance Study, outside of NCDOT Right of Way.

- ***Preformed Scour Holes***

  Preformed Scour Holes were used in order to provide diffused flow from the storm drainage picked up in the shoulder berm gutter. These structures are located at the following locations:

  - -L- Sta. 18+47 RT
  - -L- Sta. 21+65 RT
  - -Y- Sta. 12+70 LT
  - -Y- Sta. 13+10 LT
  - -Y- Sta. 15+54 LT
  - -Y- Sta. 18+66 LT
  - -L- Sta. 87+70 LT

- ***Natural Stream Design***

  The relocation of UT 1 to Muddy Creek is designed in accordance with Rosgen techniques for natural stream design.

- **Rip Rap Pads**

  Rip Rap pads will be used in order to dissipate energy and reduce velocities at pipe outlets and ditch outlets into the wetlands. These structures are located throughout the project.

- ***Cross Pipes***

  Cross pipes will be buried a minimum of 20% of the diameter of the proposed pipe size, up to and including 48" pipe, then 1 foot thereafter.

- ***Grassed Swale Locations***

  Grassed Swales were used in order to reduce flow velocities and filter pollutants from highway runoff. These structures are located at the following locations:

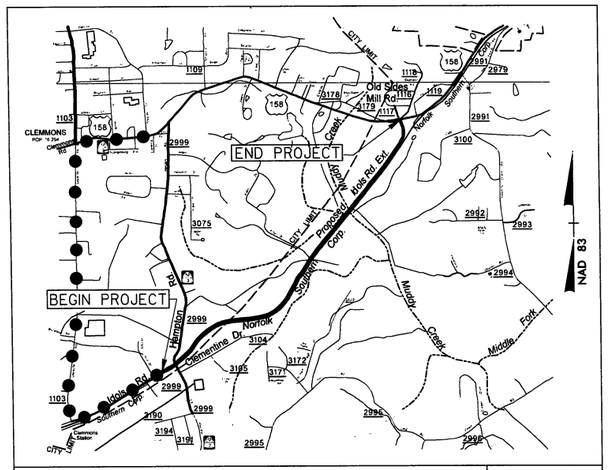
  - –L- 73+00 to 83+50 Rt. (Side slopes are 2:1 due to Right of Way restrictions caused by the Rail Road).

- -L- 91+00 to 93+50 Rt (Due to site constraints on the longitudinal slopes water quality rock checks will be installed on some portions of the grassed swale, to attain V_2 less than 2 ft/s.)
- -L- 92+06 to 96+00 Lt (Due to site constraints on the longitudinal slopes water quality rock checks will be installed on some portions of the grassed swale, to attain V_2 less than 2 ft/s.)
- -L- 92+06 Rt to 92+06 Lt

7/01/99

TIP PROJECT: U-2707

See Sheet 1-A For Index of Sheets
See Sheet 1-B For Conventional Symbols



VICINITY MAP
FORSYTH COUNTY, NC

OFF SITE DETOUR ROUTE

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

FORSYTH COUNTY

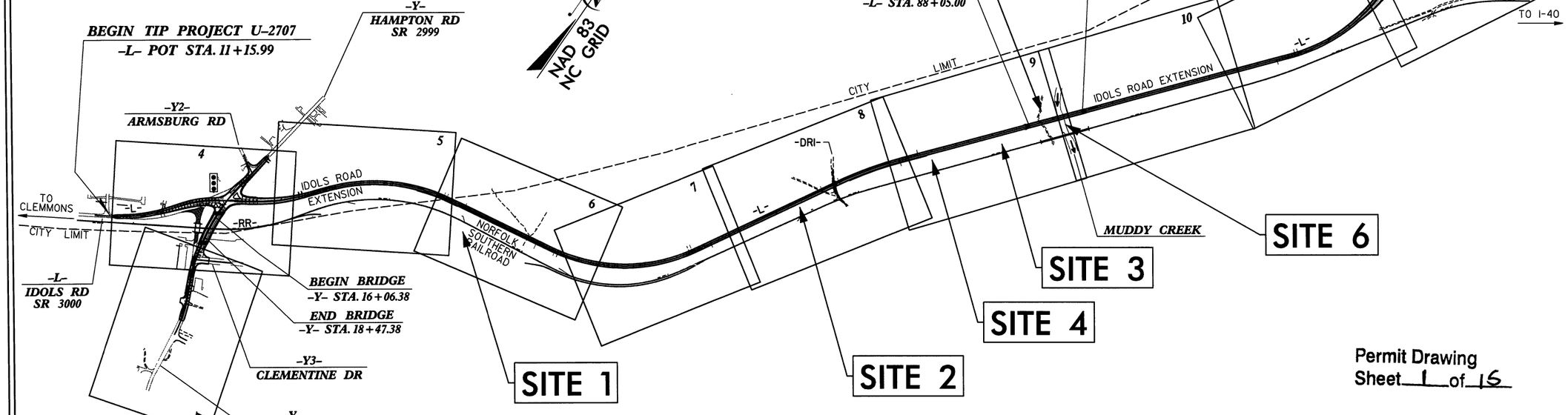
STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	U-2707	1	

W&S NO.	F. A. PROJ. NO.	DESCRIPTION
34845.1.1	STP-3000(1)	P.E.
34845.2.1	STP-3000(1)	R/W & UTIL.
34845.2.2		

LOCATION: CLEMMONS – SR 3000 (IDOLS ROAD), FROM SR 2999 (HAMPTON ROAD) TO US 158 (CLEMMONS ROAD)

TYPE OF WORK: GRADING, DRAINAGE, PAVING, STRUCTURES, SIGNING, AND SIGNALS

WETLAND & STREAM IMPACTS



Permit Drawing
Sheet 1 of 16

CLEARING ON THIS PROJECT SHALL BE PERFORMED TO THE LIMITS ESTABLISHED BY METHOD III

A PORTION OF THIS PROJECT IS WITHIN THE MUNICIPAL BOUNDARIES OF CLEMMONS.

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

CONTRACT:

GRAPHIC SCALES

PLANS 50 25 0 50 100

PROFILE (HORIZONTAL) 50 25 0 50 100

PROFILE (VERTICAL) 10 5 0 10 20

DESIGN DATA

ADT 2006 = 7800
ADT 2026 = 14467
DHV = 12 %
D = 60 %
T = 4 % *
V = 50 MPH

* TTST 1 % DUAL 3 %

PROJECT LENGTH

LENGTH ROADWAY TIP PROJECT U-2707 = 2.093 MILE

LENGTH STRUCTURE TIP PROJECT U-2707 = 0.083 MILE

TOTAL LENGTH TIP PROJECT U-2707 = 2.010 MILE

NOTE: PROJECT LENGTH FOR U-2707 DETERMINED BY USING -L-

Prepared in the Office of:
SEPI ENGINEERING GROUP
2300 Rexwoods Drive
Suite 370
Raleigh, NC 27607
Tel:919-789-9977 Fax:789-9591

2002 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE: FEBRUARY 18, 2005

LETTING DATE: NOVEMBER 21, 2006

NCDOT CONTACT

BRIAN D. SPEIGHT, PE
PROJECT ENGINEER

BRYON M. PALMER, PE
PROJECT DESIGN ENGINEER

CATHY S. HOUSER, PE
PROJECT ENGINEER ENGINEERING COORDINATION

HYDRAULICS ENGINEER

SIGNATURE: P.E.

ROADWAY DESIGN ENGINEER

SIGNATURE: P.E.

DIVISION OF HIGHWAYS STATE OF NORTH CAROLINA

STATE DESIGN ENGINEER P.E.

DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION

APPROVED
DIVISION ADMINISTRATOR *DATE*

12/5/2011
12/5/2011 11:21:40 PM
I:\2707\Roadway\Plots\PERMITS_Environmental\Drawings\U2707_hyd_prm_tsh.dgn

PROJECT REFERENCE NO.	SHEET NO.
U-2707	6
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

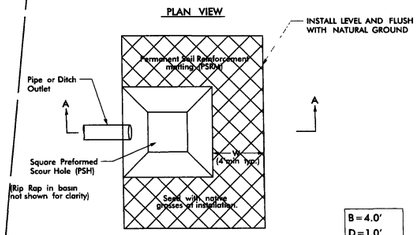
INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS 8/17/99

PREFORMED SCOUR HOLE
*NOT TO SCALE

PLAN VIEW



DETAIL 61

100' 0' 100' 200' 300'
GRAPHIC SCALE

DENOTES MECHANIZED CLEARING

NC GRID NAD 83

19 CLARK S. GENTRY AND WIFE LINDA C. GENTRY

21 OPAL B. WILSON

22 EDNA W. BINGHAM

N 05°28'08" W 962.75'

N 01°39'05" W 973.06'

SPEC. LAT BASE DITCH SEE DETAIL 6B

SPEC. LAT BASE DITCH W/CLASS "B"RIP RAP EST. 170 TONS EST. 680 SY FABRIC SEE DETAIL 6A

37+90.63 -L- 110.00

CHORD

39+50.63 -L- 110.00

ST Sta. 39+50.63

SPEC. LAT "V" DITCH SEE DETAIL 6D

CS Sta. 37+90.63

HEADWALL

48"

SPEC. GRADE DITCH -L- STA. 44+00 TO 47+00

46+92.63 -L- 110.00

48+52.63 -L- 110.00

CHORD

SC Sta. 48+52.63

TS Sta. 46+92.63

SPEC. LAT "V" DITCH SEE DETAIL 6D

51+05.00 -L- 110.00

50+95.00 -L- 110.00

51+05.00 -L- 160.00

50+95.00 -L- 150.00

50+70.00 -L- 155.00

50+60.00 -L- 165.00

CUT DITCH SEE DETAIL 6H

STD. BASE DITCH W/CLASS "B"RIP RAP EST. 20 TONS EST. 50 SY FABRIC EST. 225 CY DDE SEE DETAIL 6G

50+50.00 -L- 110.00

50+35.00 -L- 110.00

PDE

MATCH LINE -L- STA 37+50

MATCH LINE -L- STA 51+50

26' 15" RCP IV

15" CSP W/ 2 ELBOWS P.S.H. SEE DETAIL 61

N 80° 59' 01.7" E

N 80° 59' 01.7" E

EXISTING RIGHT OF WAY

+83.03 76.30

CL "I" RIP RAP W/FILTER FABRIC LINER EST. 49 S.Y. EST. 26 TONS EST. 50 SY FABRIC

RETAIN

BORE AND JACK 48" SMOOTH STEEL PIPE W/ 0.625" WALL THICKNESS

38+25.00 -L- 85.00 64.35

39+15.00 -L- 85.00 59.80

39+70.00 -L- 85.00 58.86

40+90.00 -L- 145.00 60.88

40+50.00 -L- 159.74

40+40.00 -L- 165.00 59.55

40+65.00 -L- 215.00

37+70.00 -L- 85.00 67.56

40+85.00 -L- 169.77

40+90.00 -L- 180.00

41+00.00 -L- 185.00

40+70.00 -L- 200.00

CL "I" RIP RAP W/FILTER FABRIC LINER EST. 49 S.Y. EST. 26 TONS EST. 50 SY FABRIC

STANDARD BASE DITCH W/CLASS "I"RIP RAP EST. 1 TONS EST. 2 SY FABRIC SEE DETAIL 6C

Q10 = 45.5cfs
V10 = 1.97fps

SITE 1

NORFOLK SOUTHERN RR

EXISTING R/R RIGHT OF WAY

CL "B" RIP RAP W/FILTER FABRIC LINER EST. 2 TONS EST. 7 SY FABRIC

49+70.00 -L- 93.50

CL "B" RIP RAP W/FILTER FABRIC LINER EST. 5 TONS EST. 16 SY FABRIC HEADWALL

50+55.00 -L- 97.07

BORE AND JACK 36" SMOOTH STEEL PIPE W/ 0.50" WALL THICKNESS

49+60.00 -L- 193.09

50+00.00 -L- 195.05

RETAIN

STD. BASE DITCH EST. 115 CY DDE SEE DETAIL 6E

CL "B" RIP RAP W/FILTER FABRIC LINER EST. 7 TONS EST. 22 SY FABRIC

49+50.00 -L- 230.00

49+60.00 -L- 220.00

49+95.00 -L- 235.00

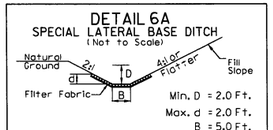
49+90.00 -L- 225.00

STD. BASE DITCH W/CLASS "I"RIP RAP EST. 12 TONS EST. 15 SY FABRIC EST. 220 CY DDE SEE DETAIL 6F

20-A LENTZ PROPERTY MANAGEMENT, LLC

20-B HUBBARD REALITY & McGUIRE CONSTRUCTION

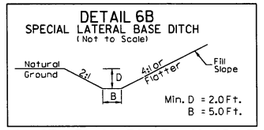
DETAIL 6A
SPECIAL LATERAL BASE DITCH (Not to Scale)



Type of Liner = CLASS "B" RIP RAP

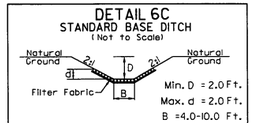
-L- STA. 36+00 TO -L- STA. 38+00 LT

DETAIL 6B
SPECIAL LATERAL BASE DITCH (Not to Scale)



-L- STA. 38+00 TO STA. 40+65 LT

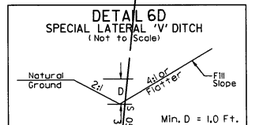
DETAIL 6C
STANDARD BASE DITCH (Not to Scale)



Type of Liner = CLASS "I" RIP RAP

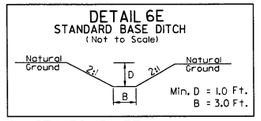
-L- STA. 40+64 RT

DETAIL 6D
SPECIAL LATERAL 'V' DITCH (Not to Scale)



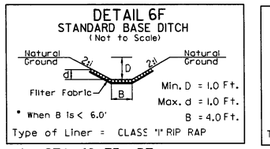
-L- STA. 40+65 TO STA. 42+50 LT
-L- STA. 43+00 TO STA. 44+00 LT
-L- STA. 48+50 TO STA. 50+60 LT

DETAIL 6E
STANDARD BASE DITCH (Not to Scale)



-L- STA. 50+15 RT

DETAIL 6F
STANDARD BASE DITCH (Not to Scale)

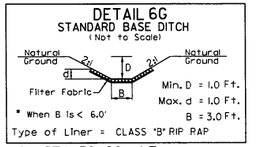


* When B Is < 6.0'

Type of Liner = CLASS "I" RIP RAP

-L- STA. 49+75 RT

DETAIL 6G
STANDARD BASE DITCH (Not to Scale)

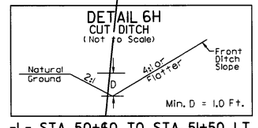


* When B Is < 6.0'

Type of Liner = CLASS "B" RIP RAP

-L- STA. 50+60 LT

DETAIL 6H
CUT DITCH (Not to Scale)



-L- STA. 50+60 TO STA. 51+50 LT

-L-

PIs Sta 38+43.98	PIs Sta 47+99.32	PI Sta 53+94.10
s = 3° 20' 00.9"	s = 3° 26' 46.9"	= 44° 18' 15.0" (LT)
Ls = 160.00'	Ls = 160.00'	D = 4° 18' 28.6"
LT = 106.69'	LT = 106.69'	L = 1,028.43
ST = 53.35'	ST = 53.35'	T = 541.47'
		R = 1,330.00'
		SE = 0.06

Permit Drawing
Sheet 2 of 15

12/5/2011
H:\Hydraulics\PERMITS_Environmental\Drawings\2707_hyd_prm_psh_06.dgn

PROJECT REFERENCE NO.	SHEET NO.
U-2707	6
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

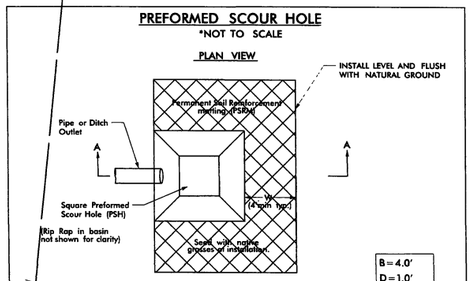
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS 6/17/99

12/5/2011 4:12:25 PM H:\Hydraulics\PERMITS_Environmental\Drawings\U2707_hyd_prm_psh_06.dgn

PREFORMED SCOUR HOLE
*NOT TO SCALE

PLAN VIEW



DETAIL 61

100' 0' 100' 200' 300'
GRAPHIC SCALE

DENOTES MECHANIZED CLEARING

NC GRID NAD 83

19 CLARK S. GENTRY AND WIFE LINDA C. GENTRY

21 OPAL B. WILSON

22 EDNA W. BINGHAM

N 05°28'18" W 962.75'

N 09°39'15" W 973.06'

SPEC. LAT BASE DITCH SEE DETAIL 6B

SPEC. LAT BASE DITCH W/CLASS "B"RIP RAP EST. 170 TONS EST. 680 SY FABRIC SEE DETAIL 6A

37+90.63 -L- 110.00

39+50.63 -L- 110.00

CHORD

ST Sta. 39+50.63

ES Sta. 37+90.63

SPEC. LAT "V" DITCH SEE DETAIL 6D

SPEC. LAT "V" DITCH SEE DETAIL 6D

SPEC. GRADE DITCH -L- STA. 44+00 TO 47+00

46+92.63 -L- 110.00

CHORD

TS Sta. 46+92.63

SC Sta. 48+52.63

48+52.63 -L- 110.00

STD. BASE DITCH W/CLASS "B"RIP RAP EST. 20 TONS EST. 50 SY FABRIC EST. 225 CY DDE SEE DETAIL 6G

SPEC. LAT "V" DITCH SEE DETAIL 6D

51+05.00 -L- 110.00

50+95.00 -L- 110.00

51+05.00 -L- 160.00

CUT DITCH SEE DETAIL 6H

50+95.00 -L- 150.00

50+70.00 -L- 155.00

50+60.00 -L- 165.00

50+50.00 -L- 110.00

50+35.00 -L- 110.00

HEADWALL

15" RCP IV

15" CSP W/ 2 ELBOWS

P.S.H. SEE DETAIL 6I

CL "I" RIP RAP W/FILTER FABRIC LINER EST. 49 SY EST. 26 TONS EST. 50 SY FABRIC

RETAIN

38+25.00 -L- 85.00 64.35

39+15.00 -L- 85.00 59.80

39+70.00 -L- 85.00 58.86

BORE AND JACK 48" SMOOTH STEEL PIPE W/ .625" WALL THICKNESS

40+30.00 -L- 145.00 60.88

40+50.00 -L- 159.74

40+40.00 -L- 165.00 59.55

40+65.00 -L- 215.00

40+85.00 -L- 169.71

40+90.00 -L- 180.00

41+00.00 -L- 185.00

40+70.00 -L- 200.00

CL "I" RIP RAP W/FILTER FABRIC LINER EST. 49 S.Y. EST. 26 TONS EST. 50 SY FABRIC

STANDARD BASE DITCH W/CLASS "I"RIP RAP EST. 1 TONS EST. 2 SY FABRIC SEE DETAIL 6C

37+70.00 -L- 85.00 67.56

Q10 = 45.5cfs
V10 = 1.97fps

SITE 1

NORFOLK SOUTHERN RR

EXISTING RIGHT OF WAY

EXISTING R/R RIGHT OF WAY

+83.03 76.30'

CL "B" RIP RAP W/FILTER FABRIC LINER EST. 2 TONS EST. 7 SY FABRIC

CL "B" RIP RAP W/FILTER FABRIC LINER EST. 5 TONS EST. 16 SY FABRIC HEADWALL

49+70.00 -L- 93.50

50+55.00 -L- 97.01

BORE AND JACK 36" SMOOTH STEEL PIPE W/ 0.50" WALL THICKNESS

49+60.00 -L- 193.09

50+00.00 -L- 195.05

RETAIN

STD. BASE DITCH EST. 115 CY DDE SEE DETAIL 6E

CL "B" RIP RAP W/FILTER FABRIC LINER EST. 7 TONS EST. 22 SY FABRIC

49+50.00 -L- 230.00

49+60.00 -L- 220.00

49+95.00 -L- 235.00

49+90.00 -L- 225.00

STD. BASE DITCH W/CLASS "I"RIP RAP EST. 12 TONS EST. 15 SY FABRIC EST. 220 CY DDE SEE DETAIL 6F

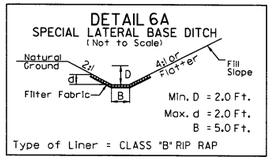
20-A LENTZ PROPERTY MANAGEMENT, LLC

20-B HUBBARD REALITY & McGUIRE CONSTRUCTION

MATCH LINE -L- STA 37+50

MATCH LINE -L- STA 51+50

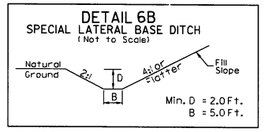
DETAIL 6A
SPECIAL LATERAL BASE DITCH
(Not to Scale)



Type of Liner = CLASS "B" RIP RAP

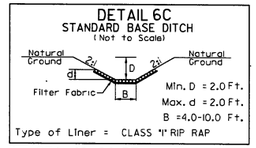
-L- STA. 36+00 TO -L- STA. 38+00 LT

DETAIL 6B
SPECIAL LATERAL BASE DITCH
(Not to Scale)



-L- STA. 38+00 TO STA. 40+65 LT

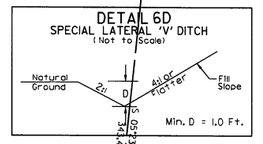
DETAIL 6C
STANDARD BASE DITCH
(Not to Scale)



Type of Liner = CLASS "I" RIP RAP

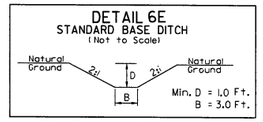
-L- STA. 40+64 RT

DETAIL 6D
SPECIAL LATERAL 'V' DITCH
(Not to Scale)



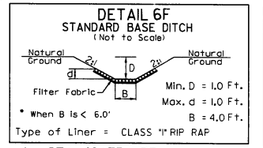
-L- STA. 40+65 TO STA. 42+50 LT
-L- STA. 43+00 TO STA. 44+00 LT
-L- STA. 48+50 TO STA. 50+60 LT

DETAIL 6E
STANDARD BASE DITCH
(Not to Scale)



-L- STA. 50+15 RT

DETAIL 6F
STANDARD BASE DITCH
(Not to Scale)

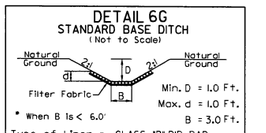


* When B Is < 6.0'

Type of Liner = CLASS "I" RIP RAP

-L- STA. 49+75 RT

DETAIL 6G
STANDARD BASE DITCH
(Not to Scale)

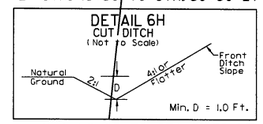


* When B Is < 6.0'

Type of Liner = CLASS "B" RIP RAP

-L- STA. 50+60 LT

DETAIL 6H
CUT DITCH
(Not to Scale)



-L- STA. 50+60 TO STA. 51+50 LT

-L-

PI Sta 38+43.98	PI Sta 47+99.32	PI Sta 53+94.10
s = 3° 20' 00.9"	s = 3° 26' 46.9"	= 44° 18' 15.0" (LT)
Ls = 160.00'	Ls = 160.00'	D = 4° 18' 28.6"
LT = 106.69'	LT = 106.69'	L = 1,028.43
ST = 53.35'	ST = 53.35'	T = 541.47'
		R = 1,330.00'
		SE = 0.06

Permit Drawing Sheet 3 of 15

PROJECT REFERENCE NO.	SHEET NO.
U-2707	6
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

8/17/99

REVISIONS

CHORD

ST Sta. 39+50.63

CS Sta. 37+90.63

HEADWALL

48"

NC GRID NAD 83

-L-

N 80° 59' 01.7" E

2GI

15" RCP IV

2GI

12

15" CSP W/ 2 ELBOWS

P.S.H. SEE DETAIL 6I

13

14

HEADWALL

48"

CL. "I" RIP RAP W/FILTER FABRIC LINER EST. 49 S.Y. EST. 26 TONS EST. 50 SY FABRIC

RETAIN

6' CMP

13

NORFOLK SOUTHERN R

15

38+25.00 -L-
85.00
64.35

39+15.00 -L-
85.00
59.80

39+70.00 -L-
85.00
58.86

BORE AND JACK 48" SMOOTH STEEL PIPE W/ 0.625" WALL THICKNESS

40+90.00 -L-
145.00
60.88

100.00'

40+50.00 -L-
159.74

40+40.00 -L-
165.00
59.55

40+65.00 -L-
215.00

37+70.00 -L-
85.00
67.56

40+85.00 -L-
160.77

40+90.00 -L-
180.00

41+00.00 -L-
185.00

40+70.00 -L-
200.00

CL. "I" RIP RAP W/FILTER FABRIC LINER EST. 49 S.Y. EST. 26 TONS EST. 50 SY FABRIC

STANDARD BASE DITCH W/CLASS "I"RIP RAP EST. 1 TONS EST. 2 SY FABRIC SEE DETAIL 6C

EXISTING R/R RIGHT OF

Q10 = 45.5cfs
V10 = 1.97fps

SITE 1

Permit Drawing
Sheet 4 of 15

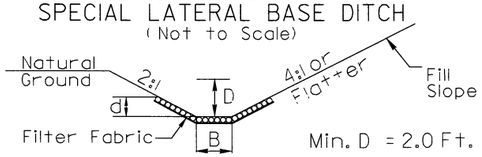
20-A

LENTZ PROPERTY MANAGE

DENOTES MECHANIZED CLEARING

50' 0' 50' 100' 150'
GRAPHIC SCALE

DETAIL 6A
SPECIAL LATERAL BASE DITCH
(Not to Scale)

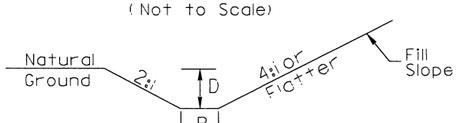


Min. D = 2.0 Ft.
Max. d = 2.0 Ft.
B = 5.0 Ft.

Type of Liner = CLASS "B" RIP RAP

-L- STA. 36+00 TO -L- STA. 38+00 LT

DETAIL 6B
SPECIAL LATERAL BASE DITCH
(Not to Scale)



Min. D = 2.0 Ft.
B = 5.0 Ft.

-L- STA. 38+00 TO STA. 40+65 L

12/5/2011
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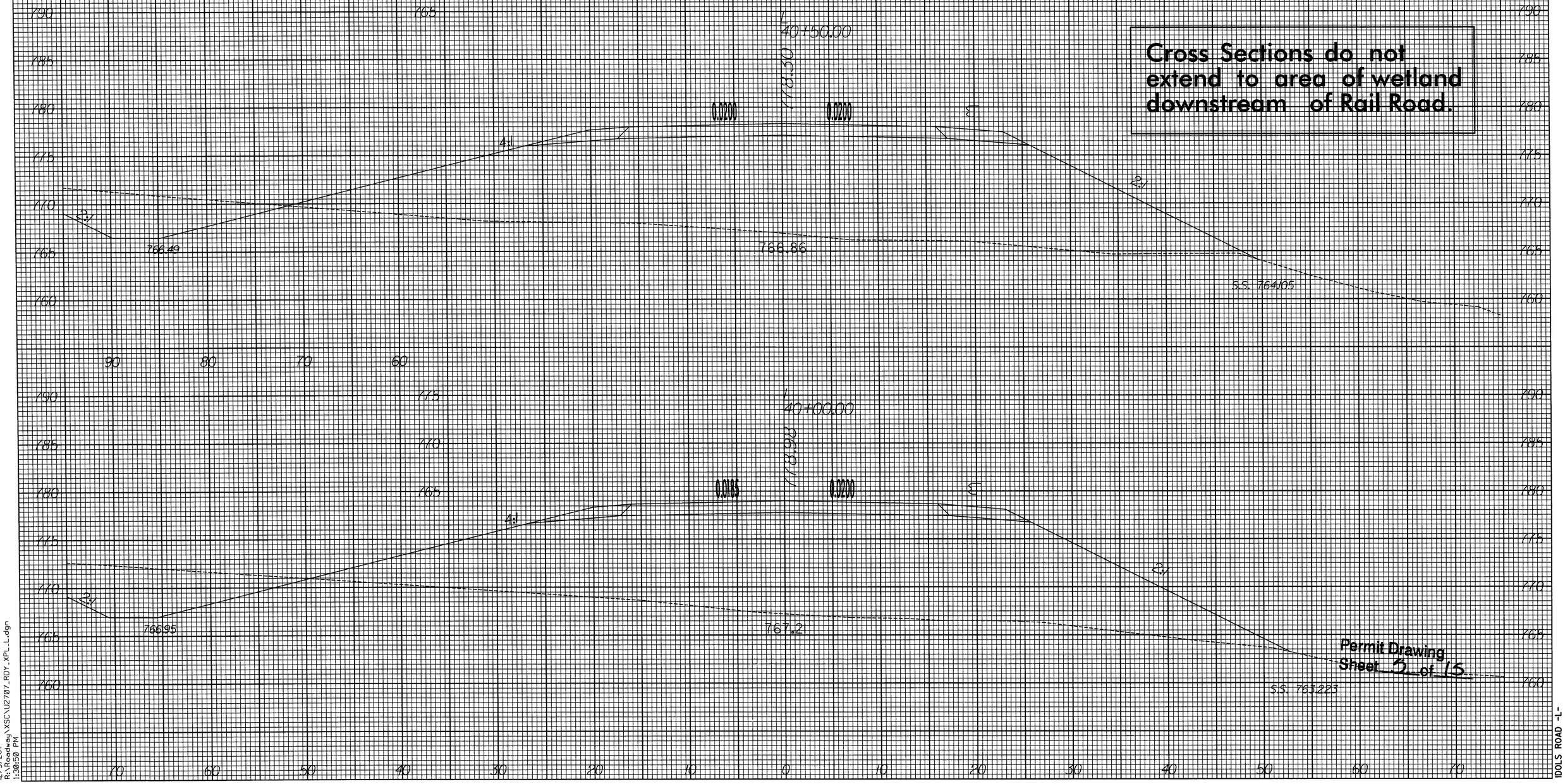
0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	U-2707	X-26

SITE 1

12/5/2011

Cross Sections do not extend to area of wetland downstream of Rail Road.



Permit Drawing
Sheet 3 of 15

12/5/2011
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IDOLS ROAD -L-

8/17/99

PROJECT REFERENCE NO.	SHEET NO.
U-2707	8
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

100' 0' 100' 200' 300'
GRAPHIC SCALE

F F DENOTES FILL IN WETLAND

S F DENOTES IMPACTS IN SURFACE WATER

NAD 83

NC GRID NAD 83

MATCH LINE -L- STA 65+00

MATCH LINE -L- STA 79+00

60" CMP INV 696.58'

695.85'

48" RW

STREAM P...

22 EDNA W. BINGHAM

SEE MITIGATION PLANS

68+05.00 -L- 145.00

68+05.00 -L- 160.00

67+95.00 -L- 110.00

67+85.00 -L- 110.00

67+85.00 -L- 130.00

67+70.00 -L- 135.00

STD. BASE DITCH W/CLASS "I" RIP RAP EST. 65 TONS EST. 100 SY FABRIC EST. 175 CY DDE SEE DETAIL 8C

68+35.00 -L- 110.00

68+50.00 -L- 110.00

CL. "B" RIP RAP W/FILTER FABRIC LINER EST. 2 TONS EST. 7 SY FABRIC

LAT BASE DITCH EST. 137 CY DDE SEE DETAIL 8H

CUT DITCH SEE DETAIL 8D

POT Sta. 71+78.03 -L- =
POT Sta. 11+98.07 -DRI-
Δ = 106°11'41.92"

PT Sta. 13+18.27

EXISTING RIGHT OF WAY

72+26.26 -L- 110.00

72+05.48 -L- 110.03

PC Sta. 71+91.06

LAT "V" DITCH EST. 187 CY DDE SEE DETAIL 8E

PT Sta. 77+69.27

77+69.27 -L- 110.00

N 40° 08' 22.9" E

HEADWALL

19 15" F.S. 2GI

20

22 F.S. 2GI

EXISTING R/R RIGHT OF WAY

SPEC GRADE CUT DITCH SEE DETAIL 8D

70+45.08 -L- 66.91

PC Sta. 11+82.80

LAT BASE DITCH EST. 245 CY DDE SEE DETAIL 8A

23 24

15" CSP W/ 2 ELBOWS

CL. "B" RIP RAP W/FILTER FABRIC LINER EST. 2 TONS EST. 7 SY FABRIC

67+00.00 -L- 61.25

RIP RAP-TOE PROTECTION W/CLASS "B" RIP RAP EST. 48 TONS EST. 53 SY FABRIC SEE DETAIL 8F

68+15.00 -L- 95.00

RR SIGNAL

MP

-EY2B-

NORFOLK SOUTHERN RR

PC Sta. 10+54.61

13 NORFOLK SOUTHERN RR

CL. "I" RIP RAP W/FILTER FABRIC LINER EST. 49 S.Y. EST. 26 TONS EST. 50 SY FABRIC

SPECIAL HEADWALL

RETAIN

21

SITE 2

STD. BASE DITCH W/CLASS "I" RIP RAP EST. 14 TONS EST. 25 SY FABRIC EST. 20 CY DDE SEE DETAIL 8B

COLLAR

68+45.00 -L- 163.54

SPEC. LAT. "A" DITCH EST. 176 CY DDE SEE DETAIL 8E

68+85.00 -L- 105.00

BORE AND JACK 48" SMOOTH STEEL PIPE W/0.625" WALL THICKNESS

68+80.00 -L- 164.09

CL. "I" RIP RAP W/FILTER FABRIC LINER EST. 60 SY EST. 33 TONS EST. 62 SY FABRIC

68+75.00 -L- 300.00

68+65.00 -L- 315.00

68+95.00 -L- 295.00

RIP RAP AT EMBANKMENT W/CLASS "I" RIP RAP SEE DETAIL 8G

69+05.00 -L- 305.00

POT Sta. 10+00.00

N 80° 57' 59.9" W 1956.61'

HANES HOUSE HISTORIC PROPERTY DO NOT DISTURB

EXISTING R/R RIGHT OF WAY

SITE 4

23 KEITH HAROLD HASTINGS PATRICK OMAR DODSON

-DRI-

PI Sta 11+20.93
= 36° 00' 35.0" (RT)
D = 28° 06' 14.7"
L = 128.13'
T = 66.26'
R = 203.87'
SE = NC

PI Sta 12+50.65
= 8° 19' 40.8" (RT)
D = 6° 08' 51.4"
L = 135.47'
T = 67.85'
R = 932.00'
SE = NC

-L-

PI Sta 74+80.95
= 10° 21' 10.0" (RT)
D = 1° 47' 25.8"
L = 578.21'
T = 289.89'
R = 3,200.00'
SE = 0.04

S75°38'41"E 958.15'

S85°27'07"E 958.15'

DETAIL 8A
LATERAL BASE DITCH
(Not to Scale)

Natural Ground, 2%, D, 2%, b, Fill Slope, 1':1Ft., B
Min. D = 1.0 Ft.
B = 2.0 Ft.
b = 5.0 Ft.

DETAIL 8B
INLET / OUTLET TYPICAL
(Not to Scale)

Natural Ground, d, 2%, D, 2%, Natural Ground, VAR, Filter Fabric, B
Min. D = 1.0 Ft.
Max. d = 1.0 Ft.
B = 5.0 Ft.
* When B Is < 6.0'
Type of Liner = CLASS "I" RIP RAP

DETAIL 8C
STANDARD BASE DITCH
(Not to Scale)

Natural Ground, 2%, d, D, 2%, Natural Ground, Filter Fabric, B
Min. D = 1.0 Ft.
Max. d = 1.0 Ft.
B = 5.0 Ft.
* When B Is < 6.0'
Type of Liner = CLASS "I" RIP RAP

DETAIL 8D
CUT DITCH
(Not to Scale)

Natural Ground, 2%, D, 4:1 or Flatter, Front Ditch Slope
Min. D = 1.0 Ft.

DETAIL 8E
LATERAL 'V' DITCH
(Not to Scale)

Natural Ground, 2%, D, 2%, b, Fill Slope, 1':1Ft.
Min. D = 1.0 Ft.
b = 5.0 Ft.

DETAIL 8H
LATERAL BASE DITCH
(Not to Scale)

Natural Ground, 2%, d, D, 2%, b, Fill Slope, 1':1Ft., Filter Fabric, B
Min. D = 1.0 Ft.
Max. d = 1.0 Ft.
B = 2.0 Ft.
b = 5.0 Ft.
* When B Is < 6.0'
Type of Liner = CLASS "B" RIP RAP

DETAIL 8F
TOE PROTECTION
(Not to Scale)

2:1 OR FLATTER Fill Slope, d, 2:1 OR FLATTER Fill Slope, Filter Fabric
d = 2.0 Ft.
Type of Liner = CLASS "B" RIP RAP

DETAIL 8G
RIP RAP AT EMBANKMENT
(Not to Scale)

Ditch Grade, 5', 1.5, 1, 0.0, Est. 3 Tons
Type of Liner = CLASS "I" RIP RAP

Permit Drawing
Sheet 6 of 15

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8/17/99

PROJECT REFERENCE NO.	SHEET NO.
U-2707	8
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

100' 0' 100' 200' 300'
GRAPHIC SCALE

F F DENOTES FILL IN WETLAND

S S DENOTES IMPACTS IN SURFACE WATER

NAD 83

NC GRID NAD 83

MATCH LINE -L- STA 65+00

MATCH LINE -L- STA 79+00

SEE MITIGATION PLANS

STREAM P...

EDNA W. BINGHAM

60" CMP INV. 696.56'

695.65'

48" RCP

48" CMP

48" WW

48" RCP

18" CMP

22

68+05.00 -L- 145.00

68+05.00 -L- 160.00

67+95.00 -L- 110.00

67+85.00 -L- 110.00

67+85.00 -L- 130.00

67+70.00 -L- 135.00

STD. BASE DITCH W/CLASS "I" RIP RAP EST. 65 TONS EST. 100 SY FABRIC EST. 175 CY DDE SEE DETAIL 8C

POT Sta.71+78.03 -L- = POT Sta.11+98.07 -DRI- Δ= 106°11'41.92"

PT Sta. 13+18.27

68+35.00 -L- 110.00

68+80.00 -L- 110.00

72+26.26 -L- 110.00

72+05.48 -L- 110.03

PC Sta. 71+91.06

PT Sta. 77+69.27

77+69.27 -L- 110.00

CL "B" RIP RAP W/FILTER FABRIC LINER EST. 2 TONS EST. 7 SY FABRIC

LAT BASE DITCH EST. 137 CY DDE SEE DETAIL 8H

CUT DITCH SEE DETAIL 8D

LAT "V" DITCH EST. 187 CY DDE SEE DETAIL 8E

HEADWALL

19

20

23

N 40° 08' 22.9" E

N 40° 08' 22.9" E

F.S. 2GI

EXISTING R/R RIGHT OF WAY

SPEC GRADE CUT DITCH SEE DETAIL 8D

67+00.00 -L- 61.25

RIP RAP TOE PROTECTION W/CLASS "B" RIP RAP EST. 48 TONS EST. 53 SY FABRIC SEE DETAIL 8F

68+55.00 -L- 66.91

70+45.00 -L- 66.91

PC Sta. 11+92.80

10+54.67

NORFOLK SOUTHERN RR

FY2B-107-7

CL "B" RIP RAP W/FILTER FABRIC LINER EST. 2 TONS EST. 7 SY FABRIC

CL "I" RIP RAP W/FILTER FABRIC LINER EST. 49 S.Y. EST. 26 TONS EST. 50 SY FABRIC

SPECIAL HEADWALL

RETAIN

21

SPEC LAT "V" DITCH EST. 176 CY DDE SEE DETAIL 8E

68+85.00 -L- 105.00

BORE AND JACK 48" SMOOTH STEEL PIPE W/0.625" WALL THICKNESS

68+80.00 -L- 164.09

68+45.00 -L- 163.54

CL "I" RIP RAP W/FILTER FABRIC LINER EST. 60 SY EST. 33 TONS EST. 62 SY FABRIC

68+75.00 -L- 300.00

68+65.00 -L- 315.00

68+95.00 -L- 295.00

69+05.00 -L- 305.00

RIP RAP AT EMBANKMENT W/CLASS "I" RIP RAP SEE DETAIL 8G

N 81° 34' 59.2" W 1286.61'

S 15° 38' 18" W 528.15'

S 85° 17' 02" E

POT Sta. 10+00.00

HANES HOUSE HISTORIC PROPERTY DO NOT DISTURB

SITE 2

SITE 4

KEITH HAROLD HASTINGS
PATRICK OMAR DODSON

-DRI-

PI Sta 11+20.93
= 36° 00' 35.0" (RT)
D = 28° 06' 14.7"
L = 128.13'
T = 66.26'
R = 203.87'
SE = NC

PI Sta 12+50.65
= 8° 19' 40.8" (RT)
D = 6° 08' 51.4"
L = 135.47'
T = 67.85'
R = 932.00'
SE = NC

-L-

PI Sta 74+80.95
= 10° 21' 10.0" (RT)
D = 1° 47' 25.8"
L = 578.21'
T = 289.89'
R = 3,200.00'
SE = 0.04

DETAIL 8A
LATERAL BASE DITCH
(Not to Scale)
Natural Ground, 2:1, D, 2:1, b, 1':1Ft., Fill Slope, B
Min. D = 1.0 Ft.
B = 2.0 Ft.
b = 5.0 Ft.

DETAIL 8B
INLET / OUTLET TYPICAL
(Not to Scale)
Natural Ground, d, 2:1, D, VAR, 2:1, Natural Ground, d, Filter Fabric, B
Min. D = 1.0 Ft.
Max. d = 1.0 Ft.
B = 5.0 Ft.
* When B Is < 6.0'
Type of Liner = CLASS "I" RIP RAP

DETAIL 8C
STANDARD BASE DITCH
(Not to Scale)
Natural Ground, d, 2:1, D, 2:1, Natural Ground, Filter Fabric, B
Min. D = 1.0 Ft.
Max. d = 1.0 Ft.
B = 5.0 Ft.
* When B Is < 6.0'
Type of Liner = CLASS "I" RIP RAP

DETAIL 8D
CUT DITCH
(Not to Scale)
Natural Ground, 2:1, D, 4:1 or Flatter, Front Ditch Slope
Min. D = 1.0 Ft.

DETAIL 8E
LATERAL 'V' DITCH
(Not to Scale)
Natural Ground, 2:1, D, 2:1, b, 1':1Ft., Fill Slope
Min. D = 1.0 Ft.
b = 5.0 Ft.

DETAIL 8H
LATERAL BASE DITCH
(Not to Scale)
Natural Ground, 2:1, D, 2:1, b, 1':1Ft., Fill Slope, d, Filter Fabric, B
Min. D = 1.0 Ft.
Max. d = 1.0 Ft.
B = 2.0 Ft.
b = 5.0 Ft.
* When B Is < 6.0'
Type of Liner = CLASS "B" RIP RAP

DETAIL 8F
TOE PROTECTION
(Not to Scale)
2:1 OR FLATTER, Fill Slope, d, 2:1 OR FLATTER, Fill Slope, Filter Fabric
d = 2.0 Ft.
Type of Liner = CLASS "B" RIP RAP

DETAIL 8G
RIP RAP AT EMBANKMENT
(Not to Scale)
Ditch Grade, 5', 1.5, 0.0, Est. 3 Tons
Type of Liner = CLASS "I" RIP RAP

Permit Drawing
Sheet 7 of 15

12/5/2011
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8/17/99

PROJECT REFERENCE NO.	SHEET NO.
U-2707	8
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NC GRID NAD 83

110.00

67+85.00 -L-
110.00

67+85.00 -L-
130.00

68+35.00 -L-
110.00

68+50.00 -L-
110.00

67+70.00 -L-
135.00

POT Sta.11+98.07 -DRI-
Δ= 106°11'41.92"

CL. "B" RIP RAP
W/FILTER FABRIC LINER
EST. 2 TONS
EST. 7 SY FABRIC

LAT BASE DITCH
EST. 137 CY DDE
SEE DETAIL 8H

CUT DITCH
SEE DETAIL 8D

HEADWALL

19

15"

2GI

F.S.

20

48"

N 29°47'52.9" E

-L-

22

F.S. 2GI

15"

EXISTING R/R RIGHT OF WAY

SPEC GRADE CUT DITCH
SEE DETAIL 8D

67+00.00 -L-
61.25

RIP RAP TOE
PROTECTION
W/CLASS "B" RIP RAP
EST. 48 TONS
EST. 53 SY FABRIC
SEE DETAIL 8F

68+15.00 -L-
85.00

70+45.00 -L-
66.91

MP

RR SIGNAL

-EY2B-

CL. "B" RIP RAP
W/FILTER FABRIC LINER
EST. 2 TONS
EST. 7 SY FABRIC

WD

EXISTING R/R RIGHT OF WAY

CL. "I" RIP RAP
W/FILTER FABRIC LINER
EST. 49 S.Y.
EST. 26 TONS
EST. 50 SY FABRIC

SPECIAL
HEADWALL

21

SPEC. LAT "V" DITCH
EST. 176 CY DDE
SEE DETAIL 8E

68+85.00 -L-
105.00

RETAIN

STD. BASE DITCH
W/CLASS "I" RIP RAP
EST. 14 TONS
EST. 25 SY FABRIC
EST. 20 CY DDE
SEE DETAIL 8B

68+45.00 -L-
163.54

COLLAR

BORE AND JACK
48" SMOOTH STEEL PIPE
W/0.625" WALL THICKNESS

68+80.00 -L-
164.09

POT Sta. 10+00.00

SITE 2

DENOTES IMPACTS IN SURFACE WATER

CL. "I" RIP RAP
W/FILTER FABRIC LINER
EST. 60 SY
EST. 33 TONS
EST. 62 SY FABRIC

68+75.00 -L-
300.00

68+65.00 -L-
315.00

68+95.00 -L-
295.00

RIP RAP AT EMBANKMENT
W/CLASS "I" RIP RAP
SEE DETAIL 8G

69+05.00 -L-
305.00

-DRI-

50' 0' 50' 100' 150'
GRAPHIC SCALE

Permit Drawing
Sheet 8 of 15

DETAIL 8A
LATERAL BASE DITCH
(Not to Scale)

DETAIL 8B
INLET / OUTLET TYPICAL
(Not to Scale)

12/5/2011
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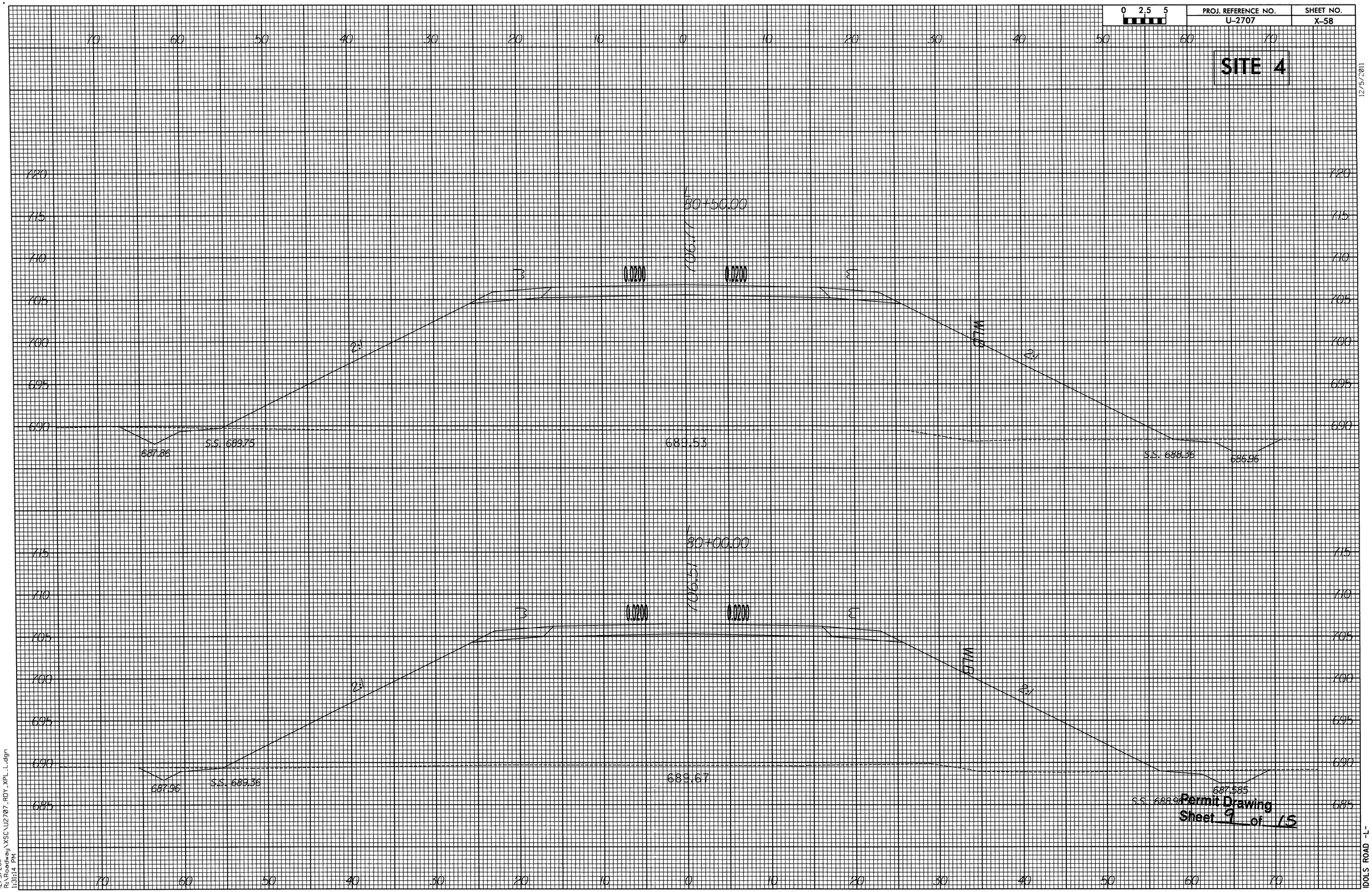
0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	U-2707	X-58

SITE 4

12/5/2011



Permit Drawing
Sheet 9 of 15

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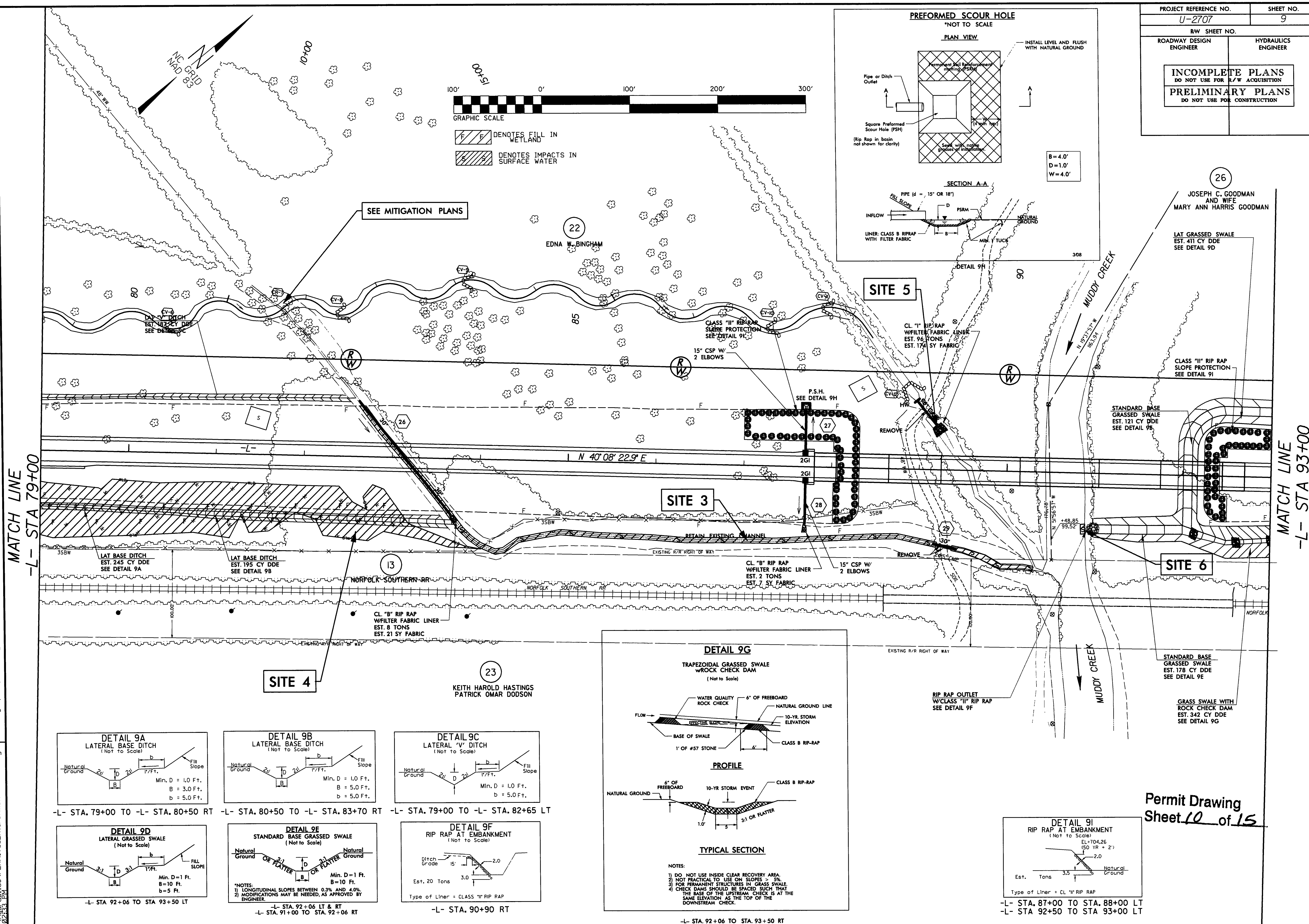
IDOLS ROAD -L-



PROJECT REFERENCE NO. U-2707
SHEET NO. 9
R/W SHEET NO.
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
INCOMPLETE PLANS DO NOT USE FOR R/W ACQUISITION
PRELIMINARY PLANS DO NOT USE FOR CONSTRUCTION
PREFORMED SCOUR HOLE
*NOT TO SCALE
PLAN VIEW
SECTION A-A
B=4.0'
D=1.0'
W=4.0'
GRAPHIC SCALE
DENOTES FILL IN WETLAND
DENOTES IMPACTS IN SURFACE WATER
SEE MITIGATION PLANS
EDNA W. BINGHAM
JOSEPH C. GOODMAN AND WIFE MARY ANN HARRIS GOODMAN
KEITH HAROLD HASTINGS
PATRICK OMAR DODSON
NORFOLK SOUTHERN RR
MUDDY CREEK
SITE 3
SITE 4
SITE 5
SITE 6
N 40°08' 22.9" E
MATCH LINE -L- STA 79+00
MATCH LINE -L- STA 93+00
LAT BASE DITCH EST. 245 CY DDE SEE DETAIL 9A
LAT BASE DITCH EST. 195 CY DDE SEE DETAIL 9B
CL. "B" RIP RAP W/FILTER FABRIC LINER EST. 8 TONS EST. 21 SY FABRIC
CL. "B" RIP RAP W/FILTER FABRIC LINER EST. 2 TONS EST. 7 SY FABRIC
15" CSP W/ 2 ELBOWS
CLASS "II" RIP RAP SLOPE PROTECTION SEE DETAIL 9I
CL. "I" RIP RAP W/FILTER FABRIC LINER EST. 96 TONS EST. 174 SY FABRIC
P.S.H. SEE DETAIL 9H
RETAIN EXISTING CHANNEL
LAT GRASSED SWALE EST. 411 CY DDE SEE DETAIL 9D
STANDARD BASE GRASSED SWALE EST. 121 CY DDE SEE DETAIL 9E
STANDARD BASE GRASSED SWALE EST. 178 CY DDE SEE DETAIL 9E
GRASS SWALE WITH ROCK CHECK DAM EST. 342 CY DDE SEE DETAIL 9G
RIP RAP OUTLET W/CLASS "II" RIP RAP SEE DETAIL 9F
EXISTING R/W RIGHT OF WAY
REMOVE
DETAIL 9A LATERAL BASE DITCH (Not to Scale) Min. D = 1.0 Ft. B = 3.0 Ft. b = 5.0 Ft.
-L- STA. 79+00 TO -L- STA. 80+50 RT
DETAIL 9B LATERAL BASE DITCH (Not to Scale) Min. D = 1.0 Ft. B = 3.0 Ft. b = 5.0 Ft.
-L- STA. 80+50 TO -L- STA. 83+70 RT
DETAIL 9C LATERAL 'V' DITCH (Not to Scale) Min. D = 1.0 Ft. b = 5.0 Ft.
-L- STA. 79+00 TO -L- STA. 82+65 LT
DETAIL 9D LATERAL GRASSED SWALE (Not to Scale) Min. D=1 Ft. B=10 Ft. b=5 Ft.
-L- STA 92+06 TO STA 93+50 LT
DETAIL 9E STANDARD BASE GRASSED SWALE (Not to Scale) Min. D=1 Ft. B=10 Ft.
*NOTES: 1) LONGITUDINAL SLOPES BETWEEN 0.3% AND 4.0%. 2) MODIFICATIONS MAY BE NEEDED, AS APPROVED BY ENGINEER.
-L- STA. 92+06 LT & RT
-L- STA. 91+00 TO STA. 92+06 RT
DETAIL 9F RIP RAP AT EMBANKMENT (Not to Scale) Est. 20 Tons Type of Liner = CLASS "II" RIP RAP
-L- STA. 90+90 RT
DETAIL 9G TRAPEZOIDAL GRASSED SWALE w/ROCK CHECK DAM (Not to Scale)
PROFILE
TYPICAL SECTION
NOTES:
1) DO NOT USE INSIDE CLEAR RECOVERY AREA.
2) NOT PRACTICAL TO USE ON SLOPES > 5%.
3) FOR PERMANENT STRUCTURES IN GRASS SWALE.
4) CHECK DAMS SHOULD BE SPACED SUCH THAT THE BASE OF THE UPSTREAM CHECK IS AT THE SAME ELEVATION AS THE TOP OF THE DOWNSTREAM CHECK.
-L- STA. 92+06 TO STA. 93+50 RT
DETAIL 9I RIP RAP AT EMBANKMENT (Not to Scale) EL=704.26 (50 YR + 2') Type of Liner = CL "II" RIP RAP
-L- STA. 87+00 TO STA. 88+00 LT
-L- STA 92+50 TO STA 93+00 LT
Permit Drawing Sheet 10 of 15
REVISIONS
8/17/99
12/5/2011 R:\Hydraulics\PERMITS_Environmental\Drawings\u2707_hyd_prm_psh_09.dgn

PROJECT REFERENCE NO.	SHEET NO.
U-2707	9
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS 8/17/99

N.C. GRID NAD 83

10+00 15+00

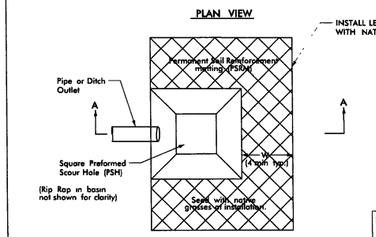
100' 0' 100' 200' 300'
GRAPHIC SCALE

F F DENOTES FILL IN WETLAND

S S DENOTES IMPACTS IN SURFACE WATER

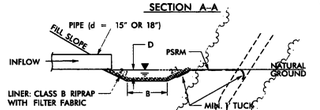
PREFORMED SCOUR HOLE
*NOT TO SCALE

PLAN VIEW



B=4.0'
D=1.0'
W=4.0'

SECTION A-A



3/08

SEE MITIGATION PLANS

22 EDNA W. BINGHAM

DAT 'V' DITCH
EST. 182 CY DDE
SEE DETAIL 9C

CLASS "II" RIP-RAP SLOPE PROTECTION SEE DETAIL 9I

15" CSP W/ 2 ELBOWS

P.S.H. SEE DETAIL 9H

SITE 5

DETAIL 9H

CL "I" RIP RAP W/FILTER FABRIC LINER
EST. 96 TONS
EST. 174 SY FABRIC

REMOVE

MUDDY CREEK

N 15°51'54" W
166.19'

26 JOSEPH C. GOODMAN AND WIFE MARY ANN HARRIS GOODMAN

LAT GRASSED SWALE
EST. 411 CY DDE
SEE DETAIL 9D

CLASS "II" RIP-RAP SLOPE PROTECTION SEE DETAIL 9I

STANDARD BASE GRASSED SWALE
EST. 121 CY DDE
SEE DETAIL 9E

-L- N 40° 08' 22.9" E

2GI

SITE 3

RETAIN EXISTING CHANNEL

N 35°52'57" W
+48.85
99.52'

SITE 6

LAT BASE DITCH
EST. 245 CY DDE
SEE DETAIL 9A

LAT BASE DITCH
EST. 195 CY DDE
SEE DETAIL 9B

13

NORFOLK SOUTHERN RR

CL "B" RIP RAP
W/FILTER FABRIC LINER
EST. 2 TONS
EST. 7 SY FABRIC

15" CSP W/ 2 ELBOWS

REMOVE

CL "B" RIP RAP
W/FILTER FABRIC LINER
EST. 8 TONS
EST. 21 SY FABRIC

EXISTING R/R RIGHT OF WAY

SITE 4

23 KEITH HAROLD HASTINGS PATRICK OMAR DODSON

RIP RAP OUTLET W/CLASS "II" RIP RAP SEE DETAIL 9F

MUDDY CREEK

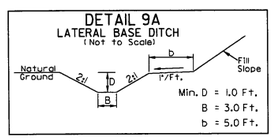
STANDARD BASE GRASSED SWALE
EST. 178 CY DDE
SEE DETAIL 9E

GRASS SWALE WITH ROCK CHECK DAM
EST. 342 CY DDE
SEE DETAIL 9G

MATCH LINE -L- STA 79+00

MATCH LINE -L- STA 93+00

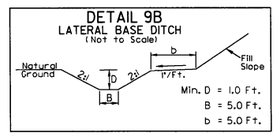
DETAIL 9A
LATERAL BASE DITCH
(Not to Scale)



Min. D = 1.0 Ft.
B = 3.0 Ft.
b = 5.0 Ft.

-L- STA. 79+00 TO -L- STA. 80+50 RT

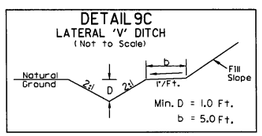
DETAIL 9B
LATERAL BASE DITCH
(Not to Scale)



Min. D = 1.0 Ft.
B = 5.0 Ft.
b = 5.0 Ft.

-L- STA. 80+50 TO -L- STA. 83+70 RT

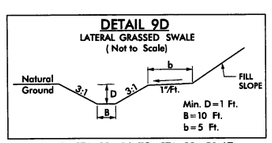
DETAIL 9C
LATERAL 'V' DITCH
(Not to Scale)



Min. D = 1.0 Ft.
b = 5.0 Ft.

-L- STA. 79+00 TO -L- STA. 82+65 LT

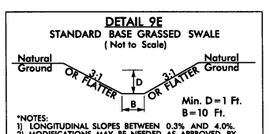
DETAIL 9D
LATERAL GRASSED SWALE
(Not to Scale)



Min. D=1 Ft.
B=10 Ft.
b=5 Ft.

-L- STA 92+06 TO STA 93+50 LT

DETAIL 9E
STANDARD BASE GRASSED SWALE
(Not to Scale)

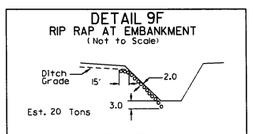


Min. D=1 Ft.
B=10 Ft.

*NOTES:
1) LONGITUDINAL SLOPES BETWEEN 0.3% AND 4.0%.
2) MODIFICATIONS MAY BE NEEDED, AS APPROVED BY ENGINEER.

-L- STA. 92+06 LT & RT
-L- STA. 91+00 TO STA. 92+06 RT

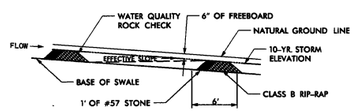
DETAIL 9F
RIP RAP AT EMBANKMENT
(Not to Scale)



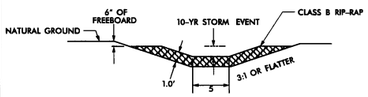
Type of Liner = CLASS "II" RIP RAP

-L- STA. 90+90 RT

DETAIL 9G
TRAPEZOIDAL GRASSED SWALE w/ROCK CHECK DAM
(Not to Scale)



PROFILE

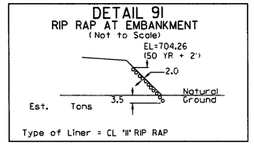


TYPICAL SECTION

NOTES:
1) DO NOT USE INSIDE CLEAR RECOVERY AREA.
2) NOT PRACTICAL TO USE ON SLOPES > 5%.
3) FOR PERMANENT STRUCTURES IN GRASS SWALE.
4) CHECK DAMS SHOULD BE SPACED SUCH THAT THE BASE OF THE UPSTREAM CHECK IS AT THE SAME ELEVATION AS THE TOP OF THE DOWNSTREAM CHECK.

-L- STA. 92+06 TO STA. 93+50 RT

DETAIL 9I
RIP RAP AT EMBANKMENT
(Not to Scale)



Type of Liner = CL "II" RIP RAP

-L- STA. 87+00 TO STA. 88+00 LT
-L- STA 92+50 TO STA 93+00 LT

Permit Drawing
Sheet 11 of 15

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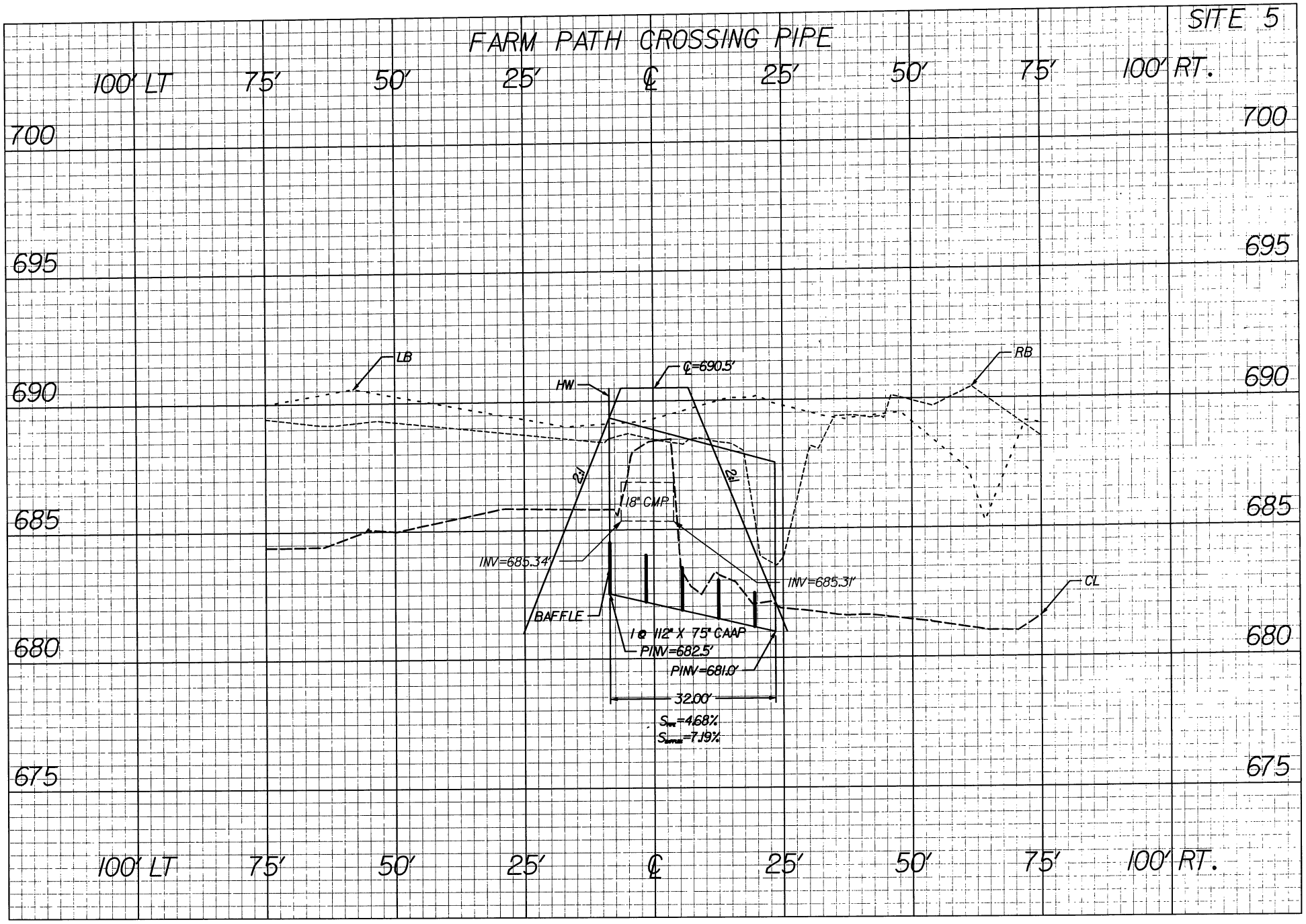
SITE 5
FARM PATH CROSSING PIPE
100' LT
75'
50'
25'
℄
25'
50'
75'
100' RT.
700
695
690
685
680
675
LB
RB
℄=690.5'
HW
2:1
2:1
18" CMP
INV=685.34'
INV=685.31'
BAFFLE
CL
1 @ 112" X 75" CAAP
PINV=682.5'
PINV=681.0'
32.00'
S_{min}=4.68%
S_{max}=7.19%

5/28/99

SEPI ENGINEERING GROUP
2300 REXWOODS DRIVE SUITE 370
RALEIGH, NC 27607
TEL: 919-789-9977 FAX: 789-9591

PROJECT REFERENCE NO.	SHEET NO.
U-2707	16
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

-L-

SPECIAL GRADE DITCH
-L- STA.66+50 TO 68+45 LT

STA= 66+50.00
EL= 728.00

(-)18.86%

STA= 67+50.00
EL= 719.14

(-)16.60%

(+)4.0%

(+)0.85%

SPECIAL GRADE DITCH
-L- STA.68+45 TO 69+50 RT

STA= 68+45.00
EL= 715.82

STA= 68+45.00
EL= 708.75

STA= 69+50.00
EL= 710.22

STA= 70+00.00
EL= 715.87

SPECIAL GRADE DITCH
-L- STA.70+00 TO 71+50 RT

STA= 70+00.00
EL= 720.58

(+)0.50%

STA= 71+50.00
EL= 714.62

VPC = 72+00.22
EL= 713.65

PI = 75+25.22
EL = 704.00'
K = 158
VC = 650'

(-)3.58%

(+)0.52%

STA= 74+00.00
EL= 693.03

(-)4.78%

(-)1.07%

STA= 73+00.00
EL= 696.56

STA= 74+00.00
EL= 691.78

SPECIAL GRADE DITCH
-L- STA.74+50 TO 82+65 LT

(-)0.92%

(-)0.77%

(-)0.48%

SPECIAL GRADE DITCH
-L- STA.73+00 TO 79+00 RT

VPT = 78+50.22
EL = 705.72

STA= 78+50.00
EL= 686.22

STA= 79+00.00
EL= 686.08

SEE SHEET 8 FOR -L- PLAN

BM #6 ELEV=715.26 R/R SPIKE IN BASE OF 44" OAK -L- STA. 75+58.48 (614.79' LT)

PIPE HYDRAULIC DATA
DRAINAGE STRUCTURE NO. 20

DRAINAGE AREA	= 26.53	AC
DESIGN FREQUENCY	= 50	YRS
DESIGN DISCHARGE	= 96.2	CFS
DESIGN HW ELEVATION	= 718.26	FT
100 YEAR DISCHARGE	= 111.8	CFS
100 YEAR HW ELEVATION	= 719.5	FT
OVERTOPPING FREQUENCY	= >100	YRS
OVERTOPPING DISCHARGE	= >100	CFS
OVERTOPPING ELEVATION	= 728.55	FT

-L-

SITE 6

PIPE HYDRAULIC DATA
DRAINAGE STRUCTURE NO. 26

DRAINAGE AREA	= 6.73	AC
DESIGN FREQUENCY	= 50	YRS
DESIGN DISCHARGE	= 19.97	CFS
DESIGN HW ELEVATION	= 689.13	FT
100 YEAR DISCHARGE	= 21.58	CFS
100 YEAR HW ELEVATION	= 689.28	FT
OVERTOPPING FREQUENCY	= >500	YRS
OVERTOPPING DISCHARGE	= >500	CFS
OVERTOPPING ELEVATION	= 710.74	FT

BRIDGE HYDRAULIC DATA

DESIGN DISCHARGE	= 18000	CFS
DESIGN FREQUENCY	= 50	YRS
DESIGN HW ELEVATION	= 702.2	FT
BASE DISCHARGE	= 19000	CFS
BASE FREQUENCY	= 100	YRS
BASE HW ELEVATION	= 702.6	FT
OVERTOPPING DISCHARGE	= 26000	CFS
OVERTOPPING FREQUENCY	= 100+	YRS
OVERTOPPING ELEVATION	= 704.8	FT
DATE OF SURVEY	= 10-2-03	
W.S. ELEVATION AT DATE OF SURVEY	= 679.9	FT

(-)0.92%

(-)0.20%

(-)0.19%

SPECIAL GRADE DITCH
-L- STA.80+50 TO 83+70 RT

STA= 80+00.00
EL= 687.96

STA= 80+50.00
EL= 686.96

STA= 82+65.00
EL= 687.43

STA= 83+70.00
EL= 696.35

SEE SHEET 9 FOR -L- PLAN

VPC = 92+49.23
EL = 713.54

(-)4.46%

(+)0.60%

STA= 92+15.00
EL= 693.90

STA= 92+15.00
EL= 693.75

SPECIAL GRADE DITCH
-L- STA.92+15 TO 100+50 RT

SPECIAL GRADE DITCH
-L- STA.91+00 TO 92+15 RT

STA= 91+00.00
EL= 688.00

BM #7 ELEV=693.90 R/R SPIKE IN BASE OF 18" ELM -L- STA. 92+06.11 (228.64' LT)

Permit Drawing
Sheet 12 of 15

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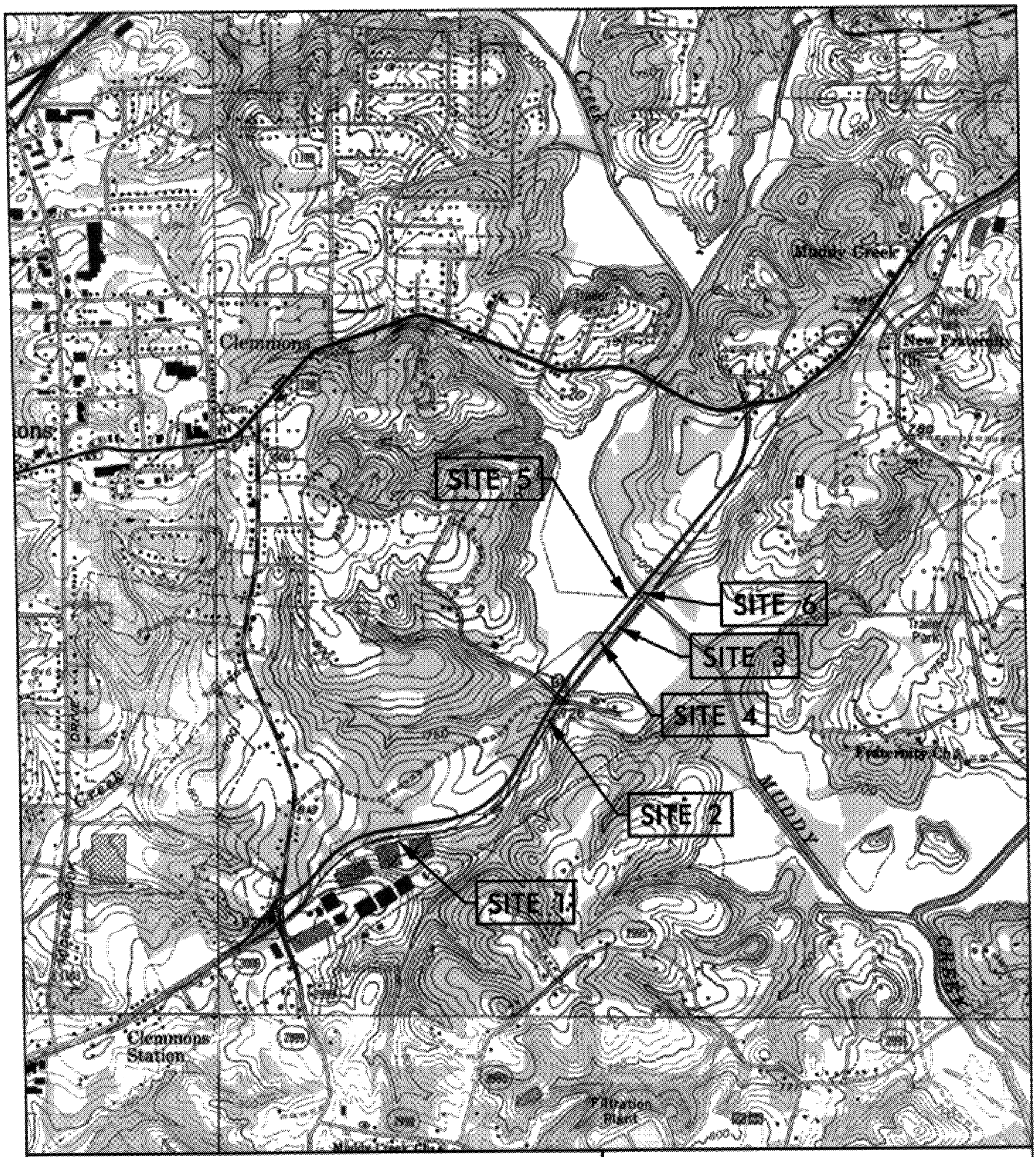


TOPO MAP

SCALE: 1" = 2000'

NCDOT

DIVISION OF HIGHWAYS
FORSYTH COUNTY
PROJECT: U-2707

SR 3000 (IDOLS ROAD), FROM SR 2999 (HAMPTON ROAD) TO US 158 (CLEMMONS ROAD)

PROPERTY OWNERS

NAMES AND ADDRESSES

REFERENCE NO.	NAMES	ADDRESSES
20-A	LENTZ PROPERTY MANAGEMENT, LLC	PO BOX 989 CLEMMONS, NC 27012
22	EDNA BINGHAM	PO BOX 5 CLEMMONS, NC 27012
13	NORFOLK SOUTHERN RR	THREE COMMERCIAL PLACE NORFOLK, VA 23510
26	JOSEPH C. GOODMAN MARY ANN HARRIS GOODMAN	3049 S. STRATFORD ROAD WINSTON SALEM, NC 27103

NCDOT

DIVISION OF HIGHWAYS

FORSYTH COUNTY

PROJECT: U-2707

SR 3000 (IDOLS ROAD), FROM
SR 2999 (HAMPTON ROAD)
TO US 158 (CLEMMONS ROAD)

WETLAND PERMIT IMPACT SUMMARY

Site No	Station (From/To)	Structure Size / Type	WETLAND IMPACTS					SURFACE WATER IMPACTS				
			Permanent Fill In Wetlands (ac)	Temp. Fill In Wetlands (ac)	Excavation in Wetlands (ac)	Mechanized Clearing in Wetlands (ac)	Hand Clearing in Wetlands (ac)	Permanent SW impacts (ac)	Temp. SW impacts (ac)	Existing Channel Impacts Permanent (ft)	Existing Channel Impacts Temp. (ft)	Natural Stream Design (ft)
1	-L- 40+80	48"				0.03						
2	-L- 68+50	48"						<0.01		61		
3	-L- 73+09 to 90+31	Roadway Fill						0.10		831		1876.5
4	-L- 75+98 to 84.02 Rt	Roadway Fill	0.78									
5*	-L- 89.00 Lt	1@96" CAAP										
6	-L- 90+85 Rt	Bank Stabilization						<0.01		11		
TOTALS			0.78			0.03		0.10		903		1876.5

* The proposed 96" CAAP is considered an enhancement due to the reconnection of the fish passage and hydrology, therefore no impacts will be calculated here.

NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

FORSYTH COUNTY
WBS : 34845.1.1 (U-2707)

SHEET 15 of 15 12/07/11

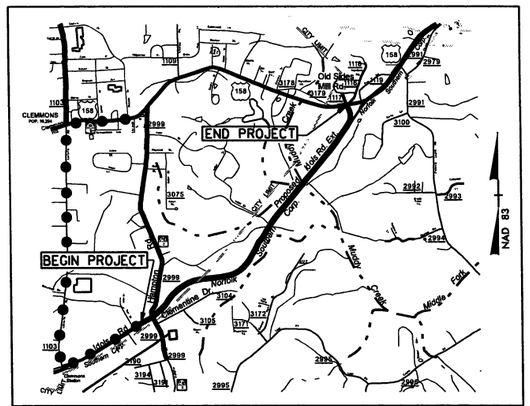
AIN Revised 3/31/05

7/01/99

TIP PROJECT: U-2707

CONTRACT:

See Sheet 1-A For Index of Sheets
See Sheet 1-B For Conventional Symbols



VICINITY MAP
FORSYTH COUNTY, NC

OFF SITE DETOUR ROUTE

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

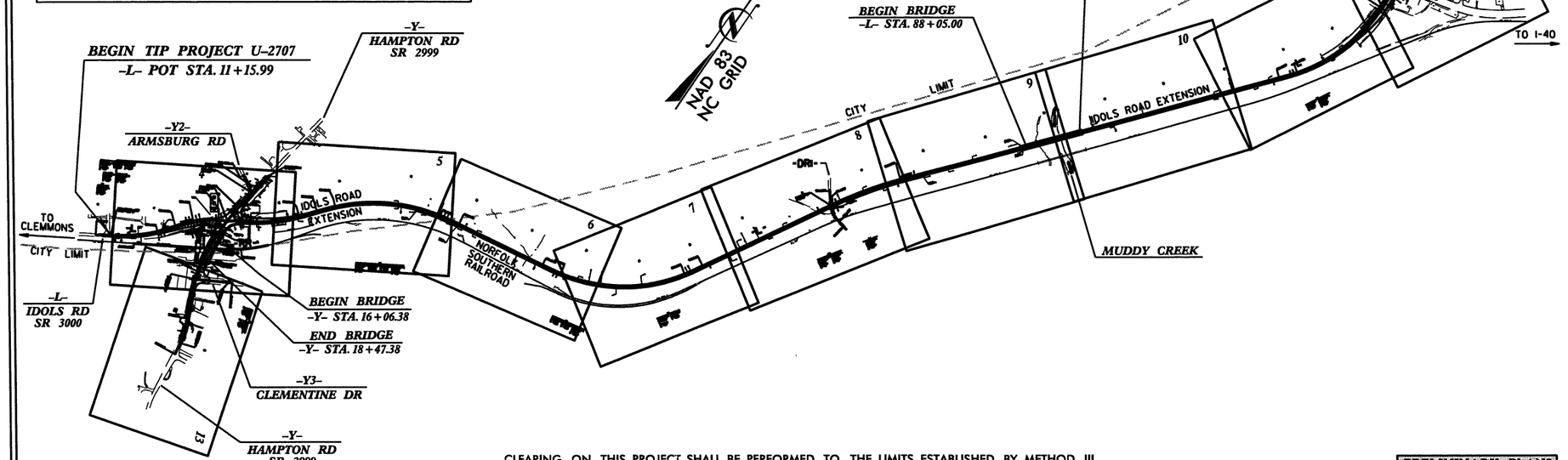
FORSYTH COUNTY

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	U-2707	1	

WBS NO.	F.A. PROJ. NO.	DESCRIP., ROW
34845.1.1	STP-3000(1)	P.E.
34845.2.1	STP-3000(1)	R/W & UTIL.
34845.2.2		

LOCATION: *CLEMMONS – SR 3000 (IDOLS ROAD), FROM SR 2999 (HAMPTON ROAD) TO US 158 (CLEMMONS ROAD)*

TYPE OF WORK: *GRADING, DRAINAGE, PAVING, STRUCTURES, SIGNING, AND SIGNALS*



CLEARING ON THIS PROJECT SHALL BE PERFORMED TO THE LIMITS ESTABLISHED BY METHOD III

A PORTION OF THIS PROJECT IS WITHIN THE MUNICIPAL BOUNDARIES OF CLEMMONS.

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

GRAPHIC SCALES

PLANS: 50 25 0 50 100

PROFILE (HORIZONTAL): 50 25 0 50 100

PROFILE (VERTICAL): 10 5 0 10 20

DESIGN DATA

ADT 2006 = 7800
ADT 2026 = 14467
DHV = 12 %
D = 60 %
T = 4 % *
V = 50 MPH

* TTST 1 % DUAL 3 %

PROJECT LENGTH

LENGTH ROADWAY TIP PROJECT U-2707 = 2.093 MILE

LENGTH STRUCTURE TIP PROJECT U-2707 = 0.083 MILE

TOTAL LENGTH TIP PROJECT U-2707 = 2.010 MILE

NOTE: PROJECT LENGTH FOR U-2707 DETERMINED BY USING -L-

Prepared in the Office of:
SEPI ENGINEERING GROUP
2300 Rexwoods Drive
Suite 370
Raleigh, NC 27607
Tel:919-789-9977 Fax:789-9591

2002 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE: FEBRUARY 18, 2005

LETTING DATE: NOVEMBER 21, 2006

NCDOT CONTACT

BRIAN D. SPEIGHT, PE
PROJECT ENGINEER

BRYON M. PALMER, PE
PROJECT DESIGN ENGINEER

CATHY S. HOUSER, PE
PROJECT ENGINEER ENGINEERING COORDINATION

HYDRAULICS ENGINEER

SIGNATURE: P.E.

ROADWAY DESIGN ENGINEER

SIGNATURE: P.E.

DIVISION OF HIGHWAYS STATE OF NORTH CAROLINA

STATE DESIGN ENGINEER P.E.

DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION

APPROVED
DIVISION ADMINISTRATOR DATE

$DATE$
15-FEB-2002 16:43
$USERNAME$
$FILENAME$

SEPI
ENGINEERING GROUP
2309 RENAISSANCE DRIVE SUITE 370
RALEIGH, NC 27607
TEL: 919-789-9977 FAX: 789-9979

PROJECT REFERENCE NO.	SHEET NO.
U-2707	2

ROADWAY DESIGN ENGINEER

PAVEMENT DESIGN ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

PAVEMENT SCHEDULE

C1	PROP. APPROX. 1.5 " ASPHALT CONCRETE SURFACE COURSE, TYPE S9.5B, AT AN AVERAGE RATE OF 168 LBS. PER SQ. YD.
C2	PROP. APPROX. 3.0" ASPHALT CONCRETE SURFACE COURSE, TYPE S9.5B, AT AN AVERAGE RATE OF 168 LBS. PER SQ. YD. IN EACH OF TWO LAYERS.
C3	PROP. VAR. DEPTH ASPHALT CONCRETE SURFACE COURSE, TYPE S9.5B, AT AN AVERAGE RATE OF 112 LBS. PER SQ. YD. PER 1" DEPTH. TO BE PLACED IN LAYERS NOT LESS THAN 1.5" IN DEPTH OR GREATER THAN 2.0" IN DEPTH.
D1	PROP. APPROX. 3.5" ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE I19.0B, AT AN AVERAGE RATE OF 399 LBS. PER SQ. YD.
D2	PROP. APPROX. 4.0" ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE I19.0B, AT AN AVERAGE RATE OF 456 LBS. PER SQ. YD.
D3	PROP. VAR. DEPTH ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE I19.0B, AT AN AVERAGE RATE OF 114 LBS. PER SQ. YD. PER 1" DEPTH, TO BE PLACED IN LAYERS NOT LESS THAN 2.5" IN DEPTH OR GREATER THAN 4.0" IN DEPTH.
E1	PROP. APPROX. 4.0" ASPHALT CONCRETE BASE COURSE, TYPE B25.0B, AT AN AVERAGE RATE OF 456 LBS. PER SQ. YD.
E2	PROP. APPROX. 5.0" ASPHALT CONCRETE BASE COURSE, TYPE B25.0B, AT AN AVERAGE RATE OF 570 LBS. PER SQ. YD.
E3	PROP. VAR. DEPTH ASPHALT CONCRETE BASE COURSE, TYPE B25.0, AT AN AVERAGE RATE OF 114 LBS. PER SQ. YD. PER 1" DEPTH. TO BE PLACED IN LAYERS NOT LESS THAN 3.0" IN DEPTH OR GREATER THAN 5.5" IN DEPTH.
J1	PROP. 8.0" AGGREGATE BASE COURSE.
R	2'-6" CONCRETE CURB AND GUTTER.
U	EXISTING PAVEMENT.
T	EARTH MATERIAL.
W	VARIABLE DEPTH ASPHALT PAVEMENT (SEE WEDGING DETAIL)

NOTE: PAVEMENT EDGE SLOPES ARE 1:1 UNLESS OTHERWISE NOTED.
SHOULDER DRAINS NOT REQUIRED.

SEPI ENGINEERING GROUP
2300 RENAISSANCE DRIVE SUITE 310
RALEIGH, NC 27607
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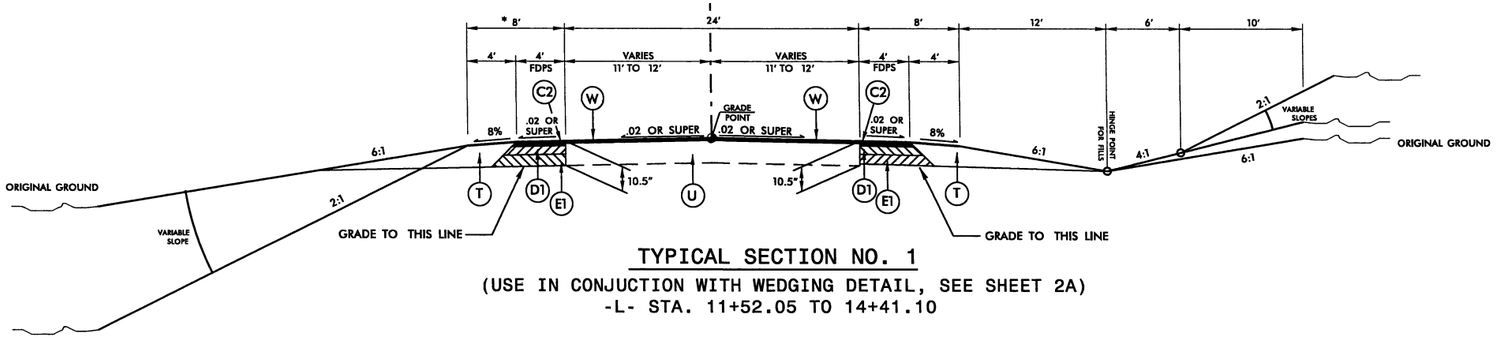
PROJECT REFERENCE NO.	SHEET NO.
U-2707	2A
ROADWAY DESIGN ENGINEER	PAVEMENT DESIGN ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

℄ -L- IDOLS ROAD

* SHOULDER WIDTH WILL BE 11' IF GUARDRAIL IS REQUIRED

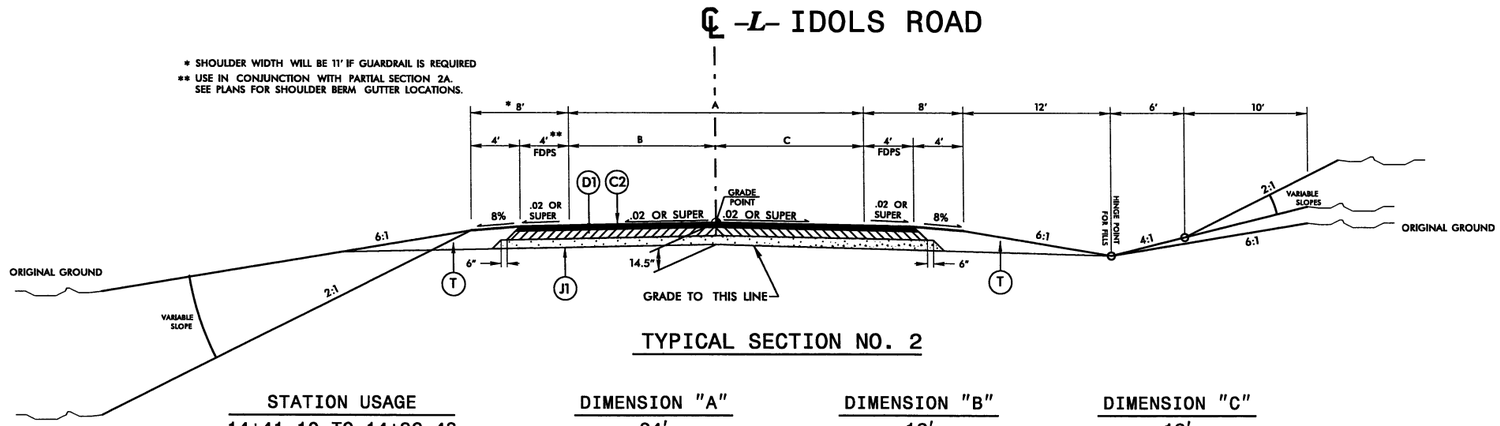


TYPICAL SECTION NO. 1

(USE IN CONJUCTION WITH WEDGING DETAIL, SEE SHEET 2A)
-L- STA. 11+52.05 TO 14+41.10

℄ -L- IDOLS ROAD

* SHOULDER WIDTH WILL BE 11' IF GUARDRAIL IS REQUIRED
** USE IN CONJUNCTION WITH PARTIAL SECTION 2A. SEE PLANS FOR SHOULDER BERM GUTTER LOCATIONS.

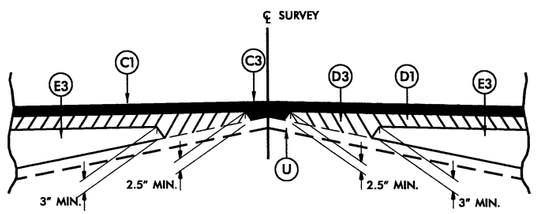


TYPICAL SECTION NO. 2

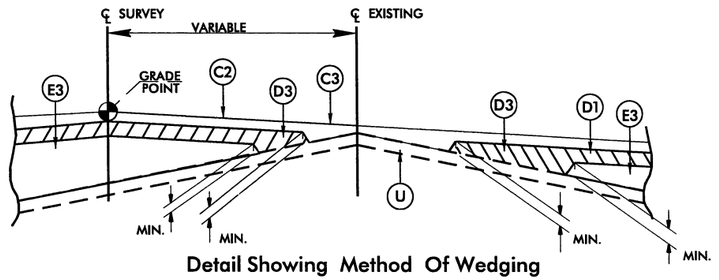
STATION USAGE	DIMENSION "A"	DIMENSION "B"	DIMENSION "C"
14+41.10 TO 14+96.43	24'	12'	12'
14+96.43 TO 20+67.02	VAR. 24' TO 48'	VAR. 12' TO 18'	VAR. 12' TO 30'
20+67.02 TO 27+30.00	VAR. 24' TO 48'	VAR. 12' TO 30'	VAR. 12' TO 18'
27+30.00 TO 88+05.00 (BEGIN BRIDGE)	24'	12'	12'
92+45.00 (END BRIDGE) TO 112+96.36	24'	12'	12'
112+96.36 TO 121+24.55	VAR. 24' TO 60'	VAR. 12' TO 24'	VAR. 12' TO 36'

PAVEMENT SCHEDULE	
C1	1.5 " S9.5B
C2	3.0" S9.5B
C3	VAR. DEPTH S9.5B
D1	3.5" I19.0B
D2	4.0" I19.0B
D3	VAR. DEPTH I19.0B
E1	4.0" B25.0B,
E2	5.0" B25.0B
E3	VAR. DEPTH B25.0
J1	8.0" ABC
R	2'-6" CONCRETE CURB AND GUTTER
T	EARTH MATERIAL
U	EXISTING PAVEMENT
W	WEDGING

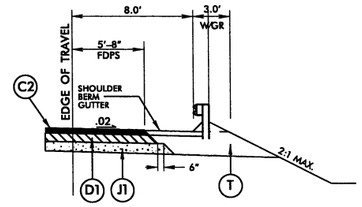
NOTE: PAVEMENT EDGE SLOPE ARE 1:1 UNLESS OTHERWISE NOTED. SHOULDER DRAINS NOT REQUIRED.



Detail Showing Method of Wedging



Detail Showing Method Of Wedging



PARTIAL SECTION 2A
RELATION OF PAVED SHOULDER TO SHOULDER BERM GUTTER ON -L-

18+45.00 -L- TO 16+00.35 -Y- RT.
12+70.01 -Y- TO 22+95.98 -L- LT.
15+59.53 -Y- TO 21+68.81 -L- LT.
18+58.06 -Y- TO 19+00.00 -Y- LT.
36+00.00 -L- TO 39+45.00 -L- RT.
73+05.00 -L- TO 79+50.00 -L- RT.
87+70.00 -L- TO 87+80.00 -L- LT. & RT.

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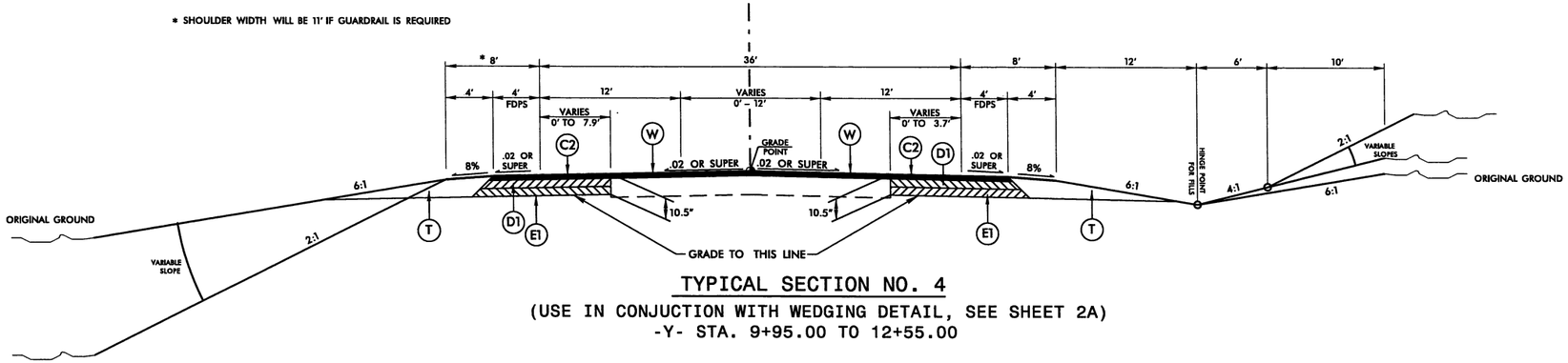
SEPI ENGINEERING GROUP
2309 RENWOOD DRIVE SUITE 370
RALEIGH, NC 27607
TEL: 919-789-9977 FAX: 789-9959

PROJECT REFERENCE NO.	SHEET NO.
U-2707	2B
ROADWAY DESIGN ENGINEER	PAVEMENT DESIGN ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

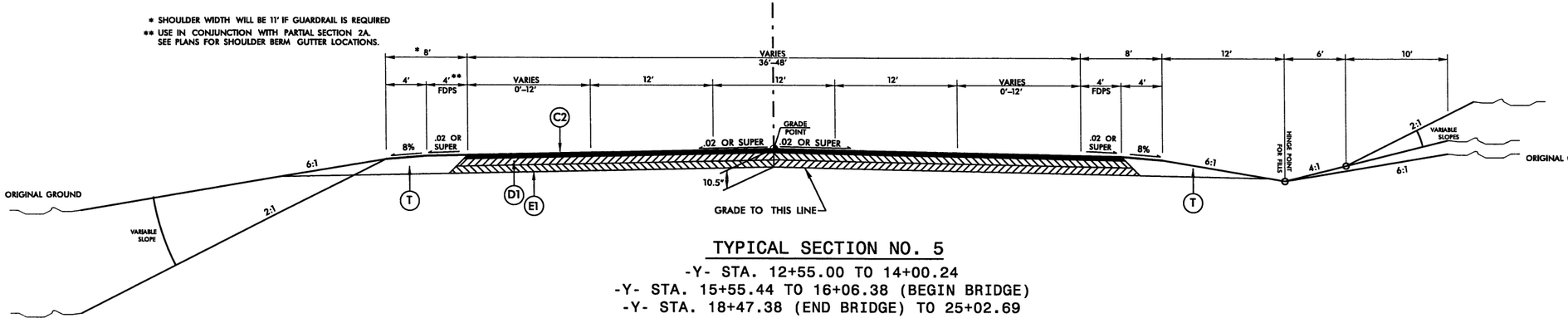
℄ -Y- HAMPTON ROAD



TYPICAL SECTION NO. 4

(USE IN CONJUCTION WITH WEDGING DETAIL, SEE SHEET 2A)
-Y- STA. 9+95.00 TO 12+55.00

℄ -Y- HAMPTON ROAD



TYPICAL SECTION NO. 5

-Y- STA. 12+55.00 TO 14+00.24
-Y- STA. 15+55.44 TO 16+06.38 (BEGIN BRIDGE)
-Y- STA. 18+47.38 (END BRIDGE) TO 25+02.69

PAVEMENT SCHEDULE	
C1	1.5 " S9.5B
C2	3.0" S9.5B
C3	VAR. DEPTH S9.5B
D1	3.5" I19.0B
D2	4.0" I19.0B
D3	VAR. DEPTH I19.0B
E1	4.0" B25.0B,
E2	5.0" B25.0B
E3	VAR. DEPTH B25.0
J1	8.0" ABC
R	2'-6" CONCRETE CURB AND GUTTER
T	EARTH MATERIAL
U	EXISTING PAVEMENT
W	WEDGING

NOTE: PAVEMENT EDGE SLOPE ARE 1:1 UNLESS OTHERWISE NOTED. SHOULDER DRAINS NOT REQUIRED.

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REVISIONS

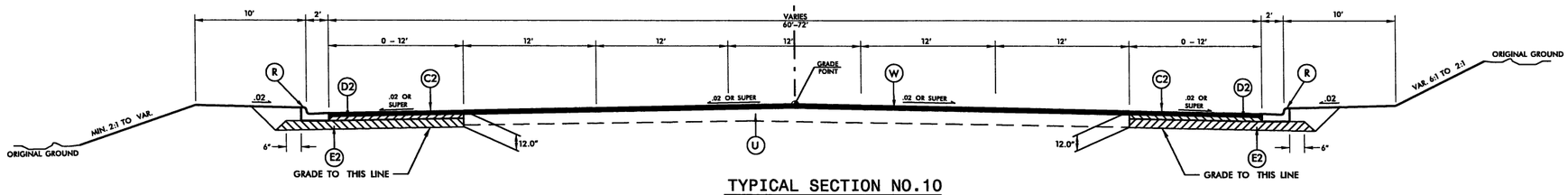
SEPI ENGINEERING GROUP
2309 RENAISSANCE DRIVE SUITE 370
RALEIGH, NC 27607
TEL: 919-789-9977 FAX: 789-9931

PROJECT REFERENCE NO.	SHEET NO.
U-2707	2C
ROADWAY DESIGN ENGINEER	PAVEMENT DESIGN ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

℄ -Y4- US 158 - CLEMMONS RD



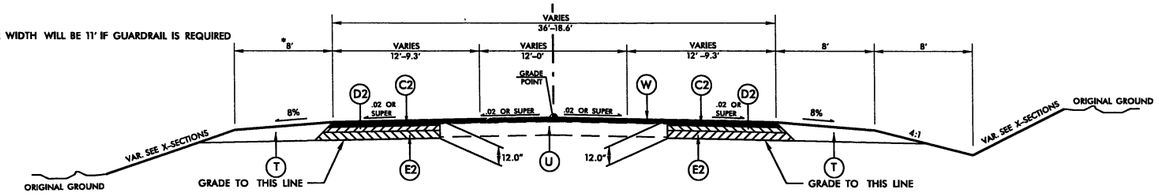
TYPICAL SECTION NO.10
(USE IN CONJUCTION WITH WEDGING DETAIL, SEE SHEET 2A)
-Y4- STA. 11+73.04 TO 16+65.00

PAVEMENT SCHEDULE	
C1	1.5 " S9.5B
C2	3.0" S9.5B
C3	VAR. DEPTH S9.5B
D1	3.5" I19.0B
D2	4.0" I19.0B
D3	VAR. DEPTH I19.0B
E1	4.0" B25.0B,
E2	5.0" B25.0B
E3	VAR. DEPTH B25.0
J1	8.0" ABC
R	2'-6" CONCRETE CURB AND GUTTER
T	EARTH MATERIAL
U	EXISTING PAVEMENT
W	WEDGING

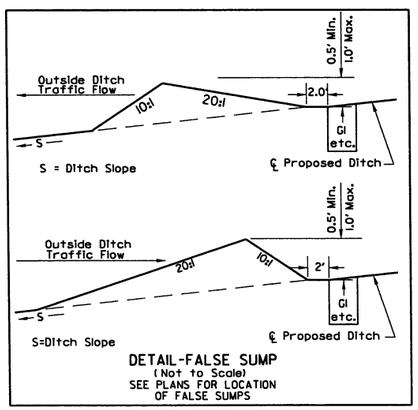
NOTE: PAVEMENT EDGE SLOPE ARE 1:1 UNLESS OTHERWISE NOTED. SHOULDER DRAINS NOT REQUIRED.

℄ -Y5- SR 1117 - OLD SIDES MILL RD

* SHOULDER WIDTH WILL BE 11' IF GUARDRAIL IS REQUIRED

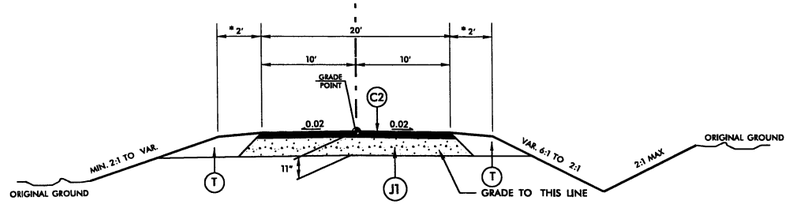


TYPICAL SECTION NO. 11
(USE IN CONJUCTION WITH WEDGING DETAIL, SEE SHEET 2A)
-Y5- STA. 10+83.19 TO 13+28.79



DETAIL-FALSE SUMP
(Not to Scale)
SEE PLANS FOR LOCATION OF FALSE SUMPS

℄ -DR1-



TYPICAL SECTION NO. 12
-DR1- STA. 11+25.00 TO 11+67.31

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8/17/99

REVISIONS

PROJECT REFERENCE NO.	SHEET NO.
U-2707	
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

PI Sta 13+25.43
Δ = 16°26'34.70" (LT)
D = 4°46'28.73"
L = 344.38'
T = 173.38'
R = 1,200.00'
SE = 0.06

PIs Sta 15+46.45
θs = 3°34'51.6"
Ls = 150.00'
LT = 100.02'
ST = 50.02'

PIs Sta 17+46.47
θs = 5°08'46.8"
Ls = 150.00'
LT = 100.04'
ST = 50.04'

PI Sta 18+97.07
Δ = 13°44'42.2" (RT)
D = 6°51'42.4"
L = 200.31'
T = 100.64'
R = 835.00'
SE = 0.06

PI Sta 24+47.09
Δ = 15°01'44.9" (LT)
D = 3°49'11.0"
L = 396.08'
T = 199.20'
R = 1,500.00'
SE = 0.06

-Y-

PI Sta 15+84.89
Δ = 19°45'58.9" (LT)
D = 3°57'05.2"
L = 500.23'
T = 252.63'
R = 1,450.00'
SE = 0.03

PREFORMED SCOUR HOLE
*NOT TO SCALE

TYPICAL QUANTITIES FOR PREFORMED SCOUR HOLES 1-6
EST. 36.7 TONS
EST. 57.0 CY DDE
EST. 108.5 SY PSRM
EST. 52.2 SY FILTER FABRIC

PLAN VIEW
Top of Bank Elevation
Pipe or Ditch Outlet
Square Preformed Scour Hole (PSH)
(No flap in basin not shown for clarity)
INSTALL LEVEL AND FLUSH WITH NATURAL GROUND
Bed Elevation
B = 4'
D = 1'
W = 4'

SECTION A-A
PIPE (d = 15" OR 18")
FILL SLOPE
INFLOW
D
PSRM
NATURAL GROUND
LINER: CLASS B RIPRAP WITH FILTER FABRIC
MIN. 1' TUCK

308

DETAIL 4C
DITCH CLEAN OUT
(Not To Scale)
Natural Ground
2d
D
4d or Flatter
Front Ditch Slope
DDE = 10 CY
Min. D = 1.0 Ft.

-Y2- STA. 9+80 TO 11+00 LT

DETAIL 4A
CUT DITCH
(Not To Scale)
Natural Ground
2d
D
4d or Flatter
Front Ditch Slope
Min. D = 1.0 Ft.

-Y- STA. 12+00 TO STA. 14+00 RT
-L- STA. 14+00 TO STA. 15+00 RT
-L- STA. 22+96 TO STA. 23+50 LT.

DETAIL 4B
CUT DITCH
(Not To Scale)
Natural Ground
2d
D
4d or Flatter
Front Ditch Slope
Min. D = 1.5 Ft.

-Y- STA. 14+00 TO -Y2- STA. 20+50 RT
-Y- STA. 18+00 TO STA. 10+90 "R"

STA. 18+47 RT
STA. 21+65 RT
STA. 12+70 LT
STA. 13+10 LT
STA. 15+54 LT
STA. 18+66 LT

2 GUY THOMAS TUTTEROW, III
DB 2022 PG 1291
PB 37 PG 137

3 AVA KATRINA ROBERSON (WIDOW)
DB 1541 PG 646
PB 37 PG 137

5 PAULINE BARBER PRATT
DB 1977 PG 1902
PB 37 PG 137

6 BETTY W. PHILLIPS
DB 1931 PG 2242
PB 37 PG 137

7 JAMES L. LINDSEY, JR. AND WIFE CATHY F. LINDSEY
DB 2243 PG 2982
PB 37 PG 137

8 LARRY W. MILLER
DB 1941 PG 1872
PB 37 PG 137

10 AUSTIN D. McGUIRE, JR
DB 2148 PG 3252

NC GRID NAD 83

4 DEANNA R. POWELL
DB 2026 PG 2657
PB 37 PG 137

9 JOANN K. BE
DB 1226 PG
DB 1759 PG
DB 1954 PG

POT Sta. 10+00.00 -Y2-
10+55.00 -Y2- 34.65
DITCH CLEANOUT SEE DETAIL 4C
RETAIN
BEGIN CONSTRUCTION -Y2-
POT Sta.10+66.50
POT Sta.11+72.33 -Y =
POT Sta.11+57.55 -Y2-
Δ = 110°41'03.05"
-BYI- 32 PINC
-Y- STA.11+99.77 (17.80 LT)
FRANCIS A. MILLER
DB 1948 PG 1838
PB 37 PG 137
10+60.00 -Y2- 15.64
TIE TO EXIST. DITCH
SPEC GRADE CUT DITCH SEE DETAIL 4A
PC Sta. 13+32.26
POT Sta.20+67.02 -L- =
POC Sta.14+70.58 -Y-
Δ = 126°14'02.86"
PT Sta. 19+96.74
12+30.00 -Y- 50.00
SPEC GRADE CUT DITCH SEE DETAIL 4A
BEGIN SHLD BERM GUTTER 12+80.01 LT -Y-
END SHLD BERM GUTTER 22+95.98 LT -Y-
P.S.H. SEE DETAIL 4D
CL "B" RIP RAP W/FILTER FABRIC LINER EST. 1 TONS EST. 5 SY FABRIC
300' TRANSITION
RELOCATE 12' WD
ISFD
53-CENTER RADIUS 200'-100'-200' 3' OFFSET
19+85.58 -L- 65.00
SC Sta. 17+96.43
17+96.43 -L- 65.00
SRS Sta. 16+46.43
BEGIN PROJECT U-2707
PC Sta.11+15.99 -L-
SUSANNE T. SCHIESS
DB 2023 PG 288
DB 2086 PG 196
PB 31 PG 45
14+96.43 -L- 50.00
CB Sta. 14+96.43
POT Sta. 9+98.62
ROBERT L. DUKE
DB 1706 PG 1408
PB 31 PG 45
11+15.99 -L- 10.30
12+25.00 -L- 50.00
HUNTERS RUN DR
4" FDPS
8d TAPER
EXISTING RIGHT OF WAY
N 58°22'17.0"E
-L-
-RR- N 58°49'04.3" E
13+05.00 -L- 55.93
NORFOLK SOUTHERN RR
MILE POST L "H 0
11+30.00 -L- LOI
14+00.00 -L- 70.00
14+15.00 -L- 80.00
14+25.00 -L- 60.00
14+35.00 -L- 80.00
-RR- POT Sta.10+00.00
REMOVE EXIST. STRUCTURE (STRUCTURE ITEM)
-RR- POT Sta. 15+13.12
-RR- SC Sta. 18+59.97
POC Sta.17+34.88 -Y- =
POS Sta.16+06.03 -RR-
Δ = 65°37'30.33"
17+56.38 -Y- EXIST R/W
BEGIN SHLD BERM GUTTER 18+58.06 LT -Y-
PT Sta. 18+32.49 -Y-
END BRIDGE
-Y- STA 18+47.36
18+80.00 -Y- 65.00
END SHLD BERM GUTTER 19+00.00 LT -Y-
PC Sta. 19+39.58
SPECIAL GRADE CUT DITCH SEE DETAIL 13A ON SHEET 13
SHOP CURVED
BEGIN SHLD BERM GUTTER 18+45.00 RT -L-
END SHLD BERM GUTTER 18+00.35 RT -Y-
P.S.H. SEE DETAIL 4D
CL "B" RIP RAP W/FILTER FABRIC LINER EST. 5 TONS EST. 140 SY FABRIC
ENDWALL
24" CSP W/ 2 ELBOWS
15" CSP W/ 2 ELBOWS
SPEC GRADE CUT DITCH SEE DETAIL 4B
-BL- 10 PINC
-BYI- PINC
-L- STA.17+79.79 (137.96 RT)
-Y- STA.17+26.65 (130.43 RT)
APPROACH SLAB
-Y- STA 18+71.30
CL "B" RIP RAP W/FILTER FABRIC LINER EST. 2 TONS EST. 7 SY FABRIC
RETAIN
HEADWALL
SPEC GRADE CUT DITCH SEE DETAIL 4B
11 FRISBY ACQUISITION CORPORATION
DB 1987 PG 2388
BM #1 STA. 16+69 139' RT. V. = 815.54
MES L. SMITH AND WIFE AN T. SMITH 262 PG 2289
S 27°48'59" E 205.62'
EXISTING R/W RIGHT OF WAY
BEGIN SHLD BERM GUTTER 15+59.53 LT -Y-
APPROACH SLAB -Y- STA.15+82.00
BEGIN BRIDGE -Y- STA.16+06.03 -RR-
EXISTING R/W RIGHT OF WAY
ELIZABETH L. SHELTON DB 2222 PG 2544
BROOKSTOWN WAREHOUSES, INC. DB 1247 PG 370
S 28°41'30" E 230.71'
PCSta. 23+50.88
MATCH LINE -L- STA 23+50
MATCH LINE -Y- STA 19+50

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PROJECT REFERENCE NO.	SHEET NO.
U-2707	5
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NC GRID NAD 83

REVISIONS 8/17/99

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MATCH LINE -L- STA 23+50

MATCH LINE -L- STA 37+50

BEGIN CONSTRUCTION -Y-
POT Sta.9+80.00

9+80.00 -Y-
60.00
EXIST R/W

10+69.15 -Y-
60.00

SPEC GRADE CUT DITCH
SEE DETAIL 4X

SPEC GRADE CUT DITCH
SEE DETAIL 5H

STD. BASE DITCH
W/CLASS "B"RIP RAP
EST. 35 TONS
EST. 65 SY FABRIC
EST. 70 CY DDE
SEE DETAIL 5B

SPEC. LAT "V" DITCH
W/CLASS "B" RIP RAP
EST. 113 TONS
EST. 125 S.Y. FABRIC
SEE DETAIL 5D

SPEC. LAT "V" DITCH
SEE DETAIL 5A

SPEC. LAT BASE DITCH
SEE DETAIL 5E

SPEC. LAT BASE DITCH
W/CLASS "B"RIP RAP
EST. 188 TONS
EST. 346 SY FABRIC
SEE DETAIL 5F

SPEC. LAT BASE DITCH
W/CLASS "B"RIP RAP
EST. 170 TONS
EST. 680 SY FABRIC
SEE DETAIL 5G

BM #2
-L- STA. 25+24.13
(140.58 LT)
ELEV. = 809.75
-BL- STA. 31+83
163' LT.

SRS Sta. 27+93.97

CS Sta. 26+43.97

SC Sta. 29+43.97

-BL- 13 PINC
-L- STA.33+98.34 (2.04 LT)

-BL- 12 PINC
-L- STA.28+47.68 (7.67 RT)

-BL- 11 PINC
-L- STA.24+43.46 (37.19 RT)

-L-

PI Sta 24+47.09	PIs Sta 26+93.98	PIs Sta 28+93.99	PI Sta 33+81.20
Δ = 15°07' 44.9" (LT)	θs = 2°51' 53.2"	θs = 3°01' 30.8"	Δ = 35°16' 48.5" (RT)
D = 3°49' 11.0"	Ls = 150.00'	Ls = 150.00'	D = 4°10' 01.1"
L = 396.08'	LT = 100.01'	LT = 100.02'	L = 846.66'
T = 199.20'	ST = 50.01'	ST = 50.01'	T = 437.23'
R = 1,500.00'			R = 1,375.00'
SE = 0.06			SE = 0.06

TIMOTHY R. QUEEN
AND WIFE
LISA G. QUEEN
DB 1726 PG 1522

(15) ROY LEE CORNATZER AND WIFE JO ANN CORNATZER DB 2107 PG 123

(16) MINNIE C. HUTCHINS DB 905 PG 572

(17) JAMES R. BRANNOCK AND WIFE JEAN C. BRANNOCK DB 1671 PG 3279

(18) OPAL B. WILSON DB 1297 PG 142

(19) CLARK S. GENTRY AND WIFE LINDA C. GENTRY DB 1520 PG 697 DB 1520 PG 702

(14) S. RAY DANIELS AND WIFE PAULINE T. DANIELS DB 1549 PG 3223

(10) AUSTIN D. MCGUIRE, JR DB 2148 PG 3252

(13) NORFOLK SOUTHERN RR

(20) NATIONAL TEXTILES, LLC DB 1978 PG 3966

(20-A)

SAMUAL LENTZ SANDERS
DB 1425 PG 1246

ELIZABETH LAWING SHELTON
DB 2222 PG 2544

HEADWALL
TEMP. RAILROAD CROSSING REQUIRED

BORE AND JACK
48" SMOOTH STEEL PIPE
W/0.50" WALL THICKNESS

RETAIN

STD. BASE DITCH
W/CLASS "I"RIP RAP
EST. 40 TONS
EST. 60 SY FABRIC
EST. 150 CY DDE
SEE DETAIL 5C

CL "B" RIP RAP
W/FILTER FABRIC LINER
EST. 11 TONS
EST. 28 SY FABRIC

BEGIN SHLD
BEGIN GUTTER
36+00.00 RT

DETAIL 5A
SPECIAL LATERAL 'V' DITCH
(Not to Scale)
Min. D = 1.0 Ft.
-L- STA. 28+75 TO -L- STA. 30+00 LT

DETAIL 5B
STANDARD BASE DITCH
(Not to Scale)
Filter Fabric
* When B is < 6.0'
Min. D = 1.0 Ft.
Max. d = 1.0 Ft.
B = 3.0 Ft.
Type of Liner = CLASS "B" RIP RAP
-L- STA. 28+50 LT

DETAIL 5C
STANDARD BASE DITCH
(Not to Scale)
Filter Fabric
* When B is < 6.0'
Min. D = 2.0 Ft.
Max. d = 2.0 Ft.
B = 4.0 Ft.
Type of Liner = CLASS "I" RIP RAP
-L- STA. 29+70 RT

DETAIL 5D
SPECIAL LATERAL 'V' DITCH
(Not to Scale)
Filter Fabric
Min. D = 1.0 Ft.
Max. d = 1.0 Ft.
Type of Liner = CLASS "B" RIP RAP
-L- STA. 25+00 TO -L- STA. 28+75 LT

DETAIL 5E
SPECIAL LATERAL BASE DITCH
(Not to Scale)
Filter Fabric
Min. D = 2.0 Ft.
Max. d = 2.0 Ft.
B = 3.0 Ft.
Type of Liner = CLASS "B" RIP RAP
-L- STA. 30+00 TO -L- STA. 33+50 LT

DETAIL 5F
SPECIAL LATERAL BASE DITCH
(Not to Scale)
Filter Fabric
Min. D = 2.0 Ft.
Max. d = 2.0 Ft.
B = 3.0 Ft.
Type of Liner = CLASS "B" RIP RAP
-L- STA. 33+50 TO -L- STA. 36+00 LT

DETAIL 5G
SPECIAL LATERAL BASE DITCH
(Not to Scale)
Filter Fabric
Min. D = 2.0 Ft.
Max. d = 2.0 Ft.
B = 5.0 Ft.
Type of Liner = CLASS "B" RIP RAP
-L- STA. 36+00 TO -L- STA. 38+00 LT

DETAIL 5H
CUT DITCH
(Not to Scale)
Min. D = 1.0 Ft.
-L- STA. 23+50 TO STA. 25+00 LT.

PROJECT REFERENCE NO.	SHEET NO.
U-2707	6
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

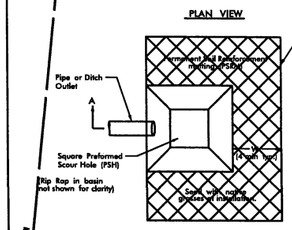
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

8/17/99

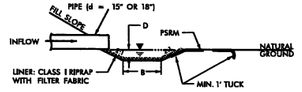
REVISIONS

PREFORMED SCOUR HOLE
*NOT TO SCALE

PLAN VIEW



SECTION A-A



308

DETAIL 61

N 05°29'18" W 962.75'

(19) CLARK S. GENTRY AND WIFE LINDA C. GENTRY
DB 1520 PG 697
DB 1520 PG 702

(21) OPAL B. WILSON
DB 1297 PG 1404
DB 1297 PG 1406

(22Z) EDNA W. BINGHAM
DB 786 PG 441

NC GRID NAD 83

N 01°39'51" W 917.06'

45

SPEC. LAT BASE DITCH SEE DETAIL 6B

SPEC. LAT BASE DITCH W/CLASS "B"RIP RAP EST. 170 TONS EST. 680 SY FABRIC SEE DETAIL 6A

37+90.63 -L- 110.00

BM #4 -BL- STA. 45+39 181' LT. ELEV. = 781.34 -L- STA. 39+10.35 (198.49 LT)

-BL- 14 PINC -L- STA.39+00.56 (18.20 LT)

39+50.63 -L- 110.00

CHORD

ST Sta. 39+50.63

CS Sta. 37+90.63

SPEC. LAT "V" DITCH SEE DETAIL 6D

SPEC. LAT "V" DITCH SEE DETAIL 6D

-BL- 15 PINC -L- STA.44+03.27 (0.40 LT)

SPEC. GRADE DITCH -L- STA. 44+00 TO 47+00

-BL- 16 PINC -L- STA.46+27.74 (4.58 RT)

46+92.63 -L- 110.00

48+52.63 -L- 110.00

CHORD

SC Sta. 48+52.63

TS Sta. 46+92.63

51+05.00 -L- 110.00

50+95.00 -L- 110.00

51+05.00 -L- 160.00

50+95.00 -L- 150.00

50+70.00 -L- 155.00

50+60.00 -L- 165.00

CUT DITCH SEE DETAIL 6H

STD. BASE DITCH W/CLASS "B"RIP RAP EST. 20 TONS EST. 50 SY FABRIC EST. 225 CY DDE SEE DETAIL 6G

50+50.00 -L- 110.00

50+35.00 -L- 110.00

SPEC. LAT "V" DITCH SEE DETAIL 6D

HEADWALL

4' FDPS

15" CSP W/ 2 ELBOWS P.S.H. SEE DETAIL 61

5.67' FDPS

8d TAPER

TEMP. RAILROAD CROSSING REQUIRED

38+25.00 -L- 85.00 64.35

39+15.00 -L- 85.00 59.80

39+70.00 -L- 85.00 38.86

BORE AND JACK 48" SMOOTH STEEL PIPE W/ 0.625" WALL THICKNESS

RETAIN

CL "I" RIP RAP W/FILTER FABRIC LINER EST. 5 TONS EST. 26 TONS EST. 50 SY FABRIC

END SHLD BERM GUTTER 39+45.00 RT -L-

39+50.00 -L- 159.74

37+70.00 -L- 85.00 67.56

40+40.00 -L- 165.00 59.55

40+65.00 -L- 215.00

3:1 SLOPE

PDE

40+90.00 -L- 145.00 60.88

40+85.00 -L- 160.27

40+90.00 -L- 180.00

41+00.00 -L- 185.00

CL "I" RIP RAP W/FILTER FABRIC LINER EST. 49 S.Y. EST. 26 TONS EST. 50 SY FABRIC

40+70.00 -L- 200.00

STANDARD BASE DITCH W/CLASS "I"RIP RAP EST. 1 TONS EST. 2 SY FABRIC SEE DETAIL 6C

NORFOLK SOUTHERN RR

EXISTING RIGHT OF WAY

EXISTING R/R RIGHT OF WAY

CL "B" RIP RAP W/FILTER FABRIC LINER EST. 2 TONS EST. 7 SY FABRIC

TEMP. RAILROAD CROSSING REQUIRED

HEADWALL

BORE AND JACK 36" SMOOTH STEEL PIPE W/ 0.50" WALL THICKNESS

49+70.00 -L- 93.50

50+55.00 -L- 97.07

50+00.00 -L- 195.05

RETAIN

49+60.00 -L- 193.09

CL "B" RIP RAP W/FILTER FABRIC LINER EST. 7 TONS EST. 22 SY FABRIC

49+50.00 -L- 230.00

49+60.00 -L- 220.00

49+95.00 -L- 235.00

49+90.00 -L- 225.00

STD. BASE DITCH W/CLASS "I"RIP RAP EST. 12 TONS EST. 15 SY FABRIC EST. 220 CY DDE SEE DETAIL 6F

STD. BASE DITCH EST. 115 CY DDE SEE DETAIL 6E

(20-A) LENTZ PROPERTY MANAGEMENT, LLC
DB 2103 PG 2072

(20-B) HUBBARD REALITY & McGUIRE CONSTRUCTION
DB 1541 PG 137

S 05°25'25" E 343.49'

MATCH LINE -L- STA 37+50

MATCH LINE -L- STA 51+50

N 80°59'01" E

N 80°59'01" E

-L-

GRAU-350

+75.00

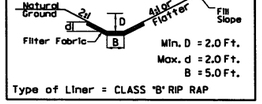
+83.03 76.30'

+99.30

+25.59'

+39.30

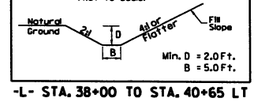
DETAIL 6A
SPECIAL LATERAL BASE DITCH
(Not to Scale)



Type of Liner = CLASS "B" RIP RAP

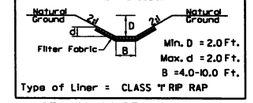
-L- STA. 36+00 TO -L- STA. 38+00 LT

DETAIL 6B
SPECIAL LATERAL BASE DITCH
(Not to Scale)



-L- STA. 38+00 TO STA. 40+65 LT

DETAIL 6C
STANDARD BASE DITCH
(Not to Scale)



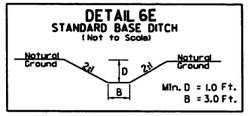
Type of Liner = CLASS "I" RIP RAP

-L- STA. 40+64 RT

DETAIL 6D
SPECIAL LATERAL "V" DITCH
(Not to Scale)

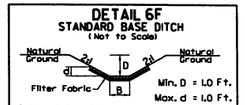
-L- STA. 40+65 TO STA. 42+50 LT
-L- STA. 43+00 TO STA. 44+00 LT
-L- STA. 48+50 TO STA. 50+60 LT

DETAIL 6E
STANDARD BASE DITCH
(Not to Scale)



-L- STA. 50+15 RT

DETAIL 6F
STANDARD BASE DITCH
(Not to Scale)

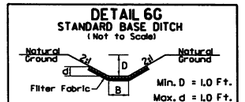


* When B is < 6.0'

Type of Liner = CLASS "I" RIP RAP

-L- STA. 49+75 RT

DETAIL 6G
STANDARD BASE DITCH
(Not to Scale)

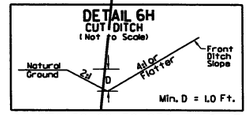


* When B is < 6.0'

Type of Liner = CLASS "B" RIP RAP

-L- STA. 50+60 LT

DETAIL 6H
CUT DITCH
(Not to Scale)



-L- STA. 50+60 TO STA. 51+50 LT

-L-

PI Sta 38+43.98	PI Sta 47+99.32	PI Sta 53+94.10
θs = 3° 20' 00.9"	θs = 3° 26' 46.9"	Δ = 44° 18' 15.0" (LT)
Ls = 160.00'	Ls = 160.00'	D = 4° 18' 28.6"
LT = 106.69'	LT = 106.69'	L = 1,028.43
ST = 53.35'	ST = 53.35'	T = 541.47'
		R = 1,330.00'
		SE = 0.06

15-FEB-2012 16:43
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$$$$USERNAME$$$$

PROJECT REFERENCE NO.	SHEET NO.
U-2707	7
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

8/17/95

REVISIONS

NC GRID
NAD 83

MATCH LINE
-L- STA 51+50

22Z
EDNA W. BINGHAM
DB 786 PG 441

-BL- 17 PINC
-L- STA.51+99.62 (7.32 RT)

CUT DITCH
SEE DETAIL 7A

-BL- 18 PINC
-L- STA.56+25.77 (8.42 LT)

SPECIAL GRADE DITCH
SEE PROFILE SHEET No. 15

4' FDPS

58+81.06 -L-
110.00

60+41.06 -L-
110.00

CHORD

ST Sta. 60+41.06

CS Sta. 58+81.06

-BL- 19 PINC
-L- STA.60+75.15 (2.93 LT)

SPECIAL GRADE CUT DITCH
SEE DETAIL 7A

STANDARD BASE DITCH
SEE DETAIL 7B
DDE = 20 CY

SPEC. GRADE CUT DITCH
SEE DETAIL 7A

4' FDPS

N 29°41'12.9" E

MATCH LINE
-L- STA 65+00

EXISTING RIGHT OF WAY

CL. "B" RIP RAP
W/FILTER FABRIC LINER
EST. 2 TONS
EST. 7 SY FABRIC

CL. "B" RIP RAP
W/FILTER FABRIC LINER
EST. 2 TONS
EST. 7 SY FABRIC

62+25.00 -L-
53.21

62+70.00 -L-
54.50

CL. "B" RIP RAP
W/FILTER FABRIC LINER
EST. 2 TONS
EST. 7 SY FABRIC

13
NORFOLK SOUTHERN RR

NORFOLK SOUTHERN RR

62+45.00 -L-
97.00

62+95.00 -L-
97.00

CL. "B" RIP RAP
W/FILTER FABRIC LINER
EST. 5 TONS
EST. 14 SY FABRIC

EXISTING R/W RIGHT OF WAY

395.53'
S56°30'40"E

20-B
HUBBARD REALITY &
McGUIRE CONSTRUCTION
DB 1641 PG 137

-L-

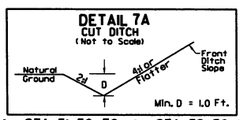
PI Sta. 53+94.10
Δ = 44°18'15.0" (LT)
D = 4°18'28.6"
L = 1,028.43'
T = 541.47'
R = 1,330.00'
SE = 0.06

PIs Sta. 59+34.41
Θs = 3°26'46.9"
Ls = 160.00'
LT = 106.69'
ST = 53.35'

BM #5
ELEV. = 718.74
-L- STA. 58+47.28
(321.01 RT)

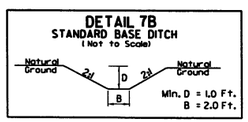
23
KEITH HAROLD HASTINGS
PATRICK OMAR DODSON
DB 1448 PG 773
DB 2126 PG 4653
DB 2179 PG 2174

DETAIL 7A
CUT DITCH
(Not to Scale)



-L- STA. 51+50 TO -L- STA. 52+50 LT
-L- STA. 59+50 TO -L- STA. 62+00 LT
-L- STA. 62+00 TO -L- STA. 63+00 LT

DETAIL 7B
STANDARD BASE DITCH
(Not to Scale)



-L- STA. 61+85 LT

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PROJECT REFERENCE NO.	SHEET NO.
U-2707	8
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS
8/17/99
R/W REVISION - 1/31/12 TR - REVISED RIGHT OF WAY ON PARCEL 22 TO ACCOMODATE ONSITE MITIGATION AND CHANGED PARCEL 22 TO 22Z.

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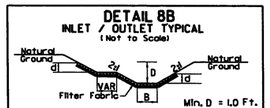
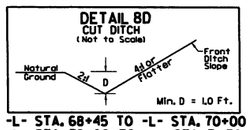
DETAIL 8B
INLET / OUTLET TYPICAL
(Not to Scale)



Min. D = 1.0 Ft.
Max. d = 1.0 Ft.
B = 5.0 Ft.
* When B is < 6.0' B = 5.0 Ft.
Type of Liner = CLASS "I" RIP RAP

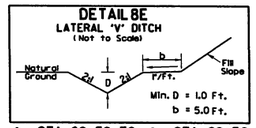
-L- STA. 68+50 RT

DETAIL 8D
CUT DITCH
(Not to Scale)



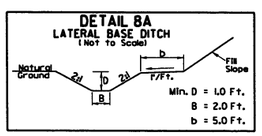
-L- STA. 68+45 TO -L- STA. 70+00 LT
-L- STA. 70+00 TO -L- STA. 71+50 RT

DETAIL 8E
LATERAL "V" DITCH
(Not to Scale)



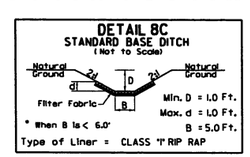
-L- STA. 68+58 TO -L- STA. 69+50 RT
-L- STA. 74+50 TO -L- STA. 79+00 LT

DETAIL 8A
LATERAL BASE DITCH
(Not to Scale)



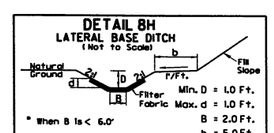
-L- STA. 73+00 TO -L- STA. 79+00 RT

DETAIL 8C
STANDARD BASE DITCH
(Not to Scale)



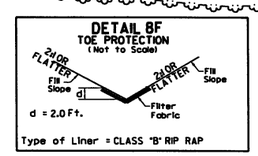
-L- STA. 68+45 LT

DETAIL 8H
LATERAL BASE DITCH
(Not to Scale)



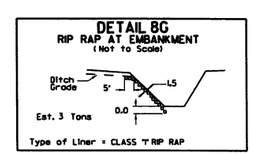
-L- STA. 66+50 TO -L- STA. 68+45 LT

DETAIL 8F
TOE PROTECTION
(Not to Scale)



-L- STA. 67+20 TO -L- STA. 68+40 RT

DETAIL 8G
RIP RAP AT EMBANKMENT
(Not to Scale)



-L- STA. 90+90 RT

MATCH LINE -L- STA 65+00 SEE SHEET 7

MATCH LINE -L- STA 79+00 SEE SHEET 9

-BL- 20 PINC
-L- STA.66+82.30 (12.57 RT)

68+05.00 -L- 145.00
68+05.00 -L- 160.00
67+95.00 -L- 110.00
67+85.00 -L- 110.00
67+85.00 -L- 130.00
67+70.00 -L- 135.00

CL "B" RIP RAP W/FILTER FABRIC LINER EST. 2 TONS EST. 7 SY FABRIC

LAT BASE DITCH EST. 137 CY DDE SEE DETAIL 8H

STD. BASE DITCH W/CLASS "I" RIP RAP EST. 65 TONS EST. 100 SY FABRIC EST. 175 CY DDE SEE DETAIL 8C

68+35.00 -L- 110.00
68+50.00 -L- 110.00

CUT DITCH SEE DETAIL 8D

HEADWALL

4' FDPS

N 29° 47' 12.9" E

POT Sta.71+78.03 -L- =
POT Sta.11+98.07 -DRI-
Δ= 106°11'41.92"

PT Sta.13+18.27

72+05.48 -L- 110.03

PC Sta. 71+91.06

+55.03 -L- 517.07'

INV = 695.85'

60" CMP

INV = 696.58'

NAD 83

NC GRID NAD 83

+92.89 -L- 366.64'

48" W

22Z
EDNA W. BINGHAM
DB 786 PG 441

+81.21 -L- 292.58'

PROPOSED BANKFULL CHANNEL

PROPOSED THALWEG

-BL- 22 PINC
-L- STA.76+54.24 (77.11 LT)

PT Sta. 77+69.27

LAT "V" DITCH EST. 187 CY DDE SEE DETAIL 8E

EDNA W. BINGHAM
DB 786 PG 441

GRAU-350

4' FDPS

-L-

N 40° 08' 22.9" E

BEGIN SHLD BERM GUTTER 73+05.00 RT -L-

PC Sta. 11+82.80

8:1 TAPER

5.67' FDPS

LAT BASE DITCH EST. 245 CY DDE SEE DETAIL 8A

CL "B" RIP RAP W/FILTER FABRIC LINER EST. 2 TONS EST. 7 SY FABRIC

15" CSP W/ 2 ELBOWS

PC Sta. 10+54.61

NORFOLK SOUTHERN RR

RR SIGNAL

67+00.00 -L- 61.25

RIP RAP FOR PROTECTION W/CLASS "B" RIP RAP EST. 88 TONS EST. 53 SY FABRIC SEE DETAIL 8F

68+15.00 -L- 85.00

TEMP. RAILROAD CROSSING

CL "I" RIP RAP REQUIRED W/FILTER FABRIC LINER EST. 49 S.Y. EST. 25 TONS EST. 50 SY FABRIC

HEADWALL

RETAIN

COLLAR

STD. BASE DITCH W/CLASS "I" RIP RAP EST. 14 TONS EST. 25 SY FABRIC EST. 20 CY DDE SEE DETAIL 8B

68+45.00 -L- 163.54

SPEC. GRADE CUT DITCH SEE DETAIL 8D

68+45.00 -L- 66.91

SPEC. LAT. DITCH EST. 176 CY DDE SEE DETAIL 8E

68+85.00 -L- 105.00

-BL- 21 PINC
-L- STA.71+48.71 (13.14 RT)

POT Sta.10+00.00

BORE AND JACK 48" SMOOTH STEEL PIPE W/0.625" WALL THICKNESS

68+80.00 -L- 164.09

CL "I" RIP RAP W/FILTER FABRIC LINER EST. 60 SY EST. 33 TONS EST. 62 SY FABRIC

68+75.00 -L- 300.00

68+95.00 -L- 295.00

69+05.00 -L- 305.00

68+65.00 -L- 315.00

RIP RAP AT EMBANKMENT W/CLASS "I" RIP RAP SEE DETAIL 8G

-DRI-

PI Sta 11+20.93
Δ = 36°00'35.0" (RT)
D = 28°06'14.7"
L = 128.13'
T = 66.26'
R = 203.87'
SE = NC

PI Sta 12+50.65
Δ = 8°19'40.8" (RT)
D = 6°08'51.4"
L = 135.47'
T = 67.85'
R = 932.00'
SE = NC

-L-

PI Sta 74+80.95
Δ = 10°21'10.0" (RT)
D = 1°41'25.8"
L = 578.21'
T = 289.89'
R = 3,200.00'
SE = 0.04

HANES HOUSE HISTORIC PROPERTY DO NOT DISTURB

13
NORFOLK SOUTHERN RR

23
KEITH HAROLD HASTINGS
PATRICK OMAR DODSON
DB 1448 PG 173
DB 2128 PG 4653
DB 2179 PG 2174

N 25° 29' 29.8" W

S 38° 52' 30.2" E

S 38° 52' 30.2" E
456.61'

PROJECT REFERENCE NO.	SHEET NO.
U-2707	9
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

8/17/99

REVISIONS

R/W REVISION - 1/31/12 TR - REVISED RIGHT OF WAY ON PARCEL 22 TO ACCOMODATE ONSITE MITIGATION AND CHANGED PARCEL 22 TO 22Z.

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$$$$INTERNODE$$$$

MATCH LINE
-L- STA 79+00

MATCH LINE
-L- STA 93+00

N.C. GRID NAD 83

PREFORMED SCOUR HOLE
*NOT TO SCALE

PLAN VIEW

INSTALL LEVEL AND FLUSH WITH NATURAL GROUND

Pipe or Ditch Outlet

Square Preformed Scour Hole (PSH)

(Rip Rap in basin not shown for clarity)

B=4.0'
D=1.0'
W=4.0'

SECTION A-A

PIPE (d = 15" OR 18")

FILL SLOPE

D

PSHH

INFLOW

NATURAL GROUND

LINER: CLASS B RIPRAP WITH FILTER FABRIC

MIN. 1' TUCK

308

DETAIL 9H

+48.49 -L-
252.37'

+68.25 -L-
253.49'

+36.22 -L-
267.53'

PROPOSED THALWEG

PROPOSED BANKFULL CHANNEL

EDNA W. BINGHAM
DB 786 PG 448
22Z

JOSEPH C. GOODMAN AND WIFE MARY ANN HARRIS GOODMAN
DB 2226 PG 4675
DB 1629 PG 3747
26

LAT GRASSED SWALE
EST. 411 CY DDE
SEE DETAIL 9D

BM #7
ELEV. = 693.90
-L- STA. 92+06.11
(228.64 LT)

WUDDY CREEK

N 13°31'57" W
65.58'

+51.75 -L-
80'

CLASS "II" RIP RAP SLOPE PROTECTION
SEE DETAIL 9I

STANDARD BASE GRASSED SWALE
EST. 121 CY DDE
SEE DETAIL 9E

"V" DITCH
EST. 187 CY DDE
SEE DETAIL 9C

30" SEWER LINE EASEMENT

CLASS "II" RIP RAP SLOPE PROTECTION
SEE DETAIL 9I

15" CSP W/ 2 ELBOWS

BEGIN SHLD BERM GUTTER
87+70.00 LT -L-

27A
P.S.H.
SEE DETAIL 9H

EDNA W. BINGHAM
DB 786 PG 448
22

4' FDFS

8d TAPER

N 40°08'22.9" E

TYPE-III

2GI

END SHLD BERM GUTTER
79+50.00 RT -L-

BEGIN SHLD BERM GUTTER
82+20.00 RT -L-

RETAIN EXISTING CHANNEL

EXISTING R/R RIGHT OF WAY

LAT BASE DITCH
EST. 245 CY DDE
SEE DETAIL 9A

LAT BASE DITCH
EST. 195 CY DDE
SEE DETAIL 9B

13
NORFOLK SOUTHERN RR

CL. "B" RIP RAP W/FILTER FABRIC LINER
EST. 8 TONS
EST. 21 SY FABRIC

CL. "I" RIP RAP W/FILTER FABRIC LINER
EST. 96 TONS
EST. 174 SY FABRIC

18" CONC.

REMOVE

CL. "B" RIP RAP W/FILTER FABRIC LINER
EST. 2 TONS
EST. 7 SY FABRIC

15" CSP W/ 2 ELBOWS

-BL- 23 PINC
-L- STA.84+89.25 (58.86 RT)

-BL- 24 PINC
-L- STA.90+05.76 (22.15 RT)

RIP RAP OUTLET
W/CLASS "II" RIP RAP
SEE DETAIL 9F

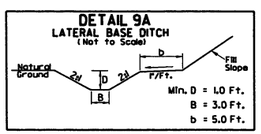
STANDARD BASE GRASSED SWALE
EST. 178 CY DDE
SEE DETAIL 9E

GRASS SWALE WITH ROCK CHECK DAM
EST. 342 CY DDE
SEE DETAIL 9G & 9H

HAMES HOUSE
HISTORIC PROPERTY
DO NOT DISTURB

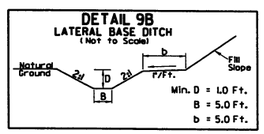
23
KEITH HAROLD HASTINGS
PATRICK OMAR DODSON
DB 1448 PG 773
DB 2226 PG 4653
DB 2179 PG 2174

DETAIL 9A
LATERAL BASE DITCH
(Not to Scale)



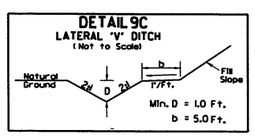
-L- STA. 79+00 TO -L- STA. 80+50 RT

DETAIL 9B
LATERAL BASE DITCH
(Not to Scale)



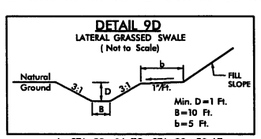
-L- STA. 80+50 TO -L- STA. 83+70 RT

DETAIL 9C
LATERAL 'V' DITCH
(Not to Scale)



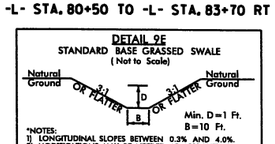
-L- STA. 79+00 TO -L- STA. 82+65 LT

DETAIL 9D
LATERAL GRASSED SWALE
(Not to Scale)



-L- STA 92+06 TO STA 93+50 LT

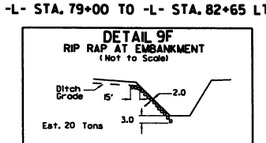
DETAIL 9E
STANDARD BASE GRASSED SWALE
(Not to Scale)



*NOTES:
1) LONGITUDINAL SLOPES BETWEEN 0.3% AND 4.0%.
2) MODIFICATIONS MAY BE NEEDED, AS APPROVED BY ENGINEER.

-L- STA. 92+06 LT & RT
-L- STA. 91+00 TO STA. 92+06 RT

DETAIL 9F
RIP RAP AT EMBANKMENT
(Not to Scale)

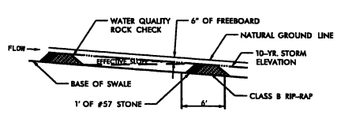


Type of Liner = CLASS "B" RIP RAP

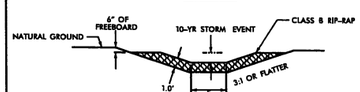
-L- STA. 90+90 RT

-L- STA. 79+00 TO -L- STA. 82+65 LT

DETAIL 9G
TRAPEZOIDAL GRASSED SWALE
wROCK CHECK DAM
(Not to Scale)



PROFILE

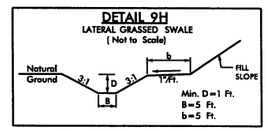


TYPICAL SECTION

NOTES:
1) DO NOT USE INSIDE CLEAR RECOVERY AREA.
2) NOT PRACTICAL TO USE ON SLOPES > 5%.
3) FOR PERMANENT STRUCTURES IN GRASS SWALE.
4) CHECK DAMS SHOULD BE SPACED SUCH THAT THE BASE OF THE UPSTREAM CHECK IS AT THE SAME ELEVATION AS THE TOP OF THE DOWNSTREAM CHECK.

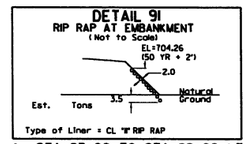
-L- STA 92+06 TO 93+50 RT

DETAIL 9H
LATERAL GRASSED SWALE
(Not to Scale)



-L- STA 92+06 TO 93+50 RT

DETAIL 9I
RIP RAP AT EMBANKMENT
(Not to Scale)



Type of Liner = CL "I" RIP RAP

-L- STA. 87+00 TO STA. 88+00 LT
-L- STA 92+50 TO STA 93+00 LT

PROJECT REFERENCE NO.	SHEET NO.
U-2707	10
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NC GRID NAD 83

REVISIONS

8/17/95

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26
JOSEPH C. GOODMAN
AND WIFE
MARY ANN HARRIS GOODMAN
DB 2226 PG 4675
DB 1529 PG 3747

MATCH LINE
-L- STA 93+00

MATCH LINE
-L- STA 105+50

95 100 105

LAT GRASSED SWALE
EST. 411 CY DDE
SEE DETAIL 10B

GRASS SWALE WITH
ROCK CHECK DAM
EST. 655 CY DDE
SEE DETAIL 10B & 10C

LAT BASE DITCH
W/CLASS "B" RIP RAP
EST. 147 TONS
EST. 325 S.Y. FABRIC
EST. 142 CY DDE
SEE DETAIL 10A

4" FDPS
GRAU-350
N 40°08'22.9" E
-L-
EXISTING R/R RIGHT OF WAY
SOUTHERN RR
NORFOLK SOUTHERN RR
13
-BL- 25 PNC
-L- STA.94+16.45 (35.36 RT)
-BL- 26 PNC
-L- STA.100+11.16 (39.40 RT)
-BL- 27 PNC
-L- STA.104+66.49 (31.28 RT)

LAT BASE DITCH
W/CLASS "B" RIP RAP
EST. 195 TONS
EST. 433 S.Y. FABRIC
EST. 211 CY DDE
SEE DETAIL 10A

GRASS SWALE WITH
ROCK CHECK DAM
EST. 342 CY DDE
SEE DETAIL 10D & 10E

DETAIL 10A
LATERAL BASE DITCH
(Not to Scale)

Natural Ground, 2%, D, 3:1, b, 1'/Ft., Fill Slope, d, B, Filter Fabric
Min. D = 1.0 Ft.
Max. d = 1.0 Ft.
B = 2.0 Ft.
b = 5.0 Ft.
* When B is < 6.0'
Type of Liner = CLASS "B" RIP RAP

-L- STA. 96+00 TO -L- STA. 101+50 LT
-L- STA 93+50 RT TO STA 100+50 RT

DETAIL 10B
LATERAL GRASSED SWALE
(Not to Scale)

Natural Ground, 3:1, D, 3:1, b, 1'/Ft., FILL SLOPE, B
Min. D = 1 Ft.
B = 7 Ft.
b = 5 Ft.

-L- STA 92+06 TO STA 96+00 LT

DETAIL 10D
LATERAL GRASSED SWALE
(Not to Scale)

Natural Ground, 3:1, D, 3:1, b, 1'/Ft., FILL SLOPE, B
Min. D = 1 Ft.
B = 5 Ft.
b = 5 Ft.

-L- STA 92+06 TO STA 93+50 RT

EXISTING R/R RIGHT OF WAY

DETAIL 10C
TRAPEZOIDAL GRASSED SWALE
wROCK CHECK DAM
(Not to Scale)

WATER QUALITY ROCK CHECK, 6" OF FREEBOARD, NATURAL GROUND LINE, FLOW, EFFECTIVE SLOPE, 1.5', BASE OF SWALE, 1' OF #57 STONE, 6', CLASS B RIP-RAP

PROFILE

6" OF FREEBOARD, CLASS B RIP-RAP, NATURAL GROUND, 0.5', 1.0', 7', 3:1 OR FLATTER

TYPICAL SECTION

NOTES:
1) DO NOT USE INSIDE CLEAR RECOVERY AREA.
2) NOT PRACTICAL TO USE ON SLOPES > 5%.
3) FOR PERMANENT STRUCTURES IN GRASS SWALE.
4) CHECK DAMS SHOULD BE SPACED SUCH THAT THE BASE OF THE UPSTREAM CHECK IS AT THE SAME ELEVATION AS THE TOP OF THE DOWNSTREAM CHECK.

-L- STA 93+50 TO STA 96+00 LT

DETAIL 10E
TRAPEZOIDAL GRASSED SWALE
wROCK CHECK DAM
(Not to Scale)

WATER QUALITY ROCK CHECK, 6" OF FREEBOARD, NATURAL GROUND LINE, FLOW, EFFECTIVE SLOPE, 1.5', BASE OF SWALE, 1' OF #57 STONE, 6', CLASS B RIP-RAP

PROFILE

6" OF FREEBOARD, CLASS B RIP-RAP, NATURAL GROUND, 0.5', 1.0', 5', 3:1 OR FLATTER

TYPICAL SECTION

NOTES:
1) DO NOT USE INSIDE CLEAR RECOVERY AREA.
2) NOT PRACTICAL TO USE ON SLOPES > 5%.
3) FOR PERMANENT STRUCTURES IN GRASS SWALE.
4) CHECK DAMS SHOULD BE SPACED SUCH THAT THE BASE OF THE UPSTREAM CHECK IS AT THE SAME ELEVATION AS THE TOP OF THE DOWNSTREAM CHECK.

-L- STA. 92+06 TO STA. 93+50 RT

PROJECT REFERENCE NO.	SHEET NO.
U-2707	11
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS 8/17/95

NC GRID NAD 83

26
JOSEPH C. GOODMAN
AND WIFE
MARY ANN HARRIS GOODMAN
DB 2226 PG 4675
DB 1529 PG 3747

BM #8
-BL- STA. 119+65
445 LT.
ELEV. = 751.53
-L- STA. 112+47.56
(458.24 LT)

MATCH LINE
-L- STA 105+50

SPEC GRADE CUT DITCH
SEE DETAIL 11A

109+05.83 -L-
110.00

WIDE DRAW
FALSE SUMP
SEE DETAIL 11B

F.S.

110+55.83 -L-
110.00

CHORD

TS Sta. 109+05.83

SC Sta. 110+55.83

-L- N 40°08'22.9" E

4' FDPS

30

12'
12'

105

+55.83 +05.83 +30.83

SPEC GRADE DITCH
SEE PROFILE SHEET No 17

+96.36

-BL- 29 PINC
-L- STA. 116+29.02 (0.69 LT)

200' BAY TAPER

600' TRANSITION

300' TRANSITION

+54.08
124.43

87+04.28 -L-
110.03

86+79.21 -L-
174.08

3 51'16'59" E

7.00'

29
CAROL PAGE ARMSTRONG
DB 2066 PG 670

MATCH LINE
-L- STA 117+75

110+50.00 -L-
55.41

111+40.00 -L-
62.00

112+75.00 -L-
59.25

CL. "B" RIP RAP
W/FILTER FABRIC LINER
EST. 2 TONS
EST. 7 SY FABRIC

SPEC GRADE CUT DITCH
SEE DETAIL 11A

CL. "B" RIP RAP
W/FILTER FABRIC LINER
EST. 3 TONS
EST. 10 SY FABRIC

-BL- 28 PINC
-L- STA. 110+75.91 (22.34 RT)

EXISTING R/R RIGHT OF WAY

13
NORFOLK SOUTHERN RR

100.00'

-L-

PIs Sta. 110+05.85	PI Sta. 115+08.96
θs = 3°16'04.1"	Δ = 38°01'36.1" (LT)
Ls = 150.00'	D = 4°21'25.5"
LT = 100.02'	L = 872.75'
ST = 50.01'	T = 453.13'
	R = 1,315.00'
	SE = 0.06

DETAIL IIA
CUT DITCH
(Not to Scale)

Natural Ground
2d
D
Front Ditch Slope
Min. D = 1.5 Ft.

-L- STA. 106+75 TO -L- STA. 108+00 LT
-L- STA. 107+50 TO -L- STA. 110+00 RT

DETAIL IIB
SPECIAL FALSE SUMP
(Not to Scale)

Outside Ditch Traffic Flow
Cross Pipe
20d
2.0'
S
S = Ditch Slope
℄ Proposed Ditch

-L- STA. 106+60 LT

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PROJECT REFERENCE NO.	SHEET NO.
U-2707	12
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

8/17/99

REVISIONS

PC Sta. 10+00.00

BEGIN CONSTRUCTION -Y4-
POC Sta. 10+87.00

10+87.00 -Y4-
45.33
EXIST R/W

11+78.14 -Y4-
66.00

CS Sta. 12+27.70

13+05.00 -Y4-
EXIST R/W

13+36.00 -Y4-
80.00

13+28.00 -Y4-
87.00

CL "B" RIP RAP
W/FILTER FABRIC LINER
EST. 3 TONS
EST. 11 SY FABRIC

CL "B" RIP RAP
W/FILTER FABRIC LINER
EST. 5 TONS
EST. 14 SY FABRIC

CL "B" RIP RAP
W/FILTER FABRIC LINER
EST. 2 TONS
EST. 7 SY FABRIC

POT Sta. 13+62.68

13+50.00 -Y5-
25.38

END CONSTRUCTION -Y5-
POT Sta. 13+50.00

12+90.00 -Y5-
55.00

11+45.00 -Y5-
65.00

11+40.00 -Y5-
55.00

13+50.00 -Y5-
24.65

12+90.00 -Y5-
55.00

ST Sta. 120+78.59

120+78.59 -L-
80.00

119+28.59 -L-
80.00

ST Sta. 14+77.70

45° R- 4' OFFSET
10:1 TAPER

180°-60°-180°
6' OFFSET

END 4' FDPS
BEGIN C&G
LT & RT

2GI W/
FLAT
GRATE

600' TRANSITION

200' BAT TAPER

600' FULL LANE

CS Sta. 119+28.59

MATCH LINE
-L- STA 117+75

STD. BERM DITCH
SEE DETAIL 12A

15" CSP W/
2 ELBOWS &
BERM DITCH OUTLET

117+57.90 -L-
90.00

15.00 -Y4-
EXIST R/W

15.00 -Y4-
45.05
EXIST R/W

-BL- 30 (POT 127+81.37 =
-L- STA.121+22.48 (5.29 RT)
-Y4- STA.14+58.61 (44.73 RT)

-BY2- / PINC

POT Sta. 17+99.93

END CONSTRUCTION
POT Sta. 16+80.00

16+80.90 -Y4-
45.11
EXIST R/W

END TIP PROJECT U-2707
POT Sta. 121+66.90 -L- =
POS Sta. 14+59.06 -Y4- =
POT Sta. 10+00.00 -Y5-
Δ = 82°41'27.42" -Y5-
Δ = 97°22'05.88" -L-

PI Sta 11+14.[illegible]
Δ = 12° 41' 26.0" (LT)
D = 5° 37' 02.0"
L = 227.70
T = 114.33'
R = 1,020.00'
SE = EXIST.

es = 7° 01' 17.5"
Ls = 250.00'
LT = 166.80'
ST = 83.45'
SE = EXIST.

-L-

PI Sta 115+08.96
Δ = 38° 01' 36.1" (LT)
D = 4° 21' 25.5"
L = 817.75
T = 453.13'
R = 1,315.00'
SE = 0.06

PIs Sta 119+78.60
es = 3° 16' 04.1"
Ls = 150.00'
LT = 100.02'
ST = 50.01'

DETAIL 12C
LATERAL "V" DITCH
(Not to Scale)

Natural Ground | 2d | d | b | 2:1 | F/Ft. | Fill Slope | Filter Fabric

Min. D = 1.0 Ft.
Max. d = 1.0 Ft.
b = 5.0 Ft.

Type of Liner = CLASS "B" RIP RAP

-Y4- STA. 15+00 RT TO STA. 16+00 RT

DETAIL 12A
BERM DITCH
(Not to Scale)

SLOPE STAKE | 5.0' | 6.0' | 5.0' | CLEARING LIMITS | 4.0' | 10.0' V.C. | 2d | D VAR.

Min. D = 1.0 Ft.

-L- STA. 120+00 RT TO -Y4- STA. 15+85 RT
-Y4- STA. 12+30 TO STA. 13+00 RT

DETAIL 12B
CUT DITCH
(Not to Scale)

Natural Ground | 2d | d | 4d or Flatter | Front Ditch Slope | Filter Fabric

Min. D = 1.0 Ft.
Max. d = 1.0 Ft.

Type of Liner = CLASS "B" RIP RAP

-Y5- STA. 11+00 RT TO STA. 11+35 RT
-Y5- STA. 11+35 RT TO STA. 12+00 RT

26 JOSEPH C. GOODMAN AND WIFE MARY ANN HARRIS GOODMAN DB 2226 PG 4675 DB 1629 PG 3747

27 CHARLES L. [illegible]MAN, III AND WIFE RHONDA [illegible]RKMAN DB 2213 PG 5259

28 J. B. INGRAM AND WIFE VIRGINIA S. INGRAM DB 690 PG 391 DB735 PG 79 DB 941PG 842 PB 12 PG 81

29 CAROL PAGE ARMSTRONG DB 2066 PG 670

30 DEWEY O. SMITH DB 1446 PG 375

31 BLUE DOLPHIN DIVE SHOP, INC. DB 1582 PG 3382 DB 1760 PG 2851

DEWEY O. SMITH, JR. AND WIFE LINDA CRATER SMITH DB 1446 PG 375

BARRY G. LAWSON AND WIFE SANDRA T. LAWSON DB 1698, PG 29

WALTER B. BELLINGS DB 1223 PG 1357 DB 1771 PG 1147 PB 12 PG 99

ROY L. LAWSON DB 1506 PG 1740 DB 1766 PG 1303 PB 12 PG 99

EVOLA B. PHELPS DB 1854 PG 1288 DB 1775 PG 1052 PB 12 PG 99

JOAN T. ROBERTSON DB 1584 PG 3886 DB 1778 PG 2952 PB 12 PG 99

N NC GRID NAD 83

EXISTING R/R RIGHT OF WAY

MILE POST 49

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PROJECT REFERENCE NO.	SHEET NO.
U-2707	13
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NC GRID NAD 83

8/17/99

REVISIONS

-Y-

PI Sta 24+77.65
Δ = 18° 15' 54.9" (RT)
D = 6° 01' 52.5"
L = 302.85'
T = 152.72'
R = 950.00'
SE = 0.04

PI Sta 20+52.02
Δ = 13° 30' 00.2" (LT)
D = 6° 01' 52.5"
L = 223.84'
T = 112.44'
R = 950.00'
SE = 0.04

MATCH LINE -Y- STA 19+50

POT 12+90.56 -Y3-

12+60.00 -Y3-
44.00
EXIST R/W

RETAIN

END CONSTRUCTION -Y3-
POT Sta.12+60.00 -Y3-

MAINTAIN EXISTING DITCH
RETAIN AND ADJUST ROOF DRAINS AS NECESSARY

11+15.00 -Y3-
EXIST R/W

11+15.00 -Y3-
35.75

10+80.00 -Y3-
45.73

20+53.00 -Y-
51.00

22+62.99 -Y-
39.05

22+65.00 -Y-
50.00

34' DRIVE

22+00.00 -Y-
EXIST R/W

22+02.00 -Y-
50.00

4' FDPS

SPECIAL GRADE
CUT DITCH
SEE DETAIL 13B

SPECIAL GRADE
CUT DITCH
SEE DETAIL 13A

22+25.00 -Y-
59.00

21+63.42 -Y-
50.00

REPLACE C&G ON DRIVEWAY TURNOUT

PC Sta. 21+24.93

PT Sta. 26+27.78

-BY1- 33 PINC
-Y- STA.25+60.72 (23.78 LT)

END CONSTRUCTION -Y-
POC Sta.25+30.00 -Y-

23+82.00 -Y-
45.00

23+77.00 -Y-
60.00

23+25.00 -Y-
55.18

23+50.00 -Y-
60.00

24+50.00 -Y-
50.00

16' DRIVE

10'R

8d TAPER

23+83.14 -Y-
50.00

23+50.00 -Y-
59.00

23+24.93 -Y-
50.00

25+20.00 -Y-
50.00
EXIST R/W

25+30.00 -Y-
29.41

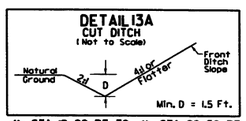
25+00.00 -Y-
50.00

REMOVE

+99.20
29.89'

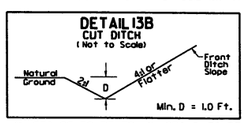
POC Sta.20+04.54 -Y- =
POT Sta.10+00.00 -Y3-
Δ = 75°33'54.76"

DETAIL 13A
CUT DITCH
(Not to Scale)



-Y- STA. 18+00 RT TO -Y- STA. 20+50 RT

DETAIL 13B
CUT DITCH
(Not to Scale)



-Y- STA. 20+50 RT TO -Y- STA. 21+50 RT

32 BROOKSTOWN WAREHOUSES, INC.
DB 1260 PG 387

33 DUKE POWER COMPANY
DB 854 PG 332

11 FRISBY ACQUISITION CORPORATION
DB 1987 PG 2388

THOMAS M. DOWD
MICHAEL DOWD
DB 1307 PG 214

WELLINGTON ASSOCIATES, LLC
DB 2127 PG 3342

MARGARET E. HEATH
73-E-111

VERNON L. MOORE
88-E-1763
DB 843 PG 95

ROBERT L. THOMPSON
AND WIFE
BILLIE THOMPSON
DB 1108 PG 683
PB 38 PG 185

ELNICE E. COPE
AND HUSBAND
WALTER L. COPE, JR.
DB 1858 PG 2099

SR 2999 HAMPTON RD 24' BST

NATURAL AREA

BST PARKING

ISAIL BLVD

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5/28/99

SEPI ENGINEERING GROUP
2320 Cascades Drive, Suite 370
Raleigh, NC 27601
Tel: 919-789-9977 Fax: 789-9911

PROJECT REFERENCE NO.	SHEET NO.
U-2707	14
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

-L-

PI = 12+65.00
EL = 819.95'
K = 84
VC = 130'

PI = 15+65.00
EL = 817.48'
K = 95
VC = 345'

PI = 18+50.00
EL = 822.62
K = 85
VC = 305'

PI = 20+44.17
EL = 825.40'

PI = 20+78.78
EL = 824.78'

PI = 21+08.41
EL = 824.15'

(+)4.40%
(-)0.82%
(-)0.30%
(-)0.82%
(+)2.81%
(-)2.78%
(-)12.85%
(-)12.85%
(-)1.42%

STA = 11+00.00
EL = 815.00'

STA = 13+25.00
EL = 809.75'

STA = 14+00.00
EL = 809.38'

STA = 16+28.00
EL = 807.09'

STA = 20+44.50
EL = 825.30'

STA = 23+36.00
EL = 817.00'

SPECIAL GRADE DITCH
-L- STA.14+00 TO 15+00 RT

BM #1 ELEV=815.54 R/R SPIKE IN BASE OF 18" RED OAK -BL- STA. 16+69 (139' RT) OUTSIDE OF PROJECT LIMITS

SEE SHEET 4 FOR -L- PLAN

-L-

PI = 28+60.00
EL = 794.46
K = 120
VC = 300'

(-)2.40%
(-)0.82%
(-)0.82%
(-)1.22%
(-)1.56%
(-)0.35%
(+)2.00%
(+)1.20%
(+)2.00%
(-)3.50%
(-)10.30%
(-)5.10%
(-)10.30%
(-)1.40%

STA = 22+50.00
EL = 798.50

STA = 25+00.00
EL = 795.00

STA = 26+28.00
EL = 793.75

STA = 28+00.00
EL = 792.50

STA = 28+75.00
EL = 792.25

STA = 30+00.00
EL = 793.50

STA = 31+00.00
EL = 795.50

STA = 33+50.00
EL = 799.25

STA = 34+50.00
EL = 799.00

STA = 36+00.00
EL = 797.00

SPECIAL GRADE DITCH
-L- STA.22+56 TO 25+00 LT

SPECIAL GRADE DITCH
-L- STA.25+00 TO 28+75 LT

SPECIAL GRADE DITCH
-L- STA.28+75 TO 30+00 LT

SPECIAL GRADE DITCH
-L- STA.30+00 TO 31+50 LT

SPECIAL GRADE DITCH
-L- STA.33+50 TO 36+00 LT

SPECIAL GRADE DITCH
-L- STA.33+50 TO 36+00 LT

SPECIAL GRADE DITCH
-L- STA.36+00 TO 38+00 LT

PIPE HYDRAULIC DATA

DRAINAGE STRUCTURE NO. 10

DRAINAGE AREA	= 7.34	AC
DESIGN FREQUENCY	= 50	YRS
DESIGN DISCHARGE	= 26.6	CFS
DESIGN HW ELEVATION	= 785.5	FT
100 YEAR DISCHARGE	= 28.8	CFS
100 YEAR HW ELEVATION	= 785.63	FT
OVERTOPPING FREQUENCY	= 100+	YRS
OVERTOPPING DISCHARGE	= 100+	CFS
OVERTOPPING ELEVATION	= 786.9	FT

BM #2 ELEV=809.75 R/R SPIKE IN BASE OF 24" WHITE OAK -L- STA. 25+24.13 (140.58' LT)
BM #3 ELEV=811.83 R/R SPIKE IN BASE OF 18" WHITE OAK COURSE FORM BYI-31 TO BM#2 (OUT OF PROJECT LIMITS)

SEE SHEET 5 FOR -L- PLAN

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5/28/99

PROJECT REFERENCE NO.	SHEET NO.
U-2707	15
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

SEPI ENGINEERING GROUP
2305 HERBOORS DRIVE SUITE 370
RALEIGH, NC 27607
TEL: 919-789-9977 FAX: 789-9979

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

-L-

PI = 47+47.09
EL = 768.83'
K = 387
VC = 300'

SPECIAL GRADE DITCH
-L- STA.36+00 TO 38+00 LT

SPECIAL GRADE DITCH
-L- STA.39+00 TO 40+65 LT

SPECIAL GRADE DITCH
-L- STA.40+65 TO 42+50 LT

SPECIAL GRADE DITCH
-L- STA.43+00 TO 44+00 LT

SPECIAL GRADE DITCH
-L- STA.46+00 TO 47+00 LT

SPECIAL GRADE DITCH
-L- STA.48+50 TO 50+60 LT

STA = 37+52.000
EL = 769.00

STA = 38+40.000
EL = 768.00

STA = 40+65.770
EL = 768.35

STA = 42+50.000
EL = 768.70

STA = 44+00.000
EL = 768.70

STA = 47+00.000
EL = 768.70

STA = 47+00.000
EL = 768.70

STA = 47+00.000
EL = 768.70

STA = 48+50.000
EL = 768.28

STA = 50+60.000
EL = 768.28

STA = 47+00.000
EL = 768.70

(-)2.40%
(-).50%
(+)1.24%
(-)1.06%
(-)3.57%
(-)2.13%
(-)1.47%
(+)1.34%

48"
30"

PIPE HYDRAULIC DATA
DRAINAGE STRUCTURE NO. 14

DRAINAGE AREA	= 19.08	AC
DESIGN FREQUENCY	= 50	YRS
DESIGN DISCHARGE	= 72.2	CFS
DESIGN HW ELEVATION	= 770.15	FT
100 YEAR DISCHARGE	= 83.9	CFS
100 YEAR HW ELEVATION	= 770.59	FT
OVERTOPPING FREQUENCY	= >500	YRS
OVERTOPPING DISCHARGE	= >500	CFS
OVERTOPPING ELEVATION	= 778.09	FT

PIPE HYDRAULIC DATA
DRAINAGE STRUCTURE NO. 16

DRAINAGE AREA	= 4.5	AC
DESIGN FREQUENCY	= 50	YRS
DESIGN DISCHARGE	= 18.4	CFS
DESIGN HW ELEVATION	= 756.04	FT
100 YEAR DISCHARGE	= 19.56	CFS
100 YEAR HW ELEVATION	= 756.07	FT
OVERTOPPING FREQUENCY	= <100	YRS
OVERTOPPING DISCHARGE	= <100	CFS
OVERTOPPING ELEVATION	= 756.84	FT

BM #4 ELEV=781.34 R/R SPIKE IN BASE OF 24" WHITE OAK -L- STA. 39+10.35 (198.49' LT)

SEE SHEET 6 FOR -L- PLAN

38 39 40 41 42 43 44 45 46 47 48 49 50 51

780 770 760 750 740 730 720

-L-

PI = 56+14.18
EL = 749.52'
K = 532
VC = 850'

PI = 63+26.55
EL = 746.05'
K = 96
VC = 300'

SPECIAL GRADE DITCH
-L- STA.50+60 TO 52+50 LT

SPECIAL GRADE DITCH
-L- STA.56+50 TO 62+00 LT

SPECIAL GRADE DITCH
-L- STA.62+00 TO 63+00 LT

STA = 52+50.000
EL = 749.00

STA = 54+50.000
EL = 748.00

STA = 56+50.000
EL = 748.00

STA = 58+50.000
EL = 748.00

STA = 60+50.000
EL = 748.00

STA = 62+00.000
EL = 746.00

STA = 63+00.000
EL = 746.00

(+)1.44%
(-)2.53%
(-)1.50%
(-)1.51%
(-)2.05%
(-)1.59%
(+)3.42%

24"

PIPE HYDRAULIC DATA
DRAINAGE STRUCTURE NO. 18

DRAINAGE AREA	= 4.06	AC
DESIGN FREQUENCY	= 50	YRS
DESIGN DISCHARGE	= 12.5	CFS
DESIGN HW ELEVATION	= 741.66	FT
100 YEAR DISCHARGE	= 13.51	CFS
100 YEAR HW ELEVATION	= 741.08	FT
OVERTOPPING FREQUENCY	= 746.9	YRS
OVERTOPPING DISCHARGE	= >500	CFS
OVERTOPPING ELEVATION	= >500	FT

BM #5 ELEV 718.74 R/R SPIKE IN BASE OF 18" FORKED OAK -L- STA. 58+47.28 (321.01' RT)

SEE SHEET 7 FOR -L- PLAN

52 53 54 55 56 57 58 59 60 61 62 63 64 65

780 770 760 750 740 730 720 710 700 690

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SEPI ENGINEERING GROUP	PROJECT REFERENCE NO.	SHEET NO.
2300 RENAISSANCE DRIVE SUITE 370 RALEIGH, NC 27607 TEL: 919-789-9977 FAX: 789-9958	U-2707	16
	ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

-L-

SPECIAL GRADE DITCH
-L- STA.68+45 TO 70+00 LT

STA= 66+50.00
EL= 728.00

SPECIAL GRADE DITCH
-L- STA.66+50 TO 68+45 LT

STA= 67+50.00
EL= 718.4

STA= 68+45.00
EL= 718.26

STA= 69+50.00
EL= 718.26

STA= 70+00.00
EL= 718.26

STA= 70+43.00
EL= 720.26

STA= 71+50.00
EL= 719.5

STA= 72+00.00
EL= 719.5

PI= 75+25.22
EL= 704.00
K= 159
VC= 650'

STA= 74+00.00
EL= 688.56

STA= 74+50.00
EL= 688.56

STA= 75+50.00
EL= 688.56

STA= 76+50.00
EL= 688.56

STA= 77+50.00
EL= 688.56

STA= 78+50.00
EL= 688.56

STA= 79+00.00
EL= 688.56

(-)0.85%
(+)0.50%
(-)1.58%
(-)1.07%
(+)0.52%
(-)1.07%
(-)1.04%

SPECIAL GRADE DITCH
-L- STA.70+40 TO 71+50 RT

SPECIAL GRADE DITCH
-L- STA.68+45 TO 69+50 RT

SPECIAL GRADE DITCH
-L- STA.74+50 TO 82+65 LT

SPECIAL GRADE DITCH
-L- STA.73+00 TO 79+00 RT

PIPE HYDRAULIC DATA
DRAINAGE STRUCTURE NO. 20

DRAINAGE AREA	= 26.53	AC
DESIGN FREQUENCY	= 50	YRS
DESIGN DISCHARGE	= 96.2	CFS
DESIGN HW ELEVATION	= 718.26	FT
100 YEAR DISCHARGE	= 111.8	CFS
100 YEAR HW ELEVATION	= 719.5	FT
OVERTOPPING FREQUENCY	= >100	YRS
OVERTOPPING DISCHARGE	= >100	CFS
OVERTOPPING ELEVATION	= 728.55	FT

SEE SHEET 8 FOR -L- PLAN

BM #6 ELEV=715.26 R/R SPIKE IN BASE OF 44" OAK -L- STA. 75+58.48 (614.79' LT)

PIPE HYDRAULIC DATA
DRAINAGE STRUCTURE NO. 26

DRAINAGE AREA	= 6.73	AC
DESIGN FREQUENCY	= 50	YRS
DESIGN DISCHARGE	= 19.97	CFS
DESIGN HW ELEVATION	= 689.13	FT
100 YEAR DISCHARGE	= 21.58	CFS
100 YEAR HW ELEVATION	= 689.28	FT
OVERTOPPING FREQUENCY	= >500	YRS
OVERTOPPING DISCHARGE	= >500	CFS
OVERTOPPING ELEVATION	= 710.74	FT

STA= 80+50.00
EL= 689.36

STA= 80+70.00
EL= 689.36

STA= 82+50.00
EL= 689.36

STA= 83+00.00
EL= 689.36

STA= 83+50.00
EL= 689.36

STA= 84+50.00
EL= 689.36

STA= 91+00.00
EL= 689.28

STA= 92+06.11
EL= 689.28

STA= 92+50.00
EL= 689.28

STA= 93+50.00
EL= 689.28

(-)0.92%
(-)0.20%
(-)1.09%
(+)1.67%
(+)2.00%

SPECIAL GRADE DITCH
-L- STA.80+50 TO 83+70 RT

SPECIAL GRADE DITCH
-L- STA.92+15 TO 100+50 RT

SPECIAL GRADE DITCH
-L- STA.91+00 TO 92+15 RT

BRIDGE HYDRAULIC DATA

DESIGN DISCHARGE	= 18000	CFS
DESIGN FREQUENCY	= 50	YRS
DESIGN HW ELEVATION	= 702.2	FT
BASE DISCHARGE	= 19000	CFS
BASE FREQUENCY	= 100	YRS
BASE HW ELEVATION	= 702.6	FT
OVERTOPPING DISCHARGE	= 26000	CFS
OVERTOPPING FREQUENCY	= 100+	YRS
OVERTOPPING ELEVATION	= 704.8	FT
DATE OF SURVEY	= 10-2-03	
W.S.ELEVATION AT DATE OF SURVEY	= 679.9	FT

SEE SHEET 9 FOR -L- PLAN

BM #7 ELEV=693.90 R/R SPIKE IN BASE OF 18" ELM -L- STA. 92+06.11 (228.64' LT)

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SEPI ENGINEERING GROUP
2300 RENAISSANCE BLVD, SUITE 370
RALEIGH, NC 27607
TEL: 919-789-9977 FAX: 789-9959

PROJECT REFERENCE NO.	SHEET NO.
U-2707	17
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

-L-

PI = 92+67.27
EL = 714.27
K = 146
VC = 350'

STA=91+50.00
EL= 695.33

STA=94+00.00
EL= 697.50

STA=94+50.00
EL= 703.38

STA=95+25.00
EL= 703.38

STA=96+25.00
EL= 708.15

STA=97+00.00
EL= 708.38

STA=97+50.00
EL= 708.38

STA=98+00.00
EL= 708.26

STA=98+50.00
EL= 708.26

PI = 99+42.31
EL = 709.32
K = 146
VC = 350'

STA=99+00.00
EL= 708.26

STA=99+50.00
EL= 708.26

STA=100+00.00
EL= 708.26

STA=101+00.00
EL= 708.26

STA=101+50.00
EL= 708.26

PI = 102+77.49
EL = 736.22
K = 146
VC = 350'

(+)2.00%
(+)1.45%
(+)2.00%
(+)2.00%
(+)5.29%
(+)2.00%
(+)1.45%
(+)3.50%
(+)5.29%
(+)3.50%
(+)8.00%
(+)5.40%
(+)4.67%

SPECIAL GRADE DITCH
-L- STA 92+15 TO 100+50 RT

SPECIAL GRADE DITCH
-L- STA 92+15 TO 101+50 LT

SPECIAL GRADE DITCH
-L- STA 92+15 TO 101+50 LT

SEE SHEET 10 FOR -L- PLAN

93 94 95 96 97 98 99 100 101 102 103 104 105 106

-L-

PIPE HYDRAULIC DATA
DRAINAGE STRUCTURE NO. 29

DRAINAGE AREA	= 2.4	AC
DESIGN FREQUENCY	= 50	YRS
DESIGN DISCHARGE	= 7.95	CFS
DESIGN HW ELEVATION	= 744.63	FT
100 YEAR DISCHARGE	= 8.58	CFS
100 YEAR HW ELEVATION	= 744.78	FT
OVERTOPPING FREQUENCY	= 100+	YRS
OVERTOPPING DISCHARGE	= 100+	CFS
OVERTOPPING ELEVATION	= 744.98	FT

STA=106+75.00
EL= 742.40

STA=107+25.00
EL= 742.05

STA=108+50.00
EL= 742.00

STA=109+50.00
EL= 741.50

STA=110+00.00
EL= 741.34

PI = 109+02.49
EL = 735.72
K = 350
VC = 1,350

STA=111+50.00
EL= 736.30

STA=112+50.00
EL= 736.30

(+)2.88%
(+)1.02%
(+)0.76%
(+)0.76%
(+)2.00%
(+)0.50%
(+)0.82%
(+)0.30%
(+)0.50%
(+)0.30%
(+)0.30%

SPECIAL GRADE DITCH
-L- STA 106+75 TO 108+50 LT

SPECIAL GRADE DITCH
-L- STA 107+50 TO 110+00 RT

SPECIAL GRADE DITCH
-L- STA 110+00 TO 111+50 RT

SPECIAL GRADE DITCH
-L- STA 108+00 TO 111+50 LT

BM #8 ELEV=751.53 R/R SPIKE IN BASE OF 24" BEECH -L- STA. 112+47.56 (458.24' LT)

SEE SHEET 11 FOR -L- PLAN

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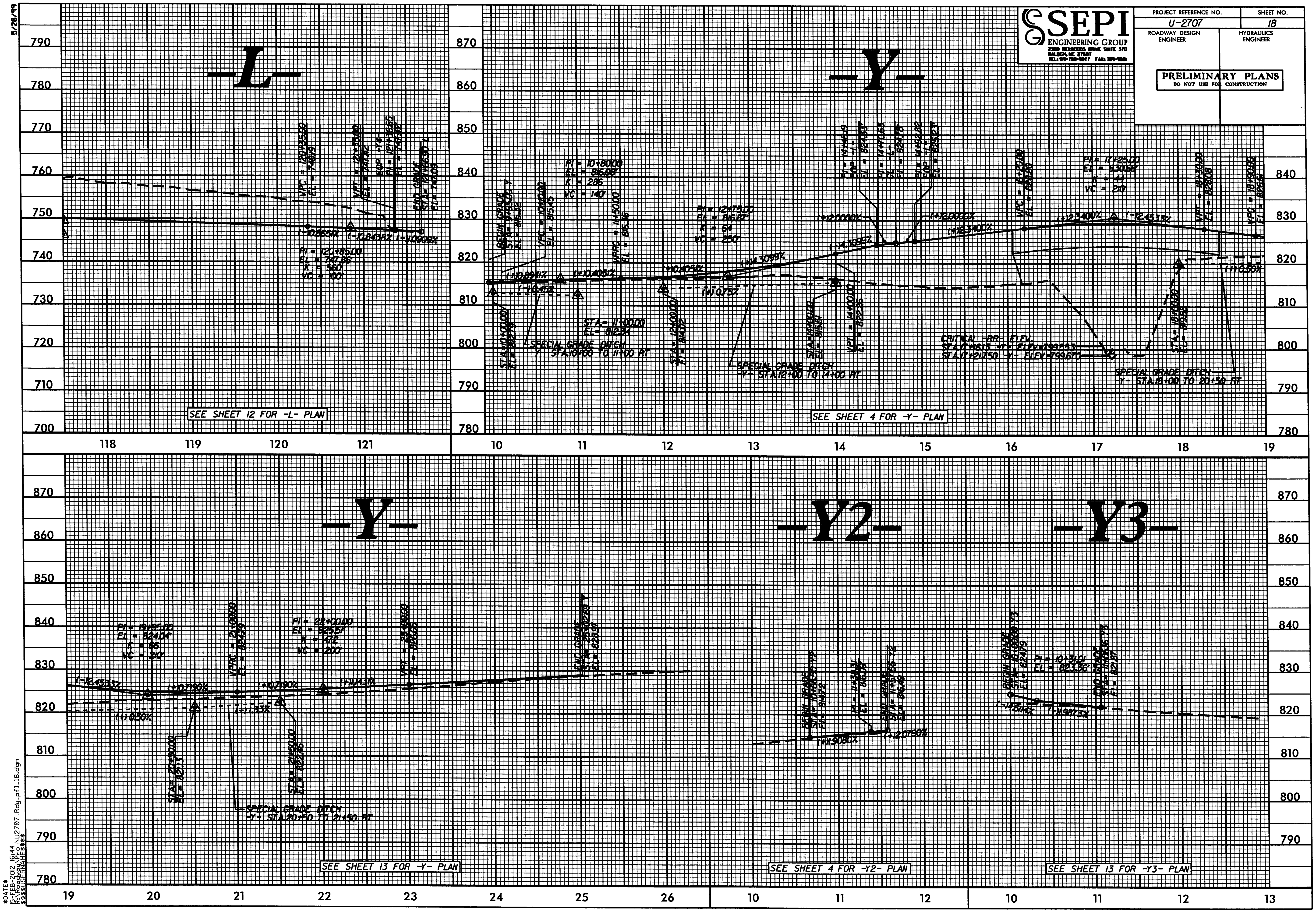
5/28/99
SEPI ENGINEERING GROUP
2300 REXWOODS DRIVE SUITE 370
RALEIGH, NC 27607
PROJECT REFERENCE NO.
U-2707
SHEET NO.
18
ROADWAY DESIGN ENGINEER
HYDRAULICS ENGINEER
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION
-L-
VPC = 120+35.00
EL = 748.19
VPT = 121+35.00
EL = 747.42
EOP -Y4-
PI = 121+36.65
EL = 747.82
END GRADE
STA= 121+56.90 L
EL = 747.09
(-)0.6651%
(-)0.8436%
(-)1.0909%
PI = 120+85.00
EL = 747.86'
K = 560
VC = 100'
SEE SHEET 12 FOR -L- PLAN
-Y-
BEGIN GRADE
STA= 9+95.00 Y
EL = 815.32
VPC = 10+10.00
EL = 815.45
PI = 10+80.00
EL = 816.08'
K = 286
VC = 140'
VPRC = 11+50.00
EL = 816.36
(+)0.8941%
(-)0.45%
(+)0.4051%
STA=10+00.00
EL= 812.79
STA.= 11+00.00
EL= 812.34
SPECIAL GRADE DITCH
-Y- STA.10+00 TO 11+00 RT
PI = 12+75.00
EL = 816.87'
K = 64
VC = 250'
(+)0.4051%
(+)4.3099%
(+)0.75%
STA.= 12+00.00
EL= 814.02
SPECIAL GRADE DITCH
-Y- STA.12+00 TO 14+00 RT
STA.=14+00.00
EL= 815.51
VPT = 14+00.00
EL = 822.26
(+)4.3099%
(+)2.0000%
PI = 14+46.19
EOP -L-
EL = 824.33'
PI = 14+70.63
CL -L-
EL = 824.78'
PI = 14+92.82
EOP -L-
EL = 825.23'
(+)2.0000%
(+)2.3400%
VPC = 16+20.00
EL = 828.20
PI = 17+25.00
EL = 830.66'
K = 44
VC = 210'
(+)2.3400%
(-)2.4535%
VPT = 18+30.00
EL = 828.08
VPC = 18+90.00
EL = 826.61
(+)0.50%
CRITICAL -RR- ELEV.
STA.17+16.15 -Y- ELEV=799.553
STA.17+21.750 -Y- ELEV=799.670
STA.= 18+00.00
EL= 819.88
SPECIAL GRADE DITCH
-Y- STA.18+00 TO 20+50 RT
SEE SHEET 4 FOR -Y- PLAN
-Y-
PI = 19+65.00
EL = 824.04'
K = 66
VC = 210'
(-)2.4535%
(+)0.7190%
(+)0.50%
STA.= 20+50.00
EL= 821.13
VPRC = 21+00.00
EL = 824.79
(+)0.7190%
(+)1.33%
PI = 22+00.00
EL = 825.51'
K = 472
VC = 200'
STA.= 21+50.00
EL= 822.46
SPECIAL GRADE DITCH
-Y- STA.20+50 TO 21+50 RT
(+)1.1431%
VPT = 23+00.00
EL = 826.65
END GRADE
STA= 25+02.69 Y
EL = 828.97
SEE SHEET 13 FOR -Y- PLAN
-Y2-
BEGIN GRADE
STA= 10+66.50 Y2
EL = 814.72
(+)1.9080%
PI = 11+38.31
EL = 816.09
END GRADE
STA= 11+57.55 Y2
EL= 816.49
(+)2.0790%
SEE SHEET 4 FOR -Y2- PLAN
-Y3-
BEGIN GRADE
STA= 10+00.00 Y3
EL= 824.79
PI = 10+31.01
EL = 823.36'
(-)4.5114%
(-)1.9873%
END GRADE
STA= 11+06.16 Y3
EL= 821.87
SEE SHEET 13 FOR -Y3- PLAN
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$$$$USERNAME$$$$

5/28/99

SEPI ENGINEERING GROUP
2300 RENAISSANCE DRIVE, SUITE 370
RALEIGH, NC 27607
TEL: 919-789-9977 FAX: 789-9589

PROJECT REFERENCE NO.	SHEET NO.
U-2707	19
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

-Y4-

BEGIN GRADE STA.= 11+75.00 EL.= 734.45

VPT STA.= 11+45.00 EL.= 737.31

PI = 12+45.00 EL = 739.13 K = 88 VC = 120

VPT STA.= 11+69.28 EL.= 741.37

(+)2.36%

(+)2.55%

END GRADE STA.= 12+35.00 Y4 EL.= 754.89

STA.= 11+92.56

STA.= 11+60.00 EL.= 743.92

STA.= 11+60.00 EL.= 743.92

SPECIAL GRADE DITCH -Y4- STA.11+00 TO 11+00 LT

SEE SHEET 12 FOR -Y4- PLAN

-Y5-

BEGIN GRADE STA.= 10+00.00 Y5 EL.= 746.39

VPT STA.= 10+25.00 EL.= 743.81

VPC = 100 EL.= 743.81

PI = 10+40.50 EL.= 743.68

VPT STA.= 10+56.00 EL.= 743.81

(-)1.56%

(-)3.45%

PI = 11+40.00 EL = 739.80 K = 29 VC = 195

STA.= 11+60.00 EL.= 739.81

(+)10.00%

(-)10.30%

SPECIAL GRADE DITCH -Y5- STA.11+00 TO 12+00 RT

STA.= 11+35.00 EL.= 737.81

VPC = 100 EL.= 737.81

PI = 11+70.50 EL.= 738.08

VPT STA.= 11+85.00 EL.= 740.05

(+)10.00%

END GRADE STA.= 11+90.00 Y5 EL.= 741.29

PI = 12+90.00 EL = 741.29 K = 63 VC = 85

PIPE HYDRAULIC DATA
DRAINAGE STRUCTURE NO. 39

DRAINAGE AREA	= 6.0	AC
DESIGN FREQUENCY	= 25	YRS
DESIGN DISCHARGE	= 12.96	CFS
DESIGN HW ELEVATION	= 739.44	FT
100 YEAR DISCHARGE	= 15.6	CFS
100 YEAR HW ELEVATION	= 739.7	FT
OVERTOPPING FREQUENCY	= 100	YRS
OVERTOPPING DISCHARGE	= 15.6	CFS
OVERTOPPING ELEVATION	= 739.7	FT

SEE SHEET 12 FOR -Y5- PLAN

-DRI-

SEE SHEET 8 FOR -DRI- PLAN

PI = 11+15.00 EL = 760.12 VC = 30 K = 5

BEGIN GRADE STA.= 11+00.00 EL.= 760.00

VPT STA.= 11+15.00 EL.= 760.75

PI = 11+65.00 EL = 776.95 VC = 30 K = 7

PI = 12+23.00 EL = 776.48 VC = 15 K = 4

-DRI- PROFILE GRADES

1	(+)10.6874%
2	(-)18.3482%
3	(-)14.0000%
4	(+)10.9025%
5	(+)11.1969%
6	(-)12.0000%
7	(-)15.4813%

-RR-

SEE SHEET 4 FOR -RR- PLAN

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