F-057 COBB COUNTY

CULVERT ANALYSIS

$Q_{50} = 3501$ CFS

COMPUTED 50 YR. HIGHWATER — EL. 929.34'
FLOWLINE OF CULVERT — EL. 918.50
DEPTH OF WATER — 10.84'

INLET CONTROL (DBL. DBL. 10X12)

$\frac{HW}{D} = \frac{10.84}{12} = 0.903$

$Q/B = 107$

$B = 3501/107 = 32.72$

$Q/B = 3501/40 = 87.52$

$HW/D = 0.80$

$HW = 0.80(12) = 9.60$ FT.

OUTLET CONTROL (DBL. DBL. 10X12)

AREA = 120X4

LENGTH OF CULVERT = 214 FT.

DISCHARGE PER BARREL = 3501/4 = 875.25 CFS

H = 1.42'

ELEV. = 929.34' + 1.42' = 930.76 FT.

COST ANALYSIS

BARREL

DESIGN 2
STEEL = (5542)(174')(2)($0.24/LB.) = $46,287
CONCRETE = (4.076)(174')(2)($110/FT.^{3}) = $156,028

DESIGN 1
STEEL = (419)(40')(2)($0.24/LB.) = $8045
CONCRETE = (3,158)(40')(2)($110/FT.^{3}) = $28,142

F-057 COBB COUNTY

COST ANALYSIS (CON'T.) DBL. DBL. 10X12 CULVERT

WINGWALL & PARAPETS

CONCRETE = 59.31 + 3.198(2) + [(.83)(21)(1.33) + (.50)(1)(21)] 2/27

CONCRETE = [59.31 + 6.40 + 2.48] ($110/FT.^{3}) = $7500

STEEL = 5518 ($0.24/LB.) = $1324

OUTLET APRON

CONCRETE = [13.93 + (21)(15)(.50)/27] ($110/FT.^{3}) = $2174

STEEL = 1028 ($0.24/LB.) = $247

FILL MATERIAL

[(3040 FT.^{2})(68 FT.)(2) + ½(37)(2)]/27 = 15,314 CU. YDS.

15,314 CU. YD. ($0.70/CU. YD.) = $10,720

TOTAL COST (DBL. DBL. 10X12) = $260,467

COST ANALYSIS (DUAL 170'X42' BRIDGES)

(170')(42')(2) ($22/FT.^{2}) = $314,160

ELEV. OF HOUSE LOCATED 388 FT. UPSTREAM = 933.80 FT.

50 YR. H.W. = 929.34 FT.

RISE IN WATER SURFACE DUE TO SLOPE = (.00165) 388' = 0.64'

929.98
11.12
930.50

TRIPLE 10x12 CULVERT

AREA = 120 X 3

3073/3 = 1026 CFS

H = 2.00'

INLET

$\frac{HW}{D} = \frac{10.36}{12} = .86$

Q/B = 98

B = 3073/98 = 31.3

HW/D = .89 (7)

DBL. DBL. 10X10

HW/D = 10.36/10 = 1.036

Q/B = 98

B = 3073/98 = 31.3

B = 40'

Q/B = 3073/40 = 76.8'

HW/D = .86

HW = .86 (10) = 8.60'

OUTLET

AREA = 100 X 4

H = 1.62

GEORGIA DEPARTMENT OF TRANSPORTATION

HYDRAULIC ENGINEERING FIELD REPORT

FOR

DESIGN OF BRIDGES

DATE: 12 JAN 76

I. FIELD REPORT

LOCATION:

District: 7 County: COBB Project No. RFF-057(4)
On road from MARIETTA (town) to WOODSTOCK (town)
at Station 123+15. General location is _____ miles
from _____ (town) in a _____ direction.
Surveyed by LEWIS ALDRED C.E.T. PLANS & SURVEY - DIST #7

SITE INFORMATION

1 → Attach U.S.G.S. Quadrangle Map or map of comparable detail showing location of bridge.
2 → Attach Aerial photos of proposed site.
Attach map of site with contour intervals of 1 to 2 feet and/or 3 cross sections perpendicular to flood flow (1) 500' to 1000' upstream of crossing, (2) at crossing, and (3) 500' to 1000' downstream of crossing. (NOTE: Cross sections should be wide enough to cover the entire area flooded by the H.W. elevation.)
Drainage area _____ sq. miles. How obtained (maps, traverse) _____
Character of drainage area: Flat, rolling, mountainous, etc. ROLLING
Type of stream bed (rocky, sand, etc.) SANDY
3 → Is stream straight, crooked, etc. CROOKED
Are banks stable, caving, steep, etc.? STEEP & STABLE
Is stream cutting or filling at site? _____
Describe type of vegetation on flood plain (pasture, forest, cultivated, dense or light undergrowth, etc.) PASTURE & FOREST WITH LIGHT UNDERGROWTH
Are dikes present? NO If so, describe them _____
Are there other things in flood plain which would interfere with natural drainage of site? NO
Attach photos of stream and flood plain at crossing site.
Describe character of flood valley as to uniformity and obstructions. Also determine any natural obstructions. _____

WATER SURFACE DATA AT BRIDGE SITE

If not available, give elevations where found.

	Extreme High Water (Give date of occurrence)	Water surface Elevation at time of Survey
Elevations and dates of same	926.09 1975	918.73 100' LT ℄
Source of information	LYNN STEPHEN	918.40 100' RT ℄
Head (or backwater from ____).....		

Elevation of extreme low water _____, date _____
Slope of river upstream from bridge site _____ ft. per mile
Are there flood control works (dams, levees, etc.) upstream of crossing? NO
If so, give location, date of construction, drainage area, etc. _____

Give other factors which affect water stages (highwater from other streams, reservoirs, tides, etc.) _____

EXISTING BRIDGE AT OR NEAR PROPOSED SITE None

(NOTE: Complete all information in this section if the new bridge is replacing the old bridge.)

Bridge Identification Number: _____
Elev. floor _____ Roadway width _____ Built by _____ Date _____
Number and length of spans _____
Kind of superstructure _____ Condition _____
Kind of substructure _____ Condition _____
Will it interfere with construction of new bridge? _____
Can piers or abutments be utilized for new bridge? _____. If so, give complete sketches and dimensions _____
What is effective waterway under bridge, at 90° with direction of flow, below extreme high water? _____ sq. ft.
If high-water elevation is above bottom of structure, give free waterway available below structure _____.
Does this waterway carry the entire flood discharge? _____. If not, give profile showing entire waterway during extreme flood.
Does the bridge back the water up during extreme flood? _____
Is there any indication of scour at piers or abutments? _____
Is this due to insufficient waterway or poor location of bridge? _____
Are piers oriented with flood flow? _____. Is bridge on skew? _____
Describe any protective work around piers or abutments (or show sketch of same on survey)
Was this placed subsequent to construction? _____

MISCELLANEOUS INFORMATION

Are there any houses that have been flooded or may be flooded? No

Provide location and floor elevation _____

Give any other information that would be helpful to designers (floor elevation of any houses that have been flooded or might be flooded) _____

OTHER BRIDGES ACROSS SAME STREAM

All the information in this section is needed for bridges immediately upstream and downstream bridges. Submit sketches of waterway of these bridges with survey. Sketches of structure not required. Include photos of each crossing.

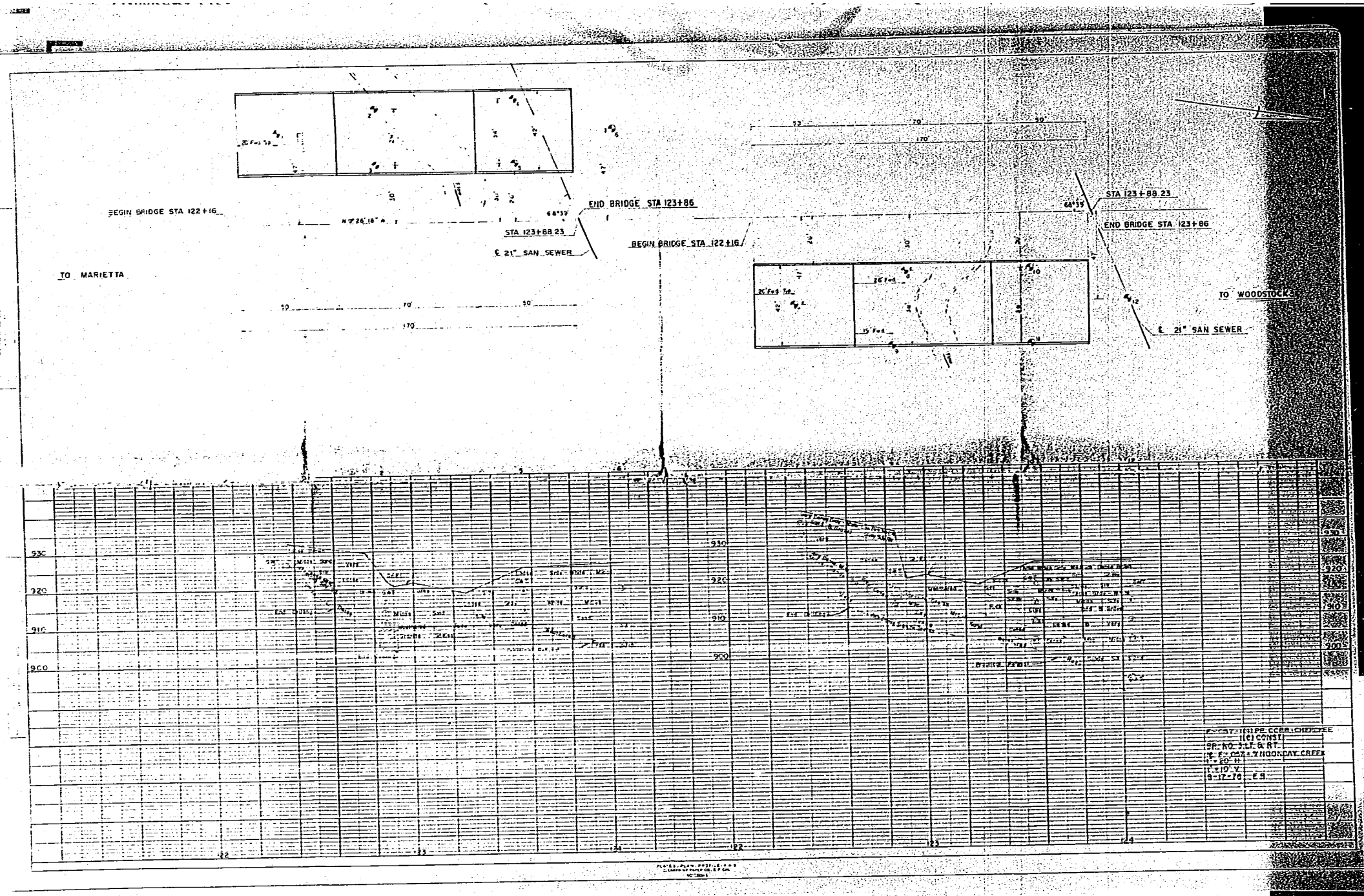
	UPSTREAM No. 1	DOWNSTREAM No. 2
Distance from proposed structure, upstream or down		
Railroad or highway bridge. Year of construction		
Type (deck or thru truss, girder, etc.)		
Kind of substructure		
Number and length of spans		
Drainage area above bridge	sq.miles	sq. miles
Area of waterway below extreme high water	sq.miles	sq. miles
Does this carry entire flood discharge?		
If not, state kind and area of additional waterway	sq.miles	sq. miles
Character of surface material or stream bed		
Character of underlying material of stream bed		
Give all obtainable information as to scour		
Has any protective work been placed since construction?		
Should waterway be greater or less?		
Why?		
Is bridge well located with respect to stream and valley?		

MISCELLANEOUS INFORMATION

Give any other information that would be helpful to designers _____

Prepared by:

Lewis L. Eldred CE II


BEGIN BRIDGE STA 122+16
END BRIDGE STA 123+86
STA 123+88.23
℄ 21" SAN SEWER
TO MARIETTA
TO WOODSTOCK
BEGIN BRIDGE STA 122+16
END BRIDGE STA 123+86
STA 123+88.23
℄ 21" SAN SEWER

D.O.T. 66 —

BDM

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

INTERDEPARTMENT CORRESPONDENCE

FILE F-057-1 (4) PE, Cobb-Cherokee Counties
F-057-1 (6) Construction

OFFICE Materials & Research
Forest Park, Georgia

DATE October 8, 1976

FROM David A. Mitchell, Chief, Geotechnical Engineering Bureau

TO John T. Kratzer, State Bridge & Structural Design Engineer

SUBJECT Bridge Foundation Investigation
Mainline Over Noonday Creek
Bridges 3 Left and 3 Right

As requested, a bridge foundation investigation has been made at the above listed site. The results of this work are attached.

If any additional information is needed, please notify us.

Jim Stivender

Jim Stivender
Soil Engineering Branch

JDS/mw

Attachments

3 Copies filed 10-13-76 LBP

5. Channel Change - Some light blasting may be required to excavate the proposed channel change.

6. Rip Rap - Type I Rip Rap (filter fabric not required) should be used as fill slope protection at this site.

7. Corrosion - No problem.

8. Danger From Fill Settlement - We recommend waiting 30 days from the completion of fill placement and commencement of pile driving at the end bents.

Reported By:
Jim Stivender, CE II

JDS/mw

October 8, 1976

DOT 490

DEPARTMENT OF TRANSPORTATION

OFFICE OF MATERIALS AND TEST, FOREST PARK, GEORGIA
SOILS ENGINEERING AND GEOLOGY BRANCH

BRIDGE SUBSURFACE INVESTIGATION

PROJECT F-057-1(4) COUNTY Cobb-Cherokee DATE 7/13/76

LOCATION Br.No.3 Lt. BORING NO. 2

BENT NO. 2 FOOTING 59' Lt. ℄ Offset 20' Fwd. GROUND ELEV. 921.82

PROPOSED FOOTING ELEV. PARTY CHIEF Pulliam

ELEV.	BORING LOG	SAMPLE	BLOW	UNIFIED	W	γ	Gs	C.	∅	BC	LL	PI	% 200	% CLAY	e
	Gr. El.														
920															
Gwt.	V. Loose Brown Gray Micas. Sand	1s	2												
			2												
910		3s	2	V. Dse. Weathered Rock											
	Granite Gneiss			100% Rec.											
	End Coring														

DOT 490

DEPARTMENT OF TRANSPORTATION

OFFICE OF MATERIALS AND TEST, FOREST PARK, GEORGIA
SOILS ENGINEERING AND GEOLOGY BRANCH

BRIDGE SUBSURFACE INVESTIGATION

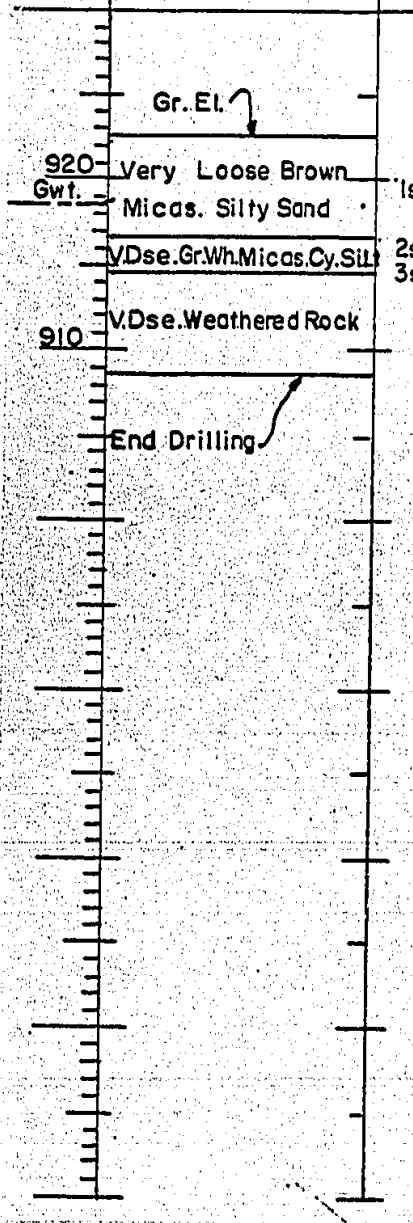
PROJECT F-057-1(4) COUNTY Cobb-Cherokee DATE 7/13/76

LOCATION Br.No.3 Lt. BORING NO. 3

BENT NO. 2 FOOTING 30'Lt.℄ Offset 20' Fwd. GROUND ELEV. 922.62

PROPOSED FOOTING ELEV. PARTY CHIEF Pulliam

ELEV.	BORING LOG	SAM. PLE	BLOW	UNIFIED	W.	γ	Gs	C.	ø	BC	LL	PI	% 200	% CLAY	e
	Gr. El.														
920	Very Loose Brown	1s	3												
Gwt.	Micas. Silty Sand														
	V.Dse.Gr.Wh.Micas.Cy.Sil.	2s	60=5'												
		3s	60=2'												
	V.Dse.Weathered Rock														
910															
	End Drilling														



DOT 490

DEPARTMENT OF TRANSPORTATION

OFFICE OF MATERIALS AND TEST, FOREST PARK, GEORGIA
SOILS ENGINEERING AND GEOLOGY BRANCH

BRIDGE SUBSURFACE INVESTIGATION

PROJECT F-057-1(4) COUNTY Cobb-Cherokee DATE 7/15/76

LOCATION Br. No. 3 Lt. BORING NO. 4

BENT NO. 3 FOOTING 64' Lt. ℄ Lt Offset 20' Fwd. GROUND ELEV. 923.97

PROPOSED FOOTING ELEV. PARTY CHIEF Pulliam

ELEV.	BORING LOG	SAMPLE	BLOW	UNIFIED	W	γ	Gs	C.	∅	BC	LL	PI	% 200	% CLAY	e
	Gr. El.														
920	Very Loose Brown Micas. Silty Sand	1s	4												
Gwt.															
	Loose Mitc. Micas. Silty Sand	2s	5												
910		3s	42												
	Dense Mitc. Micas. Sandy Silt														
	v. dse. weathered rock	4s	HB												
900	Practical Refusal														

DOT 490

DEPARTMENT OF TRANSPORTATION

OFFICE OF MATERIALS AND TEST, FOREST PARK, GEORGIA
SOILS ENGINEERING AND GEOLOGY BRANCH

BRIDGE SUBSURFACE INVESTIGATION

PROJECT F-057-1(4) COUNTY Cobb-Cherokee DATE 7/15/76

LOCATION Br. No. 3 Lt. BORING NO. 5

BENT NO. 3 FOOTING 30' Lt. ℄ Offset 20' Fwd. GROUND ELEV. 924.87

PROPOSED FOOTING ELEV. PARTY CHIEF Pulliam

ELEV.	BORING LOG	SAMPLE	BLOW	UNIFIED	W	γ	Gs	C.	∅	BC	LL	PI	% 200	% CLAY	e
	Gr. El. 7														
920	V. Loose Brown Gray Micas. Cy. Silty Sand	1s	4												
Gwt.	Loose Gray White Micas. Silty Sand	2s	8												
910	V. Dse. Weathered Rock														
	Refusal 5														

DOT 490

DEPARTMENT OF TRANSPORTATION

OFFICE OF MATERIALS AND TEST, FOREST PARK, GEORGIA
SOILS ENGINEERING AND GEOLOGY BRANCH

BRIDGE SUBSURFACE INVESTIGATION

PROJECT F-057-1(4) COUNTY Cobb-Cherokee DATE 7/7/76

LOCATION F-057 O/ Noonday Ck. Br. No. 3 Rt. BORING NO. 7

BENT NO. 1 FOOTING 47' Rt. ℄ Offset 20' Fwd. GROUND ELEV. 939.05

PROPOSED FOOTING ELEV. 943.6± Pile Cutoff PARTY CHIEF Pulliam

ELEV.	BORING LOG	SAMPLE	BLOW	UNIFIED	W	γ	Gs	C.	ø	BC	LL	PI	% 200	% CLAY	e
940	Gr. El.														
	Very Dense Gray White Sand & Gravel	1s	60=2												
	V.Dse. Weathered Rock	2s	HB												
930	Very Dense Mtc. Micas. Sandy Silt	3s	60=4												
	V.Dse. Weathered Rock														
920	End Drilling														

DOT 490

DEPARTMENT OF TRANSPORTATION

OFFICE OF MATERIALS AND TEST, FOREST PARK, GEORGIA
SOILS ENGINEERING AND GEOLOGY BRANCH

BRIDGE SUBSURFACE INVESTIGATION

PROJECT F-057-1(4) COUNTY Cobb-Cherokee DATE 7/13/76

LOCATION Br. No. 3 Rt BORING NO. 8

BENT NO. 2 FOOTING 30' Rt ℄ Offset 26' Fwd GROUND ELEV. 921.77

PROPOSED FOOTING ELEV. PARTY CHIEF Pulliam

ELEV.	BORING LOG	SAMPLE	BLOW	UNIFIED	W	γ	Gs	C.	ø	BC	LL	PI	% 200	% CLAY	e
	Gr. El. 7														
920	Very Loose Mltc.														
Gwt.	Micas. Sandy Silt	1s	4												
	Very Dense Same	2s	60												
	V. Dse. Weathered Rock														
	End Drilling														

DOT 400

DEPARTMENT OF TRANSPORTATION

OFFICE OF MATERIALS AND TEST, FOREST PARK, GEORGIA
SOILS ENGINEERING AND GEOLOGY BRANCH

BRIDGE SUBSURFACE INVESTIGATION

PROJECT F-057-1(4) COUNTY Cobb-Cherokee DATE 7/12/76

LOCATION Br. No. 3 Rt. BORING NO. 9

BENT NO. 2 FOOTING 68' Rt. ℄ Offset 8 Fwd. GROUND ELEV. 933.52

PROPOSED FOOTING ELEV. PARTY CHIEF Pulliam

ELEV.	BORING LOG	SAM-PLE	BLOW	UNIFIED	W	γ	Gs	C.	ϕ	BC	LL	PI	% 200	% CLAY	e
	Gr. El. 7														
	Loose Brown Micas.														
930	Clayey Sandy Silt														
	V. Dse. Weathered Rock														
Gwt															
920															
	Granite. Gneiss			100% Rec.											
	Very Dense Mltc. Micas. Silty Sand (WR)	ls	60=7"												
910	V. Dse. Weathered Rock														
	V. dse. granite gneiss														
	End Drilling														

DOT 490

DEPARTMENT OF TRANSPORTATION

OFFICE OF MATERIALS AND TEST, FOREST PARK, GEORGIA
SOILS ENGINEERING AND GEOLOGY BRANCH

BRIDGE SUBSURFACE INVESTIGATION

PROJECT F-057-1(4) COUNTY Cobb-Cherokee DATE 6/22/76

LOCATION Br. No.3 Rt. BORING NO. 10

BENT NO. 3 FOOTING 30' Rt. ℄ Offset 20' Fwd. GROUND ELEV. 924.75

PROPOSED FOOTING ELEV. PARTY CHIEF Pulliam

ELEV.	BORING LOG	SAMPLE	BLOW	UNIFIED	W	γ	Gs	C.	∅	BC	LL	PI	% 200	% CLAY	e
	Gr. El.														
	Loose Brown Gray Micas Silty Sand	1s	5												
920															
Gwt															
	Soft Gray Micas. Sandy Silty Clay	2s	2												
910															
	vdse. mitc. micas sdy. silt	3s	60=7"												
	V. Dse. Weathered Rock														
	Dense Mitc. Micas. Sandy Silt	4s	40												
	V. Dse. Weathered Rock														
900															
	Practical Refusal														

DOT 480

DEPARTMENT OF TRANSPORTATION

OFFICE OF MATERIALS AND TEST, FOREST PARK, GEORGIA
SOILS ENGINEERING AND GEOLOGY BRANCH

BRIDGE SUBSURFACE INVESTIGATION

PROJECT F-057-1(4) COUNTY Cobb-Cherokee DATE 6/22/76

LOCATION Br. No. 3 Rt. BORING NO. 12

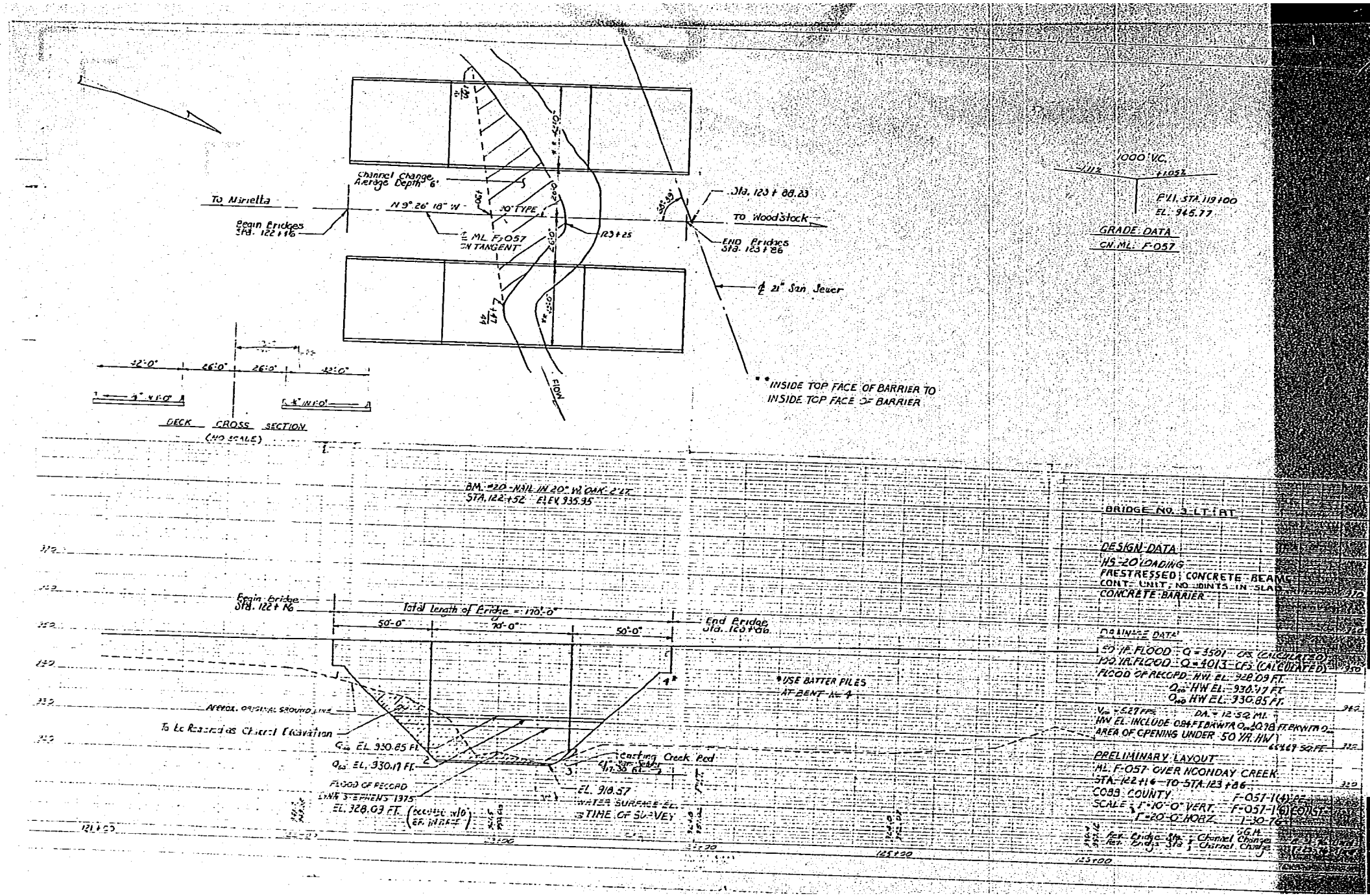
BENT NO. 4 FOOTING 47' Rt. ℄ Offset 20' Fwd. GROUND ELEV. 924.85

PROPOSED FOOTING ELEV. 945.3 ± Pile Cutoff PARTY CHIEF Pulliam

ELEV.	BORING LOG	SAMPLE	BLOW	UNIFIED	W	γ	Gs	C.	ø	BC	LL	PI	% 200	% CLAY	e
	Gr. El.														
	Medum Dse. Brn. Gray														
920	Micas. Cy. Sandy Silt	1s	11												
Gwt															
	Loose Gray White Micas.	2s	8												
	Silty Sand & Gravel														
910		3s	25												
	Dense Mitc. Same														
		4s	60=5"												
900															
	Very Dense Mitc.	5s	60=9"												
	Micas. Sandy Silt														
		6s	60=5"												
	V. Dse. Weathered Rock														
890															
	Practical Refusal														

LEGEND OF SYMBOLS

Sample	u (undisturbed) s (split spoon)
Blows	number of blows with a 140 pound hammer dropping 30 in. required to drive split spoon 1 ft.
W	Water content (%)
γ	Unit weight of undisturbed sample (pcf)
G_s	Specific gravity of soils solids
e	Void ratio
S	Degree of saturation (%)
LL	Liquid limit (%)
PI	Plasticity Index (%)
C	Cohesion - apparent or real (ksf)
ϕ	Angle of internal friction (degrees)
q	Indicated ultimate strength (ksf)
B.C.	Estimated safe bearing capacity based on assumptions noted on report sheet (ksf)
$\underline{wl}$	Water level at time boring was made
NP	Non-plastic
NR	No results or no recovery


Channel Change
Average Depth 6'
To Mirietta
N 9° 26' 18" W
30° TYPE
℄ ML F-057
ON TANGENT
Begin Bridge
Sta. 122+16
Sta. 123+88.23
TO Woodstock
END Bridge
Sta. 123+86
123+25
℄ 21" San Sewer
1000' V.C.
-1.1%
+1.0%
P.I. STA. 119+00
EL. 945.77
GRADE DATA
ON ML. F-057
42'-0"
46'-0"
26'-0"
42'-0"
3" x 11'-0"
1" x 11'-0"
DECK CROSS SECTION
(NO SCALE)
FLOW
** INSIDE TOP FACE OF BARRIER TO
INSIDE TOP FACE OF BARRIER
BM. #20 - NAIL IN 20" ½ OAK: 2' LT.
STA. 122+52 ELEV. 935.35
BRIDGE NO. 3-LT-FAT
DESIGN DATA
HS-20 LOADING
PRESTRESSED CONCRETE BEAMS
CONT. UNIT; NO JOINTS IN SLAB
CONCRETE BARRIER
Begin Bridge
Sta. 122+16
Total Length of Bridge = 170'-0"
50'-0"
70'-0"
50'-0"
End Bridge
Sta. 123+86
HYDRAULIC DATA
50 YR. FLOOD Q = 3501 CFS. (CALCULATED)
100 YR. FLOOD Q = 4013 CFS. (CALCULATED)
FLOOD OF RECORD HW EL. 328.09 FT.
Q50 HW EL. 330.17 FT.
Q100 HW EL. 330.85 FT.
V50 = 5.27 FPS DA = 12.52 MI.
HW EL. INCLUDE 0.84 FT. BKWTR Q50 3018 FT. BKWTR Q100
AREA OF OPENING UNDER 50 YR. HW
*USE BATTER PILES
AT BENT # 4
Approx. original ground line
To be Required Channel Excavation
Q100 EL. 330.85 FT.
Q50 EL. 330.17 FT.
FLOOD OF RECORD
JUNE 3 - EFFIENS 1975
EL. 328.09 FT. (Recorded w/10 yr. range)
Cooking Creek Bed
EL. 318.57
WATER SURFACE EL.
@ TIME OF SURVEY
PRELIMINARY LAYOUT
ML. F-057 OVER NOONDAY CREEK
STA. 122+16 TO STA. 123+86
COBB COUNTY F-057-1(4)
SCALE 1"=10'-0" VERT. F-057-1(6)
1"=20'-0" HORZ. 1-30-16
Ref. Bridge Sta. ; Channel Changes
Ref. Bridge Sta. ; Channel Change

PEF-057-1(4) BRIDGE OVER NOONDAY CREEK
COBB COUNTY

Slope Calculation:

100' Lt. ℄ Water Surface Elevation @ time of Survey = 918.73'

100' Rt. ℄ Water Surface Elevation @ time of Survey = 918.40'

$\therefore$ Slope = $\frac{.33}{200}$ = 0.00165 ft/ft

Q_{50} Calculation:

Discharge = Flood Frequency Method Region 2

$Q_{50} = 727 A^{.58}$

D.A. = 10.6 $mi.^2$ @ I-75

D.A. = 12.0 $mi.^2$ @ F-057

$\therefore Q_{50} = 727(12)^{.58} \approx$ 3,073 cfs.

Q_{100} Calculation:

$Q_{100} = 862 A^{.57}$

$= 862 (12)^{.57}$

$Q_{100} \approx$ 3554 cfs.

Spur Dike Calculation:

Q = Total discharge of stream = 3,073 cfs.

Q_f = Lateral of flood plain flow (one side) measured @ sect. 1

Q_f STA. 124+00 TO STA. 125+80

$Q_f = \left(\frac{757.40 - 161.50}{757.4}\right) 934.88$ cfs

Q_f = 735.5 cfs

Check

$AV = Q$

$(595\ ft^2)(1.23\ fps)$

$733\ cfs. = Q$

$\therefore Q_f \approx 735$ cfs.

Q_{100} = Discharge in 100 ft. of stream adjacent to abutment, measured @ sect. 1

from STA. 123+00 TO STA. 124+00

$Q_f = \frac{229.96 \# 193.56\ ft^2}{557.33\ ft^2}(2080.44\ cfs.) + \frac{161.5\ ft^2}{751.40\ ft^2}(934.88\ cfs) + 57.54\ cfs$

Q_f = 1839.4

$\therefore Q_f \approx 1839$ cfs.

Check

$Q = VA$

$= [(229.96)(193.56)]\,3.73 + 57.54 + 161.5(1.23)$

$= 1835.9$ cfs

$\frac{Q_f}{Q_{100}}$ = Spur dike discharge ratio

$\frac{735}{1839} = 0.40$

$\therefore$ NO SPUR DIKE NEEDED

COST ANALYSIS (CONT.) DBL. DBL 10X10

WINGWALL & PARAPETS

CONCRETE = 47.05 + 2.975(2) + [(1.83)(21)(1.33) + (1.50)(1.5)(21)] 2 / 27

CONCRETE = [47.05 + 5.85 + 2.48] ($110 / FT.³) = $6103

STEEL = 3681 ($0.24 / LB.) = $883

OUTLET APRON

CONCRETE = [11.72 + (21)(15)(.50)/2] ($110 / FT.³) = $1903

STEEL = 866 ($0.24 / LB.) = $208

FILL MATERIAL

[(3120 FT.²)(68 FT.)(2) + ½(40)(20)(2)] / 27 = 15,745 CU. YDS.

15,745 CU. YDS ($0.70 / CU. YD.) = $11,022

TOTAL COST (DBL. DBL. 10X10) = $199,425

COST ANALYSIS (DUAL 170' X 42' BRIDGES)

(170')(42')(2)($22 / FT.²) = $314,160

F-057-1 (4) COBB-CHEROKEE COUNTIES

NOONDAY CREEK

HYDRAULIC AND HYDROLOGICAL STUDY

Examined and Approved:

3-15-76
Date

J. T. Kratzer, P. E.
State Bridge Engineer

SAG/kg

3-10-76

cc: W. B. Lawing

F-057-1 (4) COBB-CHEROKEE COUNTIES

NOONDAY CREEK

HYDRAULIC AND HYDROLOGICAL STUDY

This site lies on a new location and, therefore, has no existing bridge in place. Dual bridges with lengths of 170 feet are proposed for the site. The lengths of these bridges were determined by the 50 year flood. The drainage area, flood of record elevation and the water surface elevations used in determining the hydraulic slope were supplied by District personnel.

The 50 year and 100 year discharges were computed by the "Flood Frequency Method" and then multiplied by an urbanization factor. The 50 year and 100 year flood stage elevations, area of opening under floodstage, single bridge backwater values and velocities through the bridge opening were computed utilizing the "Hydraulics of Bridge Waterways" computer program. The dual bridge backwater values were determined from the method shown in Chapter V of "Hydraulics of Bridge Waterways".

The house closest to the proposed bridge site is located 388 feet upstream from the proposed survey centerline. Computations were made to determine if the proposed 170' dual bridges would cause any flooding of the house. The computations showed that the 100 year flood, including backwater, would be 0.62 feet below the floor elevation of the house. Therefore, the placement of the proposed 170' dual bridges will not cause the house to be flooded at a 50 year or 100 year flood frequency.

The small drainage area of 12 square miles dictated that a culvert analysis be made for this site. A hydraulic site inspection was then made for the site on February 19, 1976. As a result of this site inspection, a decision was made not to use a culvert due to the poor alignment of the stream. This decision was made in concurrence with the Office of Engineering Services.

Calculations indicate that no spur dikes will be required at this site.

The required calculations, maps, aerial photos, "Hydraulic Field Report", and the preliminary layout are shown on the following pages.

Prepared By: S. Allen Groover

SAG/kg

3-10-76

F-057-1(4) COBB-CHEROKEE CO.

DRAINAGE DATA

DRAINAGE AREA = 12 SQ. MILES (FROM DISTRICT)

DISCHARGE DETERMINATION

RURAL AREA DISCHARGE

$Q_2 = 175 A^{.60} = 175(12)^{.60} = 850$ CFS

$Q_{50} = 727 A^{.58} = 727(12)^{.58} = 3073$ CFS

$Q_{100} = 862 A^{.57} = 862(12)^{.57} = 3554$ CFS

DISCHARGE CONSIDERING URBANIZATION FACTOR

IMPERVIOUS AREA = 10% } ESTIMATED
SEWAGE AREA = 10% }

$R_2 = 1.30$ (FROM CHARTS, GIVEN BY MACDORICE)

$Q_{50} = 2.26 (R_2 - 1) Q_{50\,RURAL} + .167 (7 - R_2) Q_{50\,RURAL}$

$Q_{50} = 2.26 (1.3 - 1)(850) + .167 (7 - 1.3)(3073)$

$Q_{50} = 576 + 2925$

$Q_{50} = 3501$ CFS ← USE

$Q_{100} = 2.47 (1.3 - 1)(850) + .167 (7 - 1.3)(3554)$

$Q_{100} = 630 + 3383$

$Q_{100} = 4013$ CFS USE

SLOPE OF CREEK

WATER SURFACE ELEVATION 100 FT. UPSTREAM OF $\mathcal{L}$ = 918.73 FT.
WATER SURFACE ELEVATION 100 FT. DOWNSTREAM OF $\mathcal{L}$ = 918.40 FT.

SLOPE = (918.73' - 918.40')/200 FT. = 0.00165 FT./FT.

F-057-1(4) CORE COUNTY

DUAL BRIDGE BACKWATER

50 YEAR FLOOD

$Q_{50} = 3501$ CFS

SINGLE BRIDGE BACKWATER $(h_1^*) = 0.63$ FT.

$h_d^* = h_1^* n$ (PAGE 28, "HYDRAULICS OF BRIDGE WATERWAYS")

$L_d/L = 136/42 = 3.23$

$n = 1.33$ (FIG. 14, "HYDRAULICS OF BRIDGE WATERWAYS")

$h_d^* = (0.63)(1.33)$

$h_d^* = 0.84$ FT. (DUAL BRIDGE BKWT. VALUE)

100 YEAR FLOOD

$Q_{100} = 4013$ CFS

SINGLE BRIDGE BACKWATER $(h_1^*) = 0.74$ FT.

$h_d^* = h_1^* n$

$h_d^* = (0.74)(1.33)$

$h_d^* = 0.98$ FT. (DUAL BRIDGE BKWT. VALUE)

F-057-1(4) CORB-CHEROKEE CO.

HYDRAULIC DATA

50 YEAR FLOOD

DISCHARGE = 3501 CFS

VALLEY SECTION FLOODSTAGE = 929.33 FT.

SINGLE BRIDGE BACKWATER = 0.63 FT.

DUAL BRIDGE BACKWATER = 0.24 FT.

AREA OF OPENING UNDER H.W. = 665 FT.^{2}

VELOCITY THROUGH BRIDGE OPENING = 5.27 FPS

100 YEAR FLOOD

DISCHARGE = 4013 CFS

VALLEY SECTION FLOODSTAGE = 929.87 FT.

SINGLE BRIDGE BACKWATER = 0.74 FT.

DUAL BRIDGE BACKWATER = 0.38 FT.

AREA OF OPENING UNDER H.W. = 717 FT.^{2}

VELOCITY THROUGH BRIDGE OPENING = 5.60 FPS

DISTANCE UPSTREAM TO POINT OF MAXIMUM BACKWATER (50 YR. FLOOD)

SINGLE BRIDGE BACKWATER

$b = \frac{A_{n2}}{y} = \frac{665 FT.^2}{8.33} = 80 FT.$

ASSUME $\Delta h = 1.35 FT.$

$\frac{\Delta h}{y} = \frac{1.35'}{8.33} = 0.162$

$\frac{L^*}{b} = 0.69$ (FROM FIG. 13 "HYDRAULICS OF BR. WATERWAYS")

$L^* = 0.69(80) = 55 FT.$

$S_o L_{1-2} = 0.00165 (55 + 54) = 0.18 FT.$

WATER SURFACE ELEV. @ SECT. 1 = 929.33 FT. + 0.18 FT. + 0.63 FT
" " " " " " = 930.14 FT.

WATER SURFACE ELEV. @ SECT. 3

$m = 0.682$ (COMPUTER PROGRAM)

$D_b = 0.52$ (FROM FIG. 12 "HYDRAULICS OF BR. WATERWAYS")

$h_3^* = h_b^* (\frac{1}{D_b} - 1) = 0.63 (\frac{1}{.52} - 1) = 0.58 FT.$

ELEV. @ SECT. 3 = 929.33' − 0.58' = 928.75 FT.

DROP IN WATER SURFACE ACROSS EMBANKMENT

$\Delta h = 930.14' - 928.75' = 1.39 FT.$

CHECKS W/ ASSUMED Δh

E-057-1(4) COBB - CHEROKEE CO.

DISTANCE UPSTREAM TO POINT OF MAXIMUM BACKWATER (CON'T.) (50 YR. FLOOD)

DUAL BRIDGE BACKWATER

$b = \frac{A_{n3}}{\bar{y}} = \frac{665\ FT.^2}{8.33} = 80\ FT.$

ASSUME $\Delta h_{38} = 2.00\ FT.$

$\frac{\Delta b}{b} = \frac{20.0'}{80.0'} = 0.24.$

$\frac{L^*}{b} = 0.87$ (FROM FIG. 13 "HYDRAULICS OF BRIDGE WATERWAYS")

$L^* = 0.87(80') = 70.0\ FT.$

$S_o L_{1-E} = 0.00165(70.0+54) = 0.20\ FT.$

WATER SURFACE ELEV. @ SECT. 1 = 929.33 + 0.20 + 0.84 = 930.37 FT.

WATER SURFACE ELEV. @ SECT. 3B

$L_d/L = 3.23$

$E = \psi h_{38} / \psi h = 1.28$ (FROM FIG. 15 "HYDRAULICS OF BRIDGE WATERWAYS")

$\psi h = h_1^* + h_3^* = 0.63 + 0.58 = 1.21$

$\psi h_{38} = E \psi h = 1.28(1.21) = 1.55\ FT.$

$L_{1-3B} = 70.0' + 54 + 115 + 45 = 284.0'$

$S_o L_{1-3B} = 0.00165(284.0') = 0.47\ FT.$

$\Delta h_{3B} = \psi h_{3B} + S_o L_{1-3B} = 1.55' + 0.47' = 2.02\ FT.$

CHECKS W/ ASSUMED Δh_{3B}

∴ DISTANCE FROM E TO PT. OF MAX. BKWT. = 171 FT.
ELEV. AT PT. OF MAX. BKWT. = 930.37 FT.

E-057-1(4) CORR-CHEROKEE CO.

DISTANCE TO POINT OF MAXIMUM BACKWATER (100YR. FLOOD)

SINGLE BRIDGE BACKWATER

$b = \frac{A_{n2}}{\bar{y}} = \frac{717 FT^2}{8.87 FT.} = 81 FT.$

ASSUME $\Delta h = 1.55$ FT.

$\frac{\Delta h}{\bar{y}} = \frac{1.55}{8.87} = 0.174$

$\frac{L^*}{b} = 0.73$ (FROM FIG. 13 "HYDRAULICS OF BRIDGE WATERWAYS")

$L^* = 0.73(81) = 59$ FT.

$S_o L_{1-2} = (0.00165)(57 + 54) = 0.19$ FT.

WATER SURFACE ELEV. @ SECT. 1 = 929.87 FT. + 0.19 FT. + 0.74 FT.
" " " " " " = 930.80 FT.

WATER SURFACE ELEV. @ SECT. 3

$m = 0.665$ (COMPUTER PROGRAM)

$D_b = 0.54$ (FROM FIG. 12 "HYDRAULICS OF BRIDGE WATERWAYS").

$h_3^* = h_b^* \left(\frac{1}{D_b} - 1\right) = 0.74\left(\frac{1}{0.54} - 1\right) = 0.63$ FT.

ELEV. @ SECT. 3 = 929.87 − 0.63 = 929.24 FT.

DROP IN WATER SURFACE ACROSS EMBANKMENT

$\Delta h = 930.80 FT. - 929.24 FT. = 1.56$ FT.

CHECKS W/ ASSUMED Δh

F-057-1(4) COBB-CHEROKEE CO.

DISTANCE TO POINT OF MAXIMUM BACKWATER (CON'T.) (100 YR. FLOOD)

DUAL BRIDGE BACKWATER

$b = \frac{A_{n2}}{\bar{y}} = \frac{717\ FT.^2}{8.87\ FT.} = 81\ FT.$

ASSUME $\Delta h_{3B} = 2.30$

$\frac{\Delta h}{\bar{y}} = \frac{2.30}{8.87} = 0.25$

$\frac{L^*}{b} = 0.87$ (FROM FIG. 13 "HYDRAULICS OF BRIDGE WATERWAYS")

$L^* = 0.87(81) = 70.5\ FT.$

$S_o L_{1-\mathbb{C}} = 0.00165\,(70.5 + 54) = 0.21\ FT.$

WATER SURFACE ELEV. @ SECT. 1 = 929.87 + 0.21 + 0.98 = 931.06 FT.

WATER SURFACE ELEV. @ SECT. 3R

$L_d / l = 3.23$

$\varepsilon = \psi h_{3B} / \psi h = 1.28$ (FROM FIG. 15 "HYDRAULICS OF BRIDGE WATERWAYS")

$\psi h = h_1^* + h_3^* = 0.74 + 0.63 = 1.37\ FT.$

$\psi h_{3B} = \varepsilon \psi h = 1.28(1.37) = 1.75\ FT.$

$L_{1-3B} = 70.5 + 54 + 115 + 45 = 284.50'$

$S_o L_{1-3B} = 0.00165\,(284.50') = 0.47\ FT.$

$\Delta h_{3B} = \psi h_{3B} + S_o L_{1-3B} = 1.75' + 0.47' = 2.22\ FT.$

CHECKS APPROX. W/ ASSUMED Δh_{3B}

∴ DISTANCE FROM ℄ TO PT. OF MAX. BKWT. = 171.50 FT.
ELEV. AT PT. OF MAX. BKWT. = 931.06 FT.

257-1(4) CORR-CHANNEL CO.

HOUSES THAT MAY BE FLOODED

THE PHILLIPS RESIDENCE IS LOCATED 388 FEET UPSTREAM FROM THE SURVEY ℄ OF THE BRIDGE CROSSING AND 183 FEET FROM THE EDGE OF THE CREEK.

FLOOR ELEVATION = 932.04'

ELEV. OF POINT OF MAX. BACKWATER 171 FT. UPSTREAM FROM ℄ FOR 50 YR. FLOOD = 930.37 FT.

APPROX. 50 YR. WATER SURFACE ELEV. @ HOUSE = (.00165)(388-171)+930.37'
" " " " " " " " " = 0.36+930.37'
" " " " " " " " " = 930.73 FT.

DIFFERENCE IN FLOOR ELEV. OF HOUSE & 50 YR. FLOOD W/ BKWT.

932.04' - 930.73' = 1.31 FT.

∴ PHILLIPS RESIDENCE WILL NOT BE FLOODED BY 50 YR. FLOOD.

ELEV. OF POINT OF MAX. BACK WATER 171.50 FT. UPSTREAM FROM ℄ FOR 100 YR. FLOOD = 931.06 FT.

APPROX. 100 YR. WATER SURFACE ELEV. @ HOUSE = (.00165)(388-171)+931.06'
" " " " " " " " " = 0.36+931.06'
" " " " " " " " " = 931.42 FT.

DIFFERENCE IN FLOOR ELEV. OF HOUSE & 100 YR. FLOOD W/ BKWT.

932.04' - 931.42' = 0.62 FT.

∴ PHILLIPS RESIDENCE WILL NOT BE FLOODED BY 100 YR. FLOOD

SPUR DIKE CHECK

BEGIN BRIDGE UPSTREAM SIDE (STA. 122+36)

$Q_{50} = 3501$ CFS

$Q_f = 0$ CFS

$Q_{100}' = 2586$ CFS

$Q_f / Q_{100}' = 0 / 2586 = 0$

$V_{50} = 5.27$ FPS

NO SPUR DIKE REQUIRED

END BRIDGE UPSTREAM SIDE (STA. 129+06)

$Q_{50} = 3501$ CFS

$Q_f = \frac{198}{200}(1135) = 1124$ CFS

$Q_{100}' = \frac{3}{200}(1135) + 69 + 2298 = 2378$ CFS

$Q_f / Q_{100}' = 1124 / 2378 = 0.47$

$V_{50} = 5.27$ FPS

$L_s < 50$ FT.

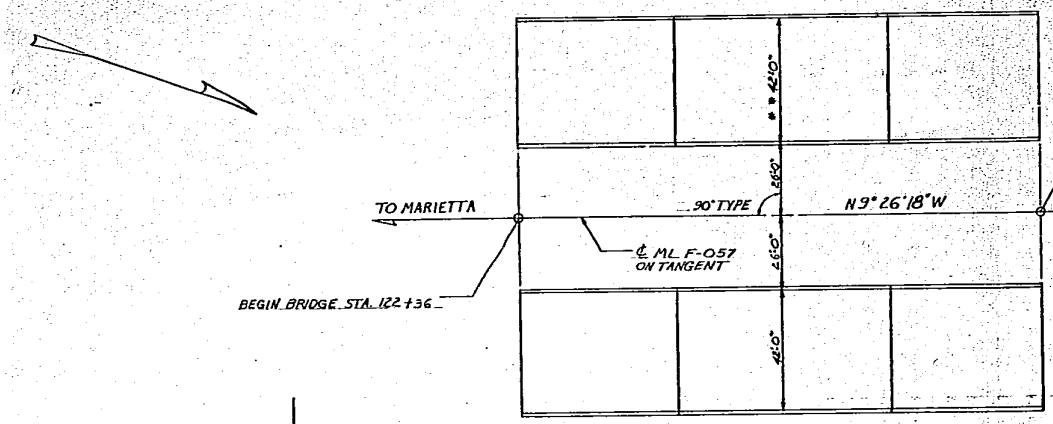
NO SPUR DIKE REQUIRED

NOTE: SPUR DIKE LENGTHS DETERMINED FROM FIG. 30 OF "HYDRAULICS OF BRIDGE WATERWAYS"

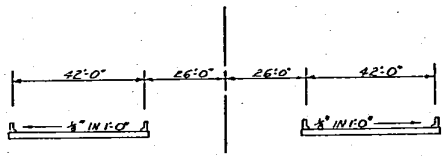
Wooten Lake
20TH DISTRICT
16TH DISTRICT
Chastains Lakes
Golf Course
FLOOD
FLOOD
AREA
FLOOD

10-20-75
1-1000
033-5
45 5

MADE IN U. S. A.



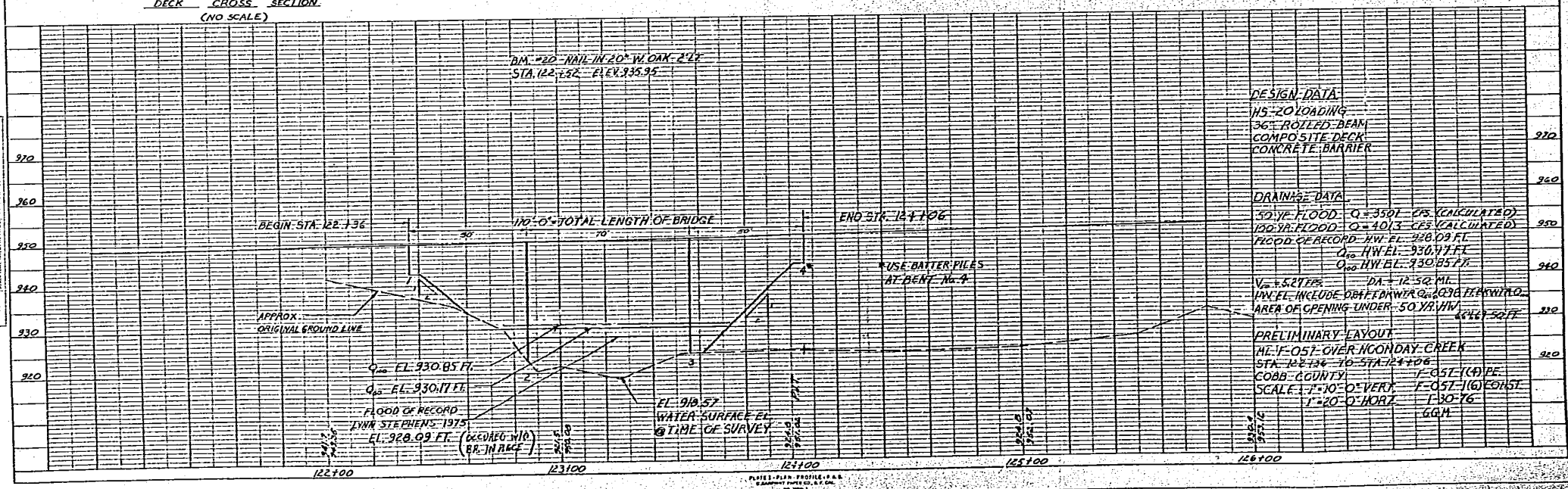
** INSIDE TOP FACE OF BARRIER TO INSIDE TOP FACE OF BARRIER



DECK CROSS SECTION
(NO SCALE)

1000' V.C.
-1.11%
+1.05%
P.V.I. STA. 119+00
EL. 945.77

GRADE DATA
ON ML. F-057



DESIGN DATA
H5-20 LOADING
36" ROLLED BEAM
COMPOSITE DECK
CONCRETE BARRIER

DRAINAGE DATA
50 YR. FLOOD Q = 3591 CFS. (CALCULATED)
100 YR. FLOOD Q = 4013 CFS. (CALCULATED)
FLOOD OF RECORD HW EL. 928.09 FT.
Q_{50} HW EL. 930.17 FT.
Q_{100} HW EL. 930.85 FT.
V_{50} = 5.27 FPS. DA = 12 SQ. MI.
HW EL. INCLUDE 0.81 FT. DRIFT ON TOP OF Q_{100} 2.36 FT. FREEBOARD
AREA OF OPENING UNDER 50 YR. HW 6646 SQ. FT.

PRELIMINARY LAYOUT
AL. F-057 OVER NOONDAY CREEK
STA. 122+36 TO STA. 124+06
COBB COUNTY F-057 (4) PE.
SCALE 1" = 10'-0" VERT. F-057-1(6) COBB
1" = 20'-0" HORZ. 1-30-76
GGM

PLATE 1 - PLAN - PROFILE - P & B
BEAMPORT PIPES CO., S.F. CAL.
NO. 10871

DTENDD1901 GEORGIA DEPARTMENT OF TRANSPORTATION

HIGHWAY DIVISION - BRIDGE DESIGN OFFICE

HYDRAULICS OF BRIDGE WATERWAYS PROB. NO. 0105

F057 1 6 BRIDGE OVER NOONDAY CREEK BDM GGM

PAGE 1

INPUT DATA

STAGE ELEVATION = 929.87 FEET****DESIGN STAGE****
SLOPE OF RIVER = .001650 FEET PER FOOT
DESIGN DISCHARGE = 4012.00 CFS
SKEW ANGLE = .00 DEGREES

100 YR. FLOOD
PROPOSED BR.

RESULTANT DATA

X BEGINNING	X ENDING	MANNINGS N	AREA	WETTED PER	HYD.RADIUS	CONVEYANCE	DISCHARGE	VELOCITY
1270.60	1276.00	.0400	.96	5.21				
SUB-SECTION TOTALS * * * * * * * * * * *			.96	5.21	.1852	11.67	.47	.49
1276.00	1290.00	.0600	68.90	16.70				
1290.00	1300.00	.0600	89.21	10.06				
1300.00	1326.00	.0600	256.65	26.17				
1326.00	1352.00	.0600	220.25	26.64				
SUB-SECTION TOTALS * * * * * * * * * * *			635.02	79.57	7.9807	63020.36	2559.90	4.03
1352.00	1361.50	.1201	51.98	9.50				
SUB-SECTION TOTALS * * * * * * * * * * *			51.98	9.50	5.4701	2003.08	81.37	1.57
1361.50	1400.00	.1200	201.02	38.50				
1400.00	1406.00	.1200	31.33	6.01				
1406.00	1450.00	.1200	242.94	44.00				
1450.00	1500.00	.1200	268.56	50.00				
1500.00	1550.00	.1200	198.56	50.05				
1550.00	1564.36	.1200	20.61	14.64				
SUB-SECTION TOTALS * * * * * * * * * * *			963.02	203.20	4.7392	33755.04	1371.14	1.42

TOTAL AREA = 1650.98 SQUARE FEET
TOTAL CONVEYANCE = 98790.14 CFS
TOTAL DISCHARGE = 4012.87 CFS

USE

BRIDGE INFORMATION INPUT
BRIDGE LENGTH = 170.00
LEFT ABUTMENT POSITION - - XAB(1) = 1236.00 YAB(1) = 936.00
XAB(2) = 1269.00 YAB(2) = 930.00

RIGHT ABUTMENT POSITION - - XAB(3) = 1361.50 YAB(3) = 924.50
XAB(4) = 1406.00 YAB(4) = 924.50

BRIDGE OPENING AT WATER SURFACE = 101.51
BASE BACKWATER CURVE USED = 1

CALCULATED INFORMATION
PORTION OF DISCHARGE LEFT OF OPENING (GA) = .00 CFS
PORTION OF DISCHARGE THRU OPENING (GB) = 2668.02 CFS
PORTION OF DISCHARGE RIGHT OF OPENING (GC) = 1344.85 CFS
AREA OF PIERS BELOW WATER SURFACE = 46.35 SQ FEET
ALPHA1 = 1.88
ALPHA2 = 1.59
TOTAL BACKWATER COEFFICIENT = .91
BRIDGE WATERWAY OPENING BELOW NORMAL DEPTH (AN2) = 717.01 SQ FEET
MEAN VELOCITY THRU BRIDGE OPENING (VN2) = 5.60 FPS
DISCHARGE RATIO (M) = .665
BACKWATER APPROXIMATION NO.1 = .69933 FEET
FINAL BACKWATER APPROXIMATION = .73696 FEET
NUMBER OF ITERATIONS TO OBTAIN FINAL BACKWATER = 3

DTEN001901

GEORGIA DEPARTMENT OF TRANSPORTATION

.GHWAY DIVISION - BRIDGE DESIGN OFFICE

HYDRAULICS OF BRIDGE WATERWAYS

PROB. NO. 0105

F057 T 6 BRIDGE OVER NOONDAY CREEK BDM GGM

PAGE 1

INPUT DATA

STAGE ELEVATION = 929.33 FEET****DESIGN STAGE****
SLOPE OF RIVER = .001650 FEET PER FOOT
DESIGN DISCHARGE = 7501.00 CFS
SKEW ANGLE = .00 DEGREES

50 YR. FLOOD
PROPOSED BRIDGE

RESULTANT DATA

X BEGINNING	X ENDING	MANNINGS N	AREA	WETTED PER	HYD.RADIUS	CONVEYANCE	DISCHARGE	VELOCITY
1276.25	1290.00	.0600	61.41	16.39				
1290.00	1300.00	.0600	83.85	10.06				
1300.00	1326.00	.0600	242.71	26.17				
1326.00	1352.00	.0600	206.31	26.64				
SUB-SECTION TOTALS * * * * * * * * * * *			594.27	79.27	7.4972	56568.89	2297.84	3.87
1352.00	1361.50	.1201	46.88	9.50				
SUB-SECTION TOTALS * * * * * * * * * * *			46.88	9.50	4.9336	1686.55	68.51	1.46
1361.50	1400.00	.1200	180.37	38.50				
1400.00	1406.00	.1200	28.11	6.01				
1406.00	1450.00	.1200	219.34	44.00				
1450.00	1500.00	.1200	241.75	50.00				
1500.00	1550.00	.1200	171.75	50.05				
1550.00	1561.67	.1200	13.63	11.91				
SUB-SECTION TOTALS * * * * * * * * * * *			854.93	200.47	4.2647	27930.19	1134.53	1.33

TOTAL AREA = 1496.09 SQUARE FEET
TOTAL CONVEYANCE = 86165.63 CFS
TOTAL DISCHARGE = 3500.88 CFS

BRIDGE INFORMATION INPUT
BRIDGE LENGTH = 170.00
LEFT ABUTMENT POSITION - - XAB(1) = 1236.00 YAB(1) = 936.00
XAB(2) = 1269.00 YAB(2) = 930.00
RIGHT ABUTMENT POSITION - - XAB(3) = 1361.50 YAB(3) = 924.50
XAB(4) = 1406.00 YAB(4) = 924.50

BRIDGE OPENING AT WATER SURFACE = 94.98
BASE BACKWATER CURVE USED = 1

CALCULATED INFORMATION
PORTION OF DISCHARGE LEFT OF OPENING (QA) = .00 CFS
PORTION OF DISCHARGE THRU OPENING (QB) = 2386.20 CFS
PORTION OF DISCHARGE RIGHT OF OPENING (QC) = 1114.67 CFS
AREA OF PIERS BELOW WATER SURFACE = 42.59 SQ FEET
ALPHA1 = 1.90
ALPHA2 = 1.62
TOTAL BACKWATER COEFFICIENT = .86
BRIDGE WATERWAY OPENING BELOW NORMAL DEPTH (AN2) = 664.69 SQ FEET
MEAN VELOCITY THRU BRIDGE OPENING (VN2) = 5.27 FPS
DISCHARGE RATIO (M) = .682
BACKWATER APPROXIMATION NO.1 = .59705 FEET
FINAL BACKWATER APPROXIMATION = .62989 FEET
NUMBER OF ITERATIONS TO OBTAIN FINAL BACKWATER = 3