

PROJECT: C202155 ID: R-3324

NOTE: SEE SHEET 1A FOR PLAN SHEET LAYOUT AT TIME OF INVESTIGATION

**CONTENTS**

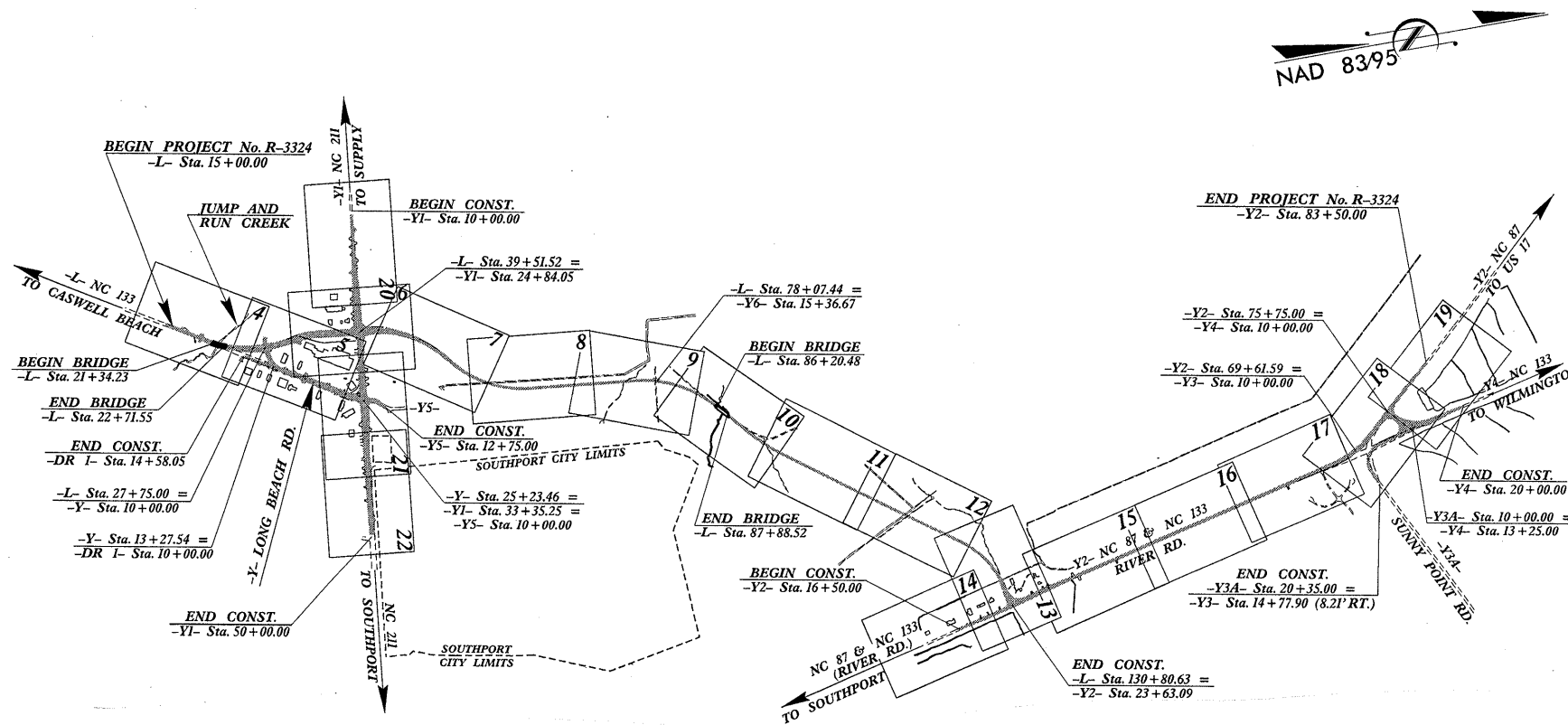
LINE	STATION	PLAN	PROFILE	XS	SECT
-L-	15+00 - 29+55	04	22	NA	
-L-	29+55 - 43+00	05	22-23	NA	
-L-	43+00 - 56+00	06	23	NA	
-L-	56+00 - 69+00	07	23-24	NA	
-L-	69+00 - 81+50	08	24	NA	
-L-	81+50 - 94+50	09	24-25	NA	
-L-	94+50 - 107+50	10	25-26	NA	
-L-	107+50 - 120+75	11	26	NA	
-L-	120+75 - 130+81	12	26	NA	
-Y2-	10+00 - 18+75	13	29	NA	
-Y2-	18+75 - 28+00	12	29	NA	
-Y2-	28+00 - 42+50	14	30	NA	
-Y2-	42+50 - 54+50	15	30-31	NA	
-Y2-	54+50 - 66+50	16	31	NA	
-Y2-	66+50 - 79+50	17	31-32	NA	
-Y2-	79+50 - 83+50	18	32	NA	
-Y1-	10+00 - 20+00	19	28	NA	
-Y1-	20+00 - 29+50	05	28	NA	
-Y1-	29+50 - 37+00	20	28-29	NA	
-Y1-	37+00 - 44+18	21	29	NA	
-Y-	10+00 - 13+45	04	27	NA	
-Y-	13+45 - 25+24	20	27	NA	
-Y3-	10+00 - 15+00	17	32	NA	
-Y4-	10+00 - 14+50	17	33	NA	
-Y4-	14+50 - 20+00	18	33	NA	
-Y5-	10+00 - 12+80	20	33	NA	

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

# ROADWAY SUBSURFACE INVESTIGATION

STATE PROJECT: 34531.1-1 F.A. PROJ. STP-133(3)  
 COUNTY: BRUNSWICK  
 PROJECT DESCRIPTION: New Route from NC 133 (Long Beach Road) to NC 133 and NC 87 (River Road) North of NC 133 on NC 87 (George II Road)

## INVENTORY



**ADDENDUM**

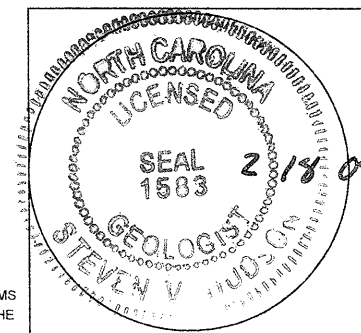
R-3324 Contains an Inventory Addendum  
 Please refer to this addendum as well as  
 The Subsurface Investigation

**INFILTRATION BASINS**

R-3324 Contains Infiltration Basins  
 Please refer to these basins as well as  
 The Subsurface Investigation

**INVESTIGATED BY:**  
 CATLIN ENGINEERS AND SCIENTISTS  
**SUBMITTED BY:**  
 STEVEN V. HUDSON, P.G.  
**CHECKED BY:**  
 STEVEN V. HUDSON, P.G.  
**DATE:**  
 February 5, 2008

**PERSONNEL:**  
 Thomas Stetler  
 Justin Heter  
 Michael D. Mason  
 Bobbie D. Fowler, C.W.D.  
 William J. Miller, C.W.D.  
 John Wood, C.W.D.



For Letting

DRAWN BY: STEVEN V. HUDSON, P.G.

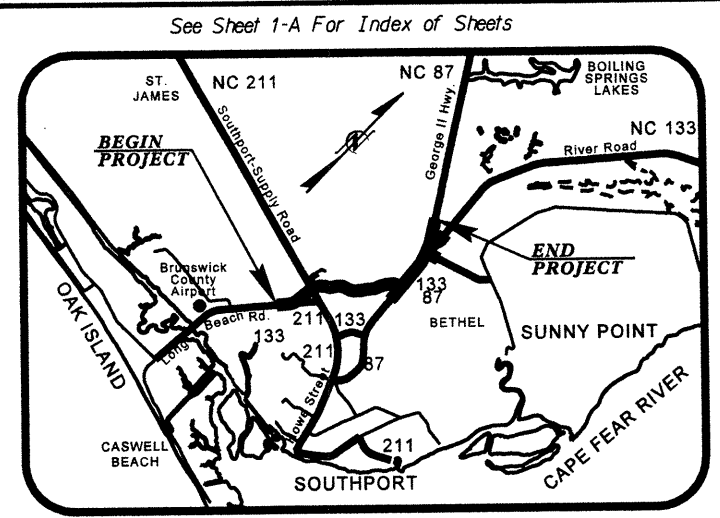
NOTE - THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS BEING ACCURATE NOR IS IT CONSIDERED TO BE PART OF THE PLANS, SPECIFICATIONS, OR CONTRACT FOR THE PROJECT.

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.

09/08/09

SYSTEM\$\$\$\$  
 \$\$\$DGN\$\$\$\$  
 \$\$\$SERIAL\$\$\$\$  
 \$\$\$NAME\$\$\$\$

**CONTRACT: 34531.1.1**  
**TIP PROJECT: R-3324**



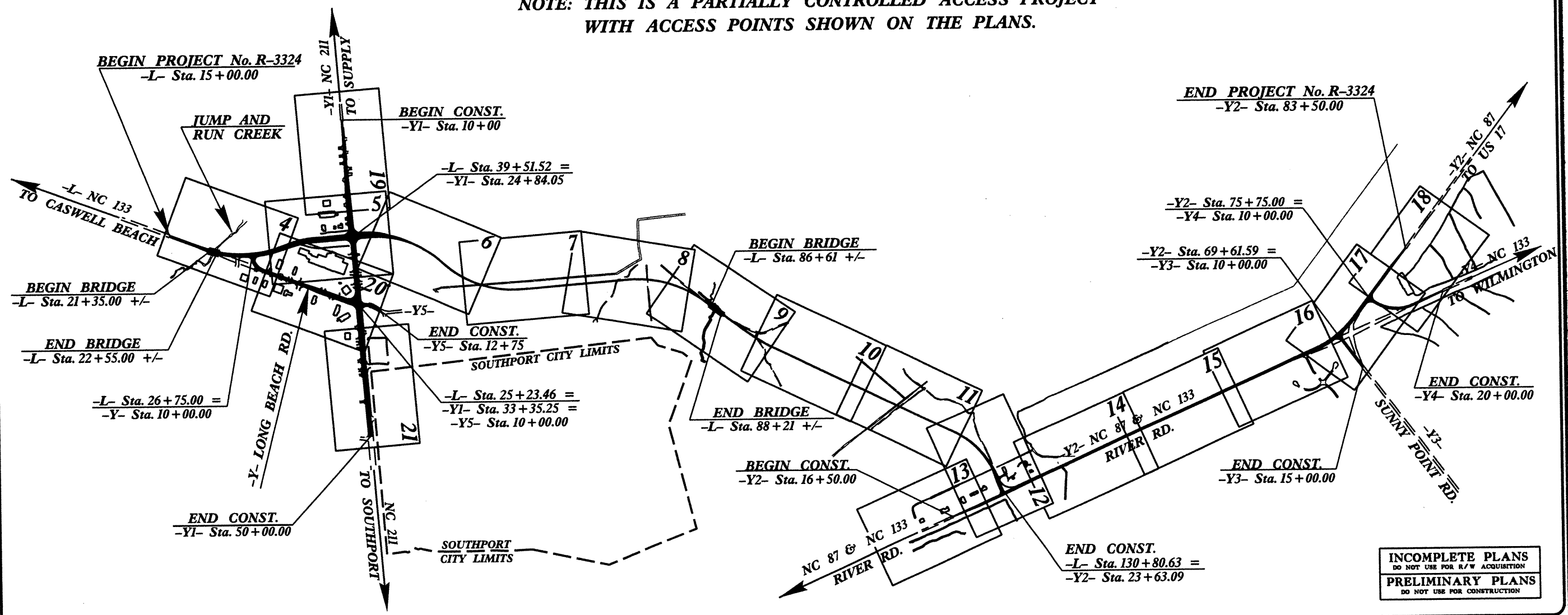
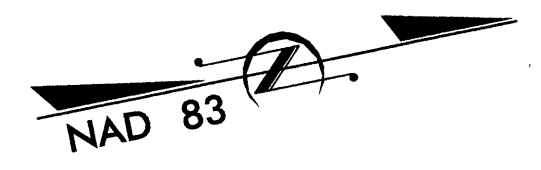
STATE OF NORTH CAROLINA  
 DIVISION OF HIGHWAYS  
**BRUNSWICK COUNTY**

**LOCATION: NEW ROUTE FROM NC 133 (LONG BEACH RD.)  
 TO NC 133 & NC 87 (RIVER RD.),  
 NORTH OF NC 133 ON NC 87 (GEORGE II RD.).**

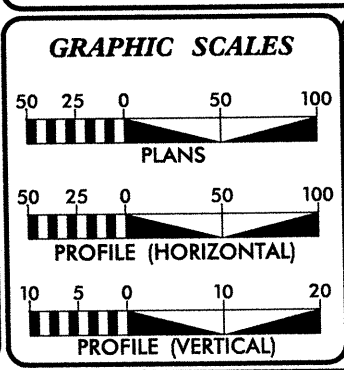
**TYPE OF WORK: GRADING, PAVING, DRAINAGE, STRUCTURES**

**NOTE: THIS IS A PARTIALLY CONTROLLED ACCESS PROJECT  
 WITH ACCESS POINTS SHOWN ON THE PLANS.**

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	R-3324	01A	37
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION	
34531.1.1	STP-133(3)	PE	



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



**DESIGN DATA**

ADT 2009 = 9,500 - 13,700
ADT 2030 = 13,600 - 47,100
DHV = 50 %
D = 10 %
T = 5 % *
V = 50 MPH
FUNCTIONAL CLASSIFICATION: LOCAL
* TTST 2% DUAL 3%

**PROJECT LENGTH**

LENGTH ROADWAY TIP No. R-3324 (-L-) =	2.140 MILES
LENGTH ROADWAY TIP No. R-3324 (-Y2-) =	1.269 MILES
LENGTH STRUCTURES TIP No. R-3324 =	0.053 MILES
<b>TOTAL LENGTH TIP PROJECT No. R-3324 =</b>	<b>3.462 MILES</b>

**THIS PROJECT IS NOT WITHIN ANY MUNICIPAL BOUNDARIES.**

Prepared in the Office of:  
**DIVISION OF HIGHWAYS**  
 1000 Birch Ridge Dr., Raleigh NC, 27610  
 2006 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE: MARCH, 2008	JIMMY GOODNIGHT, PE PROJECT ENGINEER
LETTING DATE: JUNE, 2009	STEVE KENDALL, PE PROJECT DESIGN ENGINEER

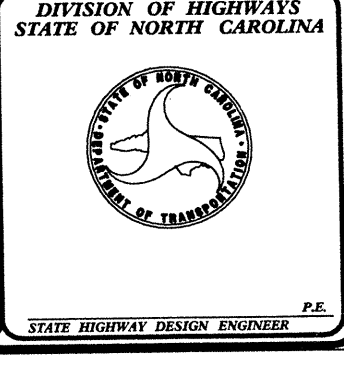
HYDRAULICS ENGINEER

SIGNATURE: \_\_\_\_\_ P.E.

ROADWAY DESIGN ENGINEER

SIGNATURE: \_\_\_\_\_ P.E.

STATE HIGHWAY DESIGN ENGINEER



# SUBSURFACE INVESTIGATION

## SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION				GRADATION				ROCK DESCRIPTION				TERMS AND DEFINITIONS																																																																																																																																																																																																																																																											
SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED OR WEATHERED EARTH MATERIALS WHICH CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND WHICH YIELDS LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM AND BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE: VERY STIFF, GRAY SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6				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.				HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WHEN 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 AS FOLLOWS:				ALLUVIUM (ALLUV.) - SOILS WHICH 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 IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE. CALCAREOUS (CALC.) - SOILS WHICH 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. DIRECT PUSH - ADVANCEMENT OF SAMPLE TOOLING UTILIZING DIRECT PUSH METHODOLOGY (ex. GEOPROBE) 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 (F.P.) - 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. HYDRAULIC PUSH (HP) - ADVANCEMENT OF SAMPLING TOOLS UTILIZING MECHANICAL/HYDRAULIC DOWN-FORCE OF DRILLING MACHINE. 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 (MOT.) - 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 SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK. ROCK QUALITY DESIGNATION (R.Q.D.) - 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 WHICH 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, WHICH HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED 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 (N OR B.P.F.) 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 LESS THAN 0.1 FOOT PENETRATION WITH 60 BLOWS. STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE. STRATA ROCK QUALITY DESIGNATION (S.R.Q.D.) - 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 (T.S.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.																																																																																																																																																																																																																																																											
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VERY WIDE	> 10 FEET	VERY THICKLY BEDDED	> 4 FEET	THICKLY BEDDED	1.5 - 4 FEET	THINLY BEDDED	0.16 - 1.5 FEET																																																																																																																																																																																																																																																																
WIDE	3 TO 10 FEET	VERY THINLY BEDDED	0.03 - 0.16 FEET	THICKLY LAMINATED	0.008 - 0.03 FEET	THINLY LAMINATED	< 0.008 FEET																																																																																																																																																																																																																																																																
MODERATELY CLOSE	1 TO 3 FEET																																																																																																																																																																																																																																																																						
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FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF THE MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.	FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE. GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE. BREAKS EASILY WHEN HIT WITH HAMMER.																																																																																																																																																																																																																																																																					
MODERATELY INDURATED	INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.																																																																																																																																																																																																																																																																					
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DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YEL-BRN, BLUE-GRAY) MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.				<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="4">EQUIPMENT USED ON SUBJECT PROJECT</th> </tr> <tr> <td><input type="checkbox"/></td> <td>POST HOLE DIGGER</td> <td><input type="checkbox"/></td> <td>HAND AUGER</td> </tr> <tr> <td><input type="checkbox"/></td> <td>SOUNDING ROD</td> <td><input type="checkbox"/></td> <td>VANE SHEAR TEST</td> </tr> <tr> <td><input type="checkbox"/></td> <td>OTHER</td> <td colspan="2"></td> </tr> </table>				EQUIPMENT USED ON SUBJECT PROJECT				<input type="checkbox"/>	POST HOLE DIGGER	<input type="checkbox"/>	HAND AUGER	<input type="checkbox"/>	SOUNDING ROD	<input type="checkbox"/>	VANE SHEAR TEST	<input type="checkbox"/>	OTHER			ELEVATION:																																																																																																																																																																																																																																															
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**ROADWAY INVENTORY**  
for  
**New Route from NC 133 (Long Beach Road) to  
NC 133 and NC 87 (River Road) North of  
NC 133 on NC 87 (George II Road)**

**PROJECT NUMBER: 34531.1.1**  
**TIP NUMBER: R-3324**  
**F.A. NUMBER: STP-133(3)**  
**COUNTY: BRUNSWICK**

February 5, 2008

**Prepared For:**

**Mr. Njoroge Wainaina, PE**  
**North Carolina Department of Transportation**  
**Geotechnical Engineering Unit**  
**1585 Mail Service Center (MAIL)**  
**1020 Birch Ridge Drive (DELIVERY)**  
**Raleigh, North Carolina 27610**

**Prepared By:**

**CATLIN Engineers and Scientists**  
**220 Old Dairy Road**  
**P.O. Box 10279**  
**Wilmington, North Carolina 28404-0279**

**CATLIN Project Number: 207-068**

**Project Description**

The project consists of widening and re-alignment of NC 87 (-Y2-) and NC 133 (-Y4) from where the two roads intersect with Sunny Point Road (-Y3-) to approximately 1.25 miles south of the intersection. New construction (-L-) will extend from -Y2- Station 23+63 approximately 2 miles southwestward to NC 211 (-Y1-) and will continue across NC 211 to the intersection with existing NC 133 (-L-). Additional widening and re-alignment will be constructed in the vicinity of existing intersections of NC 133 (Long Beach Road) and NC 211.

A geotechnical investigation was conducted October and November 2007. Borings were advanced utilizing a Central Mine Equipment (CME) 45B drill machine mounted on a rubber tired Gemco All-terrain vehicle (ATV) and a trailer mounted Diedrich D-50 drill machine. Both drill machines were equipped with manual hammers. Standard Penetration Tests were performed at an average of every 200 linear feet along each alignment in borings advanced using standard hollow-stem auger drilling techniques. Testing was conducted in general accordance with American Society for Testing and Materials (ASTM) D-1586-84, "Penetration Test and Split Barrel Sampling of Soils" or American Association of State Highway and Transportation Officials (AASHTO) Standard Method T206-81. Representative soil samples were collected for visual classification in the field per AASHTO Designation M145-91, "The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes." Selected samples were submitted for laboratory analysis by CATLIN Geotechnical Laboratories in accordance with the following AASHTO Standards as modified by NCDOT:

T 87-86 (Dry Preparation of Disturbed Soil)  
T 88-93 (Particle Size Analysis)  
T 89-94 (Liquid Limit)  
T 90-94 (Plastic Limit)  
T 265-93 (Soil Moisture Content)

Additional samples were submitted to the North Carolina Department of Transportation (NCDOT) Materials and Tests Unit for organics analysis. All measurements were recorded in English Units (feet). The following alignments were investigated:

<u>Line</u>	<u>Station(±)</u>
-L-	21+00 to 130+00
-Y-	14+00 to 22+20
-Y1-	15+00 to 43+00
-Y2-	16+00 to 83+00
-Y3-	10+00 to 15+00
-Y4-	10+00 to 20+00
-Y5-	10+00 to 12+80

**Areas of Special Geotechnical Interest**

- 1) **Highly Plastic Clays:** Highly plastic (PI>20) clays and clayey sands were encountered on the project at the following intervals:

<u>Line</u>	<u>Station (±)</u>
-L-	22+25 to 287+75
-Y-	10+00 to 13+75

The clays were encountered at an average elevation of approximately -5 feet mean sea level (MSL). Laboratory analysis of selected samples indicated that the material was predominantly silt and clay with trace amounts of sand.

- 2) **Organic Soils:** The following sections contained organic soils that were encountered on the project:

<u>Line</u>	<u>Station (±)</u>
-L-	85+00 to 91+00
-L-	108+50 to 111+50
-L-	127+25 to 129+50

It should be noted that wood fragments and organic debris was typically encountered between depths of approximately two feet to roughly ten feet below land surface (BLS) across the project site.

- 3) **Groundwater:** No areas were identified during this investigation exhibiting a high water table. However, the area is currently experiencing a drought and the seasonal rainfall is approximately 1.7 feet below average. Numerous areas along the -L- alignment are designated wetlands on the NCDOT provided plan sheets.
- 4) **Water Wells:** Water wells (and monitoring wells) within or in close proximity of the right of way or construction easement were noted at the following locations.

<u>Line</u>	<u>Station (±) / Offset ft.(±)</u>
-L-	35+00-39+00 / <100 Rt./Lt.
-L-	35+16 / 147 Lt.
-L-	21+53 / 280 Rt.
-Y-	12+45 / 253 Rt.
-Y-	16+01 / 96 Rt.
-Y-	16+25 / 432 Rt.
-Y1-	15+25 / 522 Rt.
-Y1-	16+38 / 584 Rt.
-Y1-	45+96 / 432 Rt.
-Y1-	46+19 / 305 Rt.

<u>Line</u>	<u>Station (±) / Offset ft.(±)</u>
-Y1-	46+34 / 138 Rt.
-Y1-	47+89 / 614 Rt.
-Y2-	21+21 / 249 Lt.
-Y2-	20+20 / 200Lt.

The water wells may be abandoned and water levels could not be determined. Other wells may be present along the project corridor that were not detected

**Physiography and Geology**

The project is located within the extreme southeast portion of the North Carolina Coastal Plain physiographic province. The land surface is predominantly flat with a gradual decrease in land surface elevation to the south. The majority of relief along the project is created by numerous drainage ditches that intersect the project corridor. A relatively large portion of the project will cross designated wetlands. Land use along the project corridor consists of woods, businesses, and private residences. Review of aerial photographs revealed that the area within and surrounding the project is populated with many Carolina Bays of various sizes. Geology beneath the alignments was relatively consistent across the project. The project is underlain by undifferentiated Coastal Plain (Recent Coastal Plain (RCP)) material to an approximate depth of 20 feet where materials of the Waccamaw Formation were typically encountered. The surficial materials (RCP) are typical soils associated with Carolina Bays. The project is drained by numerous manmade drainage ditches located throughout the project and an unnamed creek located at the beginning of the -L- alignment.

**Soil Properties**

Soils encountered at the project site include roadway embankment, artificial fill, and undifferentiated Coastal Plain and Coastal Plain sediments of the Waccamaw Formation.

Roadway Embankment and Artificial Fill soils are present along the -Y- alignments associated with existing roads NC 133, NC 211, and NC 87. These soils consist of tan, brown, and gray, dry to wet, loose to medium dense, silty, fine sand and fine to coarse sand (A-2-4, A-3).

Recent Coastal Plain material consisting of light gray to brown ("light colored"), dry to wet, fine sand to silty, very loose to dense, fine sand (A-3, A-2-4), was identified in the undeveloped/undisturbed areas of the project from the land surface to an average approximate depth of five feet BLS. Dark brown to black, coarse to fine grained sand with trace to minor amounts of organic silt and clay (A3, A-2-4) was typically encountered beneath the surficial sands (light colored sands) or from the land surface or beneath the embankment/artificial fill where the light colored sands were not present. The sands were wet to saturated, very loose to very dense, and occasionally contained rotten wood fragments located sporadically throughout the interval. Dark brown to brown, loose to very dense, fine sand and fine to coarse grained sand (A-3) was identified consistently beneath the dark brown to black material and occasionally at or near the land surface where the previously two described units were absent. The sand often graded from fine sand to coarse to fine sand that occasionally contained well rounded, gravel sized quartz.

Waccamaw Formation materials consisting of loose to medium dense, greenish gray to brown, silty, fine grained sand (A-2-4) were identified beneath the coarse to fine grained sand at an average depth of approximately 15 to 20 feet BLS. Materials encountered beneath the coarse to fine grained sand at the beginning of -L- (approximate stations 22+00 to 28+00) differed slightly than those encountered at the other portions of the project whereas the initial sediments of the Waccamaw Formation were more silty and clayey in nature (A-4, A-6). The silty/clayey material was underlain by approximately five feet of medium dense, fine grained gray sand with trace to little amounts of shell fragments. This material was underlain by gray, medium to high plasticity, soft, silty clay (A-7, A-6).

#### Groundwater

Groundwater was encountered in all borings advanced during this project. Twenty-four hour groundwater measurements ranged from 1.1 to 10.4 feet BLS. As previously mentioned, the area has been experiencing a drought and rainfall deficits were approximately 1.7 feet at the time of this investigation.

### Earthwork Balance Sheet

Volumes in Cubic Yards

PROJECT: R-3324

COUNTY: Brunswick

DATE: 12/10/2012

COMPILED BY: lc

SHEET \_\_ OF \_\_ SHEETS

STATION	STATION	EXCAVATION				EMBANKMENT				BORROW	WASTE				
		TOTAL UNCLASS.	ROCK	UNDERCUT	UNSUIT. UNCLASS.	SUITABLE UNCLASS.	TOTAL	ROCK	EARTH		EMBANK. 0.25	ROCK	SUITABLE	UNSUIT.	TOTAL
SUMMARY	No. 1														
DET1 12+00	23+50	649				649				1,431		1,431	1,789	1,140	
DET2 10+16.33	17+74.26	1,227				1,227				132		132	165		
L 15+00	21+34.23	714				714				5,770		5,770	7,213	1,062	
L 22+71.55	39+00	1,684				1,684				49,954		49,954	62,443	60,759	
Y 11+25	24+50	572				572				8,099		8,099	10,124	9,552	
Y1 10+50	25+50	3,327			817	2,510				1,073		1,073	1,341		
Y1 25+50	49+70	6,040			1,570	4,470				1,147		1,147	1,434	1,169	
Y5 10+46	12+75	35				35				66		66	84	817	
DR1 10+26.32	14+58.05	94				94				342		342	428	1,570	
No. 1	<b>SUBTOTAL</b>	<b>14,342</b>			<b>2,387</b>	<b>11,955</b>				<b>68,014</b>		<b>68,014</b>	<b>85,021</b>	<b>78,333</b>	
SUMMARY	No. 2														
L 40+00	70+00	235				235				84,763		84,763	105,954	105,719	
No. 2	<b>SUBTOTAL</b>	<b>235</b>				<b>235</b>				<b>84,763</b>		<b>84,763</b>	<b>105,954</b>	<b>105,719</b>	
SUMMARY	No. 3														
L 70+00	86+20.48									41,430		41,430	51,788	51,788	
L 87+88.52	100+00									43,087		43,087	53,859	53,859	
No. 3	<b>SUBTOTAL</b>									<b>84,517</b>		<b>84,517</b>	<b>105,647</b>	<b>105,647</b>	
SUMMARY	No. 4														
L 100+00	130+69.90	573				573				81,849		81,849	102,311	101,738	
No. 4	<b>SUBTOTAL</b>	<b>573</b>				<b>573</b>				<b>81,849</b>		<b>81,849</b>	<b>102,311</b>	<b>101,738</b>	
SUMMARY	No. 5														
Y2 16+50	46+50	4,366			891	3,475				5,459		5,459	6,824	3,349	
No. 5	<b>SUBTOTAL</b>	<b>4,366</b>			<b>891</b>	<b>3,475</b>				<b>5,459</b>		<b>5,459</b>	<b>6,824</b>	<b>3,349</b>	
SUMMARY	No. 6														
Y2 46+50	76+50	10,040			623	9,417				4,912		4,912	6,140		
No. 6	<b>SUBTOTAL</b>	<b>10,040</b>			<b>623</b>	<b>9,417</b>				<b>4,912</b>		<b>4,912</b>	<b>6,140</b>	<b>3,277</b>	
SUMMARY	No. 7														
Y2 76+50	83+00	376				376				703		703	879	503	
Y3A 10+50	20+00	141				141				828		828	1,035	894	
Y4 10+50	19+50	1,048				1,048				1,679		1,679	2,099	1,051	
No. 7	<b>SUBTOTAL</b>	<b>1,565</b>				<b>1,565</b>				<b>3,210</b>		<b>3,210</b>	<b>4,013</b>	<b>2,448</b>	
SUMMARY	No. 8														
DET1 REMOVAL 12+00	23+50	1,789				1,789								1,789	
DET2 REMOVAL 10+16.33	17+74.26	165				165								165	
No. 8	<b>SUBTOTAL</b>	<b>1,954</b>				<b>1,954</b>								<b>1,954</b>	
<b>TOTAL</b>		<b>33,075</b>			<b>3,901</b>	<b>29,174</b>				<b>332,724</b>		<b>332,724</b>	<b>415,910</b>	<b>397,234</b>	
SHOULDER MATERIAL										8,630		8,630	10,788	10,788	
UNSUITABLE UNCLASS. EXCAV.		100			100									100	
CLASS IV SUBGRADE STABILIZATION ADJUSTMENT												-800	-1,000	-1,000	
WASTE IN LIEU OF BORROW													-8,544	-8,544	
<b>PROJECT TOTAL</b>		<b>33,175</b>			<b>4,001</b>	<b>29,174</b>				<b>341,354</b>		<b>340,554</b>	<b>425,698</b>	<b>398,478</b>	
EST. 5% TO REPLACE TOP SOIL ON BORROW PIT														19,924	
<b>GRAND TOTAL</b>		<b>33,175</b>			<b>4,001</b>	<b>29,174</b>				<b>341,354</b>		<b>340,554</b>	<b>425,698</b>	<b>418,403</b>	
<b>SAY</b>		<b>33,500</b>												<b>419,000</b>	

NOTE: APPROXIMATE QUANTITIES ONLY. UNCLASSIFIED EXCAVATION, FINE GRADING, CLEARING AND GRUBBING, REMOVAL OF EXISTING PAVEMENT AND BREAKING OF EXISTING PAVEMENT WILL BE PAID FOR AT THE LUMP SUM PRICE FOR "GRADING".

NOTE: EARTHWORK QUANTITIES ARE CALCULATED BY THE ROADWAY DESIGN UNIT. THESE EARTHWORK QUANTITIES ARE BASED IN PART ON SUBSURFACE DATA PROVIDED BY THE GEOTECHNICAL ENGINEERING UNIT.

EST. DDE 9,085 CUBIC YARDS

CLASS IV SUBGRADE STABILIZATION 7,900 TONS

EST. UNDERCUT EXCAVATION 1,700 CY

SHALLOW UNDECUT BY STATION: 4,250 CY

SHALLOW UNDERCUT CONTINGENCY: 80 CY

TOTAL SHALLOW UNDERCUT: 4,330 CY

PAVEMENT STRUCTURE VOLUME 11,000 CY

8/17/99  
SYSTEMS  
DATE  
USER  
NAME

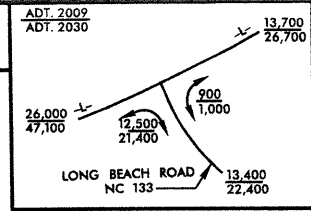
PROPERTY OWNERS			
4	MIR-B, LLC DB 1390 PG 1348 DB 602 PG 1379 MB 19 PG 26	11	DAVIDSON ANIMAL HOSPITAL, PA DB 1635 PG 420 DB 2650 PG 844 DB 195 PG 888 MB Y PG 263
6	BUFFLEHEAD PROPERTIES, LLC DB 1362 PG 930 MB T PG 382	12	RONALD M. HUGHES DB 904 PG 482 MB X PG 28
8	SOUTHPORT-OAK ISLAND CHAMBER OF COMMERCE DB 576 PG 382 DB 134 PG 894	13	GREGORY K. HEDRICK DB 1284 PG 974 DB 155 PG 910 DB 2160 PG 844 DB 876 PG 835
9	MARINA LAND COMPANY, LLC DB 1489 PG 1362 DB 199 PG 63	15	133 PROPERTIES, LLC DB 2044 PG 471 DB 134 PG 55

-L-  
PI Sta 20+73.01 Δ = 32° 50' 51.0" (LT)  
θs = 2° 57' 48.9" D = 3° 57' 05.2"  
Ls = 150.00' L = 831.28'  
LT = 100.0' T = 427.4'  
ST = 50.0' R = 1,450.00'

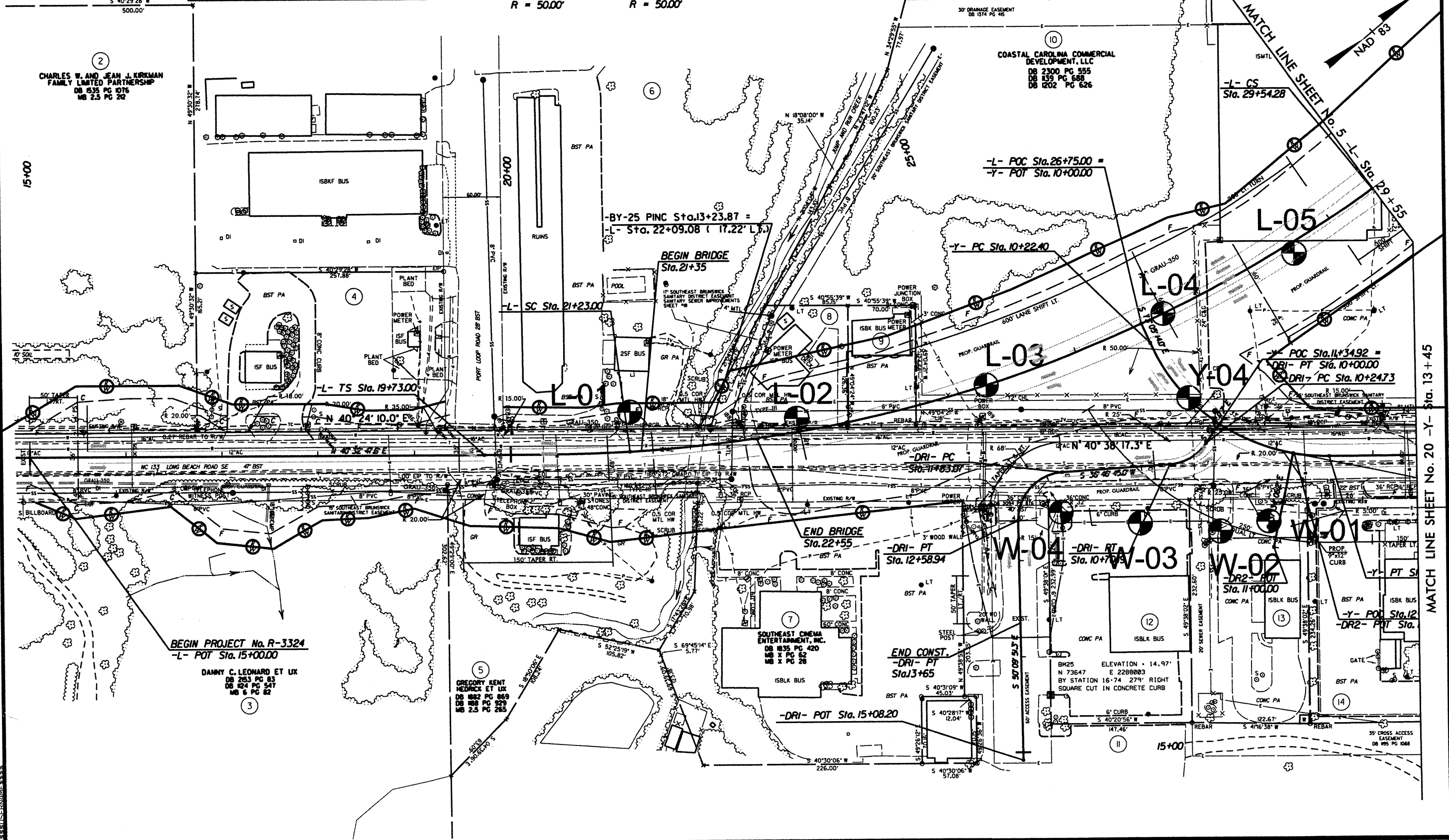
-Y-  
PI Sta 11+53.91 Δ = 66° 39' 19.0" (LT)  
θs = 2° 57' 48.9" D = 28° 38' 52.4"  
Ls = 150.00' L = 232.67'  
LT = 100.0' T = 131.5'  
ST = 50.0' R = 200.00'

-DRI-  
PI Sta 10+49.17 Δ = 52° 06' 02.7" (RT)  
θs = 11° 35' 29.6" D = 11° 35' 29.6"  
Ls = 150.00' L = 45.47'  
LT = 100.0' T = 24.44'  
ST = 50.0' R = 50.00'

SEE SHEET No. 22 FOR -L- PROFILE  
SEE SHEET No. 27 FOR -Y- PROFILE



PROJECT REFERENCE NO. R-3324	SHEET NO. 4
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>INCOMPLETE PLANS</b> DO NOT USE FOR A/W ACQUISITION <b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	



MATCH LINE SHEET No. 20 -Y- Sta. 13+45

MATCH LINE SHEET No. 5 -L- Sta. 29+55  
-L- CS Sta. 29+54.28  
-L- POC Sta. 26+75.00 =  
-Y- POT Sta. 10+00.00  
-Y- PC Sta. 10+22.40  
-Y- POT Sta. 10+24.73  
-DRI- PT Sta. 10+00.00  
-DRI- PC Sta. 10+24.73

BEGIN PROJECT No. R-3324  
-L- POT Sta. 15+00.00

DANNY C. LEONARD ET UX  
DB 263 PG 83  
DB 824 PG 547  
MB 6 PG 82

GREGORY KENT  
HEDRICK ET UX  
DB 1882 PG 869  
DB 1888 PG 929  
MB 2.5 PG 265

SOUTHEAST CINEMA  
ENTERTAINMENT, INC.  
DB 1835 PG 420  
DB X PG 62  
MB X PG 28

BM25 ELEVATION = 14.97'  
N 73647 E 2288003  
BY STATION 16+74 279' RIGHT  
SQUARE CUT IN CONCRETE CURB

35' CROSS ACCESS  
EASEMENT  
DB 195 PG 108



-L-

PIs Sta 30+04.29 Os = 2' 57" 48.5" Ls = 150.00' LT = 100.01' ST = 50.01'	PIs Sta 32+04.30 Os = 3' 42" 16.1" Ls = 150.00' LT = 100.02' ST = 50.02'	PIs Sta 33+16.50 Δ = 6' 08" 25.8" (RT) D = 4' 56" 21.4" L = 124.32' T = 62.22' R = 1160.00'	PIs Sta 34+28.62 Os = 3' 42" 16.1" Ls = 150.00' LT = 100.02' ST = 50.02'
PIs Sta 41+48.62 Os = 3' 34" 51.6" Ls = 150.00' LT = 100.02' ST = 50.02'	PIs Sta 46+11.79 Δ = 38' 00" 00.0" (RT) D = 4' 46" 28.7" L = 795.87' T = 413.19' R = 1200.00'		

MATCH LINE SHEET No. 19 -Y1- Sta. 20+00

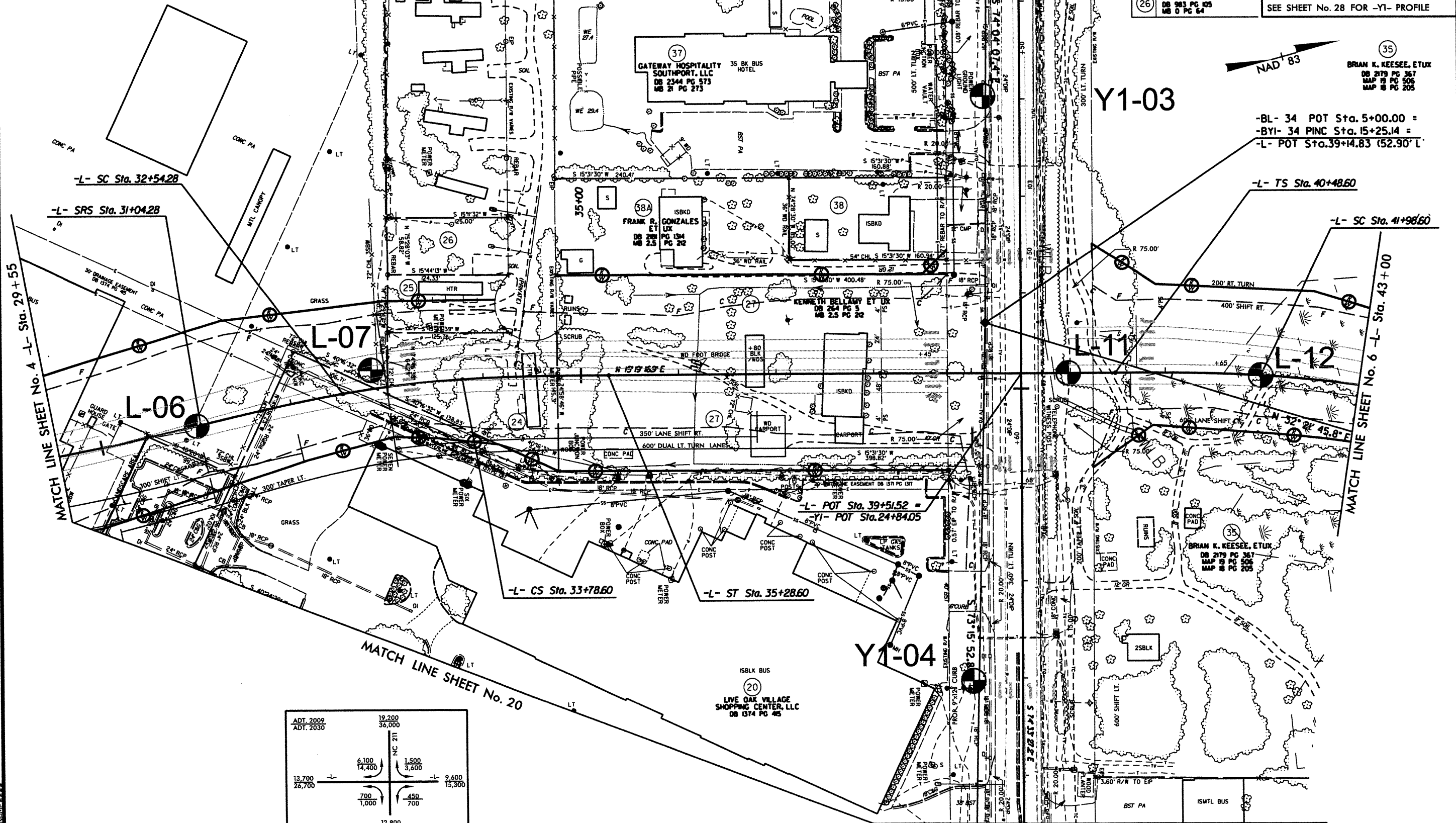
PROPERTY OWNERS	
24	THOMAS WALTER HARPER DB 790 PG 730 MB 0 PG 64
25	DWAYNE BARTLET DB 2594 PG 84 MB 1 PG 372
26	BRUCE McLAURIN IVES DB 983 PG 105 MB 0 PG 64

NAD 83

35  
BRIAN K. KEESEE, ETUX  
DB 279 PG 367  
MAP 19 PG 306  
MAP 8 PG 205

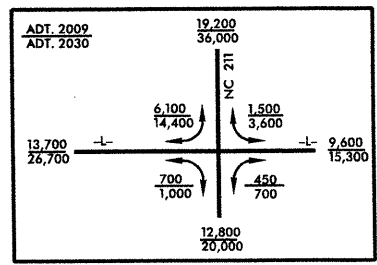
-BL- 34 POT Sta. 5+00.00 =  
-BYI- 34 PINC Sta. 15+25.14 =  
-L- POT Sta. 39+14.83 (52.90' L)

Y1-03



MATCH LINE SHEET No. 4 -L- Sta. 29+55

MATCH LINE SHEET No. 6 -L- Sta. 43+00



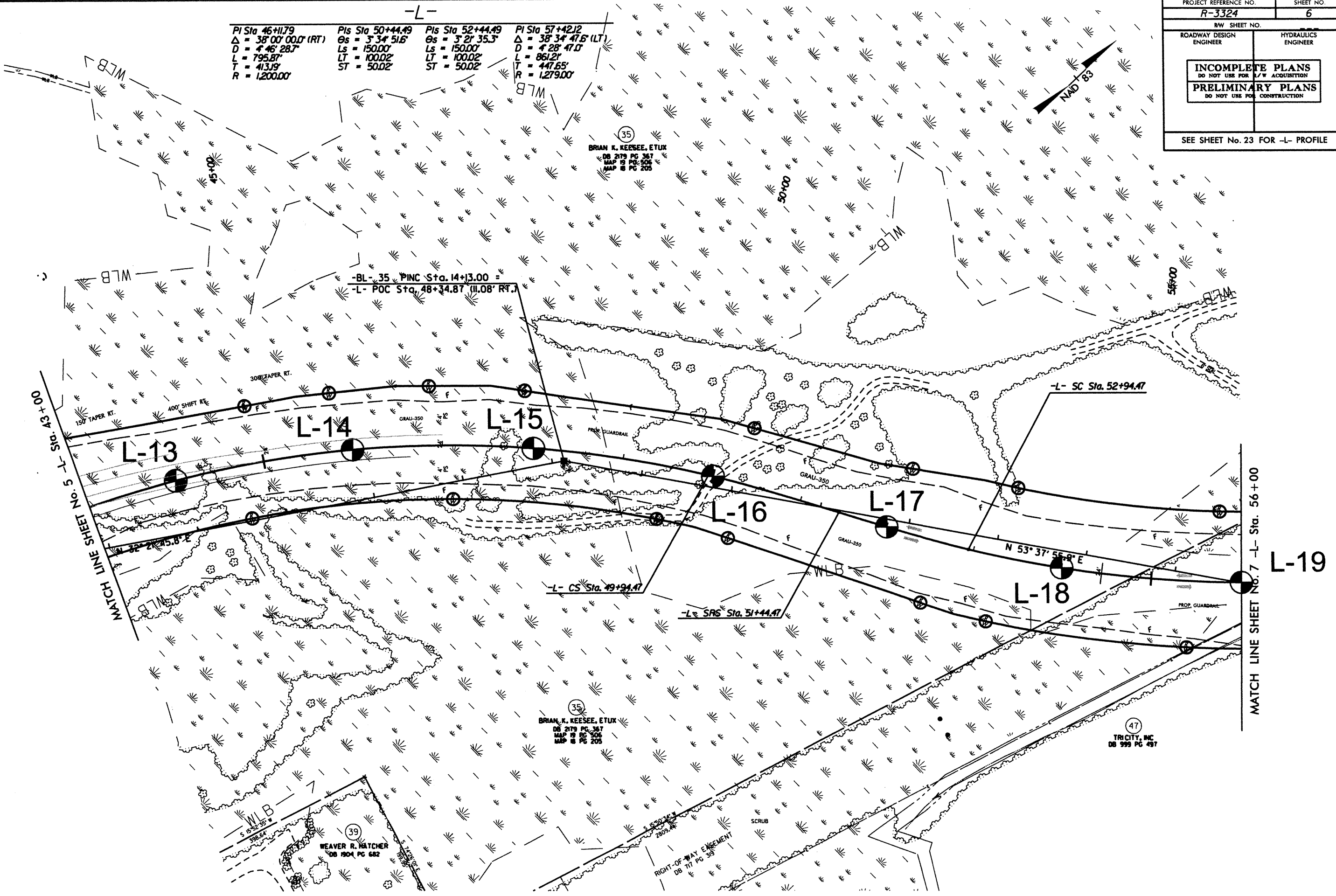
MATCH LINE SHEET No. 20 -Y1- Sta. 29+50

8/17/99  
SYSTEM: \*\*\*\*\*  
CONTS: \*\*\*\*\*  
USER: \*\*\*\*\*

8/17/99

PROJECT REFERENCE NO. <b>R-3324</b>	SHEET NO. <b>6</b>
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>INCOMPLETE PLANS</b> DO NOT USE FOR A/E ACQUISITION	
<b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	
SEE SHEET No. 23 FOR -L- PROFILE	

PI Sta 46+11.79 Δ = 38° 00' 00" (RT) D = 4' 46" 28.7" L = 795.87' T = 413.19' R = 1200.00'	PI Sta 50+44.49 Os = 3' 34' 51.6" Ls = 150.00' LT = 100.02' ST = 50.02'	PI Sta 52+44.49 Os = 3' 21' 35.3" Ls = 150.00' LT = 100.02' ST = 50.02'	PI Sta 57+42.12 Δ = 38° 34' 47.6" (LT) D = 4' 28' 47.0" L = 861.21' T = 447.65' R = 1279.00'
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SYSTEMS  
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WEAVER R. WATCHER  
DB 1904 PG 682

BRIAN K. KEESSE, ETUX  
DB 2179 PG 367  
MAP 19 PG 306  
MAP 18 PG 205

TRICITY, INC  
DB 599 PG 497

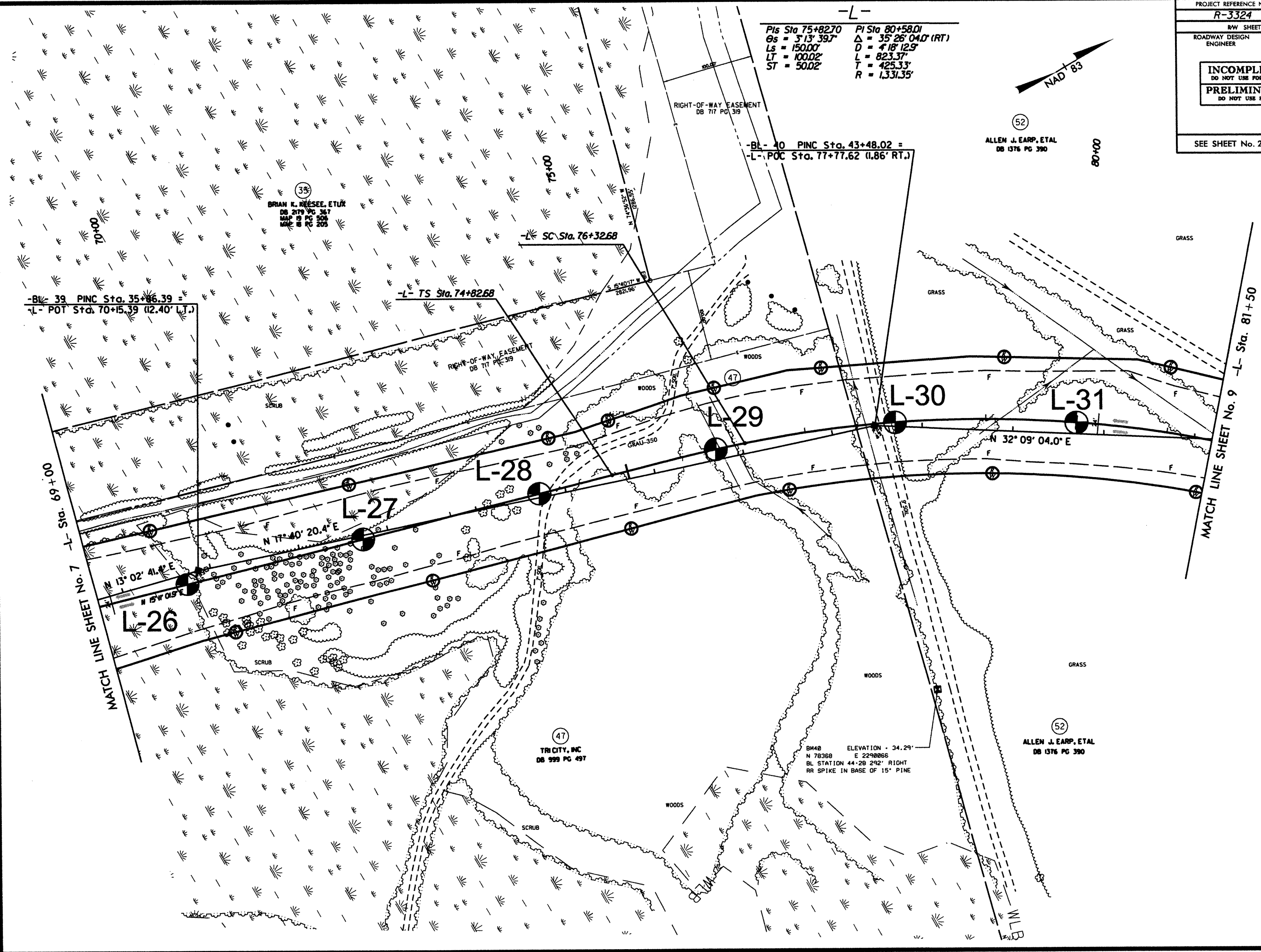
RIGHT-OF-WAY EASEMENT  
DB 717 PG 319



PROJECT REFERENCE NO. <b>R-3324</b>	SHEET NO. <b>8</b>
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>INCOMPLETE PLANS</b> DO NOT USE FOR A/W ACQUISITION <b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	
SEE SHEET No. 24 FOR -L- PROFILE	

-L-

<b>PI Sta 75+82.70</b>	<b>PI Sta 80+58.01</b>
$\theta_s = 3'13'' 39.7'$	$\Delta = 35'26'' 04.0'$ (RT)
$L_s = 150.00'$	$D = 4'18'' 12.9'$
$LT = 100.02'$	$L = 823.37'$
$ST = 50.02'$	$T = 425.33'$
	$R = 1,331.35'$



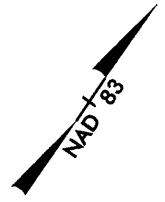
8/17/99

\*\*\*\*\*  
 SYSTEMS  
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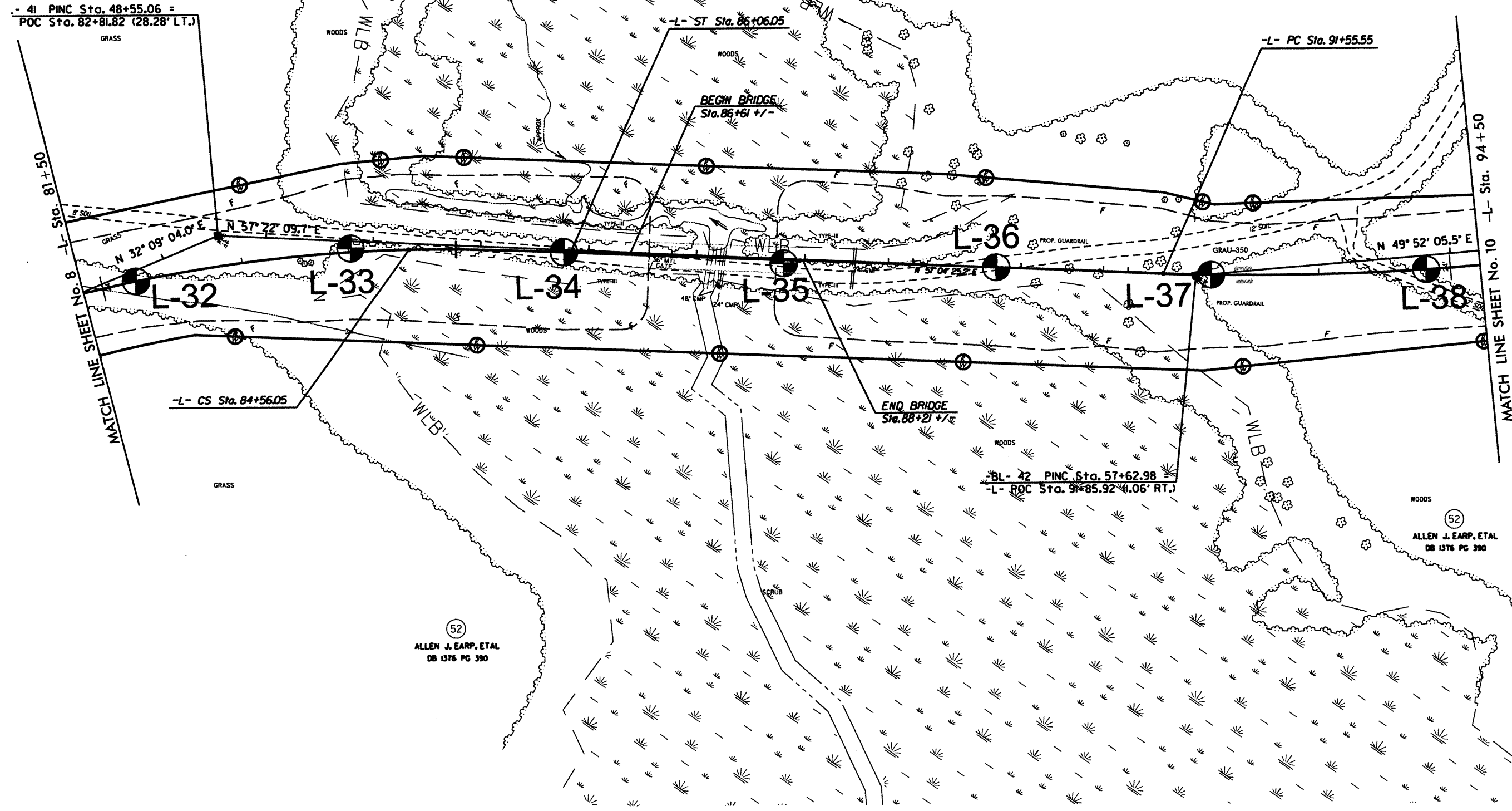
PROJECT REFERENCE NO. <b>R-3324</b>	SHEET NO. <b>9</b>
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>INCOMPLETE PLANS</b> DO NOT USE FOR L/W ACQUISITION <b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	
SEE SHEET No. 24 & 25 FOR -L- PROFILE	
SEE SHEET No. 2-F FOR RELATIONSHIP OF BRIDGE TO ROADWAY SKETCH	
SEE SHEET No's. S- to S- FOR STRUCTURE PLANS	

-L-

PI Sta 80+58.01 Δ = 35' 26" 04.0' (RT) D = 4' 18" 12.9" L = 823.37' T = 425.33' R = 1,331.35'	PIs Sta 85+06.07 Θs = 3' 13" 39.7" Ls = 150.00' LT = 100.02' ST = 50.02'	PI Sta 93+83.71 Δ = 11' 19" 49.1' (LT) D = 2' 29" 28.0" L = 454.83' T = 228.16' R = 2,300.00'
--	--	--



- 41 PINC Sta. 48+55.06 =  
POC Sta. 82+81.82 (28.28' LT.)

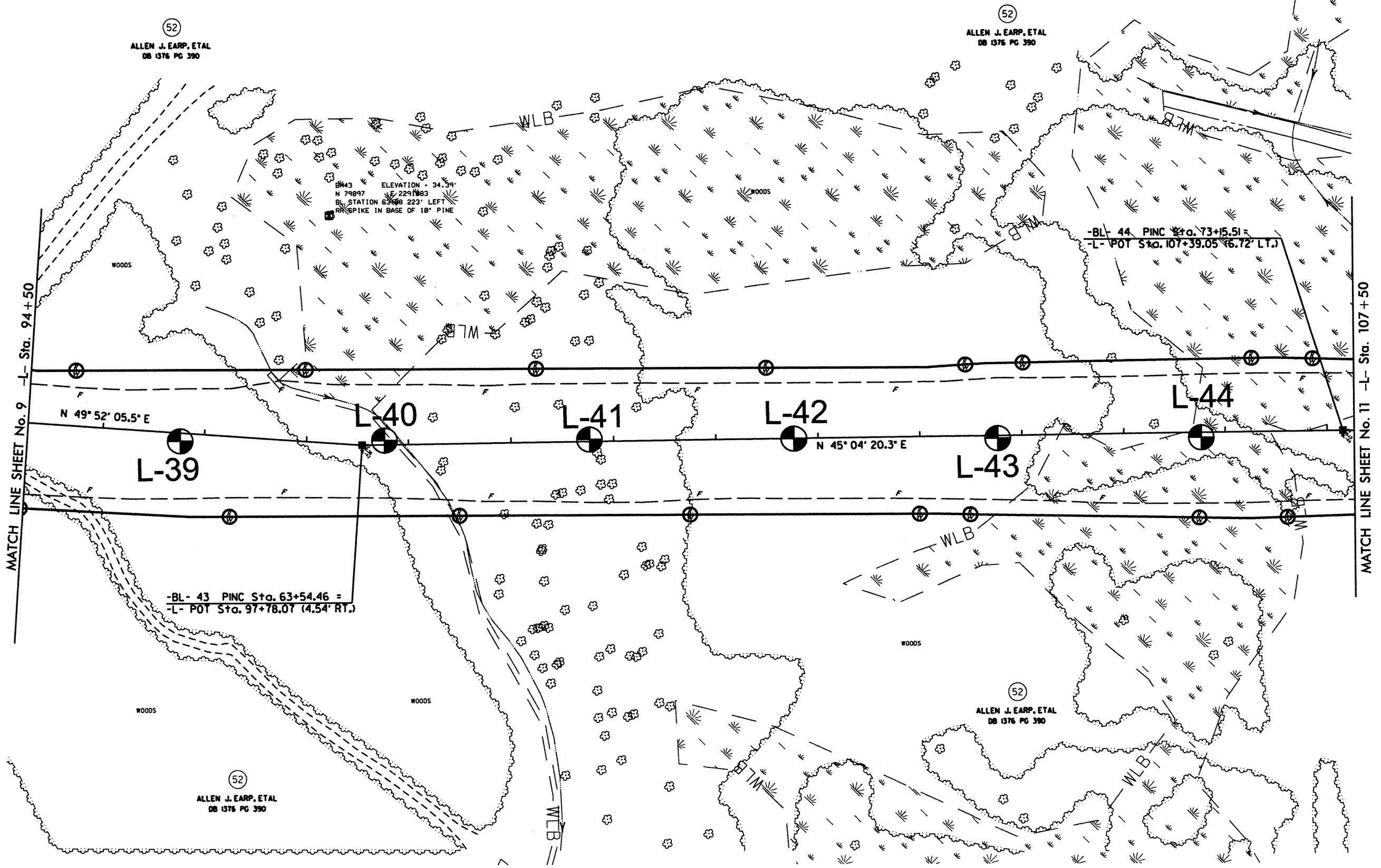
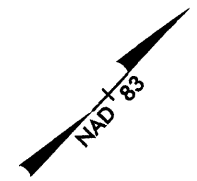


8/17/99  
\*\*\*\*\*SYSTEMTIME\*\*\*\*\*  
\*\*\*\*\*SYSDRAWN\*\*\*\*\*  
\*\*\*\*\*USERNAME\*\*\*\*\*

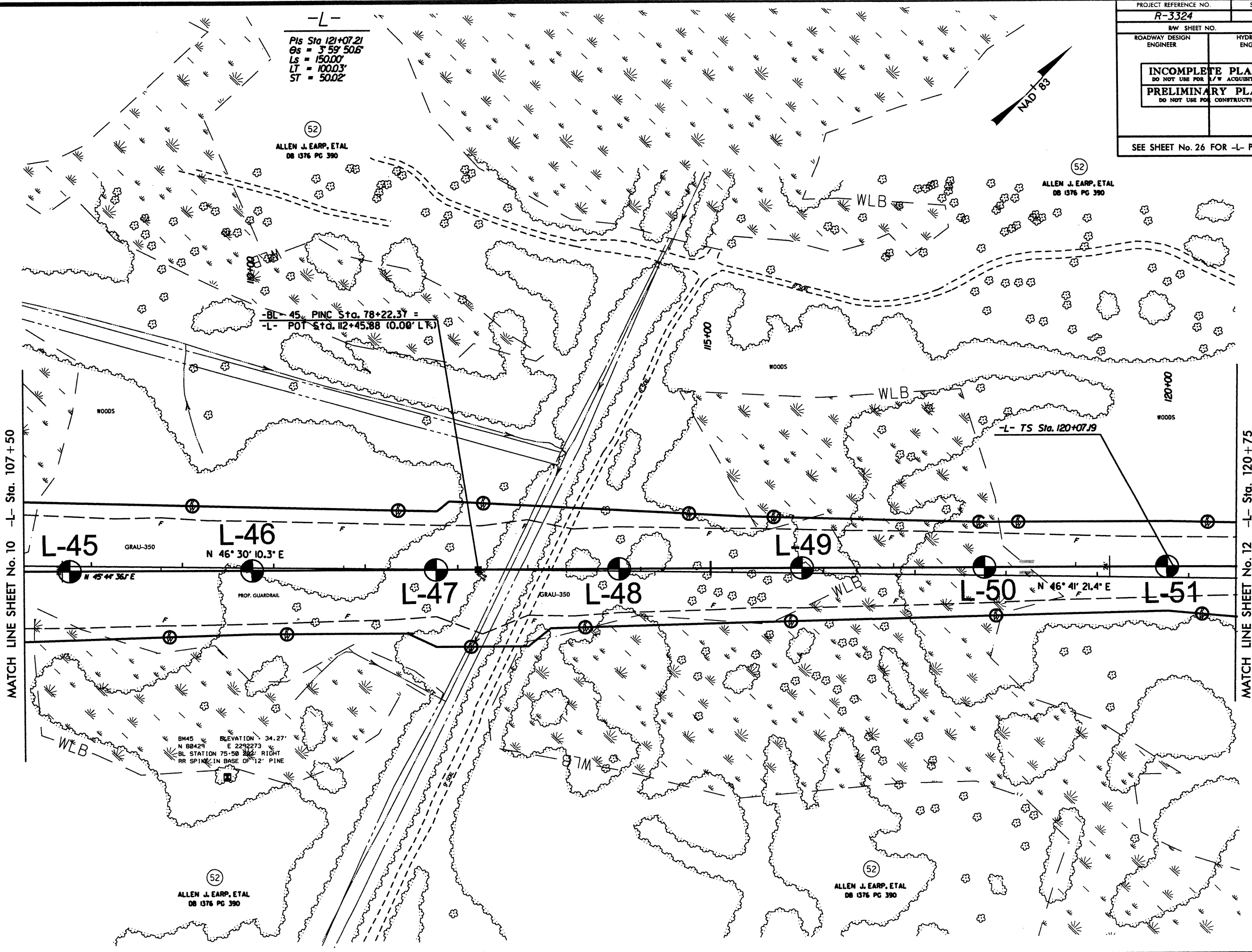
8/17/99

\*\*\*\*\*  
SYSTEM \*\*\*\*\*  
DESIGN \*\*\*\*\*  
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\*\*\*\*\*  
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PROJECT REFERENCE NO. <b>R-3324</b>	SHEET NO. <b>10</b>
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>INCOMPLETE PLANS</b> DO NOT USE FOR ACQUISITION <b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	
SEE SHEET No. 25 & 26 FOR -L- PROFILE	



PROJECT REFERENCE NO. R-3324		SHEET NO. 11	
RW SHEET NO.			
ROADWAY DESIGN ENGINEER		HYDRAULICS ENGINEER	
<b>INCOMPLETE PLANS</b> DO NOT USE FOR R/W ACQUISITION <b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION			
SEE SHEET No. 26 FOR -L- PROFILE			



-L-

$Pis Sta. 121+07.21$   
 $\theta_s = 3^{\circ} 59' 50.6"$   
 $L_s = 150.00'$   
 $LT = 100.03'$   
 $ST = 50.02'$

(52)  
ALLEN J. EARP, ETAL  
DB 1376 PG 390

(52)  
ALLEN J. EARP, ETAL  
DB 1376 PG 390

-BL- 45, PINC Sta. 78+22.37 =  
-L- POT Sta. 112+45.88 (0.00' L.K.)

BM45 ELEVATION 34.27'  
N 88429 E 22+2273  
-BL STATION 75+58 3/4 RIGHT  
RR SPINE IN BASE OF 12" PINE

(52)  
ALLEN J. EARP, ETAL  
DB 1376 PG 390

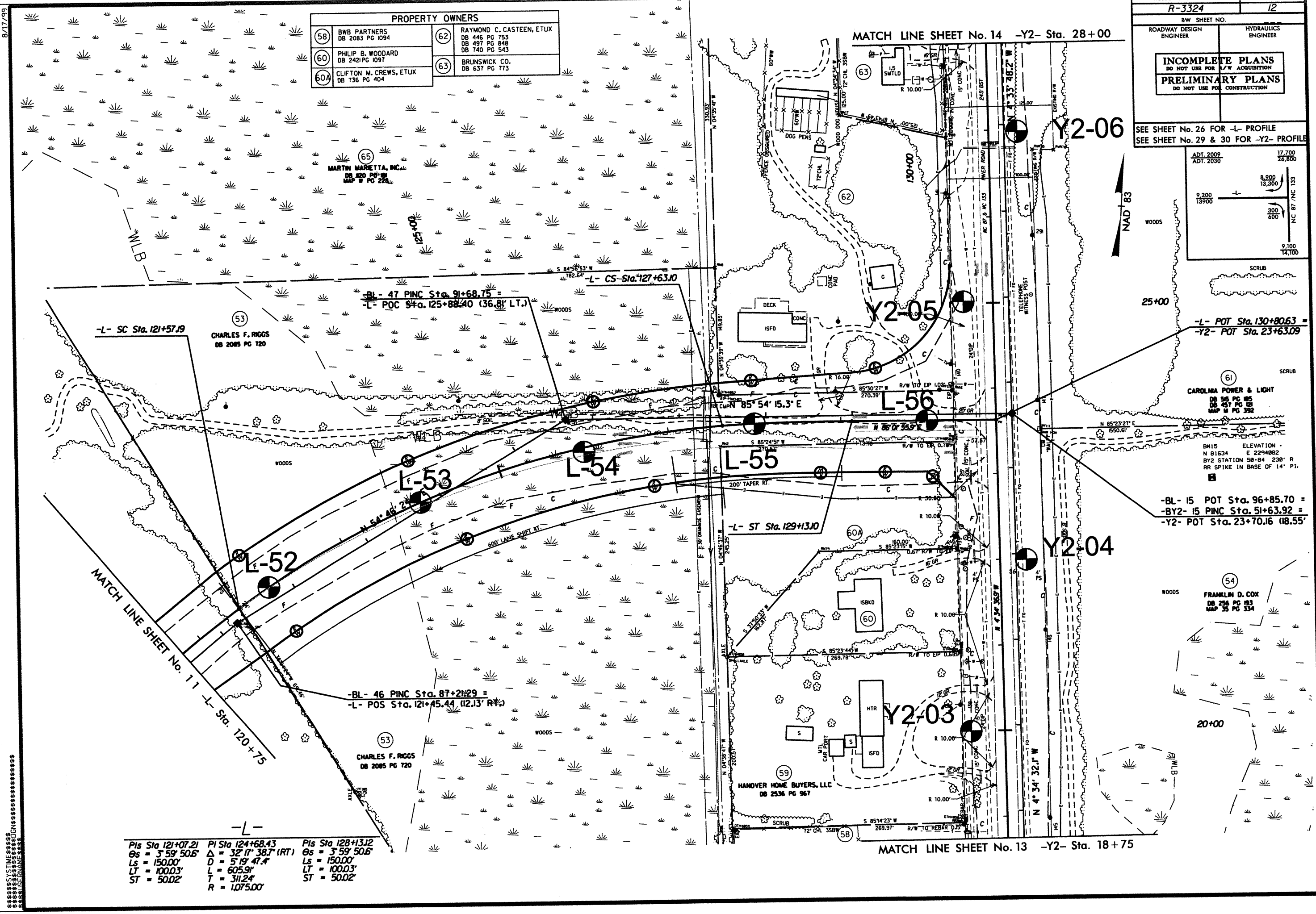
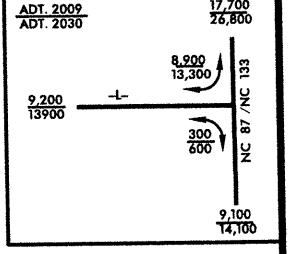
(52)  
ALLEN J. EARP, ETAL  
DB 1376 PG 390

\*\*\*\*\*  
SYSTIME  
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8/17/99

PROPERTY OWNERS			
58	BWB PARTNERS DB 2083 PG 1094	62	RAYMOND C. CASTEEN, ETUX DB 446 PG 753 DB 497 PG 848 DB 740 PG 543
60	PHILIP B. WOODARD DB 2421 PG 1097	63	BRUNSWICK CO. DB 637 PG 773
60A	CLIFTON M. CREWS, ETUX DB 736 PG 404		

PROJECT REFERENCE NO <b>R-3324</b>	SHEET NO. <b>12</b>
RW SHEET NO.	HYDRAULICS ENGINEER
ROADWAY DESIGN ENGINEER	
<b>INCOMPLETE PLANS</b> DO NOT USE FOR ACQUISITION <b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	
SEE SHEET No. 26 FOR -L- PROFILE	
SEE SHEET No. 29 & 30 FOR -Y2- PROFILE	



MATCH LINE SHEET No. 11

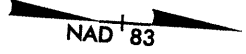
MATCH LINE SHEET No. 14 -Y2- Sta. 28+00

MATCH LINE SHEET No. 13 -Y2- Sta. 18+75

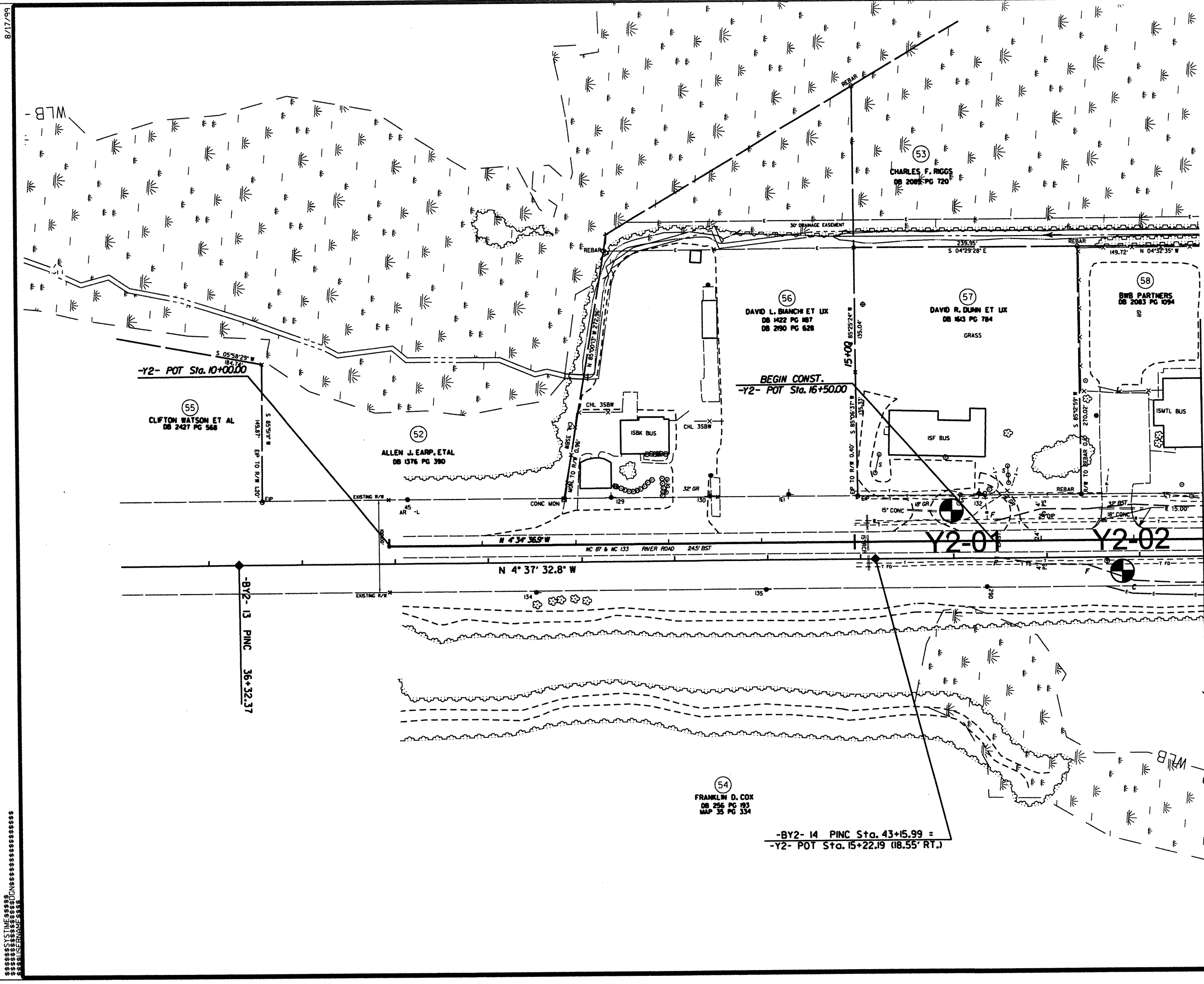
-L-	
Pls Sta 121+07.21	Pls Sta 124+68.43
Os = 3° 59' 50.6"	Δ = 32° 17' 38.7" (RT)
Ls = 150.00'	D = 5° 19' 47.4"
LT = 100.03'	L = 605.91'
ST = 50.02'	T = 311.24'
	R = 1,075.00'

\*\*\*\*\*  
 SYSTEMS  
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8/17/99



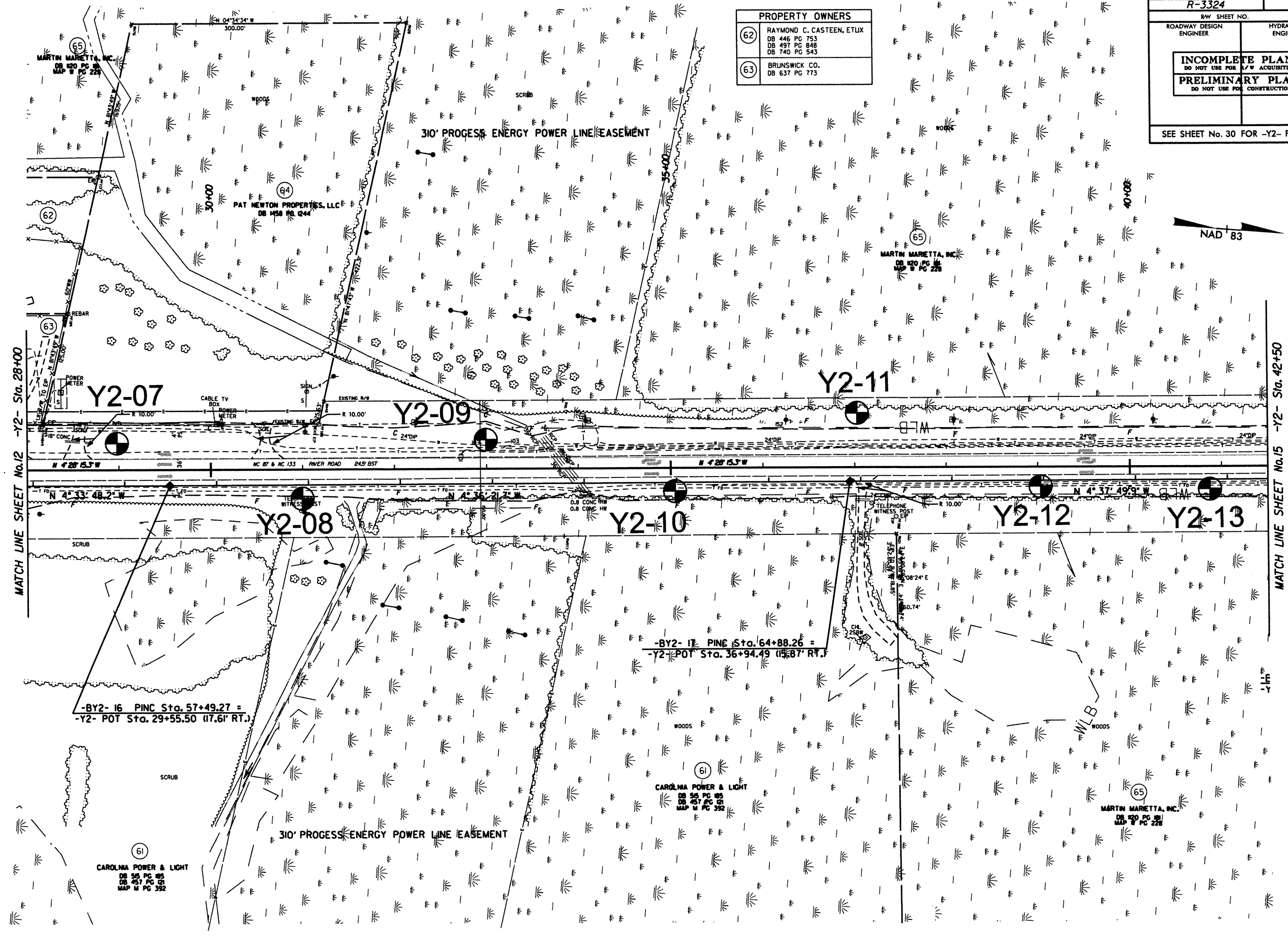
MATCH LINE SHEET No. 12 -Y2- Sta. 18+75

\*\*\*\*\*  
 SYSTEMS  
 \*\*\*\*\*

-BY2- 14 PINC Sta. 43+15.99 =  
-Y2- POT Sta. 15+22.19 (18.55' RT.)

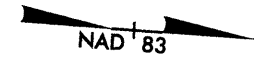
PROJECT REFERENCE NO. <b>R-3324</b>	SHEET NO. <b>14</b>
RAW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>INCOMPLETE PLANS</b> DO NOT USE FOR ACQUISITION <b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	
SEE SHEET No. 30 FOR -Y2- PROFILE	

PROPERTY OWNERS	
(62)	RAYMOND C. CASTEEN, ETUX DB 446 PG 753 DB 497 PG 848 DB 740 PG 543
(63)	BRUNSWICK CO. DB 637 PG 773



MATCH LINE SHEET No.12 -Y2- Sta. 28+00

MATCH LINE SHEET No.15 -Y2- Sta. 42+50



-BY2- 16 PINE Sta. 57+49.27 =  
-Y2- POT Sta. 29+55.50 (17.61' RT.)

-BY2- 17 PINE Sta. 64+88.26 =  
-Y2- POT Sta. 36+94.49 (11.87' RT.)

(61)  
CAROLINA POWER & LIGHT  
DB 55 PG 186  
DB 457 PG 121  
MAP M PG 392

(61)  
CAROLINA POWER & LIGHT  
DB 55 PG 186  
DB 457 PG 121  
MAP M PG 392

(65)  
MARTIN MARETTA, INC.  
DB 120 PG 228  
MAP M PG 228

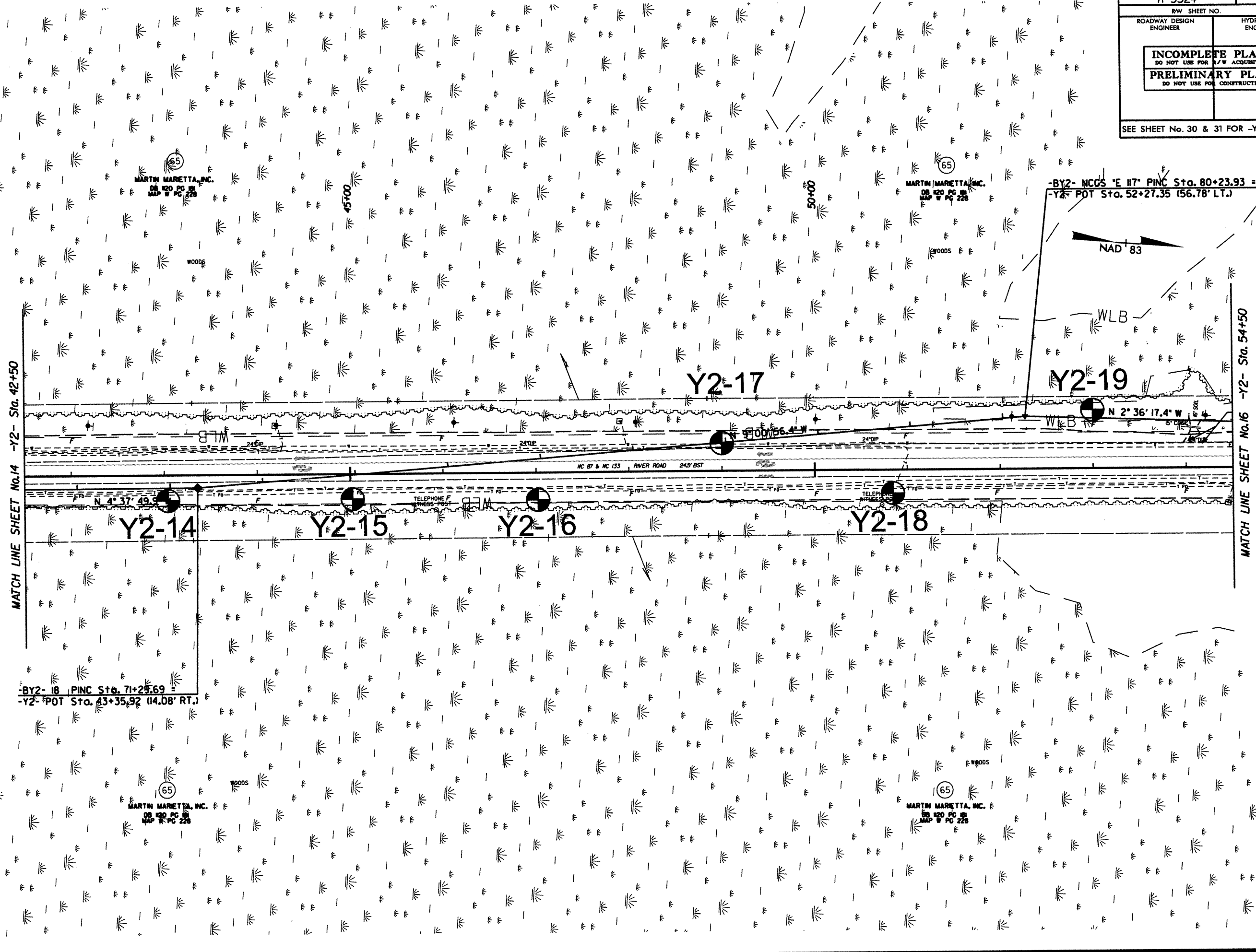
\*\*\*\*\*SYSTEMS\*\*\*\*\*  
\*\*\*\*\*DRAWING\*\*\*\*\*  
\*\*\*\*\*DATE\*\*\*\*\*

PROJECT REFERENCE NO. <b>R-3324</b>	SHEET NO. <b>15</b>
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>INCOMPLETE PLANS</b> DO NOT USE FOR ACQUISITION <b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	
SEE SHEET No. 30 & 31 FOR -Y2- PROFILE	

8/17/99

MATCH LINE SHEET No.14 -Y2- Sta. 42+50

MATCH LINE SHEET No.16 -Y2- Sta. 54+50



-BY2- NCGS 'E 117' PINC Sta. 80+23.93 =  
 -Y2- POT Sta. 52+27.35 (56.78' LT.)

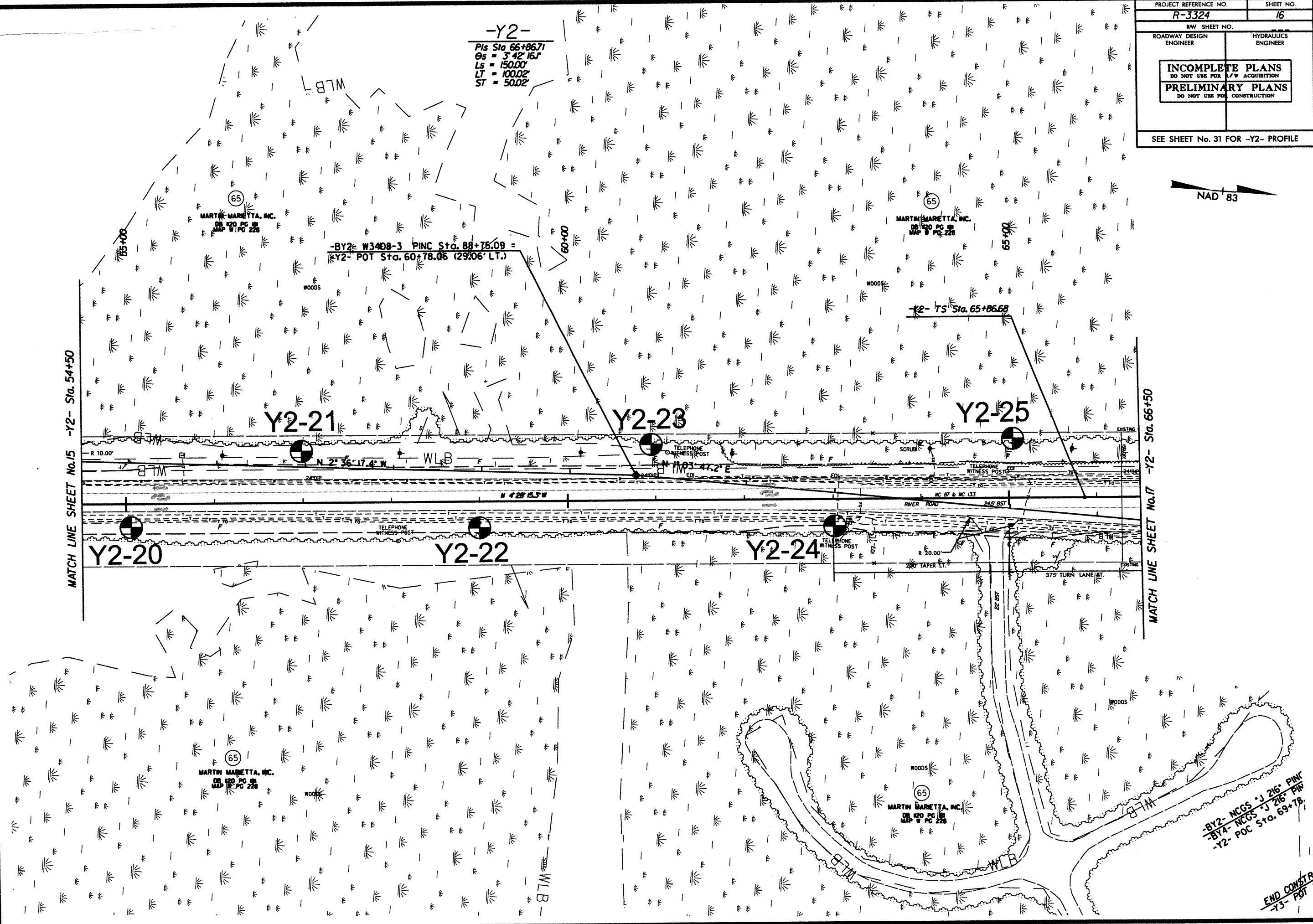
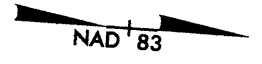
-BY2- 18 PINC Sta. 71+25.69 =  
 -Y2- POT Sta. 43+35.92 (14.08' RT.)

\*\*\*\*\*SYSTEMS\*\*\*\*\*  
 \*\*\*\*\*DESIGN\*\*\*\*\*  
 \*\*\*\*\*\*\*\*\*\*

8/17/99

\*\*\*\*\*SYSTEMS DESIGN\*\*\*\*\*  
\*\*\*\*\*SERIALS\*\*\*\*\*

PROJECT REFERENCE NO. <b>R-3324</b>	SHEET NO. <b>16</b>
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>INCOMPLETE PLANS</b> DO NOT USE FOR ACQUISITION <b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	
SEE SHEET No. 31 FOR -Y2- PROFILE	



**-Y2-**  
 PIs Sta 66+86.71  
 Os = 3'42" 16J  
 Ls = 150.00'  
 LT = 100.02'  
 ST = 50.02'

**-BY2- W3408-3 PINC Sta. 88+75.09 =**  
**-Y2- POT Sta. 60+78.06 (29'06" LT.)**

**-Y2- TS Sta. 65+86.68**

MATCH LINE SHEET No.15 -Y2- Sta. 54+50

MATCH LINE SHEET No.17 -Y2- Sta. 66+50

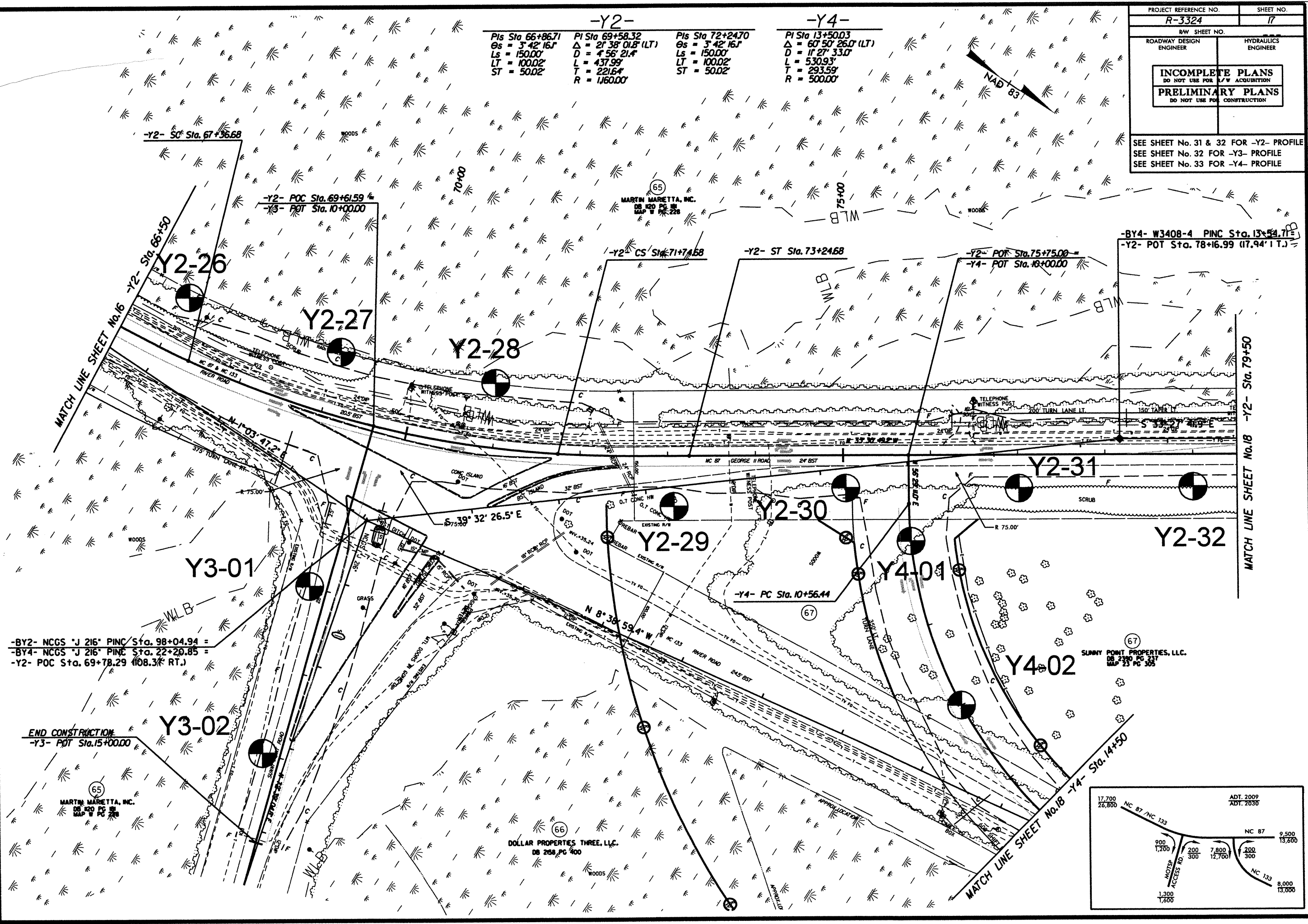
**-BY2- NCGS -J 216' PINC**  
**-BY4- NCGS -J 216' PINC**  
**-Y2- POC Sta. 69+78**

**END CONSTR**  
**-Y3- POT**

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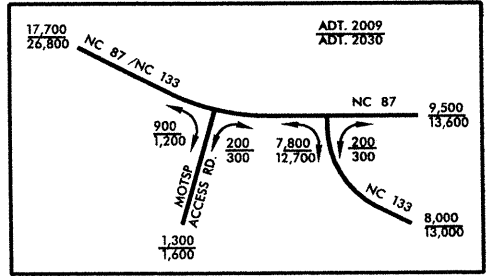
PROJECT REFERENCE NO. <b>R-3324</b>	SHEET NO. <b>17</b>
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>INCOMPLETE PLANS</b> DO NOT USE FOR A/W ACQUISITION <b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	
SEE SHEET No. 31 & 32 FOR -Y2- PROFILE SEE SHEET No. 32 FOR -Y3- PROFILE SEE SHEET No. 33 FOR -Y4- PROFILE	

-Y2-		-Y4-	
PIs Sta 66+86.71	PI Sta 69+58.32	PIs Sta 72+24.70	PI Sta 13+50.03
Δs = 3' 42" 16J	Δ = 2' 38" 01.8' (LT)	Δs = 3' 42" 16J	Δ = 60' 50" 26.0' (LT)
Ls = 150.00'	D = 4' 56" 21.4'	Ls = 150.00'	D = 1' 27" 33.0'
LT = 100.02'	L = 437.99'	LT = 100.02'	L = 530.93'
ST = 50.02'	T = 221.64'	ST = 50.02'	T = 293.59'
	R = 1160.00'		R = 500.00'



-BY2- NCGS 'J 216' PINC Sta. 98+04.94 =  
 -BY4- NCGS 'J 216' PINC Sta. 22+20.85 =  
 -Y2- POC Sta. 69+78.29 (108.3% RT.)

END CONSTRUCTION  
 -Y3- PPT Sta. 15+00.00



\*\*\*\*\* SYSTEMS \*\*\*\*\*  
 \*\*\*\*\* DIMENSIONS \*\*\*\*\*  
 \*\*\*\*\* DISTANCES \*\*\*\*\*

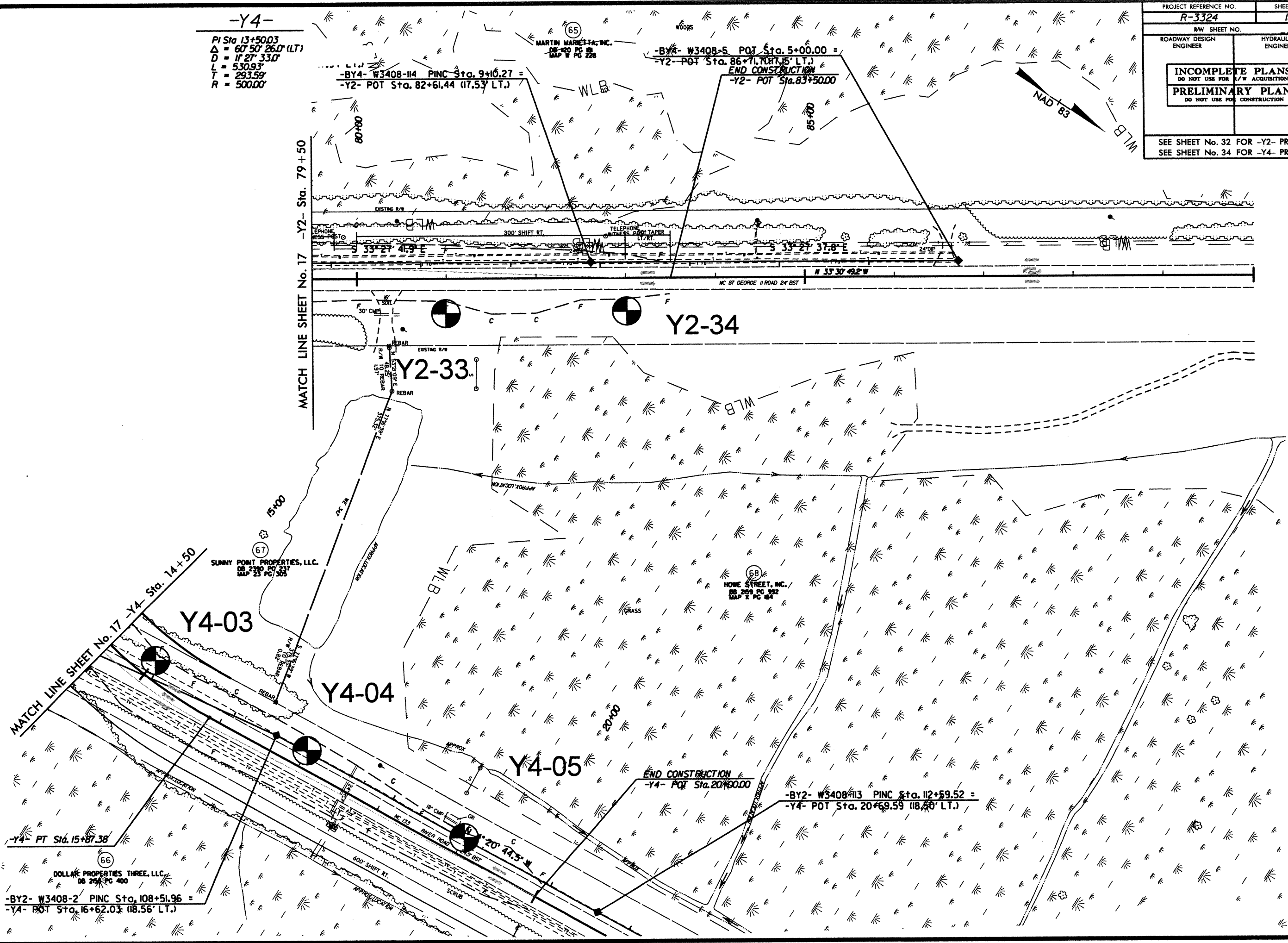
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PROJECT REFERENCE NO. <b>R-3324</b>	SHEET NO. <b>18</b>
RAW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>INCOMPLETE PLANS</b> DO NOT USE FOR P/W ACQUISITION <b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	
SEE SHEET No. 32 FOR -Y2- PROFILE	
SEE SHEET No. 34 FOR -Y4- PROFILE	

**-Y4-**  
 PI Sta 13+50.03  
 $\Delta = 60^{\circ}50'26.0''$  (LT.)  
 $D = 11^{\circ}27'33.0''$   
 $L = 530.93'$   
 $T = 293.59'$   
 $R = 500.00'$

**-BY4- W3408-14** PINC Sta. 9+16.27 =  
**-Y2- POT Sta. 82+61.44** (17.53' LT.)

**-BY4- W3408-5** POT Sta. 5+00.00 =  
**-Y2- POT Sta. 86+71.77** (5' LT.)  
 END CONSTRUCTION  
**-Y2- POT Sta. 83+50.00**



MATCH LINE SHEET No. 17 -Y4- Sta. 14+50

**SUNNY POINT PROPERTIES, LLC.**  
 DB 230 PG 237  
 MAP 23 PG 305

**HOWE STREET, INC.**  
 DB 229 PG 392  
 MAP 3 PG 84

**DOLLAR PROPERTIES THREE, LLC.**  
 DB 254 PG 400

**-BY2- W3408-2** PINC Sta. 108+51.96 =  
**-Y4- POT Sta. 16+62.03** (18.56' LT.)

END CONSTRUCTION  
**-Y4- POT Sta. 20+00.00**

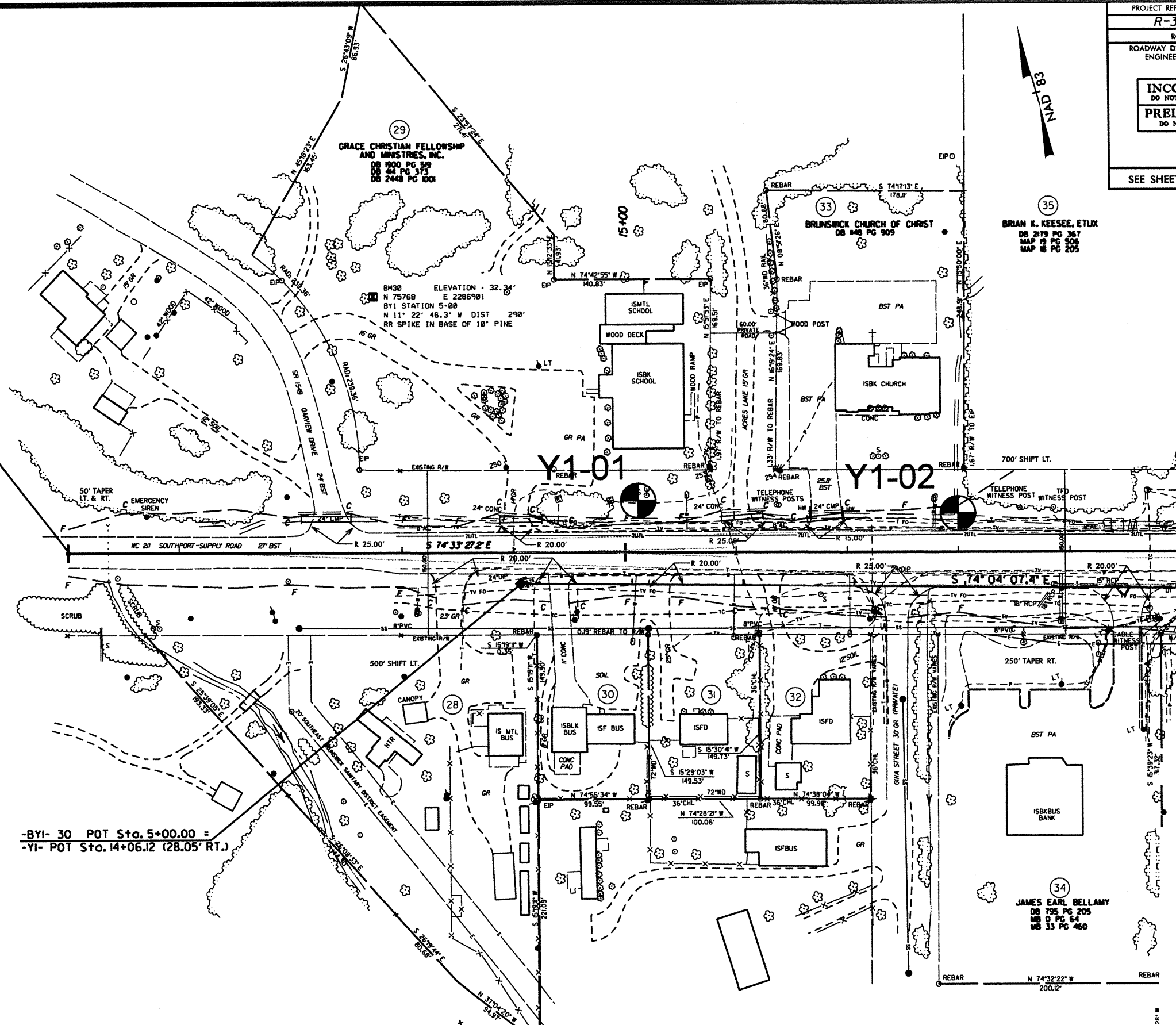
**-BY2- W3408-13** PINC Sta. 112+59.52 =  
**-Y4- POT Sta. 20+69.59** (18.46' LT.)

\*\*\*\*\*SYSTEMS\*\*\*\*\*  
 \*\*\*\*\*DRAWING\*\*\*\*\*  
 \*\*\*\*\*REVISIONS\*\*\*\*\*

8/17/99

PROJECT REFERENCE NO. <b>R-3324</b>	SHEET NO. <b>19</b>
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>INCOMPLETE PLANS</b> DO NOT USE FOR ACQUISITION	
<b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	
SEE SHEET No. 28 FOR -Y1- PROFILE	

POT Sta. 10+00.00



-BYI- 30 POT Sta. 5+00.00 =  
 -YI- POT Sta. 14+06.12 (28.05' RT.)

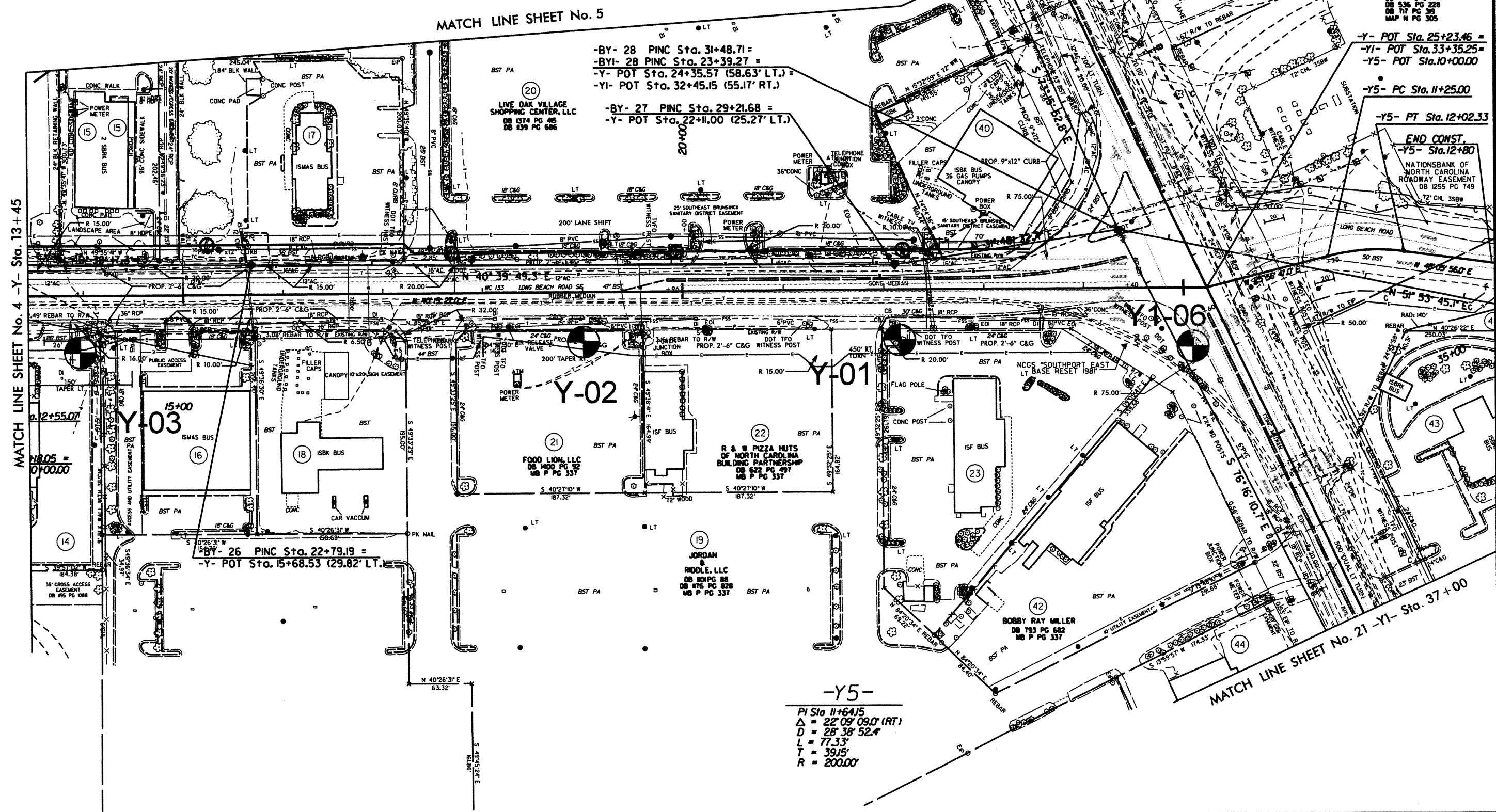
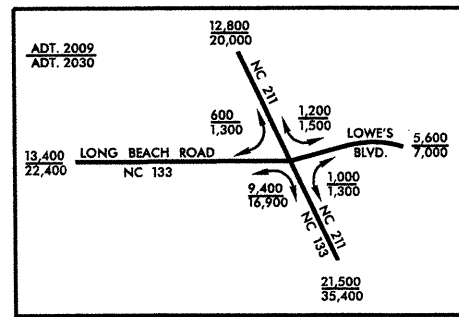
MATCH LINE SHEET No. 5 -Y1- Sta. 20+00

PROPERTY OWNERS			
(28)	TERRY W. KLUTZ ET UX DB 674 PG 495 DB 124 PG 274 MB 0 PG 64	(32)	EDGAR N. HUTT ET UX DB 790 PG 457 MB 0 PG 64
(30)	DONALD STEPHENSON DB 1386 PG 266 MB 0 PG 64	(38)	THE FAMILY EMERGENCY TEEN SHELTER DB 1333 PG 1333 MB 2.5 PG 22
(31)	JOYCE VEREEN FORMY-DUVAL DB 955 PG 64 MB 0 PG 64		

\*\*\*\*\*SYSTEMS SOURCE\*\*\*\*\*  
\*\*\*\*\*BY DATE\*\*\*\*\*  
\*\*\*\*\*BY DATE\*\*\*\*\*

PROJECT REFERENCE NO. <b>R-3324</b>	SHEET NO. <b>20</b>
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>INCOMPLETE PLANS</b> DO NOT USE FOR A/W ACQUISITION	
<b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	
SEE SHEET No. 27 FOR -Y- PROFILE SEE SHEET No. 28 & 29 FOR -YI- PROFILE SEE SHEET No. 33 FOR -Y5- PROFILE	

PROPERTY OWNERS			
(14) OAK ISLAND PROPERTIES, LLC DB 2160 PG 840 DB 1596 PG 1295	(23) MCDONALD'S CORPORATION DB 879 PG 694 MB P PG 337	(39) WEAVER R. HATCHER DB 1504 PG 682	(41) BRUNSWICK ELECTRIC MEMBERSHIP CORP. DB 17 PG 674 DB 536 PG 228 DB 717 PG 395 MAP W PG 305
(16) ISAAC SHAMAN ET UX DB 1389 PG 1088 MB 23 PG 49	(40) BALD HEAD ISLAND LIMITED DB 13 PG 677	(42) BOBBY RAY MILLER DB 793 PG 682 MB P PG 337	(43) NATIONS BANK OF NORTH CAROLINA DB 96 PG 320 MAP 1 PG 140
(17) KEITH R. ROGERS ET UX DB 849 PG 990	(44) SAMPSON-BLADEN OL. CO., INC. DB 608 PG 1052 DB 124 PG 262		
(18) JOHN L. HELMS DB 1490 PG 3 MB P PG 337			



-BY- 28 PINC Sta. 31+48.71 =  
-YI- 28 PINC Sta. 23+39.27 =  
-Y- POT Sta. 24+35.57 (58.63' LT.) =  
-YI- POT Sta. 32+45.15 (55.17' RT.)

-BY- 27 PINC Sta. 29+21.68 =  
-Y- POT Sta. 22+11.00 (25.27' LT.)

-Y- POT Sta. 25+23.46 =  
-YI- POT Sta. 33+35.25 =  
-Y5- POT Sta. 10+00.00 =  
-Y5- PC Sta. 11+25.00 =  
-Y5- PT Sta. 12+02.33 =

END CONST.  
-Y5- Sta. 12+80  
NATIONS BANK OF NORTH CAROLINA  
ROADWAY EASEMENT  
DB 1255 PG 749  
72' CHL 358W

-Y5-  
PI Sta 11+64.15  
Δ = 22° 09' 09.0" (RT)  
D = 28' 38" 52.4"  
L = 77.33'  
T = 39.15'  
R = 200.00'

MATCH LINE SHEET No. 4 -Y- Sta. 13+45

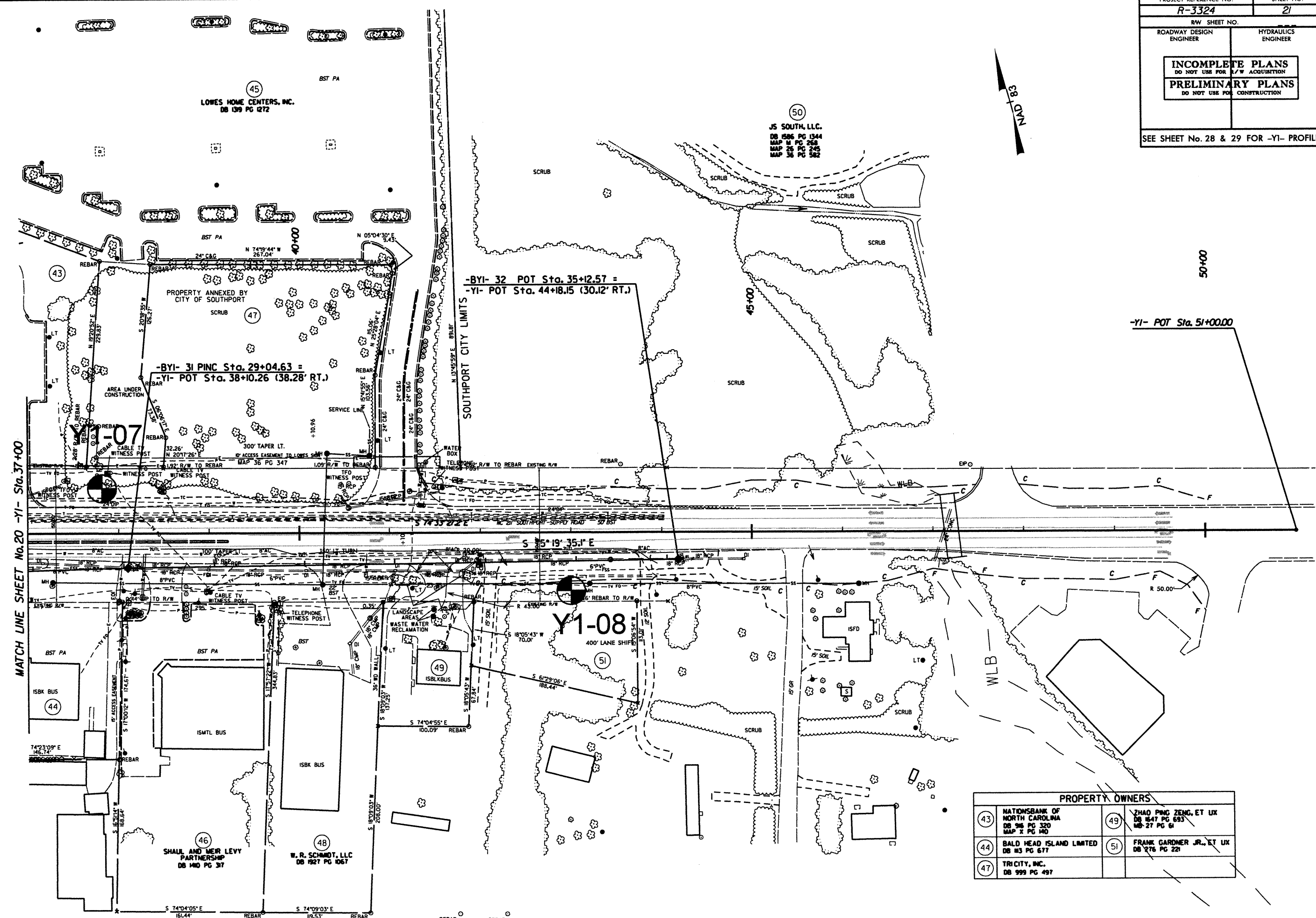
MATCH LINE SHEET No. 21 -YI- Sta. 37+00

\*\*\*\*\*  
SYSTEMS  
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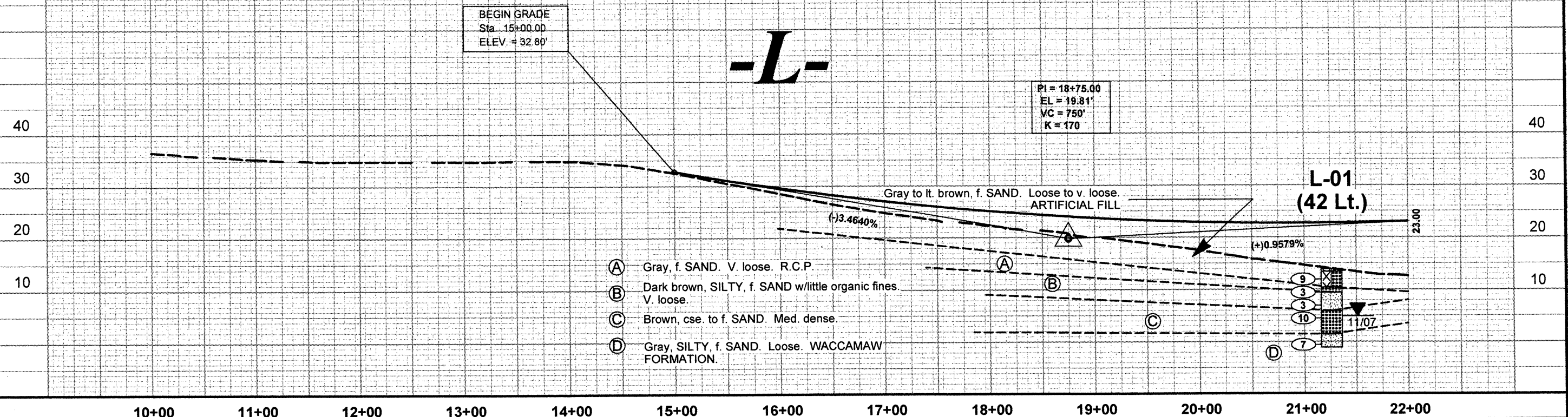
8/17/99

PROJECT REFERENCE NO. <b>R-3324</b>	SHEET NO. <b>21</b>
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>INCOMPLETE PLANS</b> DO NOT USE FOR A/W ACQUISITION	
<b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	
SEE SHEET No. 28 & 29 FOR -Y1- PROFILE	



PROPERTY OWNERS			
43	NATIONSBANK OF NORTH CAROLINA DB 96 PG 320 MAP X PG 140	49	ZHAO PING ZENG, ET UX DB 1647 PG 693 MB-27 PG 6
44	BALD HEAD ISLAND LIMITED DB 143 PG 677	51	FRANK GARDNER JR., ET UX DB 176 PG 22
47	TRICITY, INC. DB 999 PG 497		

\*\*\*\*\*SYTIME\*\*\*\*\*  
\*\*\*\*\*CROSSING\*\*\*\*\*  
\*\*\*\*\*\*\*\*\*\*



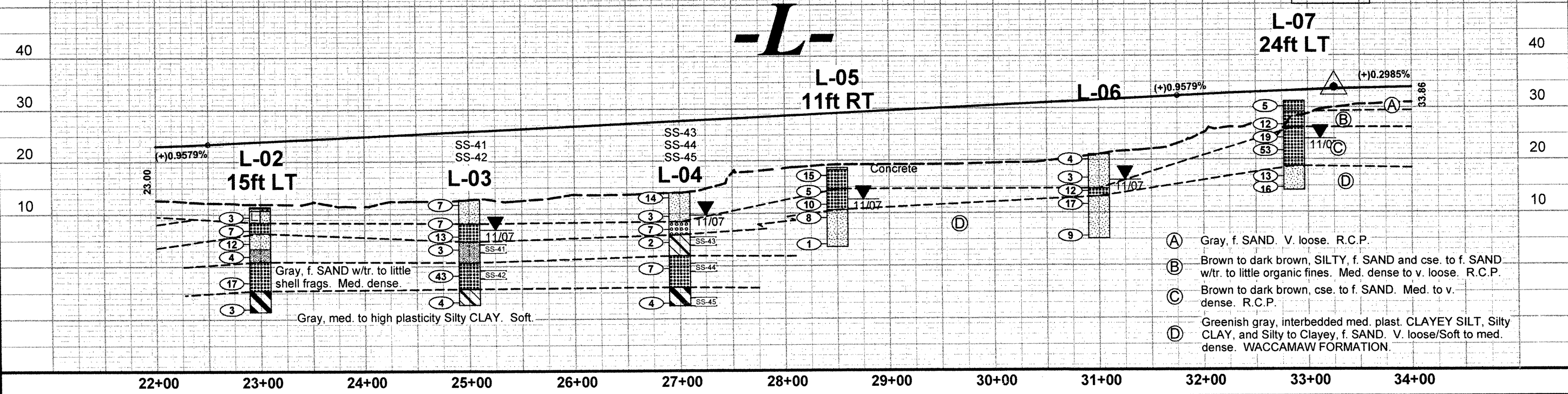
- (A) Gray, f. SAND. V. loose. R.C.P.
- (B) Dark brown, SILTY, f. SAND w/little organic fines. V. loose.
- (C) Brown, cse. to f. SAND. Med. dense.
- (D) Gray, SILTY, f. SAND. Loose. WACCAMAW FORMATION.

10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00

SAMPLE NUMBER	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	LL	PL. I.	% BY WEIGHT				% PASSING SIEVES			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
							SS-41	0	25+00	8.5 - 10.0	A-4(2)	24	8		
SS-42	0	25+00	13.5 - 15.0	A-3(0)	24	NP	9.7	84.2	2.6	3.5	98	93	7	26	NA
SS-43	0	27+00	8.5 - 10.0	A-6(6)	29	14	9.0	33.9	33.7	23.4	100	97	64	41	NA
SS-44	0	27+00	13.5 - 15.0	A-3(0)	23	NP	3.4	93.0	3.0	0.6	100	98	4	26	NA
SS-45	0	27+00	20.0 - 21.5	A-7-6(28)	50	27	1.6	6.5	50.1	41.8	100	99	93	58	NA

SEE SHEETS No's. 4 & 5 FOR -L- DESIGN

PI = 33+25.00  
EL = 33.70'  
VC = 300'  
K = 455

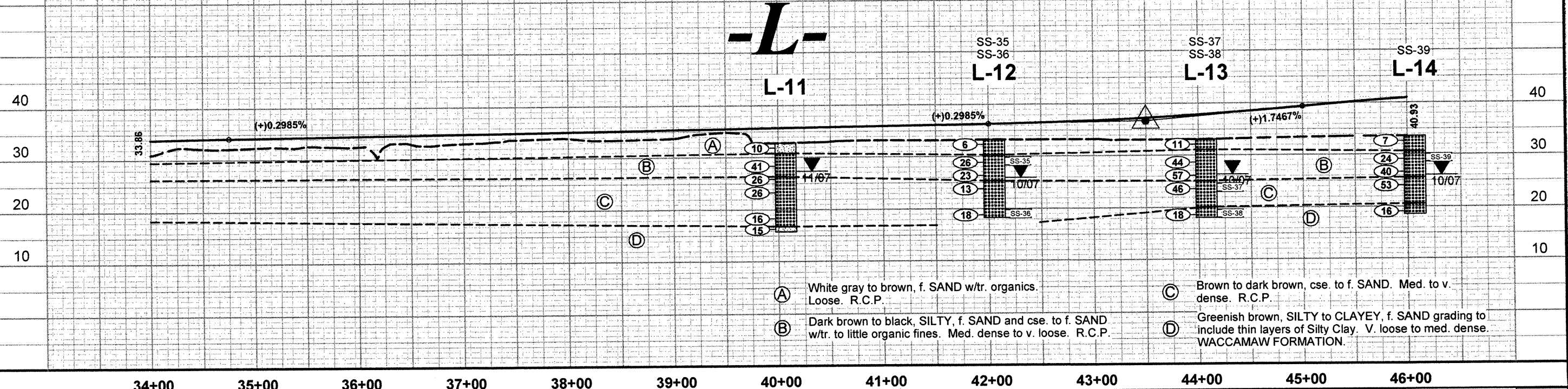


- (A) Gray, f. SAND. V. loose. R.C.P.
- (B) Brown to dark brown, SILTY, f. SAND and cse. to f. SAND w/tr. to little organic fines. Med. dense to v. loose. R.C.P.
- (C) Brown to dark brown, cse. to f. SAND. Med. to v. dense. R.C.P.
- (D) Greenish gray, interbedded med. plast. CLAYEY SILT, Silty CLAY, and Silty to Clayey, f. SAND. V. loose/Soft to med. dense. WACCAMAW FORMATION.

22+00 23+00 24+00 25+00 26+00 27+00 28+00 29+00 30+00 31+00 32+00 33+00 34+00

SAMPLE NUMBER	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.L. I.	% BY WEIGHT				% PASSING SIEVES			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-35	0	42+00	3.5 - 5.0	A-3(0)	14	NP	51.5	39.7	4.1	4.7	100	85	9	15	NA
SS-36	0	42+00	13.5 - 15.0	A-3(0)	18	NP	54.4	44.7	0.9	0.0	99	98	1	15	NA
SS-37	0	44+00	8.5 - 10.0	A-3(0)	16	NP	23.7	73.9	2.4	0.0	100	89	3	25	NA
SS-38	0	44+00	13.5 - 15.0	A-3(0)	12	NP	56.6	42.3	1.1	0.0	99	68	1	22	NA
SS-39	0	46+00	3.5 - 5.0	A-3(0)	16	NP	55.4	39.0	5.6	0.0	100	86	7	17	NA

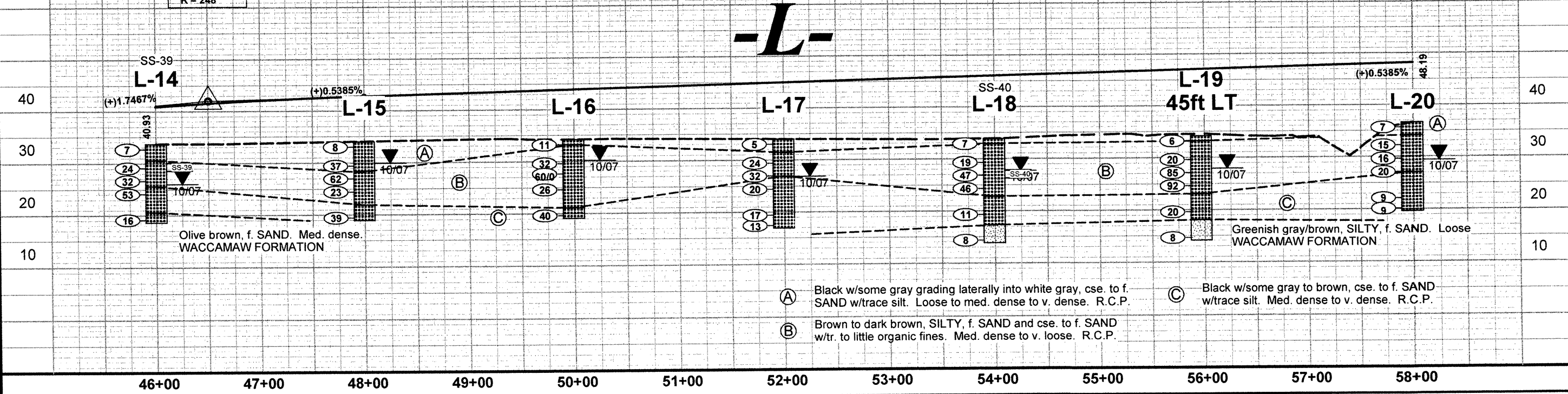
PI = 43+50.00  
 EL = 36.76'  
 VC = 300'  
 K = 207



SAMPLE NUMBER	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.L. I.	% BY WEIGHT				% PASSING SIEVES			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-40	0	54+00	6.0 - 7.5	A-3(0)	13	NP	54.9	40.2	4.1	0.8	100	88	5	21	NA

SEE SHEETS No's. 5 & 6 FOR -L- DESIGN

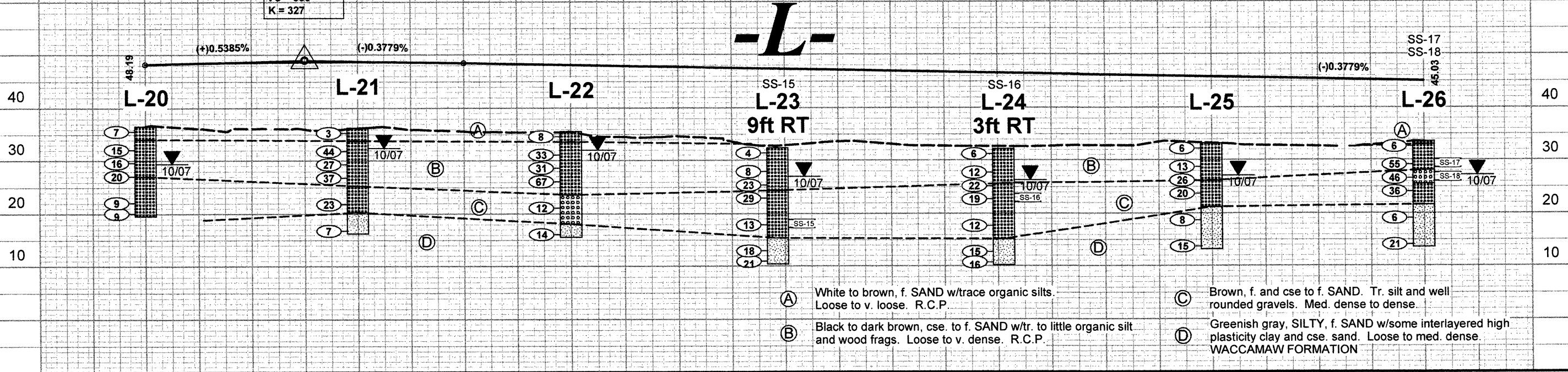
PI = 46+50.00  
 EL = 42.00'  
 VC = 300'  
 K = 248



- (A) Black w/some gray grading laterally into white gray, cse. to f. SAND w/trace silt. Loose to med. dense to v. dense. R.C.P.
- (B) Brown to dark brown, SILTY, f. SAND and cse. to f. SAND w/tr. to little organic fines. Med. dense to v. loose. R.C.P.
- (C) Black w/some gray to brown, cse. to f. SAND w/trace silt. Med. dense to v. dense. R.C.P.

SOIL TEST RESULTS															
SAMPLE NUMBER	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.L.	% BY WEIGHT				% PASSING SIEVES			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-15	9 Rt	63+93	13.5 - 15.0	A-3(0)	24	NP	49.2	48.4	2.4	0.0	93	53	3	28	NA
SS-16	3 Rt	66+06	8.5 - 10.0	A-3(0)	20	NP	43.4	54.7	1.9	0.0	93	66	2	25	NA
SS-17	0	70+00	3.5 - 5.0	A-3(0)	18	NP	50.7	44.3	5.0	0.0	100	90	6	13	NA
SS-18	0	70+00	6.0 - 7.5	A-3(0)	21	NP	81.0	16.5	2.5	0.0	99	50	3	20	NA

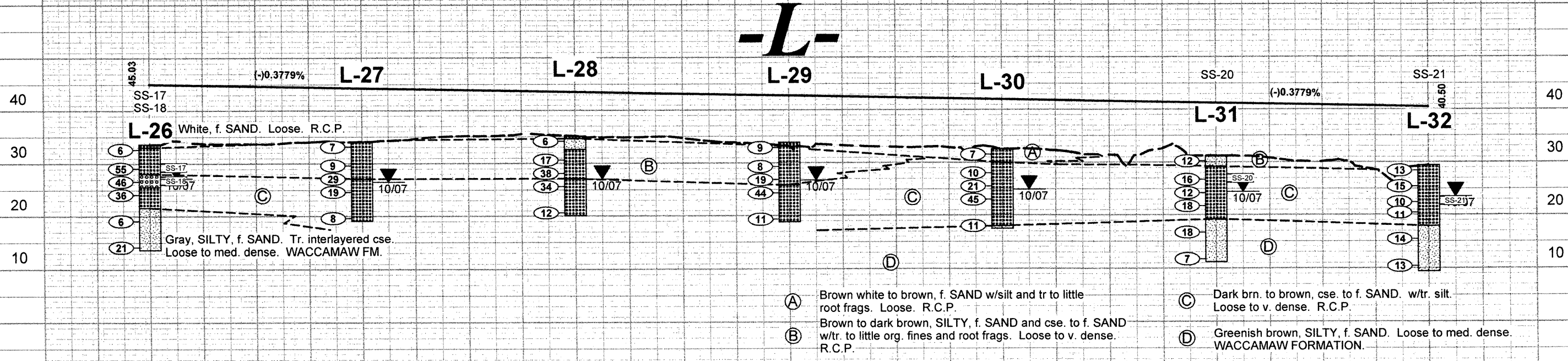
PI = 59+50.00  
EL = 49.00'  
VC = 300'  
K = 327



58+00 59+00 60+00 61+00 62+00 63+00 64+00 65+00 66+00 67+00 68+00 69+00 70+00

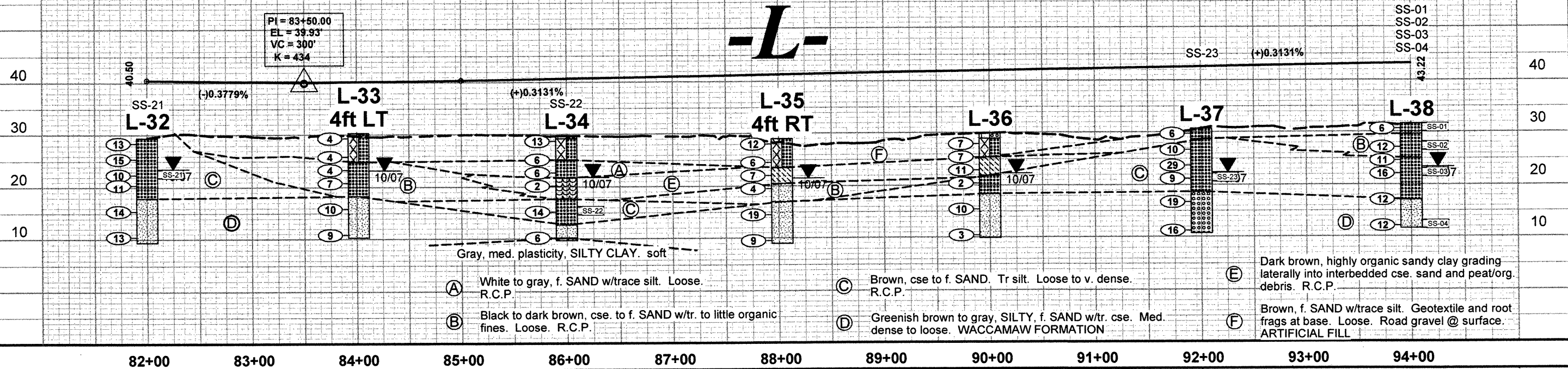
SOIL TEST RESULTS															
SAMPLE NUMBER	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.L.	% BY WEIGHT				% PASSING SIEVES			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-19	0	78+00	13.5 - 15.0	A-3(0)	20	NP	55.1	43.1	1.8	0.0	90	50	2	16	NA
SS-20	0	80+00	3.5 - 5.0	A-3(0)	15	NP	45.4	46.4	2.4	5.8	100	89	8	15	NA
SS-21	0	82+00	6.0 - 7.5	A-3(0)	18	NP	51.3	47.4	1.3	0.0	94	66	1	22	NA

SEE SHEETS No's 7, 8 & 9 FOR -L- DESIGN

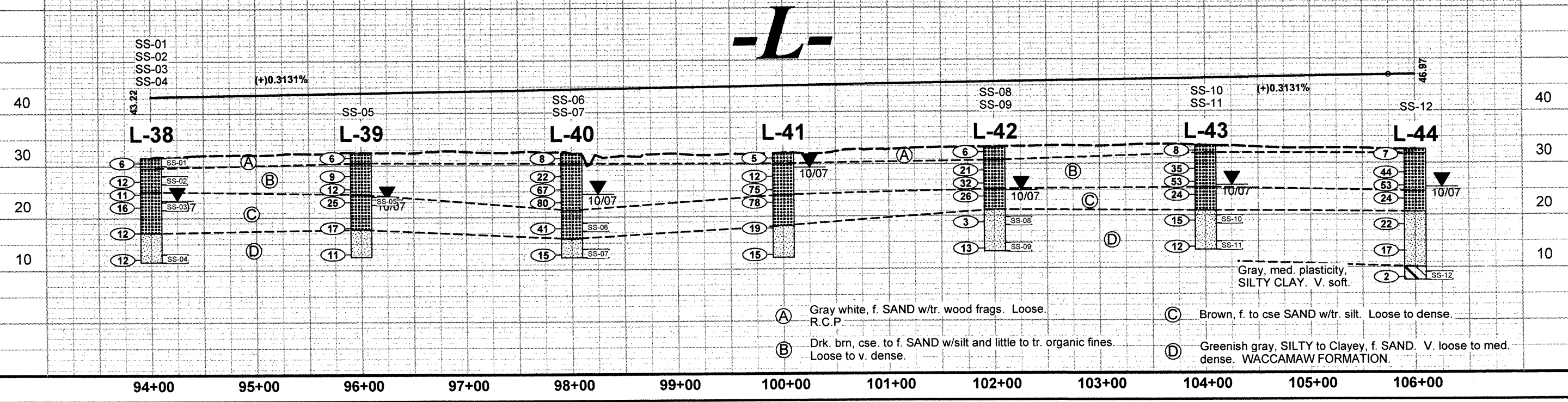


70+00 71+00 72+00 73+00 74+00 75+00 76+00 77+00 78+00 79+00 80+00 81+00 82+00

SAMPLE NUMBER	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	PL. I.	% BY WEIGHT				% PASSING SIEVES			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-21	0	82+00	6.0 - 7.5	A-3(0)	18	NP	51.3	47.4	1.3	0.0	94	66	1	22	NA
SS-33A	4 Lt	84+02	6.0 - 7.5	A-3(0)	25	NP	66.4	26.2	5.4	2.0	100	64	8		3.4
SS-33B	4 Lt	84+02	8.5 - 10.0	A-3(0)	24	NP	55.8	38.6	3.6	2.0	96	69	6		1.1
SS-34	0	86+00	8.5 - 10.0	( )			NOT ENOUGH MATERIAL				ENOUGH MATERIAL				32.2
SS-22	0	86+00	13.5 - 15.0	A-3(0)	20	NP	59.7	38.7	0.8	0.8	100	68	2	23	NA
SS-35	4 Rt	88+03	8.5 - 10.0	A-2-4(0)	28	NP	33.5	51.0	7.4	8.1	100	90	17		4.7
SS-23	0	92+00	8.5 - 10.0	A-3(0)	15	NP	55.0	43.4	1.6	0.0	98	65	2	23	NA
SS-01	0	94+00	0.0 - 1.5	A-3(0)	16	NP	45.6	51.2	2.0	1.2	100	91	3	3	NA
SS-02	0	94+00	3.5 - 5.0	A-3(0)	15	NP	55.7	42.6	1.5	0.2	100	87	2	10	NA
SS-03	0	94+00	8.5 - 10.0	A-3(0)	20	NP	54.9	44.3	-0.4	1.2	99	74	1	21	NA
SS-04	0	94+00	18.5 - 20.0	A-2-4(0)	25	NP	3.0	90.3	5.5	1.2	99	97	15		NA

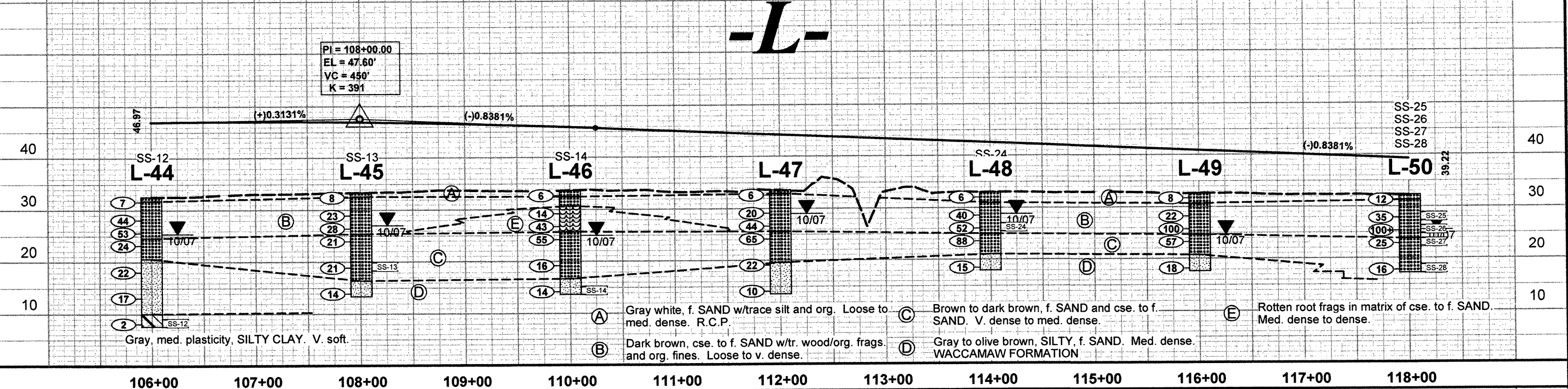


SAMPLE NUMBER	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	PL. I.	% BY WEIGHT				% PASSING SIEVES			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-05	0	96+00	8.5 - 10.0	A-3(0)	23	NP	41.8	55.9	1.1	1.2	97	70	3	21	NA
SS-06	0	98+00	13.5 - 15.0	A-3(0)	19	NP	49.5	48.5	1.8	0.2	98	63	3	23	NA
SS-07	0	98+00	18.5 - 20.0	A-2-4(0)	28	NP	1.4	86.7	5.6	6.3	100	99	22	32	NA
SS-08	0	102+00	13.5 - 15.0	A-2-4(0)	23	NP	1.1	80.7	7.5	10.7	100	99	20	29	NA
SS-09	0	102+00	18.5 - 20.0	A-2-4(0)	27	NP	0.5	88.1	4.8	6.6	100	100	19	30	NA
SS-10	0	104+00	13.5 - 15.0	A-2-4(0)	26	NP	1.3	90.7	0.3	7.7	100	99	12	31	NA
SS-11	0	104+00	18.5 - 20.0	A-2-4(0)	26	NP	0.3	88.8	6.3	4.6	100	100	18	28	NA
SS-12	0	106+00	23.5 - 25.0	A-6(12)	34	17	1.3	26.8	42.5	29.4	100	100	79	36	NA

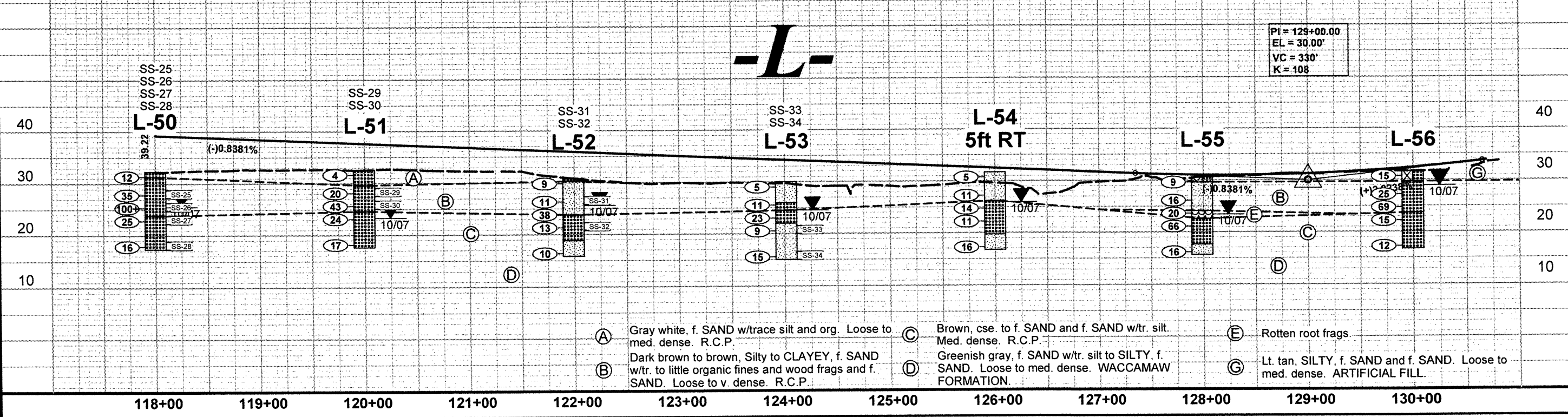


SEE SHEETS No's. 9 & 10 FOR -L- DESIGN

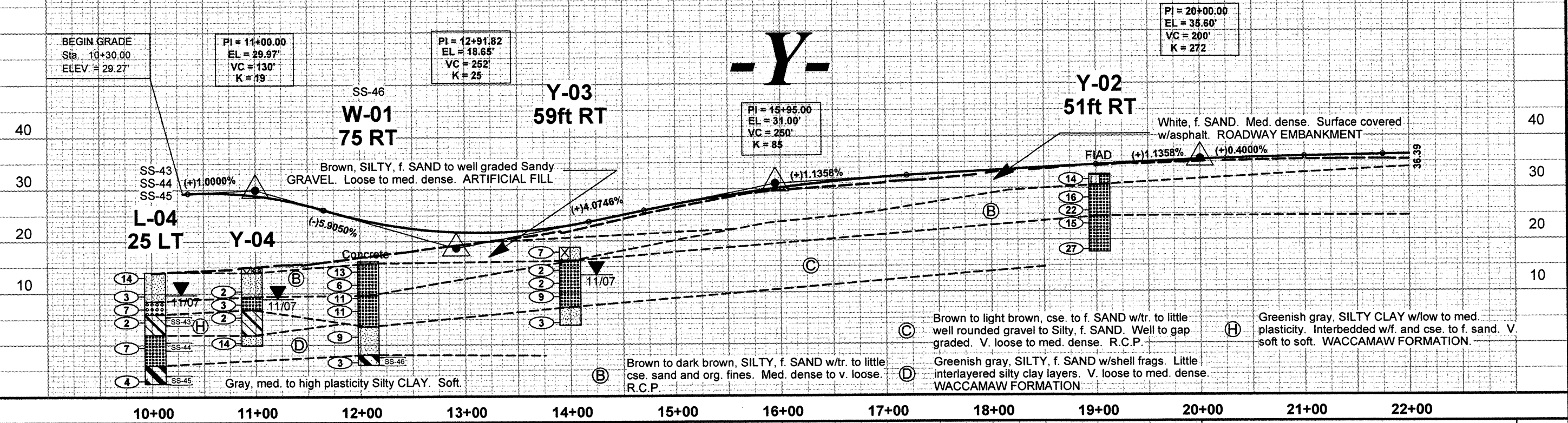
SAMPLE NUMBER	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	PL. I.	% BY WEIGHT				% PASSING SIEVES			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-12	0	106+00	23.5 - 25.0	A-6(12)	34	17	1.3	26.8	42.5	29.4	100	100	79	36	NA
SS-13	0	108+00	13.5 - 15.0	A-3(0)	20	NP	50.1	48.1	1.2	0.6	98	71	2	23	NA
SS-14	0	110+00	18.5 - 20.0	A-2-4(0)	26	NP	2.4	87.4	6.8	3.6	100	99	20	NA	NA
SS-24	0	114+00	6.0 - 7.5	A-3(0)	18	NP	47.9	47.8	2.0	2.3	99	83	5	20	NA
SS-25	0	118+00	3.5 - 5.0	A-3(0)	20	NP	41.0	53.1	2.6	3.3	100	87	7	19	NA
SS-26	0	118+00	6.0 - 7.5	A-3(0)	18	NP	47.6	48.5	1.6	2.3	100	85	4	19	NA
SS-27	0	118+00	8.5 - 10.0	A-3(0)	17	NP	50.2	47.9	0.6	1.3	98	68	2	21	NA
SS-28	0	118+00	13.5 - 15.0	A-3(0)	26	NP	11.9	84.2	2.6	1.3	98	89	8	28	NA



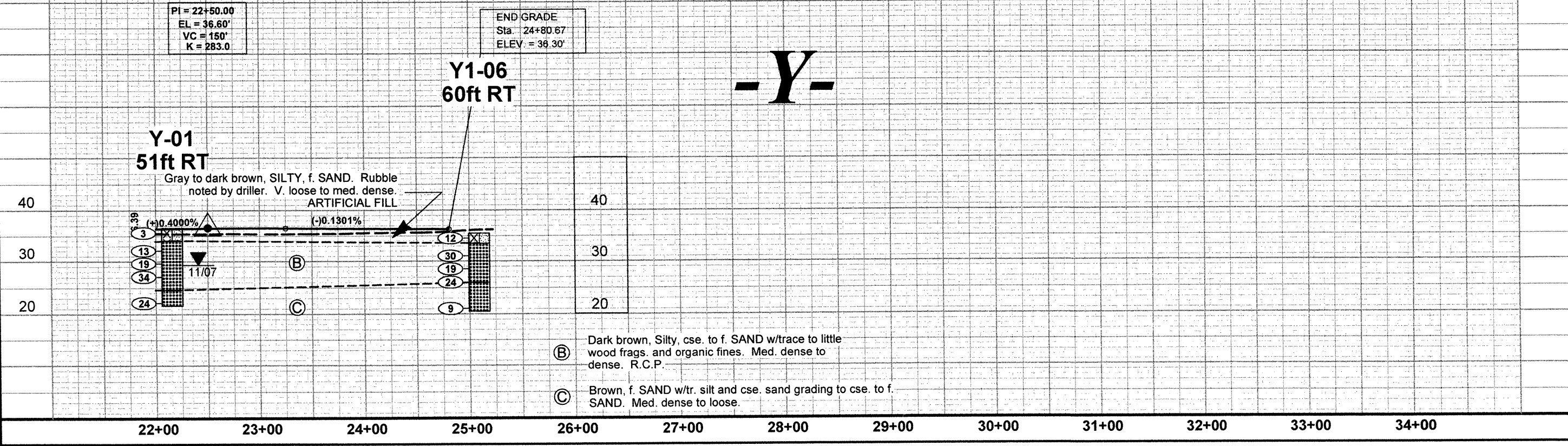
SAMPLE NUMBER	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	PL. I.	% BY WEIGHT				% PASSING SIEVES			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-29	0	120+00	3.5 - 5.0	A-3(0)	26	NP	54.9	38.0	3.8	3.3	99	85	8	22	NA
SS-30	0	120+00	8.5 - 10.0	A-3(0)	24	NP	43.9	54.4	0.4	1.3	99	76	2	24	NA
SS-31	0	122+00	3.5 - 5.0	A-2-4(0)	30	NP	28.9	63.1	8.2	1.8	99	92	11	105	NA
SS-32	0	122+00	8.5 - 10.0	A-3(0)	26	NP	8.2	89.5	2.3	0.0	100	95	4	29	NA
SS-33	0	122+02	8.5 - 10.0	A-2-4(0)	21	NP	2.7	89.5	7.8	0.0	100	98	11	29	NA
SS-34	0	122+02	13.5 - 15.0	A-2-4(0)	27	NP	0.9	90.6	8.5	0.0	100	99	24	33	NA

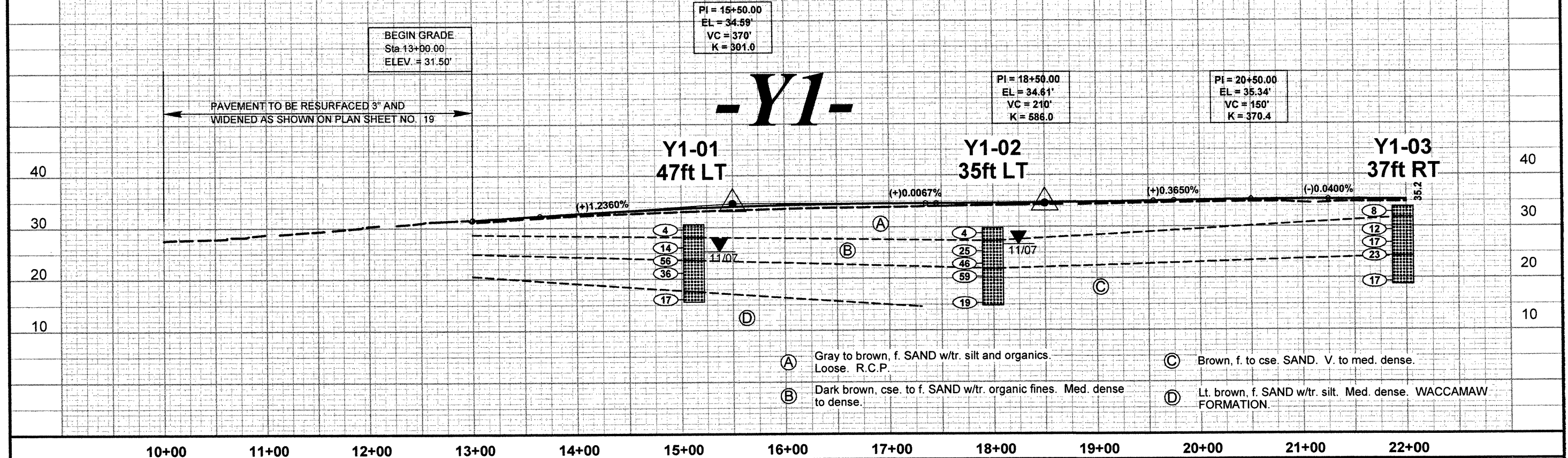


SOIL TEST RESULTS															
SAMPLE NUMBER	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	PL. I.	% BY WEIGHT				% PASSING SIEVES			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-43	25 Lt.	10+00	8.5 - 10.0	A-6(6)	29	14	9.0	33.9	33.7	23.4	100	97	64	41	NA
SS-44	25 Lt.	10+00	13.5 - 15.0	A-3(0)	23	NP	3.4	93.0	3.0	0.6	100	98	4	26	NA
SS-45	25 Lt.	10+00	20.0 - 21.5	A-7-6(28)	50	27	1.6	6.5	50.1	41.8	100	99	93	58	NA
SS-46	75 Rt.	12+09	18.5 - 20.0	A-7-6(24)	46	24	2.8	6.7	53.2	37.3	100	99	91	38	NA



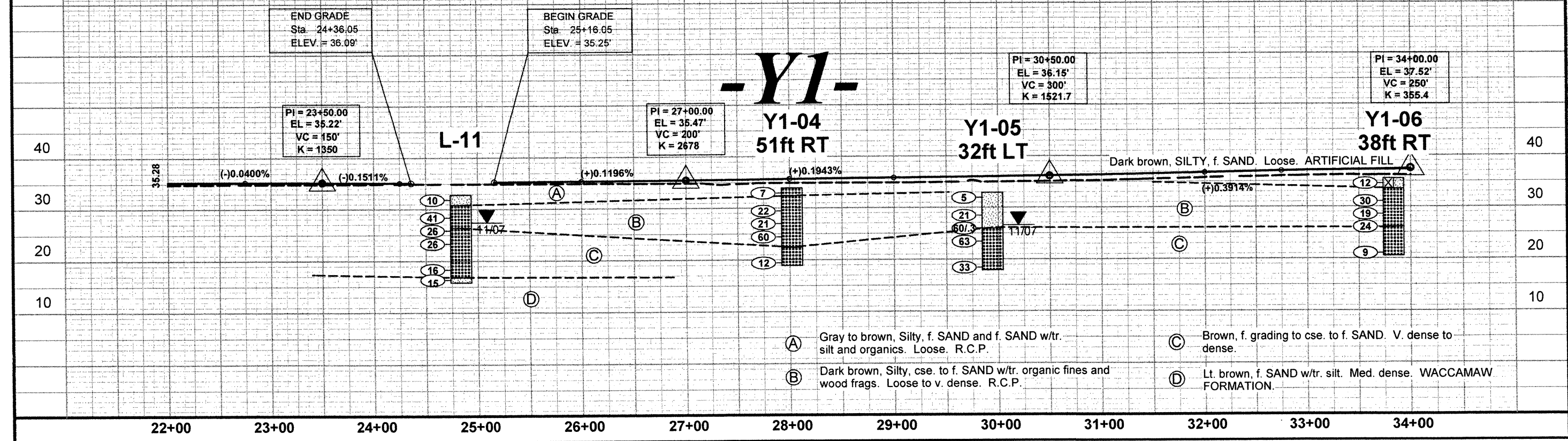
SEE SHEETS No's. 4 & 20 FOR -Y- DESIGN





10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00

SEE SHEETS No's. 20 & 5 FOR -Y1- DESIGN



22+00 23+00 24+00 25+00 26+00 27+00 28+00 29+00 30+00 31+00 32+00 33+00 34+00



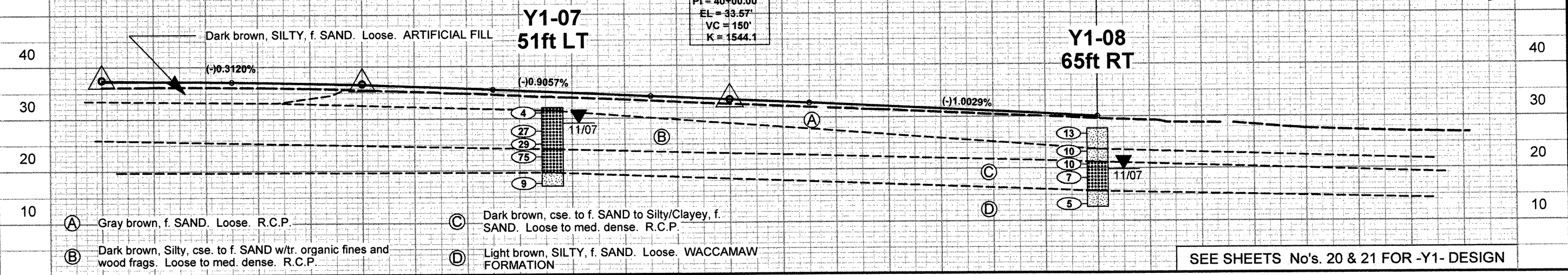
PI = 34+00.00  
 EL = 37.52'  
 VC = 250'  
 K = 355.4

PI = 36+50.00  
 EL = 36.74'  
 VC = 250'  
 K = 421.1

# -Y1-

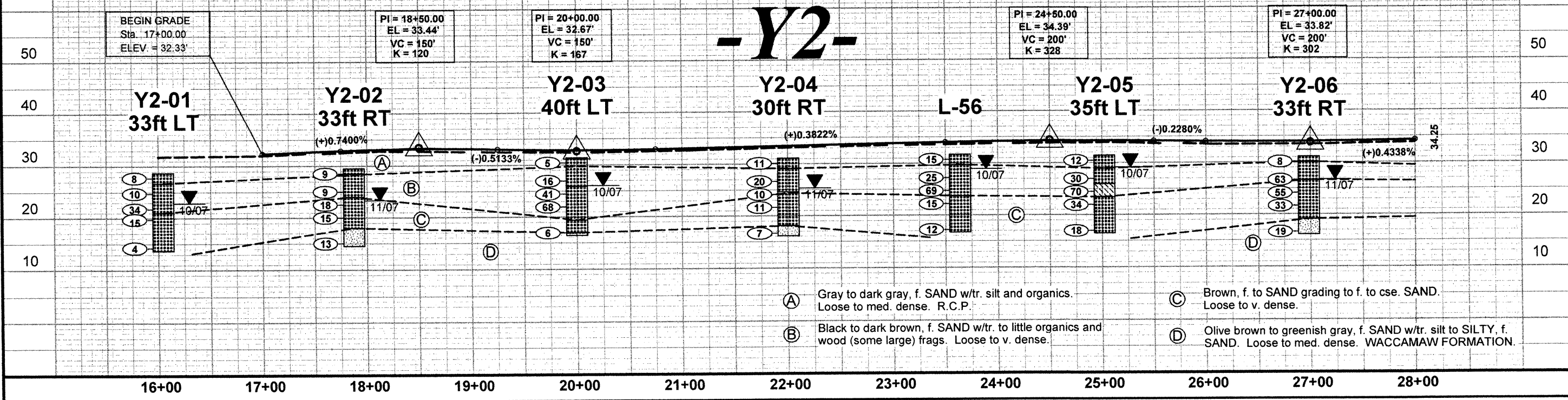
END GRADE  
 Sta. 43+50.00  
 ELEV. = 30.06'

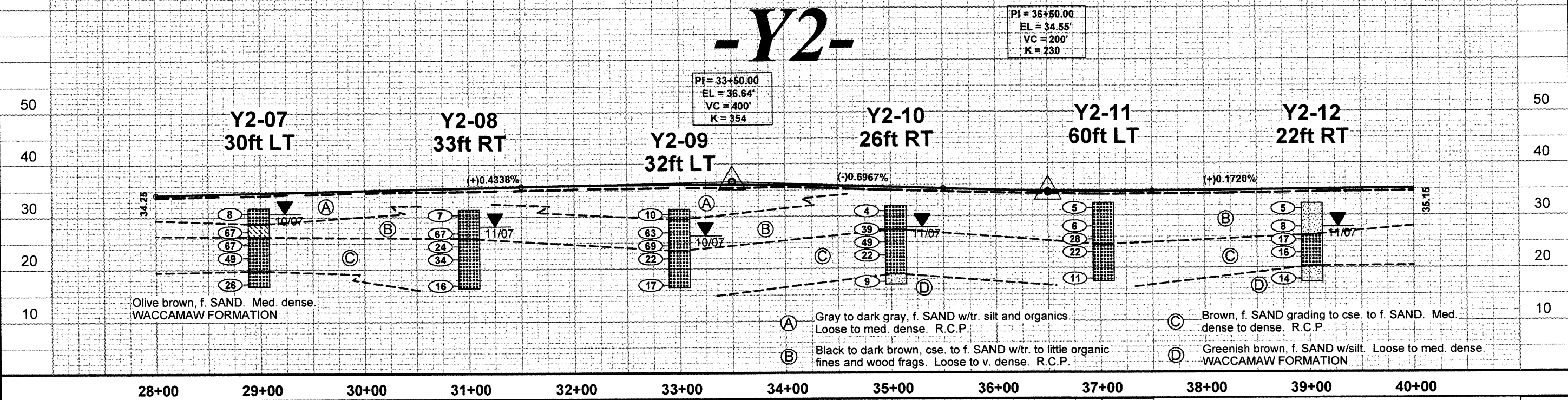
PAVEMENT TO BE RESURFACED 3" AND WIDENED  
 AS SHOWN ON PLAN SHEET NO. 21 TO STA 50+00



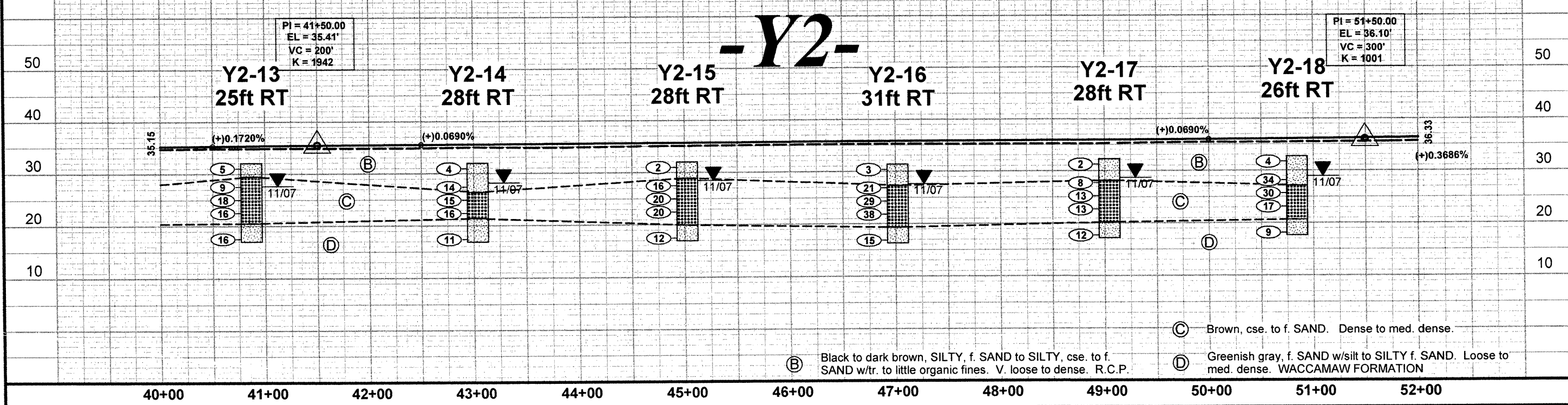
SEE SHEETS No's. 20 & 21 FOR -Y1- DESIGN

SEE SHEETS No's. 13 & 12 FOR -Y2- DESIGN

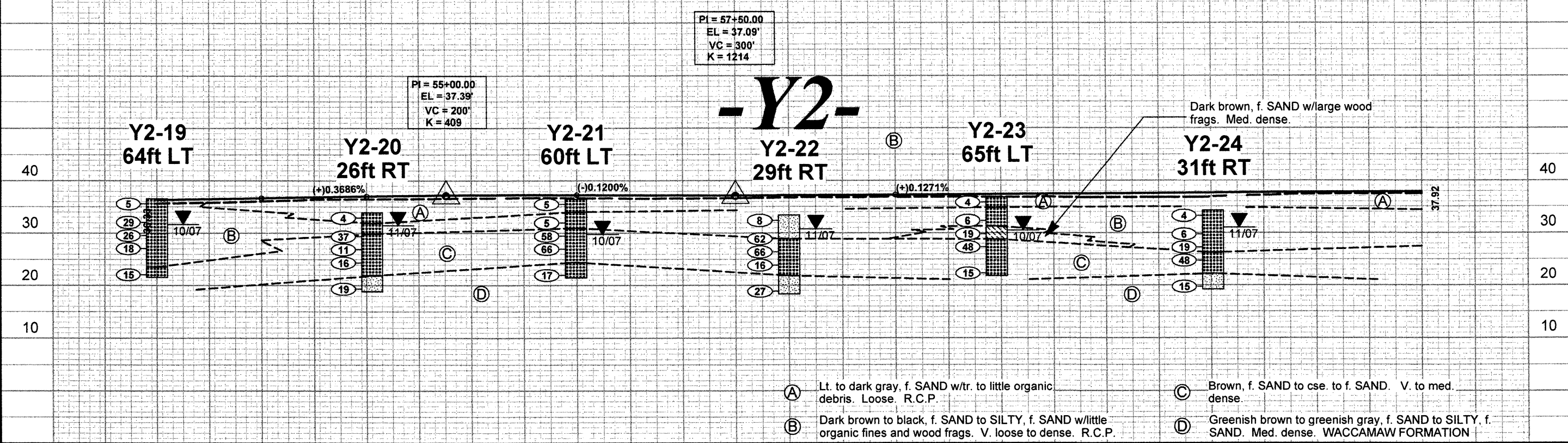




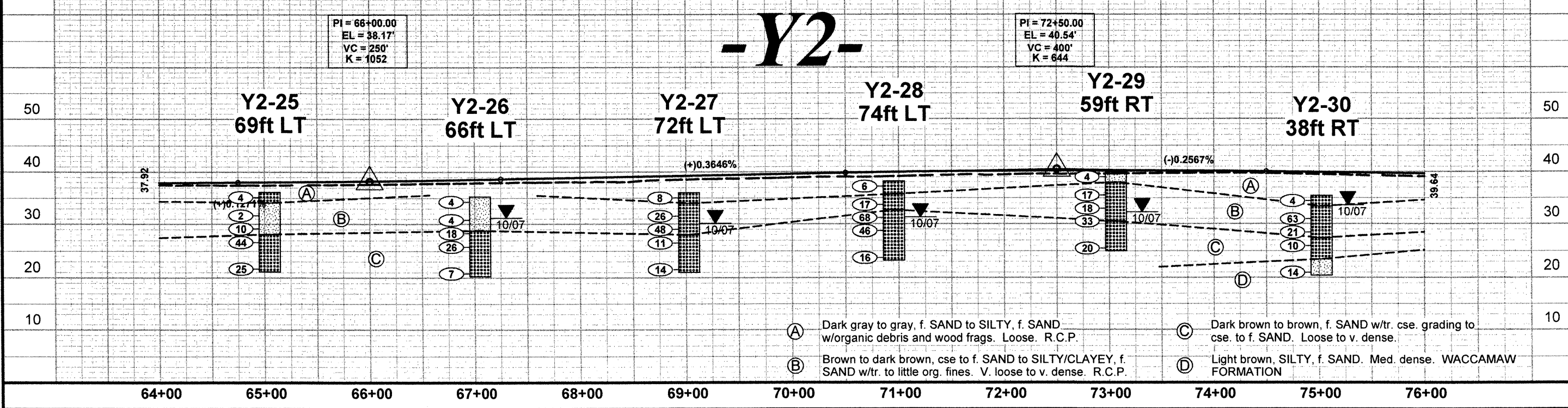
SEE SHEETS No's. 12, 14 & 15 FOR -Y2- DESIGN

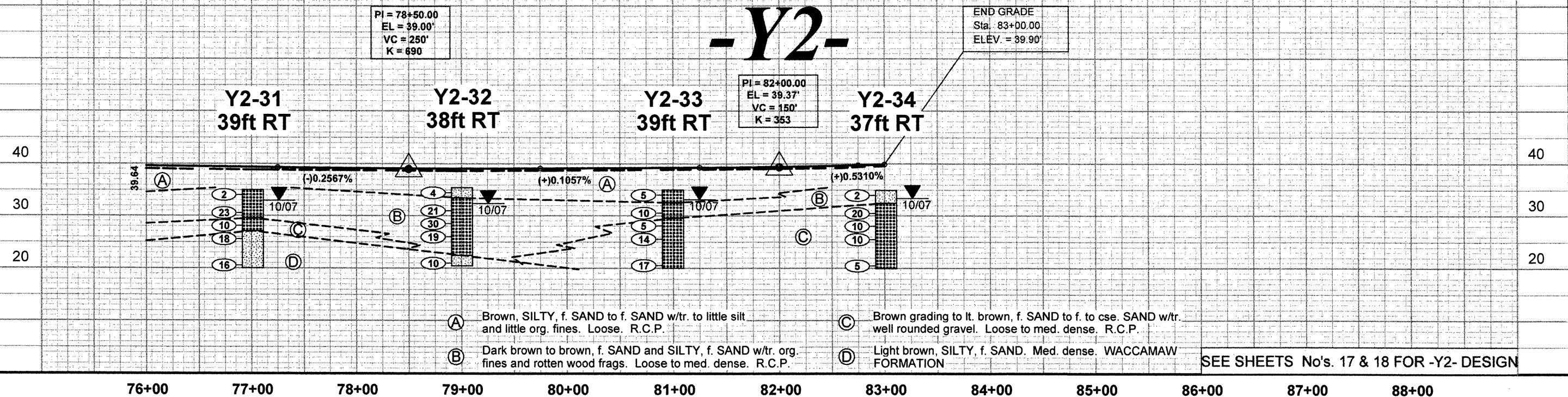


(C) Brown, cse. to f. SAND. Dense to med. dense.  
 (B) Black to dark brown, SILTY, f. SAND to SILTY, cse. to f. SAND w/tr. to little organic fines. V. loose to dense. R.C.P.  
 (D) Greenish gray, f. SAND w/silt to SILTY f. SAND. Loose to med. dense. WACCAMAW FORMATION



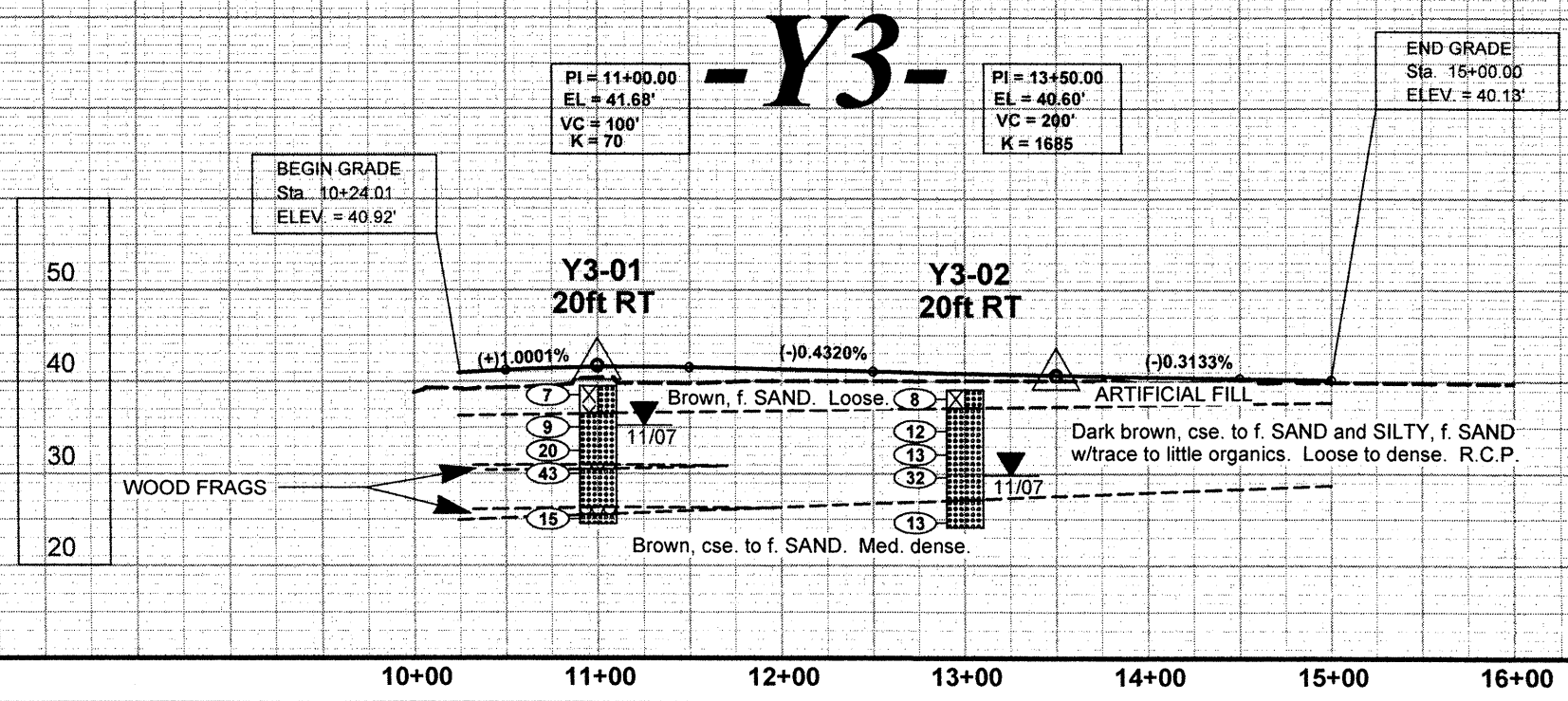
SEE SHEETS No's. 15, 16 & 17 FOR -Y2- DESIGN





76+00    77+00    78+00    79+00    80+00    81+00    82+00    83+00    84+00    85+00    86+00    87+00    88+00

SEE SHEET No. 17 FOR -Y3- DESIGN



10+00    11+00    12+00    13+00    14+00    15+00    16+00

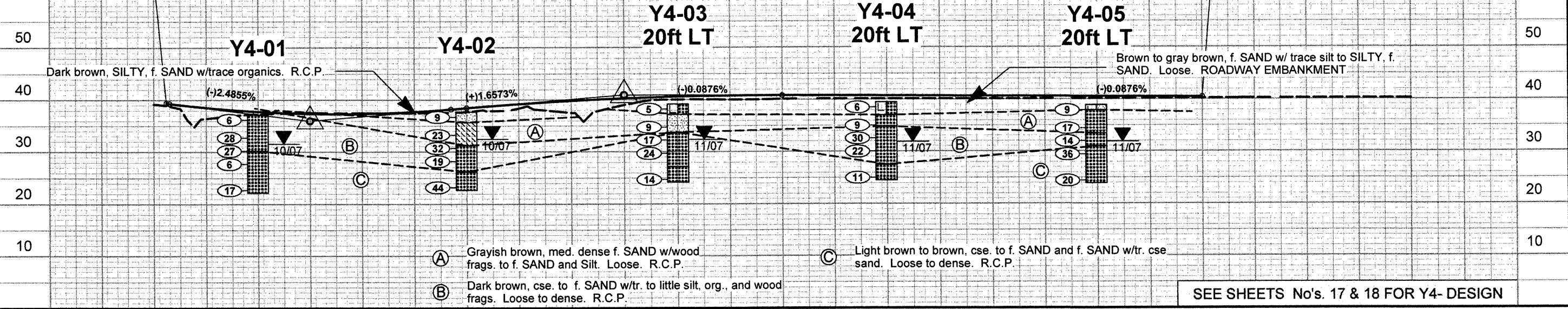
BEGIN GRADE  
Sta. 10+12.00  
ELEV. = 39.41'

PI = 11+50.00  
EL = 35.98'  
VC = 270'  
K = 65

PI = 14+50.00  
EL = 40.95'  
VC = 300'  
K = 172

END GRADE  
Sta. 20+00.00  
ELEV. = 40.47'

# -Y4-



10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00

SEE SHEET No. 20 FOR -Y5- DESIGN

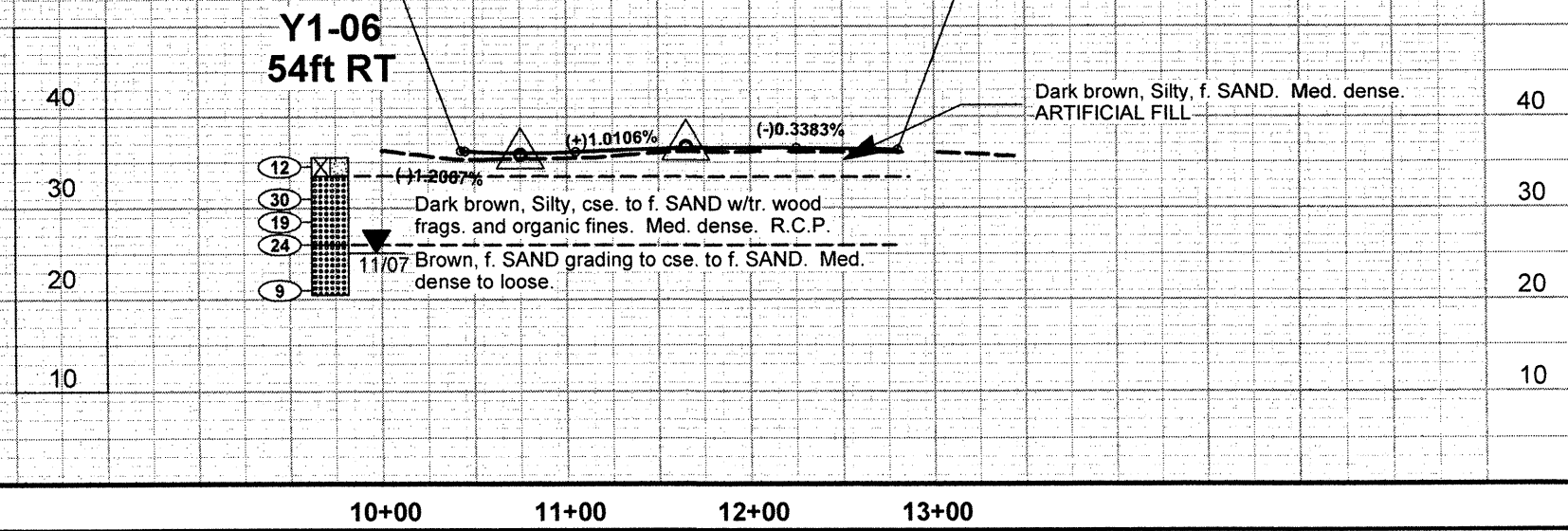
PI = 10+75.00  
EL = 35.79'  
VC = 60'  
K = 27

PI = 11+65.00  
EL = 36.70'  
VC = 120'  
K = 89

BEGIN GRADE  
Sta. 10+42.72  
ELEV. = 36.18'

# -Y5-



END GRADE  
Sta. 12+80.00  
ELEV. = 36.31'



10+00 11+00 12+00 13+00

# NCDOT LABORATORY SUMMARY SHEET

## AASHTO Standard Specifications (As modified by NCDOT, Material and Tests Unit, 2000.)

DESCRIPTION: <b>New Route from NC 133 to NC 133 and NC 87 North of NC 133 on NC 87</b>	<b>ENGLISH</b>	PROJ. NO.: 34531.1.1 SHEET NO.: 34 T.I.P. NO.: R-3324 TOTAL SHEETS: 37 F.A. NO.: STP-133(3) R/W SHEET NO.: COUNTY: BRUNSWICK
	CATLIN PROJECT:  207-068	 GEOTECHNICAL LABORATORY Wilmington, North Carolina

### TEST RESULTS

Field Sample Number	SS-41	SS-42	SS-43	SS-44	SS-45	SS-35	SS-36	SS-37	SS-38	SS-39	SS-40	SS-15	SS-16	SS-17	SS-18
Lab Sample Number	SS-41	SS-42	SS-43	SS-44	SS-45	SS-35	SS-36	SS-37	SS-38	SS-39	SS-40	SS-15	SS-16	SS-17	SS-18
Retained #4 Sieve %	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Passing #10 Sieve %	100	98	100	100	100	100	99	100	99	100	100	93	93	100	99
Passing #40 Sieve %	96	93	97	98	99	85	58	89	68	86	88	53	66	90	50
Passing #200 Sieve %	59	7	64	4	93	9	1	3	1	7	5	3	2	6	3
<b>MINUS NUMBER 10 FRACTION</b>															
<b>SOIL MORTAR - 100%</b>															
Coarse Sand Ret. #60 %	16.1	9.7	9.0	3.4	1.6	51.5	54.4	23.7	56.6	55.4	54.9	49.2	43.4	50.7	81.0
Fine Sand Ret. #270 %	32.2	84.2	33.9	93.0	6.5	39.7	44.7	73.9	42.3	39.0	40.2	48.4	54.7	44.3	16.5
Silt 0.05 - 0.005mm %	36.4	2.6	33.7	3.0	50.1	4.1	0.9	2.4	1.1	5.6	4.1	2.4	1.9	5.0	2.5
Clay <0.005mm %	15.3	3.5	23.4	0.6	41.8	4.7	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0
Liquid Limit (LL)	24	24	29	23	50	14	18	16	12	16	13	24	20	18	21
Plasticity Index (PI)	8	NP	14	NP	27	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
AASHTO Classification /Group Index	<b>A-4(2)</b>	<b>A-3(0)</b>	<b>A-6(6)</b>	<b>A-3(0)</b>	<b>A-7-6(28)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>
Station	25+00	25+00	27+00	27+00	27+00	42+00	42+00	44+00	44+00	46+00	54+00	63+93	66+06	70+00	70+00
Offset	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	9ft RT	3ft RT	0ft CL	0ft CL
Alignment	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-
Boring Identification	<b>L-03</b>	<b>L-03</b>	<b>L-04</b>	<b>L-04</b>	<b>L-04</b>	<b>L-12</b>	<b>L-12</b>	<b>L-13</b>	<b>L-13</b>	<b>L-14</b>	<b>L-18</b>	<b>L-23</b>	<b>L-24</b>	<b>L-26</b>	<b>L-26</b>
Depth ( )	8.5	13.5	8.5	13.5	20.0	3.5	13.5	8.5	13.5	3.5	6.0	13.5	8.5	3.5	6.0
to	10.0	15.0	10.0	15.0	21.5	5.0	15.0	10.0	15.0	5.0	7.5	15.0	10.0	5.0	7.5
Field Moisture Content	37	26	41	26	58	15	15	25	22	17	21	28	25	13	20
Tested By	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM
Submitted By	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH
Date Submitted	11/09/07	11/09/07	11/09/07	11/09/07	11/09/07	10/29/07	10/29/07	10/29/07	10/29/07	10/29/07	10/29/07	10/19/07	10/19/07	10/19/07	10/19/07



NP = Non-Plastic

  
 Laboratory Manager

Report Date: 11/21/2007  
 Laboratory Report Page 1 of 4

# NCDOT LABORATORY SUMMARY SHEET

## AASHTO Standard Specifications (As modified by NCDOT, Material and Tests Unit, 2000.)

DESCRIPTION: <b>New Route from NC 133 to NC 133 and NC 87 North of NC 133 on NC 87</b>	<b>ENGLISH</b>	PROJ. NO.: 34531.1.1   SHEET NO.: 35 T.I.P. NO.: R-3324   TOTAL SHEETS: 37 F.A. NO.: STP-133(3)   R/W SHEET NO.: COUNTY: BRUNSWICK
	CATLIN PROJECT:  207-068	 ENGINEERS and SCIENTISTS GEOTECHNICAL LABORATORY Wilmington, North Carolina

### TEST RESULTS

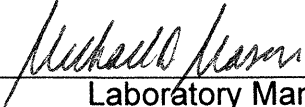
Field Sample Number	SS-19	SS-20	SS-21	SS-33A	SS-33B	SS-34	SS-22	SS-35	SS-23	SS-01	SS-02	SS-03	SS-04	SS-05	SS-06
Lab Sample Number	SS-19	SS-20	SS-21	741774	741775	741776	SS-22	741777	SS-23	SS-01	SS-02	SS-03	SS-04	SS-05	SS-06
Retained #4 Sieve %	1	0	1	0	0	NOT	0	0	1	0	0	0	0	1	0
Passing #10 Sieve %	90	100	94	100	96	ENOUGH	100	100	98	100	100	99	99	97	98
Passing #40 Sieve %	50	89	66	64	69	MATERIAL	68	90	65	91	87	74	97	70	63
Passing #200 Sieve %	2	8	1	8	6		2	17	2	3	2	1	15	3	3

### MINUS NUMBER 10 FRACTION

SOIL MORTAR - 100%															
Coarse Sand Ret. #60 %	55.1	45.4	51.3	66.4	55.8	NOT	59.7	33.5	55.0	45.6	55.7	54.9	3.0	41.8	49.5
Fine Sand Ret. #270 %	43.1	46.4	47.4	26.2	38.6	ENOUGH	38.7	51.0	43.4	51.2	42.6	44.3	90.3	55.9	48.5
Silt 0.05 - 0.005mm %	1.8	2.4	1.3	5.4	3.6	MATERIAL	0.8	7.4	1.6	2.0	1.5	0.4	5.5	1.1	1.8
Clay <0.005mm %	0.0	5.8	0.0	2.0	2.0		0.8	8.1	0.0	1.2	0.2	0.4	1.2	1.2	0.2

Liquid Limit (LL)	20	15	18	25	24		20	28	15	16	15	20	25	23	19
Plasticity Index (PI)	NP	NP	NP	NP	NP		NP	NP	NP	NP	NP	NP	NP	NP	NP
AASHTO Classification / Group Index	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>()</b>	<b>A-3(0)</b>	<b>A-2-4(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-2-4(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>
Station	78+00	80+00	82+00	84+02	84+02	86+00	86+00	88+03	92+00	94+00	94+00	94+00	94+00	96+00	98+00
Offset	0ft CL	0ft CL	0ft CL	4ft LT	4ft LT	0ft CL	0ft CL	4ft RT	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL
Alignment	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-
Boring Identification	<b>L-30</b>	<b>L-31</b>	<b>L-32</b>	<b>L-33</b>	<b>L-33</b>	<b>L-34</b>	<b>L-34</b>	<b>L-35</b>	<b>L-37</b>	<b>L-38</b>	<b>L-38</b>	<b>L-38</b>	<b>L-38</b>	<b>L-39</b>	<b>L-40</b>
Depth ( )	13.5	3.5	6.0	6.0	8.5	8.5	13.5	8.5	8.5	0.0	3.5	8.5	18.5	8.5	13.5
to	15.0	5.0	7.5	7.5	10.0	10.0	15.0	10.0	10.0	1.5	5.0	10.0	20.0	10.0	15.0
Field Moisture Content	16	15	22				23		23	3	10	21		21	23
Tested By	MDM	MDM	MDM	NCDOT	NCDOT	NCDOT	MDM	NCDOT	MDM	MDM	MDM	MDM	MDM	MDM	MDM
Submitted By	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH
Date Submitted	10/19/07	10/19/07	10/19/07	10/24/07	10/24/07	10/24/07	10/19/07	10/24/07	10/19/07	10/16/07	10/16/07	10/16/07	10/16/07	10/16/07	10/16/07

NP = Non-Plastic

  
 Laboratory Manager

Report Date: 11/21/2007  
 Laboratory Report Page 2 of 4

# NCDOT LABORATORY SUMMARY SHEET

## AASHTO Standard Specifications (As modified by NCDOT, Material and Tests Unit, 2000.)

DESCRIPTION: New Route from NC 133 to NC 133 and NC 87 North of NC 133 on NC 87	<b>ENGLISH</b>	PROJ. NO.: 34531.1.1 T.I.P. NO.: R-3324 F.A. NO.: STP-133(3) COUNTY: BRUNSWICK	SHEET NO. 36 TOTAL SHEETS: 37 R/W SHEET NO.:
			CATLIN PROJECT:  207-068
			GEOTECHNICAL LABORATORY Wilmington, North Carolina

### TEST RESULTS

Field Sample Number	SS-07	SS-08	SS-09	SS-10	SS-11	SS-12	SS-13	SS-14	SS-24	SS-25	SS-26	SS-27	SS-28	SS-29	SS-30
Lab Sample Number	SS-07	SS-08	SS-09	SS-10	SS-11	SS-12	SS-13	SS-14	SS-24	SS-25	SS-26	SS-27	SS-28	SS-29	SS-30
Retained #4 Sieve %	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Passing #10 Sieve %	100	100	100	100	100	100	98	100	99	100	100	98	98	99	99
Passing #40 Sieve %	99	99	100	99	100	100	71	99	83	87	85	68	89	85	76
Passing #200 Sieve %	22	20	19	12	18	79	2	20	5	7	4	2	8	8	2

### MINUS NUMBER 10 FRACTION

SOIL MORTAR - 100%															
Coarse Sand Ret. #60 %	1.4	1.1	0.5	1.3	0.3	1.3	50.1	2.4	47.9	41.0	47.6	50.2	11.9	54.9	43.9
Fine Sand Ret. #270 %	86.7	80.7	88.1	90.7	88.8	26.8	48.1	87.4	47.8	53.1	48.5	47.9	84.2	38.0	54.4
Silt 0.05 - 0.005mm %	5.6	7.5	4.8	0.3	6.3	42.5	1.2	6.6	2.0	2.6	1.6	0.6	2.6	3.8	0.4
Clay <0.005mm %	6.3	10.7	6.6	7.7	4.6	29.4	0.6	3.6	2.3	3.3	2.3	1.3	1.3	3.3	1.3

Liquid Limit (LL)	28	23	27	26	26	34	20	26	18	20	18	17	26	26	24
Plasticity Index (PI)	NP	NP	NP	NP	NP	17	NP	NP	NP	NP	NP	NP	NP	NP	NP
AASHTO Classification /Group Index	<b>A-2-4(0)</b>	<b>A-2-4(0)</b>	<b>A-2-4(0)</b>	<b>A-2-4(0)</b>	<b>A-2-4(0)</b>	<b>A-6(12)</b>	<b>A-3(0)</b>	<b>A-2-4(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>	<b>A-3(0)</b>
Station	98+00	102+00	102+00	104+00	104+00	106+00	108+00	110+00	114+00	118+00	118+00	118+00	118+00	120+00	120+00
Offset	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL	0ft CL
Alignment	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-	-L-
Boring Identification	<b>L-40</b>	<b>L-42</b>	<b>L-42</b>	<b>L-43</b>	<b>L-43</b>	<b>L-44</b>	<b>L-45</b>	<b>L-46</b>	<b>L-48</b>	<b>L-50</b>	<b>L-50</b>	<b>L-50</b>	<b>L-50</b>	<b>L-51</b>	<b>L-51</b>
Depth ( )	18.5	13.5	18.5	13.5	18.5	23.5	13.5	18.5	6.0	3.5	6.0	8.5	13.5	3.5	8.5
to	20.0	15.0	20.0	15.0	20.0	25.0	15.0	20.0	7.5	5.0	7.5	10.0	15.0	5.0	10.0
Field Moisture Content	32	29	30	31	28	36	23		20	19	19	21	28	22	24
Tested By	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM	MDM
Submitted By	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH	SVH
Date Submitted	10/16/07	10/18/07	10/18/07	10/18/07	10/18/07	10/18/07	10/18/07	10/18/07	10/18/07	10/29/07	10/29/07	10/29/07	10/29/07	10/29/07	10/29/07

NP = Non-Plastic



Laboratory Manager

Report Date: 11/21/2007  
 Laboratory Report Page 3 of 4



# NCDOT LABORATORY SUMMARY SHEET

**AASHTO Standard Specifications**  
(As modified by NCDOT, Material and Tests Unit, 2000.)

DESCRIPTION <b>New Route from NC 133 to NC 133 and NC 87 North of NC 133 on NC 87</b>	<b>ENGLISH</b>	PROJ. NO.: 34531.1.1 SHEET NO. 37 T.I.P. NO.: R-3324 TOTAL SHEETS 37 F.A. NO.: STP-133(3) RW SHEET NO.: COUNTY: BRUNSWICK
	CATLIN PROJECT:  207-068	 <b>CATLIN</b> ENGINEERS and SCIENTISTS 207-068 GEOTECHNICAL LABORATORY Wilmington, North Carolina

## TEST RESULTS

Field Sample Number	SS-31	SS-32	SS-33	SS-34	SS-46									
Lab Sample Number	SS-31	SS-32	SS-33	SS-34	SS-46									
Retained #4 Sieve %	1	0	0	0	0									
Passing #10 Sieve %	99	100	100	100	100									
Passing #40 Sieve %	92	95	98	99	99									
Passing #200 Sieve %	11	4	11	24	91									

## MINUS NUMBER 10 FRACTION

SOIL MORTAR - 100%														
Coarse Sand Ret. #60 %	26.9	8.2	2.7	0.9	2.8									
Fine Sand Ret. #270 %	63.1	89.5	89.5	90.6	6.7									
Silt 0.05 - 0.005mm %	8.2	2.3	7.8	8.5	53.2									
Clay <0.005mm %	1.8	0.0	0.0	0.0	37.3									

Liquid Limit (LL)	30	26	21	27	46									
Plasticity Index (PI)	NP	NP	NP	NP	24									
AASHTO Classification /Group Index	<b>A-2-4(0)</b>	<b>A-3(0)</b>	<b>A-2-4(0)</b>	<b>A-2-4(0)</b>	<b>A-7-6(24)</b>									
Station	122+00	122+00	122+02	122+02	12+09									
Offset	0ft CL	0ft CL	0ft CL	0ft CL	75ft RT									
Alignment	-L-	-L-	-L-	-L-	-Y-									
Boring Identification	<b>L-52</b>	<b>L-52</b>	<b>L-53</b>	<b>L-53</b>	<b>W-01</b>									
Depth ( )	3.5	8.5	8.5	13.5	18.5									
to	5.0	10.0	10.0	15.0	20.0									
Field Moisture Content	105	29	29	33	38									
Tested By	MDM	MDM	MDM	MDM	MDM									
Submitted By	SVH	SVH	SVH	SVH	SVH									
Date Submitted	10/29/07	10/29/07	10/29/07	10/29/07	11/15/07									

NP = Non-Plastic

  
 Laboratory Manager

Report Date: 11/21/2007  
 Laboratory Report Page 4 of 4

10-3324 Inventory

NOTE: SEE SHEET 1A FOR PLAN SHEET LAYOUT AT TIME OF INVESTIGATION

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

STATE	STATE PROJECT REFERENCE NO.	SHEET	TOTAL SHEETS
N.C.	34531.1.1 (R-3324)	1	11
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION	
		P.E.	
		RW & UTIL.	

CONTENTS

LINE	STATION	PLAN	PROFILE	XSECT
-L-	84+00 TO 90+00	4	-	5-10

**ROADWAY  
SUBSURFACE INVESTIGATION**

PROJ. REFERENCE NO. 34531.1.1 F.A. PROJ. STP-133(3)  
COUNTY BRUNSWICK  
PROJECT DESCRIPTION NEW ROUTE FROM NC 133 (LONG BEACH ROAD) TO NC 133 & NC 87 (RIVER ROAD), NORTH OF NC 133 ON NC 87 (GEORGE II ROAD)

**INVENTORY ADDENDUM**

**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.

CONTRACT: ID: R-3324

PERSONNEL

C.A. YOUNGBLOOD

B.D. WORLEY

G. M. GILLAND

CATLIN ENGINEERS

& SCIENTIST, INC

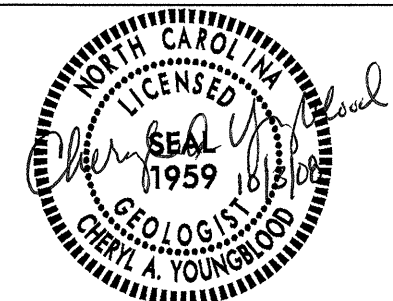
EASTERN REGIONAL

INVESTIGATED BY C.A. YOUNGBLOOD

CHECKED BY K.B. MILLER

SUBMITTED BY K.B. MILLER

DATE AUGUST, 2008



DRAWN BY: C.A. YOUNGBLOOD

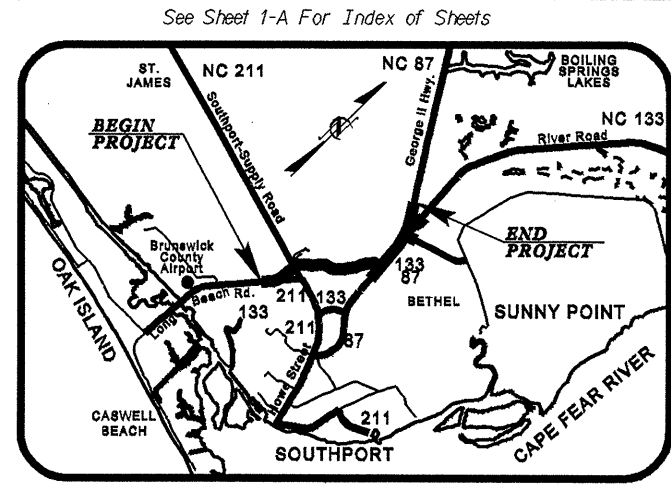
NOTE - THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS BEING ACCURATE NOR IS IT CONSIDERED TO BE PART OF THE PLANS, SPECIFICATIONS, OR CONTRACT FOR THE PROJECT.

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.



03-OCT-2008 11:22 s:\contracts\inve\hgt\log\projects\3324-geo-r.dwg-add\oadd\geotech\planproj\3324-rdy-fsh.dgn cyoundb00d AT 65C237886

**CONTRACT: 34531.1.1**      **TIP PROJECT: R-3324**



STATE OF NORTH CAROLINA  
DIVISION OF HIGHWAYS

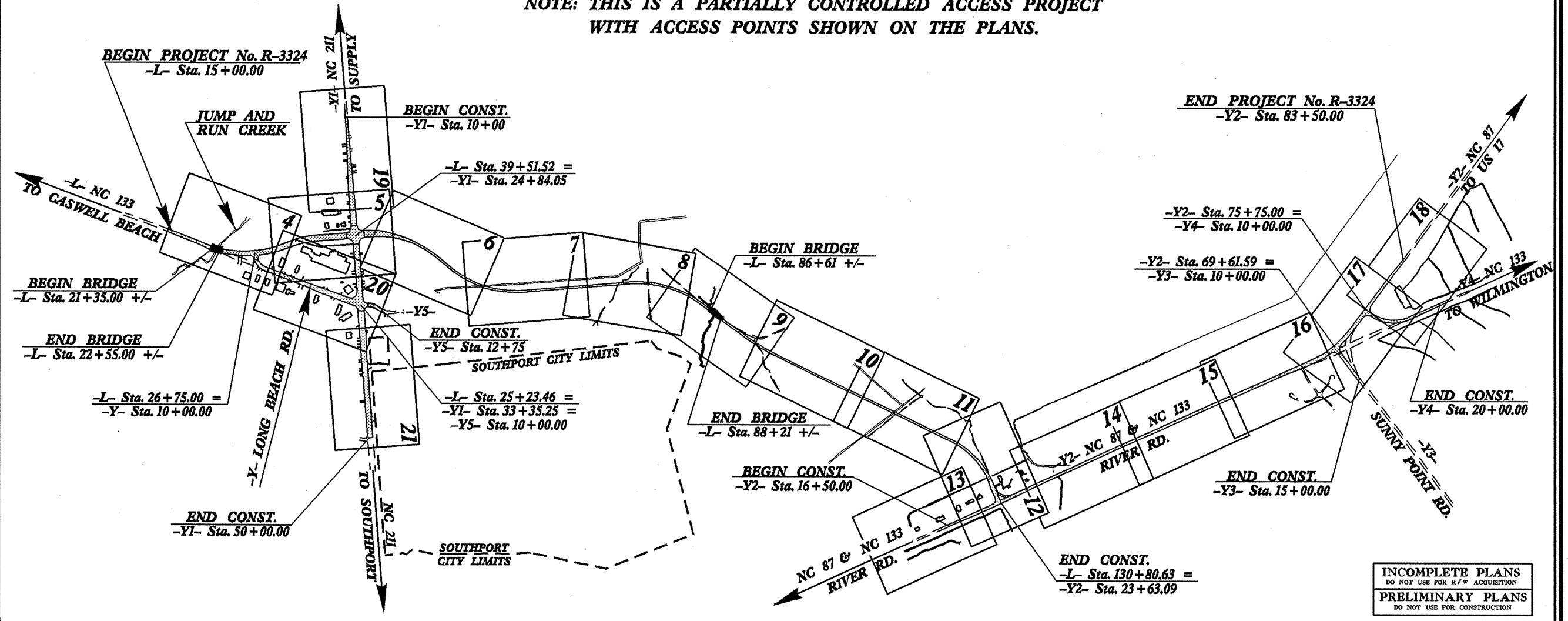
# BRUNSWICK COUNTY

**LOCATION: NEW ROUTE FROM NC 133 (LONG BEACH RD.)  
TO NC 133 & NC 87 (RIVER RD.),  
NORTH OF NC 133 ON NC 87 (GEORGE II RD.).**

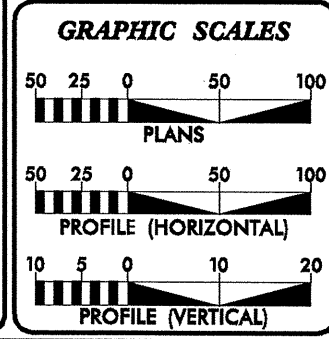
**TYPE OF WORK: GRADING, PAVING, DRAINAGE, STRUCTURES**

**NOTE: THIS IS A PARTIALLY CONTROLLED ACCESS PROJECT  
WITH ACCESS POINTS SHOWN ON THE PLANS.**

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	R-3324	2A	11
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION	
34531.1.1	STP-133(3)	PE	



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



**DESIGN DATA**

ADT 2009 = 9,500 - 13,700  
ADT 2030 = 13,600 - 47,100

DHV = 50 %  
D = 10 %  
T = 5 % \*  
V = 50 MPH

FUNCTIONAL CLASSIFICATION:  
LOCAL

\* TTST 2%      DUAL 3%

**PROJECT LENGTH**

LENGTH ROADWAY TIP No. R-3324 (-L-) = 2.140 MILES  
LENGTH ROADWAY TIP No. R-3324 (-Y2-) = 1.269 MILES  
LENGTH STRUCTURES TIP No. R-3324 = 0.053 MILES

TOTAL LENGTH TIP PROJECT No. R-3324 = 3.462 MILES

**THIS PROJECT IS NOT WITHIN ANY MUNICIPAL BOUNDARIES.**

Prepared In the Office of:  
**DIVISION OF HIGHWAYS**  
1000 Birch Ridge Dr., Raleigh NC, 27610

2006 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE: MARCH, 2008  
LETTING DATE: JUNE, 2009

JIMMY GOODNIGHT, PE  
PROJECT ENGINEER

STEVE KENDALL, PE  
PROJECT DESIGN ENGINEER

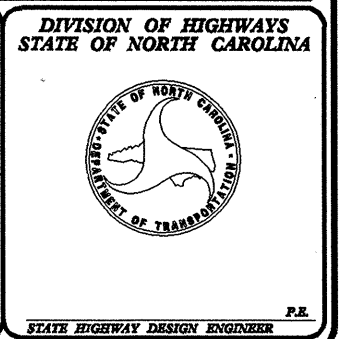
**HYDRAULICS ENGINEER**

SIGNATURE: \_\_\_\_\_ P.E.

ROADWAY DESIGN ENGINEER

SIGNATURE: \_\_\_\_\_ P.E.

STATE HIGHWAY DESIGN ENGINEER





STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY  
GOVERNOR

LYNDO TIPPETT  
SECRETARY

August 8, 2008

STATE PROJECT: 34531.1.1 (R-3324)  
FEDERAL PROJECT: STP-133(3)  
COUNTY: Brunswick

DESCRIPTION: New Route from NC 133 (Long Beach Road) to NC 133 & NC 87 (River Road), North of NC 133 on NC 87 (George II Road)

SUBJECT: Geotechnical Report –Inventory Addendum

**Project Description**

The project consists of constructing a four lane divided facility on new location between NC 211 and NC 87/NC 133 and widening NC 87/NC 133. The project begins on existing NC 133 south of Long Beach Road and extends northward for 2.14 miles to NC 87/NC 133 (River Road).

An additional geotechnical investigation was conducted April, 2008 to determine the extent of organic material. The additional borings were advanced utilizing hand auger equipment. Representative soil samples were collected for visual classification in the field and selected samples were submitted for laboratory analysis by the Materials and Tests Unit. The following alignments were investigated

<u>Line</u>	<u>Station(±)</u>
-L-	84+00 to 90+00

**Areas of Special Geotechnical Interest**

- 1) **Organic Soils:** The following sections contained organic soils that were encountered on the project.

<u>Line</u>	<u>Station (±)</u>
-L-	84+75 to 91+59

MAILING ADDRESS:  
NC DEPARTMENT OF TRANSPORTATION  
GEOTECHNICAL ENGINEERING UNIT  
1589 MAIL SERVICE CENTER  
RALEIGH NC 27699-1589

TELEPHONE: 919-250-4088  
FAX: 919-250-4237

WEBSITE: WWW.DOH.DOT.STATE.NC.US

LOCATION:  
CENTURY CENTER COMPLEX  
ENTRANCE B-2  
1020 BIRCH RIDGE DRIVE  
RALEIGH NC

**Physiography and Geology**

The project is located in the flat to gently rolling terrain of the Coastal Plain Physiographic Province. Land use along the project corridor is mostly wooded with some residential development. Geologically, the project is located within the Quaternary aged Waccamaw Formation. The Waccamaw formation is believed to have been deposited in a continental shelf environment. Soils along the project are derived from alluvial and coastal plain sediments. Manmade drainage ditches drain the project.

**Soil Properties**

Soils encountered at the project site include artificial fill, alluvial and coastal plain sediments that include the Waccamaw Formation.

Artificial Fill soils are present along -L- from Sta. 82+25 to Sta. 91+25 and consist of brown, moist, very loose to loose, gravel (A-1-a) and fine sand (A-3). The artificial fill is underlain by alluvial deposits.

Alluvial deposits are located within the floodplain of an unnamed creek. These soils are primarily white to gray, moist, loose, fine sand (A-3) to black and dark brown, saturated, very soft, muck/peat.

Coastal Plain soils underlie the alluvial soils and are comprised of dark brown to brown, saturated, medium dense, fine silty sand (A-3, A-2-4). The Coastal Plain soils overlie the Waccamaw Formation.

The Waccamaw Formation is comprised of light brown to gray, saturated, loose to medium dense, silty sand (A-2-4) and gray, saturated, soft, silty clay (A-6).

**Ground Water**

Groundwater was encountered in every hand auger boring throughout the project. Groundwater occurred from 0.3 feet to 1.5 feet below the ground surface.

Prepared by,

Cheryl A. Youngblood, L.G.  
Senior Project Geological Engineer

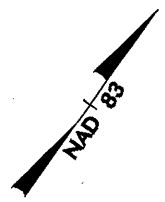
**BULK SAMPLES**

**There were no bulk samples collected during the geotechnical investigation addendum.**

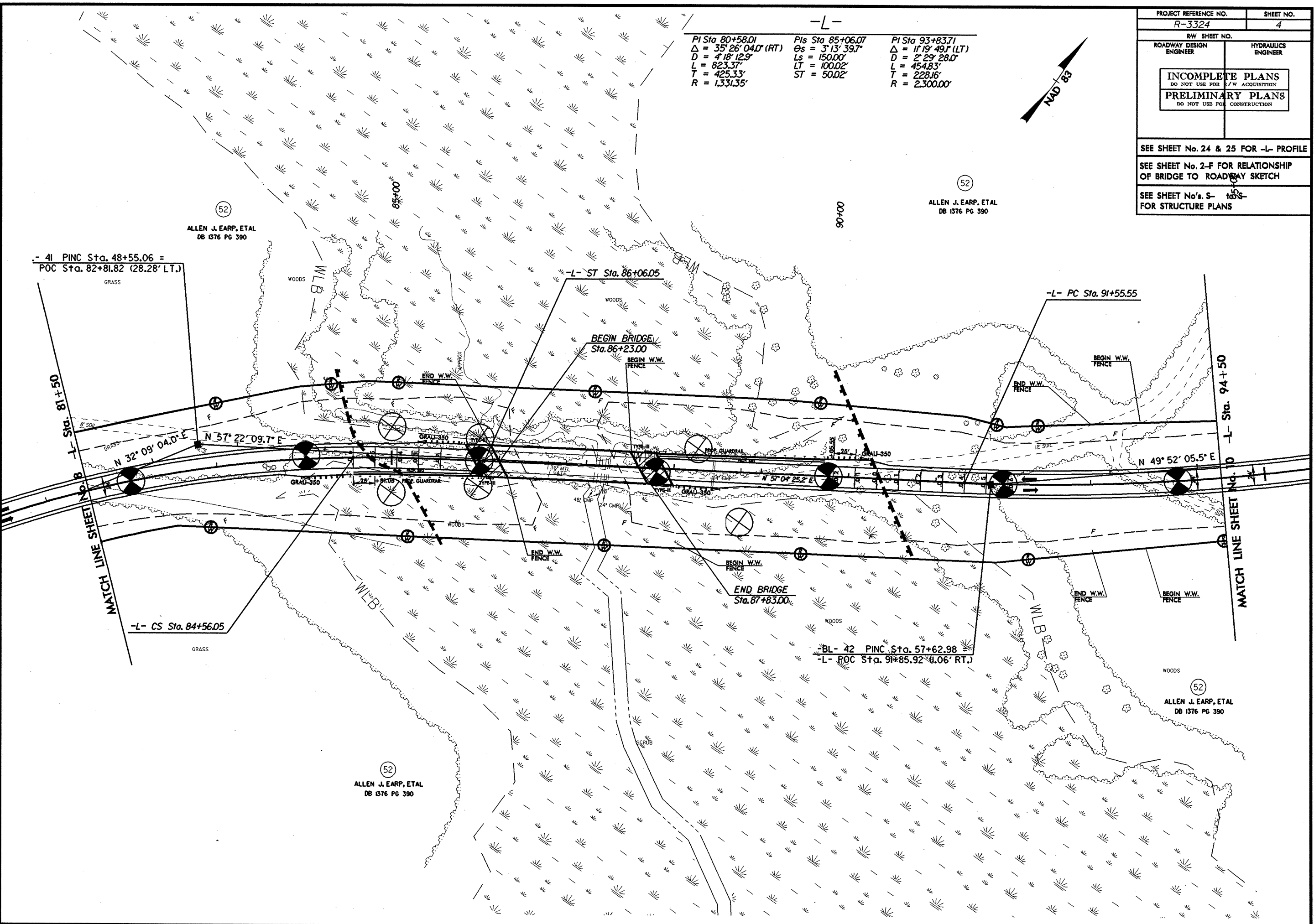
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-L-

PI Sta 80+58.01 $\Delta = 35^{\circ} 26' 04.0''$ (RT) $D = 418' 12.9''$ $L = 823.37'$ $T = 425.33'$ $R = 1,331.35'$	Pis Sta 85+06.07 $\Theta_s = 3' 13' 39.7''$ $L_s = 150.00'$ $LT = 100.02'$ $ST = 50.02'$	PI Sta 93+83.71 $\Delta = 1' 19' 49.1''$ (LT) $D = 2' 29' 28.0''$ $L = 454.83'$ $T = 228.16'$ $R = 2,300.00'$
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PROJECT REFERENCE NO. R-3324	SHEET NO. 4
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
<b>INCOMPLETE PLANS</b> DO NOT USE FOR E/W ACQUISITION <b>PRELIMINARY PLANS</b> DO NOT USE FOR CONSTRUCTION	
SEE SHEET No. 24 & 25 FOR -L- PROFILE	
SEE SHEET No. 2-F FOR RELATIONSHIP OF BRIDGE TO ROADWAY SKETCH	
SEE SHEET No's. S-105- FOR STRUCTURE PLANS	



- 41 PINC Sta. 48+55.06 =  
POC Sta. 82+81.82 (28.28' LT.)

MATCH LINE SHEET No. B  
Sta. 81+50

-L- CS Sta. 84+56.05

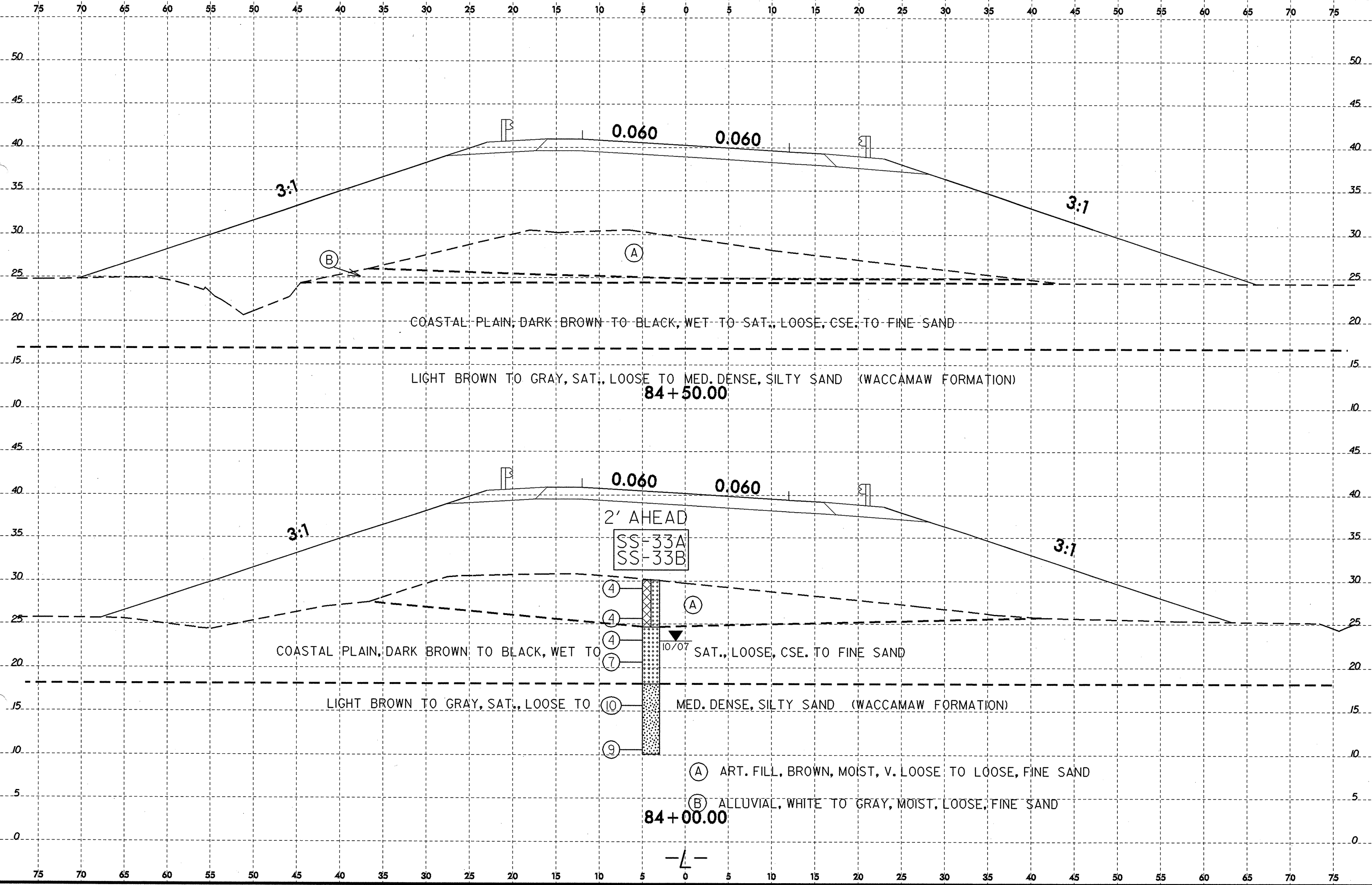
-L- ST Sta. 86+06.05

-L- PC Sta. 91+55.55

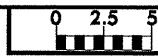
MATCH LINE SHEET No. D  
Sta. 94+50

BL- 42 PINC Sta. 57+62.98 =  
-L- POC Sta. 91+85.92 (4.06' RT.)

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- (A) ART. FILL, BROWN, MOIST, V. LOOSE TO LOOSE, FINE SAND
- (B) ALLUVIAL, WHITE TO GRAY, MOIST, LOOSE, FINE SAND
- (C) ALLUVIAL, BLACK, SAT., V. SOFT, MUCK AND ROOTMAT

COASTAL PLAIN, TAN-BLACK, SAT., LOOSE, FINE, SILTY SAND

LIGHT BROWN TO GRAY, SAT., LOOSE TO MED. DENSE, SILTY SAND (WACCAMAW FORMATION)

GRAY, SAT., SOFT, SILTY CLAY

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COASTAL PLAIN, TAN-BLACK, SAT., LOOSE, FINE, SILTY SAND

LIGHT BROWN TO GRAY, SAT., LOOSE TO MED. DENSE, SILTY SAND (WACCAMAW FORMATION)

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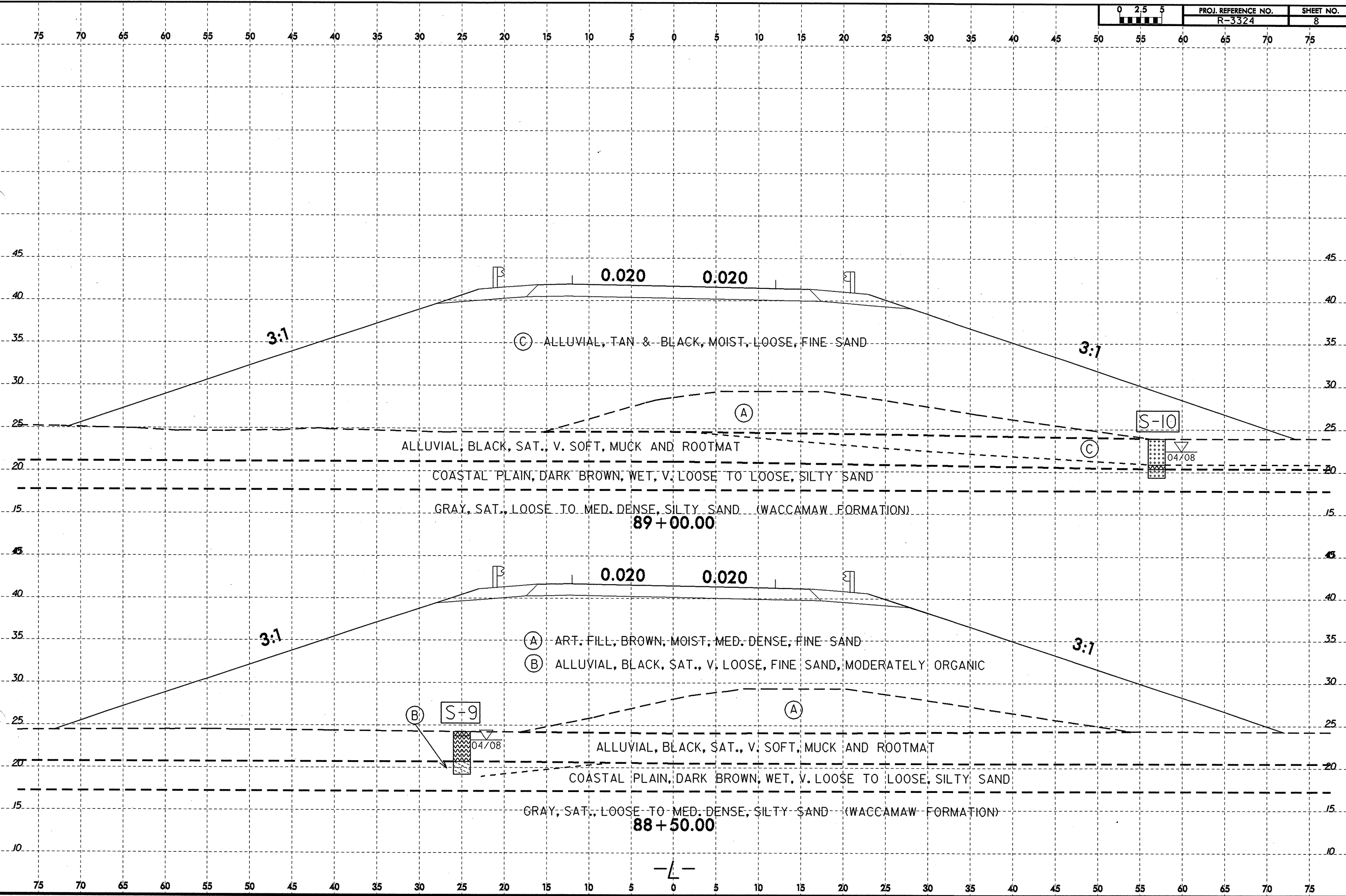
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(C) ALLUVIAL, TAN & BLACK, MOIST, LOOSE, FINE SAND

ALLUVIAL, BLACK, SAT., V. SOFT, MUCK AND ROOTMAT  
COASTAL PLAIN, DARK BROWN, WET, V. LOOSE TO LOOSE, SILTY SAND  
GRAY, SAT., LOOSE TO MED. DENSE, SILTY SAND (WACCAMAW FORMATION)  
89+00.00

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(A) ART. FILL, BROWN, MOIST, MED. DENSE, FINE SAND  
(B) ALLUVIAL, BLACK, SAT., V. LOOSE, FINE SAND, MODERATELY ORGANIC

(B) S-9  
04/08

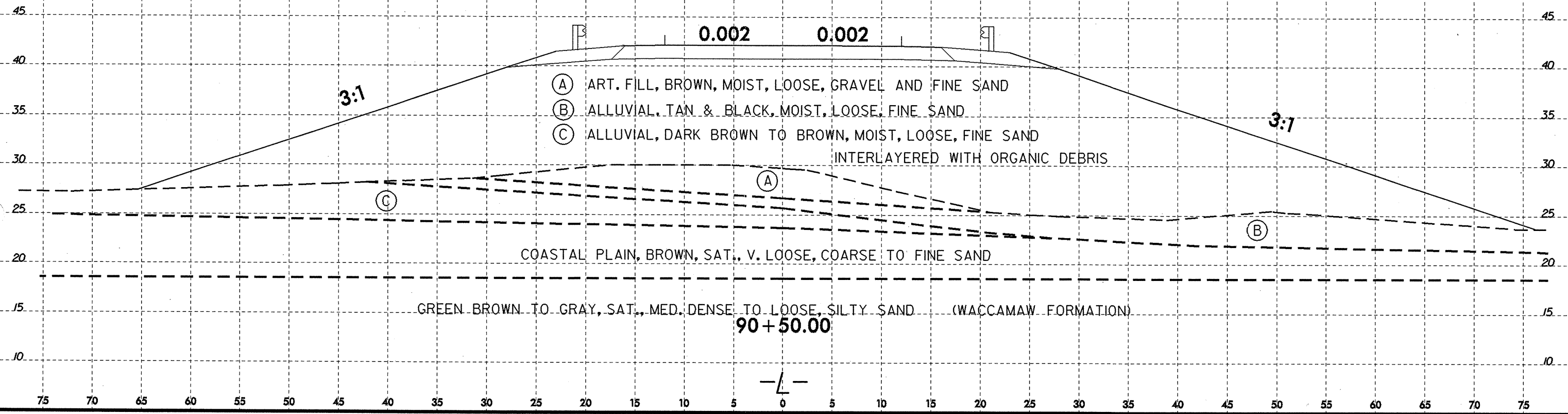
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COASTAL PLAIN, DARK BROWN, WET, V. LOOSE TO LOOSE, SILTY SAND  
GRAY, SAT., LOOSE TO MED. DENSE, SILTY SAND (WACCAMAW FORMATION)  
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NOTE: SEE SHEET 3 FOR PLAN SHEET LAYOUT AT TIME OF INVESTIGATION

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

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	34531.1.1	1	11
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION	
34531.1.1	STPF-133(3)	P.E. CONST.	

CONTENTS:

LINE	STATION	PLAN	PROFILE	XSECTS
-L-	15+00.00 - 29+55.00	4	----	----

**INFILTRATION**  
**BASIN INVESTIGATION**

SUBJECT:

NCDOT Geotechnical Engineering Unit  
 Soil and Rock Classification Sheet

Sheet 2

Roadway Title Sheet

Sheet 3

Geotechnical/K<sub>SAT</sub> Report

Sheets 3A - 3B

Boring Location Plan

Sheet 4

Amoozometer Results

Sheets 5 & 6

Hand Auger Soil Profile Descriptions

Sheets 7 & 8

Summary of Laboratory Test Data

Sheet 9

Grain Size Curves

Sheets 10 & 11

STATE PROJ. 34531.1.1 I.D. R-3324 F.A. PROJ. STPF-133(3)  
 COUNTY BRUNSWICK  
 PROJECT DESCRIPTION NEW ROUTE FROM NC 211 TO NC 87  
AT SR 1525 (BETHEL ROAD)

**CAUTION NOTICE**

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WAS 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 # 1991250-4088. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA IS 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.

**CONTRACT: ID: R-3324**

**RECEIVED**  
 DEC 14 2007

DEPARTMENT OF TRANSPORTATION  
 DIVISION OF HIGHWAYS  
 GEOTECHNICAL UNIT

PERSONNEL

J. DAVIS

P. MASTEN

S. JOHNSON

L. RAUP

P. PHELPS

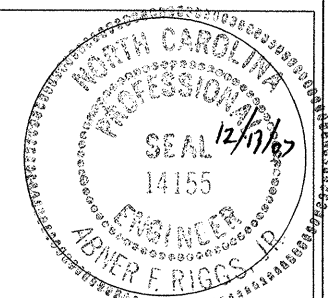
T. PEREZ

INVESTIGATED BY S&ME, INC.

CHECKED BY A.F. RIGGS, JR.

SUBMITTED BY S&ME, INC.

DATE DECEMBER 13, 2007



*Alfred F. Riggs, Jr.*

DRAWN BY: T. PEREZ

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.

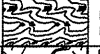

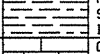
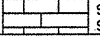
NOTE - BY HAVING REQUESTED THIS INFORMATION THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.

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

ID	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
R-3324	34531.1.1	2	11

## SUBSURFACE INVESTIGATION

### SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION	GRADATION	ROCK DESCRIPTION	TERMS AND DEFINITIONS
SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED OR WEATHERED EARTH MATERIALS WHICH CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND WHICH YIELDS LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM AND BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: STENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE: <i>VERY STIFF, GRAY SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGH PLASTIC, A-7-6</i>	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.  THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS ARE DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.	HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WHEN 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 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:  WEATHERED ROCK (WR)  NON-COASTAL PLAIN MATERIAL THAT YIELDS SPT N VALUES > 100 BLOWS PER FOOT.  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.  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 PHYLLITE, SLATE, SANDSTONE, ETC.  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.	ALLUVIUM (ALLUV.) - SOILS WHICH 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 WHICH 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 ROCKS 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 (F.P.) - 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 (MOT.) - 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 SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK. ROCK QUALITY DESIGNATION (R.Q.D.) - 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 WHICH 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, WHICH HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED 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 B.P.F. 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 LESS THAN 60 BLOWS. STRATA CORE RECOVERY (SREC) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE. STRATA ROCK QUALITY DESIGNATION (S.R.Q.D.) - 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 (T.S.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.
<b>SOIL LEGEND AND AASHTO CLASSIFICATION</b>	<b>MINERALOGICAL COMPOSITION</b>	<b>WEATHERING</b>	
GENERAL CLASS. GRANULAR MATERIALS (< 75% PASSING #200) SILT-CLAY MATERIALS (> 75% PASSING #200) ORGANIC MATERIALS	MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.	FRESH ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE. VERY SLIGHT (V. SLI.) ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN. CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE. SLIGHT (SLI.) ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS. MODERATE (MOD.) SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK. MODERATELY SEVERE (MOD. SEV.) ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. <i>IF TESTED, WOULD YIELD SPT REFUSAL</i> SEVERE (SEV.) ALL ROCKS EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. <i>IF TESTED, YIELDS SPT N VALUES &gt; 100 BPF</i> VERY SEVERE (V. SEV.) ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. <i>IF TESTED, YIELDS SPT N VALUES &lt; 100 BPF</i> COMPLETE ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.	
<b>SOIL LEGEND AND AASHTO CLASSIFICATION</b>	<b>COMPRESSIONIBILITY</b>	<b>GROUND WATER</b>	
GROUP CLASS. A-1, A-3, A-2, A-4, A-5, A-6, A-7, A-7.5, A-7.6	SLIGHTLY COMPRESSIBLE LIQUID LIMIT LESS THAN 30 MODERATELY COMPRESSIBLE LIQUID LIMIT 31-50 HIGHLY COMPRESSIBLE LIQUID LIMIT GREATER THAN 50	WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING. STATIC WATER LEVEL AFTER 24 HOURS. PERCHED WATER, SATURATED ZONE OR WATER BEARING STRATA SPRING OR SEEPAGE HOLE CAVED	
<b>SOIL LEGEND AND AASHTO CLASSIFICATION</b>	<b>PERCENTAGE OF MATERIAL</b>	<b>MISCELLANEOUS SYMBOLS</b>	
SYMBOL	ORGANIC MATERIAL GRANULAR SOILS SILT-CLAY SOILS OTHER MATERIAL TRACE OF ORGANIC MATTER 2 - 3% 3 - 5% TRACE 1 - 10% LITTLE ORGANIC MATTER 3 - 5% 5 - 12% LITTLE 10 - 20% MODERATELY ORGANIC 5 - 10% 12 - 20% SOME 20 - 35% HIGHLY ORGANIC >10% >20% HIGHLY 35% AND ABOVE	ROADWAY EMBANKMENT WITH SOIL DESCRIPTION SOIL SYMBOL ARTIFICIAL FILL OTHER THAN ROADWAY EMBANKMENTS INFERRED SOIL BOUNDARIES INFERRED ROCK LINE ALLUVIAL SOIL BOUNDARY DIP/DIP DIRECTION OF ROCK STRUCTURES SOUNDING ROD	
<b>TEXTURE OR GRAIN SIZE</b>	<b>GROUND WATER</b>	<b>ABBREVIATIONS</b>	
U.S. STD. SIEVE SIZE OPENING (MM) 4, 10, 40, 60, 200, 270	WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING. STATIC WATER LEVEL AFTER 24 HOURS. PERCHED WATER, SATURATED ZONE OR WATER BEARING STRATA SPRING OR SEEPAGE HOLE CAVED	AR - AUGER REFUSAL BT - BORING TERMINATED CL - CLAY CPT - CONE PENETRATION TEST CSE - COARSE DMT - DILATOMETER TEST DPT - DYNAMIC PENETRATION TEST e - VOID RATIO f - FINE FOSS. - FOSSILIFEROUS FRAC. - FRACTURED FRAGS. - FRAGMENTS MED. - MEDIUM PMT - PRESSUREMETER TEST SD. - SAND, SANDY SL. - SILT, SILTY SLI. - SLIGHTLY TCR - TRICONE REFUSAL γ - UNIT WEIGHT γ <sub>d</sub> - DRY UNIT WEIGHT W - MOISTURE CONTENT V. - VERY VST - VANE SHEAR TEST	
<b>SOIL MOISTURE - CORRELATION OF TERMS</b>	<b>ABBREVIATIONS</b>	<b>EQUIPMENT USED ON SUBJECT PROJECT</b>	
SOIL MOISTURE SCALE (ATTERBERG LIMITS) FIELD MOISTURE DESCRIPTION GUIDE FOR FIELD MOISTURE DESCRIPTION	AR - AUGER REFUSAL BT - BORING TERMINATED CL - CLAY CPT - CONE PENETRATION TEST CSE - COARSE DMT - DILATOMETER TEST DPT - DYNAMIC PENETRATION TEST e - VOID RATIO f - FINE FOSS. - FOSSILIFEROUS FRAC. - FRACTURED FRAGS. - FRAGMENTS MED. - MEDIUM PMT - PRESSUREMETER TEST SD. - SAND, SANDY SL. - SILT, SILTY SLI. - SLIGHTLY TCR - TRICONE REFUSAL γ - UNIT WEIGHT γ <sub>d</sub> - DRY UNIT WEIGHT W - MOISTURE CONTENT V. - VERY VST - VANE SHEAR TEST	DRILL UNITS: MOBILE B- BK-51 CME-550x CME-750 PORTABLE HOIST OTHER OTHER	
<b>PLASTICITY</b>	<b>EQUIPMENT USED ON SUBJECT PROJECT</b>	<b>FRACTURE SPACING</b>	
NONPLASTIC LOW PLASTICITY MED. PLASTICITY HIGH PLASTICITY	ADVANCING TOOLS: CLAY BITS 6" CONTINUOUS FLIGHT AUGER 6" HOLLOW AUGERS HARD FACED FINGER BITS TUNG-CARBIDE INSERTS CASING w/ ADVANCER TRICONE STEEL TEETH TRICONE TUNG-CARB. CORE BIT OTHER OTHER	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	
<b>COLOR</b>	<b>EQUIPMENT USED ON SUBJECT PROJECT</b>	<b>BEDDING</b>	
DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YEL-BRN, BLUE-GRAY) MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.	HAMMER TYPE: AUTOMATIC MANUAL CORE SIZE: B N H HAND TOOLS: POST HOLE DIGGER HAND AUGER SOUNDING ROD VANE SHEAR TEST OTHER	TERM THICKNESS VERY THICKLY BEDDED > 4 FEET THICKLY BEDDED 1.5 - 4 FEET MODERATELY 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	
	<b>INDURATION</b>	<b>INDURATION</b>	
	FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF THE MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.	FRIABLE RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE. MODERATELY INDURATED GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER. INDURATED GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER. EXTREMELY INDURATED SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.	<b>BENCH MARK: REBAR &amp; CAP STAMPED -BY- 25</b> <b>LOCATED AT -BY- STATION 13+23.87, -L- STATION 22+09.08 17.22' LT</b> <b>ELEVATION: 11.95'</b>
			<b>NOTES:</b>

05/08/99

See Sheet 1-A For Index of Sheets

STATE OF NORTH CAROLINA  
DIVISION OF HIGHWAYS

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	R-3324	3	11
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION	
34531.1.1	STP-133(3)	PE	

# BRUNSWICK COUNTY

**LOCATION: NEW ROUTE FROM NC.133 (LONG BEACH RD.)  
TO NC 133 & NC 87 (RIVER RD.),  
NORTH OF NC 133 ON NC 87 (GEORGE II RD.).**

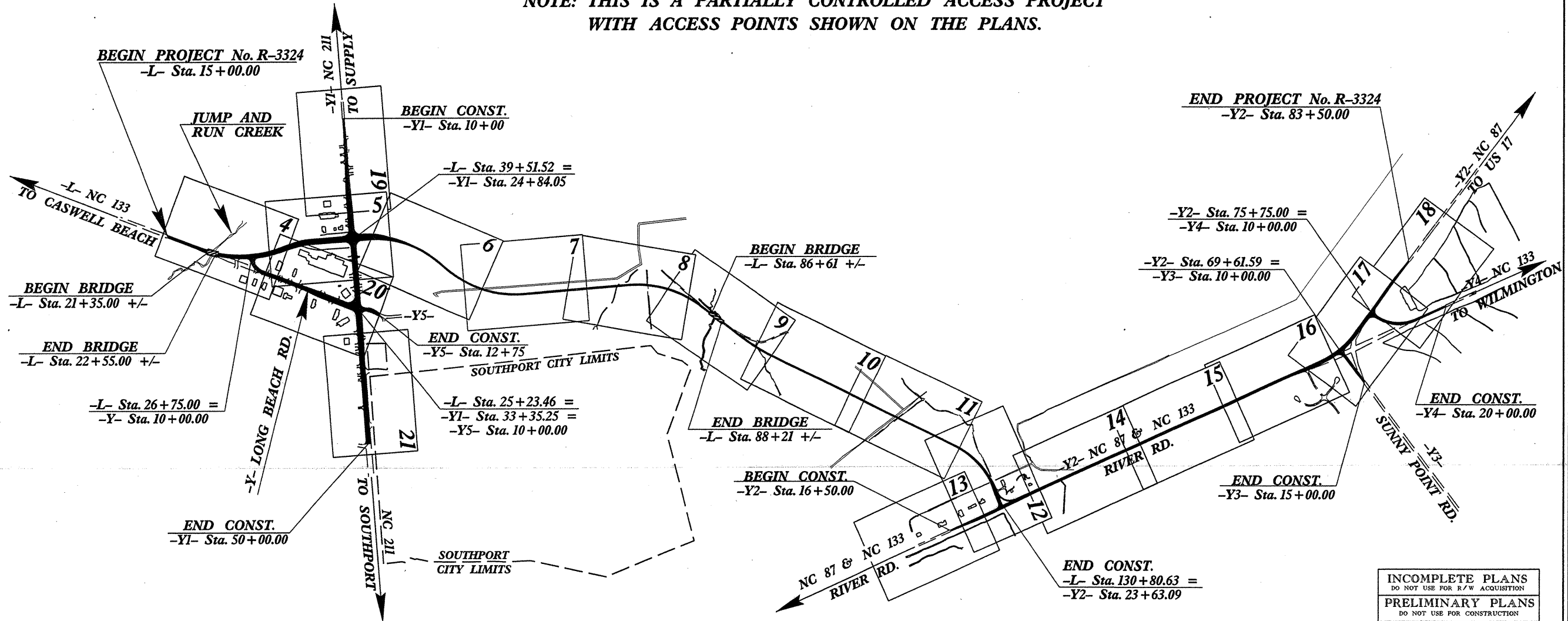
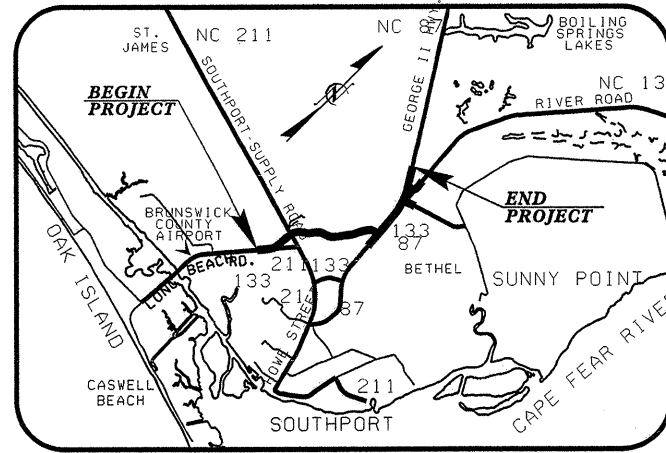
**TYPE OF WORK: GRADING, PAVING, DRAINAGE, STRUCTURES**

**NOTE: THIS IS A PARTIALLY CONTROLLED ACCESS PROJECT  
WITH ACCESS POINTS SHOWN ON THE PLANS.**

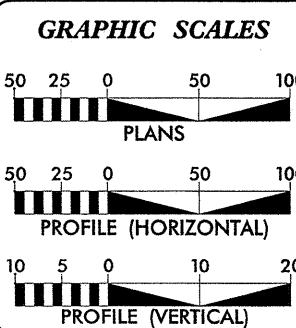


TIP PROJECT: R-3324

CONTRACT: 34531.1.1



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



**DESIGN DATA**

ADT 2009 =	9,500 - 13,700
ADT 2030 =	13,600 - 47,100
DHV =	50 %
D =	10 %
T =	5 % *
V =	50 MPH
FUNCTIONAL CLASSIFICATION:	LOCAL
* TTST 2%	DUAL 3%

**PROJECT LENGTH**

LENGTH ROADWAY TIP No. R-3324 (-L-)	=	2.140 MILES
LENGTH ROADWAY TIP No. R-3324 (-Y2-)	=	1.269 MILES
LENGTH STRUCTURES TIP No. R-3324	=	0.053 MILES
<b>TOTAL LENGTH TIP PROJECT No. R-3324</b>	<b>=</b>	<b>3.462 MILES</b>

**THIS PROJECT IS NOT WITHIN ANY MUNICIPAL BOUNDARIES.**

Prepared in the Office of:  
**DIVISION OF HIGHWAYS**  
1000 Birch Ridge Dr., Raleigh NC, 27610

2006 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE: MARCH, 2008

LETTING DATE: JUNE, 2009

JIMMY GOODNIGHT, PE  
PROJECT ENGINEER

STEVE KENDALL, PE  
PROJECT DESIGN ENGINEER

**HYDRAULICS ENGINEER**

SIGNATURE: \_\_\_\_\_ P.E.

**ROADWAY DESIGN ENGINEER**

SIGNATURE: \_\_\_\_\_ P.E.

**DIVISION OF HIGHWAYS  
STATE OF NORTH CAROLINA**

STATE HIGHWAY DESIGN ENGINEER

SYSTEMS ENGINEERING

STATE PROJECT NO.: 34531.1.1  
 I.D. NO.: R-3324  
 FEDERAL PROJECT NO.: STPF-133(3)  
 COUNTY: Brunswick

DESCRIPTION: New Route from NC 211 to NC 87 at SR 1525 (Bethel Road)  
 Infiltration Basin Investigation

SUBJECT: Infiltration Basin Investigation – Addendum to Inventory Report

#### Project Description

The project site is located along existing NC 133 (Long Beach Road) southwest of its intersection with Port Loop Road and extends north over Jump and Run Creek and across NC 211 to NC 133 and NC 87 at the intersection of Bethel Road (SR 1525) in Brunswick County, North Carolina. The proposed project is part of the new route from NC 211 to NC 87 at Bethel Road (SR 1525) in which infiltration basins are to be constructed adjacent to the new alignment. The proposed infiltration basins will be located along existing NC 133 on each side of Jump and Run Creek. Grading plans of the proposed infiltration basin were not provided at the time of our investigation.

The sites are located within commercial and residential areas. The sites consist of grassed lawns and soil parking areas. Underground utilities including fiber optic cables, water, sewer and power are located along the roadway shoulders of the adjacent roads. In addition, private underground power and phone lines are located in the vicinity of the proposed Infiltration Basins.

A geotechnical investigation was conducted to determine hydraulic conductivity, depth to the seasonal groundwater table and the depth to observed water levels. S&ME personnel conducted three (3) in-situ saturated hydraulic conductivity tests for the proposed Infiltration Basins on December 3, 2007. The field test locations were selected by NCDOT and located in the field using a non-survey quality sub-meter Global Positioning System (GPS). The reported elevations were determined by S&ME personnel in the field utilizing survey techniques referencing a bench mark provided by NCDOT. The soil borings/hydraulic conductivity test locations selected by the NCDOT are shown on (Sheet 4) at the following stations:

Site	Station	Offset
B-1	-L- 20+14	+/- 90' Right
B-2	-L- 21+85	+/- 75' Left
B-3	-L- 22+93	+/- 100' Left

In-situ saturated hydraulic conductivity (Ksat) measurements were performed with a compact constant head permeameter (cchp). Test locations evaluated were B-1 through B-3. The in-situ hydraulic conductivity measurements were performed in the unsaturated material above the observed water table on the date of field testing. Hand auger borings were conducted and the material was described from the surface down to depths of 57 to 84 inches (4.8 to 7.0 feet) below the existing surface. The hand auger borings were generally terminated when water was encountered. The seasonal groundwater table was also determined by soil type and groundwater encountered in the hand auger borings. The seasonally high water table ranged from 33 to 51 inches (2.8 to 4.3 feet) feet below the surface. See attached soil profile description for each location for seasonally high water table determinations.

#### Test Results

Representative soil samples were tested in S&ME's laboratory to determine the soil index properties and to verify field classification. Four (4) soil samples from the site were analyzed for grain size distribution (including hydrometer) T88-90 and determination of liquid limit (T89-90), plastic limit and plasticity index in accordance with AASHTO T90-87 and NCDOT modifications to AASHTO T88-90, T89-90 and T90-87. Results of the laboratory tests are presented on the test data sheets in the Appendix.

#### Physiography and Geology

The site is located within the lower eastern portion of the Coastal Plain Physiographic and Geologic Province of North Carolina in Brunswick County. The Coastal Plain Province is typically characterized by marine and eolian sediments that were deposited during the transgressive and regressive depositional sequences. As such, the Coastal Plain Province is characterized by subdued topographic features and flat, low-lying terrain. The geology of the southeast quadrant of Brunswick County, near the project site, primarily consists of Undifferentiated Surface Deposits of Quaternary Age. Typically, the Undifferentiated Deposits consist of sands with localized zones of fine-grained silts and clays. These deposits are underlain by the Waccamaw Formation which consists of loosely consolidated bluish-gray fossiliferous sands with silt and clay. The Waccamaw Formation is underlain by the Pee Dee Formation of the Upper Cretaceous Age. The Pee Dee Formation consists of dark gray silts and clays interbedded with gray sand, calcareous sandstone, and limestone.

#### Materials

The hand auger borings were advanced to depths of 4.8 to 7.0 feet below the ground surface at collar elevations ranging from 10.3 to 12.8 feet.

Artificial fill materials were encountered in borings B-1 and B-2 to depths of about 20 to 27 inches (1.7 to 2.3 feet) below the collar elevation. The fill materials encountered in the hand auger borings consist of gray silty coarse to fine sand (A-2-4) with trace of clay.

Undifferentiated Coastal Plain deposits were encountered beneath the artificial fill materials in borings B-1 and B-2 and at the ground surface in boring B-3 and extend to the depth of boring termination. Typically, Undifferentiated Coastal Plain deposits encountered consist of gray coarse to fine sand (A-3) with trace of silt and clay and gray silty coarse to fine sand (A-2-4) with trace of clay.

#### Ksat Testing Results

The in-situ saturated hydraulic conductivity values were calculated based on field measurements using the Glover Equation. Saturated hydraulic conductivity measurements ranged from 133.82 to 493.86 gallons per day per square foot (gpd/ft<sup>2</sup>) (Appendix). In boring B-1, the water leaving the permeameter could not keep up with the flow rate going into the material, therefore possibly skewing the test results. For design purposes, we recommend a Ksat value of no more than 40 feet/ day. A detailed soil profile description was performed at each Ksat location to determine the most limiting horizon at which the test should be performed.



Table 1 below summarizes hydraulic conductivity measurements for each location, including the location, and depth.

**Table 1: Hydraulic Conductivity Measurements**

Test Location	Depth (Feet)	Hydraulic Conductivity	
		gpd/ft <sup>2</sup>	feet/day
B-1	2.0	493.86	*40.00
B-2	2.0	228.80	30.59
B-3	2.0	133.82	17.89

\* Recommended hydraulic conductivity for design

Groundwater

Groundwater depths were measured at the time of hand auger operations for all of the hand auger borings. Groundwater depths ranging from about 50 to 82 inches (4.2 to 6.8 feet) beneath the collar elevation were measured in the hand auger borings. Based on the hand auger borings and observation of soil mottling in near surface soils, the seasonal high water table was estimated at depths ranging from 33 to 51 inches (2.8 to 4.3 feet) beneath collar elevations.

Table 2 below summarizes the location, ground surface elevation, seasonal high ground water and measured water levels at the time of boring completion for each location.

**Table 2: Season High Water Ground Water Estimates**

Location	Elevation Ground Surface (feet)	Depths to Seasonal High Ground Water (feet)	Water Levels Depth (Feet)	Date 2007
B-1	10.6	2.8	6.8	12/3/2007
B-2	12.8	4.3	6.1	12/3/2007
B-3	10.3	2.8	4.2	12/3/2007

Qualifications of Report

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The findings contained in this report were based on the applicable standards of our profession at the time this report was prepared. No other warranty, expressed or implied, is made.

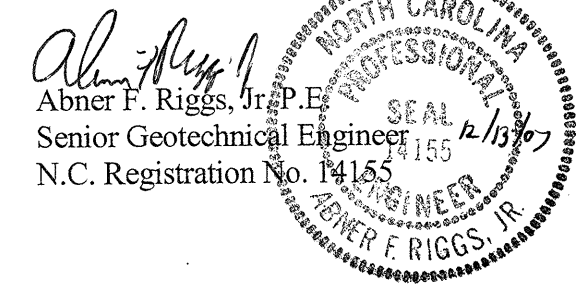
The findings submitted in this report are based, in part, upon the data obtained from the subsurface exploration. The nature and extent of subsurface variations between the borings may not become evident until construction. If variations appear evident, then the findings contained in this report may need to be re-evaluated. In the event that any changes in the nature, design, or location of the structure are planned, the findings contained in this report will not be considered valid unless the changes are reviewed by S&ME, and the findings of the report are modified or verified in writing.

S&ME appreciates the opportunity to be your geotechnical consultant on this project. If you have any questions or need additional information in regard to this report, please contact us.

Very truly yours,

**S&ME, Inc.**

*J.R. Davis*  
John R. Davis, LSS  
Project Manager



Attachments

S:\PROJECTS\2007\07-501 Infiltration Basins NC211 to NC87 Brunswick Co\Geotech DOT\Report\501 rpt.doc



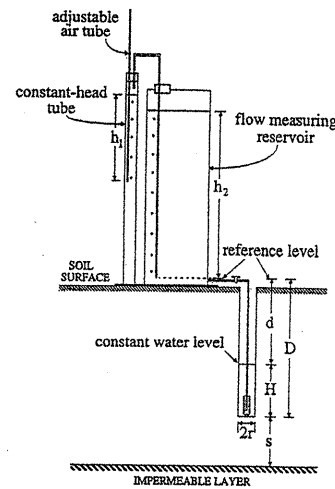
S&ME  
"IN-SITU" CONSTANT HEAD PERMEAMETER

Date: 12/3/2007  
 Location: B-1  
 Horizon: Fill Horizon  
 Client: NCDOT  
 Project Name: New Route from NC 211 to NC 87  
 Project No.: 34531.1.1  
 Tip No.: R-3324

Hole Depth:	2.00	Feet
Hole Radius (r):	0.08	Feet
Bubble Tube to Surface:	0.30	Feet
Reference Tube to Hole Bottom (D):	2.30	Feet
Water Depth in Hole (H):	0.50	Feet
CHT Tube(s) Setting (h <sub>1</sub> ):	1.80	Feet

Chamber Used:	0.11	ft <sup>2</sup>
---------------	------	-----------------

Initial Water in Hole:	0.21	Feet
Final Water in Hole:	0.21	Feet



$$K_{sat} = CQ / (2\pi H^2)$$

$$C = \sinh^{-1} \left( \frac{H}{r} - \left[ \left( \frac{r}{H} \right)^2 + 1 \right]^{1/2} \right) + r/H$$

$\sinh^{-1}$  = inverse hyperbolic sin of a number

H = Height of water in hole (cm)

r = radius of hole (cm)

Q = Constant Flow Rate (Gal/day)

= Cross Sectional Area of Reservoir x Length of Drop in Water Column over Time

$$r = \frac{0.08}{0.21} \text{ ft}$$

$$C = 0.98$$

$$Q = 139.80 \text{ Gallons/Day}$$

Time	Drop in Water Column	
	(ft)	(cm)
2	0.123	3.75
3	0.123	3.75
4	0.123	3.75
5	0.107	3.25
6	0.115	3.50
7	0.115	3.50
8	0.115	3.50
9	0.115	3.50
10	0.115	3.50
11	0.115	3.50
Avg.	0.115	

Time (min) = 1

$$\text{Cross Sectional Area} = 0.11 \text{ ft}^2$$

$$\text{Length of Drop in Water Column} = 165.35 \text{ ft/day}$$

$$K_{sat} = 493.86 \text{ Gallons/Day/ft}^2$$

Cm/Hour = 83.85  
 Inches/Hour = 33.01  
 Feet/Day = 66.02

Note: In material with high permeability, the water leaving the permeameter cannot keep up with the flow rate into the material, for this reason calculations can be skewed. For design of infiltration galleries, S&ME recommends not to exceed 40 feet/day.

Note: K<sub>sat</sub> calculations are based on average drop in Water Column (ft) after equilibrium is reached.

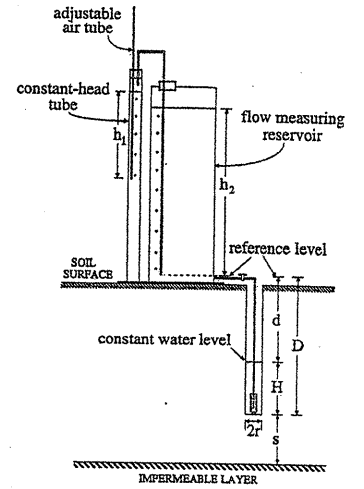
S&ME  
"IN-SITU" COMPACT CONSTANT HEAD PERMEAMETER

Date: 12/3/2007  
 Location: B-2  
 Horizon: A  
 Client: NCDOT  
 Project Name: New Route from NC 211 to NC 87  
 Project No.: 34531.1.1  
 Tip No.: R-3324

Hole Depth:	2.00	Feet
Hole Radius (r):	0.08	Feet
Bubble Tube to Surface:	0.30	Feet
Reference Tube to Hole Bottom (D):	2.30	Feet
Water Depth in Hole (H):	0.50	Feet
CHT Tube(s) Setting (h <sub>1</sub> ):	1.80	Feet

Chamber Used:	0.11	ft <sup>2</sup>
---------------	------	-----------------

Initial Water in Hole:	0.29	Feet
Final Water in Hole:	0.29	Feet



$$K_{sat} = CQ / (2\pi H^2)$$

$$C = \sinh^{-1} \left( \frac{H}{r} - \left[ \left( \frac{r}{H} \right)^2 + 1 \right]^{1/2} \right) + r/H$$

$\sinh^{-1}$  = inverse hyperbolic sin of a number

H = Height of water in hole (cm)

r = radius of hole (cm)

Q = Constant Flow Rate (Gal/day)

= Cross Sectional Area of Reservoir x Length of Drop in Water Column over Time

$$r = \frac{0.08}{0.29} \text{ ft}$$

$$C = 1.21$$

$$Q = 99.86 \text{ Gallons/Day}$$

Time	Drop in Water Column	
	(ft)	(cm)
6	0.082	2.50
7	0.082	2.50
8	0.082	2.50
9	0.082	2.50
10	0.082	2.50
11	0.082	2.50
12	0.082	2.50
13	0.082	2.50
14	0.082	2.50
15	0.082	2.50
Avg.	0.082	

Time (min) = 1

$$\text{Cross Sectional Area} = 0.11 \text{ ft}^2$$

$$\text{Length of Drop in Water Column} = 118.11 \text{ ft/day}$$

$$K_{sat} = 228.80 \text{ Gallons/Day/ft}^2$$

Cm/Hour = 38.85  
 Inches/Hour = 15.29  
 Feet/Day = 30.59

Note: K<sub>sat</sub> calculations are based on average drop in Water Column (ft) after equilibrium is reached.

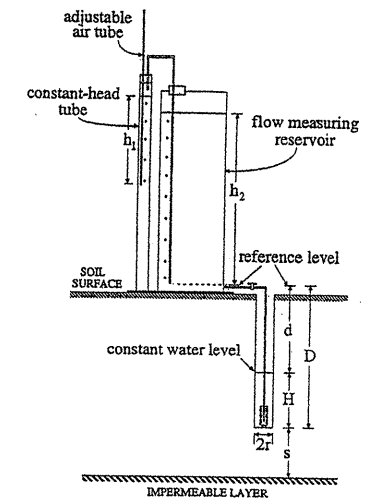
"IN-SITU" COMPACT CONSTANT HEAD PERMEAMETER

Date: 12/3/2007  
 Location: B-3  
 Horizon: E  
 Client: NCDOT  
 Project Name: New Route from NC 211 to NC 87  
 Project No.: 34531.1.1  
 Tip No.: R-3324

Hole Depth:	2.00	Feet
Hole Radius (r):	0.08	Feet
Bubble Tube to Surface:	0.30	Feet
Reference Tube to Hole Bottom (D):	2.30	Feet
Water Depth in Hole (H):	0.50	Feet
CHT Tube(s) Setting (h <sub>1</sub> ):	1.80	Feet

Chamber Used:	0.11	▼	Ft <sup>2</sup>
---------------	------	---	-----------------

Initial Water in Hole:	0.33	Feet
Final Water in Hole:	0.33	Feet



$K_{sat} = CQ/(2\pi H^2)$

$C = \sinh^{-1}(H/r) - [(r/H)^2 + 1]^{1/2} + r/H$

$\sinh^{-1}$  = inverse hyperbolic sin of a number

H = Height of water in hole (cm)

r = radius of hole (cm)

Q = Constant Flow Rate (Gal/day)

= Cross Sectional Area of Reservoir x Length of Drop in Water Column over Time

$r = \frac{0.08}{12}$  ft  
 $H = \frac{0.33}{12}$  ft

C = 1.31  
 Q = 69.90 Gallons/Day

Time	Drop in Water Column	
	(ft)	(cm)
6	0.057	1.75
7	0.057	1.75
8	0.057	1.75
9	0.057	1.75
10	0.057	1.75
11	0.057	1.75
12	0.057	1.75
13	0.057	1.75
14	0.057	1.75
15	0.057	1.75
Avg.	0.057	

Time (min) = 1

Cross Sectional Area = 0.11 ft<sup>2</sup>  
 Length of Drop in Water Column = 82.68 ft/day

$K_{sat} = 133.82$  Gallons/Day/ft<sup>2</sup>

Cm/Hour = 22.72  
 Inches/Hour = 8.95  
 Feet/Day = 17.89

Note: K<sub>sat</sub> calculations are based on average drop in Water Column (ft) after equilibrium is reached.

Prepared by: S&ME, Inc.  
 Paul Masten

**S&ME, Inc**  
**Soil Profile Descriptions**

Client: NCDOT Date: 3-Dec-07  
 Project Name: New Route from NC 211 to NC 87 at SR 1525 S&ME Project No.: 1051-07-501  
 Project No.: 34531.1.1 State: North Carolina  
 Tip No.: R-3324  
 F.A. No.: STPF-133(3)  
 County: Brunswick  
 Location: B-1  
 Station: 20+14 Northing: 73420.9  
 Offset: 90 ft RT Easting: 2287592.7  
 Alignment: -L- Elevation: 10.6 feet  
 Apparent Water Table: 82 Inches (6.8 feet) Boring Terminained at: 84 Inches (7.0 feet)  
 Seasonal High Water Table: 34 Inches (2.8 feet)  
 Slope: 2%  
 Vegetation:

Horizon	Depth(in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Fill 1	0-14"	10YR 4/2		Fine Sand	Granular		
Fill 2	14-27"	10YR 5/4		Fine Sand	Granular		
A	27-34"	10YR 4/1		Fine Sand	Granular		
B1	34-54"	10YR 2/1		Silty Sand	Sub-Ang Blocky		Organics
B2	54-65"	10YR 3/1	10YR 7/2	Fine Sand	Granular		
C	65-84"	10YR 7/2	10YR 3/1	Fine Sand	Granular		

COMMENTS:  
 S-1 65-84" Gray coarse to fine sand (A-3)(0) with trace of silt and clay

ABBREVIATIONS:  
 10 YR 3/2 - Munsell Color Chip#  
 Sub Ang - Subangular

**S&ME, Inc**  
**Soil Profile Descriptions**

Client: NCDOT Date: 3-Dec-07  
 Project Name: New Route from NC 211 to NC 87 at SR 1525 S&ME Project No.: 1051-07-501  
 Project No.: 34531.1.1 State: North Carolina  
 Tip No.: R-3324  
 F.A. No.: STPF-133(3)  
 County: Brunswick  
 Location: B-2  
 Station: 21+85 Northing: 73575.9  
 Offset: 75 ft LT Easting: 2287501.6  
 Alignment: -L- Elevation: 12.8 feet  
 Apparent Water Table: 73 Inches (6.1 feet) Boring Terminained at: 80 Inches (6.7 feet)  
 Seasonal High Water Table: 51 Inches (4.3 feet)  
 Slope: 1%  
 Vegetation:

Horizon	Depth(in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Fill 1	0-9"	10YR 5/2		Sand Gravel	Granular		
Fill 2	9-20"	10YR 6/3		Fine Sand	Granular		
A	20-51"	10YR 4/1		Fine Sand	Granular		
B1	51-57"	10YR 2/1		Silty Sand	Sub-Ang Blocky		Organics
B2	57-80"	10YR 3/2	10YR 3/3	Silty Sand	Sub-Ang Blocky		Organics

COMMENTS:  
 S-2 51-80" Gray silty coarse to fine sand (A-2-4)(0) with trace of clay

ABBREVIATIONS:  
 10 YR 3/2 - Munsell Color Chip#  
 Sub Ang - Subangular

**S&ME, Inc**  
**Soil Profile Descriptions**

Client:	NCDOT	Date:	3-Dec-07
Project Name:	New Route from NC 211 to NC 87 at SR 1525	S&ME Project No.:	1051-07-501
Project No.:	34531.1.1	State:	North Carolina
Tip No.:	R-3324		
F.A. No.:	STPF-133(3)		
County:	Brunswick		
Location:	B-3		
Station:	22+93	Northing:	73675.1
Offset:	100 ft LT	Easting:	2287536.2
Alignment:	-L-	Elevation:	10.3 feet
Apparent Water Table:	50 Inches (4.2 feet)	Boring Terminated at:	57 Inches (4.8 feet)
Seasonal High Water Table:	33 Inches (2.8 feet)		
Slope:	2%		
Vegetation:	Grass		

Horizon	Depth(in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-14"	10YR 2/2		Fine Sand	Granular		Few Organics
B	14-23"	10YR 5/3		Fine Sand	Granular		
E	23-33"	10YR 5/1		Fine Sand	Granular		
Bh	33-46"	10YR 2/1		Silty Sand	Sub-Ang Blocky		Organics
C	46-57"	7.5YR 3/3		Fine Sand	Granular		

COMMENTS:

S-3 14-33" Gray fine to coarse sand (A-3)(0) with trace of silt and clay
S-4 33-46" Gray silty coarse to fine sand (A-2-4)(0) with trace of clay

ABBREVIATIONS:

10 YR 3/2 - Munsell Color Chip#
Sub Ang - Subangular

**SUMMARY OF LABORATORY TEST DATA**



Soil Classification and Gradation

<b>S&amp;ME Project #:</b>	<b>1051-07-501</b>	<b>Test Date(s):</b>	<b>12/6 - 12/8/07</b>
<b>State Project No.:</b>	<b>34531.1.1</b>	<b>County:</b>	<b>Brunswick</b>
<b>Federal ID No.:</b>	<b>STPF-133(3)</b>	<b>TIP No.:</b>	<b>R-3324</b>
<b>Project Name:</b>	<b>New Route from NC 211 to NC 87 at SR 1525</b>		
<b>Client Name:</b>	<b>NCDOT</b>		
<b>Client Address:</b>	<b>Raleigh, NC</b>		

Boring No.	Sample No.	Sample Depth (in)	AASHTO Classification	Total % Passing					Total Mortar Fraction				LL	PL	PI	Moisture Content %
				Sieve #					Coarse Sand	Fine Sand	Silt	Clay				
				10	40	60	200	270								
B-1	S-1	65 - 84"	A-3 (0)	100	95	56	3.1	3	44	53	2	1	22	0	N.P.	ND
B-2	S-2	51 - 80"	A-2-4 (0)	100	97	87	18.1	12	13	75	8	4	31	0	N.P.	ND
B-3	S-3	14 - 33"	A-3 (0)	100	87	50	2.4	2	50	48	1	1	13	0	N.P.	ND
B-3	S-4	33 - 46"	A-2-4 (0)	100	99	83	14.2	10	16	74	6	4	22	0	N.P.	ND

Notes: ND=Not Determined

N.P.=Non Plastic

Technical Responsibility: B. Riggs

*Signature*

Geotechnical Engineer

*Position*

### Particle Size Analysis of Soils

AASHTO T 88 as Modified by NCDOT

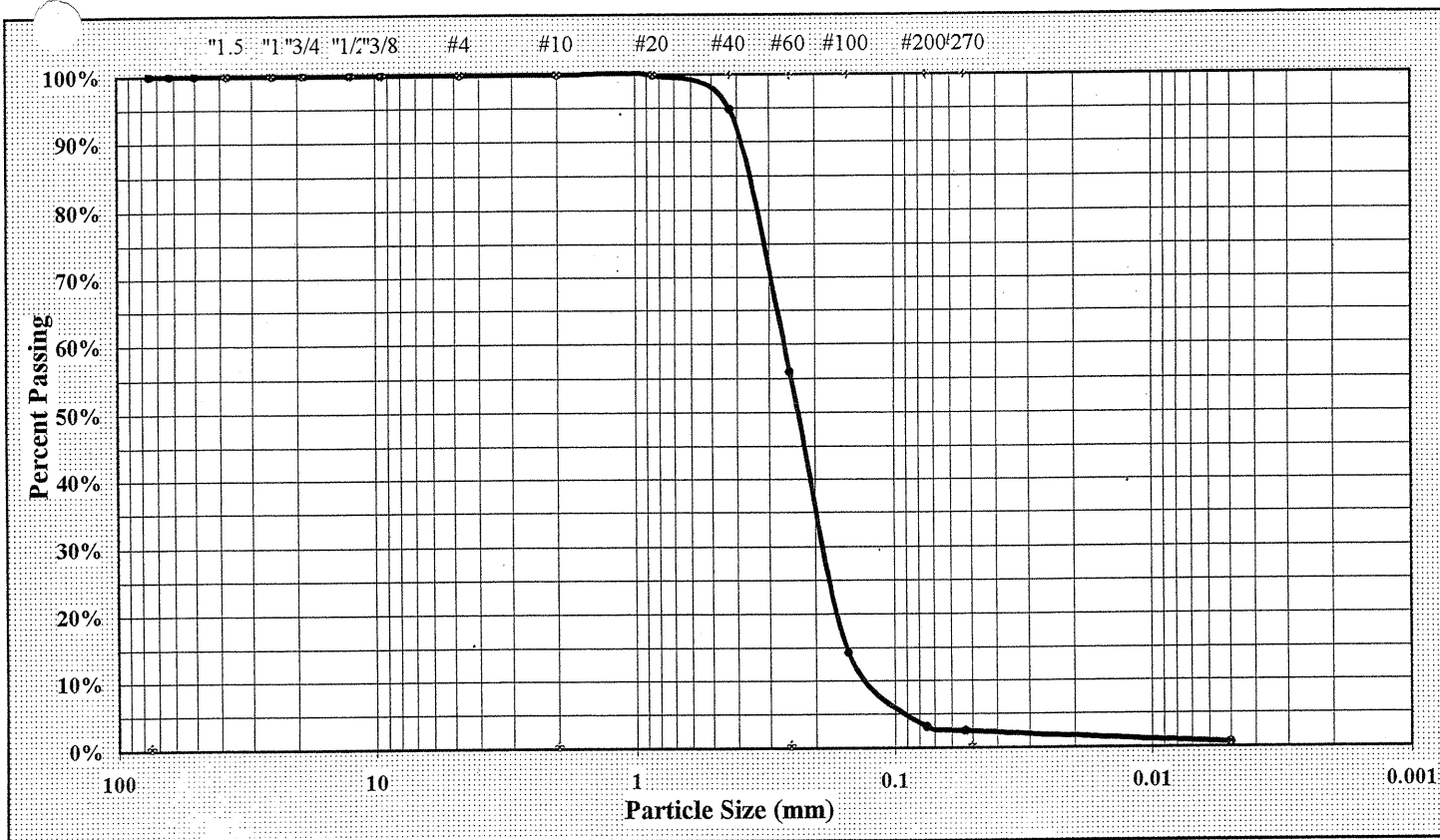


S&ME Project #: **1051-07-501**  
 Project Name: **New Route from NC 211 to NC 87 at SR 1525**  
 Client Name: **NCDOT**  
 Client Address: **Raleigh, NC**  
 State Project #: **34531.1.1**

Report Date: **12/8/2007**  
 Test Date(s): **12/6 - 12/8/07**

F.A. Project No: **STPF-133(3)**      TIP NO: **R-3324**

Boring #: **B-1**      Sample #: **S-1**      Sample Date: **12/3/2007**  
 Location: **20+14**      Offset: **90' RT**      Depth: **65 - 84"**  
 Sample Description: **Gray Coarse to Fine Sand with trace of silt and Clay      A-3 (0)**



As Defined by NCDOT		Fine Sand	< 0.25 mm and > 0.05 mm
Gravel	< 75 mm and > 2.00 mm	Silt	< 0.05 and > 0.005 mm
Coarse Sand	< 2.00 mm and > 0.25 mm	Clay	< 0.005 mm
Maximum Particle Size	#10	Coarse Sand	44.0%
		Silt	2.0%
Gravel	0.0%	Fine Sand	53.5%
		Clay	1.0%
Apparent Relative Density		Moisture Content	% Passing #200 3.1%
Liquid Limit	22	Plastic Limit	0
		Plastic Index	N.P.

#### Soil Mortar (-#10 Sieve)

Coarse Sand 44.0%      Fine Sand 53.5%      Silt 1.8%      Clay 0.7%

Description of Sand & Gravel Particles:    Rounded     Angular     Hard & Durable     Soft     Weathered & Friable   
 Mechanical Stirring Apparatus (A)    Length of Dispersion Period: 1 min.    Dispersing Agent: Sodium Hexametaphosphate: 40 g./Liter

References: AASHTO T88: Particle Size Analysis of Soils as Modified by the NCDOT  
 AASHTO T87: Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test      AASHTO T265: Laboratory Determination of Moisture Content of Soils  
 AASHTO T89: Determining the Liquid Limit of Soils      AASHTO T90: Determining the Plastic Limit & Plasticity Index of Soils  
 AASHTO M 145: The Classification of Soils and Soil Aggregate Mixtures for Highway Construction Purposes      ASTM D 854: Specific Gravity of Soils

Technical Responsibility: Mal Krajan      Laboratory Supervisor

### Particle Size Analysis of Soils

AASHTO T 88 as Modified by NCDOT



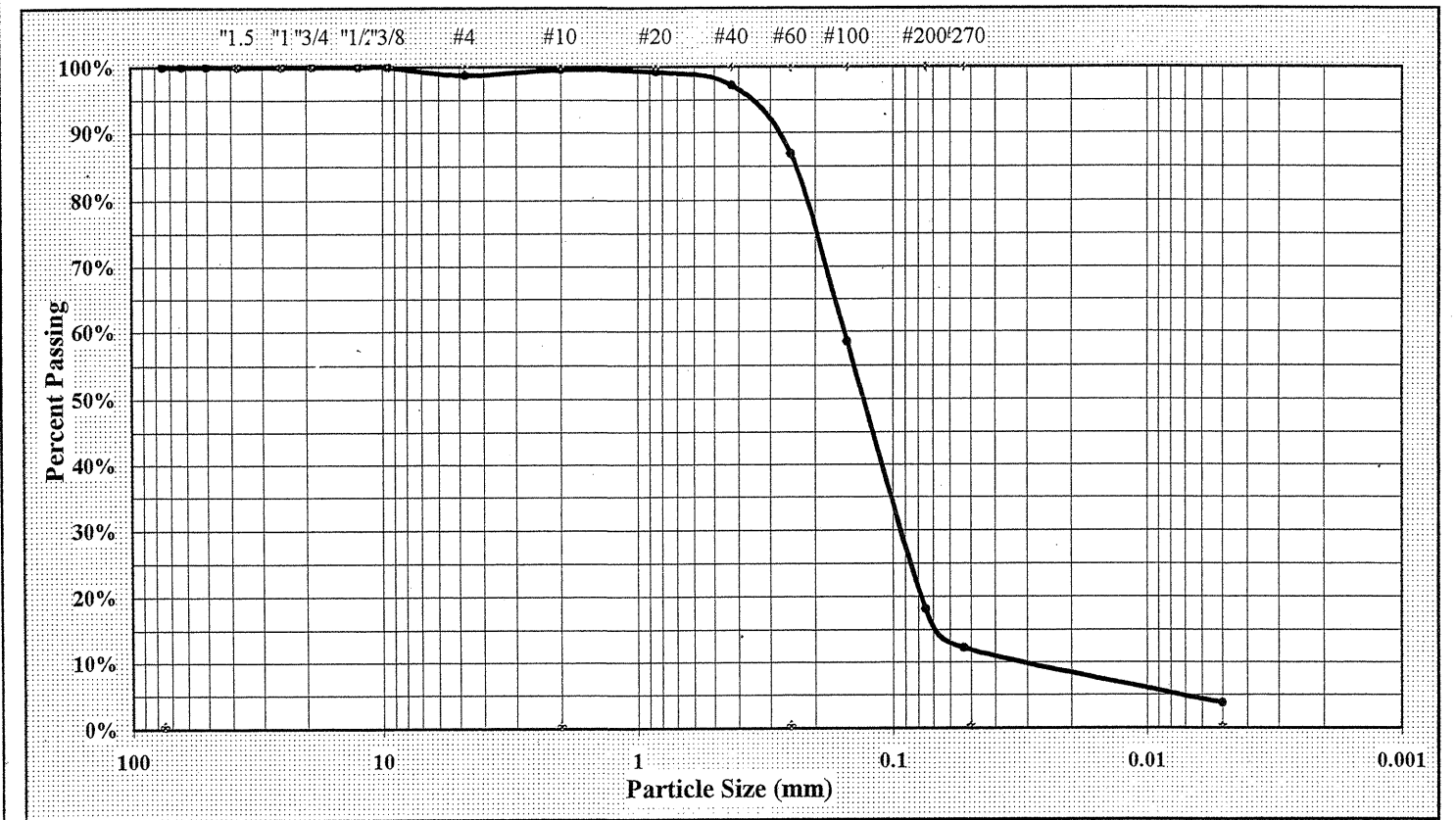
SHEET 10 OF 11

S&ME Project #: **1051-07-501**  
 Project Name: **New Route from NC 211 to NC 87 at SR 1525**  
 Client Name: **NCDOT**  
 Client Address: **Raleigh, NC**  
 State Project #: **34531.1.1**

Report Date: **12/8/2007**  
 Test Date(s): **12/6 - 12/8/07**

F.A. Project No: **STPF-133(3)**      TIP NO: **R-3324**

Boring #: **B-2**      Sample #: **S-2**      Sample Date: **12/3/2007**  
 Location: **21+85**      Offset: **75' LT**      Depth: **51 - 80"**  
 Sample Description: **Gray Silty Coarse to fine Sand with trace of clay      A-2-4 (0)**



As Defined by NCDOT		Fine Sand	< 0.25 mm and > 0.05 mm
Gravel	< 75 mm and > 2.00 mm	Silt	< 0.05 and > 0.005 mm
Coarse Sand	< 2.00 mm and > 0.25 mm	Clay	< 0.005 mm
Maximum Particle Size	#4	Coarse Sand	12.7%
		Silt	9.0%
Gravel	0.4%	Fine Sand	74.7%
		Clay	4.0%
Apparent Relative Density		Moisture Content	% Passing #200 18.1%
Liquid Limit	31	Plastic Limit	0
		Plastic Index	N.P.

#### Soil Mortar (-#10 Sieve)

Coarse Sand 12.8%      Fine Sand 75.0%      Silt 8.5%      Clay 3.7%

Description of Sand & Gravel Particles:    Rounded     Angular     Hard & Durable     Soft     Weathered & Friable   
 Mechanical Stirring Apparatus (A)    Length of Dispersion Period: 1 min.    Dispersing Agent: Sodium Hexametaphosphate: 40 g./Liter

References: AASHTO T88: Particle Size Analysis of Soils as Modified by the NCDOT  
 AASHTO T87: Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test      AASHTO T265: Laboratory Determination of Moisture Content of Soils  
 AASHTO T89: Determining the Liquid Limit of Soils      AASHTO T90: Determining the Plastic Limit & Plasticity Index of Soils  
 AASHTO M 145: The Classification of Soils and Soil Aggregate Mixtures for Highway Construction Purposes      ASTM D 854: Specific Gravity of Soils

Technical Responsibility: Mal Krajan      Laboratory Supervisor





NOTE: SEE SHEET 3 FOR PLAN SHEET LAYOUT AT TIME OF INVESTIGATION

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

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	34531.1.1	1	11
STATE PROJ. NO.	P.A. PROJ. NO.	DESCRIPTION	
34531.1.1	STPF-133(3)	P.E. CONST.	

CONTENTS:

LINE	STATION	PLAN	PROFILE	XSECTS
-L-	15+00.00 - 29+55.00	4	----	----

**INFILTRATION**  
**BASIN INVESTIGATION**

SUBJECT:

NCDOT Geotechnical Engineering Unit Soiland Rock Classification Sheet	Sheet 2
Roadway Title Sheet	Sheet 3
Geotechnical/K <sub>SAT</sub> Report	Sheets 3A - 3B
Boring Location Plan	Sheet 4
Amoozemeter Results	Sheets 5 & 6
Hand Auger Soil Profile Descriptions	Sheets 7 & 8
Summary of Laboratory Test Data	Sheet 9
Grain Size Curves	Sheets 10 & 11

STATE PROJ. 34531.1.1 I.D. R-3324 F.A. PROJ. STPF-133(3)  
 COUNTY BRUNSWICK  
 PROJECT DESCRIPTION NEW ROUTE FROM NC 211 TO NC 87  
AT SR 1525 (BETHEL ROAD)

**CAUTION NOTICE**

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WAS 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 # 1981 250-4088. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA IS 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-PLACED) TEST DATA CAN BE RELED 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.

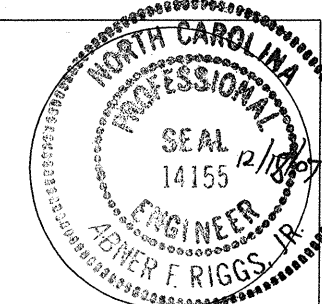
**CONTRACT: ID: R-3324**

**FOR LETTING**

PERSONNEL

- J. DAVIS
- P. MASTEN
- S. JOHNSON
- L. RAUP
- P. PHELPS
- T. PEREZ

INVESTIGATED BY S&ME, INC.  
 CHECKED BY A.F. RIGGS, JR.  
 SUBMITTED BY S&ME, INC.  
 DATE DECEMBER 13, 2007



*Abner F. Riggs, Jr.*

DRAWN BY: T. PEREZ

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**

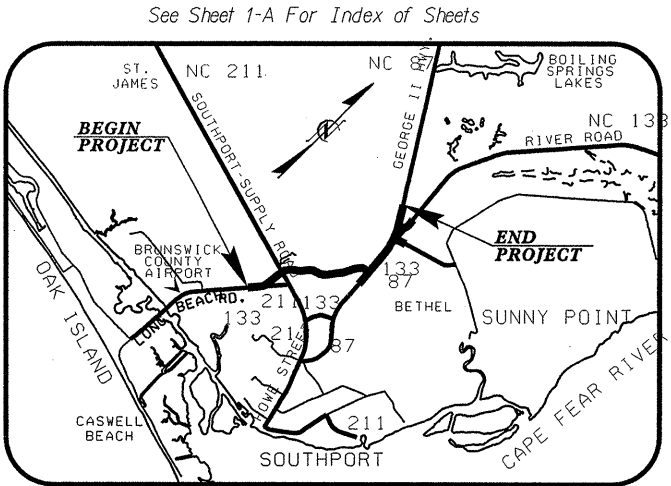
ID	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
R-3324	34531.1.1	2	11

**SUBSURFACE INVESTIGATION**

**SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS**

SOIL DESCRIPTION				GRADATION				ROCK DESCRIPTION				TERMS AND DEFINITIONS																																																																																																																																			
SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED OR WEATHERED EARTH MATERIALS WHICH CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND WHICH YIELDS LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (ASHTO T208, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE ASHTO SYSTEM AND BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, ASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE: VERY STIFF, GRAY SILTY CLAY, MOST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6				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.				HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WHEN 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:				ALLUVIUM (ALLUV.) - SOILS WHICH 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 IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE. CALCAREOUS (CALC.) - SOILS WHICH 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 (F.P.) - 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 (MOT.) - 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 SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK. ROCK QUALITY DESIGNATION (R.Q.D.) - 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 WHICH 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, WHICH HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED 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 (N OR B.P.F.) 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 LESS THAN 0.1 FOOT PENETRATION WITH 60 BLOWS. STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE. STRATA ROCK QUALITY DESIGNATION (S.R.Q.D.) - 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 STRATUM AND EXPRESSED AS A PERCENTAGE. TOPSOIL (T.S.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.																																																																																																																																			
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ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.				<b>WEATHERING</b> FRESH - ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE. VERY SLIGHT (V. SL.) - ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN. CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE. SLIGHT (SL.) - ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS. MODERATE (MOD.) - SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK. MODERATELY SEVERE (MOD. SEV.) - ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. <i>IF TESTED, WOULD YIELD SPT REFUSAL</i> SEVERE (SEV.) - ALL ROCKS EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. <i>IF TESTED, YIELDS SPT N VALUES &gt; 100 BPF</i> VERY SEVERE (V. SEV.) - ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. <i>IF TESTED, YIELDS SPT N VALUES &lt; 100 BPF</i> COMPLETE - ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.			
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<b>BENCH MARK: REBAR &amp; CAP STAMPED -BY- 25</b> <b>LOCATED AT -BY- STATION 13+23.87, -L- STATION 22+09.08 17.22' LT</b> <b>ELEVATION: 11.95'</b>				<b>NOTES:</b>																																																																																																																																											

09/08/99  
 CONTRACT: 34531.1.1  
 TIP PROJECT: R-3324  
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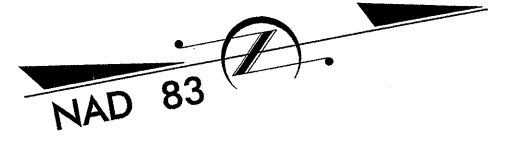


STATE OF NORTH CAROLINA  
 DIVISION OF HIGHWAYS  
**BRUNSWICK COUNTY**

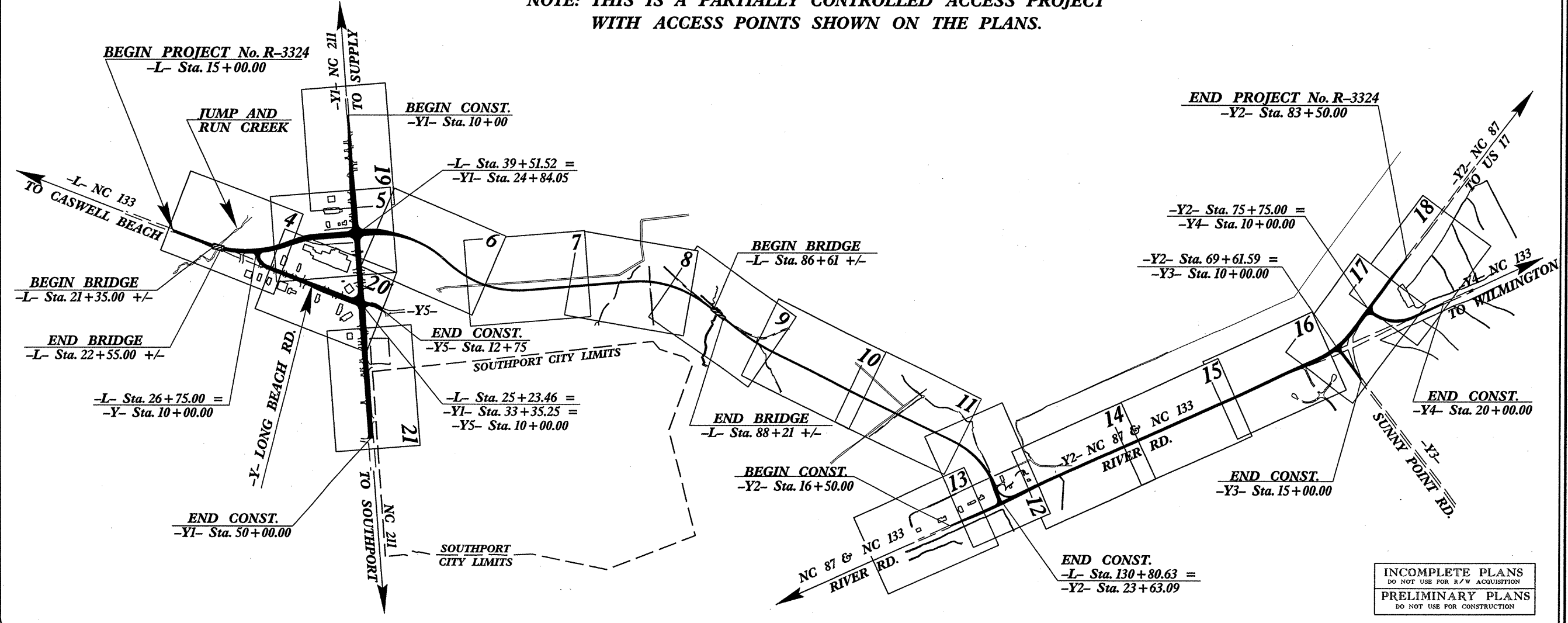
STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	R-3324	3	11
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION	
34531.1.1	STP-133(3)	PE	

**LOCATION: NEW ROUTE FROM NC 133 (LONG BEACH RD.)  
 TO NC 133 & NC 87 (RIVER RD.),  
 NORTH OF NC 133 ON NC 87 (GEORGE II RD.).**

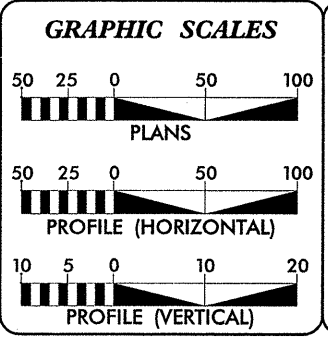
**TYPE OF WORK: GRADING, PAVING, DRAINAGE, STRUCTURES**



**NOTE: THIS IS A PARTIALLY CONTROLLED ACCESS PROJECT  
 WITH ACCESS POINTS SHOWN ON THE PLANS.**



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



**DESIGN DATA**

ADT 2009 = 9,500 - 13,700
ADT 2030 = 13,600 - 47,100
DHV = 50 %
D = 10 %
T = 5 % *
V = 50 MPH
FUNCTIONAL CLASSIFICATION: LOCAL
* TTST 2% DUAL 3%

**PROJECT LENGTH**

LENGTH ROADWAY TIP No. R-3324 (-L-) =	2.140 MILES
LENGTH ROADWAY TIP No. R-3324 (-Y2-) =	1.269 MILES
LENGTH STRUCTURES TIP No. R-3324 =	0.053 MILES
<b>TOTAL LENGTH TIP PROJECT No. R-3324 =</b>	<b>3.462 MILES</b>

**THIS PROJECT IS NOT WITHIN ANY MUNICIPAL BOUNDARIES.**

Prepared in the Office of:  
**DIVISION OF HIGHWAYS**  
 1000 Birch Ridge Dr., Raleigh NC, 27610  
 2006 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE: MARCH, 2008	JIMMY GOODNIGHT, PE PROJECT ENGINEER
LETTING DATE: JUNE, 2009	STEVE KENDALL, PE PROJECT DESIGN ENGINEER

**HYDRAULICS ENGINEER**

SIGNATURE: \_\_\_\_\_ P.E.

**ROADWAY DESIGN ENGINEER**

SIGNATURE: \_\_\_\_\_ P.E.

DIVISION OF HIGHWAYS  
 STATE OF NORTH CAROLINA

STATE HIGHWAY DESIGN ENGINEER

STATE PROJECT NO.: 34531.1.1  
 I.D. NO.: R-3324  
 FEDERAL PROJECT NO.: STPF-133(3)  
 COUNTY: Brunswick

DESCRIPTION: New Route from NC 211 to NC 87 at SR 1525 (Bethel Road)  
 Infiltration Basin Investigation

SUBJECT: Infiltration Basin Investigation – Addendum to Inventory Report

#### Project Description

The project site is located along existing NC 133 (Long Beach Road) southwest of its intersection with Port Loop Road and extends north over Jump and Run Creek and across NC 211 to NC 133 and NC 87 at the intersection of Bethel Road (SR 1525) in Brunswick County, North Carolina. The proposed project is part of the new route from NC 211 to NC 87 at Bethel Road (SR 1525) in which infiltration basins are to be constructed adjacent to the new alignment. The proposed infiltration basins will be located along existing NC 133 on each side of Jump and Run Creek. Grading plans of the proposed infiltration basin were not provided at the time of our investigation.

The sites are located within commercial and residential areas. The sites consist of grassed lawns and soil parking areas. Underground utilities including fiber optic cables, water, sewer and power are located along the roadway shoulders of the adjacent roads. In addition, private underground power and phone lines are located in the vicinity of the proposed Infiltration Basins.

A geotechnical investigation was conducted to determine hydraulic conductivity, depth to the seasonal groundwater table and the depth to observed water levels. S&ME personnel conducted three (3) in-situ saturated hydraulic conductivity tests for the proposed Infiltration Basins on December 3, 2007. The field test locations were selected by NCDOT and located in the field using a non-survey quality sub-meter Global Positioning System (GPS). The reported elevations were determined by S&ME personnel in the field utilizing survey techniques referencing a bench mark provided by NCDOT. The soil borings/hydraulic conductivity test locations selected by the NCDOT are shown on (Sheet 4) at the following stations:

Site	Station	Offset
B-1	-L- 20+14	+/- 90' Right
B-2	-L- 21+85	+/- 75' Left
B-3	-L- 22+93	+/- 100' Left

In-situ saturated hydraulic conductivity (Ksat) measurements were performed with a compact constant head permeameter (cchp). Test locations evaluated were B-1 through B-3. The in-situ hydraulic conductivity measurements were performed in the unsaturated material above the observed water table on the date of field testing. Hand auger borings were conducted and the material was described from the surface down to depths of 57 to 84 inches (4.8 to 7.0 feet) below the existing surface. The hand auger borings were generally terminated when water was encountered. The seasonal groundwater table was also determined by soil type and groundwater encountered in the hand auger borings. The seasonally high water table ranged from 33 to 51 inches (2.8 to 4.3 feet) feet below the surface. See attached soil profile description for each location for seasonally high water table determinations.

#### Test Results

Representative soil samples were tested in S&ME's laboratory to determine the soil index properties and to verify field classification. Four (4) soil samples from the site were analyzed for grain size distribution (including hydrometer) T88-90 and determination of liquid limit (T89-90), plastic limit and plasticity index in accordance with AASHTO T90-87 and NCDOT modifications to AASHTO T88-90, T89-90 and T90-87. Results of the laboratory tests are presented on the test data sheets in the Appendix.

#### Physiography and Geology

The site is located within the lower eastern portion of the Coastal Plain Physiographic and Geologic Province of North Carolina in Brunswick County. The Coastal Plain Province is typically characterized by marine and eolian sediments that were deposited during the transgressive and regressive depositional sequences. As such, the Coastal Plain Province is characterized by subdued topographic features and flat, low-lying terrain. The geology of the southeast quadrant of Brunswick County, near the project site, primarily consists of Undifferentiated Surface Deposits of Quaternary Age. Typically, the Undifferentiated Deposits consist of sands with localized zones of fine-grained silts and clays. These deposits are underlain by the Waccamaw Formation which consists of loosely consolidated bluish-gray fossiliferous sands with silt and clay. The Waccamaw Formation is underlain by the Peedee Formation of the Upper Cretaceous Age. The Peedee Formation consists of dark gray silts and clays interbedded with gray sand, calcareous sandstone, and limestone.

#### Materials

The hand auger borings were advanced to depths of 4.8 to 7.0 feet below the ground surface at collar elevations ranging from 10.3 to 12.8 feet.

Artificial fill materials were encountered in borings B-1 and B-2 to depths of about 20 to 27 inches (1.7 to 2.3 feet) below the collar elevation. The fill materials encountered in the hand auger borings consist of gray silty coarse to fine sand (A-2-4) with trace of clay.

Undifferentiated Coastal Plain deposits were encountered beneath the artificial fill materials in borings B-1 and B-2 and at the ground surface in boring B-3 and extend to the depth of boring termination. Typically, Undifferentiated Coastal Plain deposits encountered consist of gray coarse to fine sand (A-3) with trace of silt and clay and gray silty coarse to fine sand (A-2-4) with trace of clay.

#### Ksat Testing Results

The in-situ saturated hydraulic conductivity values were calculated based on field measurements using the Glover Equation. Saturated hydraulic conductivity measurements ranged from 133.82 to 493.86 gallons per day per square foot (gpd/ft<sup>2</sup>) (Appendix). In boring B-1, the water leaving the permeameter could not keep up with the flow rate going into the material, therefore possibly skewing the test results. For design purposes, we recommend a Ksat value of no more than 40 feet/day. A detailed soil profile description was performed at each Ksat location to determine the most limiting horizon at which the test should be performed.

Table 1 below summarizes hydraulic conductivity measurements for each location, including the location, and depth.

**Table 1: Hydraulic Conductivity Measurements**

Test Location	Depth (Feet)	Hydraulic Conductivity	
		gpd/ft <sup>2</sup>	feet/day
B-1	2.0	493.86	*40.00
B-2	2.0	228.80	30.59
B-3	2.0	133.82	17.89

\* Recommended hydraulic conductivity for design

Groundwater

Groundwater depths were measured at the time of hand auger operations for all of the hand auger borings. Groundwater depths ranging from about 50 to 82 inches (4.2 to 6.8 feet) beneath the collar elevation were measured in the hand auger borings. Based on the hand auger borings and observation of soil mottling in near surface soils, the seasonal high water table was estimated at depths ranging from 33 to 51 inches (2.8 to 4.3 feet) beneath collar elevations.

Table 2 below summarizes the location, ground surface elevation, seasonal high ground water and measured water levels at the time of boring completion for each location.

**Table 2: Season High Water Ground Water Estimates**

Location	Elevation Ground Surface (feet)	Depths to Seasonal High Ground Water (feet)	Water Levels Depth (Feet)	Date 2007
B-1	10.6	2.8	6.8	12/3/2007
B-2	12.8	4.3	6.1	12/3/2007
B-3	10.3	2.8	4.2	12/3/2007

Qualifications of Report

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The findings contained in this report were based on the applicable standards of our profession at the time this report was prepared. No other warranty, expressed or implied, is made.

The findings submitted in this report are based, in part, upon the data obtained from the subsurface exploration. The nature and extent of subsurface variations between the borings may not become evident until construction. If variations appear evident, then the findings contained in this report may need to be re-evaluated. In the event that any changes in the nature, design, or location of the structure are planned, the findings contained in this report will not be considered valid unless the changes are reviewed by S&ME, and the findings of the report are modified or verified in writing.


S&ME appreciates the opportunity to be your geotechnical consultant on this project. If you have any questions or need additional information in regard to this report, please contact us.

Very truly yours,

**S&ME, Inc.**

*John R. Davis*  
John R. Davis, LSS  
Project Manager

*Abner F. Riggs, Jr.*  
Abner F. Riggs, Jr. P.E.  
Senior Geotechnical Engineer  
N.C. Registration No. 14155



Attachments

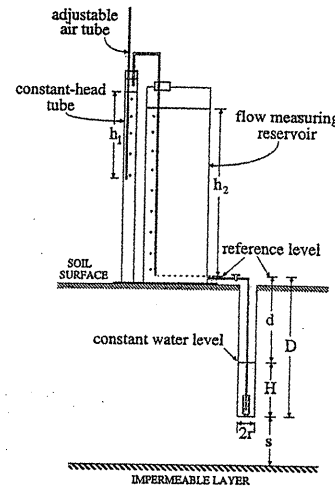
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S&ME  
"IN-SITU" CONSTANT HEAD PERMEAMETER

Date: 12/3/2007  
 Location: B-1  
 Horizon: Fill Horizon  
 Client: NCDOT  
 Project Name: New Route from NC 211 to NC 87  
 Project No.: 34531.1.1  
 Tip No.: R-3324

Hole Depth:	2.00	Feet
Hole Radius (r):	0.08	Feet
Bubble Tube to Surface:	0.30	Feet
Reference Tube to Hole Bottom (D):	2.30	Feet
Water Depth in Hole (H):	0.50	Feet
CHT Tube(s) Setting (h <sub>1</sub> ):	1.80	Feet
Chamber Used: 0.11 ft <sup>2</sup>		
Initial Water in Hole:	0.21	Feet
Final Water in Hole:	0.21	Feet



$K_{sat} = CQ / (2\pi H^2)$

$C = \sinh^{-1} (H/r) - [(r/H)^2 + 1]^{1/2} + r/H$

$\sinh^{-1}$  = inverse hyperbolic sin of a number

H = Height of water in hole (cm)

r = radius of hole (cm)

Q = Constant Flow Rate (Gal/day)

= Cross Sectional Area of Reservoir x Length of Drop in Water Column over Time

r = 0.08 ft  
 H = 0.21 ft  
 C = 0.98  
 Q = 139.80 Gallons/Day

Time	Drop in Water Column (ft)	Drop in Water Column (cm)
2	0.123	3.75
3	0.123	3.75
4	0.123	3.75
5	0.107	3.25
6	0.115	3.50
7	0.115	3.50
8	0.115	3.50
9	0.115	3.50
10	0.115	3.50
11	0.115	3.50
Avg.	0.115	

Time (min) = 1

Cross Sectional Area = 0.11 ft<sup>2</sup>  
 Length of Drop in Water Column = 165.35 ft/day

$K_{sat} = 493.86$  Gallons/Day/ft<sup>2</sup>

Cm/Hour = 83.85  
 Inches/Hour = 33.01  
 Feet/Day = 66.02

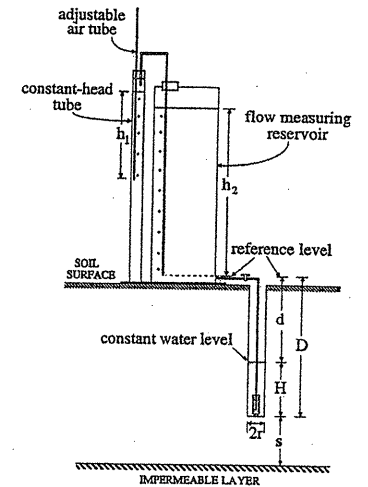
Note: In material with high permeability, the water leaving the permeameter cannot keep up with the flow rate into the material, for this reason calculations can be skewed.  
 For design of infiltration galleries, S&ME recommends not to exceed 40 feet/day.

Note:  $K_{sat}$  calculations are based on average drop in Water Column (ft) after equilibrium is reached.

S&ME  
"IN-SITU" COMPACT CONSTANT HEAD PERMEAMETER

Date: 12/3/2007  
 Location: B-2  
 Horizon: A  
 Client: NCDOT  
 Project Name: New Route from NC 211 to NC 87  
 Project No.: 34531.1.1  
 Tip No.: R-3324

Hole Depth:	2.00	Feet
Hole Radius (r):	0.08	Feet
Bubble Tube to Surface:	0.30	Feet
Reference Tube to Hole Bottom (D):	2.30	Feet
Water Depth in Hole (H):	0.50	Feet
CHT Tube(s) Setting (h <sub>1</sub> ):	1.80	Feet
Chamber Used: 0.11 ft <sup>2</sup>		
Initial Water in Hole:	0.29	Feet
Final Water in Hole:	0.29	Feet



$K_{sat} = CQ / (2\pi H^2)$

$C = \sinh^{-1} (H/r) - [(r/H)^2 + 1]^{1/2} + r/H$

$\sinh^{-1}$  = inverse hyperbolic sin of a number

H = Height of water in hole (cm)

r = radius of hole (cm)

Q = Constant Flow Rate (Gal/day)

= Cross Sectional Area of Reservoir x Length of Drop in Water Column over Time

r = 0.08 ft  
 H = 0.29 ft  
 C = 1.21  
 Q = 99.86 Gallons/Day

Time	Drop in Water Column (ft)	Drop in Water Column (cm)
6	0.082	2.50
7	0.082	2.50
8	0.082	2.50
9	0.082	2.50
10	0.082	2.50
11	0.082	2.50
12	0.082	2.50
13	0.082	2.50
14	0.082	2.50
15	0.082	2.50
Avg.	0.082	

Time (min) = 1

Cross Sectional Area = 0.11 ft<sup>2</sup>  
 Length of Drop in Water Column = 118.11 ft/day

$K_{sat} = 228.80$  Gallons/Day/ft<sup>2</sup>

Cm/Hour = 38.85  
 Inches/Hour = 15.29  
 Feet/Day = 30.59

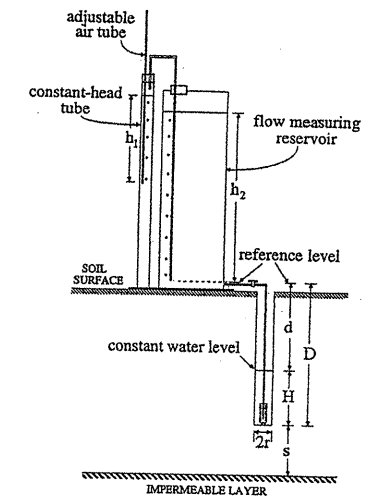
Note:  $K_{sat}$  calculations are based on average drop in Water Column (ft) after equilibrium is reached.



"IN-SITU" COMPACT CONSTANT HEAD PERMEAMETER

Date: 12/3/2007  
 Location: B-3  
 Horizon: E  
 Client: NCDOT  
 Project Name: New Route from NC 211 to NC 87  
 Project No.: 34531.1.1  
 Tip No.: R-3324

Hole Depth:	2.00	Feet
Hole Radius (r):	0.08	Feet
Bubble Tube to Surface:	0.30	Feet
Reference Tube to Hole Bottom (D):	2.30	Feet
Water Depth in Hole (H):	0.50	Feet
CHT Tube(s) Setting (h <sub>1</sub> ):	1.80	Feet
Chamber Used: 0.11 Ft <sup>2</sup>		
Initial Water in Hole:	0.33	Feet
Final Water in Hole:	0.33	Feet



$$K_{sat} = CQ / (2\pi r H^2)$$

$$C = \sinh^{-1}(H/r) - [(r/H)^2 + 1]^{1/2} + r/H$$

$\sinh^{-1}$  = inverse hyperbolic sin of a number

H = Height of water in hole (cm)

r = radius of hole (cm)

Q = Constant Flow Rate (Gal/day)

= Cross Sectional Area of Reservoir x Length of Drop in Water Column over Time

$$r = \frac{0.08}{12} \text{ ft}$$

$$H = \frac{0.33}{12} \text{ ft}$$

$$C = 1.31$$

$$Q = 69.90 \text{ Gallons/Day}$$

Time	Drop in Water Column (ft)	Drop in Water Column (cm)
6	0.057	1.75
7	0.057	1.75
8	0.057	1.75
9	0.057	1.75
10	0.057	1.75
11	0.057	1.75
12	0.057	1.75
13	0.057	1.75
14	0.057	1.75
15	0.057	1.75
Avg.	0.057	

Time (min) = 1

$$\text{Cross Sectional Area} = 0.11 \text{ ft}^2$$

$$\text{Length of Drop in Water Column} = 82.68 \text{ ft/day}$$

$$K_{sat} = 133.82 \text{ Gallons/Day/ft}^2$$

Cm/Hour = 22.72  
 Inches/Hour = 8.95  
 Feet/Day = 17.89

Note: K<sub>sat</sub> calculations are based on average drop in Water Column (ft) after equilibrium is reached.

**S&ME, Inc**  
**Soil Profile Descriptions**

Client: NCDOT Date: 3-Dec-07  
 Project Name: New Route from NC 211 to NC 87 at SR 1525 S&ME Project No.: 1051-07-501  
 Project No.: 34531.1.1 State: North Carolina  
 Tip No.: R-3324  
 A. No.: STPF-133(3)  
 County: Brunswick  
 Location: B-1  
 Station: 20+14 Northing: 73420.9  
 Offset: 90 ft RT Easting: 2287592.7  
 Alignment: -L- Elevation: 10.6 feet  
 Apparent Water Table: 82 Inches (6.8 feet) Boring Terminained at: 84 Inches (7.0 feet)  
 Seasonal High Water Table: 34 Inches (2.8 feet)  
 Slope: 2%  
 Vegetation:

Horizon	Depth(in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Fill 1	0-14"	10YR 4/2		Fine Sand	Granular		
Fill 2	14-27"	10YR 5/4		Fine Sand	Granular		
A	27-34"	10YR 4/1		Fine Sand	Granular		
B1	34-54"	10YR 2/1		Silty Sand	Sub-Ang Blocky		Organics
B2	54-65"	10YR 3/1	10YR 7/2	Fine Sand	Granular		
C	65-84"	10YR 7/2	10YR 3/1	Fine Sand	Granular		

COMMENTS:  
 S-1 65-84" Gray coarse to fine sand (A-3)(0) with trace of silt and clay

ABBREVIATIONS:  
 10 YR 3/2 - Munsell Color Chip#  
 Sub Ang - Subangular

**S&ME, Inc**  
**Soil Profile Descriptions**

Client: NCDOT Date: 3-Dec-07  
 Project Name: New Route from NC 211 to NC 87 at SR 1525 S&ME Project No.: 1051-07-501  
 Project No.: 34531.1.1 State: North Carolina  
 Tip No.: R-3324  
 F.A. No.: STPF-133(3)  
 County: Brunswick  
 Location: B-2  
 Station: 21+85 Northing: 73575.9  
 Offset: 75 ft LT Easting: 2287501.6  
 Alignment: -L- Elevation: 12.8 feet  
 Apparent Water Table: 73 Inches (6.1 feet) Boring Terminained at: 80 Inches (6.7 feet)  
 Seasonal High Water Table: 51 Inches (4.3 feet)  
 Slope: 1%  
 Vegetation:

Horizon	Depth(in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
Fill 1	0-9"	10YR 5/2		Sand Gravel	Granular		
Fill 2	9-20"	10YR 6/3		Fine Sand	Granular		
A	20-51"	10YR 4/1		Fine Sand	Granular		
B1	51-57"	10YR 2/1		Silty Sand	Sub-Ang Blocky		Organics
B2	57-80"	10YR 3/2	10YR 3/3	Silty Sand	Sub-Ang Blocky		Organics

COMMENTS:  
 S-2 51-80" Gray silty coarse to fine sand (A-2-4)(0) with trace of clay

ABBREVIATIONS:  
 10 YR 3/2 - Munsell Color Chip#  
 Sub Ang - Subangular

**S&ME, Inc**  
**Soil Profile Descriptions**

Client:	NCDOT	Date:	3-Dec-07
Project Name:	New Route from NC 211 to NC 87 at SR 1525	S&ME Project No.:	1051-07-501
Project No.:	34531.1.1	State:	North Carolina
Tip No.:	R-3324		
F.A. No.:	STPF-133(3)		
County:	Brunswick		
Location:	B-3		
Station:	22+93	Northing:	73675.1
Offset:	100 ft LT	Easting:	2287536.2
Alignment:	-L-	Elevation:	10.3 feet
Apparent Water Table:	50 Inches (4.2 feet)	Boring Terminained at:	57 Inches (4.8 feet)
Seasonal High Water Table:	33 Inches (2.8 feet)		
Slope:	2%		
Vegetation:	Grass		

Horizon	Depth(in)	Matrix	Mottles	Texture	Structure	Consistence	Notes
A	0-14"	10YR 2/2		Fine Sand	Granular		Few Organics
B	14-23"	10YR 5/3		Fine Sand	Granular		
E	23-33"	10YR 5/1		Fine Sand	Granular		
Bh	33-46"	10YR 2/1		Silty Sand	Sub-Ang Blocky		Organics
C	46-57"	7.5YR 3/3		Fine Sand	Granular		

COMMENTS:

S-3 14-33" Gray fine to coarse sand (A-3)(0) with trace of silt and clay
S-4 33-46" Gray silty coarse to fine sand (A-2-4)(0) with trace of clay

ABBREVIATIONS:

10 YR 3/2 - Munsell Color Chip#
Sub Ang - Subangular

**SUMMARY OF LABORATORY TEST DATA**



Soil Classification and Gradation

<b>S&amp;ME Project #:</b>	<b>1051-07-501</b>	<b>Test Date(s):</b>	<b>12/6 - 12/8/07</b>
<b>State Project No.:</b>	<b>34531.1.1</b>	<b>County:</b>	<b>Brunswick</b>
<b>Federal ID No.:</b>	<b>STPF-133(3)</b>	<b>TIP No.:</b>	<b>R-3324</b>
<b>Project Name:</b>	<b>New Route from NC 211 to NC 87 at SR 1525</b>		
<b>Client Name:</b>	<b>NCDOT</b>		
<b>Client Address:</b>	<b>Raleigh, NC</b>		

Boring No.	Sample No.	Sample Depth (in)	AASHTO Classification	Total % Passing					Total Mortar Fraction				LL	PL	PI	Moisture Content %
				Sieve #					Coarse Sand	Fine Sand	Silt	Clay				
				10	40	60	200	270								
B-1	S-1	65 - 84"	A-3 (0)	100	95	56	3.1	3	44	53	2	1	22	0	N.P.	ND
B-2	S-2	51 - 80"	A-2-4 (0)	100	97	87	18.1	12	13	75	8	4	31	0	N.P.	ND
B-3	S-3	14 - 33"	A-3 (0)	100	87	50	2.4	2	50	48	1	1	13	0	N.P.	ND
B-3	S-4	33 - 46"	A-2-4 (0)	100	99	83	14.2	10	16	74	6	4	22	0	N.P.	ND

Notes: ND=Not Determined

N.P.=Non Plastic

Technical Responsibility: B. Riggs

*B. Riggs*  
Signature

Geotechnical Engineer  
Position

### Particle Size Analysis of Soils

AASHTO T 88 as Modified by NCDOT

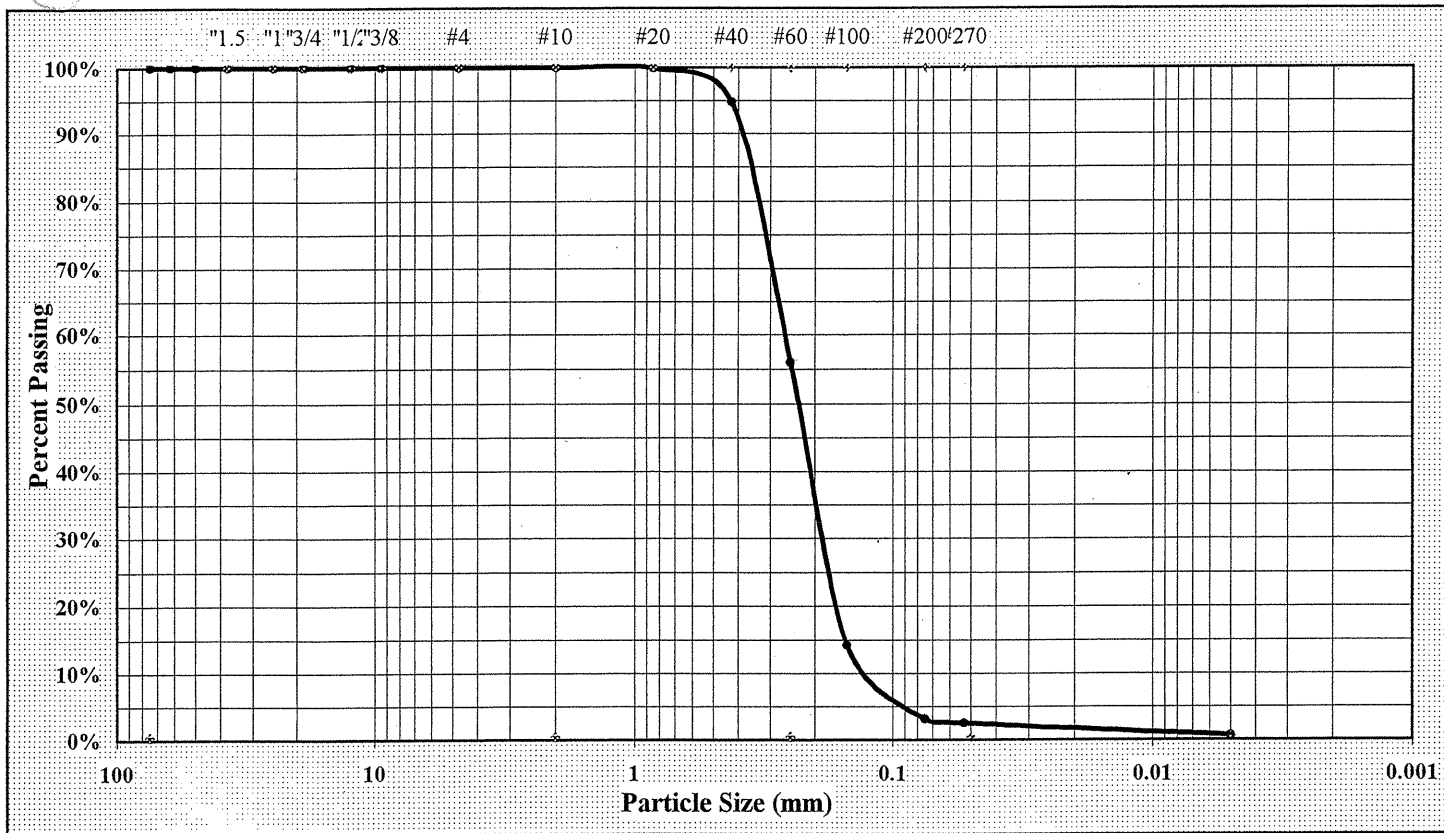


S&ME Project #: **1051-07-501**  
 Project Name: **New Route from NC 211 to NC 87 at SR 1525**  
 Client Name: **NCDOT**  
 Client Address: **Raleigh, NC**  
 State Project #: **34531.1.1**

Report Date: **12/8/2007**  
 Test Date(s): **12/6 - 12/8/07**

F.A. Project No: **STPF-133(3)**      TIP NO: **R-3324**

Boring #: **B-1**      Sample #: **S-1**      Sample Date: **12/3/2007**  
 Location: **20+14**      Offset: **90' RT**      Depth: **65 - 84"**  
 Sample Description: **Gray Coarse to Fine Sand with trace of silt and Clay**      **A-3 (0)**



As Defined by NCDOT		Fine Sand	< 0.25 mm and > 0.05 mm
Gravel	< 75 mm and > 2.00 mm	Silt	< 0.05 and > 0.005 mm
Coarse Sand	< 2.00 mm and > 0.25 mm	Clay	< 0.005 mm

Maximum Particle Size	#10	Coarse Sand	44.0%	Silt	2.0%
Gravel	0.0%	Fine Sand	53.5%	Clay	1.0%
Apparent Relative Density		Moisture Content		% Passing #200	3.1%
Liquid Limit	22	Plastic Limit	0	Plastic Index	N.P.

#### Soil Mortar (-#10 Sieve)

Coarse Sand	44.0%	Fine Sand	53.5%	Silt	1.8%	Clay	0.7%
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Description of Sand & Gravel Particles:    Rounded     Angular     Hard & Durable     Soft     Weathered & Friable

Mechanical Stirring Apparatus (A)    Length of Dispersion Period: 1 min.    Dispersing Agent: Sodium Hexametaphosphate: 40 g./ Liter

References:    AASHTO T88: Particle Size Analysis of Soils as Modified by the NCDOT  
 AASHTO T87: Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test      AASHTO T265: Laboratory Determination of Moisture Content of Soils  
 AASHTO T89: Determining the Liquid Limit of Soils      AASHTO T90: Determining the Plastic Limit & Plasticity Index of Soils  
 AASHTO M 145: The Classification of Soils and Soil Aggregate Mixtures for Highway Construction Purposes      ASTM D 854: Specific Gravity of Soils

Technical Responsibility: Mal Krajan            Laboratory Supervisor  
 Signature

### Particle Size Analysis of Soils

AASHTO T 88 as Modified by NCDOT



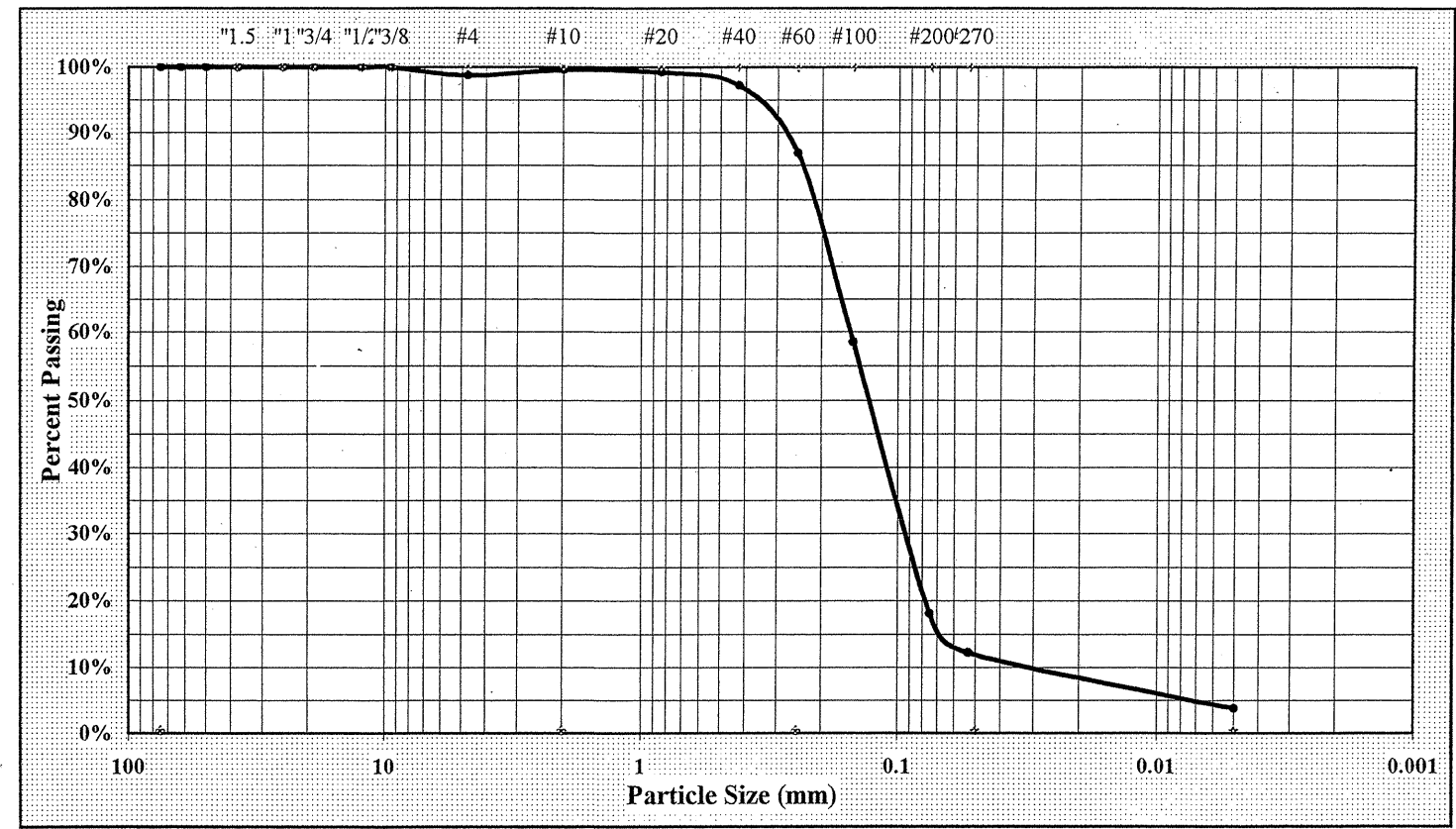
SHEET 10 OF 11

S&ME Project #: **1051-07-501**  
 Project Name: **New Route from NC 211 to NC 87 at SR 1525**  
 Client Name: **NCDOT**  
 Client Address: **Raleigh, NC**  
 State Project #: **34531.1.1**

Report Date: **12/8/2007**  
 Test Date(s): **12/6 - 12/8/07**

F.A. Project No: **STPF-133(3)**      TIP NO: **R-3324**

Boring #: **B-2**      Sample #: **S-2**      Sample Date: **12/3/2007**  
 Location: **21+85**      Offset: **75' LT**      Depth: **51 - 80"**  
 Sample Description: **Gray Silty Coarse to fine Sand with trace of clay**      **A-2-4 (0)**



As Defined by NCDOT		Fine Sand	< 0.25 mm and > 0.05 mm
Gravel	< 75 mm and > 2.00 mm	Silt	< 0.05 and > 0.005 mm
Coarse Sand	< 2.00 mm and > 0.25 mm	Clay	< 0.005 mm

Maximum Particle Size	#4	Coarse Sand	12.7%	Silt	9.0%
Gravel	0.4%	Fine Sand	74.7%	Clay	4.0%
Apparent Relative Density		Moisture Content		% Passing #200	18.1%
Liquid Limit	31	Plastic Limit	0	Plastic Index	N.P.

#### Soil Mortar (-#10 Sieve)

Coarse Sand	12.8%	Fine Sand	75.0%	Silt	8.5%	Clay	3.7%
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Description of Sand & Gravel Particles:    Rounded     Angular     Hard & Durable     Soft     Weathered & Friable

Mechanical Stirring Apparatus (A)    Length of Dispersion Period: 1 min.    Dispersing Agent: Sodium Hexametaphosphate: 40 g./ Liter

References:    AASHTO T88: Particle Size Analysis of Soils as Modified by the NCDOT  
 AASHTO T87: Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test      AASHTO T265: Laboratory Determination of Moisture Content of Soils  
 AASHTO T89: Determining the Liquid Limit of Soils      AASHTO T90: Determining the Plastic Limit & Plasticity Index of Soils  
 AASHTO M 145: The Classification of Soils and Soil Aggregate Mixtures for Highway Construction Purposes      ASTM D 854: Specific Gravity of Soils

Technical Responsibility: Mal Krajan            Laboratory Supervisor  
 Signature

### Particle Size Analysis of Soils

AASHTO T 88 as Modified by NCDOT

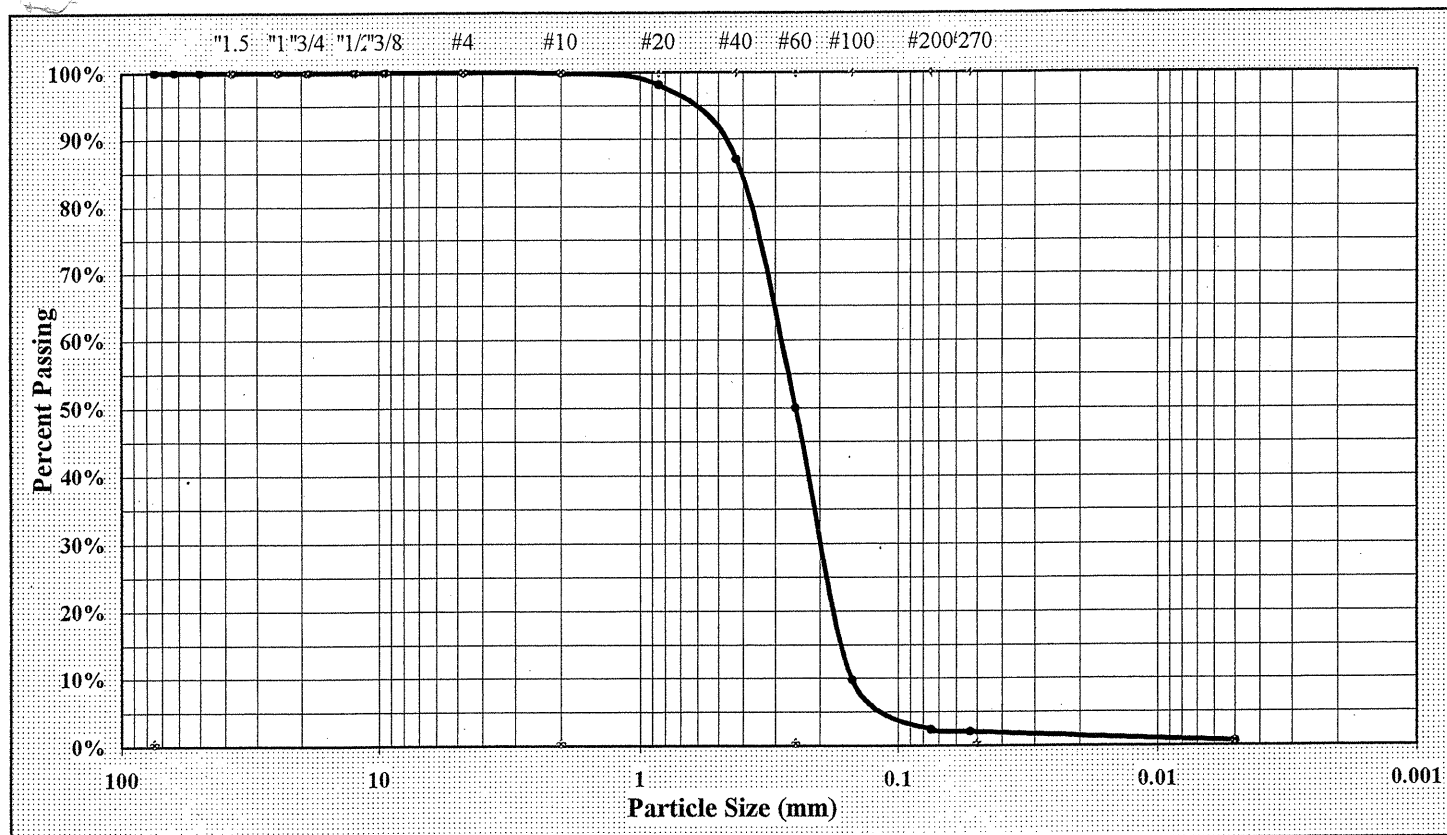


S&ME Project #: **1051-07-501**  
 Project Name: **New Route from NC 211 to NC 87 at SR 1525**  
 Client Name: **NCDOT**  
 Client Address: **Raleigh, NC**  
 State Project #: **34531.1.1**

Report Date: **12/8/2007**  
 Test Date(s): **12/6 - 12/8/07**

F.A. Project No: **STPF-133(3)**      TIP NO: **R-3324**

Boring #: **B-3**      Sample #: **S-3**      Sample Date: **12/3/2007**  
 Location: **22+93**      Offset: **100' LT**      Depth: **14 - 33"**  
 Sample Description: **Gray fine to coarse sand with trace of silt and clay**      **A-3 (0)**



As Defined by NCDOT		Fine Sand	< 0.25 mm and > 0.05 mm
Gravel	< 75 mm and > 2.00 mm	Silt	< 0.05 and > 0.005 mm
Coarse Sand	< 2.00 mm and > 0.25 mm	Clay	< 0.005 mm

Maximum Particle Size	#4	Coarse Sand	49.9%	Silt	1.0%
Gravel	0.1%	Fine Sand	47.9%	Clay	1.0%
Apparent Relative Density		Moisture Content		% Passing #200	2.4%
Liquid Limit	13	Plastic Limit	0	Plastic Index	N.P.

#### Soil Mortar (-#10 Sieve)

Coarse Sand	50.0%	Fine Sand	47.9%	Silt	1.4%	Clay	0.7%
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Description of Sand & Gravel Particles:    Rounded     Angular     Hard & Durable     Soft     Weathered & Friable

Mechanical Stirring Apparatus (A)    Length of Dispersion Period: 1 min.    Dispersing Agent: Sodium Hexametaphosphate: 40 g./ Liter

References:    AASHTO T88: Particle Size Analysis of Soils as Modified by the NCDOT    AASHTO T265: Laboratory Determination of Moisture Content of Soils  
 AASHTO T87: Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test    AASHTO T89: Determining the Liquid Limit of Soils  
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Technical Responsibility: Mal Krajan      *[Signature]*      Laboratory Supervisor  
 Signature

### Particle Size Analysis of Soils

AASHTO T 88 as Modified by NCDOT



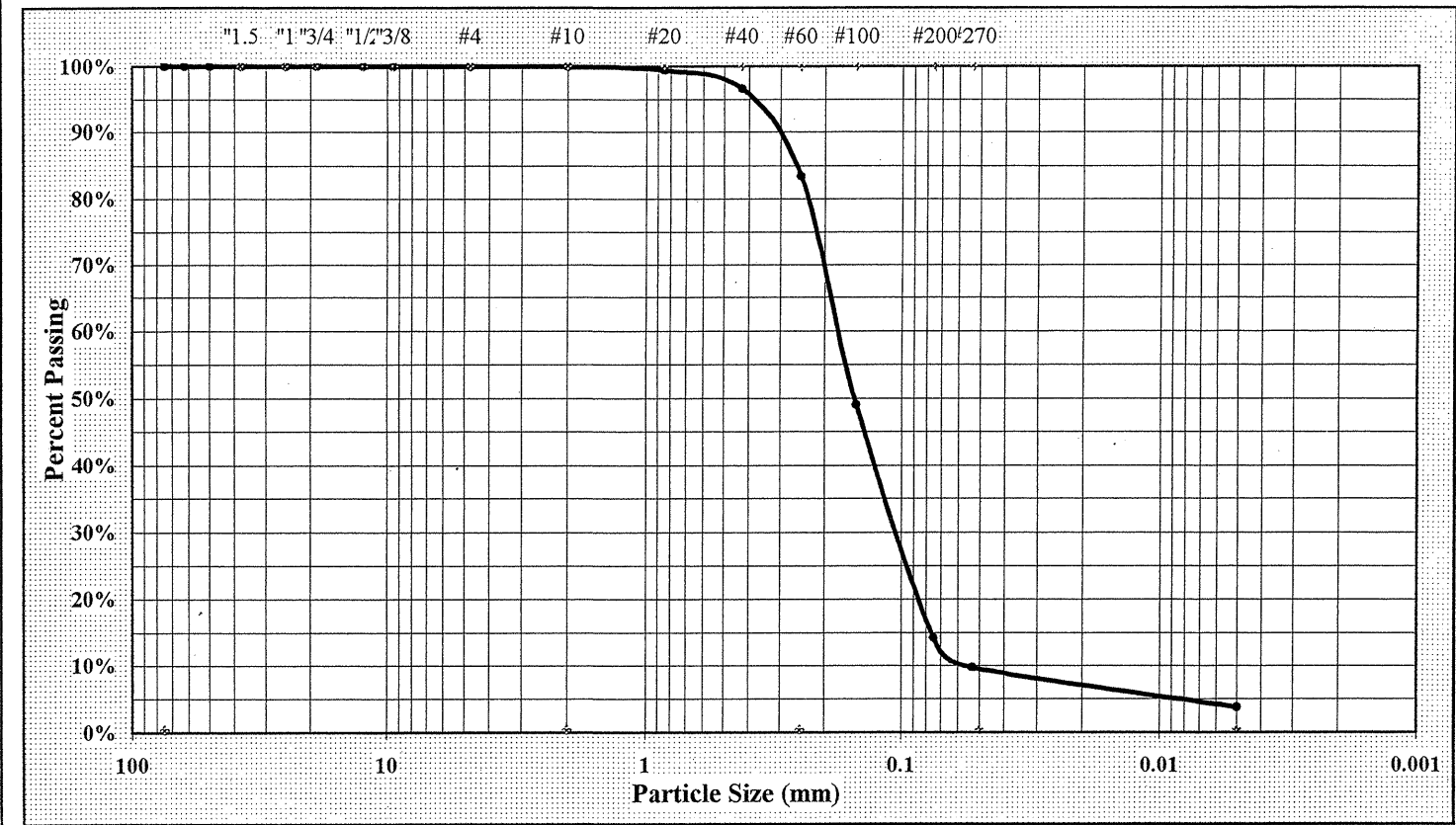
SHEET 11 OF 11

S&ME Project #: **1051-07-501**  
 Project Name: **New Route from NC 211 to NC 87 at SR 1525**  
 Client Name: **NCDOT**  
 Client Address: **Raleigh, NC**  
 State Project #: **34531.1.1**

Report Date: **12/8/2007**  
 Test Date(s): **12/6 - 12/8/07**

F.A. Project No: **STPF-133(3)**      TIP NO: **R-3324**

Boring #: **B-3**      Sample #: **S-4**      Sample Date: **12/3/2007**  
 Location: **22+93**      Offset: **100' LT**      Depth: **33 - 46"**  
 Sample Description: **Gray silty coarse to fine sand with trace of clay**      **A-2-4 (0)**



As Defined by NCDOT		Fine Sand	< 0.25 mm and > 0.05 mm
Gravel	< 75 mm and > 2.00 mm	Silt	< 0.05 and > 0.005 mm
Coarse Sand	< 2.00 mm and > 0.25 mm	Clay	< 0.005 mm

Maximum Particle Size	3/8"	Coarse Sand	16.6%	Silt	6.0%
Gravel	0.0%	Fine Sand	73.7%	Clay	4.0%
Apparent Relative Density		Moisture Content		% Passing #200	14.2%
Liquid Limit	22	Plastic Limit	0	Plastic Index	N.P.

#### Soil Mortar (-#10 Sieve)

Coarse Sand	16.6%	Fine Sand	73.7%	Silt	6.0%	Clay	3.7%
-------------	-------	-----------	-------	------	------	------	------

Description of Sand & Gravel Particles:    Rounded     Angular     Hard & Durable     Soft     Weathered & Friable

Mechanical Stirring Apparatus (A)    Length of Dispersion Period: 1 min.    Dispersing Agent: Sodium Hexametaphosphate: 40 g./ Liter

References:    AASHTO T88: Particle Size Analysis of Soils as Modified by the NCDOT    AASHTO T265: Laboratory Determination of Moisture Content of Soils  
 AASHTO T87: Dry Preparation of Disturbed Soil and Soil Aggregate Samples for Test    AASHTO T89: Determining the Liquid Limit of Soils  
 AASHTO T89: Determining the Liquid Limit of Soils    AASHTO T90: Determining the Plastic Limit & Plasticity Index of Soils  
 AASHTO M 145: The Classification of Soils and Soil Aggregate Mixtures for Highway Construction Purposes    ASTM D 854: Specific Gravity of Soils

Technical Responsibility: Mal Krajan      *[Signature]*      Laboratory Supervisor  
 Signature