



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY
GOVERNOR

LYNDO TIPPETT
SECRETARY

September 7, 2005

U.S. Army Corps of Engineers
Raleigh Regulatory Field Office
6508 Falls of Neuse Road
Suite 120
Raleigh, NC 27615

ATTN: Mr. Eric Alsmeyer
NCDOT Coordinator

Dear Sir:

SUBJECT: Permit Modification Request for TIP No. R-2809B and C, Wake County, NC DOT Division 5, Federal Aid No. STP-98(1), State Project No. 8.1402501, USACE Action ID 199601836, and DWQ Project No. 010550, \$475 Debit Work Order WBS Element 34503.1.1

On April 4, 2002 and February 4, 2002 respectively, the USACE 404 Individual Permit and the NCDWQ 401 Water Quality Certification and Neuse River Riparian Certification were issued for project R-2809. On October 27, 2004 and October 13, 2004 respectively, modifications to the USACE 404 Individual Permit and the NCDWQ 401 Water Quality Certification and Neuse River Riparian Certification were last issued. The North Carolina Department of Transportation (NCDOT) proposes to modify the construction plans for the abovementioned project. The purpose of this letter is to request a modification to the Department of the Army Individual Permit, the 401 Water Quality Certification as well as the Buffer Certification from the NC Division of Water Quality. The revised sheets of the original permit drawings, revised design plan sheets and a revised EEP confirmation letter are attached.

Summary of Impact Changes

Revisions were made to the permit drawings in order to be consistent with the construction plans. Changes in impacts result from expanding the construction areas to allow sufficient access for equipment, installation of rip rap on stream banks to prevent erosion, and changes to a proposed natural channel design.

Streams: Additional permanent stream channel impacts total 168 feet and temporary stream impacts total 322 feet on R-2809C, and permanent stream impacts decrease by 82 feet on R-2809B. Onsite natural channel design on R-2809C decreases by 60 feet. Onsite mitigation was not requested on section C in the original permit application. Onsite natural stream design on R-2809B decreases by 82 feet.

Buffers: Mitigable buffer impacts have increased by 10,654ft². Specific revisions are summarized in Table 2 and are listed below, site by site. Site numbers correspond to the original permit drawing sheets. Sheet numbers also correspond to the original permit drawings with a date that the drawing has been revised.

Site #	Station #	Original Impacts	Revised Impacts	Increase	Decrease
R-2809C-3B	-L-74+20/ 76+20	564	669	105	
R-2809C-4	-L-84+60	295	358	63	
R-2809B-4	-L-38+84	351	269		82
Total				168	82

Site #	Station #	Original Impacts	Revised Impacts	Increase
R-2809C-2		0	53	53
R-2809C-3B	-L-74+20/ 76+20	0	53	53
R-2809C-4	-L-84+60	0	30	30
R-2809C-5	-L-85+20	0	322	125
Total				261

Site #	Station #	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2
		Original Impacts (sq. ft.)*	Original Impacts (sq. ft.)*	Revised Impacts (sq. ft.)	Revised Impacts (sq. ft.)	Increase (sq. ft.)	Increase (sq. ft.)
R-2809C-3B	-L-74+20/ 76+20	46,609	25,701	50,051	29,094	3,442	3,393
R-2809C-4	-L-84+60	22,216	13,068	27,070	12,033	4,854	-1,035
Totals						8,296	2,358

*Impacts in the original permit application were measured using acres

The revised design does not compromise NCDOT's compliance with the existing permit conditions. The new impact sites have been evaluated for compliance with the avoidance/minimization criteria and are in compliance with all previous Individual Permit factors, including the following:

- Protected Species,
- Cultural Resources,
- Aquatic Life passage,
- FEMA compliance, and
- Utilities.

REVISIONS RESULTING IN 404 and 401 JURISDICTIONAL CHANGES

R-2809C Site 2, Sheet 5 of 12

Station -L-66+40

The impacts at this site have increased due to stream bank grading at culvert inlet. No mitigation is proposed because impacts are temporary

Impact change: Increase of 53 feet of Temporary Stream Impacts

R-2809C Site 3B, Sheet 6 of 12

Station -L-74+20 / 76+20

The bank at the culvert inlet and outlet was re-graded so the fill from the roadway could tie into the natural elevation of the stream bank. Rip rap was also installed on 95 feet of the bank for bank stability where the bank was re-graded

Impact change: Increase of 105 feet of Permanent Stream Impacts

Increase of 53 feet of Temporary Stream Impacts

Decrease of 14 feet of channel relocation using natural channel design

R-2809C Site 4, Sheet 7 of 12

Station -L-84+60

The bank at the culvert inlet and outlet was re-graded so the fill from the roadway could tie into the natural elevation of the stream bank. Rip rap was also installed on 63 feet of the bank for bank stability where the bank was re-graded

Impact change: Increase of 63 feet of Permanent Stream Impacts

Increase of 30 feet of Temporary Stream Impacts

Decrease of 46 feet of channel relocation using natural channel design

R-2809C Site 5, Sheet 8 and 8B of 12

Station -L-85+20

Construction access to build the temporary lateral base ditch required use of the entire construction easement. A step pool was also constructed to tie in the Unnamed Tributary at the culvert inlet at Station 84+80-L-. When the original permit application was submitted, temporary stream impacts were not calculated on the Impact Summary Sheets. If the impacts were reported at that time they would have been estimated to be 197 feet. Total temporary impacts now total 322 feet.

Impact change: Increase of 125 feet of Temporary Stream Impacts

R-2809B Site 4, Sheets 17 and 18 of 26

Station -L-38+84

Plans for the prior approved relocation of Richland Creek using natural channel design have been revised so that a smaller portion of the channel will be impacted. The only portion of Richland Creek that will be relocated using natural channel design will be the portion adjacent to the bridge bent number 2. Revised plan view and cross sections have

been included with the permit drawings showing the revised stream relocation.

**Impact change: Decrease of 82 feet of Permanent Stream Impacts
Decrease of 82 feet of Natural Stream Design**

REVISIONS RESULTING IN BUFFER CHANGES

R-2809C Site 3B, Sheet 6 of 12

Station -L-74+20 / 76+20

The bank at the culvert inlet and outlet was re-graded to the construction easement so the fill from the roadway could tie into the natural elevation of the stream bank. Rip rap was also installed for bank stability where the bank was re-graded

Impact change: Increase of 6,835ft² of Mitigable Buffer Impacts.

R-2809C Site 4, Sheet 7 of 12

Station -L-84+60

Additional area for construction access was needed at this site to re-grade the stream banks and to install the rip rap along the banks.

Impact change: Increase of 3,819ft² of Mitigable Buffer Impacts.

Mitigation Strategy

Based upon the agreements stipulated in the "Memorandum of Agreement Among the North Carolina Department of Environment and Natural Resources, the North Carolina Department of Transportation, and the U.S. Army Corps of Engineers, Wilmington District" (MOA), it is understood that the North Carolina Department of Environment and Natural Resources Ecosystem Enhancement Program (EEP), will assume responsibility for satisfying the federal Clean Water Act compensatory mitigation requirements for NCDOT projects that are listed in Exhibit 1 of the subject MOA during the EEP transition period which ends on June 30, 2005.

Since the subject project is listed in Exhibit 1, the necessary compensatory mitigation to offset unavoidable impacts to waters that are jurisdictional under the federal Clean Water Act will be provided by the EEP. The offsetting mitigation will derive from an inventory of assets already in existence within the same 8-digit cataloguing unit. The Department has avoided and minimized impacts to jurisdictional resources to the greatest extent possible as described above.

Streams: The increase in permanent stream impacts total 168 feet. The unavoidable impacts to 168 feet of jurisdictional streams will be offset by compensatory mitigation provided by the EEP program. The EEP acceptance letter is attached.

Buffers: The increase in mitigable buffer impacts totals 10,654 ft². Additional mitigation will be provided by the EEP.

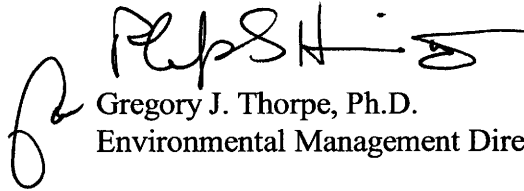
Regulatory Approval

The NCDOT respectfully requests that the referenced 404 Permit, 401 Water Quality Certification, and Neuse River Riparian Certification be modified to reflect the revisions outlined in this letter. In compliance with Section 143-215.3D(e) of the NCAC we will

provide \$475 to act as payment for processing the Section 401 permit application previously noted in this application (see Subject line).

If you have any questions or need additional information, please contact Brett Feulner at (919) 715-1488.

Respectfully,



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

w/ attachment

Mr. John Hennessy, DWQ (7 copies)
Mr. Travis Wilson, NCWRC
Dr. David Chang, P.E., Hydraulics
Ms. Becky Fox, EPA
Mr. Ricky Green, P.E. Division 4
Mr. Jon Nance, P.E. Division 5
Mr. Gary Jordan, USFWS

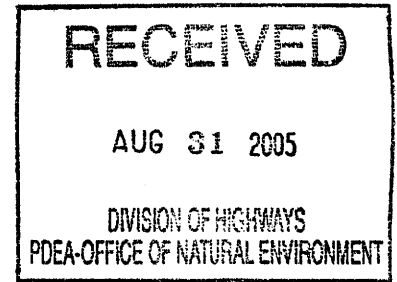
Mr. Greg Perfetti, P.E., Structure Design
Mr. Mark Staley, Roadside Environmental
Mr. Ronald Mikulak, EPA
Mr. Michael Street, NCDMF
Mr. Jamie Shern, DEO, Division 4
Mr. Chris Murray, DEO Division 5
Mr. Clarence Coleman, P.E., FHWA

w/o attachment

Mr. Omar Sullivan, P.E., Prog. Develop.
Mr. Scott McLendon, COE, Wilmington
Mr. James Bridges, PDEA
Mr. Todd Jones, NCDOT External Audit Branch

Mr. Jay Bennett, P.E., Roadway
Mr. Art McMillan, P.E., Highway Design
Ms. Beth Harmon, EEP

File: R-2809



August 29, 2005

Mr. Gregory J. Thorpe, Ph.D.
Environmental Management Director
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:

R-2809, Wake Forest Bypass, Wake County

The purpose of this letter is to notify you that the Ecosystem Enhancement Program (EEP) will provide the additional stream mitigation for the subject project. Based on the information supplied by you in a letter dated August 19, 2005, the impacts are located in CU 03020201 of the Neuse River Basin in the Central Piedmont (CP) Eco-Region, and are as follows:

Stream Impacts: 168 feet

Also, as indicated in your letter, this project will impact buffers located in CU 03020201 of the Neuse River Basin. The total buffer impacts are 8,296 square feet in Zone 1 and 2,358 square feet in Zone 2. The NCDOT estimated buffer impacts in the 7-year Impact Projection Database submitted to EEP in May 2005. The buffer mitigation required for the NCDOT's impact projections was incorporated into EEP's biennial budget that was approved by the NCDOT in June 2005. However, EEP intends to continue managing all of the NCDOT's buffer mitigation requests and approvals through the In-Lieu Fee (ILF) Program's Buffer Fund. Any buffer impact associated with projects located in the Neuse and Tar-Pamlico River Basins, and portions of the Cape Fear and Catawba River Basins are automatic acceptances by the EEP, per the agreement with the NCDWQ.

The NCDOT will be responsible to ensure that the appropriate compensation for the buffer mitigation will be provided in the agreed upon method of fund transfer. Upon receipt of the NCDWQ's Buffer Certification, the NCDOT will provide the EEP a copy of the Certification along with a letter verifying the buffer impact/mitigation amounts and requesting a fund transfer to provide the required compensation. The EEP will transfer the appropriate funds from the MOA Account (Fund 2984) into the ILF Buffer Mitigation Fund (Fund 2982).

Restoring... Enhancing... Protecting Our State

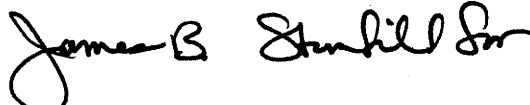


North Carolina Ecosystem Enhancement Program, 1652 Mail Service Center, Raleigh, NC 27699-1652 / 919-715-0476 / www.nceep.net

EEP will commit to implementing sufficient compensatory stream mitigation to offset the impacts associated with this project by the end of the MOA year in which the permit modification for this project is issued, in accordance with Section X of the Tri-Party MOA, signed on July 22, 2003. Compensatory stream mitigation assets available include, but are not limited to, Abbott, Jalo, and the Neu-Con Mitigation Bank.

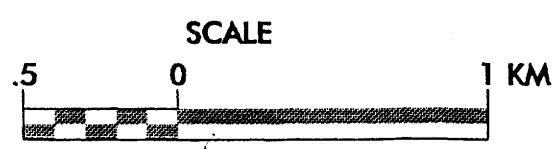
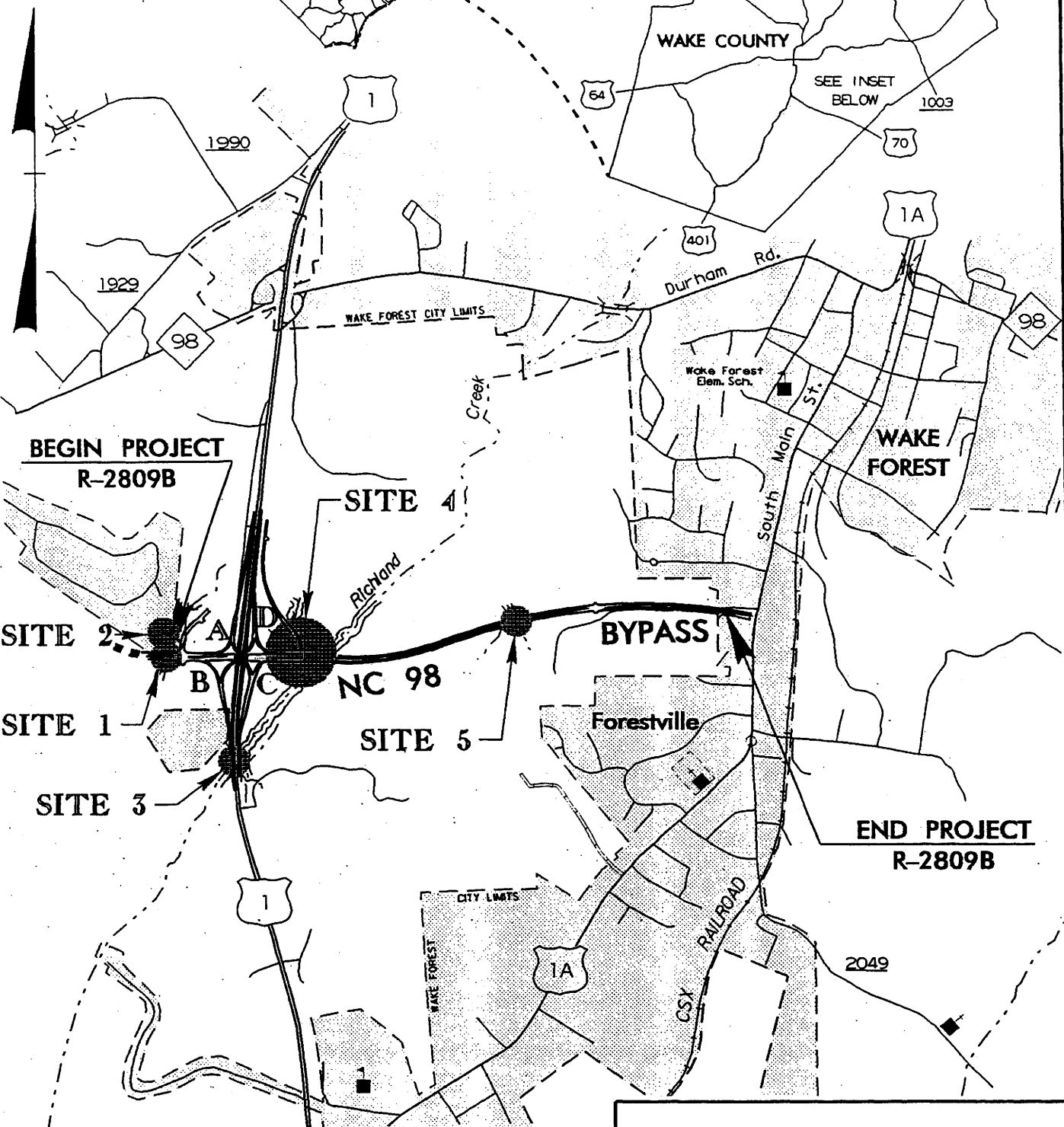
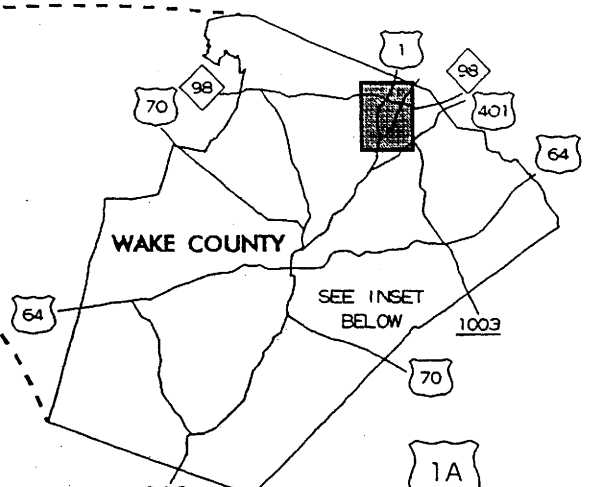
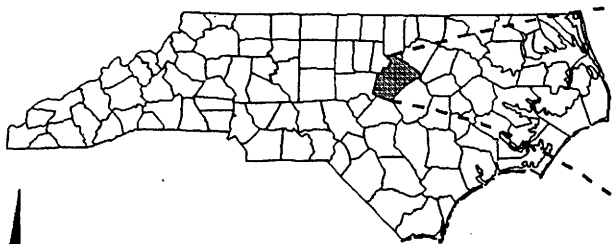
If you have any questions or need additional information, please contact Ms. Beth Harmon at 919-715-1929.

Sincerely,

A handwritten signature in black ink, appearing to read "James B. Stunhill Sr.", written over the typed name.

William D. Gilmore, P.E.
EEP Director

cc: Mr. Gregory J. Thorpe, Ph.D., NCDOT-PDEA
Mr. John Hennessy, Division of Water Quality, Wetlands/401 Unit
File: R-2809B Additional



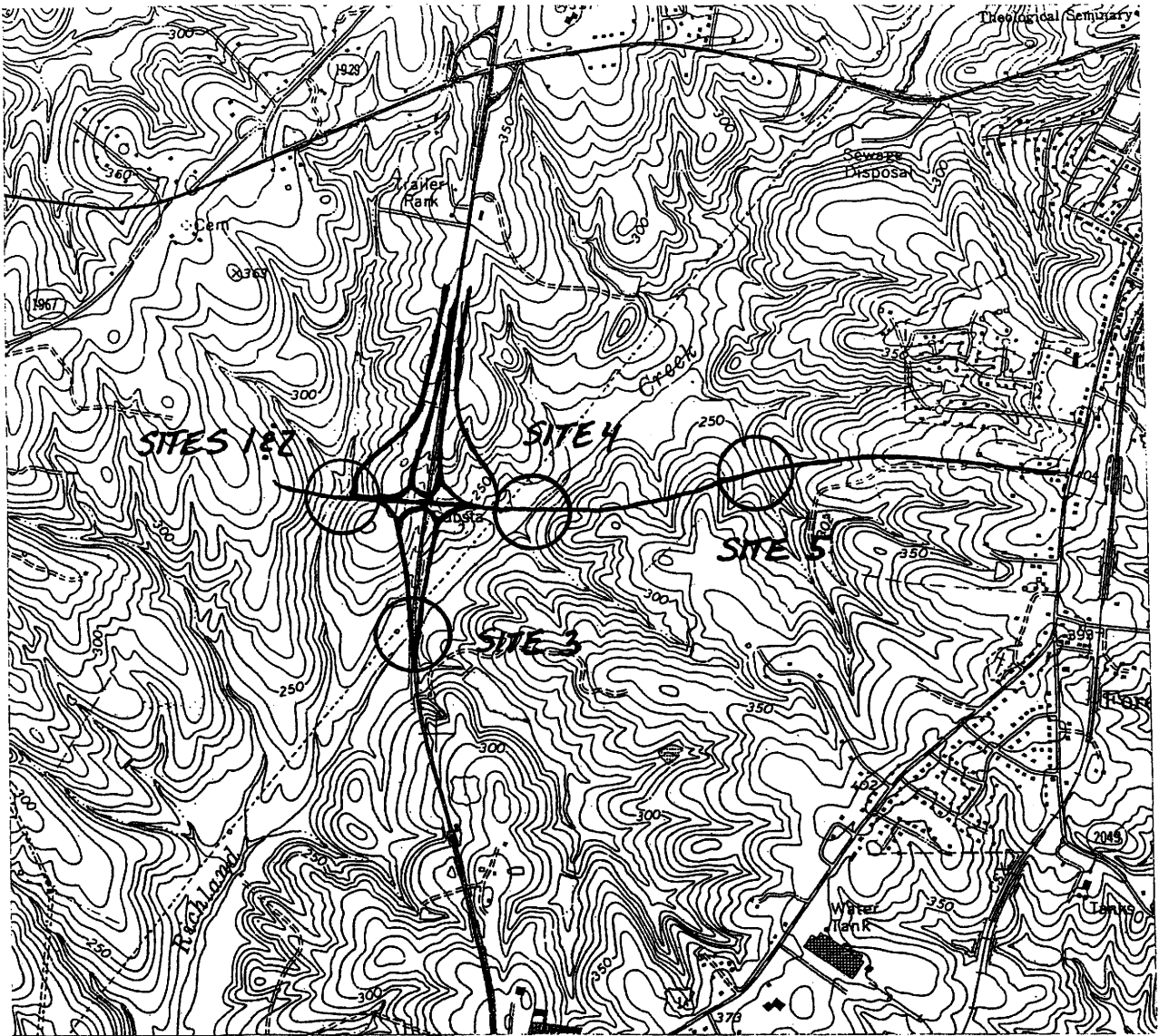
WETLAND

N.C. DEPT. OF TRANSPORTATION
 DIVISION OF HIGHWAYS

WAKE COUNTY

PROJECT: 8.1402501 (R-2809B)
 NC 98 WAKE FOREST BYPASS

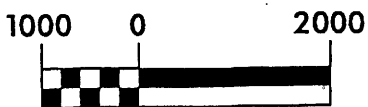
SHEET 1 OF 26



N.C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS

WAKE COUNTY

PROJECT: 8.1402501 (R-2809B)
NC 98 WAKE FOREST BYPASS

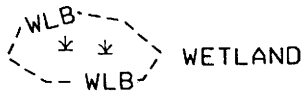


WETLAND

SHEET 2 OF 26

LEGEND

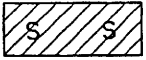
--- WLB --- WETLAND BOUNDARY



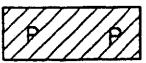
WETLAND



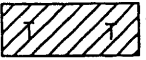
DENOTES FILL IN WETLAND



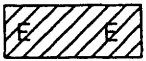
DENOTES FILL IN SURFACE WATER



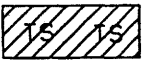
DENOTES FILL IN SURFACE WATER (POND)



DENOTES TEMPORARY FILL IN WETLAND



DENOTES EXCAVATION IN WETLAND



DENOTES TEMPORARY FILL IN SURFACE WATER



DENOTES MECHANIZED CLEARING

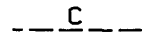
← ← FLOW DIRECTION



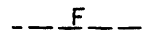
TOP OF BANK



EDGE OF WATER



PROP. LIMIT OF CUT



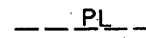
PROP. LIMIT OF FILL



PROP. RIGHT OF WAY



NATURAL GROUND



PROPERTY LINE



TEMP. DRAINAGE EASEMENT



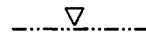
PERMANENT DRAINAGE EASEMENT



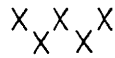
EXIST. ENDANGERED ANIMAL BOUNDARY



EXIST. ENDANGERED PLANT BOUNDARY



WATER SURFACE



LIVE STAKES



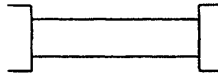
BOULDER



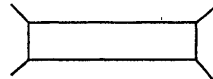
COIR FIBER ROLLS



ADJACENT PROPERTY OWNER OR PARCEL NUMBER



PROPOSED BRIDGE



PROPOSED BOX CULVERT



PROPOSED PIPE CULVERT

(DASHED LINES DENOTE EXISTING STRUCTURES)



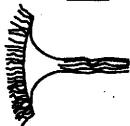
SINGLE TREE



WOODS LINE



DRAINAGE INLET



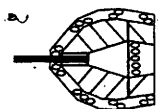
ROOTWAD



VANE



RIP RAP



RIP RAP ENERGY DISSIPATOR BASIN

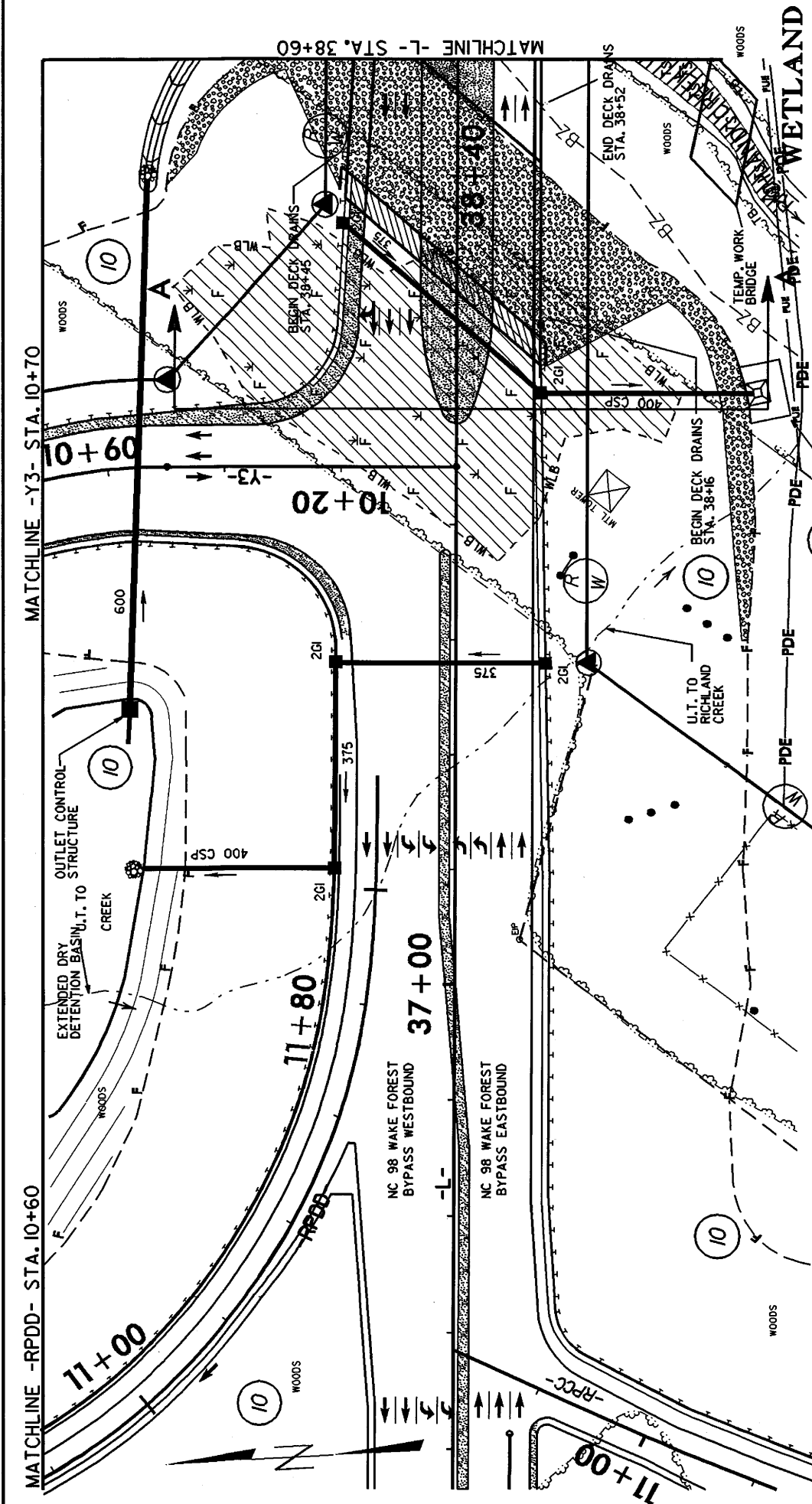
N.C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS

WAKE COUNTY

PROJECT: 8.1402501 (R-2809B)
NC-98 WAKE FOREST BYPASS

WETLAND

SHEET 3 OF 26



N.C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS

WAKE COUNTY

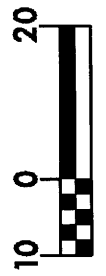
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NC 98 WAKE FOREST BYPASS

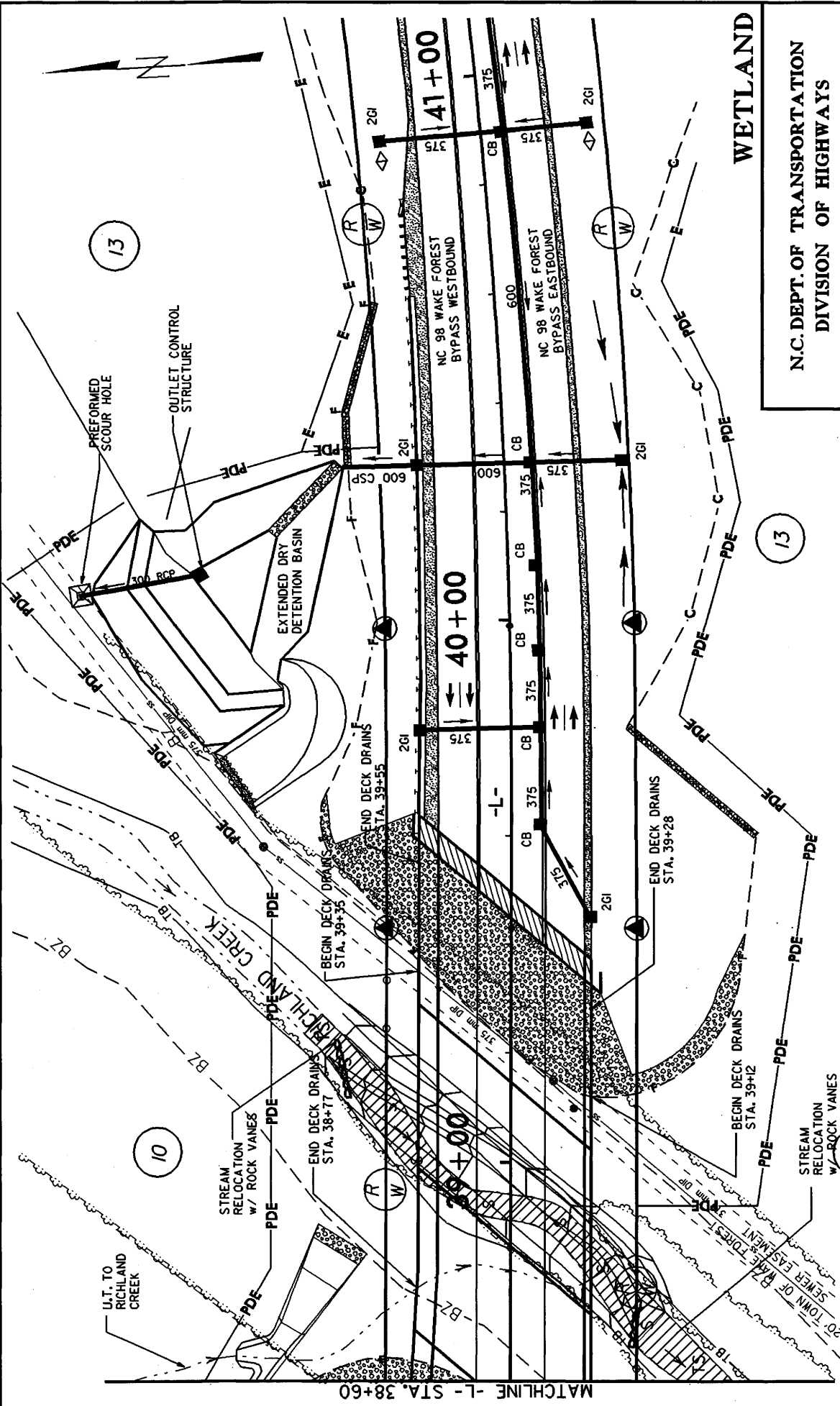
SHEET 17 OF 26

REV 8/05

PLAN VIEW
SITE 4

- DENOTES TEMPORARY IMPACT TO SURFACE WATER
- DENOTES FILL IN WETLAND





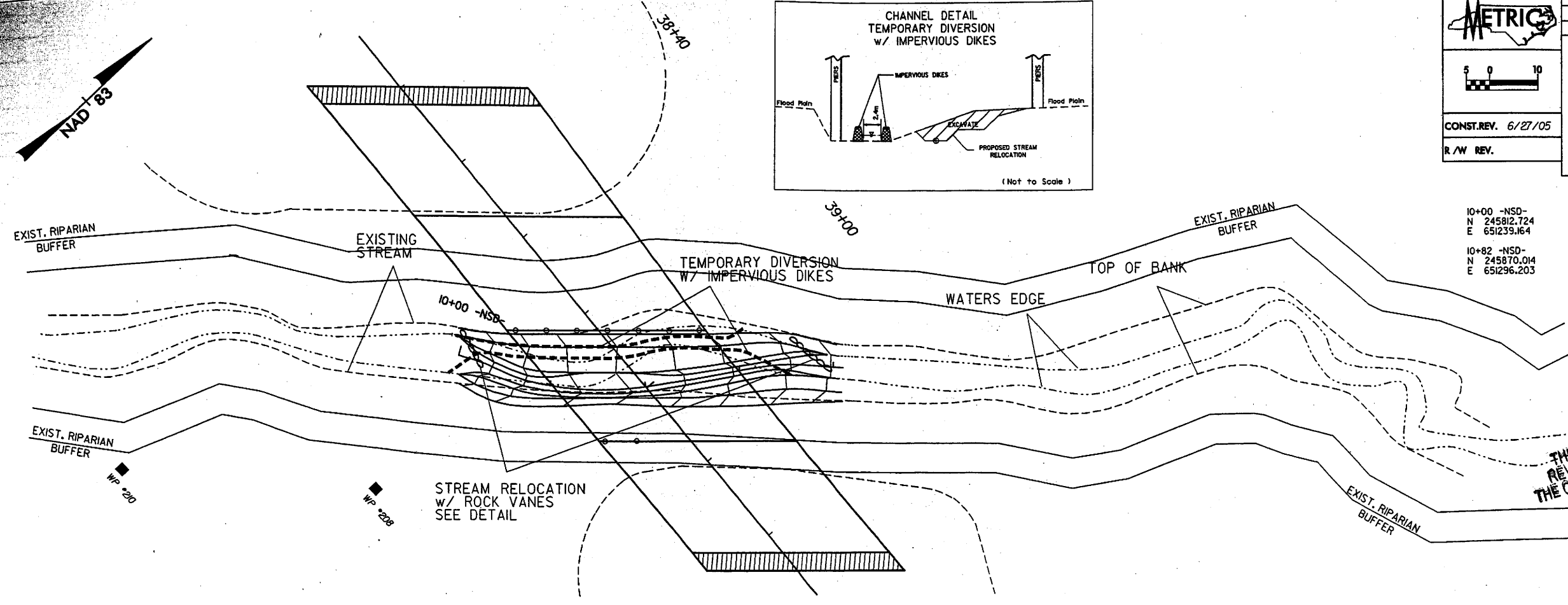
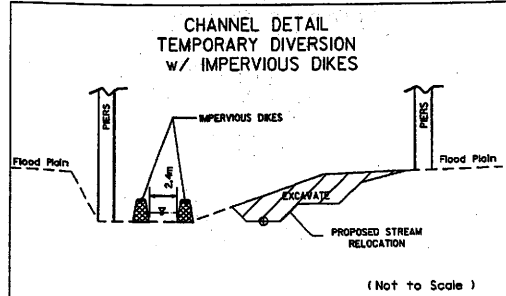
N.C. DEPT. OF TRANSPORTATION
 DIVISION OF HIGHWAYS
 WAKE COUNTY
 PROJECT: 8.1402501 (R-2809B)
 NC 98 WAKE FOREST BYPASS
 SHEET 18 OF AG REV 8/05

(13)
 DENOTES TEMPORARY IMPACT TO SURFACE WATER
 DENOTES FILL IN SURFACE WATER

PLAN VIEW
 SITE 4



 5 0 10	PROJECT REFERENCE NO.	SHEET NO.
	R-2809B	2-Z
	R/W SHEET NO.	
CONST. REV. 6/27/05	ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
R/W REV.	N/A	



PSta 10+25J-NSD-
 N 245823.248
 E 651261.818
 Δ = 33.3518
 L = 34.7m
 T = 13.22m
 R = 58.8m

 PSta 10+68.9-NSD-
 N 245860.988
 E 651286.563
 Δ = 13.7032
 L = 10.0m
 T = 5.0m
 R = 47.5m

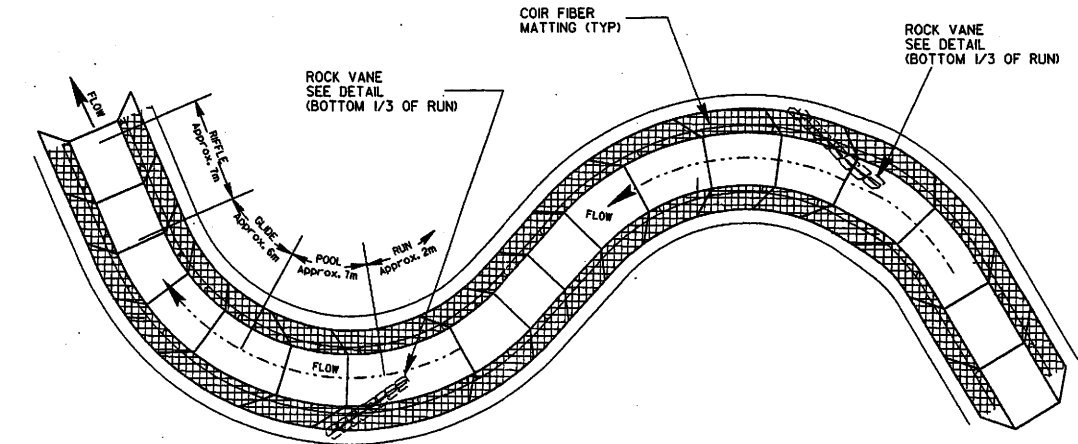
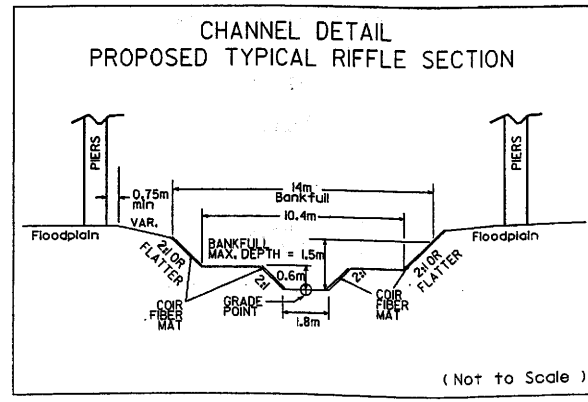
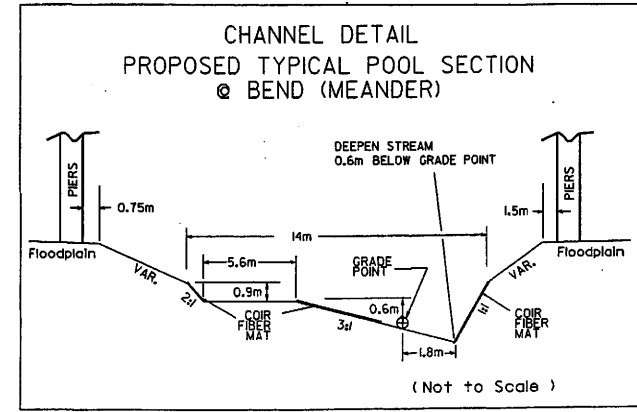
THIS IS A TRUE COPY OF THE
 REVISED PLANS SUBMITTED TO
 THE CONTRACTOR ON THIS PROJECT

 JUN 27, 2005

STREAM DETAIL

L = LENGTH ALONG STREAM CENTERLINE

QUANTITIES:
 COIR FIBER MAT = 700 sq.m.
 EXCAVATION = 500 cu.m.



NOTES:
 PLANTINGS SHOULD BE PLACED ABOVE BANKFULL DEPTH.
 ROCK VANES TO BE PLACED IN BOTTOM ONE THIRD OF RUN
 ROCK SHOULD BE OBLONG IN SHAPE AND HAVE MINIMUM DIMENSIONS OF 0.9mX0.6mX0.6m (SEE SHEET 2-CC FOR ROCK VANE DETAIL)

NCDOT
DIVISION OF HIGHWAYS
WAKE COUNTY
 PROJECT: 8.1402501 (R-2809B)
 NC 98 WAKE FOREST BYPASS

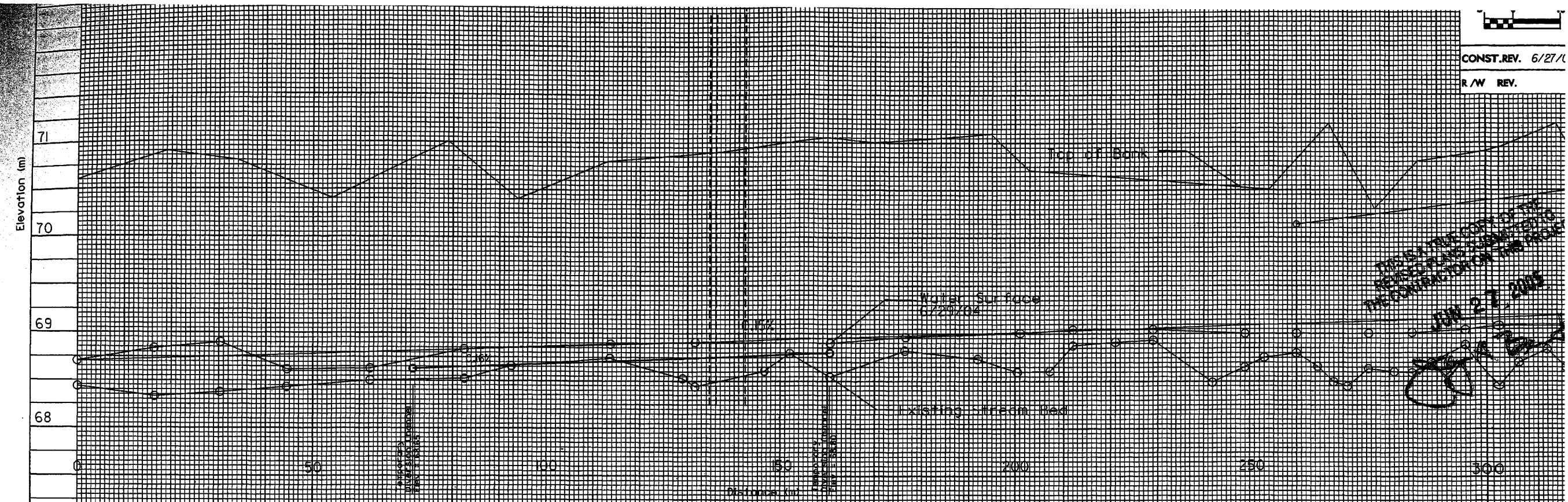
NATURAL CHANNEL DESIGN TYPICALS

27-Jul-2005 13:46:39 stream3 sht 2.dwg CONST. REVISION: 6/27/05 REVISED RICHLAND CREEK STREAM RELOCATION DETAILS



CONST. REV. 6/27/05

R/W REV.



THIS PROFILE IS FOR THE PROPOSED STREAM RELOCATION PROJECT

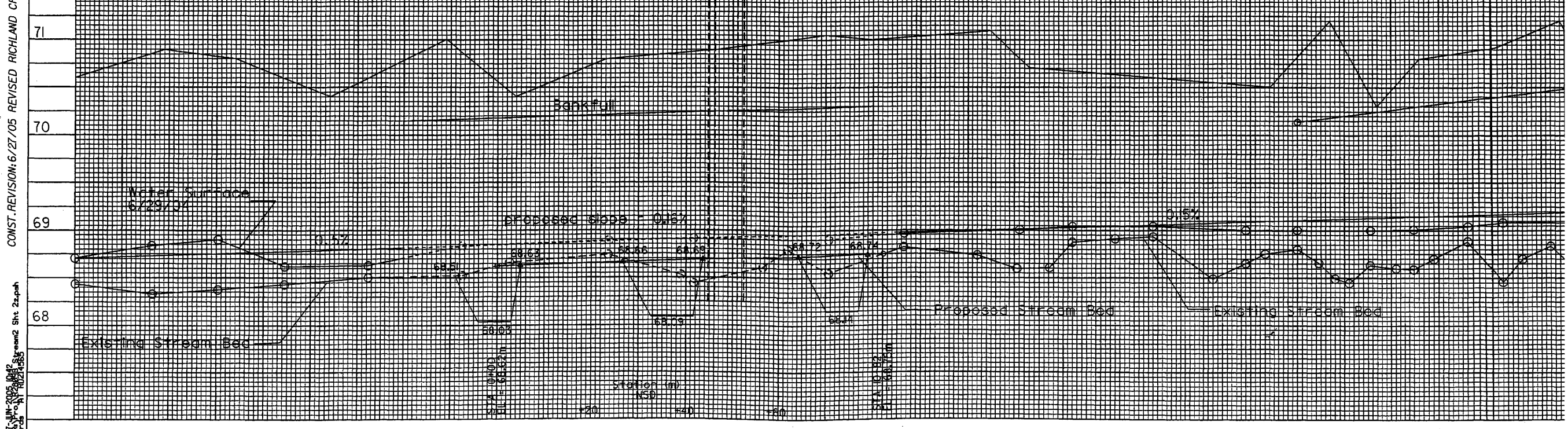
JAN 27 2005

* STATION ALONG CENTERLINE OF STREAM

PROPOSED STREAM PROFILE

CONST. REVISION: 6/27/05 REVISED RICHLAND CREEK STREAM RELOCATION PROFILES

Sheet 2 of 2



WETLAND PERMIT IMPACT SUMMARY

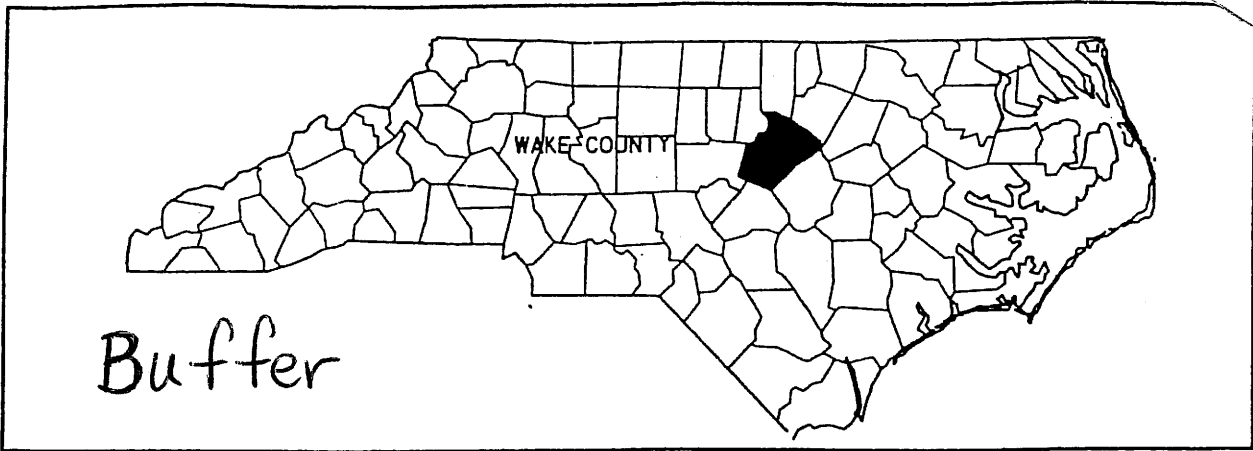
Site No.	Station (From/To)	Structure Size / Type	WETLAND IMPACTS					SURFACE WATER IMPACTS							
			Permanent Fill In Wetlands (ac)	Temp. Fill In Wetlands (ac)	Excavation in Wetlands (ac)	Mechanized Clearing in Wetlands (ac)	Hand Clearing in Wetlands (ac)	Permanent SW impacts (ac)	Temp. SW impacts (ac)	Existing Channel Impacts Permanent (ft)	Existing Channel Impacts Temp. (ft)	Natural Stream Design (ft)			
1	-L- 31+96 / -Y2- 11+38	2 @ 7' x 6' RCBC								0.190					384
2	-Y2- 10+42 - 10+89 Lt									0.010					
3	Y1- 16+88 LV -RPB- 11+08 L	4 @ 11' x 11' RCBC	0.060		0.050	0.020				0.050	0.030			147	76
4	-L- 37+34 RI - 38+34 Lt	4 @ 98' PSG Bridge	0.660							0.110	0.070			269	269
5	-L- 47+09 Lt - 47+70 RI	1 @ 10' x 6' RCBC								0.050	0.005			276	26
TOTALS:			0.72	0.00	0.05	0.02	0.00	0.00	0.41	0.11	1621	266	653		

NC DEPARTMENT OF TRANSPORTATION
 DIVISION OF HIGHWAYS
 WAKE COUNTY
 WBS - 34503.1.1 (R-2809B)
 SHEET *26 of 26* 8/3/2005

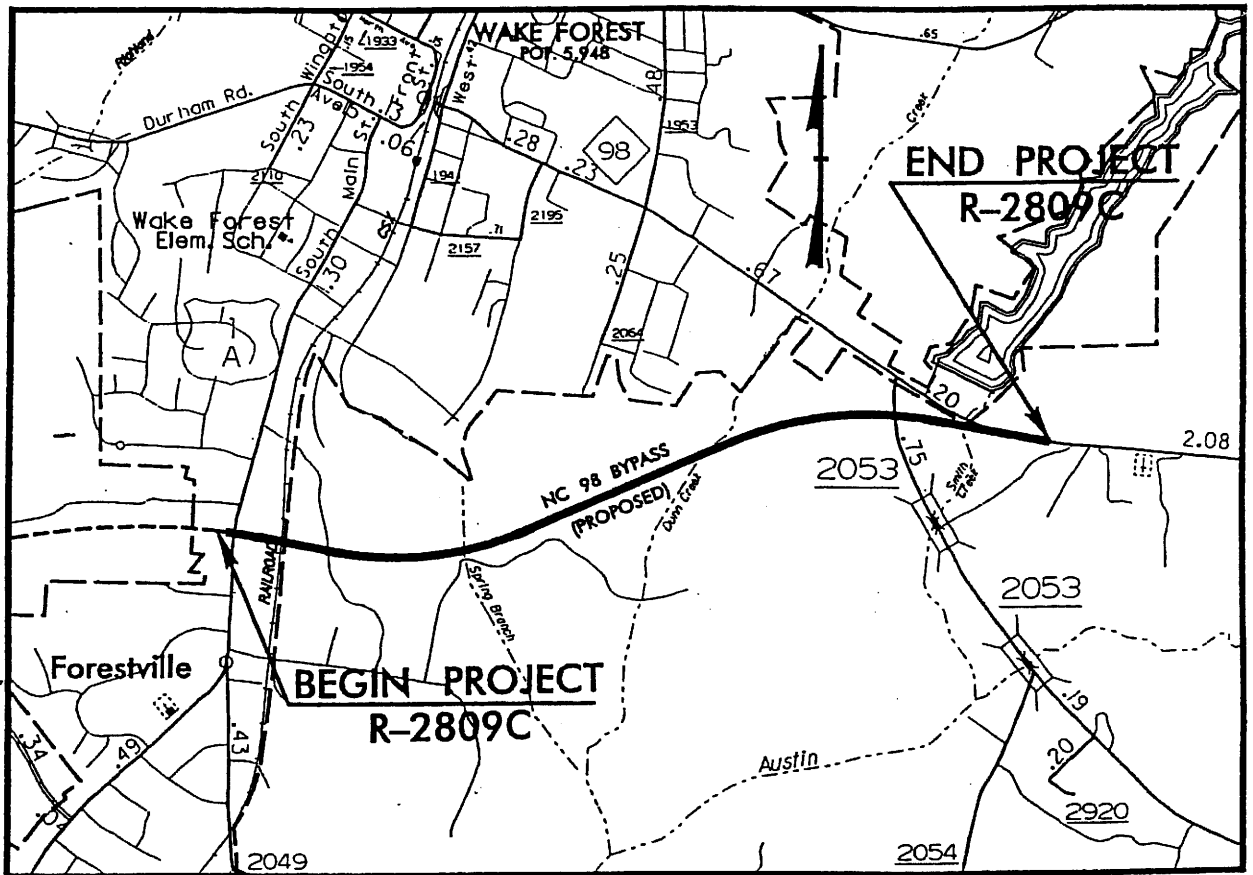
WETLAND PERMIT IMPACT SUMMARY

Site No.	Station (From/To)	Structure Size / Type	WETLAND IMPACTS					SURFACE WATER IMPACTS								
			Permanent Fill In Wetlands (ha)	Temp. Fill In Wetlands (ha)	Excavation in Wetlands (ha)	Mechanized Clearing in Wetlands (ha)	Hand Clearing in Wetlands (ha)	Permanent SW impacts (ha)	Temp. SW impacts (ha)	Existing Channel Impacts Permanent (m)	Existing Channel Impacts Temp. (m)	Natural Stream Design (m)				
1	-L- 31+96 / -Y2- 11+38	2 @ 2.1m x 1.8m RCBC									0.076		243.0			117
2	-Y2- 10+42 - 10+89 Lt										0.004		40.3			
3	Y1- 16+88 L/ -RPB- 11+08	4 @ 3.2m x 3.2m RCBC	0.024		0.021	0.008					0.019	0.013	44.8	23		
4	-L- 37+74 Rt - 38+34 Lt	4 @ 30m PSG Bridge	0.268								0.045	0.027	82.0	50		82
5	-L- 47+09 Lt - 47+70 Rt	1 @ 3.0m x 1.8m RCBC									0.018	0.002	84.0	8		
TOTALS:			0.292	0.000	0.021	0.008	0.000	0.162	0.042	494	81	199				

NC DEPARTMENT OF TRANSPORTATION
 DIVISION OF HIGHWAYS
 WAKE COUNTY
 WBS - 34503.1.1 (R-2809B)
 SHEET **26B** of **26** 8/3/2005



Buffer



VICINITY
MAPS

N. C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
WAKE COUNTY
PROJECT: 8.1402504 (R-2809C)
NC 98, WAKE FOREST BYPASS
FROM WEST OF US 1A
TO EAST OF SR 2053

SHEET 1 OF 12 REVISED 7/11/01

2010/11
5/26/05

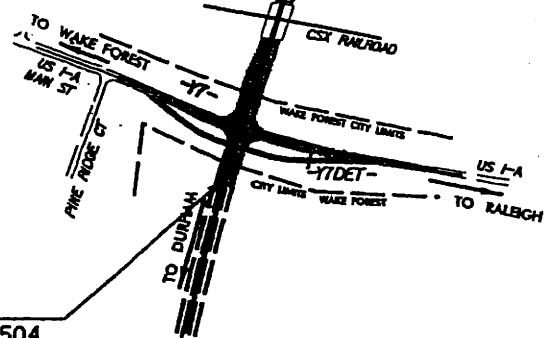


MATCHLINE SITE MAP 2

NC 98 BYPASS

SITE 2

SITE 1



-1- STA. 57+00.000
 BEGIN STATE PROJECT 8.1402504
 BEGIN F.A. PROJECT STP-98(I)
 BEGIN CONST.

SITE MAP 1

N. C. DEPT. OF TRANSPORTATION
 DIVISION OF HIGHWAYS

WAKE COUNTY

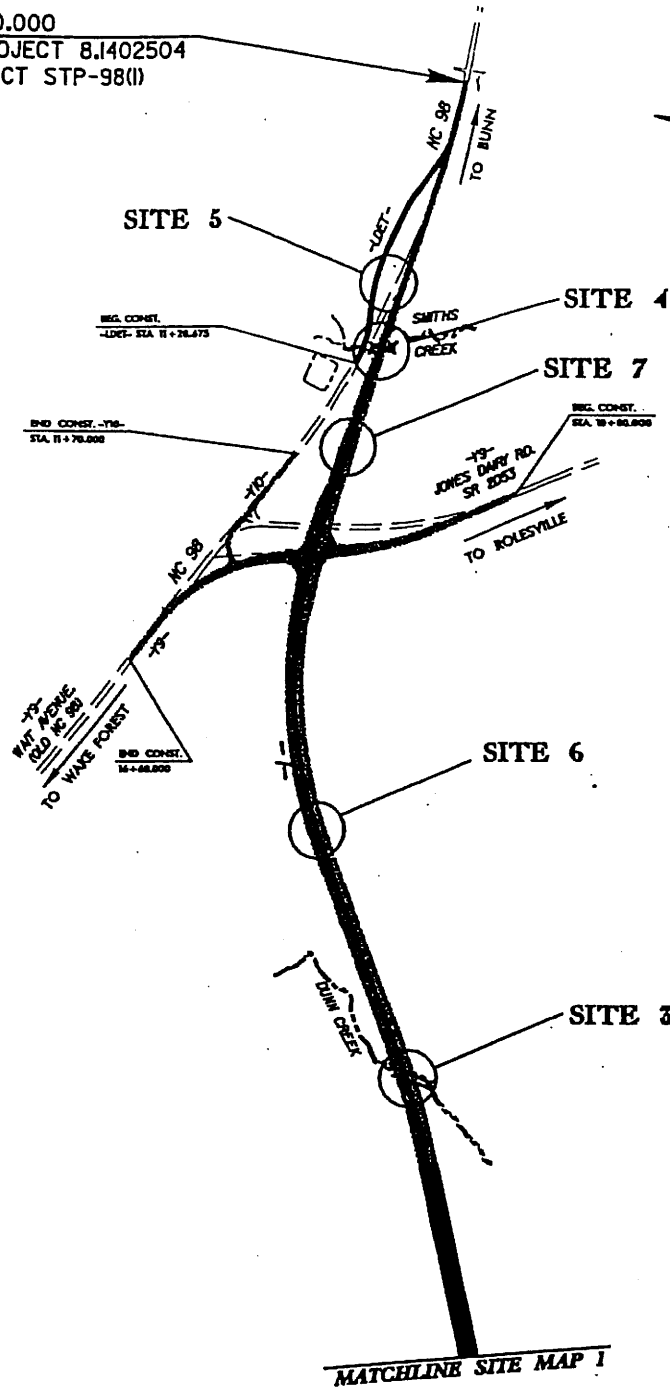
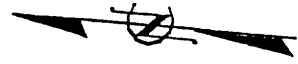
PROJECT: 8.1402504 (R-2809C)

NC 98, WAKE FOREST BYPASS
 FROM WEST OF US 1A
 TO EAST OF SR 2053

SHEET 2 OF 12 REVISED 7/11/01

updated 10/01
 7/30/02
 sh...

-L- STA. 88+20.000
 END STATE PROJECT 8.1402504
 END F.A. PROJECT STP-98(I)
 END CONST.

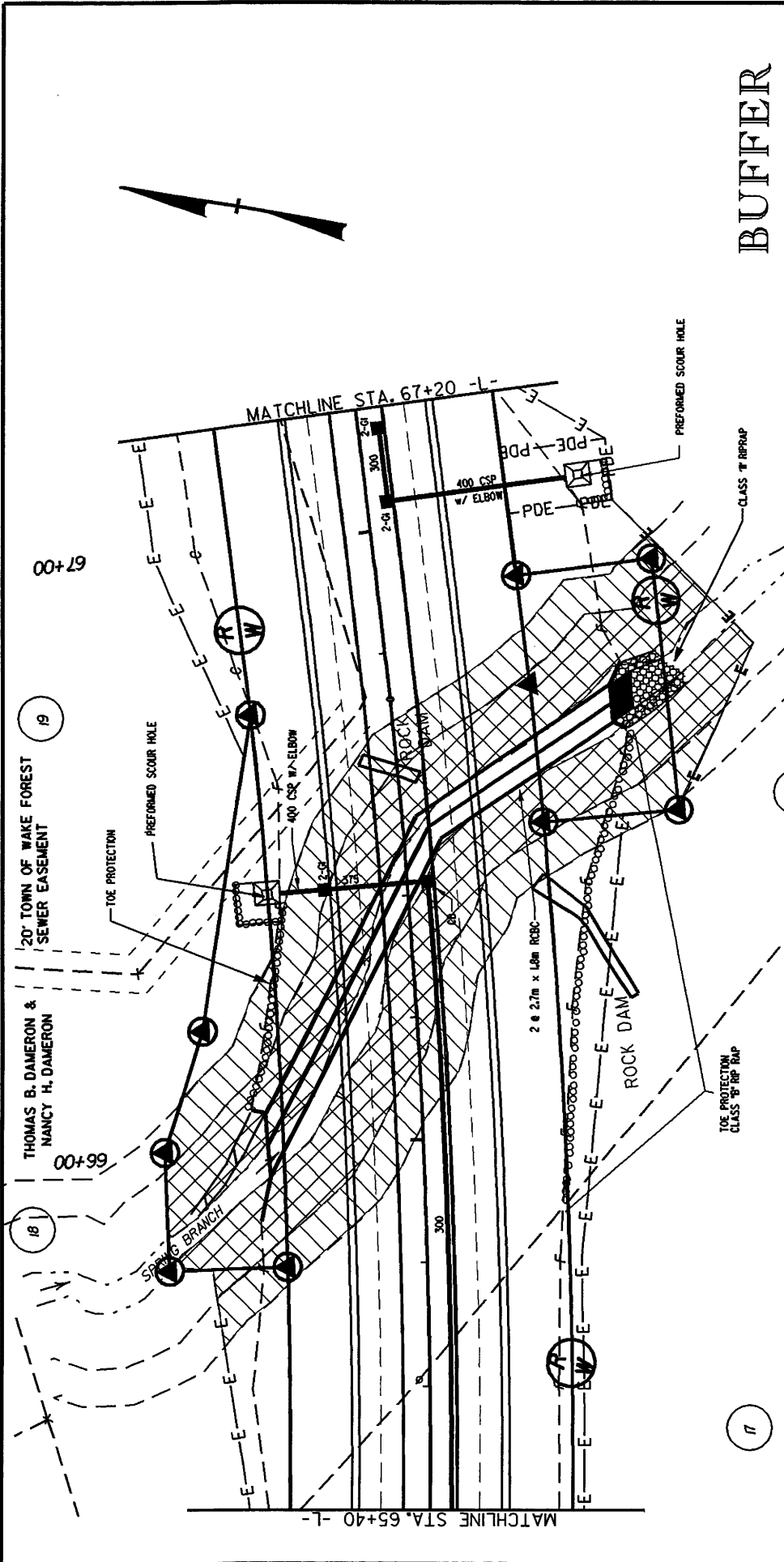


SITE MAP 2

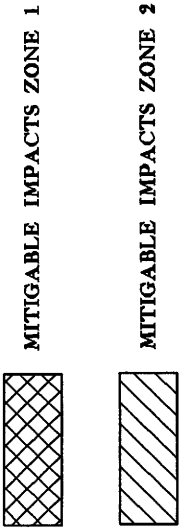
N. C. DEPT. OF TRANSPORTATION
 DIVISION OF HIGHWAYS
 WAKE COUNTY
 PROJECT: 8.1402504 (R-2809C)
 NC 98, WAKE FOREST BYPASS
 FROM WEST OF US 1A
 TO EAST OF SR 2053

SHEET 3 OF 2 REVISED 7/11/01

7/30/02
 5/26/05



**PLAN VIEW
SITE 2**



BUFFER

N. C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
WAKE COUNTY

PROJECT: 8.1402504 (R-2809C)
NC 98, WAKE FOREST BYPASS
FROM WEST OF US 1A
TO EAST OF SR 2053

SHEET **5** OF **12** REVISED 5 / 05

THOMAS B. DAMERON & NANCY H. DAMERON

THOMAS B. DAMERON & NANCY H. DAMERON

19

18

17

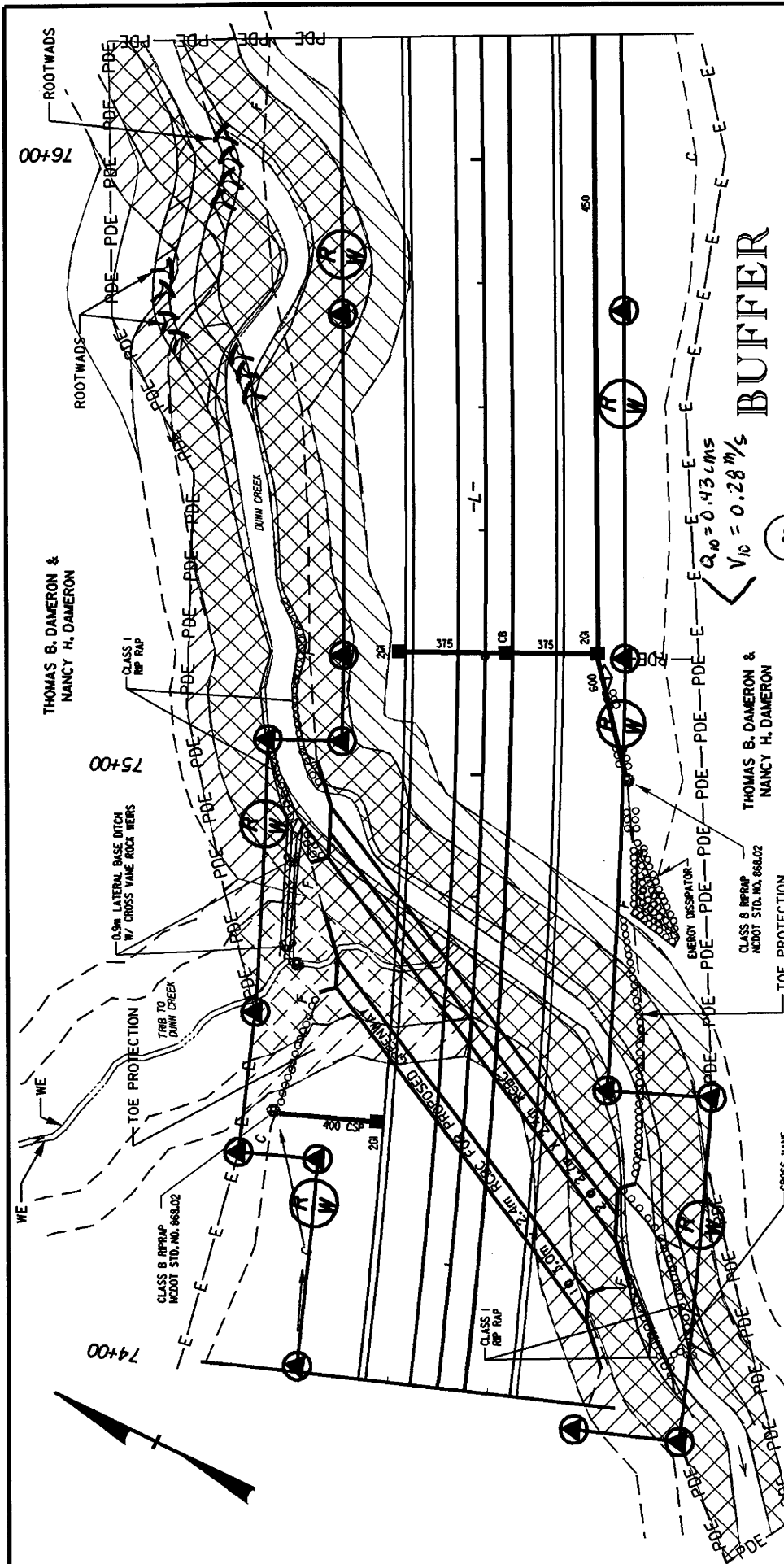
18

00+99

67+00

MATCHLINE STA. 67+20 -L-

MATCHLINE STA. 65+40 -L-



N. C. DEPT. OF TRANSPORTATION
 DIVISION OF HIGHWAYS
 WAKE COUNTY

PROJECT: 8.1402504 (R-2809C)
 NC 98, WAKE FOREST BYPASS
 FROM WEST OF US 1A
 TO EAST OF SR 2053

SHEET 6 OF 22 REVISED 5 / 05

ALLOWABLE IMPACTS ZONE 1

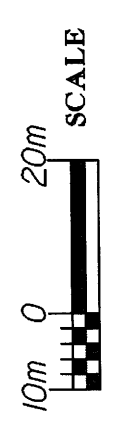
ALLOWABLE IMPACTS ZONE 2

MITIGABLE IMPACTS ZONE 1

MITIGABLE IMPACTS ZONE 2

20

PLAN VIEW
 SITE 3A & 3B

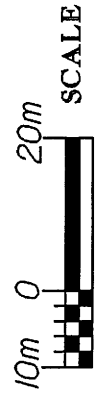
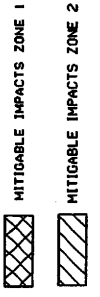
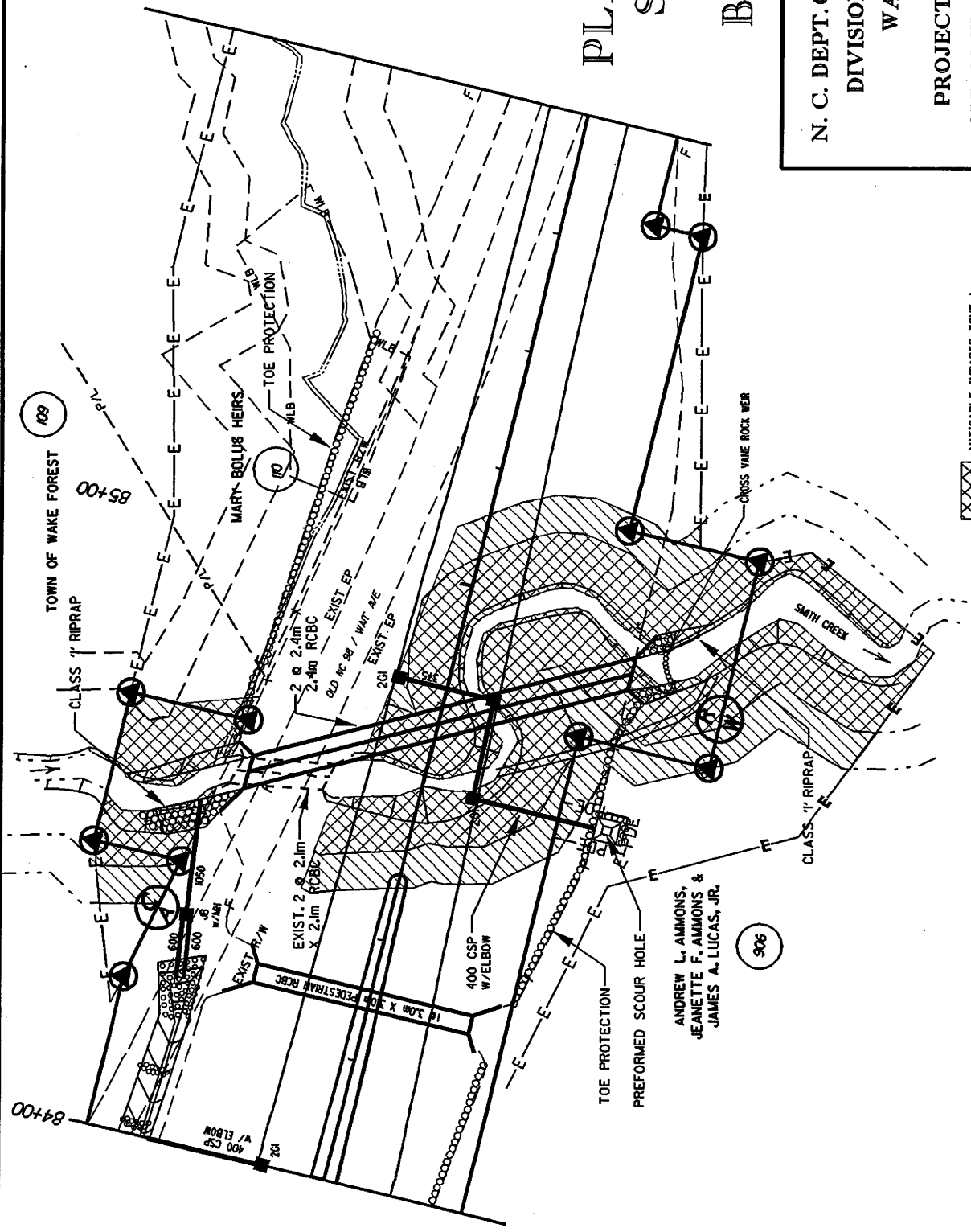


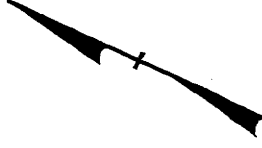
PLAN VIEW SITE 4 BUFFER

N. C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
WAKE COUNTY

PROJECT: 8.1402504 (R-2809C)
NC 98, WAKE FOREST BYPASS
FROM WEST OF US 1A
TO EAST OF SR 2053

SHEET 7 OF 12 REVISED 5/05





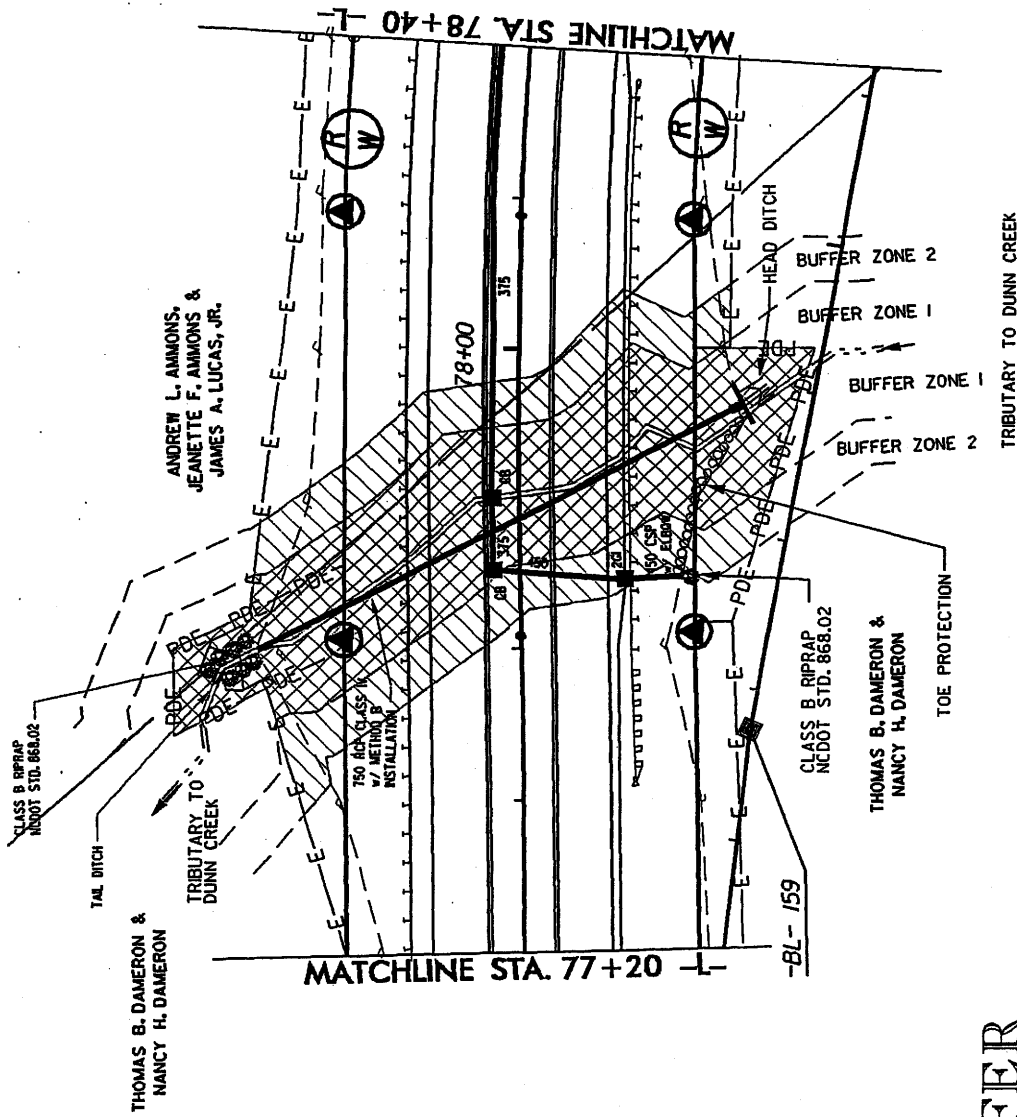
PLAN VIEW SITE 6

N. C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
WAKE COUNTY

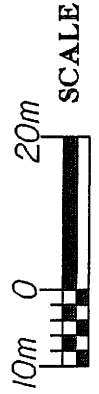
PROJECT: 8.1402504 (R-2809C)

NC 98, WAKE FOREST BYPASS
FROM WEST OF US 1A
TO EAST OF SR 2053

SHEET 9 OF 12 REVISED 5/05



BUFFER



Site No.	STRUCTURE (SIZE / TYPE)	STATION (FROM / TO)	IMPACT						MITIGABLE			BUFFER REPLACEMENT			
			TYPE		ALLOWABLE		TOTAL (m ²)	ZONE 1 (m ²)	ZONE 2 (m ²)	TOTAL (m ²)	ZONE 1 (m ²)	ZONE 2 (m ²)			
			ROAD CROSSING	PARALLEL IMPACT	ZONE 1 (m ²)	ZONE 2 (m ²)									
2	2 @ 2.7m x 1.8m RCBC	66+40 -L-	X						2456.0	1545.0	4001.0				
3A	Relocated Swale/Base Ditch	74+62 to 74+92 -L- Lt	X		731.0	297.0	1028.0								
3B	2 @ 2.7m x 2.4m RCBC	74+00 -L- Rt to 75+20 -L- Lt	X						4650.0	2703.0	7353.0		141.0	247.0	
4	2 @ 2.4m x 2.4m RCBC	84+67 -L-	X						2515.0	1118.0	3633.0				
5	Relocated Swale/Base Ditch	84+70 to 85+60 -L- Lt	X						287.0	90.0	377.0				
	TEMPORARY DETOUR	11+40 to 12+60 -L-DET- Lt	X						1907.0	1240.0	3147.0		2046.0	801.0	
6	750 RCP	77+80 -L-	X						1493.0	921.0	2414.0				
TOTALS:					731.0	297.0	1028.0		13308.0	7617.0	20925.0		2187.0	1048.0	

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

WAKE COUNTY

PROJECT: 34503.1.1 (R-2809C)
NC 98 WAKE FOREST BYPASS

BUFFER IMPACT SUMMARY

Site No.	STRUCTURE (SIZE / TYPE)	STATION (FROM / TO)	TYPE				IMPACT				MITIGABLE			BUFFER REPLACEMENT						
			ROAD CROSSING	PARALLEL IMPACT	ZONE 1 (ft ²)	ZONE 2 (ft ²)	TOTAL (ft ²)	ZONE 1 (ft ²)	ZONE 2 (ft ²)	TOTAL (ft ²)	ZONE 1 (ft ²)	ZONE 2 (ft ²)	TOTAL (ft ²)	ZONE 1 (ft ²)	ZONE 2 (ft ²)					
2	2 @ 9' x 6' RCBC	66+40 -L-	X									26436.0	16630.0	43066.0						
3A	Relocated Swale/Base Ditch	74+62 to 74+92 -L- Lt	X		7663.0	3197.0	11065.0													
3B	2 @ 9' x 8' RCBC	74+00 -L- Rt to 75+20 -L- Lt	X									50051.0	29094.0	79145.0	1518.0	2659.0				
4	2 @ 8' x 8' RCBC	84+67 -L-	X									27070.0	12033.0	39103.0						
5	Relocated Swale/Base Ditch	84+70 to 85+60 -L- Lt	X									3089.0	969.0	4058.0						
	Temporary Detour	11+40 to 12+60 -L-DET- Lt	X									20626.0	13347.0	33973.0	22022.0	8621.0				
6	30" RCP	77+80 -L-	X									16070.0	9913.0	25983.0						
TOTALS:													7868	3197	11065	143242	81986	225228	23540	11280

N.C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

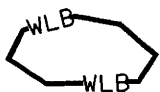
WAKE COUNTY

PROJECT 34503.1.1 (R-2809C)
NC 98 WAKE FOREST BYPASS

SHEET **106** OF **12** Aug-05

BUFFER LEGEND

—WLB— WETLAND BOUNDARY

 WETLAND

 ALLOWABLE IMPACTS ZONE 1

 ALLOWABLE IMPACTS ZONE 2

 MITIGABLE IMPACTS ZONE 1

 MITIGABLE IMPACTS ZONE 2

—BZ— RIPARIAN BUFFER ZONE

—BZ1— RIPARIAN BUFFER ZONE 1
30 ft (9.2m)

—BZ2— RIPARIAN BUFFER ZONE 2
20 ft (6.1m)

→ FLOW DIRECTION

—TB— TOP OF BANK

---WE--- EDGE OF WATER

---C--- PROP. LIMIT OF CUT

---F--- PROP. LIMIT OF FILL

▲ PROP. RIGHT OF WAY

---NG--- NATURAL GROUND

---PL--- PROPERTY LINE

—TDE— TEMP. DRAINAGE EASEMENT


—PDE— PERMANENT DRAINAGE EASEMENT

—EAB— EXIST. ENDANGERED ANIMAL BOUNDARY

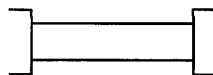
—EPB— EXIST. ENDANGERED PLANT BOUNDARY

---▽--- WATER SURFACE


 LIVE STAKES

 BOULDER


--- CORE FIBER ROLLS

 PROPOSED BRIDGE

 PROPOSED BOX CULVERT

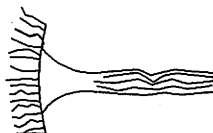
 PROPOSED PIPE CULVERT
12"-48" PIPES
54" PIPES & ABOVE

(DASHED LINES DENOTE EXISTING STRUCTURES)


 SINGLE TREE

 WOODS LINE

 DRAINAGE INLET

 ROOTWAD

 RIP RAP

 ADJACENT PROPERTY OWNER OR PARCEL NUMBER IF AVAILABLE

 PREFORMED SCOUR HOLE (PSH)

 LEVEL SPREADER (LS)

 GRASS SWALE

N. C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
WAKE COUNTY
PROJECT: 34503.1.1 (R-2809C)

NC 98 WAKE FOREST BYPASS

SHEET 11 OF 12

PROPERTY OWNERS

NAMES AND ADDRESSES

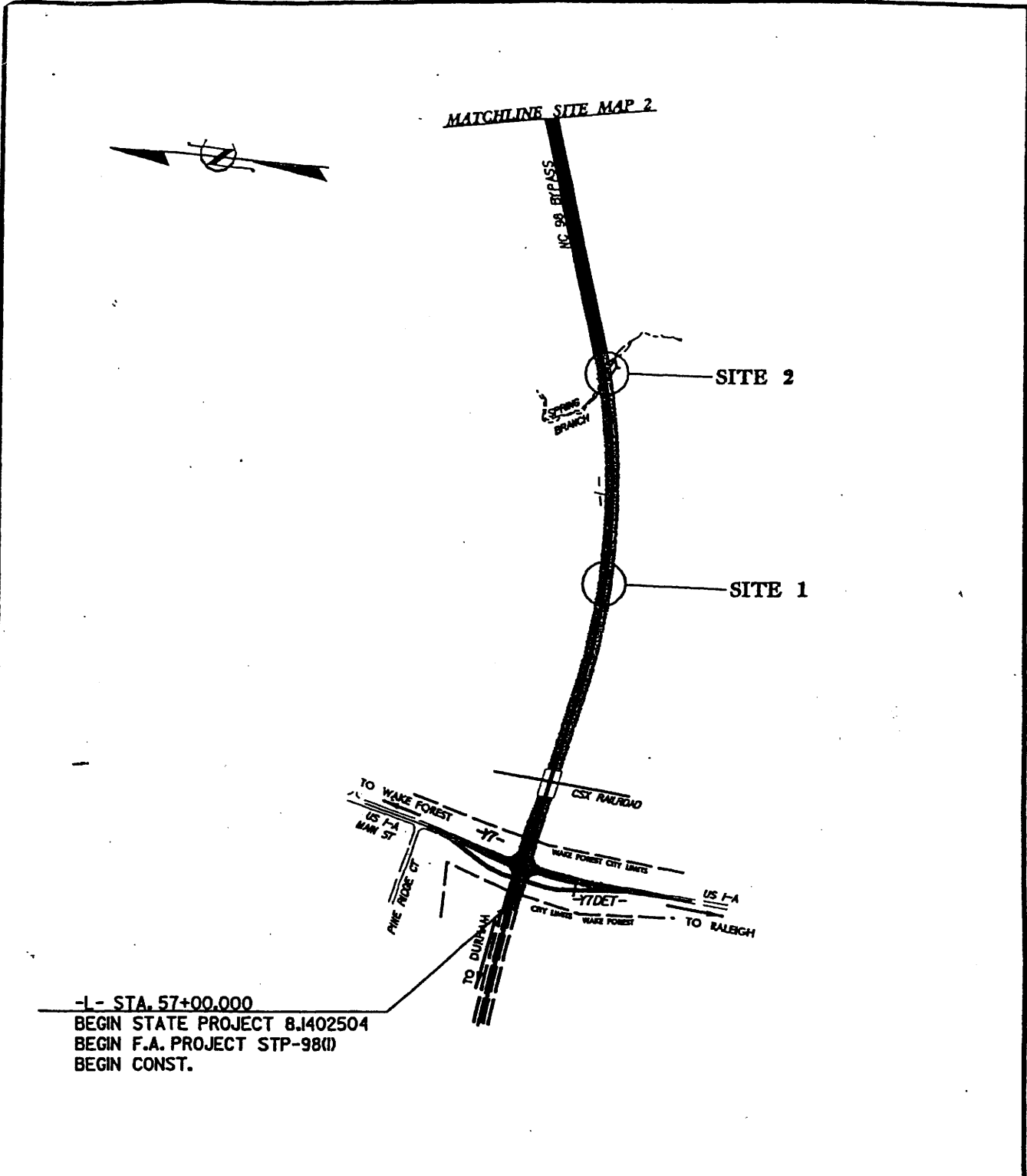
PARCEL NO.	NAMES	ADDRESSES
	CADY CONSTRUCTION CO	7020 SIX FORKS RD RALEIGH NC 27615
	ELIZABETH H. HOLDING	12630 WAKE UNION CHURCH RD WAKE FOREST NC 27588
	THOMAS DAMERON NANCY DAMERON	414 SCOTLAND ST RALEIGH, NC 27609
	TOWN OF WAKE FOREST	401E. ELM ST WAKE FOREST NC 27587
	MARY BOLUS HEIRS	C/O ELIZABETH B. NASSIF 115 E. ELM ST WAKE FOREST NC 27587
	ANDREW L. AMMONS JEANETTE AMMONS JAMES LUCAS, JR.	7412 CHAPEL HILL RD RALEIGH NC 27607

N. C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
WAKE COUNTY

PROJECT: 8.1402501 (R-2809C)
NC 98, WAKE FOREST BYPASS
FROM WEST OF US 1A
TO EAST OF SR 2053

SHEET 12 OF 12 REVISED 7/11/01

5/26/05



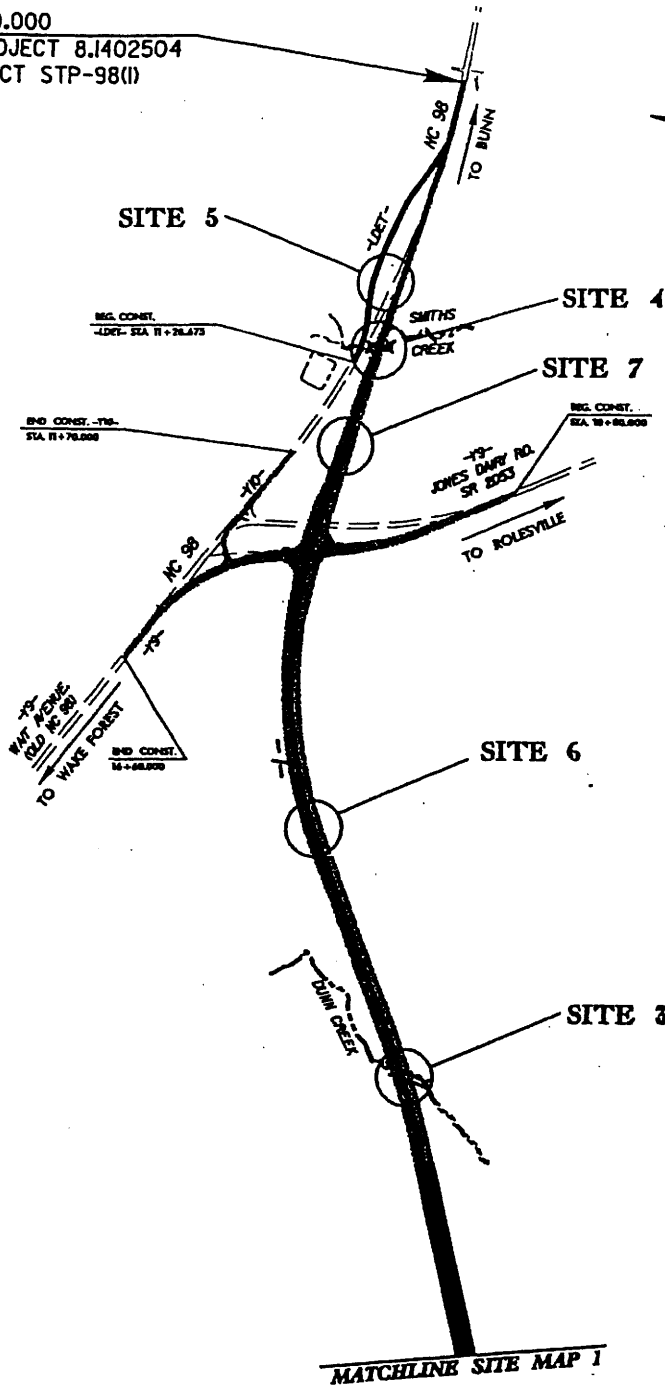
SITE MAP 1

N. C. DEPT. OF TRANSPORTATION
 DIVISION OF HIGHWAYS
 WAKE COUNTY
 PROJECT: 8.1402504 (R-2809C)
 NC 98, WAKE FOREST BYPASS
 FROM WEST OF US 1A
 TO EAST OF SR 2053

SHEET 2 OF 92 REVISED 7/11/01

updated 10/01
 7/30/02

-L- STA. 88+20.000
 END STATE PROJECT 8.1402504
 END F.A. PROJECT STP-98(I)
 END CONST.



SITE MAP 2

N. C. DEPT. OF TRANSPORTATION
 DIVISION OF HIGHWAYS
 WAKE COUNTY
 PROJECT: 8.1402504 (R-2809C)
 NC 98, WAKE FOREST BYPASS
 FROM WEST OF US 1A
 TO EAST OF SR 2053

SHEET 3 OF 12 REVISED 7/11/01

7/30/02
 5/26/05

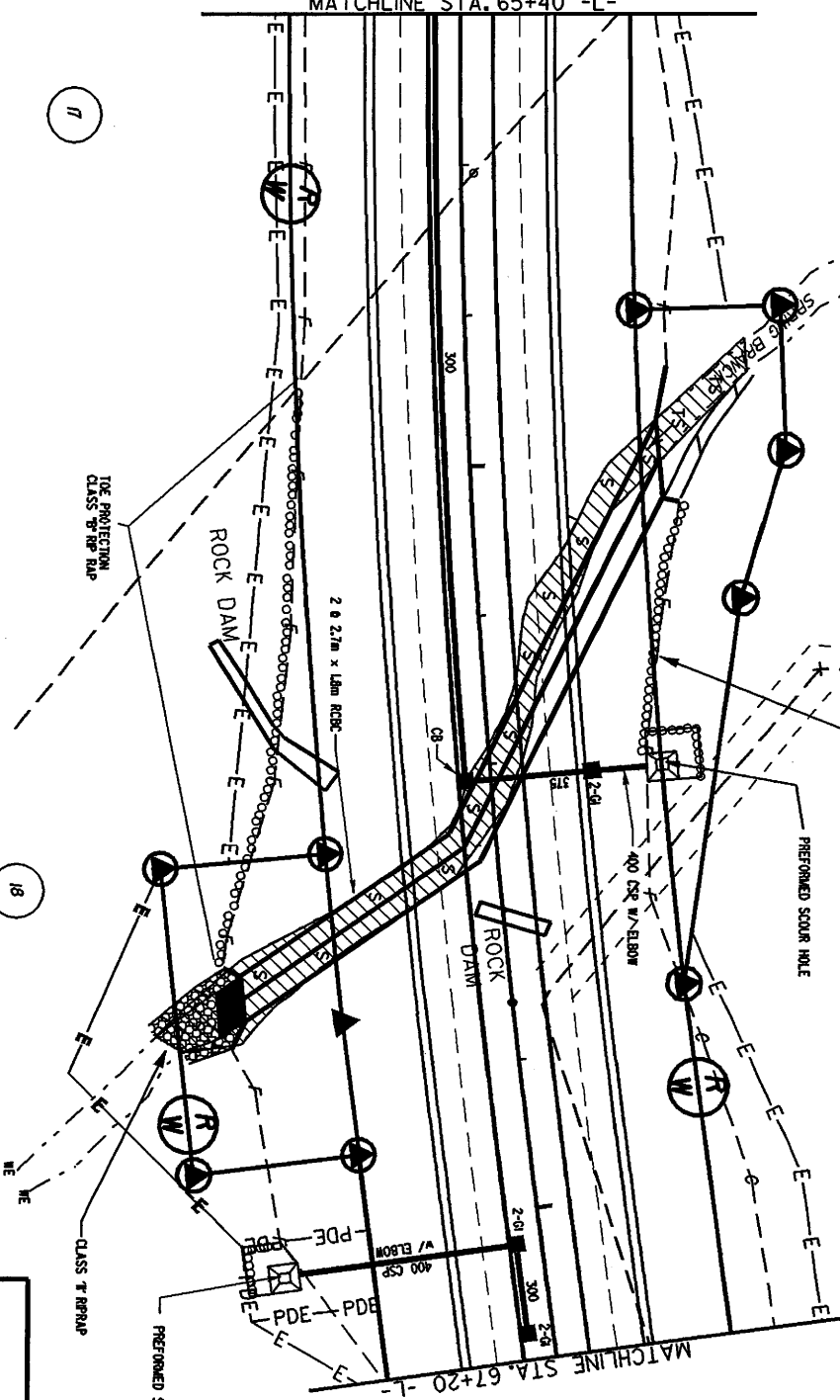
MATCHLINE STA. 65+40 -L-

18
66+00
THOMAS B. DAMERON &
NANCY H. DAMERON

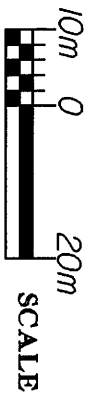
20' TOWN OF WAKE FOREST
SEWER EASEMENT


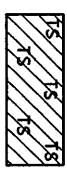
19

67+00



PLAN VIEW SITE 2



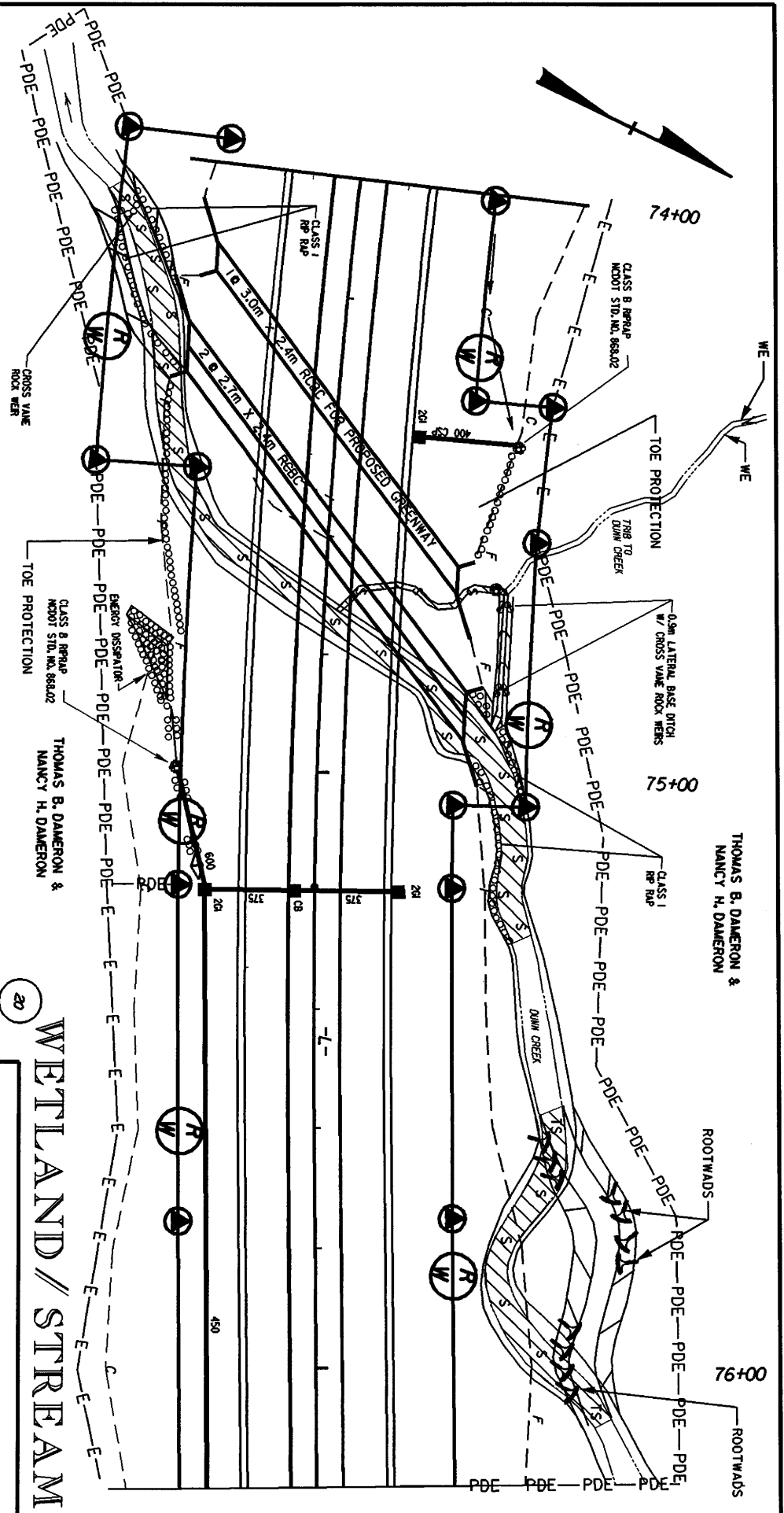
-  PERMANENT SURFACE WATER IMPACTS
-  TEMPORARY SURFACE WATER IMPACTS

THOMAS B. DAMERON &
NANCY H. DAMERON

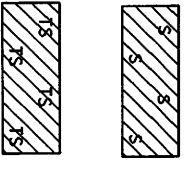
WETLAND // STREAM

N. C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
WAKE COUNTY

PROJECT: 8.1402504 (R-2809C)
NC 98, WAKE FOREST BYPASS
FROM WEST OF US 1A
TO EAST OF SR 2053
SHEET 5 OF 12 REVISED 5/05



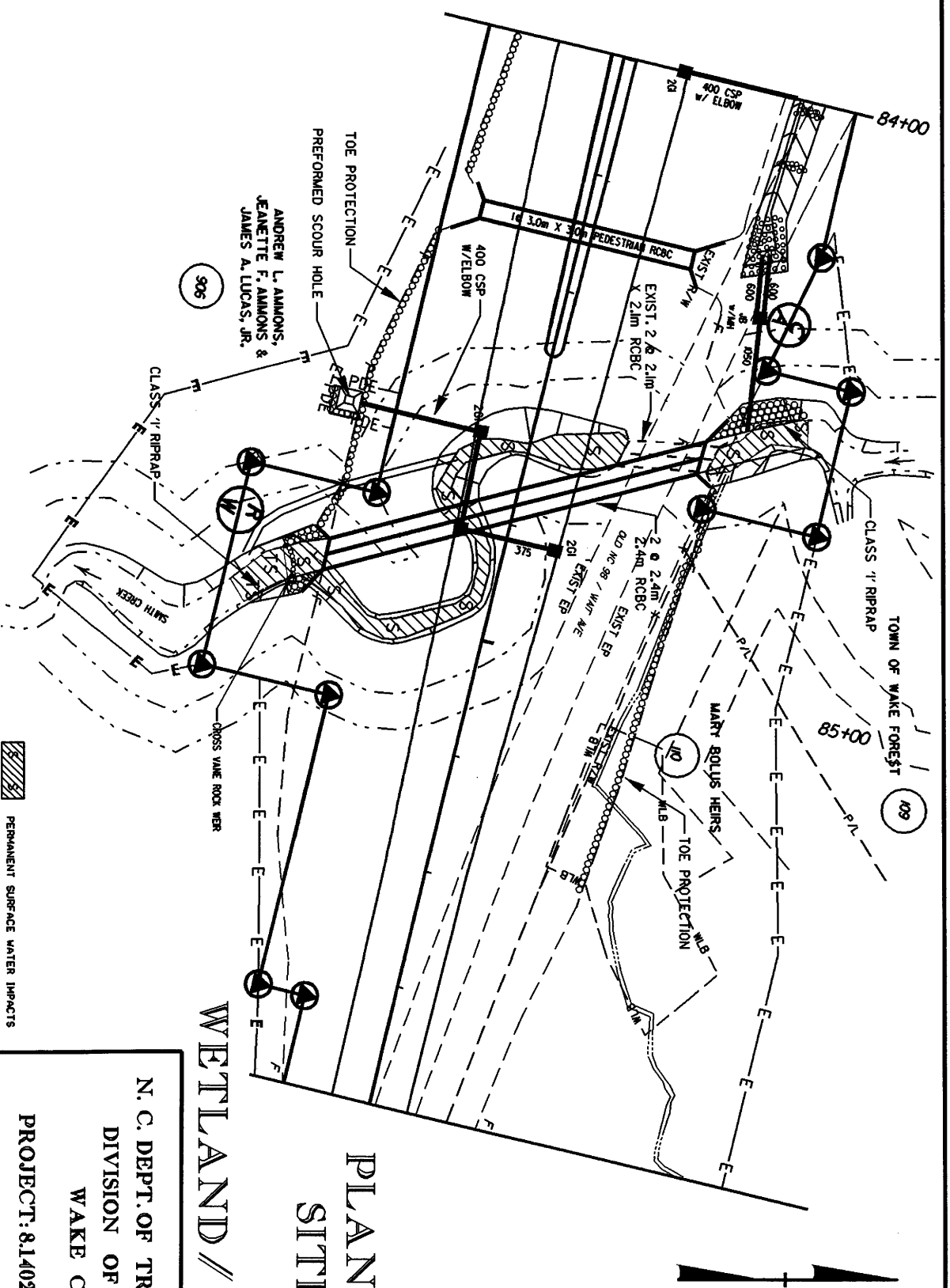
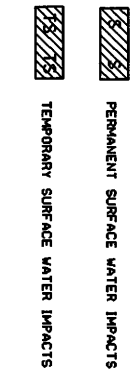
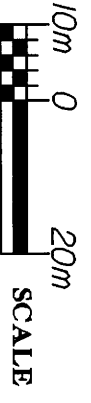
PLAN VIEW SITE 3A & 3B



WETLAND / STREAM

N. C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
WAKE COUNTY

PROJECT: 8.1(02504 (R-2809C)
NC 98, WAKE FOREST BYPASS
FROM WEST OF US 1A
TO EAST OF SR 2053
SHEET 6 OF 12 REVISED 5 / 05



ANDREW L. AMMONS,
JEANETTE F. AMMONS &
JAMES A. LUCAS, JR.

306

84+00

85+00

WETLAND // STREAM

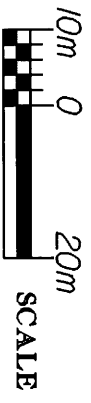
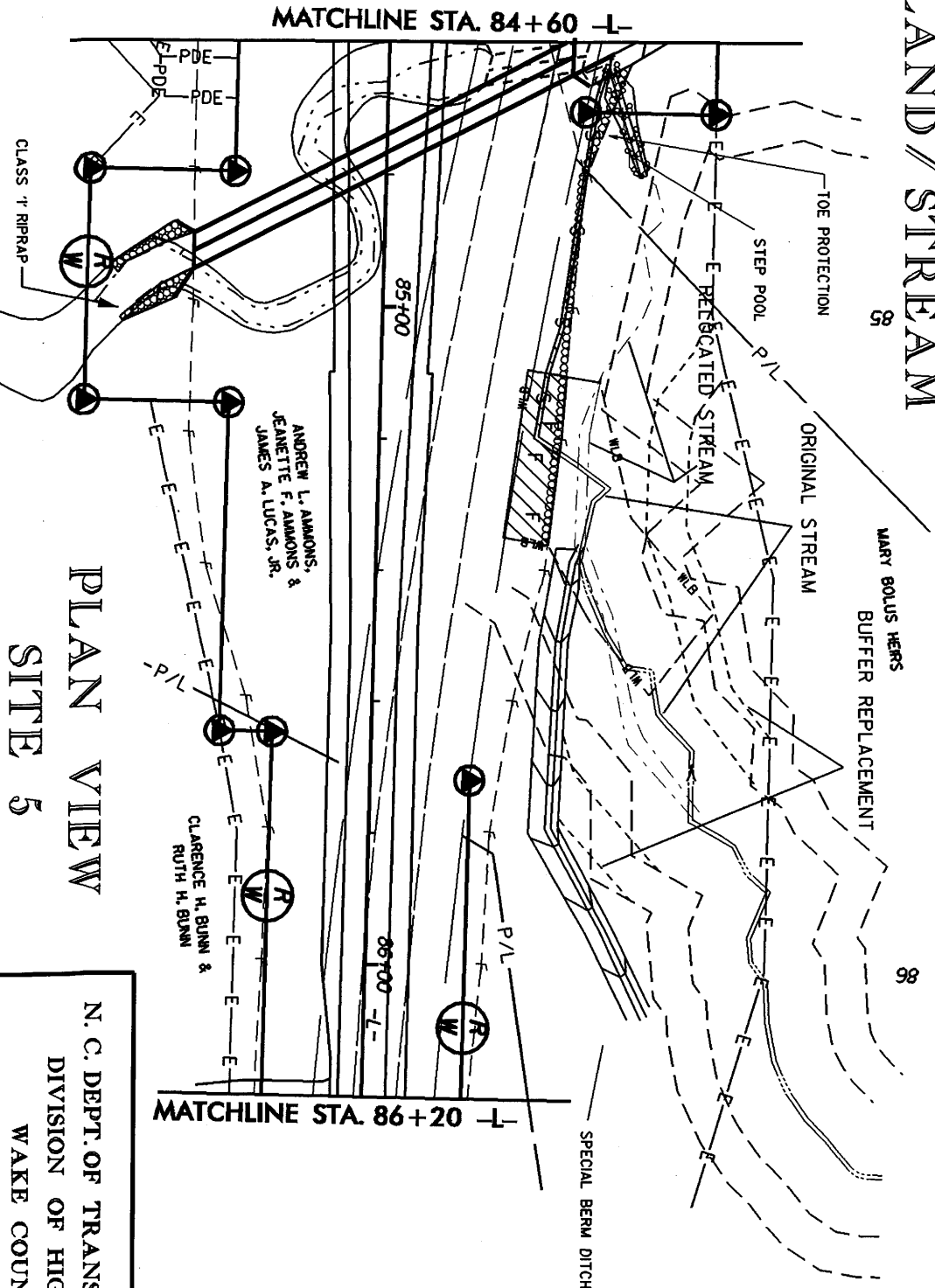
PLAN VIEW
SITE 4

N. C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
WAKE COUNTY



PROJECT: 8.1402504 (R-2809C)
NC 98, WAKE FOREST BYPASS
FROM WEST OF US 1A
TO EAST OF SR 2055

SHEET 7 OF 12 REVISED 5/05

WETLAND / STREAM



PLAN VIEW
SITE 5

-  PERMANENT SURFACE WATER IMPACTS
-  PERMANENT FILL IN WETLANDS

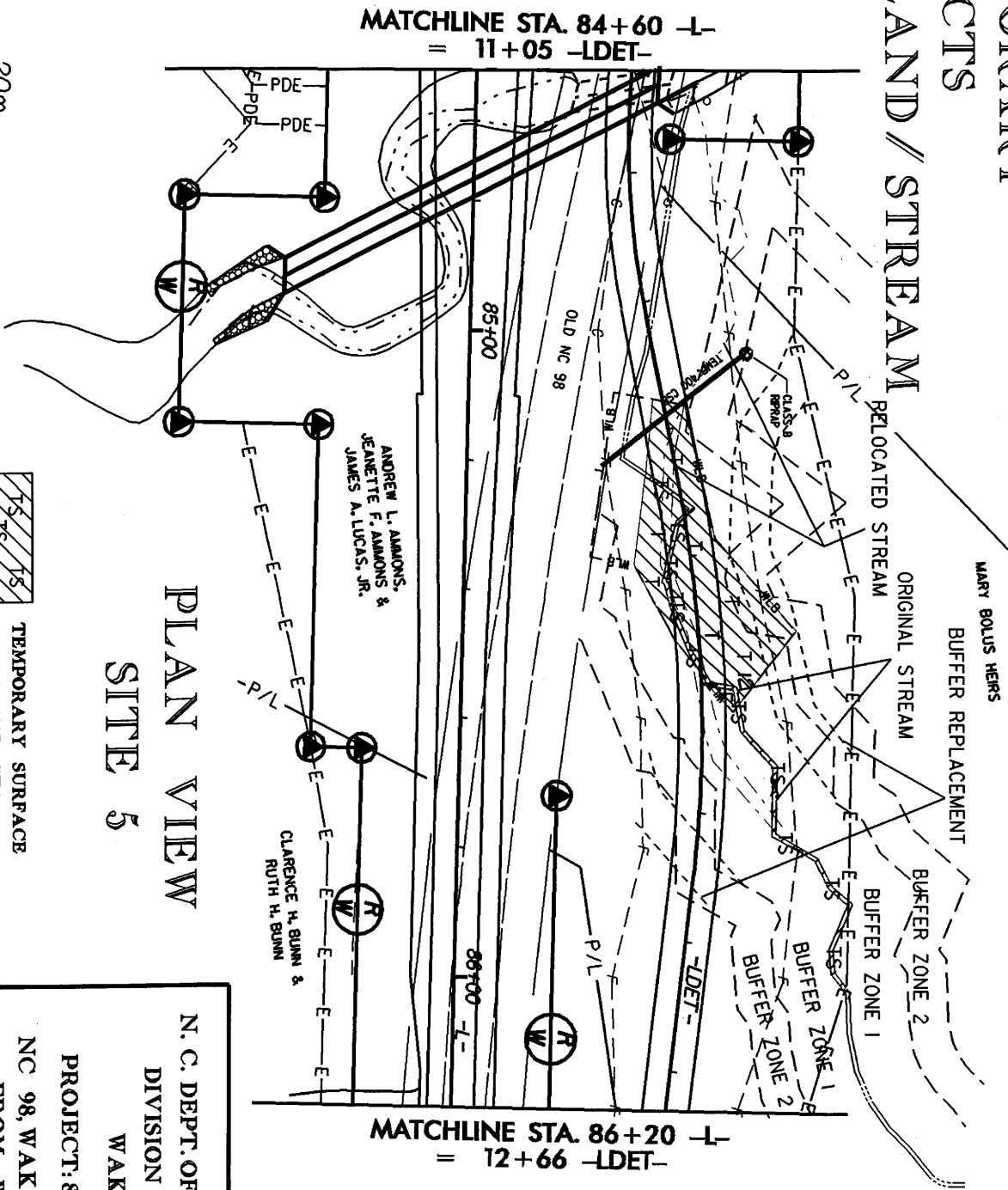
N. C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
WAKE COUNTY

PROJECT: 8.1402504 (R-2809C)

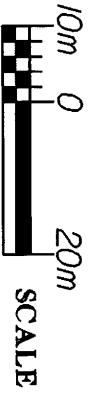
NC 98, WAKE FOREST BYPASS
FROM WEST OF US 1A
TO EAST OF SR 2055

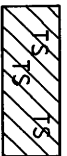
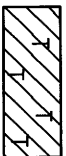
SHEET 8 OF 12 REVISED 8/05

TEMPORARY IMPACTS WETLAND / STREAM



PLAN VIEW SITE 5



-  TEMPORARY SURFACE WATER IMPACTS
-  TEMPORARY FILL IN WETLANDS

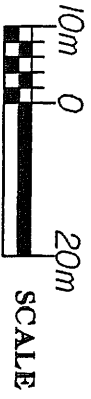
N. C. DEPT. OF TRANSPORTATION
 DIVISION OF HIGHWAYS
 WAKE COUNTY

PROJECT: 81402504 (R-2809C)

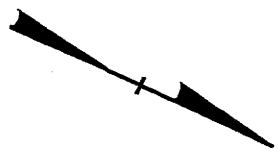
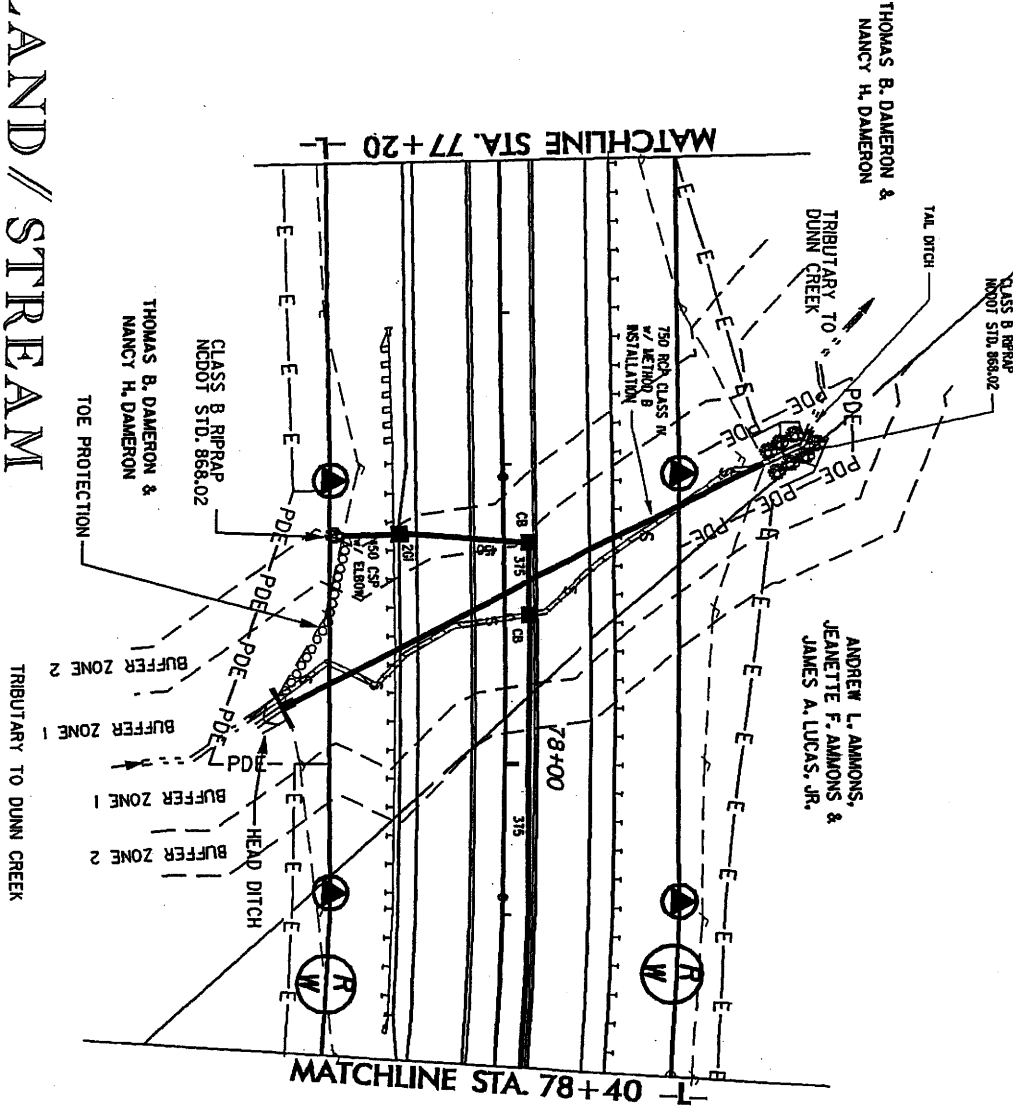
NC 98, WAKE FOREST BYPASS
 FROM WEST OF US 1A
 TO EAST OF SR 2053

SHEET 88 OF 12 REVISED 8/05

WETLAND // STREAM



PERMANENT SURFACE WATER IMPACTS



PLAN VIEW SITE 6

N. C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
WAKE COUNTY

PROJECT: 81402504 (R-2809C)

NC 98, WAKE FOREST BYPASS
FROM WEST OF US 1A
TO EAST OF SR 2053

SHEET 0 OF 12 REVISED 5/05

WETLAND PERMIT IMPACT SUMMARY

Site No.	Station (From/To)	Structure Size / Type	WETLAND IMPACTS				SURFACE WATER IMPACTS									
			Permanent Fill In Wetlands (ha)	Temp. Fill In Wetlands (ha)	Excavation In Wetlands (ha)	Mechanized Clearing In Wetlands (ha)	Hand Clearing In Wetlands (ha)	Permanent SW Impacts (ha)	Temp. SW Impacts (ha)	Existing Channel Impacts Permanent (m)	Existing Channel Impacts Temp. (m)	Natural Stream Design (m)				
1	62+95 -L-	N/A	0.004													
2	66+40 -L-	2@2.7mx1.8m RCBC							0.053	0.006	110	16				
3A	74+62 - 74+92 -L- Lt	Relocated Swale							0.003		30					23
3B	74+00 Rt - 75+20 Lt -L-	2@2.7mx2.4m RCBC							0.079	0.006	204	16				48
4	84+60 -L-	2 @ 2.4m X 2.4m RCBC							0.035	0.005	109	9				
5	85+20 -L- Lt & -LDET-	Perm. & Temp. Fill	0.016	0.051					0.004	0.006	62	98				60
6	77+80 -L-	750 RCP							0.005		87					
7	82+70 - 83+80 -L- Lt	900 RCP	0.113						0.008		138					
TOTALS:			0.133	0.051	0.000	0.000	0.000	0.187	0.023	740	139	131				

ATN Revised 06/10/05

NC DEPARTMENT OF TRANSPORTATION
 DIVISION OF HIGHWAYS
 WAKE COUNTY
 WBS - 34503.1.1 (R-2809C)

SHEET **10** OF **12** #####


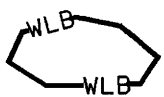


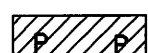
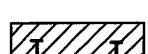
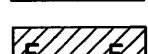
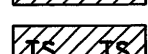
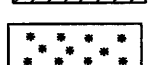

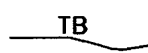
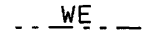



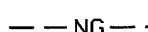









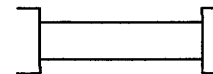
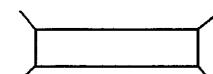








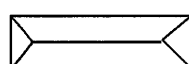
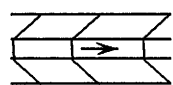
WETLAND PERMIT IMPACT SUMMARY

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	62+95 -L-	N/A	0.010													
2	66+40 -L-	2@ 9' X 6' RCBC					0.130	0.015	361	53						
3A	74+62 - 74+92 -L- Lt	Relocated Swale					0.007		98							75
3B	74+00 Rt - 75+20 Lt -L-	2@ 9' X 8' RCBC					0.195	0.015	669	53						157
4	84+60 -L-	2@ 8' X 8' RCBC					0.086	0.012	358	30						
5	85+20 -L- Lt & -LDET-	Perm. & Temp. Fill	0.040	0.126			0.010	0.015	203	322						196
6	77+80 -L-	750 RCP					0.012		285							
7	82+70 - 83+80 -L- Lt	900 RCP	0.279				0.020		453							
TOTALS:			0.33	0.13	0.00	0.00	0.00	0.46	0.06	2427	458					428

NC DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

WAKE COUNTY
WBS - 34503.1.1 (R-2809C)
10B or **12** **6/05**
SHEET #####

WETLAND LEGEND

-  WLB — WETLAND BOUNDARY
-  WLB
WLB — WETLAND
-  DENOTES FILL IN WETLAND
-  DENOTES FILL IN SURFACE WATER
-  DENOTES FILL IN SURFACE WATER (POND)
-  DENOTES TEMPORARY FILL IN WETLAND
-  DENOTES EXCAVATION IN WETLAND
-  DENOTES TEMPORARY FILL IN SURFACE WATER
-  DENOTES MECHANIZED CLEARING
-  — FLOW DIRECTION
-  TB — TOP OF BANK
-  WE — EDGE OF WATER
-  C — PROP. LIMIT OF CUT
-  F — PROP. LIMIT OF FILL
-  — PROP. RIGHT OF WAY
-  NG — NATURAL GROUND
-  PL — PROPERTY LINE
-  TDE — TEMP. DRAINAGE EASEMENT
-  PDE — PERMANENT DRAINAGE EASEMENT
-  EAB — EXIST. ENDANGERED ANIMAL BOUNDARY
-  EPB — EXIST. ENDANGERED PLANT BOUNDARY
-  ∇ — WATER SURFACE
-  X X X X X X — LIVE STAKES
-  BOULDER
-  CORE FIBER ROLLS
-  PROPOSED BRIDGE
-  PROPOSED BOX CULVERT
-  PROPOSED PIPE CULVERT
(DASHED LINES DENOTE EXISTING STRUCTURES)
-  SINGLE TREE
-  WOODS LINE
-  DRAINAGE INLET
-  ROOTWAD
-  RIP RAP
-  5 — ADJACENT PROPERTY OWNER OR PARCEL NUMBER IF AVAILABLE
-  PREFORMED SCOUR HOLE (PSH)
-  LEVEL SPREADER (LS)
-  GRASS SWALE

N. C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
WAKE COUNTY
PROJECT: 34503.1.1 (R-2809C)

NC 98 WAKE FOREST BYPASS

PROPERTY OWNERS

NAMES AND ADDRESSES

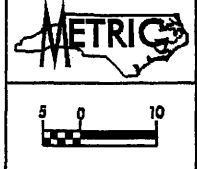
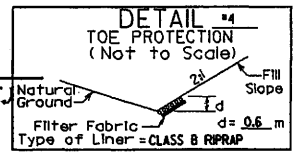
PARCEL NO.	NAMES	ADDRESSES
	CADY CONSTRUCTION CO	7020 SIX FORKS RD RALEIGH NC 27615
	ELIZABETH H. HOLDING	12630 WAKE UNION CHURCH RD WAKE FOREST NC 27588
	THOMAS DAMERON NANCY DAMERON	414 SCOTLAND ST RALEIGH, NC 27609
	TOWN OF WAKE FOREST	401E. ELM ST WAKE FOREST NC 27587
	MARY BOLUS HEIRS	C/O ELIZABETH B. NASSIF 115 E. ELM ST WAKE FOREST NC 27587
	ANDREW L. AMMONS JEANETTE AMMONS JAMES LUCAS, JR.	7412 CHAPEL HILL RD RALEIGH NC 27607

N. C. DEPT. OF TRANSPORTATION
DIVISION OF HIGHWAYS
WAKE COUNTY

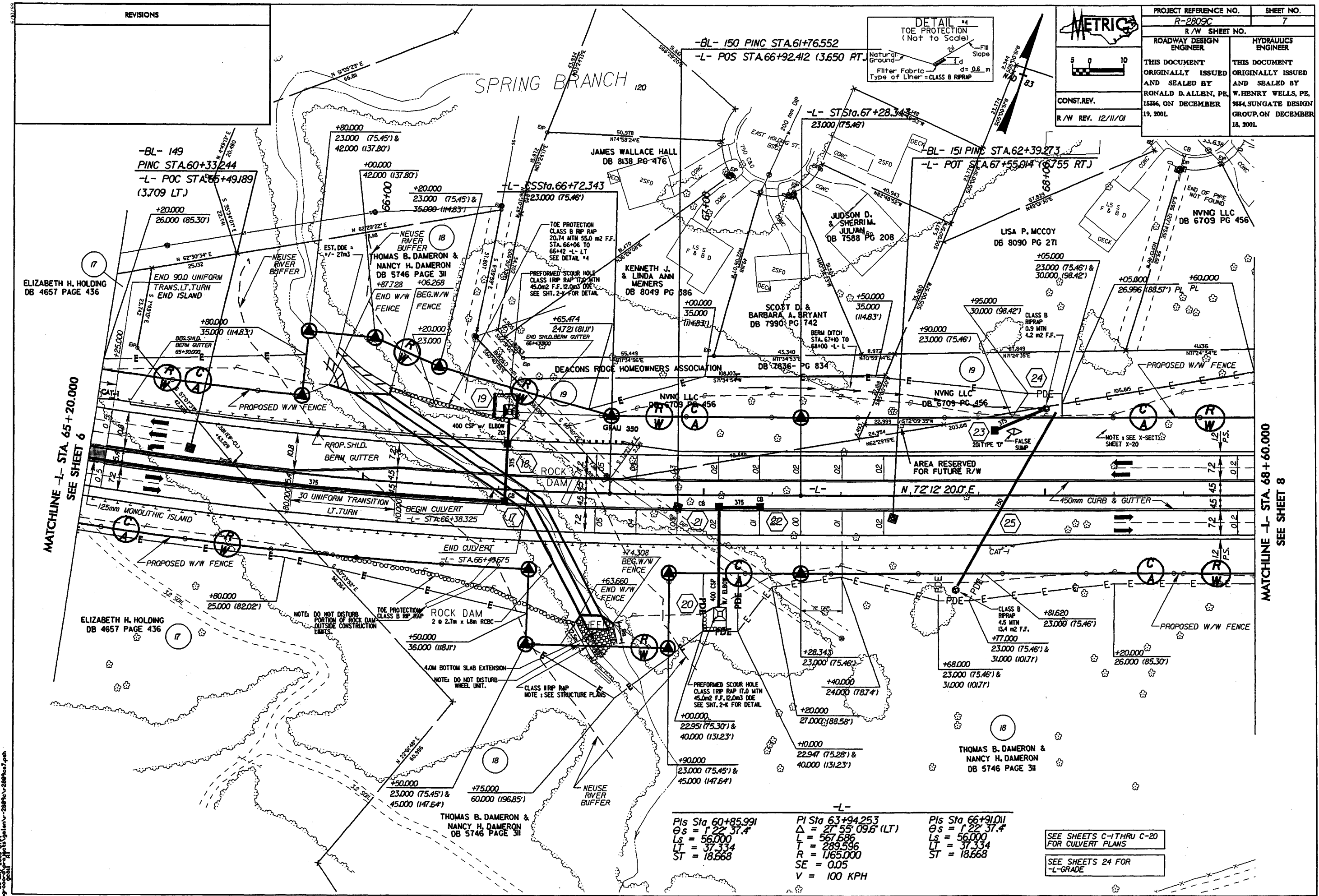
PROJECT: 8.1402501 (R-2809C)
NC 98, WAKE FOREST BYPASS
FROM WEST OF US 1A
TO EAST OF SR 2053

SHEET 12 OF 12 REVISED 7/11/01

5/20/05



5 0 10



-BL- 149
PINC STA. 60+33.244
-L- POC STA. 65+49.189
(3.709 LT.)

-BL- 150 PINC STA. 61+76.552
-L- POS STA. 66+92.412 (3.650 FT.)

-BL- 151 PINC STA. 62+39.273
-L- POT STA. 67+55.014 (6.755 RT.)

-L- STA. 66+72.343

MATCHLINE -L- STA. 65+20.000
SEE SHEET 6

MATCHLINE -L- STA. 68+60.000
SEE SHEET 8

-L-
 PIs Sta 60+85.991
 $\theta_s = 1.22.37.4$
 Ls = 56.000
 LT = 37.334
 ST = 18.668
 PIs Sta 63+94.253
 $\Delta = 27.55.09.6$ (LT)
 L = 567.686
 T = 289.596
 R = 1165.000
 SE = 0.05
 V = 100 KPH
 PIs Sta 66+91.011
 $\theta_s = 1.22.37.4$
 Ls = 56.000
 LT = 37.334
 ST = 18.668

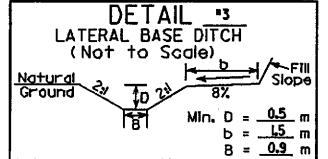
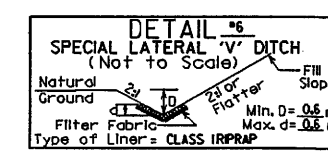
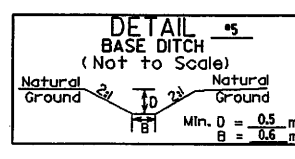
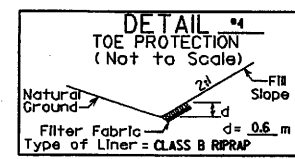
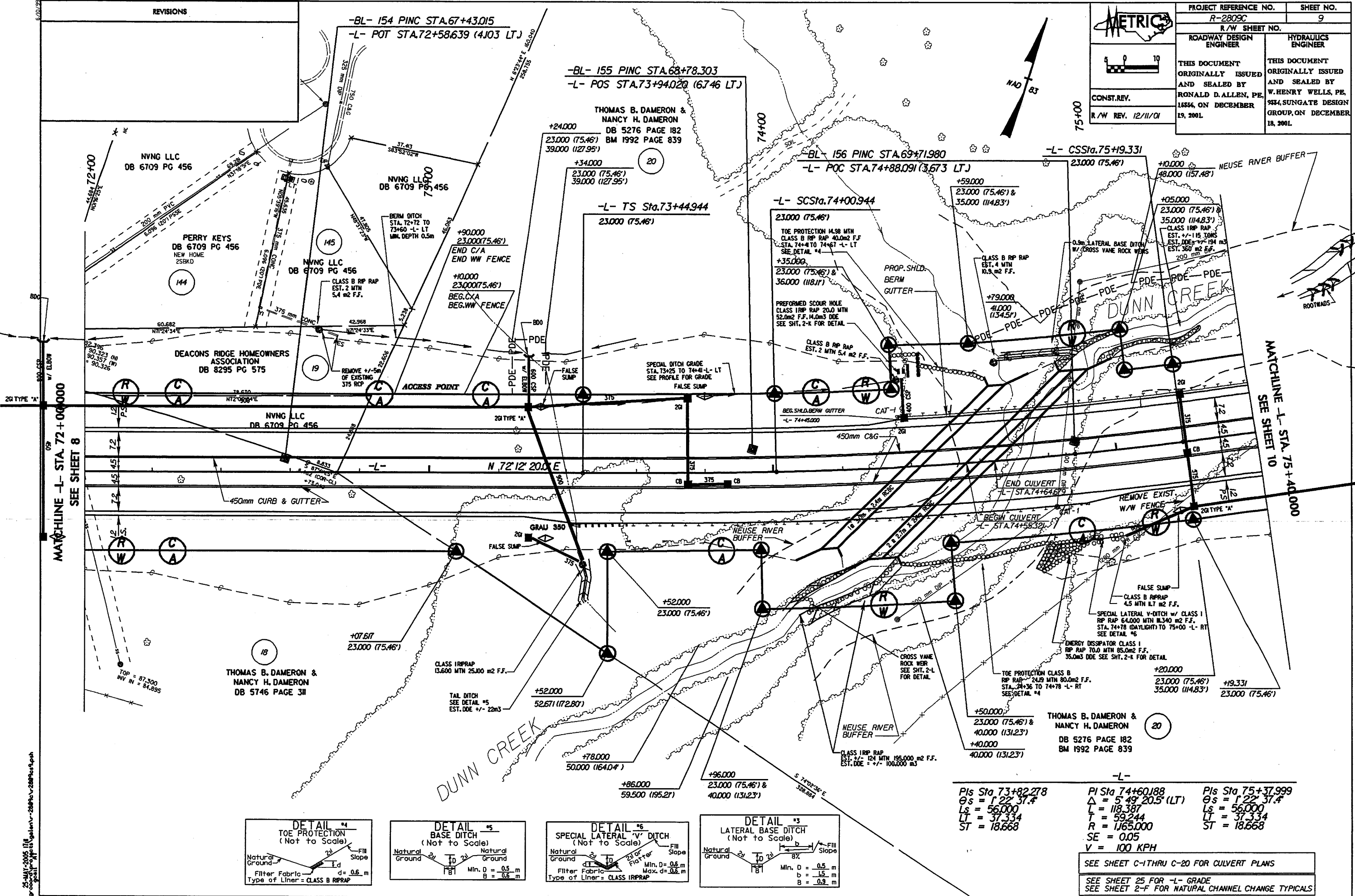
SEE SHEETS C-1 THRU C-20
FOR CULVERT PLANS

SEE SHEETS 24 FOR
-L-GRADE

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REVISIONS

PROJECT REFERENCE NO. R-2809C		SHEET NO. 9	
R/W SHEET NO.			
ROADWAY DESIGN ENGINEER		HYDRAULICS ENGINEER	
THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY RONALD D. ALLEN, PE, 18556, ON DECEMBER 19, 2001.		THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY W. HENRY WELLS, PE, 9834, SUNGATE DESIGN GROUP, ON DECEMBER 18, 2001.	
CONST. REV.			
R/W REV. 12/11/01			



$Pis Sta 73+82.278$
 $\theta s = 1^{\circ} 22' 37.4''$
 $L = 56.000$
 $LT = 37.334$
 $ST = 18.668$

$Pis Sta 74+60.188$
 $\Delta = 5^{\circ} 49' 20.5'' (LT)$
 $L = 118.387$
 $T = 59.244$
 $R = 1165.000$
 $SE = 0.05$
 $V = 100 KPH$

$Pis Sta 75+37.999$
 $\theta s = 1^{\circ} 22' 37.4''$
 $Ls = 56.000$
 $LT = 37.334$
 $ST = 18.668$


SEE SHEET C-1 THRU C-20 FOR CULVERT PLANS

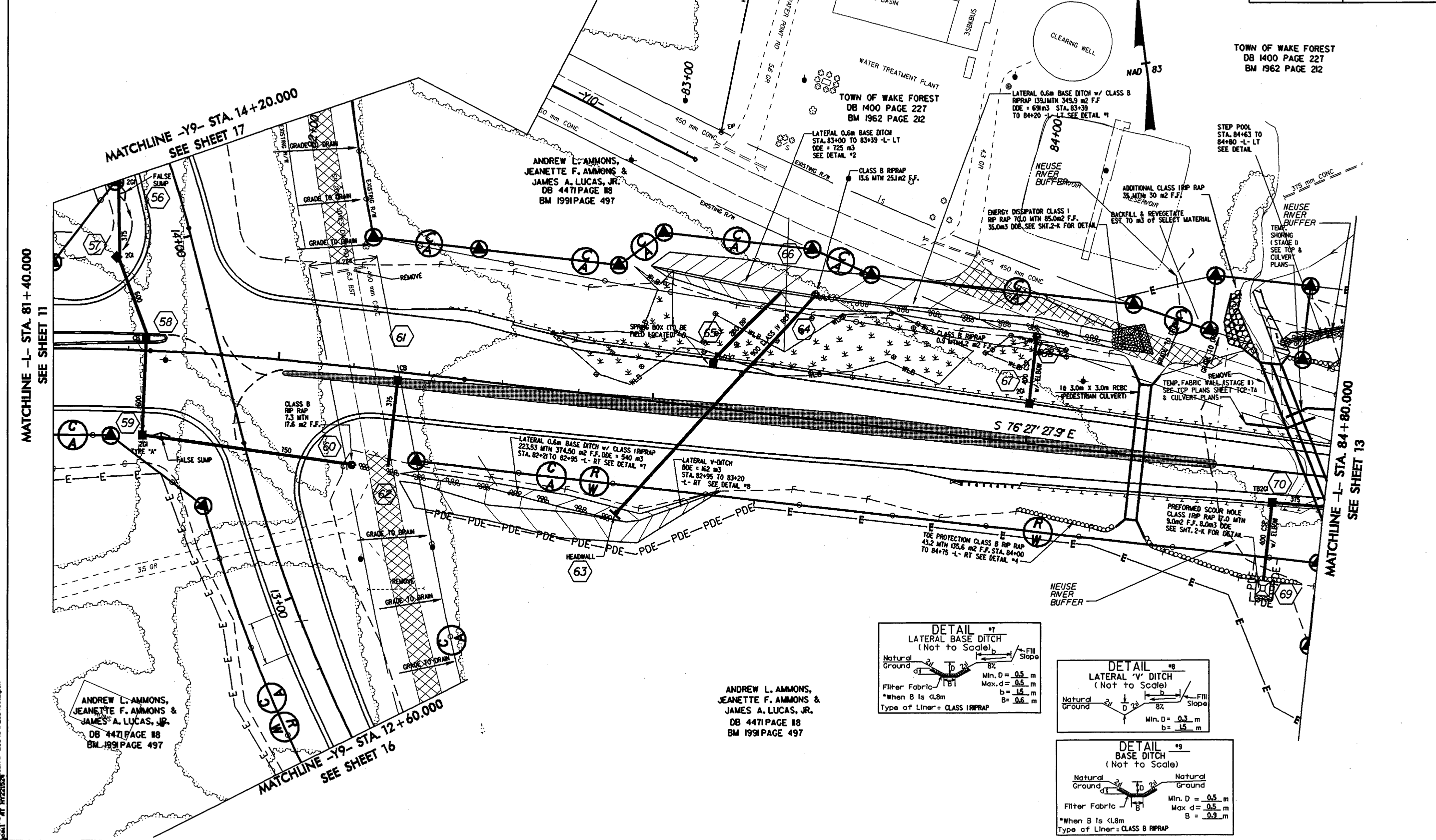
SEE SHEET 25 FOR -L- GRADE

SEE SHEET 2-F FOR NATURAL CHANNEL CHANGE TYPICALS

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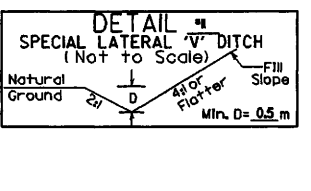
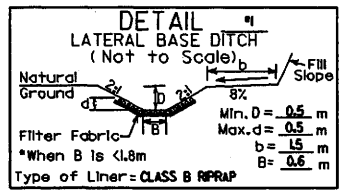
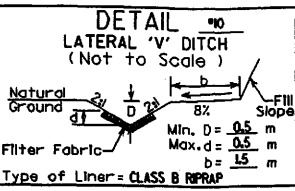
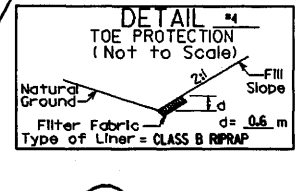
REVISIONS

	PROJECT REFERENCE NO. R-2809C	SHEET NO. 12
	R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER	
CONST. REV.		
R/W REV.		



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REVISIONS



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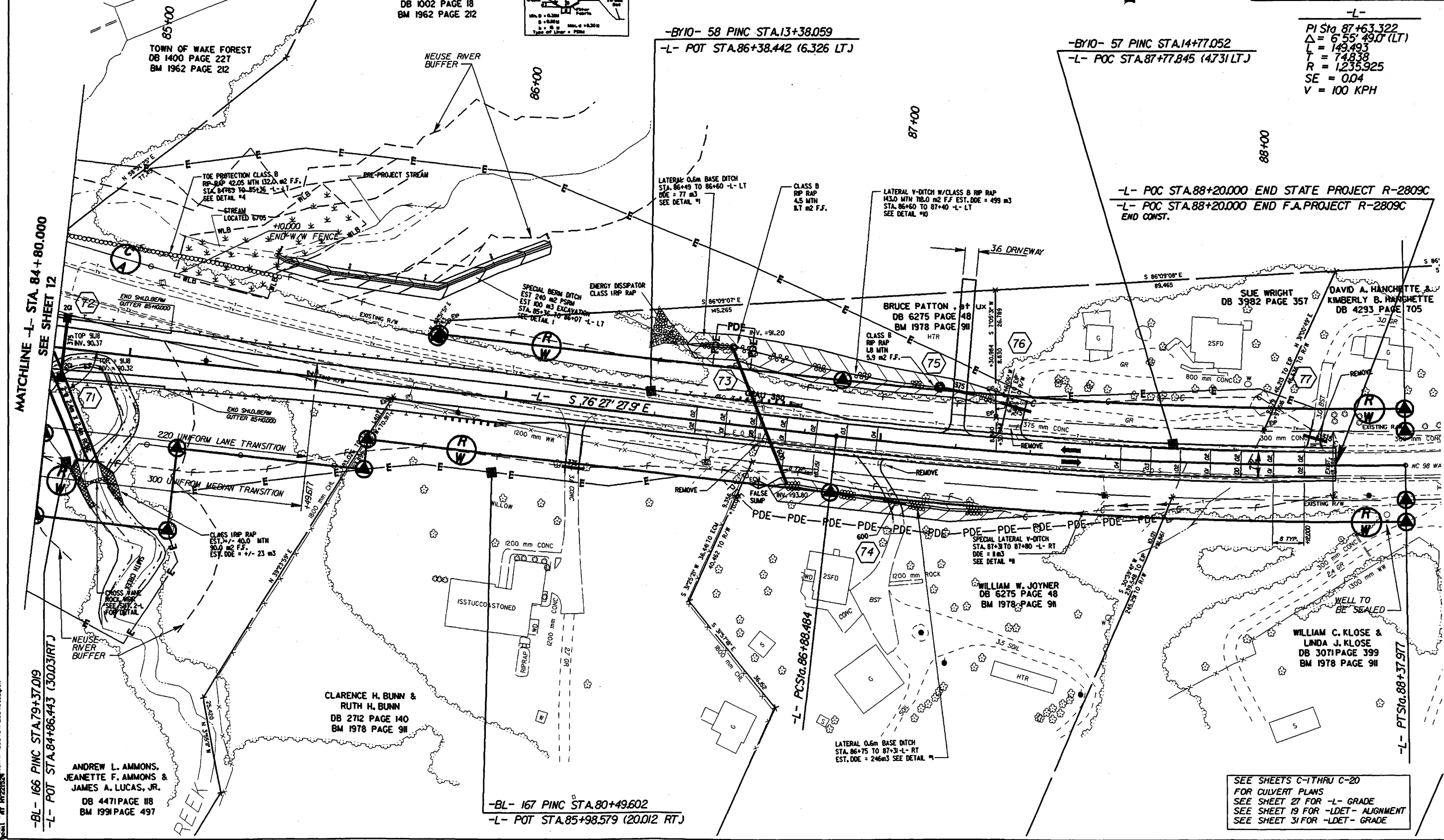
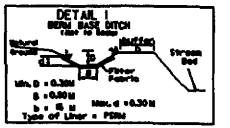
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CONST. REV.

R/W REV.

PROJECT REFERENCE NO. R-2809C	SHEET NO. 13
R/W SHEET NO.	HYDRAULICS ENGINEER
ROADWAY DESIGN ENGINEER	

110
THOMAS K. BOLUS, et al
DB 1002 PAGE 18
BM 1962 PAGE 212



-L-
PI Sta. 87+63.322
 $\Delta = 6' 55'' 49.0'' (LT)$
L = 149.493
T = 74.838
R = 1,235.925
SE = 0.04
V = 100 KPH

-L- POC STA. 88+20.000 END STATE PROJECT R-2809C
-L- POC STA. 88+20.000 END F.A. PROJECT R-2809C
END CONST.

MATCHLINE -L- STA. 84+80.000
SEE SHEET 12

-BL- 166 PINC STA. 79+37.019
-L- POT STA. 84+86.443 (300.31 RT.)

ANDREW L. AMMONS,
JEANETTE F. AMMONS &
JAMES A. LUCAS, JR.
DB 4471 PAGE 118
BM 1991 PAGE 497

CLARENCE H. BUNN &
RUTH H. BUNN
DB 2712 PAGE 140
BM 1978 PAGE 911

-BL- 167 PINC STA. 80+49.602
-L- POT STA. 85+98.579 (20.012 RT.)

-L- PCS Sta. 86+88.484

-L- PTS Sta. 88+37.977

SEE SHEETS C-1 THRU C-20
FOR CULVERT PLANS
SEE SHEET 27 FOR -L- GRADE
SEE SHEET 19 FOR -LDET- ALIGNMENT
SEE SHEET 31 FOR -LDET- GRADE

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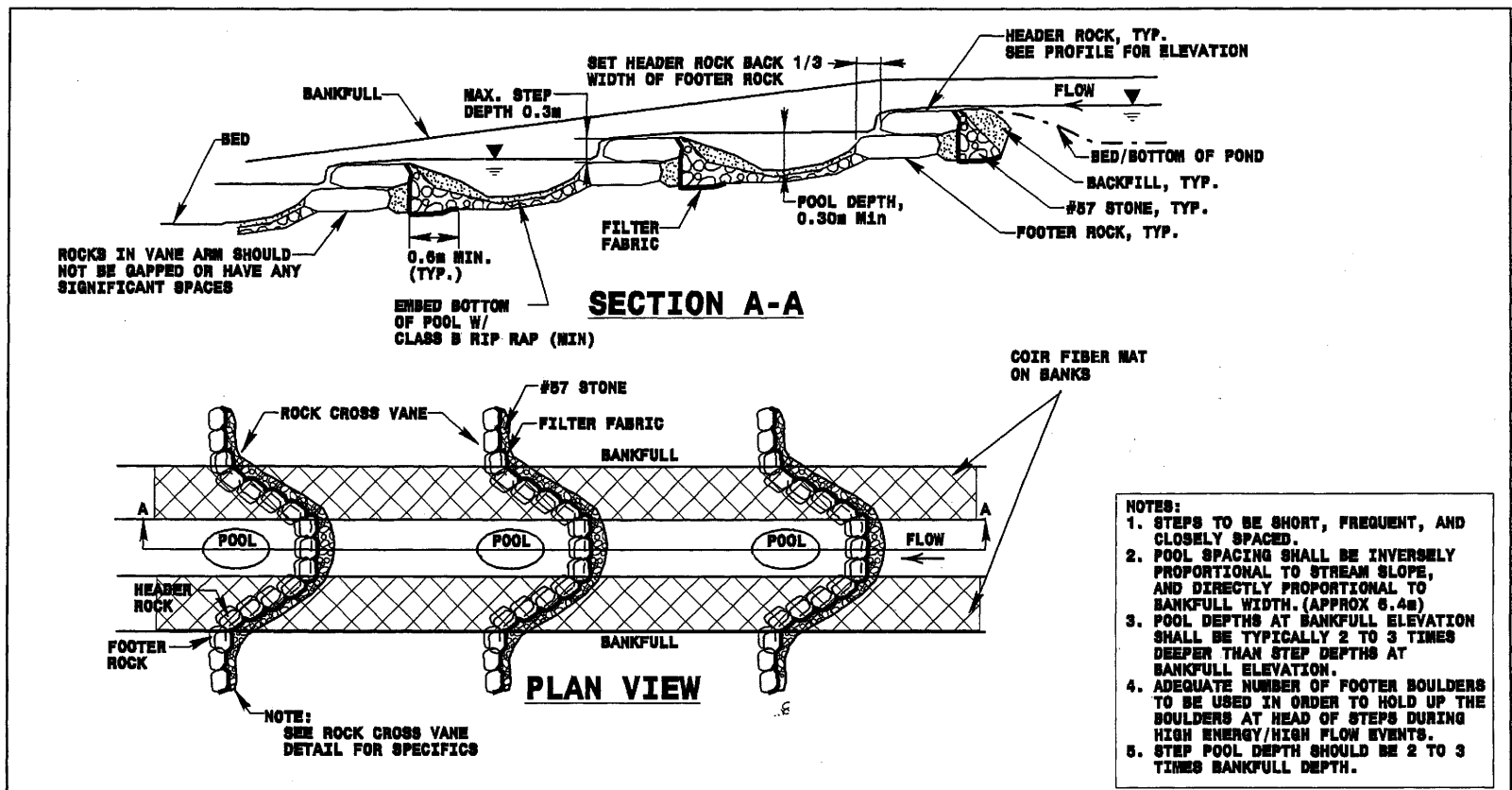
7/2/99

REVISIONS

R-2809C
Sta 84+63 to 84+80 -L- L+

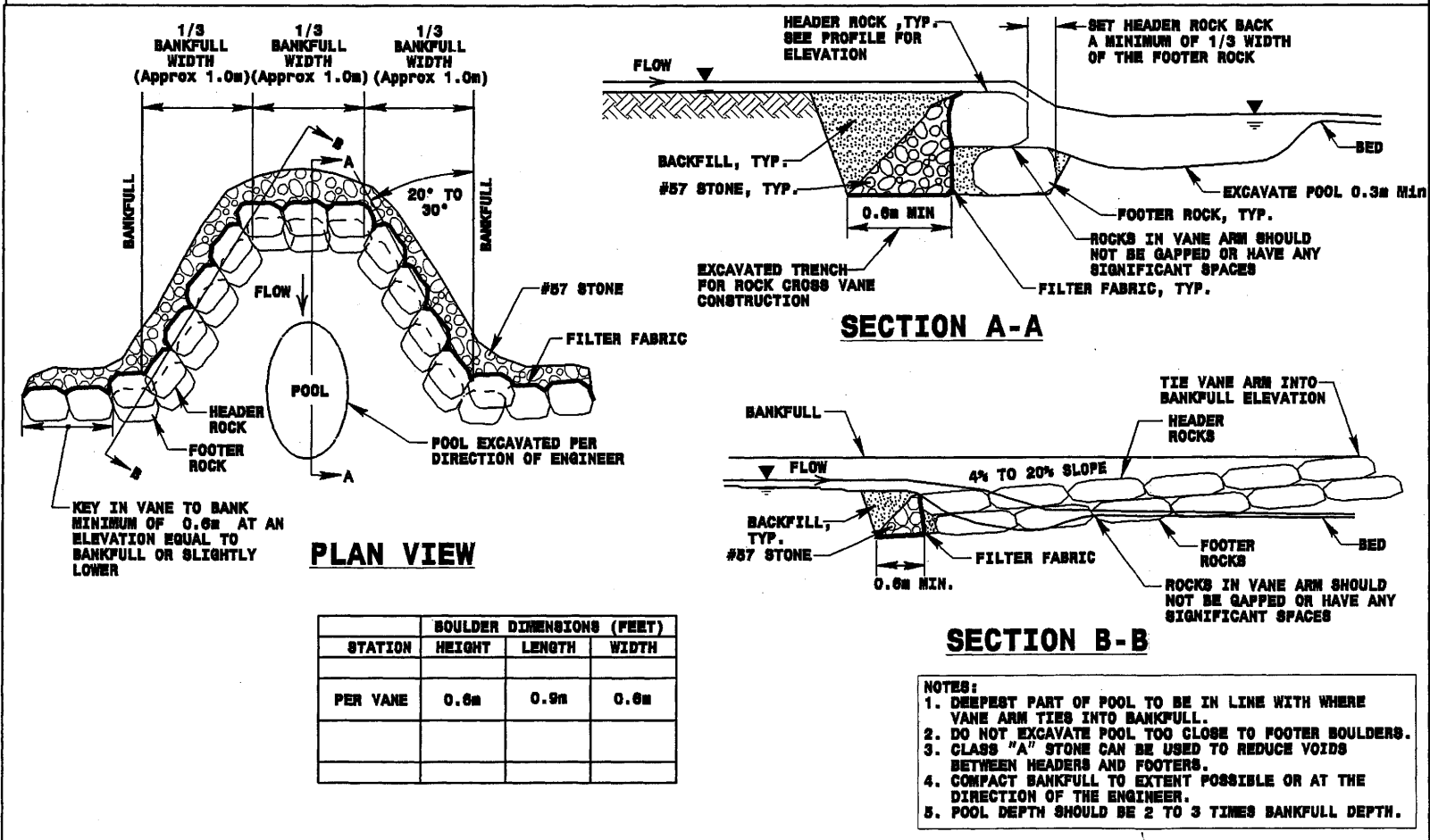
PROJECT REFERENCE NO. R-2809C	SHEET NO.
HW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

STEP POOL DETAIL
NOT TO SCALE



- NOTES:**
1. STEPS TO BE SHORT, FREQUENT, AND CLOSELY SPACED.
 2. POOL SPACING SHALL BE INVERSELY PROPORTIONAL TO STREAM SLOPE, AND DIRECTLY PROPORTIONAL TO BANKFULL WIDTH. (APPROX 6.4m)
 3. POOL DEPTHS AT BANKFULL ELEVATION SHALL BE TYPICALLY 2 TO 3 TIMES DEEPER THAN STEP DEPTHS AT BANKFULL ELEVATION.
 4. ADEQUATE NUMBER OF FOOTER BOULDERS TO BE USED IN ORDER TO HOLD UP THE BOULDERS AT HEAD OF STEPS DURING HIGH ENERGY/HIGH FLOW EVENTS.
 5. STEP POOL DEPTH SHOULD BE 2 TO 3 TIMES BANKFULL DEPTH.

ROCK CROSS VANE DETAIL FOR STEP POOL
NOT TO SCALE



- 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 BANKFULL TO EXTENT POSSIBLE OR AT THE DIRECTION OF THE ENGINEER.
 5. POOL DEPTH SHOULD BE 2 TO 3 TIMES BANKFULL DEPTH.

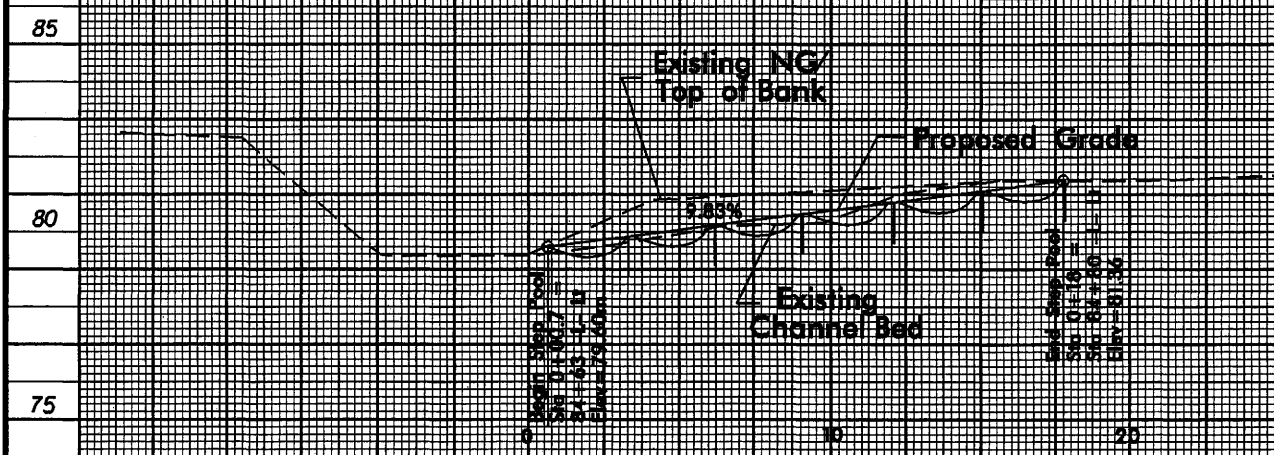
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METRIC

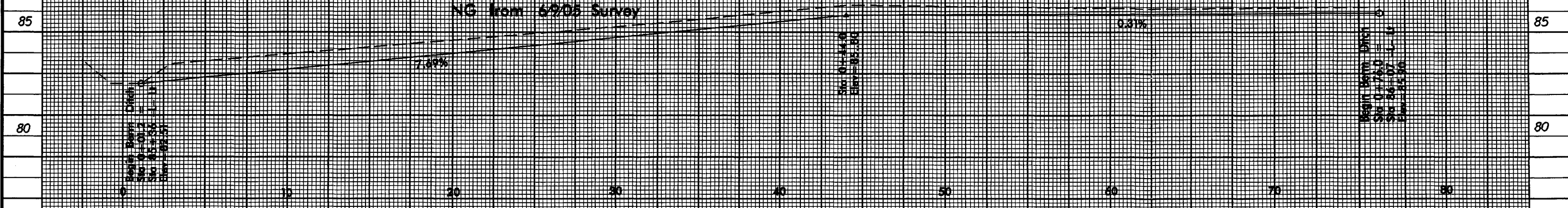
 CONST. REV.
 R/W REV.

PROJECT REFERENCE NO.	SHEET NO.
R-2809C	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

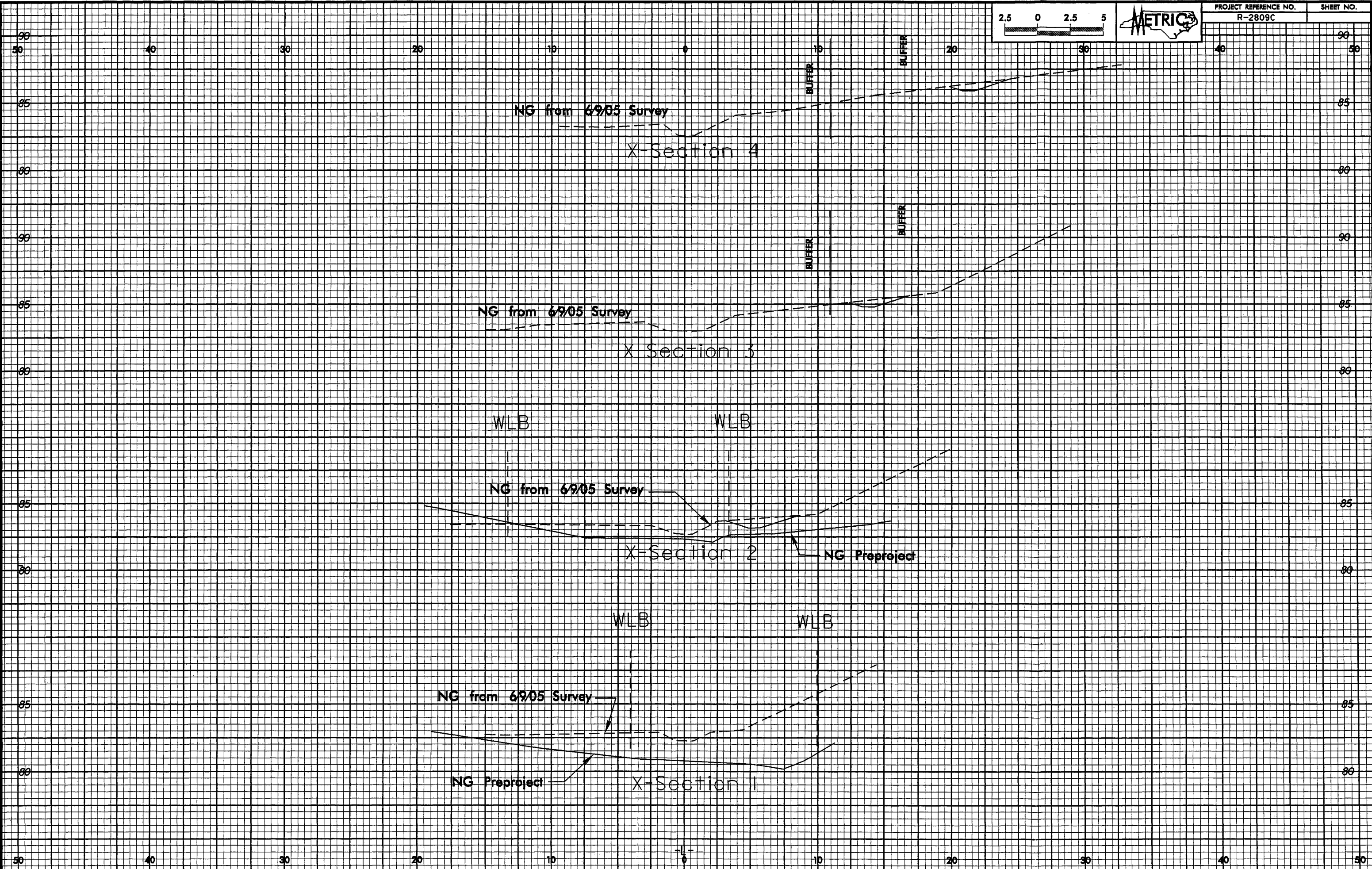
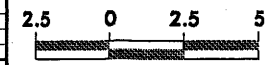
Stream Profile



Berm Ditch Profile



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 8/11/05



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050197

REVISIONS

LATERAL SWALE/DITCH W/ROCK CHECKS

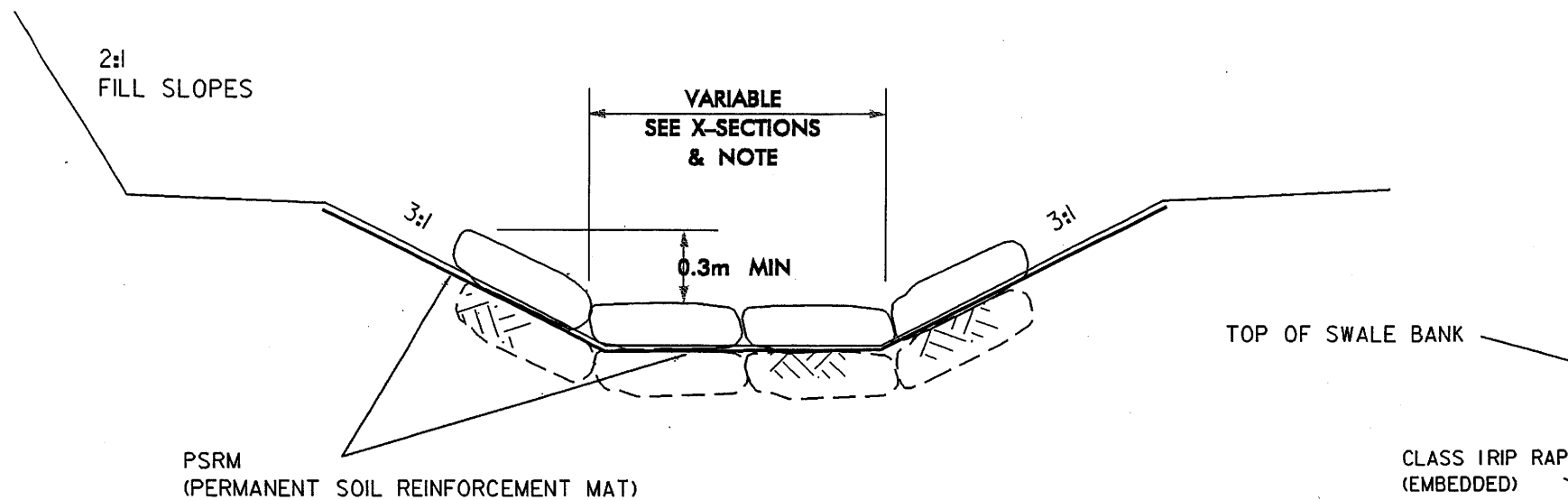
STA 82+21 TO 82+95 -L- RT

& STA 83+65 TO STA 84+20 -L- LT

R-2809C

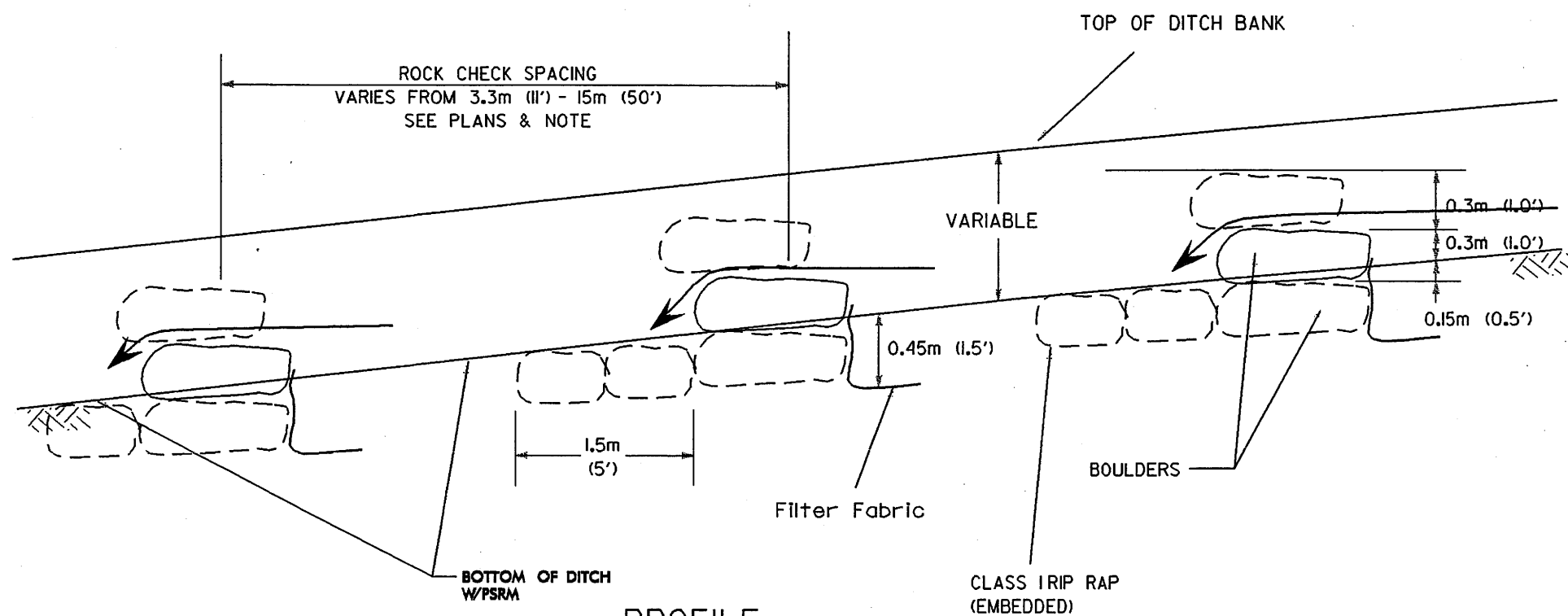
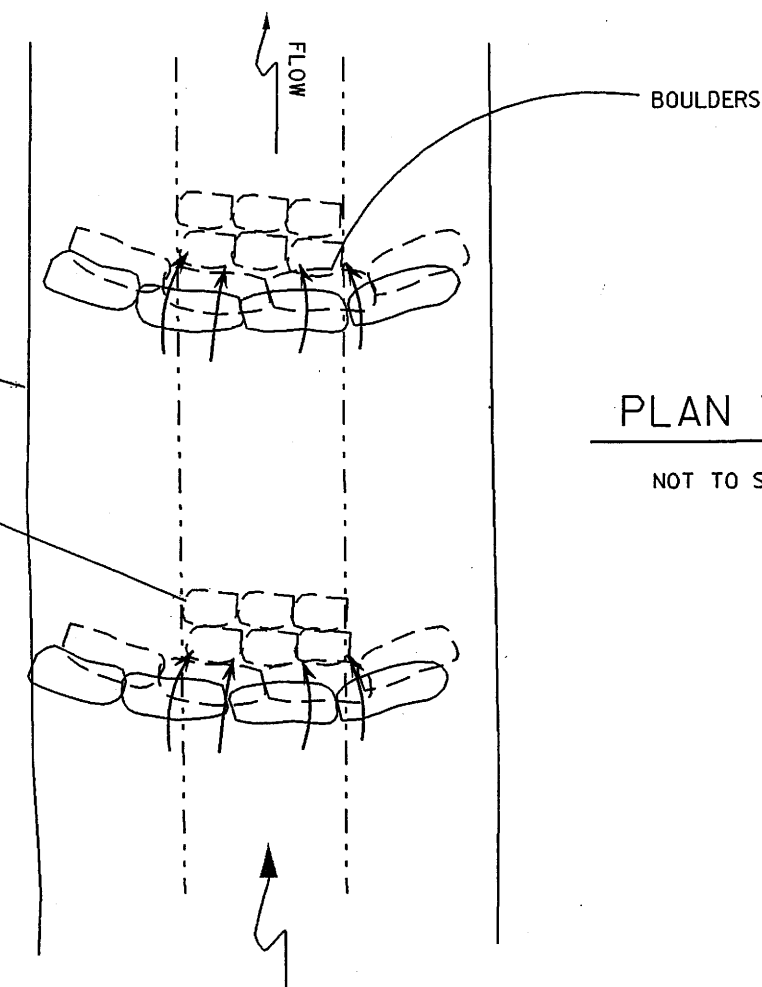
SHEET NO.

HYDRAULICS ENGINEER



TYPICAL CROSS SECTION

NOT TO SCALE



PROFILE

NOT TO SCALE

NOTE:

BOULDERS SHOULD BE ANGULAR AND OBLONG WITH APPROXIMATE DIMENSIONS OF 0.6m x 0.45m x 0.45m (2' x 1.5' x 1.5'). ROCK SHOULD FIT TIGHTLY TOGETHER WITH MINIMAL VOIDS. STAGGER BOULDER JOINTS.

ROCK CHECK SPACING IS DEPENDENT ON DITCH GRADES AT 1' DROP INTERVALS OR SLOPE CONTROL.

DITCH WIDTHS VARY. WIDEN TO EXTENT PRACTICAL WITHIN R/W LIMITS. SEE X-SECTIONS.

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

REVISIONS



PROJECT REFERENCE NO.	SHEET NO.
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
CONST. REV.	
R/W REV.	

