



STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY  
GOVERNOR

LYNDO TIPPETT  
SECRETARY

October 28, 2008

U.S. Army Corps of Engineers  
Wilmington District Headquarters  
P.O. Box 1890  
Wilmington, NC 28402-1890

ATTENTION: Mr. Richard Spencer  
NCDOT Coordinator, Division 8

Dear Sir:

SUBJECT: **Supplement to and Revision of Application for Section 404 Nationwide Permit 42 and Section 401 Water Quality Certification** for the proposed Endor Iron Furnace Greenway (Phase I) from Kiwanis Family Park on SR 1009 (Carbonton Road) to Boone Circle (an unopened road), Sanford, Lee County, Division 8. WBS Element 33906.1.1, TIP No. E-4981.

\$240.00 Debit from WBS element 33906.1.1.

REFERENCE: Application for Section 404 Nationwide Permit 42 and Section 401 Water Quality Certification, dated March 27, 2008.

This packet serves to supplement the N. C. Department of Transportation's (NCDOT) previously submitted permit application for the above-referenced project. Per your request made at our onsite meeting on July 9, 2008, NCDOT investigated alternatives to the two reinforced concrete box culverts (RCBC) proposed in our permit application (one at STA. 38+05, one at STA. 47+71) and compiled information to support our preferred choice of structures. After review, it was determined that an RCEC would still be the best alternative at both crossings. Please see the enclosed copies of the following documents, which provide the requested information: a Structural Recommendations memo, Culvert Survey and Hydraulic Design Reports for both proposed culverts, Geotechnical Reports for both proposed culvert sites, a Cost Estimates memo outlining various pedestrian bridge options, and cost estimates for the two proposed culverts.

**UPDATED IMPACTS TO WATERS OF THE UNITED STATES**

Although we plan to proceed with the use of the two RCBCs, because of a change in the proposed construction method, the stream impacts for the project have changed slightly since the initial application. Therefore, this packet also serves to update our jurisdictional impact calculations to reflect the new construction method. Please see the enclosed copies of the updated Pre-construction Notification (PCN), updated Wetland Permit Impact Summary sheet, and updated Site 1 and 2 permit drawings showing these changes.

**MAILING ADDRESS:**  
NC DEPARTMENT OF TRANSPORTATION  
PROJECT DEVELOPMENT AND ENVIRONMENTAL ANALYSIS  
1598 MAIL SERVICE CENTER  
RALEIGH NC 27699-1598

TELEPHONE: 919-715-1334  
FAX: 919-715-5501  
WEBSITE: [WWW.NCDOT.ORG](http://WWW.NCDOT.ORG)

**LOCATION:**  
2728 CAPITAL BLVD., SUITE 240  
RALEIGH NC 27604

## Permanent Impacts

### *Sites 1 and 2*

There have been no changes to the proposed permanent stream impacts associated with this project. A total of 28 linear feet of permanent perennial stream impacts will occur to UT 1 to Big Buffalo Creek at each site, totaling 56 linear feet for the entire project. These impacts are a result of the placement of the double-barreled RCBCs.

## Temporary Impacts

Originally, water was going to be redirected around the area of construction at both RCBC sites using a temporary 5-foot base diversion ditch. However, according to the new construction sequence, impervious sand bag dikes will be built upstream and downstream of where each RCBC will be installed and the area between them will be dewatered using a bypass pump. The water will temporarily be diverted into a stilling basin adjacent to the stream. Once the area is dewatered and prepared, a bypass pipe will be installed between the dikes just prior to culvert construction and use of the bypass pump will be discontinued. Once each culvert is complete, the dikes and bypass pipe will be removed and the stilling basin will be obliterated. This construction method will be used at both sites.

### *Site 1*

Originally, the construction of the RCBC (STA. 38+05) would have resulted in a temporary stream impact of 124 linear feet to UT 1 to Big Buffalo Creek. However, with the use of the new construction method, a total of 49 linear feet of temporary impacts will now occur. This is a decrease of 75 linear feet.

### *Site 2*

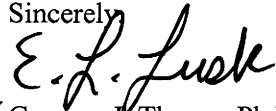
Originally, the construction of the RCBC (STA. 47+71) would have resulted in a temporary stream impact of 132 linear feet to UT 1 to Big Buffalo Creek. However, with the use of the new construction method, a total of 55 linear feet of temporary impacts will now occur. This is a decrease of 77 linear feet.

## Compensatory Mitigation

As in the initial application, no mitigation is proposed for the 56 linear feet of permanent perennial stream impacts to UT 1 to Big Buffalo Creek (28 linear feet at both Site 1 and Site 2) because of the minimal amount of impact. Additionally, the stream is in a very urbanized area, has little to no buffer or canopy, and has been impacted by sedimentation. Furthermore, the stream has already been detrimentally impacted by in-stream construction both immediately upstream (a single-barreled RCBC) and downstream (three 90-inch corrugated metal pipes) of the proposed impacts.

A copy of this memorandum will be posted on the NCDOT website at: <http://www.ncdot.org/doh/preconstruct/pe/>. If you have any questions or need additional information, please contact Mr. Jim Mason at (919) 715-5531 or [jsmason@ncdot.gov](mailto:jsmason@ncdot.gov).

Sincerely



for

Gregory J. Thorpe, Ph.D.  
Environmental Management Director, PDEA

**w/attachment**

Mr. Brian Wrenn, NCDWQ (5 copies)

**w/o attachment (see website for attachments)**

Dr. David Chang, P.E., Hydraulics

Mr. Mark Staley, Roadside Environmental

Mr. Greg Perfetti, P.E., Structure Design

Mr. Victor Barbour, P.E., Project Services Unit

Mr. Tim Johnson, P.E., Division 8 Engineer

Mr. Art King, Division 8 Environmental Officer

Mr. Jay Bennett, P.E., Roadway Design

Mr. Majed Alghandour, P. E., Programming/TIP

Mr. Art McMillan, P.E., Highway Design

Mr. Scott McLendon, USACE, Wilmington

Mr. Travis Wilson, NCWRC

Mr. Gary Jordan, USFWS

Mr. Kumar Trivedi, Project Planning Engineer, Bicycle and Pedestrian

USACE Action ID No. \_\_\_\_\_ DWQ No. \_\_\_\_\_

(If any particular item is not applicable to this project, please enter "Not Applicable" or "N/A".)

**I. Processing**

1. Check all of the approval(s) requested for this project:

- Section 404 Permit
- Section 10 Permit
- 401 Water Quality Certification
- Riparian or Watershed Buffer Rules
- Isolated Wetland Permit from DWQ
- Express 401 Water Quality Certification

2. Nationwide, Regional or General Permit Number(s) Requested: Nationwide 42

3. If this notification is solely a courtesy copy because written approval for the 401 Certification is not required, check here:

4. If payment into the North Carolina Ecosystem Enhancement Program (NCEEP) is proposed for mitigation of impacts, attach the acceptance letter from NCEEP, complete section VIII, and check here:

5. If your project is located in any of North Carolina's twenty coastal counties (listed on page 4), and the project is within a North Carolina Division of Coastal Management Area of Environmental Concern (see the top of page 2 for further details), check here:

**II. Applicant Information**

1. Owner/Applicant Information

Name: Gregory J. Thorpe, Ph.D., Environmental Management Director  
Mailing Address: North Carolina Department of Transportation  
1598 Mail Service Center  
Raleigh, NC 27699-1598  
Telephone Number: (919) 733-3141 Fax Number: (919) 733-9794  
E-mail Address: \_\_\_\_\_

2. Agent/Consultant Information (A signed and dated copy of the Agent Authorization letter must be attached if the Agent has signatory authority for the owner/applicant.)

Name: \_\_\_\_\_  
Company Affiliation: \_\_\_\_\_  
Mailing Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Telephone Number: \_\_\_\_\_ Fax Number: \_\_\_\_\_  
E-mail Address: \_\_\_\_\_

**III. Project Information**

Attach a **vicinity map** clearly showing the location of the property with respect to local landmarks such as towns, rivers, and roads. Also provide a detailed **site plan** showing property boundaries and development plans in relation to surrounding properties. Both the vicinity map and site plan must include

a scale and north arrow. The specific footprints of all buildings, impervious surfaces, or other facilities must be included. If possible, the maps and plans should include the appropriate USGS Topographic Quad Map and NRCS Soil Survey with the property boundaries outlined. Plan drawings, or other maps may be included at the applicant's discretion, so long as the property is clearly defined. For administrative and distribution purposes, the USACE requires information to be submitted on sheets no larger than 11 by 17-inch format; however, DWQ may accept paperwork of any size. DWQ prefers full-size construction drawings rather than a sequential sheet version of the full-size plans. If full-size plans are reduced to a small scale such that the final version is illegible, the applicant will be informed that the project has been placed on hold until decipherable maps are provided.

1. Name of project: The proposed Endor Iron Furnace Greenway (Phase I) from Kiwanis Family Park on SR 1009 (Carbonton Road) to Boone Circle (an unopened road) in the City of Sanford.
2. T.I.P. Project Number or State Project Number (NCDOT Only): E-4981
3. Property Identification Number (Tax PIN): N/A
4. Location  
County: Lee Nearest Town: Sanford  
Subdivision name (include phase/lot number): N/A  
Directions to site (include road numbers/names, landmarks, etc.): From points north, take U.S. Route 1 south to Sanford. Exit highway onto Spring Lane, take right. Greenway will cross Spring Lane at its intersection with River Birch Shopping Center entrance.
5. Site coordinates (For linear projects, such as a road or utility line, attach a sheet that separately lists the coordinates for each crossing of a distinct waterbody.)  
Decimal Degrees (6 digits minimum): \_\_\_\_\_ °N \_\_\_\_\_ °W
6. Property size (acres): \_\_\_\_\_
7. Name of nearest receiving body of water: Big Buffalo Creek
8. River Basin: Cape Fear  
(Note – this must be one of North Carolina's seventeen designated major river basins. The River Basin map is available at <http://h2o.enr.state.nc.us/admin/maps/>.)
9. Describe the existing conditions on the site and general land use in the vicinity of the project at the time of this application: A majority of the greenway will be built on new location. Land use in the area includes residential, business, and forested areas.
10. Describe the overall project in detail, including the type of equipment to be used: See previously-submitted cover letter, dated March 27, 2008, for project description. Heavy duty excavation equipment will be used such as trucks, dozers, and other various equipment necessary for greenway construction.
11. Explain the purpose of the proposed work: Phase I of this bicycle and pedestrian trail will provide transportation as well as recreational trail access between Kiwanis Family Park and commercial/residential destinations in Sanford. The multi-use trail, when all phases are completed, will connect to the proposed nature preserve and park at the Endor Iron Furnace historic site.

**IV. Prior Project History**

If jurisdictional determinations and/or permits have been requested and/or obtained for this project (including all prior phases of the same subdivision) in the past, please explain. Include the USACE Action ID Number, DWQ Project Number, application date, and date permits and certifications were issued or withdrawn. Provide photocopies of previously issued permits, certifications or other useful information. Describe previously approved wetland, stream and buffer impacts, along with associated mitigation (where applicable). If this is a NCDOT project, list and describe permits issued for prior segments of the same T.I.P. project, along with construction schedules. N/A

**V. Future Project Plans**

Are any future permit requests anticipated for this project? If so, describe the anticipated work, and provide justification for the exclusion of this work from the current application. N/A

**VI. Proposed Impacts to Waters of the United States/Waters of the State**

It is the applicant's (or agent's) responsibility to determine, delineate and map all impacts to wetlands, open water, and stream channels associated with the project. Each impact must be listed separately in the tables below (e.g., culvert installation should be listed separately from riprap dissipater pads). Be sure to indicate if an impact is temporary. All proposed impacts, permanent and temporary, must be listed, and must be labeled and clearly identifiable on an accompanying site plan. All wetlands and waters, and all streams (intermittent and perennial) should be shown on a delineation map, whether or not impacts are proposed to these systems. Wetland and stream evaluation and delineation forms should be included as appropriate. Photographs may be included at the applicant's discretion. If this proposed impact is strictly for wetland or stream mitigation, list and describe the impact in Section VIII below. If additional space is needed for listing or description, please attach a separate sheet.

Provide a written description of the proposed impacts: Please see attached memo, dated October 21, 2008.

1. Individually list wetland impacts. Types of impacts include, but are not limited to mechanized clearing, grading, fill, excavation, flooding, ditching/drainage, etc. For dams, separately list impacts due to both structure and flooding.

Wetland Impact Site Number (indicate on map)	Type of Impact	Type of Wetland (e.g., forested, marsh, herbaceous, bog, etc.)	Located within 100-year Floodplain (yes/no)	Distance to Nearest Stream (linear feet)	Area of Impact (acres)
Total Wetland Impact (acres)					0.00

2. List the total acreage (estimated) of all existing wetlands on the property: 0.00

3. Individually list all intermittent and perennial stream impacts. Be sure to identify temporary impacts. Stream impacts include, but are not limited to placement of fill or culverts, dam construction, flooding, relocation, stabilization activities (e.g., cement walls, rip-rap, crib walls, gabions, etc.), excavation, ditching/straightening, etc. If stream relocation is proposed, plans and profiles showing the linear footprint for both the original and relocated streams must be included. To calculate acreage, multiply length X width, then divide by 43,560.

Stream Impact Number (indicate on map)	Stream Name	Type of Impact	Perennial or Intermittent?	Average Stream Width Before Impact	Impact Length (linear feet)	Area of Impact (acres)
1	UT 1 to Big Buffalo Creek	Double-barreled RCBC (Permanent)	Perennial	12-14	28	<0.01
1	UT 1 to Big Buffalo Creek	Temporary dewatering	Perennial	12-14	49	<0.02
2	UT 1 to Big Buffalo Creek	Double-barreled RCBC (Permanent)	Perennial	12-14	28	0.01
2	UT 1 to Big Buffalo Creek	Temporary dewatering	Perennial	12-14	55	0.01
Total Stream Impact (by length and acreage)					160	<0.05

4. Individually list all open water impacts (including lakes, ponds, estuaries, sounds, Atlantic Ocean and any other water of the U.S.). Open water impacts include, but are not limited to fill, excavation, dredging, flooding, drainage, bulkheads, etc.

Open Water Impact Site Number (indicate on map)	Name of Waterbody (if applicable)	Type of Impact	Type of Waterbody (lake, pond, estuary, sound, bay, ocean, etc.)	Area of Impact (acres)
Total Open Water Impact (acres)				0.0

5. List the cumulative impact to all Waters of the U.S. resulting from the project:

Stream Impact (acres):	0.05
Wetland Impact (acres):	0.00
Open Water Impact (acres):	0
Total Impact to Waters of the U.S. (acres)	0.05
Total Stream Impact (linear feet):	160

6. Isolated Waters

Do any isolated waters exist on the property?  Yes  No

Describe all impacts to isolated waters, and include the type of water (wetland or stream) and the size of the proposed impact (acres or linear feet). Please note that this section only applies to waters that have specifically been determined to be isolated by the USACE.

7. Pond Creation

If construction of a pond is proposed, associated wetland and stream impacts should be included above in the wetland and stream impact sections. Also, the proposed pond should be described here and illustrated on any maps included with this application.

Pond to be created in (check all that apply):  uplands  stream  wetlands

Describe the method of construction (e.g., dam/embankment, excavation, installation of draw-down valve or spillway, etc.):

Proposed use or purpose of pond (e.g., livestock watering, irrigation, aesthetic, trout pond, local stormwater requirement, etc.): \_\_\_\_\_

Current land use in the vicinity of the pond: \_\_\_\_\_

Size of watershed draining to pond: \_\_\_\_\_ Expected pond surface area: \_\_\_\_\_

## VII. Impact Justification (Avoidance and Minimization)

Specifically describe measures taken to avoid the proposed impacts. It may be useful to provide information related to site constraints such as topography, building ordinances, accessibility, and financial viability of the project. The applicant may attach drawings of alternative, lower-impact site layouts, and explain why these design options were not feasible. Also discuss how impacts were minimized once the desired site plan was developed. If applicable, discuss construction techniques to be followed during construction to reduce impacts. See previously-submitted cover letter, dated March 27, 2008.

## VIII. Mitigation

DWQ - In accordance with 15A NCAC 2H .0500, mitigation may be required by the NC Division of Water Quality for projects involving greater than or equal to one acre of impacts to freshwater wetlands or greater than or equal to 150 linear feet of total impacts to perennial streams.

USACE – In accordance with the Final Notice of Issuance and Modification of Nationwide Permits, published in the Federal Register on January 15, 2002, mitigation will be required when necessary to ensure that adverse effects to the aquatic environment are minimal. Factors including size and type of proposed impact and function and relative value of the impacted aquatic resource will be considered in determining acceptability of appropriate and practicable mitigation as proposed. Examples of mitigation that may be appropriate and practicable include, but are not limited to: reducing the size of the project; establishing and maintaining wetland and/or upland vegetated buffers to protect open waters such as streams; and replacing losses of aquatic resource functions and values by creating, restoring, enhancing, or preserving similar functions and values, preferable in the same watershed.

If mitigation is required for this project, a copy of the mitigation plan must be attached in order for USACE or DWQ to consider the application complete for processing. Any application lacking a required mitigation plan or NCEEP concurrence shall be placed on hold as incomplete. An applicant may also choose to review the current guidelines for stream restoration in DWQ's Draft Technical Guide for Stream Work in North Carolina, available at <http://h2o.enr.state.nc.us/ncwetlands/strmgide.html>.

1. Provide a brief description of the proposed mitigation plan. The description should provide as much information as possible, including, but not limited to: site location (attach directions and/or map, if offsite), affected stream and river basin, type and amount (acreage/linear feet) of mitigation proposed (restoration, enhancement, creation, or preservation), a plan view, preservation mechanism (e.g., deed restrictions, conservation easement, etc.), and a description of the current site conditions and proposed method of construction. Please attach a separate sheet if more space is needed.

No mitigation is proposed for the 56 linear feet of permanent stream impacts to UT 1 to Big Buffalo Creek (28 linear feet at both Site 1 and Site 2) because of the minimal amount of impact. Additionally, the stream is in a very urbanized area, has little to no buffer or canopy, and has been impacted by sedimentation. Furthermore, the stream has already been detrimentally impacted by in-stream construction both immediately upstream (a single-barreled RCBC) and downstream (three 90-inch corrugated metal pipes) of NCDOT's proposed impacts.



2. Mitigation may also be made by payment into the North Carolina Ecosystem Enhancement Program (NCEEP). Please note it is the applicant's responsibility to contact the NCEEP at (919) 715-0476 to determine availability, and written approval from the NCEEP indicating that they are will to accept payment for the mitigation must be attached to this form. For additional information regarding the application process for the NCEEP, check the NCEEP website at <http://h2o.enr.state.nc.us/wrp/index.htm>. If use of the NCEEP is proposed, please check the appropriate box on page five and provide the following information:

Amount of stream mitigation requested (linear feet): 0  
 Amount of buffer mitigation requested (square feet): 0  
 Amount of Riparian wetland mitigation requested (acres): 0.00  
 Amount of Non-riparian wetland mitigation requested (acres): 0.00  
 Amount of Coastal wetland mitigation requested (acres): 0.00

**IX. Environmental Documentation (required by DWQ)**

1. Does the project involve an expenditure of public (federal/state/local) funds or the use of public (federal/state) land? Yes  No
2. If yes, does the project require preparation of an environmental document pursuant to the requirements of the National or North Carolina Environmental Policy Act (NEPA/SEPA)? Note: If you are not sure whether a NEPA/SEPA document is required, call the SEPA coordinator at (919) 733-5083 to review current thresholds for environmental documentation. Yes  No
3. If yes, has the document review been finalized by the State Clearinghouse? If so, please attach a copy of the NEPA or SEPA final approval letter. Yes  No

**X. Proposed Impacts on Riparian and Watershed Buffers (required by DWQ)**

It is the applicant's (or agent's) responsibility to determine, delineate and map all impacts to required state and local buffers associated with the project. The applicant must also provide justification for these impacts in Section VII above. All proposed impacts must be listed herein, and must be clearly identifiable on the accompanying site plan. All buffers must be shown on a map, whether or not impacts are proposed to the buffers. Correspondence from the DWQ Regional Office may be included as appropriate. Photographs may also be included at the applicant's discretion.

1. Will the project impact protected riparian buffers identified within 15A NCAC 2B .0233 (Neuse), 15A NCAC 2B .0259 (Tar-Pamlico), 15A NCAC 02B .0243 (Catawba) 15A NCAC 2B .0250 (Randleman Rules and Water Supply Buffer Requirements), or other (please identify \_\_\_\_\_)?  
 Yes  No

2. If "yes", identify the square feet and acreage of impact to each zone of the riparian buffers. If buffer mitigation is required calculate the required amount of mitigation by applying the buffer multipliers.

Zone*	Impact (square feet)	Multiplier	Required Mitigation
1	0	3 (2 for Catawba)	0
2	0	1.5	0
Total	0		0

\* Zone 1 extends out 30 feet perpendicular from the top of the near bank of channel; Zone 2 extends an additional 20 feet from the edge of Zone 1.

If buffer mitigation is required, please discuss what type of mitigation is proposed (i.e., Donation of Property, Riparian Buffer Restoration / Enhancement, or Payment into the Riparian Buffer Restoration Fund). Please attach all appropriate information as identified within 15A NCAC 2B .0242 or .0244, or .0260. \_\_\_\_\_

**XI. Stormwater (required by DWQ)**

Describe impervious acreage (existing and proposed) versus total acreage on the site. Discuss stormwater controls proposed in order to protect surface waters and wetlands downstream from the property. If percent impervious surface exceeds 20%, please provide calculations demonstrating total proposed impervious level. N/A

**XII. Sewage Disposal (required by DWQ)**

Clearly detail the ultimate treatment methods and disposition (non-discharge or discharge) of wastewater generated from the proposed project, or available capacity of the subject facility. N/A

**XIII. Violations (required by DWQ)**

Is this site in violation of DWQ Wetland Rules (15A NCAC 2H .0500) or any Buffer Rules?  
Yes  No


Is this an after-the-fact permit application? Yes  No

**XIV. Cumulative Impacts (required by DWQ)**

Will this project (based on past and reasonably anticipated future impacts) result in additional development, which could impact nearby downstream water quality? Yes  No   
If yes, please submit a qualitative or quantitative cumulative impact analysis in accordance with the most recent North Carolina Division of Water Quality policy posted on our website at <http://h2o.enr.state.nc.us/ncwetlands>. If no, please provide a short narrative description: N/A

**XV. Other Circumstances (Optional):**

It is the applicant's responsibility to submit the application sufficiently in advance of desired construction dates to allow processing time for these permits. However, an applicant may choose to list constraints associated with construction or sequencing that may impose limits on work schedules (e.g., draw-down schedules for lakes, dates associated with Endangered and Threatened Species, accessibility problems, or other issues outside of the applicant's control). N/A



Revised 10.27.08

Applicant/Agent's Signature

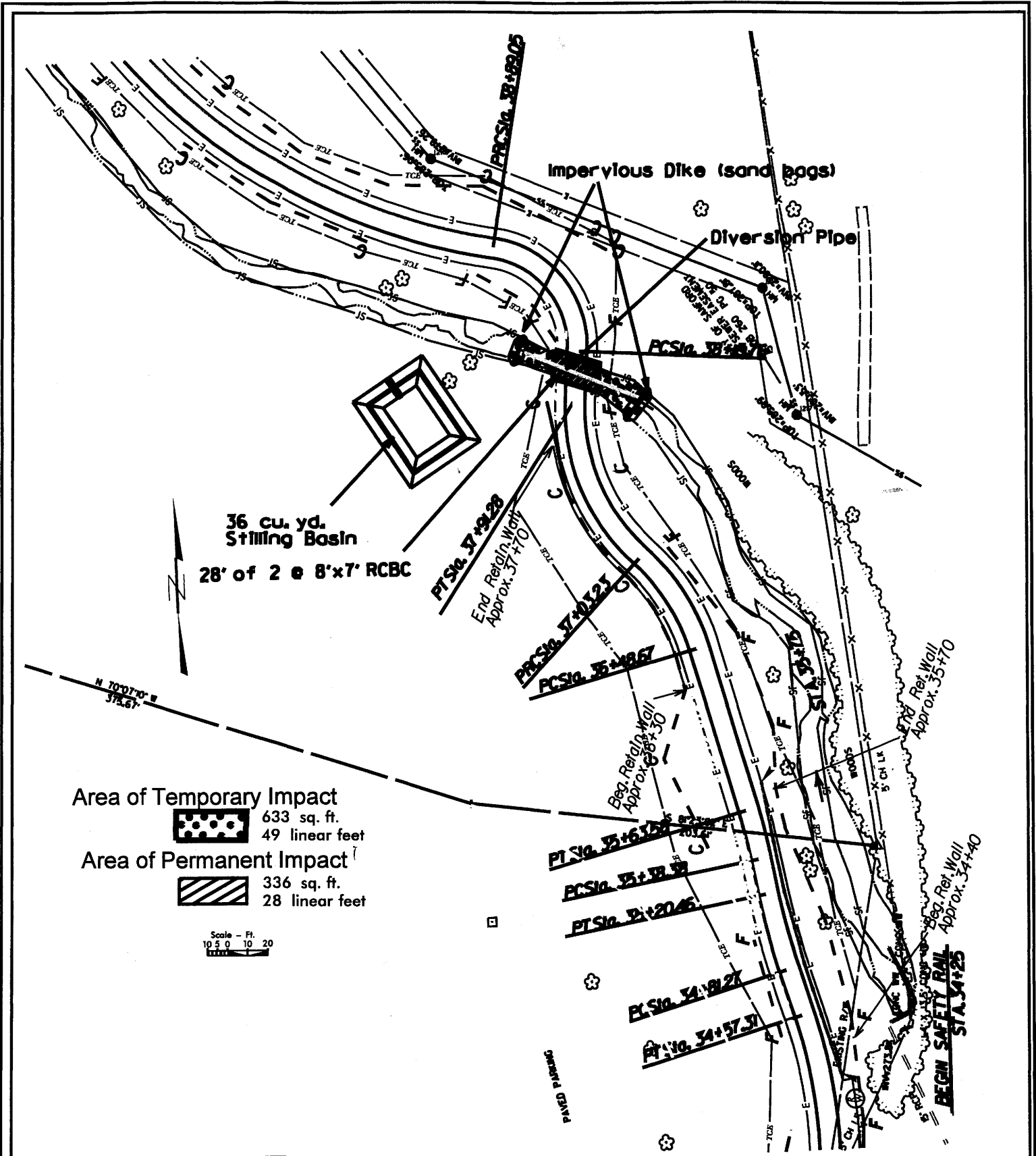
Date

(Agent's signature is valid only if an authorization letter from the applicant is provided.)

**WETLAND PERMIT IMPACT SUMMARY**



Date: 10/20/2008	WETLAND IMPACTS						SURFACE WATER IMPACTS					
	Site No.	Station (From/To)	Structure Size / Type	Fill In Wetlands (ac)	Temp. Fill In Wetlands (ac)	Excavation In Wetlands (ac)	Mechanized Clearing (Method III) (ac)	Temporary Existing Channel Impacted (ft)	Temporary Existing Channel Impacted (ac)	Permanent Existing Channel Impacted (ft)	Permanent Existing Channel Impacted (ac)	
1	-G- 37+98 TO 38+13	28-ft of 2@8'x7' RCBC		-	-	-		49	0.015	28	0.008	
2	-G- 47+62 TO 47+80	28-ft. of 2@9'x9' RCBC		-	-	-		55	0.013	28	0.012	
3	-G- 65+20.5 TO 65+75.5+80	10-ft. wide x75-ft Bridge	No impact. No structure in stream.									
			0	0	0	0	104	0.028	56	0.02		
<b>TOTALS:</b>												

NC DEPARTMENT OF TRANSPORTATION  
 DIVISION OF BICYCLE AND PEDESTRIAN  
 TOWN OF SANFORD, LEE COUNTY  
 PROJECT TIP NO: E-4981  
 SHEET / OF 3 *rev.*  
 10/20/2008



36 cu. yd.  
Stiling Basin  
28' of 2 @ 8'x7' RCBC

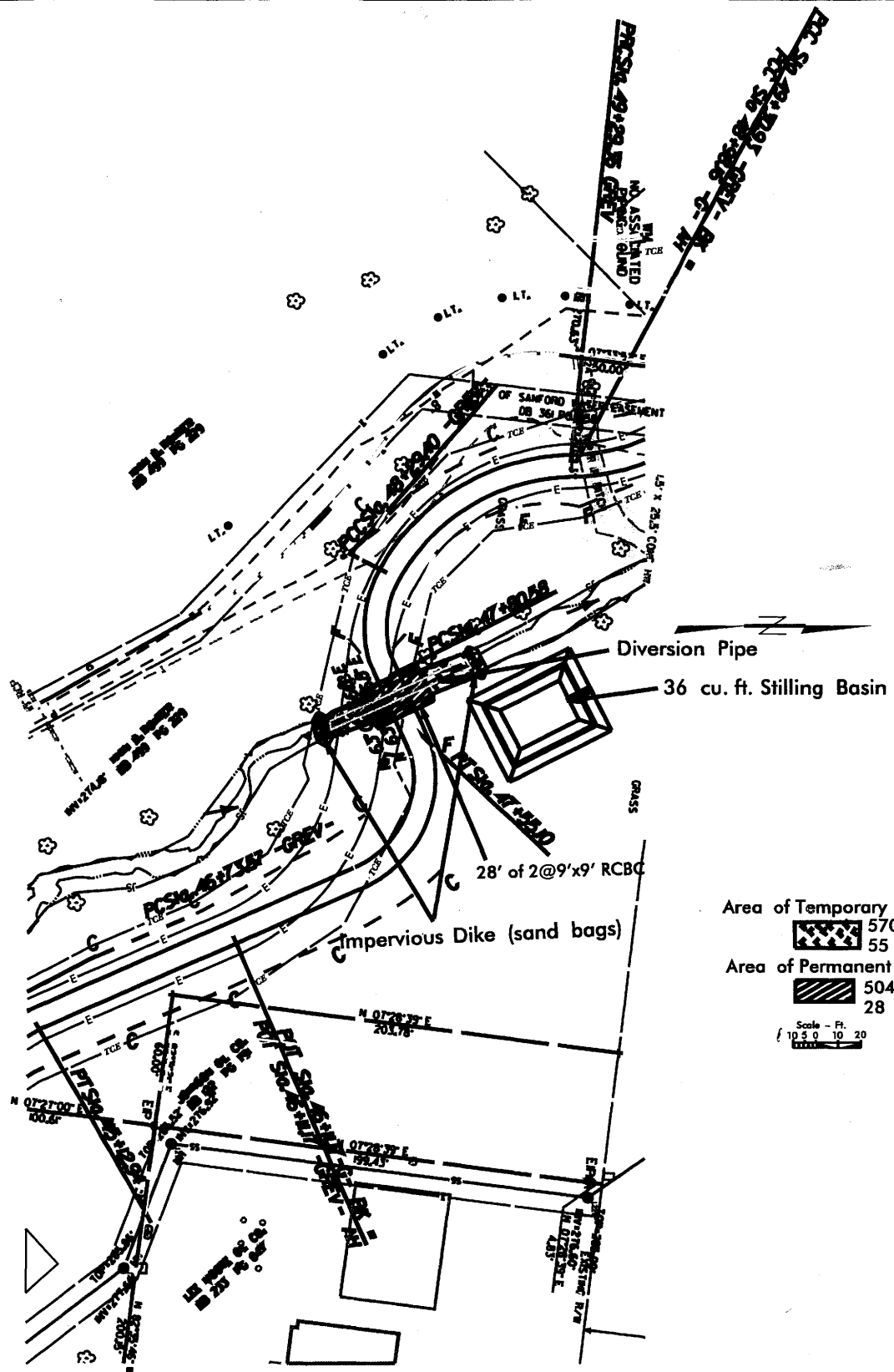
Impervious Dike (sand bags)  
Diversion Pipe

Area of Temporary Impact  
 633 sq. ft.  
 49 linear feet  
 Area of Permanent Impact  
 336 sq. ft.  
 28 linear feet

Scale - Ft.  
 10 5 0 10 20

Site 1

N.C. DEPT. OF TRANSPORTATION  
 DIVISION OF BICYCLE AND PEDESTRIAN  
 CITY OF RALEIGH, WAKE COUNTY  
 PROJECT TIP NO. E-4881  
 ENDOR FURNACE GREENWAY, PHASE 1  
 SHEET 2 OF 3 REV. 10/20/2008



Area of Temporary Impact  
 570 sq. ft.  
 55 linear feet

Area of Permanent Impact  
 504 sq. ft.  
 28 linear feet

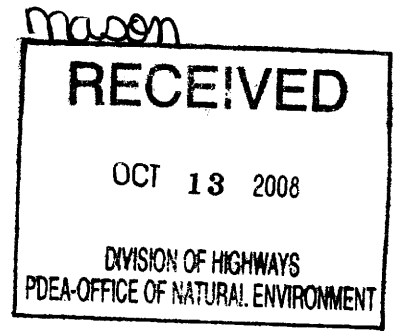
Scale - Ft.  
 10 5 0 10 20

Site 2

N.C. DEPT. OF TRANSPORTATION  
 DIVISION OF BICYCLE AND PEDESTRIAN  
 CITY OF RALEIGH, WAKE COUNTY  
 PROJECT TIP NO. E-4981  
 ENDOR FURNACE GREENWAY, PHASE 1  
 SHEET 3 OF 3 10/20/2008



STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION



MICHAEL F. EASLEY  
GOVERNOR

LYNDO TIPPETT  
SECRETARY

October 7, 2008

MEMORANDUM TO: Mr. James Mason  
Central Environmental Specialist

FROM: Carlas Sharpless, P.E. *C.S.*  
Assistant Regional Hydraulics Engineer

SUBJECT: Structure Recommendations for the Endor Iron Furnace  
Trail, E-4981

The Endor Iron Furnace Trail is a project located in Sanford, NC. The proposed alignment is approximately 1.43 Miles in length and will be constructed along power and sewer easements adjacent to Big Buffalo Creek and its tributaries. The project begins at the Kiwanis Family Park off of SR 1009 (Carbonton Rd.) and ends at Boone Circle. The trail requires three crossings of a tributary to Big Buffalo Creek (Sta. 38+05, Sta. 47+71, and Sta. 65+62). The NCDOT Hydraulics Unit has conducted hydraulic analysis at each location to determine the best viable option.

Bridges were considered at all of these locations. It is felt that a bridge will be the best option at Sta. 65+62. However due to the path alignment within the floodplain, it is felt that a RCBC will be the best alternate for the other 2 crossings for the following reasons:

- The culvert sites are located in a FEMA regulated flood zone. The culverts will minimize fill in the floodplain and thus minimize impacts to the 100 year flood elevation.
- A bridge structure would be required to accommodate maintenance and emergency vehicles. This will result in a thick superstructure depth that will require fill in the floodplain (i.e. adverse impact to 100 yr. WS Elev.)
- 3 sided structures on footings were considered but eliminated because the existing rock is not considered scour resistant. See attached geotechnical report.
- The proposed culverts will fit the existing channel with minimum excavation or other environmental impacts. See attached culvert survey reports.

MAILING ADDRESS:  
NC DEPARTMENT OF TRANSPORTATION  
HYDRAULICS UNIT  
1590 MAIL SERVICE CENTER  
RALEIGH NC 27699-1590

TELEPHONE: 919-250-4100  
FAX: 919-250-4108

WEBSITE: [WWW.DOH.DOT.STATE.NC.US](http://WWW.DOH.DOT.STATE.NC.US)

LOCATION:  
CENTURY CENTER COMPLEX  
BUILDING B  
1020 BIRCH RIDGE DRIVE  
RALEIGH NC

- The culvert construction can be phased to limit impacts to the stream. See attached culvert construction phasing.
- The proposed culvers can be buried 1' below existing stream bed.
- The proposed culverts are more cost effective than bridge structures that would accommodate emergency/maintenance vehicles. See attached cost estimates.
- There is a 1 @9'x 9' RCBC just upstream beneath US 1 and 3 @ 90" CMP just downstream beneath Spring Ln.

If you have any questions or if we may be of further assistance, please contact either Carlas Sharpless or Jerry Lindsey at (919) 250-4100.

CRS

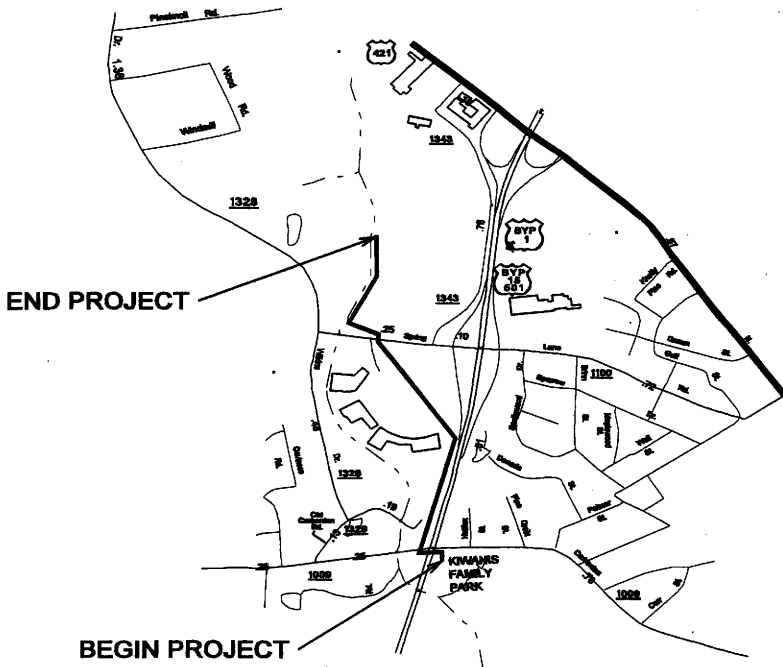
Cc: Kumar Trivedi, P.E., Senior Facility Engineer III, Bicycle and Pedestrian Division

# CULVERT SURVEY & HYDRAULIC DESIGN REPORT

N. C. DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
HYDRAULICS UNIT  
RALEIGH, N. C.

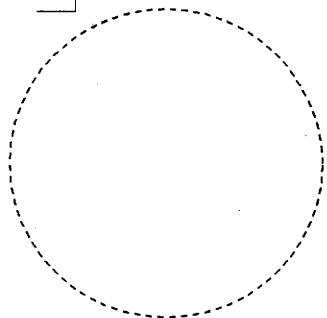
I.D. No. E-4981 Project No. 33906.1.1 Proj. Station 38+05  
County Lee Stream Tributary to Big Buffalo Creek Stru. No. 1  
On Greenway Sanford Bike Path Between Kiwanis Family Park and Boone Circle  
Recommended Structure 24' of 2 @ 8'x7' RCBC  
Recommended Width of Greenway 10 ft. Skew 108°  
Recommended Location is (Up, At, Down) Stream from Existing Crossing. PROPOSED CROSSING  
Bench Mark is NCDOT GPS MONUMENT "E-4981-1" N 629847.854 E 1940768.395  
Elev. 309.2500 Datum: NAVD '88  
Temporary Crossing NOT REQUIRED

33906.1.1  
Project No.  
E-4981  
I.D. No.  
Big Buffalo Creek  
Stream  
Stru. No.



**VICINITY MAP** (NOT TO SCALE)

Designed by: C. R. Sharpless, P.E. Date 7/07  
Assisted by: W.D. PRICE  
Project Engineer: J. L. Lindsey, P.E.  
Reviewed by: J. L. Lindsey, P.E.





**SITE DATA**

Drainage Area 1.0 SQ. MI. Source USGS QUAD MAP (SANFORD)  
 River Basin CAPE FEAR Character URBAN W/ RES. HOUSING AND RETAIL STORES  
 Stream Classification (Such as Trout, High Quality Water, etc.) C  
 Data on Existing Structure N/A  
 Debris Potential: Low X Moderate \_\_\_\_\_ High \_\_\_\_\_  
 Data on Structures Up and Down Stream EXISTING 1 @ 9'x9' RCBC UNDER US-1 BYPASS, 375' UPSTREAM  
EXISTING 2 @ 90" CMP UNDER SR 1100 (SPRING LANE RD.), .22 MI. DOWNSTREAM  
 Gage Station No. N/A Period of Records \_\_\_\_\_  
 Max. Discharge \_\_\_\_\_ c.f.s Date \_\_\_\_\_ Frequency \_\_\_\_\_

**Historical Flood Information:**

Date N/A Elev. \_\_\_\_\_ Est. Freq. \_\_\_\_\_ Source \_\_\_\_\_ Period of Knowledge \_\_\_\_\_  
 Date N/A Elev. \_\_\_\_\_ Est. Freq. \_\_\_\_\_ Source \_\_\_\_\_ Period of Knowledge \_\_\_\_\_  
 Allowable HW Elev. 277.9 (Q<sub>100</sub> = 278.8) Normal Water Surface Elev. 271.1  
 Manning's n : Left O.B. .08 Channel .035 Right O.B. .08 Obtained From FIELD  
 Flood Study / Status FEMA FZ = BACKWATER FROM BIG BUFFALO CREEK Floodway Established? NO  
BACKWATER FROM BIG BUFFALO CREEK ELEV. = 279.0

**DESIGN DATA**

Hydrological Method USGS REGRESSION EQN. 96-4084  
 Hydraulic Design Method HEC-RAS VERSION 3.1.2  

Floods Evaluated:	Freq.	Q	Natural (ft.)	Proposed (ft.)	Bridge Opening Velocity (ft/s)
10 YR	600 CFS		276.6	277.3	6.3
50 YR	1000 CFS		277.5	278.6	7.3
100 YR	1100 CFS		277.8	278.8	7.3

Design Tailwater Q<sub>10</sub> 7.2 ; Q<sub>50</sub> 8.1 ; Q<sub>100</sub> 8.4

Size & Type	Q	K <sub>e</sub>	Inlet Control		Outlet Control						Remarks
			HW/D	H.W.	dc	$\frac{dc+D}{2}$	h <sub>o</sub>	H	LS <sub>o</sub>	H.W.	
2 @ 8'x7'	Q <sub>10</sub> = 600	0.5	0.9	5.4	3.5	4.8	4.8	1.0	0.2	5.6	Outlet Control
2 @ 8'x7'	Q <sub>50</sub> = 1000	0.5	1.4	8.4	5.0	5.5	5.5	2.9	0.2	8.2	Inlet Control
2 @ 8'x7'	Q <sub>100</sub> = 1100	0.5	1.5	9.0	5.4	5.7	5.7	3.0	0.2	8.5	Inlet Control

Is a Floodway Revision Required? NO  
 Outlet Velocity, (V<sub>10</sub>) 6.3 Natural Channel Velocity, (V<sub>10</sub>) 3.4  
 Required Outlet Protection NO

**INFORMATION TO BE SHOWN ON PLANS**

Design: Discharge 600 c.f.s. Frequency 10 yr. Elev. 277.3  
 Base Flood: Discharge 1100 c.f.s. Frequency 100 yr. Elev. 278.8  
 Overtopping: Discharge 1000 c.f.s. Frequency 50 YR Elev. 278.6

ADDITIONAL INFORMATION AND COMPUTATIONS

FLOOD FREQUENCY

\*USGS REGRESSION EQN. 96-4084 DISCHARGE

10 YR

600 CFS

50 YR

1000 CFS

100 YR

1100 CFS

\*USGS REGRESSION EQUATION DISCHARGES WERE USED FOR THIS REPORT.

36+00

37+00

38+00

39+00

40+00

PI = 37+40.00  
EL = 278.18'  
VC = 100'

(-10.58%)

(-15.42%)

(+10.00%)

PI = 38+50.00  
EL = 277.89'  
VC = 50'

(-12.26%)

(-10.57%)

PI = 40+00.00  
EL = 274.50'  
VC = 100'

CENTER LINE STA. 38+05

EXISTING CENTER LINE

PROPOSED CENTER LINE

280

270

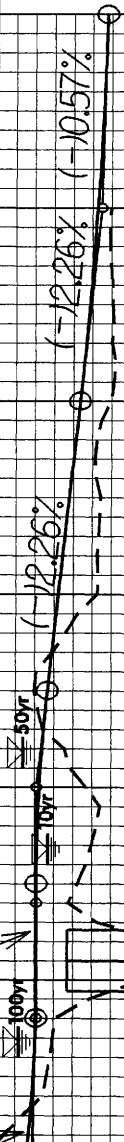
260

280

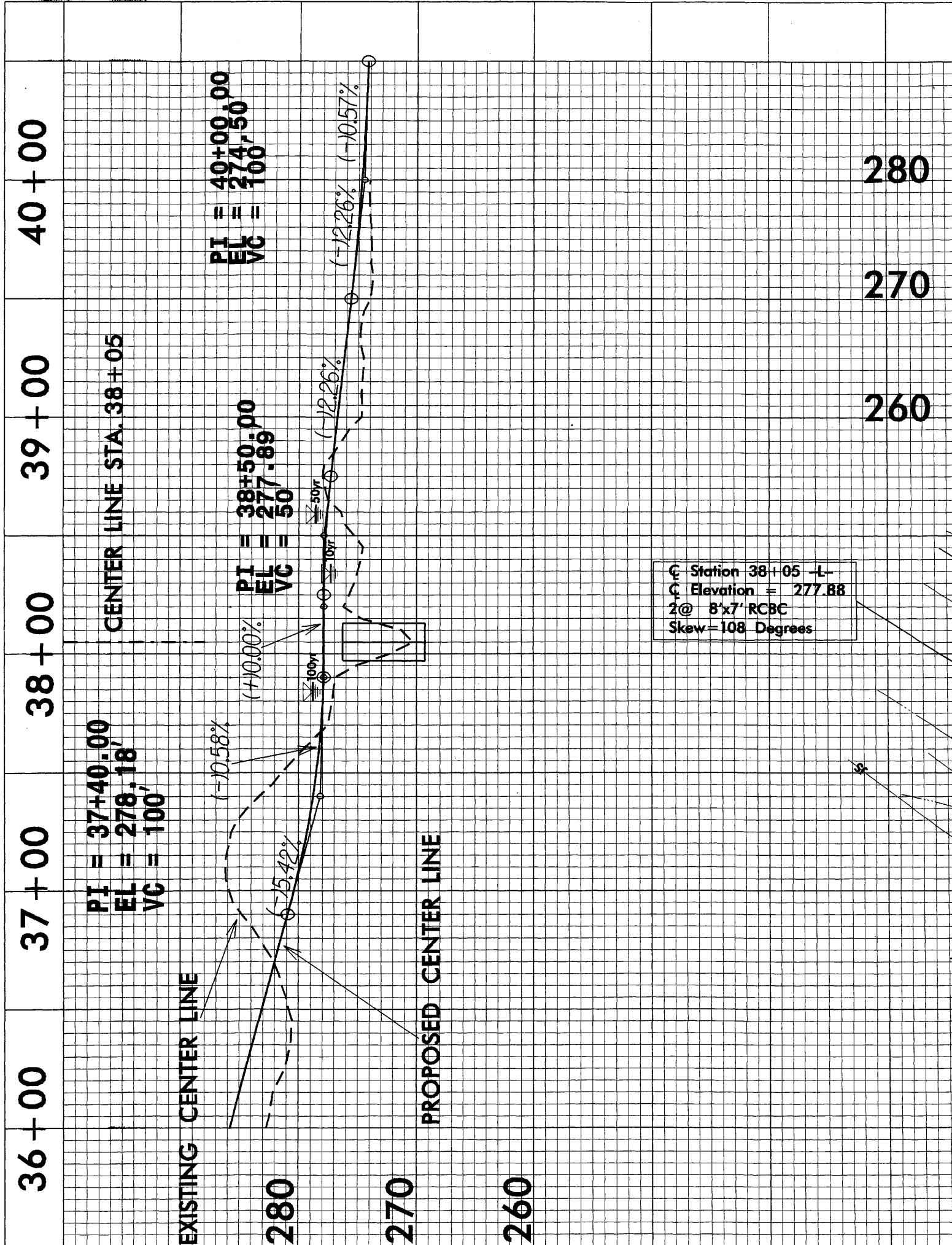
270

260

Station 38+05 -L-  
Elevation = 277.88  
2 @ 8'x7' RCBC  
Skew = 108 Degrees







36+00

37+00

38+00

39+00

40+00

PI = 37+40.00  
EL = 278.18'  
VC = 100'

PI = 38+50.00  
EL = 277.89'  
VC = 50'

PI = 40+00.00  
EL = 274.50'  
VC = 100'

CENTER LINE STA. 38+05

EXISTING CENTER LINE

PROPOSED CENTER LINE

280

270

260

280

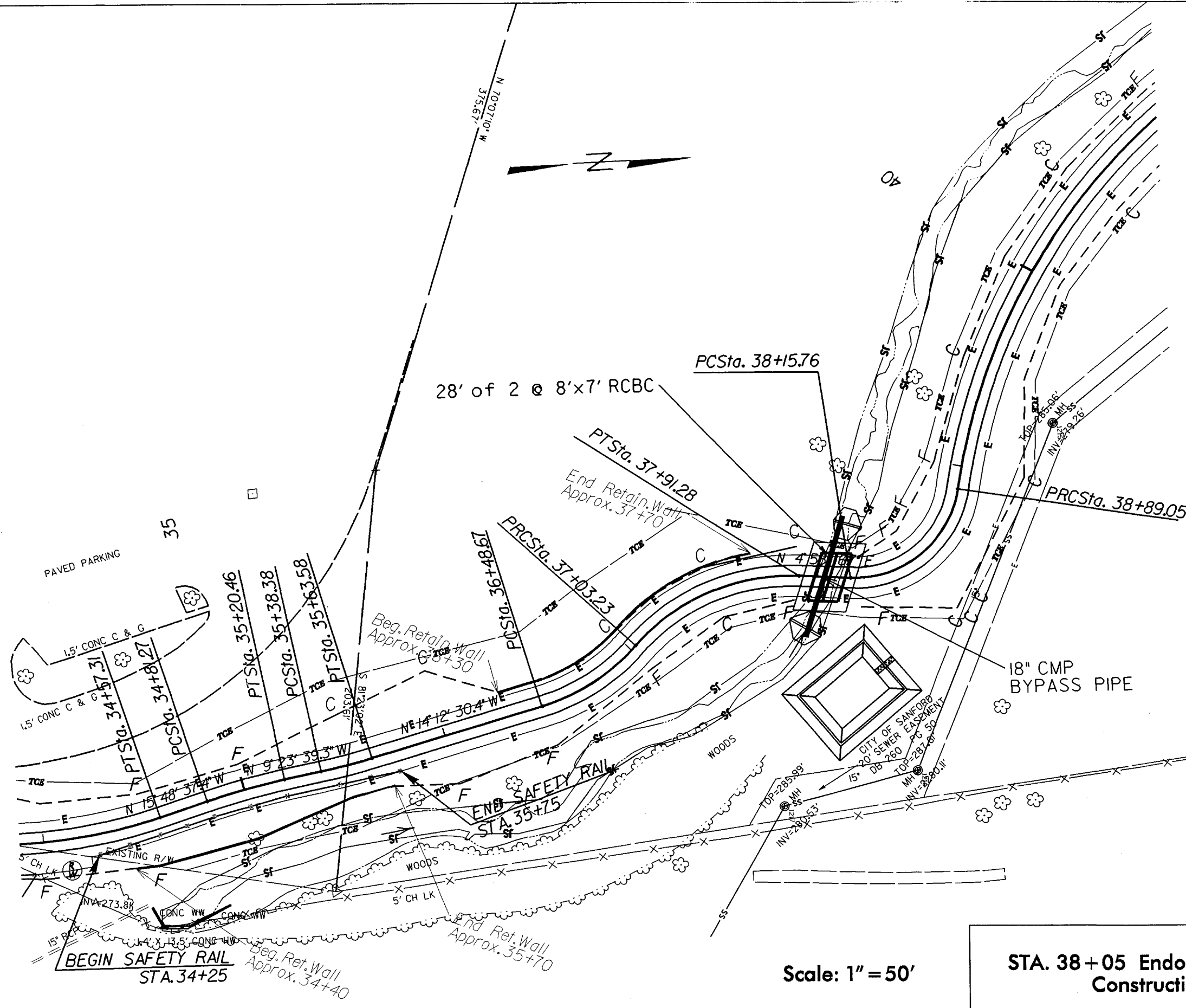
270

260

Station 38+05 -L-  
Elevation = 277.88  
2 @ 8'x7' RCBC  
Skew = 108 Degrees

Construction Sequence  
Sta. 38+05 -G-  
2@ 8' x 7' RCBC  
33906.1.1 Lee County  
E-4981

1. CONSTRUCT STILLING BASIN (MIN. 36 CUBIC YARDS)
2. INSTALL IMPERVIOUS DIKES (SAND BAGS) AND BYPASS PUMP.
3. PUMP WORK AREA BETWEEN IMPERVIOUS DIKES INTO STILLING BASIN.
4. EXCAVATE FOR CULVERT AND PREPARE FOUNDATION.
5. INSTALL 18" BYPASS PIPE BETWEEN IMPERVIOUS DIKES. (DISCONTINUE BYPASS PUMP)
6. CONSTRUCT CULVERT.
7. REMOVE IMPERVIOUS DIKES AND BYPASS PIPE.
8. REMOVE STILLING BASIN.



28' of 2 @ 8'x7' RCBC

PTSta. 37+91.28  
End Retain. Wall  
Approx. 37+70

PRCSta. 38+89.05

Beg. Retain. Wall  
Approx. 35+30

18" CMP  
BYPASS PIPE

BEGIN SAFETY RAIL  
STA. 34+25

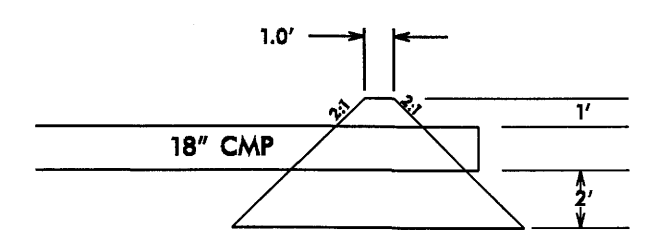
Beg. Ret. Wall  
Approx. 34+40

End Ret. Wall  
Approx. 35+70

Scale: 1" = 50'

STA. 38+05 Endor Iron Furnace Trail  
Construction Phasing

IMPERVIOUS DIKE DETAIL

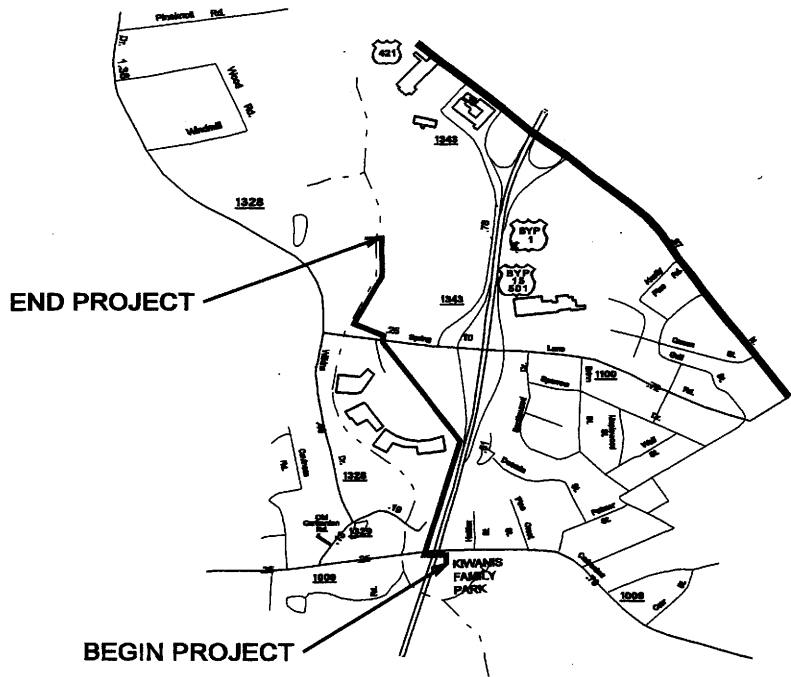


# CULVERT SURVEY & HYDRAULIC DESIGN REPORT

N. C. DEPARTMENT OF TRANSPORTATION  
 DIVISION OF HIGHWAYS  
 HYDRAULICS UNIT  
 RALEIGH, N. C.

Stream... Big Buffalo Creek... Stru. No. ... 2 ... I.D. No. E-4981 ... Project No. 33906.I.I

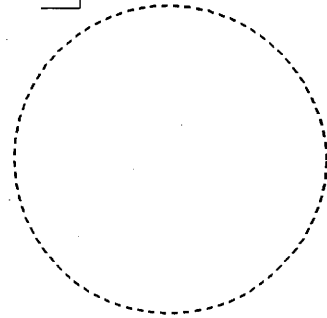
I.D. No. E-4981 Project No. 33906.I.I Proj. Station 47+71  
 County Lee Stream Tributary to Big Buffalo Creek Stru. No. 2  
 On Greenway Sanford Bike Path Between Kiwanis Family Park and Boone Circle  
 Recommended Structure 32' of 2 @ 9'x9' RCBC  
 Recommended Width of Greenway 10 ft. Skew 91°  
 Recommended Location is ~~(Up, At, Down)~~ Stream from Existing Crossing. PROPOSED CROSSING  
 Bench Mark is NCDOT GPS MONUMENT 'E-4981-I' N 629847.854 E 1940768.395  
Elev. 309.2500 Datum: NAVD '88  
 Temporary Crossing NOT REQUIRED



**VICINITY MAP** (NOT TO SCALE)

Designed by: C. R. Sharpless, P.E.  
 Assisted by: W.D. PRICE  
 Project Engineer: J. L. Lindsey, P.E.  
 Reviewed by: J. L. Lindsey, P.E.

Date 7/07





**SITE DATA**

Drainage Area ..... 1.0 SQ. MI. .... Source ..... USGS QUAD MAP (SANFORD) .....

River Basin ..... CAPE FEAR ..... Character ..... URBAN W/ RES. HOUSING AND RETAIL STORES .....

Stream Classification (Such as Trout, High Quality Water, etc.) ..... C .....

Data on Existing Structure ..... N/A .....

Debris Potential: Low X Moderate ..... High .....

Data on Structures Up and Down Stream EXISTING 1 @ 9'x9' RCBC UNDER US-1 BYPASS, 375' UPSTREAM .....

..... EXISTING 2 @ 90' CMP UNDER SR 1100 (SPRING LANE RD.), .22 MI. DOWNSTREAM .....

Gage Station No. .... N/A ..... Period of Records .....

Max. Discharge ..... c.f.s ..... Date ..... Frequency .....

Historical Flood Information:

Date N/A Elev. .... Est. Freq. .... Source ..... Period of Knowledge .....

Date N/A Elev. .... Est. Freq. .... Source ..... Period of Knowledge .....

Allowable HW Elev. .... 275.4 ..... Normal Water Surface Elev. .... 266.8 .....

Manning's n : Left O.B. .... .08 ..... Channel .... .035 ..... Right O.B. .... .08 ..... Obtained From .... FIELD .....

Flood Study / Status ..... FEMA FZ = BACKWATER FROM BIG BUFFALO CREEK ..... Floodway Established? .... NO .....

BACKWATER FROM BIG BUFFALO CREEK ELEV. = 279.0

**DESIGN DATA**

Hydrological Method ..... USGS REGRESSION EQN. 96-4084 .....

Hydraulic Design Method ..... HEC-RAS VERSION 3.1.2 .....

Floods Evaluated:	Freq.	Q	Natural (ft.)	Proposed (ft.)	Bridge Opening Velocity (ft/s)
10 YR		600 CFS	273.0	273.3	4.6
50 YR		1000 CFS	274.3	275.0	6.9
100 YR		1100 CFS	274.5	275.4	7.6

Design Tailwater  $Q_{10}$  ..... 7.8 ..... ;  $Q_{50}$  ..... 9.0 ..... ;  $Q_{100}$  ..... 9.2 .....

Size & Type	Q	Ke	Inlet Control		Outlet Control						Remarks
			HW/D	H.W.	dc	$\frac{dc+D}{2}$	h <sub>o</sub>	H	LS <sub>o</sub>	H.W.	
2 @ 9'x9'	$Q_{10} = 600$	0.5	0.6	5.4	3.4	6.2	6.2	0.4	0.3	6.3	OUTLET CONTROL
2 @ 9'x9'	$Q_{50} = 1000$	0.5	0.8	7.2	4.5	6.8	6.8	1.0	0.3	7.5	OUTLET CONTROL
2 @ 9'x9'	$Q_{100} = 1100$	0.5	0.9	8.1	5.0	7.0	7.0	1.2	0.3	7.9	INLET CONTROL

Is a Floodway Revision Required? ..... NO .....

Outlet Velocity, (V<sub>10</sub>) ..... 4.6 ..... Natural Channel Velocity, (V<sub>10</sub>) ..... 3.1 .....

Required Outlet Protection ..... CLASS 10N BANKS .....

**INFORMATION TO BE SHOWN ON PLANS**

Design: Discharge ..... 600 ..... c.f.s. Frequency ..... 10 yr. .... Elev. .... 273.3 .....

50 yr. storm : Discharge ..... 1000 ..... c.f.s. Frequency ..... 50 yr. .... Elev. .... 275.0 .....

Base Flood/ ..... Discharge ..... 1000 ..... c.f.s. Frequency ..... 100 yr. .... Elev. .... 275.4 .....

ADDITIONAL INFORMATION AND COMPUTATIONS

FLOOD FREQUENCY

•USGS REGRESSION EQN. 96-4084 DISCHARGE

10 YR

600 CFS

50 YR

1000 CFS

100 YR

1100 CFS

•USGS REGRESSION EQUATION DISCHARGES WERE USED FOR THIS REPORT.

46+00

PI = 46+00.00  
EL = 278.00  
VC = 100'

280

(-)-4.05% (+)-1.10%

270

260

47+00

UPSTREAM

100yr  
50yr  
10yr

EXISTING CENTER LINE

48+00

PI = 48+60.00  
EL = 275.13  
VC = 100'

(-)-1.10% (+)-1.25%

DOWNSTREAM

49+00

49+30.92 - GREY BK =  
48+98.76 - G - AH

50+00

49+69.47 - G - BK =  
49+75.45 - GREY AH

Station 47+71 -L-  
Elevation = 276.13  
2@ 9'x9' RCBC  
Skew = 91 Degrees

PC Sta. 46+73.57

28

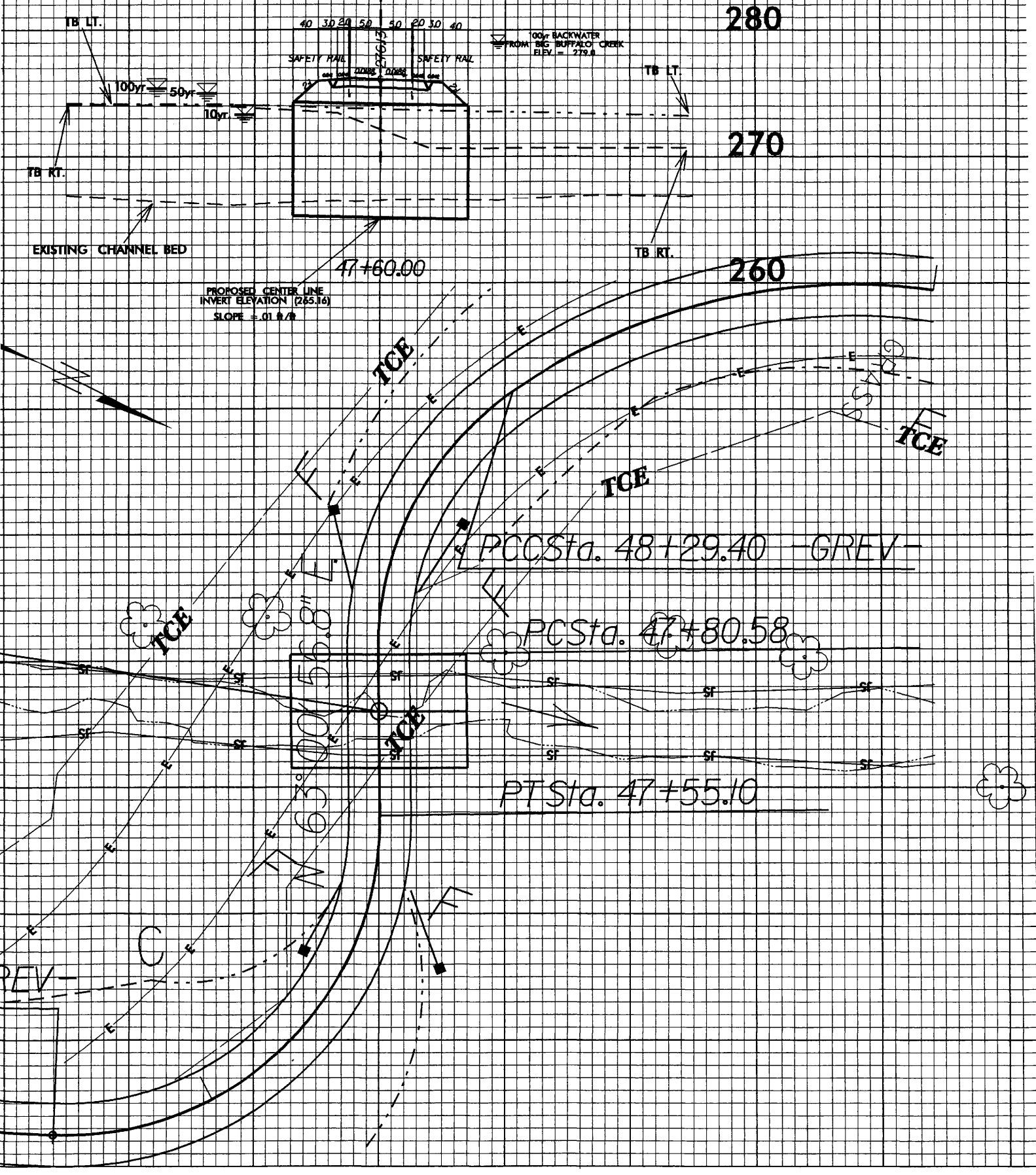
27

26

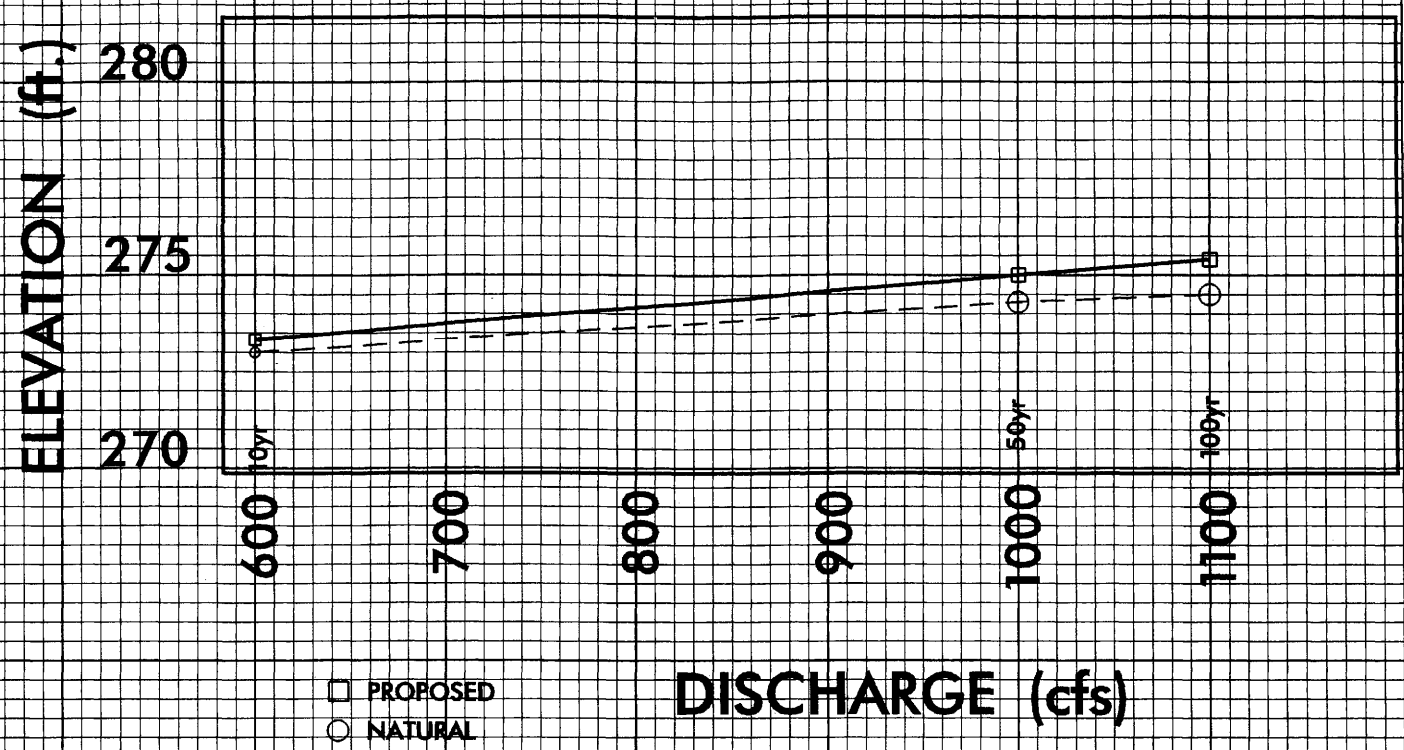
TCE

0' 40' 20' C 20' 40' 60'

C Station 47+71 -L-  
C Elevation = 276.13  
2@ 9'x9' RCBC  
Skew = 91 Degrees

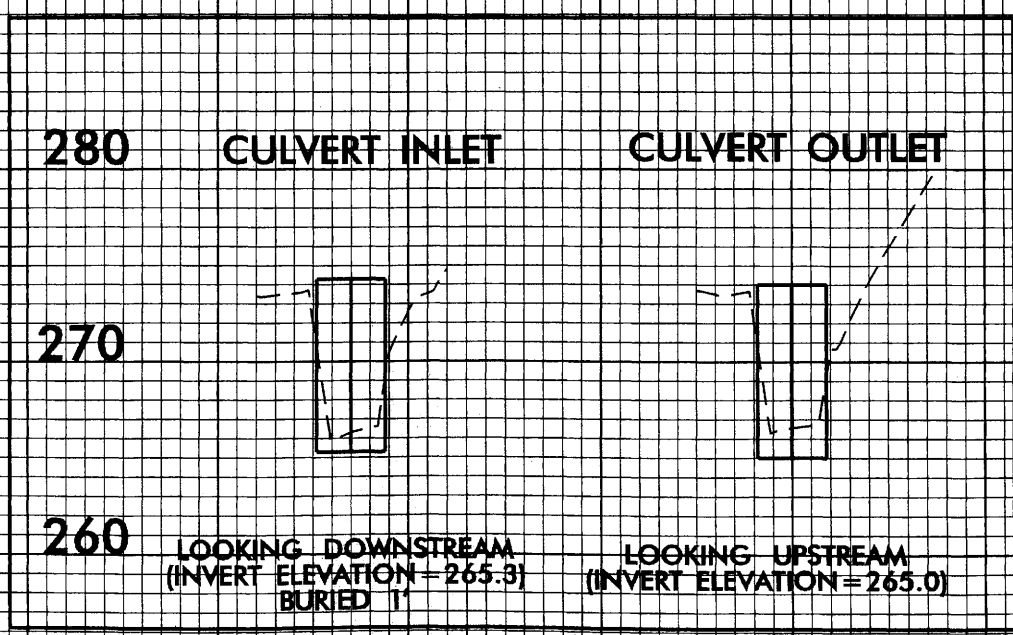
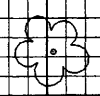


# PERFORMANCE CURVE



PROPOSED  
 NATURAL

DISCHARGE (cfs)

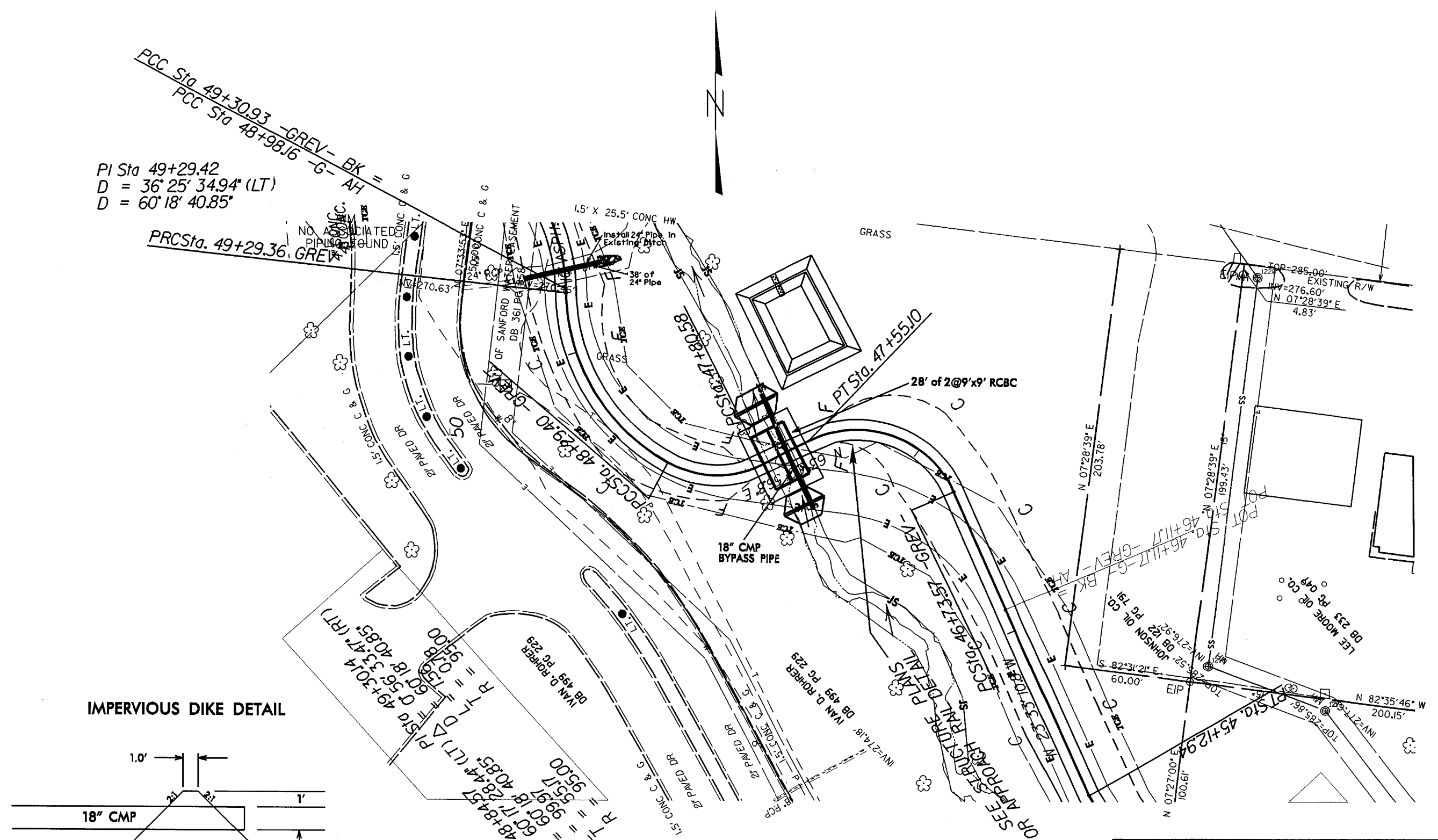
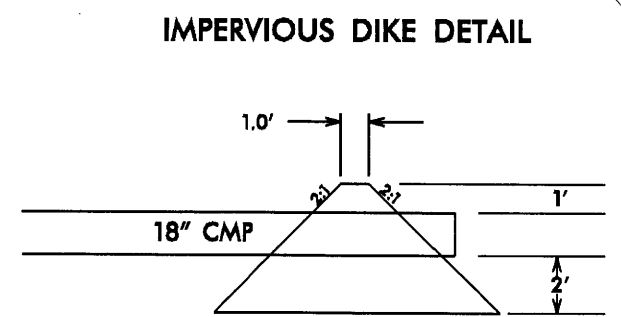


Construction Sequence  
Sta. 47+71 -G-  
2@ 9' x 9' RCBC  
33906.1.1 Lee County  
E-4981

1. CONSTRUCT STILLING BASIN (MIN. 38 CUBIC YARDS)
2. INSTALL IMPERVIOUS DIKES (SAND BAGS) AND BYPASS PUMP.
3. PUMP WORK AREA BETWEEN IMPERVIOUS DIKES INTO STILLING BASIN.
4. EXCAVATE FOR CULVERT AND PREPARE FOUNDATION.
5. INSTALL 18" BYPASS PIPE BETWEEN IMPERVIOUS DIKES. (DISCONTINUE BYPASS PUMP)
6. CONSTRUCT CULVERT.
7. REMOVE IMPERVIOUS DIKES AND BYPASS PIPE.
8. REMOVE STILLING BASIN.

PCC Sta 49+30.93 -GREV- BK =  
 PCC Sta 48+98.16 -G- AH =  
 PI Sta 49+29.42  
 D = 36° 25' 34.94" (LT)  
 D = 60° 18' 40.85"

PRCSta. 49+29.36, GREV  
 NO ASSOCIATED  
 PIPING FOUND

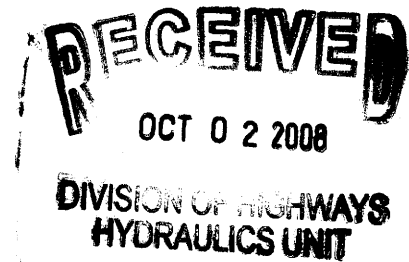


Scale: 1" = 50'

**STA. 47+71 Endor Iron Furnace Trail  
 Construction Phasing**



STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION



MICHAEL F. EASLEY  
GOVERNOR

LYNDO TIPPETT  
SECRETARY

MEMORANDUM TO: Mr. Jerry Lindsey, P.E.  
Hydraulics Project Engineer for Maintenance Studies

FROM: G. R. Perfetti, P.E.  
State Bridge Design Engineer *G.R. Perfetti*  
*TMS*

DATE: September 30, 2008

SUBJECT: Geotechnical Reports  
Culverts at Sta 47+71 and Sta 38+05  
Endor Iron Furnace, E-4981  
City of Sanford  
Lee County  
SDU File No.: C71004

Please find enclosed copies of geotechnical reports for the subject project for culverts at Sta 47+71 and Sta 38+05.

In summary, a three-sided culvert at Sta 38+05 should not be founded on the near surface rock, due to that rock being highly susceptible to degradation. A three-sided culvert at Sta 47+71 is also prohibitive because a similar type rock is found at this location, and it is at a depth of approximately five feet below the invert elevation.

If you have any questions or if we may be of further assistance, please contact either Tim Sherrill or Farzin Asefnia at (919) 250-4047.

GRP/TMS

cc: Kumar Trivedi, P.E.

MAILING ADDRESS:  
NC DEPARTMENT OF TRANSPORTATION  
STRUCTURE DESIGN UNIT  
1581 MAIL SERVICE CENTER  
RALEIGH NC 27699-1581

TELEPHONE: 919-250-4037  
FAX: 919-250-4082

WEBSITE: [WWW.DOH.DOT.STATE.NC.US](http://WWW.DOH.DOT.STATE.NC.US)

LOCATION:  
CENTURY CENTER COMPLEX  
BUILDING A  
1000 BIRCH RIDGE DRIVE  
RALEIGH NC





STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY  
GOVERNOR

LYNDO TIPPETT  
SECRETARY

September 9, 2008

STATE PROJECT: 33906 (E-4981)  
COUNTY: Lee

DESCRIPTION: Bicycle Trail, City of Sanford  
From Kiwanis Family Park to Boone Circle

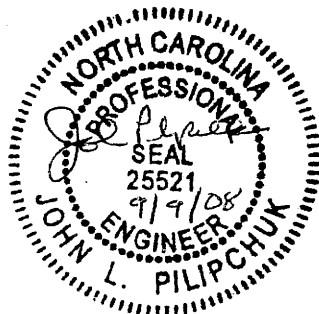
MEMORANDUM TO: Timothy M. Sherrill, P.E.  
Special Investigations Engineer  
Structure Design Unit

FROM: *John Pilipchuk*  
Njoroge Wainaina, P.E.  
State Geotechnical Engineer

SUBJECT: Geotechnical Report – Culvert @ 38+05

The possibility of using a 3-sided/bottomless culvert was considered. We do not recommend this option. Rock was encountered in the test boring and is visible in the stream channel. However, the rock type is Triassic Mudstone. This material exhibits high potential for degradation and slaking. We believe that this could possibly lead to undermining of the foundation (footings) used in the bottomless culvert design.

The Geotechnical test boring data is attached.



**STATE OF NORTH CAROLINA**  
**DEPARTMENT OF TRANSPORTATION**  
**DIVISION OF HIGHWAYS**  
**GEOTECHNICAL ENGINEERING UNIT**

**STRUCTURE**  
**SUBSURFACE INVESTIGATION**

PROJ. REFERENCE NO. 33906.1.1 (E-4981) F.A. PROJ. \_\_\_\_\_  
 COUNTY LEE  
 PROJECT DESCRIPTION BICYCLE TRAIL, CITY OF SANFORD  
FROM KIWANIS FAMILY PARK TO BOONE CIRCLE  
 SITE DESCRIPTION CULVERT @ STATION 38+05

**CONTENTS**

<u>SHEET</u>	<u>DESCRIPTION</u>
1	TITLE SHEET
2	LEGEND
3	GEOTECHNICAL REPORT
4	BORING LOG
5	SOIL SAMPLE RESULTS

**CAUTION NOTICE**

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING, AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES, AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N.C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 250-4088. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA ARE PART OF THE CONTRACT.

GENERAL SOIL AND ROCK STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON A GEOTECHNICAL INTERPRETATION OF ALL AVAILABLE SUBSURFACE DATA AND MAY NOT NECESSARILY REFLECT THE ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS OR BETWEEN SAMPLED STRATA WITHIN THE BOREHOLE, THE LABORATORY SAMPLE DATA AND THE IN SITU (IN-PLACE) TEST DATA CAN BE RELIED ON ONLY TO THE DEGREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOIL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOIL MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO CLIMATIC CONDITIONS INCLUDING TEMPERATURES, PRECIPITATION, AND WIND, AS WELL AS OTHER NON-CLIMATIC FACTORS.

THE BIDDER OR CONTRACTOR IS CAUTIONED THAT DETAILS SHOWN ON THE SUBSURFACE PLANS ARE PRELIMINARY ONLY AND IN MANY CASES THE FINAL DESIGN DETAILS ARE DIFFERENT. FOR BIDDING AND CONSTRUCTION PURPOSES, REFER TO THE CONSTRUCTION PLANS AND DOCUMENTS FOR FINAL DESIGN INFORMATION ON THIS PROJECT. THE DEPARTMENT DOES NOT WARRANT OR GUARANTEE THE SUFFICIENCY OR ACCURACY OF THE INVESTIGATION MADE, NOR THE INTERPRETATIONS MADE, OR OPINION OF THE DEPARTMENT AS TO THE TYPE OF MATERIALS AND CONDITIONS TO BE ENCOUNTERED. THE BIDDER OR CONTRACTOR IS CAUTIONED TO MAKE SUCH INDEPENDENT SUBSURFACE INVESTIGATIONS AS HE DEEMS NECESSARY TO SATISFY HIMSELF AS TO CONDITIONS TO BE ENCOUNTERED ON THIS PROJECT. THE CONTRACTOR SHALL HAVE NO CLAIM FOR ADDITIONAL COMPENSATION OR FOR AN EXTENSION OF TIME FOR ANY REASON RESULTING FROM THE ACTUAL CONDITIONS ENCOUNTERED AT THE SITE DIFFERING FROM THOSE INDICATED IN THE SUBSURFACE INFORMATION.

ID: E-4981

PROJECT: 33906

PERSONNEL

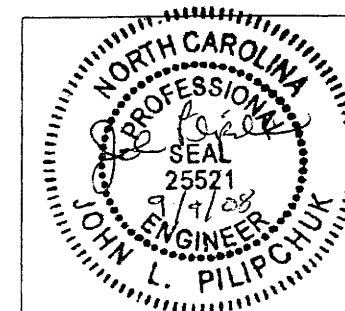
JESTEP

INVESTIGATED BY C. MURRAY

CHECKED BY LITTLE

SUBMITTED BY LITTLE

DATE AUGUST 2008



DRAWN BY: LITTLE

NOTE - THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N.C. DEPARTMENT OF TRANSPORTATION AS BEING ACCURATE NOR IS IT CONSIDERED TO BE PART OF THE PLANS, SPECIFICATIONS, OR CONTRACT FOR THE PROJECT.

NOTE - BY HAVING REQUESTED THIS INFORMATION THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION		GRADATION		ROCK DESCRIPTION		TERMS AND DEFINITIONS																																																													
<p>SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (ASTM 1206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE:</p> <p style="text-align: center;"><i>VERY STIFF, GRAY, SILTY CLAY, MOST WITH INTERBEDDED FINE SAND LAYERS, HIGH PLASTIC, A-7-5</i></p>		<p><b>WELL GRADED</b> - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE. <b>UNIFORM</b> - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. ALSO <b>POORLY GRADED</b> <b>GAP-GRADED</b> - INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.</p> <p style="text-align: center;"><b>ANGULARITY OF GRAINS</b></p> <p>THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: <b>ANGULAR</b>, <b>SUBANGULAR</b>, <b>SUBROUNDED</b>, OR <b>ROUNDED</b>.</p>		<p>HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT IF TESTED, WOULD YIELD SPT REFUSAL. AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS. IN NON-COASTAL PLAIN MATERIAL, THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK. ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:</p>		<p><b>ALLUVIUM (ALLUV.)</b> - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.</p> <p><b>AQUIFER</b> - A WATER BEARING FORMATION OR STRATA.</p> <p><b>ARENACEOUS</b> - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.</p> <p><b>ARGILLACEOUS</b> - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, AS SHALE, SLATE, ETC.</p> <p><b>ARTESIAN</b> - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IT IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE.</p> <p><b>CALCAREOUS (CALC.)</b> - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.</p> <p><b>COLLUVIUM</b> - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.</p> <p><b>CORE RECOVERY (REC.)</b> - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.</p> <p><b>DIKE</b> - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.</p> <p><b>DIP</b> - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.</p> <p><b>DIP DIRECTION (DIP AZIMUTH)</b> - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.</p> <p><b>FAULT</b> - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.</p> <p><b>FISSILE</b> - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.</p> <p><b>FLOAT</b> - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLOGGED FROM PARENT MATERIAL.</p> <p><b>FLOOD PLAIN (FP)</b> - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.</p> <p><b>FORMATION (FM)</b> - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.</p> <p><b>JOINT</b> - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.</p> <p><b>LEDGE</b> - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.</p> <p><b>LENS</b> - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.</p> <p><b>MOTTLED (MOTL.)</b> - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.</p> <p><b>PERCHED WATER</b> - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.</p> <p><b>RESIDUAL (RES.) SOIL</b> - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.</p> <p><b>ROCK QUALITY DESIGNATION (RQD)</b> - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.</p> <p><b>SAPROLITE (SAP.)</b> - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.</p> <p><b>SILL</b> - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, THAT HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS.</p> <p><b>SLICKENSIDE</b> - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.</p> <p><b>STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT)</b> - NUMBER OF BLOWS (N OR BPF) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS PENETRATION EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS.</p> <p><b>STRATA CORE RECOVERY (SREC)</b> - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.</p> <p><b>STRATA ROCK QUALITY DESIGNATION (SRQD)</b> - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE.</p> <p><b>TOPSOIL (TS)</b> - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.</p>																																																													
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<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>GENERAL CLASS.</th> <th>GRANULAR MATERIALS (≤ 35% PASSING #200)</th> <th>SILT-CLAY MATERIALS (&gt; 35% PASSING #200)</th> <th>ORGANIC MATERIALS</th> </tr> <tr> <td>GROUP CLASS.</td> <td>A-1, A-1-b, A-2, A-2-5, A-2-6, A-2-7</td> <td>A-3, A-4, A-5, A-6, A-7</td> <td>A-1, A-2, A-3, A-4, A-5, A-6, A-7</td> </tr> <tr> <td>SYMBOL</td> <td></td> <td></td> <td></td> </tr> <tr> <td>% PASSING</td> <td>10, 40, 200</td> <td>10, 40, 200</td> <td>10, 40, 200</td> </tr> <tr> <td>LIQUID LIMIT</td> <td>5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100</td> <td>5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100</td> <td>5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100</td> </tr> <tr> <td>PLASTIC INDEX</td> <td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100</td> <td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100</td> <td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100</td> </tr> <tr> <td>GROUP INDEX</td> <td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100</td> <td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100</td> <td>0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100</td> </tr> <tr> <td>USUAL TYPES OF MAJOR MATERIALS</td> <td>STONE FRAGS, GRAVEL, SAND</td> <td>FINE SAND, SILTY OR CLAYEY GRAVEL AND SAND</td> <td>SILTY SOILS, CLAYEY SOILS</td> </tr> <tr> <td>GENERATING AS A SUBGRADE</td> <td>EXCELLENT TO GOOD</td> <td>FAIR TO POOR</td> <td>POOR TO UNSUITABLE</td> </tr> </table>		GENERAL CLASS.	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ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.</p> <p style="text-align: center;"><b>COMPRESSIBILITY</b></p> <p>SLIGHTLY COMPRESSIBLE MODERATELY COMPRESSIBLE HIGHLY COMPRESSIBLE</p> <p style="text-align: center;"><b>PERCENTAGE OF MATERIAL</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>ORGANIC MATERIAL</th> <th>GRANULAR SOILS</th> <th>SILT - CLAY SOILS</th> <th>OTHER MATERIAL</th> </tr> <tr> <td>TRACE OF ORGANIC MATTER</td> <td>2 - 3%</td> <td>3 - 5%</td> <td>TRACE</td> </tr> <tr> <td>LITTLE ORGANIC MATTER</td> <td>3 - 5%</td> <td>5 - 12%</td> <td>LITTLE</td> </tr> <tr> <td>MODERATELY ORGANIC</td> <td>5 - 10%</td> <td>12 - 20%</td> <td>SOME</td> </tr> <tr> <td>HIGHLY ORGANIC</td> <td>&gt;10%</td> <td>&gt;20%</td> <td>HIGHLY</td> </tr> <tr> <td></td> <td></td> <td></td> <td>35% AND ABOVE</td> </tr> </table> <p style="text-align: center;"><b>GROUND WATER</b></p> <p>▽ WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING</p> <p>▽ STATIC WATER LEVEL AFTER 24 HOURS</p> <p>▽ PW PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA</p> <p>○ SPRING OR SEEP</p>		ORGANIC MATERIAL	GRANULAR SOILS	SILT - CLAY SOILS	OTHER MATERIAL	TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%	TRACE	LITTLE ORGANIC MATTER	3 - 5%	5 - 12%	LITTLE	MODERATELY ORGANIC	5 - 10%	12 - 20%	SOME	HIGHLY ORGANIC	>10%	>20%	HIGHLY				35% AND ABOVE	<p><b>WEATHERED ROCK (WR)</b> </p> <p><b>CRYSTALLINE ROCK (CR)</b> </p> <p><b>NON-CRYSTALLINE ROCK (NCR)</b> </p> <p><b>COASTAL PLAIN SEDIMENTARY ROCK (CP)</b> </p>			
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TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%	TRACE																																																																
LITTLE ORGANIC MATTER	3 - 5%	5 - 12%	LITTLE																																																																
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<p>DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.</p>		<p>DRILL UNITS:</p> <p><input type="checkbox"/> MOBILE B- <input type="checkbox"/> BK-51 <input type="checkbox"/> CME-45C <input checked="" type="checkbox"/> CME-55B <input type="checkbox"/> PORTABLE HOIST</p> <p>ADVANCING TOOLS:</p> <p><input type="checkbox"/> CLAY BITS <input type="checkbox"/> 6" CONTINUOUS FLIGHT AUGER <input checked="" type="checkbox"/> 8" HOLLOW AUGERS <input type="checkbox"/> HARD FACED FINGER BITS <input type="checkbox"/> TUNG-CARBIDE INSERTS <input type="checkbox"/> CASING <input type="checkbox"/> w/ ADVANCER <input type="checkbox"/> TRICONE STEEL TEETH <input type="checkbox"/> TRICONE TUNG-CARB. <input type="checkbox"/> CORE BIT</p> <p>HAMMER TYPE:</p> <p><input checked="" type="checkbox"/> AUTOMATIC <input type="checkbox"/> MANUAL</p> <p>CORE SIZE:</p> <p><input type="checkbox"/> -B <input type="checkbox"/> -N <input type="checkbox"/> -H</p> <p>HAND TOOLS:</p> <p><input type="checkbox"/> POST HOLE DIGGER <input type="checkbox"/> HAND AUGER <input type="checkbox"/> SOUNDING ROD <input type="checkbox"/> VANE SHEAR TEST</p>		<p>VERY HARD</p> <p>HARD</p> <p>MODERATELY HARD</p> <p>MEDIUM HARD</p> <p>SOFT</p> <p>VERY SOFT</p>		<p><b>FRACTURE SPACING</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>TERM</th> <th>SPACING</th> </tr> <tr> <td>VERY WIDE</td> <td>MORE THAN 10 FEET</td> </tr> <tr> <td>WIDE</td> <td>3 TO 10 FEET</td> </tr> <tr> <td>MODERATELY CLOSE</td> <td>1 TO 3 FEET</td> </tr> <tr> <td>CLOSE</td> <td>0.16 TO 1 FEET</td> </tr> <tr> <td>VERY CLOSE</td> <td>LESS THAN 0.16 FEET</td> </tr> </table> <p><b>BEDDING</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>TERM</th> <th>THICKNESS</th> </tr> <tr> <td>VERY THICKLY BEDDED</td> <td>&gt; 4 FEET</td> </tr> <tr> <td>THICKLY BEDDED</td> <td>1.5 - 4 FEET</td> </tr> <tr> <td>THINLY BEDDED</td> <td>0.16 - 1.5 FEET</td> </tr> <tr> <td>VERY THINLY BEDDED</td> <td>0.03 - 0.16 FEET</td> </tr> <tr> <td>THICKLY LAMINATED</td> <td>0.008 - 0.03 FEET</td> </tr> <tr> <td>THINLY LAMINATED</td> <td>&lt; 0.008 FEET</td> </tr> </table> <p>FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF THE MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.</p> <p>FRIABLE RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.</p> <p>MODERATELY INDURATED GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.</p> <p>INDURATED GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.</p> <p>EXTREMELY INDURATED SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.</p>		TERM	SPACING	VERY WIDE	MORE THAN 10 FEET	WIDE	3 TO 10 FEET	MODERATELY CLOSE	1 TO 3 FEET	CLOSE	0.16 TO 1 FEET	VERY CLOSE	LESS THAN 0.16 FEET	TERM	THICKNESS	VERY THICKLY BEDDED	> 4 FEET	THICKLY BEDDED	1.5 - 4 FEET	THINLY BEDDED	0.16 - 1.5 FEET	VERY THINLY BEDDED	0.03 - 0.16 FEET	THICKLY LAMINATED	0.008 - 0.03 FEET	THINLY LAMINATED	< 0.008 FEET																																		
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STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY  
GOVERNOR

LYNDO TIPPETT  
SECRETARY

August 11, 2008

STATE PROJECT: 33906.1.1 (E-4981)  
COUNTY: Lee  
DESCRIPTION: Bicycle Trail, City of Sanford  
From Kiwanis Family Park to Boone Circle

SUBJECT: Geotechnical Report  
Culvert @ Station 38+05

A single boring was obtained near the proposed culvert. The boring along with visual observation indicates that the culvert will be founded on hard Triassic residual soils, severely weathered Triassic mudstone rock, or Triassic Mudstone, depending on the depth of excavation. The invert elevations are: 269.5 (inlet) and 269.1 (outlet). The top of weathered rock in the boring was at 267.3; auger refusal occurred at elevation 267.1. The Triassic rock material in this area is considered to be degradable rock. It is known to exhibit high slaking characteristics when exposed to air and water.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Clint Little".

Clint Little  
Regional Geological Engineer

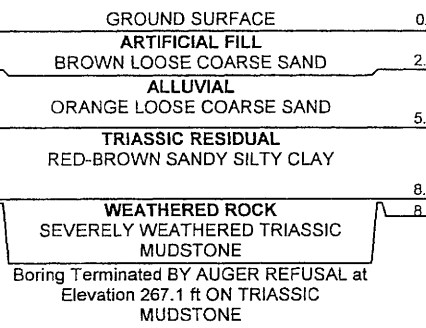


**NCDOT GEOTECHNICAL ENGINEERING UNIT**  
**BORELOG REPORT**

PROJECT NO. 33906.1.1	ID. E-4981	COUNTY LEE	GEOLOGIST Murray, C. C.
SITE DESCRIPTION N/A			GROUND WTR (ft)
BORING NO. 3820_R	STATION 38+20	OFFSET 20ft RT	ALIGNMENT -L-
COLLAR ELEV. 276.0 ft	TOTAL DEPTH 8.9 ft	NORTHING N/A	EASTING N/A
DRILL MACHINE CME-550X	DRILL METHOD H.S. Augers	HAMMER TYPE Automatic	
START DATE 11/19/07	COMP. DATE 11/19/07	SURFACE WATER DEPTH N/A	DEPTH TO ROCK N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
280																
275																
	272.0	4.0														
270	269.5	6.5	2	3	4											
			9	28	28											
265																
260																
255																
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NCDOT BORE DOUBLE E-4981\_CULVERTS.GPJ NC\_DOT\_GDT\_09/02/08



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
 DIVISION OF HIGHWAY  
 MATERIALS & TESTS UNIT  
 SOILS LABORATORY

T. I. P. No. E-4981

REPORT ON SAMPLES OF SOILS FOR QUALITY

Project 3390611 County LEE Owner \_\_\_\_\_  
 Date: Sampled 11/21/07 Received 12/5/07 Reported 12/7/07  
 Sampled from \_\_\_\_\_ By C C MURRAY  
 Submitted by N WAINAINA \_\_\_\_\_ 1995 Standard Specifications

742525 TO 742536  
 9/2/08

TEST RESULTS

Proj. Sample No.		SS-7				
Lab. Sample No.		742531				
Retained #4 Sieve	%	-				
Passing #10 Sieve	%	100				
Passing #40 Sieve	%	99				
Passing #200 Sieve	%	89				

SOIL MORTAR - 100%						
Coarse Sand Ret - #60	%	2.5				
Fine Sand Ret - #270	%	14.3				
Silt 0.05 - 0.005 mm	%	64.8				
Clay < 0.005 mm	%	18.4				
Passing #40 Sieve	%	-				
Passing #200 Sieve	%	-				

L. L.		34				
P. I.		11				
AASHTO Classification		A-6(10)				
Station		38+20				
		20' RT.				
Hole No.						
Depth (Ft)		6.5-8.0'				
	to					

\_\_\_\_\_  
 Soils Engineer



STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY  
GOVERNOR

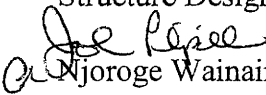
LYNDO TIPPETT  
SECRETARY

September 9, 2008

STATE PROJECT: 33906 (E-4981)  
COUNTY: Lee

DESCRIPTION: Bicycle Trail, City of Sanford  
From Kiwanis Family Park to Boone Circle

MEMORANDUM TO: Timothy M. Sherrill, P.E.  
Special Investigations Engineer  
Structure Design Unit

FROM:  George Wainaina, P.E.  
State Geotechnical Engineer

SUBJECT: Geotechnical Report – Culvert @ 47+71

The possibility of using a 3-sided/bottomless culvert was considered. We do not recommend this option. Depth to rock is greater than the normally accepted range (five feet below the invert elevation). Further, the rock type is Triassic mudstone which is susceptible to slaking and degradation when exposed.

The Geotechnical test boring data is attached.



**STATE OF NORTH CAROLINA**  
**DEPARTMENT OF TRANSPORTATION**  
**DIVISION OF HIGHWAYS**  
**GEOTECHNICAL ENGINEERING UNIT**

**STRUCTURE**  
**SUBSURFACE INVESTIGATION**

**CONTENTS**

<u>SHEET</u>	<u>DESCRIPTION</u>
1	TITLE SHEET
2	LEGEND
3	GEOTECHNICAL REPORT
4	BORING LOG
5	SOIL SAMPLE RESULTS

PROJ. REFERENCE NO. 33906.1.1 (E-4981) F.A. PROJ. \_\_\_\_\_  
COUNTY LEE  
PROJECT DESCRIPTION BICYCLE TRAIL, CITY OF SANFORD  
FROM KIWANIS FAMILY PARK TO BOONE CIRCLE  
SITE DESCRIPTION CULVERT @ STATION 47+71

**CAUTION NOTICE**

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING, AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES, AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N.C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 250-4088. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA ARE PART OF THE CONTRACT.

GENERAL SOIL AND ROCK STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON A GEOTECHNICAL INTERPRETATION OF ALL AVAILABLE SUBSURFACE DATA AND MAY NOT NECESSARILY REFLECT THE ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS OR BETWEEN SAMPLED STRATA WITHIN THE BOREHOLE. THE LABORATORY SAMPLE DATA AND THE IN SITU (IN-PLACE) TEST DATA CAN BE RELIED ON ONLY TO THE DEGREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOIL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOIL MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO CLIMATIC CONDITIONS INCLUDING TEMPERATURES, PRECIPITATION, AND WIND, AS WELL AS OTHER NON-CLIMATIC FACTORS.

THE BIDDER OR CONTRACTOR IS CAUTIONED THAT DETAILS SHOWN ON THE SUBSURFACE PLANS ARE PRELIMINARY ONLY AND IN MANY CASES THE FINAL DESIGN DETAILS ARE DIFFERENT. FOR BIDDING AND CONSTRUCTION PURPOSES, REFER TO THE CONSTRUCTION PLANS AND DOCUMENTS FOR FINAL DESIGN INFORMATION ON THIS PROJECT. THE DEPARTMENT DOES NOT WARRANT OR GUARANTEE THE SUFFICIENCY OR ACCURACY OF THE INVESTIGATION MADE, NOR THE INTERPRETATIONS MADE, OR OPINION OF THE DEPARTMENT AS TO THE TYPE OF MATERIALS AND CONDITIONS TO BE ENCOUNTERED. THE BIDDER OR CONTRACTOR IS CAUTIONED TO MAKE SUCH INDEPENDENT SUBSURFACE INVESTIGATIONS AS HE DEEMS NECESSARY TO SATISFY HIMSELF AS TO CONDITIONS TO BE ENCOUNTERED ON THIS PROJECT. THE CONTRACTOR SHALL HAVE NO CLAIM FOR ADDITIONAL COMPENSATION OR FOR AN EXTENSION OF TIME FOR ANY REASON RESULTING FROM THE ACTUAL CONDITIONS ENCOUNTERED AT THE SITE DIFFERING FROM THOSE INDICATED IN THE SUBSURFACE INFORMATION.

**PROJECT: 33906 ID: E-4981**

**PERSONNEL**

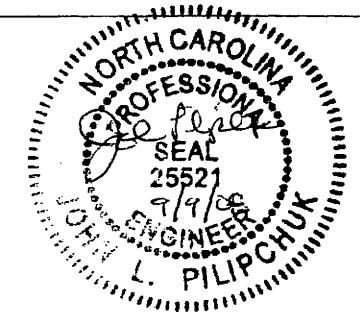
J. ESTEP

INVESTIGATED BY C. MURRAY

CHECKED BY LITTLE

SUBMITTED BY LITTLE

DATE AUGUST 2008



DRAWN BY: LITTLE

NOTE - THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N.C. DEPARTMENT OF TRANSPORTATION AS BEING ACCURATE NOR IT IS CONSIDERED TO BE PART OF THE PLANS, SPECIFICATIONS, OR CONTRACT FOR THE PROJECT.

NOTE - BY HAVING REQUESTED THIS INFORMATION THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION		GRADATION		ROCK DESCRIPTION		TERMS AND DEFINITIONS																																																																												
<p>SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE:</p> <p>VERY STIFF, BRN. SATT CLAY, MOST WITH INTERBEDDED FINE SAND LAYERS, HIGH PLASTIC, A-7-5</p>		<p>WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE. UNIFORM - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO POORLY GRADED) GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.</p> <p>ANGULARITY OF GRAINS THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.</p>		<p>HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT IF TESTED, WOULD YIELD SPT REFUSAL. AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS. IN NON-COASTAL PLAIN MATERIAL, THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK. ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:</p> <p>WEATHERED ROCK (WR) NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES &gt; 100 BLOWS PER FOOT IF TESTED.</p> <p>CRYSTALLINE ROCK (CR) FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.</p> <p>NON-CRYSTALLINE ROCK (NCR) FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLITE, SLATE, SANDSTONE, ETC.</p> <p>COASTAL PLAIN SEDIMENTARY ROCK (CP) COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.</p>		<p>ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER. AQUIFER - A WATER BEARING FORMATION OR STRATA. ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND. ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, AS SHALE, SLATE, ETC. ARTESIAN - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IT IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE. CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE. COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE. CORE RECOVERY (REC) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE. DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK. DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL. DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH. FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE. FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES. FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL. FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM. FORMATION (FM) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD. JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED. LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT. LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS. MOTTLED (MDT) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS, MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE. PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM. RESIDUAL (RES) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK. ROCK QUALITY DESIGNATION (RQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE. SAPROLITE (SAP) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK. SILL - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, THAT HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRODUCED ROCKS. SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE. STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT) - NUMBER OF BLOWS IN OR BPF) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS PENETRATION EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS. STRATA CORE RECOVERY (SCREC) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE. STRATA ROCK QUALITY DESIGNATION (SRQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE. TOPSOIL (TS) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.</p>																																																																												
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THICKLY LAMINATED	0.008 - 0.03 FEET																																																																																	
THINLY LAMINATED	< 0.008 FEET																																																																																	
<p>DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.</p>		<p>DRILL UNITS: <input type="checkbox"/> MOBILE B- <input type="checkbox"/> BK-51 <input type="checkbox"/> CME-45C <input checked="" type="checkbox"/> CME-550 <input type="checkbox"/> PORTABLE HOIST</p> <p>ADVANCING TOOLS: <input type="checkbox"/> CLAY BITS <input type="checkbox"/> 6" CONTINUOUS FLIGHT AUGER <input checked="" type="checkbox"/> 8" HOLLOW AUGERS <input type="checkbox"/> HARD FACED FINGER BITS <input type="checkbox"/> TUNG-CARBIDE INSERTS <input type="checkbox"/> CASING <input type="checkbox"/> W/ ADVANCER <input type="checkbox"/> TRICONE _____ STEEL TEETH <input type="checkbox"/> TRICONE _____ TUNG-CARB. <input type="checkbox"/> CORE BIT</p> <p>HAMMER TYPE: <input checked="" type="checkbox"/> AUTOMATIC <input type="checkbox"/> MANUAL</p> <p>CORE SIZE: <input type="checkbox"/> B- <input type="checkbox"/> N- <input type="checkbox"/> H-</p> <p>HAND TOOLS: <input type="checkbox"/> POST HOLE DIGGER <input type="checkbox"/> HAND AUGER <input type="checkbox"/> SOUNDING ROD <input type="checkbox"/> VANE SHEAR TEST</p>		<p>BENCH MARK; ELEVATIONS FROM DTM</p> <p>ELEVATION: _____ FT.</p> <p>NOTES:</p>																																																																														



STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY  
GOVERNOR

LYNDO TIPPETT  
SECRETARY

August 11, 2008

STATE PROJECT: 33906.1.1 (E-4981)  
COUNTY: Lee  
DESCRIPTION: Bicycle Trail, City of Sanford  
From Kiwanis Family Park to Boone Circle

SUBJECT: Geotechnical Report  
Culvert @ Station 47+71

A single boring was obtained near the proposed culvert. The boring along with visual observation indicates that the culvert will be founded on Triassic residual soils. The soil at the invert elevation (265' +/-) is loose silty sand. Very stiff clay was encountered below elevation 261 that grades rapidly to Triassic rock (mudstone). The Triassic rock in this area is considered to be degradable. It is prone to slaking and general degradation when exposed to air and water.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Clint Little".

Clint Little  
Regional Geological Engineer



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
 DIVISION OF HIGHWAY  
 MATERIALS & TESTS UNIT  
 SOILS LABORATORY

T. I. P. No. E-4981

REPORT ON SAMPLES OF SOILS FOR QUALITY

Project 3390611 County LEE Owner \_\_\_\_\_  
 Date: Sampled 11/21/07 Received 12/5/07 Reported 12/7/07  
 Sampled from \_\_\_\_\_ By C C MURRAY  
 Submitted by N WAINAINA \_\_\_\_\_ 1995 Standard Specifications

742525 TO 742536  
 9/2/08

TEST RESULTS

Proj. Sample No.			SS-3	SS-4	SS-5	
Lab. Sample No.						
Retained #4 Sieve	%		-	-	4	
Passing #10 Sieve	%		100	100	86	
Passing #40 Sieve	%		100	96	82	
Passing #200 Sieve	%		96	35	77	

SOIL MORTAR - 100%						
Coarse Sand Ret - #60	%		0.4	19.6	5.9	
Fine Sand Ret - #270	%		9.0	52.6	9.4	
Silt 0.05 - 0.005 mm	%		62.0	17.6	51.9	
Clay < 0.005 mm	%		28.6	10.2	32.7	
Passing #40 Sieve	%					
Passing #200 Sieve	%					

L. L.			31	20	38	
P. I.			9	NP	16	
AASHTO Classification			A-4(9)	A-2-4(0)	A-6(12)	
Station			48+00	48+00	48+00	
			15' LT.	15' LT.	15' LT.	
Hole No.						
Depth (Ft)			3.7-5.2	8.7-10.2	13.7-15.2	
	to					

cc: C C MURRAY  
 Soils File

\_\_\_\_\_  
 Soils Engineer



RECEIVED

AUG 20 2008

STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

WAYS  
UNIT

MICHAEL F. EASLEY  
GOVERNOR

LYNDO TIPPETT  
SECRETARY

MEMORANDUM TO: Mr. Jerry Lindsey, P.E.  
Hydraulics Project Engineer for Maintenance Studies

FROM: G. R. Perfetti, P.E.  
State Bridge Design Engineer *G.R. Perfetti*  
*TMS*

DATE: August 19, 2008

SUBJECT: Cost Estimates  
Various Pedestrian Bridge Options  
Endor Iron Furnace, E-4981  
City of Sanford  
Lee County  
SDU File No.: C71004

The Endor Iron Furnace Trail for the City of Sanford requires three crossings of a tributary to Big Buffalo Creek. It has been agreed that one of those crossings (Sta 65+62) will require a pedestrian bridge structure. Discussion has occurred for the other two stream crossings (Sta 38+05 and Sta 47+71), as to whether it is more appropriate to use box culverts or pedestrian bridges for these crossings. At an on site meeting on July 9, 2008, permitting, cost, maintenance, and other issues were discussed for both options.

The NCDOT Structure Design Unit (SDU) was requested to provide cost estimates for several possible bridge structure options for the two crossings. We understand that the required bridge span length for each of the crossings would be approximately 70 feet. The NCDOT minimum clear width for a pedestrian and bicycle bridge is 10 feet, and AASHTO requires that pedestrian bridges be designed for a live load of 85 psf and a vehicular load of 10,000 pounds. Below are our cost estimates for bridge structure options:

Bridge Type	Estimated Cost (70' span)	Approximate Superstructure Depth (does not include 54" rail)
Prefab Steel Truss w/ concrete deck	\$ 136,700	20"
Wood Arch Suspension w/ wood deck	\$ 127,800	18"
Steel Beam w/ concrete deck	\$ 104,000	36"

MAILING ADDRESS:  
NC DEPARTMENT OF TRANSPORTATION  
STRUCTURE DESIGN UNIT  
1581 MAIL SERVICE CENTER  
RALEIGH NC 27699-1581

TELEPHONE: 919-250-4037  
FAX: 919-250-4082

WEBSITE: [WWW.DOH.DOT.STATE.NC.US](http://WWW.DOH.DOT.STATE.NC.US)

LOCATION:  
CENTURY CENTER COMPLEX  
BUILDING A  
1000 BIRCH RIDGE DRIVE  
RALEIGH NC

Cored Slab w/ asphalt wearing surface	\$ 94,500	24"
Wood Laminate Beam w/ wood deck	\$ 93,800	48"
36" P/S Concrete Girders w/ concrete deck	\$ 88,700	45"

Please note that these estimated costs are for construction of the superstructures and substructures, only. They do not include any costs for any approach fill or other items that might be necessary.

We understand that you have acquired or generated your own cost estimates for the double 8' x 7' x 24' culvert at Sta 38+05 and the double 9' x 9' x 32' culvert at Sta 47+71.

We reiterate that, based on our experience and knowledge of the construction and maintenance costs and issues of culverts and bridges, it is our opinion that culverts are the appropriate option for these two stream crossings.

We understand that the City of Sanford will maintain these structures. We feel they should be made well aware of the maintenance issues and costs associated with the various options.

If you have any questions or if we may be of further assistance, please contact either Tim Sherrill or Farzin Asefnia at (919) 250-4047.

GRP/TMS

cc: Brian Hanks  
Kumar Trivedi

North Carolina Department of Transportation  
Preliminary Estimate  
RC BOX CULVERT

Date: 5/16/08  
For: Hydra  
By: JLL

TIP #: E-4981  
Division: 8  
New:   
Extension: \_\_\_\_\_  
Station: 38+05  
Stream: Trib to Big Bute's Creek

SIZE: 2 @ 8' x 7' - <sup>25</sup>50' (Length) - 1' (Fill Ht)\* - 108 (Skew)

Class "A" Concrete

Box 25 LF (Lgth) x 1.638 CY / LF = 41.0 CY  
Wings (See Standards) = 16.5 CY  
Headwalls (W)\*\* 18 LF x 0.0926 = 1.7 CY

Total Class "A" Concrete ..... 59.2 CY x \$670 = \$ 39,665

Reinforcing Steel

Box 25 LF (Lgth) x 284 Lbs / LF = 7,100 Tons  
Wings = 1027 Tons  
Headwalls (W)\*\* 18 LF x 2.672 = 48 Tons

Total Reinforcing Steel ..... 8,175 Tons x \$1.00 = 8,175

Foundation Excavation

53 <sup>25+28</sup> (L + 4xHt) x 21 (W+3') x 3' / 27 = 123.7 CY x \$30 = 3,710

Foundation Conditioning Material

0.035 x 25 (Lgth) x 18 (Width) = 15.8 Tons x \$40 = 630

---

Sub Total	<u>52,180</u>
Add 10% for Phase Construction	_____
Add 20% for Extensions	_____

---

Total RC Box Culvert Cost \$ 52,180

\* Fill Height is from Bottom of the Top Slab to the Grade Line  
\*\* W = Width + #Walls x 0.667 = Out to Out Width

Phased 57,398

NORTH CAROLINA Department of Transportation  
Preliminary Estimate  
RC BOX CULVERT

Date: 5/16/08  
For: Hydro  
By: JLL

TIP #: E-4981  
Division: 8  
New:   
Extension: \_\_\_\_\_  
Station: 47+71  
Stream: Trip to Big Buffalo Creek

SIZE: 2 @ 9' x 9' - 28' (Length) - 1' (Fill Ht)\* - 91° (Skew)

**Class "A" Concrete**

Box 28 LF (Lgth) x 1.940 CY / LF = 54.3 CY  
Wings (See Standards) = 25.6 CY  
Headwalls (W)\*\* 20 LF x 0.0926 = 1.9 CY

Total Class "A" Concrete ..... **81.8** CY x \$670 = \$ 54,805

**Reinforcing Steel**

Box 28 LF (Lgth) x 345 Lbs / LF = 9,660 Lbs  
Wings = 1754 Lbs  
Headwalls (W)\*\* 20 LF x 2.672 = 53 Lbs

Total Reinforcing Steel ..... **11,467** Lbs x \$1.00 = 11,465

**Foundation Excavation**

64<sup>28 + 36</sup> (L + 4xHt) x 23 (W\*\*+3') x 3' / 27 = **163.6** CY x \$30 = 4,905

**Foundation Conditioning Material**

0.035 x 28 (Lgth) x 20 (W\*\*) = **19.6** Tons x \$40 = 585

Sub Total 71,760  
Add 10% for Phase Construction \_\_\_\_\_  
Add 20% for Extensions \_\_\_\_\_

\$ / LF = \$ / LF Total RC Box Culvert Cost **\$ 71,760**

\* Fill Height is from Bottom of the Top Slab to the Grade Line  
\*\* W = Width + #Walls x 0.667 = Out to Out Width

Phasal 78,936