TERRAMAR
NEW RIVER BANK PROTECTION
DESIGN REPORT
PEORIA, ARIZONA

(HAPPY VALLEY ROAD
TO
JOMAX ROAD)

October 7, 1998

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CVL Project No. 96-0043-21

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NEW RIVER BANK PROTECTION
DESIGN REPORT
PEORIA, ARIZONA

HAPPY VALLEY ROAD
TO
JOMAX ROAD

October 7, 1998

Prepared for:

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Terramar
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1.0 INTRODUCTION

1.1 Scope and Location

This report contains engineering analyses and design of channel improvement and bank protection structures for Terramar development along a portion of New River between Happy Valley Road and Jomax Road in the City of Peoria in central Arizona (Figure 1). The purpose of this design is to provide bank stabilization so that this new residential development (Terramar) can be constructed adjacent to New River.

This report is focused on providing practical design information, evaluation, and calculations for statistical flood events up to and including the 100-year frequency flood. The procedures used herein are derived from, and performed with, currently accepted engineering methodologies and practices. Additionally, the criteria for this evaluation are designed to conform to currently applicable ordinances, regulations and policies effected by the appropriate jurisdictional regulatory authorities for the referenced site.

The analysis presented herein focuses on evaluating stormwater runoff resulting from a statistical evaluation of storm events of particular duration and frequency up to and including a 100-year frequency event. A storm event exceeding the 100-year event may cause or create the risk of greater flood impact than is addressed and presented in this assessment. However, the scope of this assessment does not include, neither did CVL's client request that, evaluation of stormwater runoff resulting from storm events exceeding the 100-year frequency event. CVL assumes no responsibility for actual flood damage, increased risks of flood damage, or increased construction or development cost resulting from or related to any such events, nor shall CVL be responsible for any changes in, or additions to, regulatory requirements which may result from, or be related to, any such events or changes in hydrologic or hydraulic conditions within the watershed.

1.2 New River Bank Protection at Terramar

The bank protection of New River along with channel improvement is proposed as part of the Terramar development process. The proposed work is intended to both provide erosion/flood protection for the planned residential lots at the southwest corner of the project and stabilize the river adjacent to the remainder of the western portion of the development.

1.3 Objective

There are two locations of bank protection (Construction Plans, Sheet 1, Appendix K). The main project area which also involves channel improvement and bank protection begins approximately 2500 feet north of Happy Valley Road where the river deviates from its generally south alignment and crosses into the Terramar site in a southeasterly direction. The downstream limit of the channel works is approximately 1700 feet north of Happy Valley Road as the river moves west – back to its original alignment (see Figure 1: Location Map). A second location is about 100 feet north of Happy Valley Road where the proposed parcel will be partially in the 100-year floodplain fringe. This area will be removed from the floodplain using a reinforced concrete floodwall and fill (Construction Plans, Sheet 1, Appendix K).

An opportunity to accomplish the channel improvement is created by the substantially reduced flow rate within New River due to the upstream New River Dam – peak 100-year discharge reduced from 53,000 cfs to 2,350 cfs (Reference 1). This reduced and concentrated flow hugs the eastern low flow channel and occupies only a portion of the older and wider New River channel section.

1.4 Methodology

Specifically, the purpose of the channel improvement of the eastern low flow channel within the wider New River channel is twofold:

- Redirect flows into the original southerly alignment thereby reducing the impinging action and erosion of land to the southeast which has a potential for endangering the proposed residential development.
- Reclaim land along the east side (of the river) that had been encroached by the river which has meandered from its original southerly course and stabilize the river banks.

The following text provides a description of the channel improvement and the hydrologic and hydraulic analyses used to accomplish the channel improvement without exacerbating existing conditions and impacting adjacent property.

1.5 Regulatory Jurisdiction

The development of this project is in accordance with the City of Peoria, FEMA, and Flood Control District of Maricopa County (FCDMC) design requirements (Reference 2).

1.6 Previous Submittals to FEMA

A Conditional Letter of Map Revision (CLOMR) for this project has been submitted to FEMA (Ref. 7). The only other known previous submittal to FEMA (Reference 3) regarding this area was the work completed for the in-force Flood Insurance Study (FIS) and associated FIRM (Reference 6).

2.0 HYDROLOGIC SETTING

Hydrologic supporting documentation is presented in Appendix A. The original hydrology for New River below the New River Dam has been altered by the dam itself. "Clear" water (without sediment) is released from the dam at a 100-year peak flow rate of 2,350 cfs (Reference 1). At the river reach under consideration, lateral flows from the watershed areas downstream of the dam have increased the peak 100-year flow to 4,200 cfs (Reference 1).

3.0 HYDRAULIC ANALYSES

The HEC-RAS River Analysis System (Reference 4) computer program by the U.S. Army Corps of Engineers was used to perform steady flow backwater computations to evaluate the flow characteristics of New River in the vicinity of the project site.

A base model for existing conditions of flow was developed. This model is listed in Reference 7 and will not be included in this report. Locating the flow path was a challenge due to numerous low flow channels within the wider New River main channel. Also, the reduced flow from the New River Dam results in some channels being dry and others flowing full or partially full.

Channel input parameters such as channel and overbank roughness and contraction/expansion coefficients were estimated after a site visit and verified with a previous hydraulic model prepared by the U.S. Army Corps of Engineers for the Federal Emergency Management Agency's (FEMA's) Flood Insurance Study (FIS) of Maricopa County, Arizona and incorporated areas (Reference 5). Channel cross sections were taken from aerial photogrammetry based upon 1 foot contour interval maps prepared by Aerial Mapping Company, Inc. in 1996.

The proposed realignment hydraulic model was created by widening the low flow channel within the Terramar project site and relocating it approximately 100 feet west. This proposed condition model is listed in Appendix B. The results show that the water surface and energy elevations compare well with the existing conditions and are lower in the realigned channel. Also, the conveyance characteristics of the improved and existing channels are similar. Flow velocities are also not significantly changed (see Table 1).

At the northern end of the realignment reach, a tributary wash enters New River (Wash 2) from the Terramar development. This wash is also realigned and improved (see construction plans, Appendix K, Sheet 1 of 9). The hydraulic HEC-2 model for the Wash 2 is presented in Appendix C.

4.0 PROPOSED CHANNEL IMPROVEMENTS

The improved channel is an excavated trapezoidal channel with a gabion-reinforced east bank (see Construction Plans, Sheets 2 and 3, Appendix K). The existing natural side slope for the east bank transitions into a stepped gabion wall which continues southeast, south and southwest to match the existing east New River bank as the channel exits Terramar. No gabion bank protection is proposed for the short stretch of the west bank affected by the proposed realignment. Instead, the channel bank on the west side will be graded to a stable slope of 3:1. It may be noted that the original channel inverts are projected onto the new realigned channel. Top of proposed bank elevations were established by increasing the computed water surface elevations by the magnitude of computed freeboard. Freeboard calculations are given in Appendix D.

The Wash 2 tributary is an unlined trapezoidal channel with side slopes of 3:1 and bottom width of 30 feet.

5.0 SCOUR ANALYSIS

A scour analysis (see Appendix D) was used to design the foundation of the gabion wall and the apron extending into the channel. This analysis included long term degradation as well as local and general scour. Due to the dam, "clear" water is expected to flow out of the outlet so that sediment inflow to the reach will be picked up from the upstream channel reach. The potential long term effect is a slight degradation in this reach. Geotechnical data for this analysis were obtained in the geotechnical report presented in Appendix E.

6.0 RETAINING WALL DESIGN

Two types of retaining walls were designed. The gabion retaining walls are rock filled types along the middle part of the development. At the southwestern corner of the development, Parcel 9B near Happy Valley Road will include reinforced concrete walls to remove some lots from the floodplain and also help stabilize steep river banks.

Gabion retaining walls were sized to withstand lateral earth pressures. Safety factors against sliding and overturning are given in Appendix G. Typical sections for the gabion retaining walls are given in Construction Plans, Sheet 4, in Appendix K.

The retaining walls are formed on concrete padding about 2 feet thick, the back side of the walls are lined with geofabric to prevent loss of fines that could result in piping failure.

The reinforced concrete retaining walls were designed to withstand lateral earth pressures. Structural calculations are given in Appendix F.

7.0 QUANTITY ESTIMATES

Quantities of materials required for the construction are estimated in Appendix H. A summary of the quantities is presented in Table 2.

8.0 SPECIFICATIONS

Technical specifications for the retaining gabion walls are presented in Appendix I (Reference 8). Specifications for the retaining concrete structural walls are given in the construction plans, Sheet S1.

9.0 SUMMARY AND CONCLUSIONS

The study demonstrates the feasibility and viability of the proposed New River channel realignment. In addition to freeing up area for development along the east side of the river, the proposed residential lots to the southeast are also protected from the eroding/scouring action of the river.

The peak 100-year flow rate of 4,200 cfs in New River will be safely conveyed across the area in a new, bank protected channel. This will essentially maintain the water surface profile and limit the 100-year floodplain width to the channel width. This channel will provide for relatively low velocities even during the 100-year flow.

10.0 REFERENCES

1. U.S. Army Corps of Engineers, Los Angeles District, *Gila River Basin and New River and Phoenix City Streams, Arizona, Design Memorandum No. 2, Part 2,* 1982.

2. Drainage Design Manual for Maricopa County, Volume II, Hydraulics, Flood Control District of Maricopa County, 1996.

3. Federal Emergency Management Agency, *Flood Insurance Study of Maricopa County, Arizona and Unincorporated Areas*, September 30, 1995.

4. U.S. Army Corps of Engineers, Hydrologic Engineering Center, *HEC-RAS River Analysis System User's and Hydraulic Reference Manuals, Version 1.0*, July 1995.

5. U.S. Army Corps of Engineers, Los Angeles District, *HEC-2 Hydraulic Study, HEC-2 Model NRIVER.DAT for Federal Emergency Management Agency's Flood Insurance Study of Maricopa County, Arizona and Unincorporated Areas* (September 30, 1995).

6. Federal Emergency Management Agency, Flood Insurance Rate Map Number 04013C1180E, September 30, 1995.

7. FEMA CLOMR Submittal for a Portion of New River, Happy Valley Road to Jomax Road, City of Peoria, Maricopa County, Arizona, Coe & Van Loo, Consultants, Inc., Phoenix, August 1998.

8. Maccaferi Environmental Solutions "Technical Specifications, Gabions", January 1998.

DOCUMENT QUALITY ASSURANCE

As part of CVL's policy to provide quality products to its clients, all reports are subject to review for technical accuracy, validity of conclusions and appropriateness of recommendations.

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Date: *October 7, 1998*

TABLES

TABLE 1

Summary Table
Comparison of Existing and Proposed Channel Characteristics[1]

Section[2] Locations	Discharge (cfs)	Water Surface Elevation (ft)		Channel Velocity (fps)		Top Width (ft)		Froude Number	
		Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
2.106 (15.144)	4200	1337.1	1337.4	4.7	5.3	776	331	0.6	0.6
2.108 (15.333)	4200	1338.8	1339.0	4.9	4.5	289	399	0.5	0.4
2.109 (15.519)	4200	1341.0	1341.0	3.7	3.7	353	352	0.4	0.4
2.120 (15.699)	4200	1347.6	1337.4	7.4	8.7	247	209	0.7	0.8
2.160 (15.977)	4200	1356.4	1356.4	5.5	5.5	475	475	0.6	0.6

Notes:

1. Refer to HEC-RAS output in the appendix for geometry of sections and the water surface profile graphics.
2. Sections in parenthesis refer to FIS section numbers

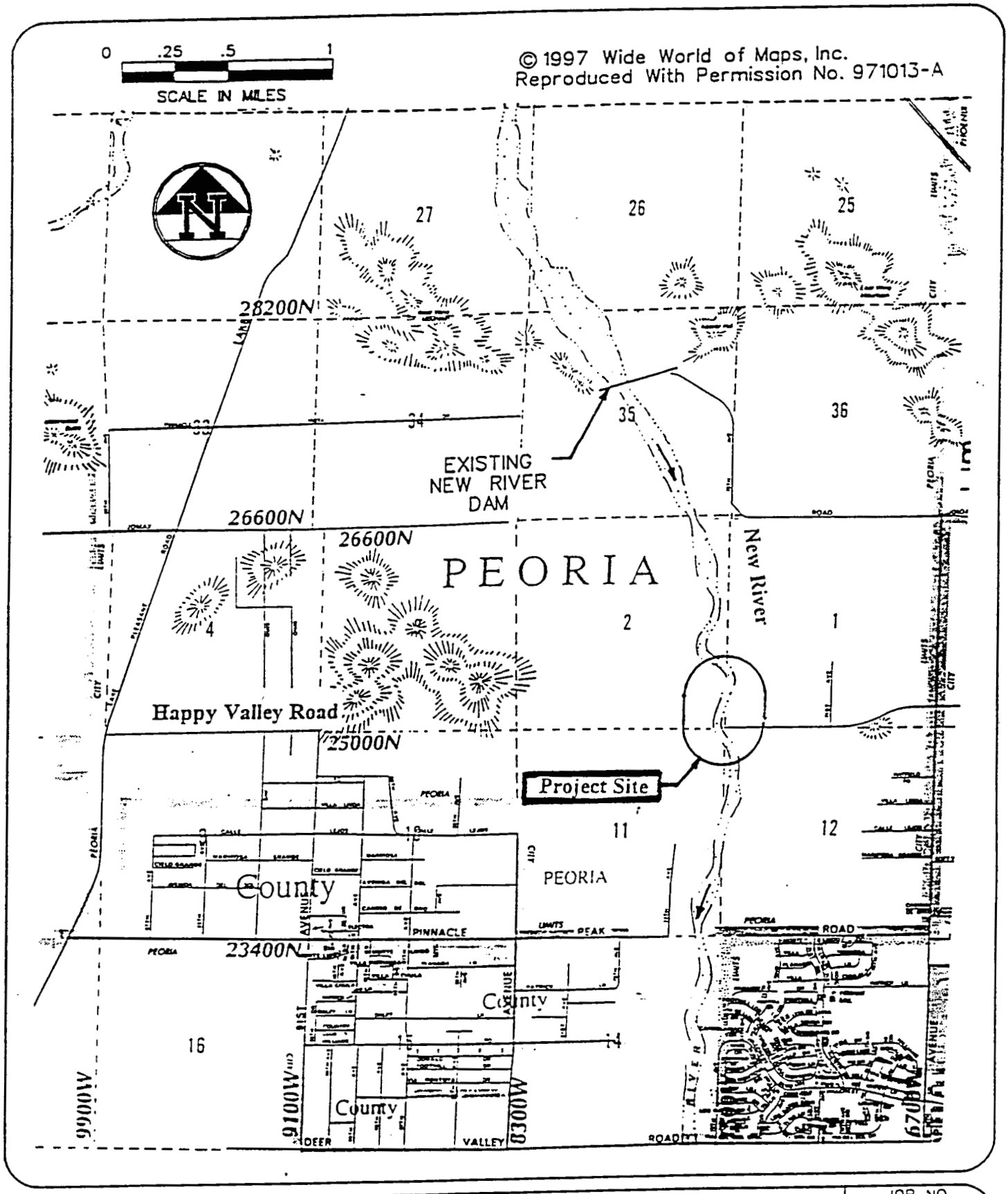
Table 2

Summary of Quantity Estimates[1.]

Item	Units	Quantity
Gabion	CY	6,310
Concrete Base (Plain)	CY	1,000
Concrete (Structural)	CY	400
Reinforcement Bars	LBS	66,000
Earthworks - Fill	CY	3,300
Earthworks - Cut	CY	2,730
Geofabric	SY	3,430

1. Engineers estimate only, contractor must verify.

FIGURES



LOCATION MAP	TERRAMAR - NEW RIVER	JOB NO 960043-21
4550 NORTH 12TH STREET PHOENIX, ARIZONA 85014 TELEPHONE (602) 264-6831	COE & VAN LOO PLANNING • ENGINEERING • LANDSCAPE ARCHITECTURE	FIGURE 1

FILE: N:\960043\LAND\SDMAP.DGN DATE:8-98

APPENDICES

APPENDIX A

HYDROLOGY

US Army Corps
of Engineers
Los Angeles District

Gila River Basin

Phoenix, Arizona & Vicinity
(including New River)

Hydrology Part 2

Design Memorandum No. 2

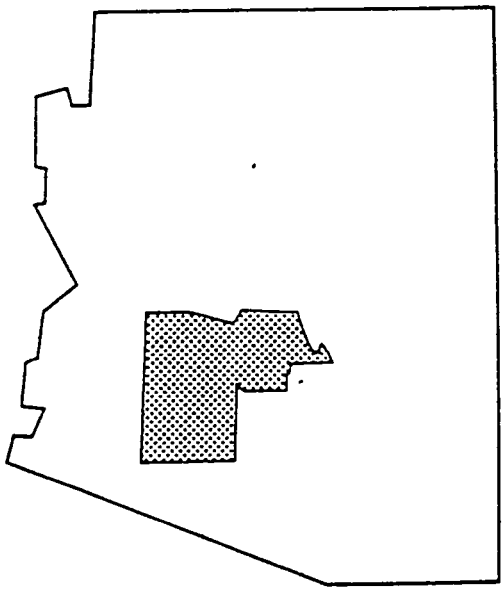
TABLE 1 (Continued)

DESIGN PEAK DISCHARGES
FUTURE CONDITIONS WITH PROJECT

CP	LOCATION	DRAINAGE AREA (mi^2)	SPF (ft^3/s)	100-YEAR FLOO (ft^3/s)
	ACDC			
1016U	Above Cave Creek	19.7	15,000[6]	15,000[2]
1016D	Below Cave Creek	61.1[8]	25,000[6]	25,000[5,8]
1018	Near 51st Ave.	70.3	26,000[6]	26,000[5]
1019	Above Skunk Creek	85.4	29,000[6]	29,000[5]
	SKUNK CREEK			
1031U	Inflow - Adobe Dam	89.6	66,000[9]	39,000[2]
1031D	Outflow - Adobe Dam	0	1890[9]	1730[9]
1021U	Above Scatter Wash	0.9	4500[9]	2800[9]
1021D	Below Scatter Wash	9.4[5]	21,000[5]	10,000[5]
1022U	Above ACDC	24.9[10]	26,000[5,10]	13,000[5,10]
1022D	Below ACDC	110.3[11]	55,000[5,11]	35,000[5,11]
1029	Above New River	111.2[11]	55,000[5,11]	35,000[5,11]
	NEW RIVER			
1033U	Inflow - New River Dam	164	76,000[3]	53,000[2]
1033D	Outflow - New River Dam	0	2665[5]	2350[5]
1025	Above Beardsley Rd.	10.3	24,000[7]	12,000[7]
1029U	Above Skunk Creek	20.7[12]	38,000[5,12]	19,000[5,12]
1029D	Below Skunk Creek	123.6	68,000[5,13]	41,000[5,13]
1039	Above Agua Fria River	159.7	69,000[5,13]	39,000[5,13]
	AGUA FRIA RIVER[14]			
1034U	Inflow - Waddell Dam	1459	158,000[5]	135,000[5]
1034D	Outflow - Waddell Dam	1459	158,000[5]	135,000[5]
1037	At Bell Rd.	1870	151,000[5]	115,000[5]

FLOOD INSURANCE STUDY

MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS
VOLUME 1 OF 12



COMMUNITY NAME	COMMUNITY NUMBER
AVONDALE, CITY OF	040038
BUCKEYE, TOWN OF	040039
CAREFREE, TOWN OF	040126
CAVE CREEK, TOWN OF	040129
CHANDLER, CITY OF	040040
EL MIRAGE, TOWN OF	040041
GILA BEND, TOWN OF	040043
GILBERT, TOWN OF	040044
GLENDALE, CITY OF	040045
GOODYEAR, TOWN OF	040046
GUADALUPE, TOWN OF	040111
LITCHFIELD PARK, CITY OF	040128
MARICOPA COUNTY UNINCORPORATED AREAS	040037
MESA, CITY OF	040048
PARADISE VALLEY, TOWN OF	040049
PEORIA, CITY OF	040050
PHOENIX, CITY OF	040051
QUEEN CREEK, TOWN OF	040132
SCOTTSDALE, CITY OF	045012
SURPRISE, TOWN OF	045053
TEMPE, CITY OF	040054
TOLLESON, CITY OF	040055
WICKENBURG, TOWN OF	040056
YOUNGSTOWN, TOWN OF	040057

REVISED: SEPTEMBER 30,1995

Federal Emergency Management Agency

Table 3. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Agua Fria River (cont'd)					
At confluence with Gila River	--[2]	22,000	68,000	94,000	183,000
Above downstream end of COE levee (0.7 mile below Lower Buckeye Road)	--[2]	22,000	69,000	95,000	184,000
New River					
Near Rock Springs	--[2]	--[1]	--[1]	34,500	--[1]
At New River Road	--[2]	--[1]	--[1]	32,000	--[1]
At Interstate 17	--[2]	--[1]	--[1]	33,400	--[1]
Above confluence with Sweat Canyon Wash	--[2]	--[1]	--[1]	33,000	--[1]
At Carefree Highway	--[2]	--[1]	--[1]	35,800	--[1]
Upstream of New River Dam	--[2]	--[1]	--[1]	49,300	--[1]
At Outflow of New River Dam	0	1,700	2,200	2,350	--[1]
Above Beardsley Road	10.3	2,400	6,500	9,800	--[1]
Above confluence with Skunk Creek	17.3	2,700	8,000	12,000	--[1]
Below confluence with Skunk Creek	--[2]	13,500	31,000	41,000	75,000
Sweat Canyon Wash					
Above confluence with New River	--[2]	--[1]	--[1]	19,800	--[1]
Powder House Wash					
At Jack Burden Road	1.9	300	1,300	1,900	4,400
Martinez Wash					
At Mouth	103.0	9,220	27,400	32,000	45,000
Mockingbird Wash					
At U.S. Highways 60, 70, and 89	6.9	2,750	4,040	5,060	7,400
Little San Domingo Wash					
At U.S. Highways 60, 70, and 89	6.2	1,690	2,620	3,090	4,250
Wittmann Drainage					
At Atchison, Topeka & Santa Fe Railway	8.6	1,760	2,770	3,060	4,350

[1]Not Computed
[2]Not Available

Table 3. Summary of Discharges (Cont'd)

LEGEND

——— — ——— 100 YEAR FLOODPLAIN

— — — — FLOODWAY

—•••— STREAMLINE

NOTE: 500 YEAR LIMIT NOT SHOWN

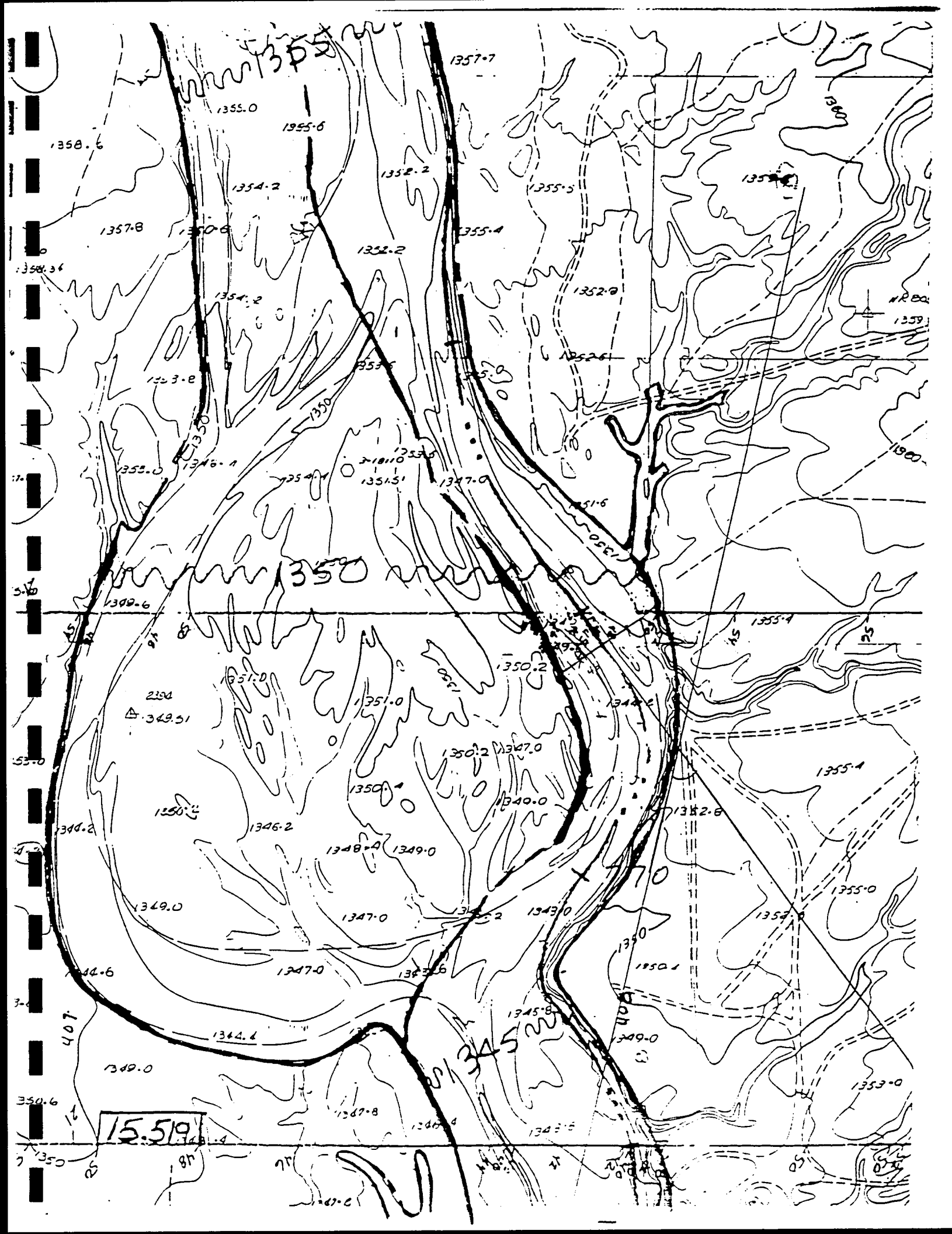
SCALE: 1" = 200'

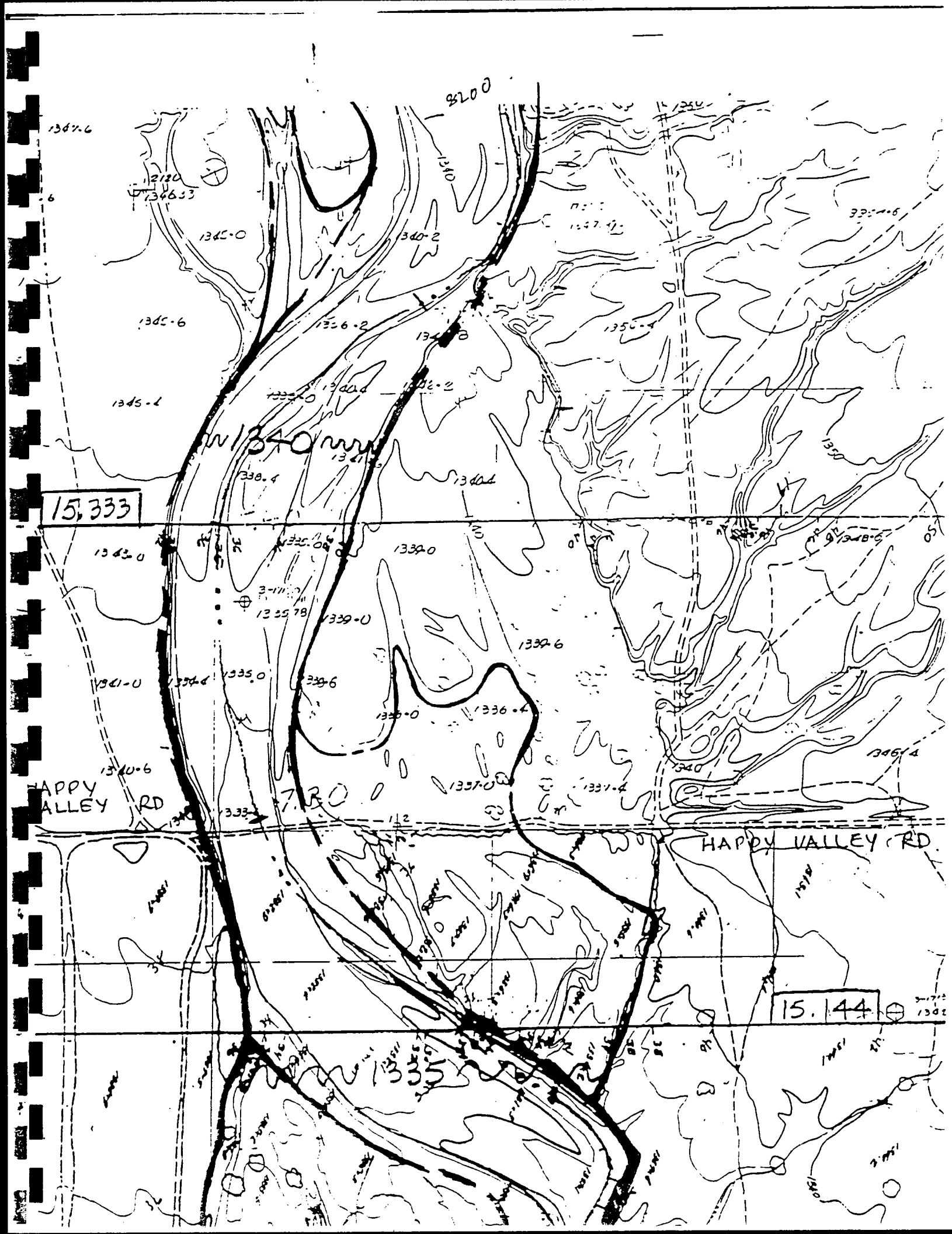
2 FT C.I.

FOLLOWING SHEETS, INCLUDING HEC-2 OUTPUT, ARE FROM THE U.S. CORPS OF ENGINEERS' HEC-2 MODEL 'RIVER-2.DAT USED TO ESTIMATE 100 YR FLOOD PLAIN FOR FEMA FIS DATED SEPT. 30, 1995. COE STUDY WAS DONE IN 1985.

HEC-2 OUTPUT SHOWS CHANGE OF 2350 CFS TO 4200 CFS WITHIN THE REALIGNMENT STUDY LIMITS.

~~FROM~~


1355
1350
1345
15.519


15,333
HAPPY VALLEY RD
HAPPY VALLEY RD
15.144
1340
1335

APPENDIX B

HEC-RAS PROPOSED CONDITION MODEL

HEC-RAS Version 2.0 April 1997
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X    X
X     X  X        X           X   X    X    X   X
XXXXXXX  XXXX     X       XXX XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
```

PROJECT DATA
Project Title: terramar new river proposed conditions
Project File : terrapro.prj
Run Date and Time: 7/30/98 3:47:54 PM

Project in English units

Project Description:
New River Near Terramar Proposed Bank Protection

PLAN DATA

Plan Title: Plan 03
Plan File : n:\960043\hydro\hecras\nriver\nrprop\terrapro.p03

Geometry Title: New River at Terramar Proposed Geomtry
Geometry File : n:\960043\hydro\hecras\nriver\nrprop\terrapro.g02

Flow Title : New River near Terramar
Flow File : n:\960043\hydro\hecras\nriver\nrexist\terraex.f01

Plan Summary Information:

Number of:	Cross Sections	= 18	Mulitple Openings	=	0
	Culverts	= 0	Inline Weirs	=	0
	Bridges	= 0			

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculaton tolerance	=	0.01
Maximum number of interations	=	20
Maximum difference tolerance	=	0.3
Flow tolerance factor	=	0.001

Computational Flow Regime: Subcritical Flow

Encroachment Data

Equal Conveyance = True
Left Offset = 0
Right Offset = 0

River = New River Reach = Terramar

RS	Profile	Method	Value1	Value2
2.16	PF#2	1	913	1210
2.150	PF#2	1	960.9	1098.5
2.140	PF#2	1	932.7	1037.2
2.135	PF#2	1	909.9	1053.8
2.130	PF#2	1	917.9	1059
2.125	PF#2	1	923	1054
2.120	PF#2	1	930	1060.5
2.118	PF#2	1	945	1103
2.116	PF#2	1	950	1110
2.113	PF#2	1	950	1120
2.1125	PF#2	1	954.1	1142.1
2.112	PF#2	1	901	1017
2.111	PF#2	1	866	1201
2.110	PF#2	1	842	1169.5
2.109	PF#2	1	787	1120
2.108	PF#2	1	841	1133
2.107	PF#2	1	885	1134
2.106	PF#2	1	710	1053

FLOW DATA

Flow Title: New River near Terramar
Flow File : n:\960043\hydro\hecras\nriver\nrexist\terraex.f01

Flow Data (cfs)

River	Reach	RS	PF#1	PF#2
New River	Terramar	2.16	4200	4200
New River	Terramar	2.150	4200	4200
New River	Terramar	2.111	4200	4200

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
New River	Terramar	PF#1	Critical	Normal S = 0.005

GEOMETRY DATA

Geometry Title: New River at Terramar Proposed Geomtry
Geometry File : n:\960043\hydro\hecras\nriver\nrprop\terrapro.g02

CROSS SECTION RIVER: New River
REACH: Terramar RS: 2.16

INPUT
Description: Upstream Cross Section (15,966 of FIS)

Station Elevation Data num= 38

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
913	1358	925	1357	927	1356	929	1355	932	1354
935	1353	938	1352	940	1351	960	1351	975	1352
1025	1352	1070	1352	1074	1353	1077	1354	1080	1355
1085	1356	1150	1356	1175	1355	1200	1355	1205	1356
1210	1357	1295	1357	1300	1355	1305	1354	1315	1354
1320	1355	1340	1356	1360	1356	1395	1355	1420	1354
1470	1354	1480	1355	1490	1356	1493	1357	1500	1358
1510	1359	1515	1359	1540	1360				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
913	.05	913	.035	1210	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
913	1210	870	761	465	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Sta L	Sta R	Elev
913	913	1357	1210	1540	1357

CROSS SECTION RIVER: New River
REACH: Terramar RS: 2.150

INPUT
Description:
Station Elevation Data num= 47

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
941.2	1353	960.9	1353	962.9	1352	964.8	1351	966.9	1350
969	1349	971.1	1348	1009.4	1347	1014.3	1346	1025.16	1345.5
1036.1	1346	1041.1	1347	1045.9	1348	1050.5	1349	1057.2	1350
1089.6	1351	1098.5	1352	1214.4	1352	1219.4	1351	1224.6	1350
1243.2	1350	1246.9	1351	1250.1	1352	1273	1352	1280	1351
1284.6	1350	1323.3	1351	1335.5	1350	1339.4	1351	1356.3	1352
1385.8	1353	1406	1353	1416	1352	1448	1352	1473	1352
1481	1351	1486	1350	1491	1349	1507	1350	1515	1351
1520	1352	1524	1352	1566	1352	1571	1353	1593	1354
1636	1354	1639	1355						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
941.2	.05	960.9	.035	1098.5	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
960.9	1098.5	175	203.8	210	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev
1098.5	1639	1355

CROSS SECTION RIVER: New River
REACH: Terramar RS: 2.140

INPUT
Description:
Station Elevation Data num= 35

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
879.7	1352	899.7	1351	932.7	1350	941.2	1349	950.4	1348
970.3	1347	986.2	1346	993.4	1345	1008.4	1344.5	1023.4	1345
1025.6	1346	1037.2	1351	1042.1	1352	1092	1352	1099	1351
1104	1350	1120	1350	1124	1351	1139	1352	1184	1352
1234	1351	1267	1351	1284	1352	1287	1352	1369	1352
1389	1351	1404	1350	1417	1349	1514	1349	1524	1350
1534	1351	1544	1352	1589	1351	1624	1352	1639	1353

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
879.7	.05	932.7	.035	1037.2	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
932.7	1037.2	156.4	193.4	236.6	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev
1042.1	1639	1352

CROSS SECTION RIVER: New River

REACH: Terramar RS: 2.135

INPUT
Description: Start Retaining Wall Left Bank
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
810	1351	830	1351	850	1350	869.2	1349	880.4	1350
909.9	1350	917.5	1349	926.2	1348	935.7	1347	945.4	1346
995.3	1345.5	1045.2	1346	1048.7	1347	1051.7	1348	1053.8	1349
1118.9	1350								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
810	.05	909.9	.035	1053.8	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
909.9	1053.8	54	51.4	66	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
810	880	1352

CROSS SECTION RIVER: New River
REACH: Terramar RS: 2.130

INPUT
Description:
Station Elevation Data num= 32

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
832	1350	840	1349	866.2	1349	917.9	1349	923.3	1348
928.4	1347	936.2	1346	996.5	1345	1005.5	1345	1050.4	1346
1059.9	1349	1104.9	1349	1110.9	1350	1159.7	1351	1172	1351
1183	1350	1195	1349	1200	1349	1210	1350	1295	1350
1300	1349	1340	1349	1355	1350	1395	1350	1460	1349
1475	1348	1490	1348	1520	1349	1560	1349	1570	1349
1580	1350	1592	1350						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
832	.05	917.9	.035	1059.9	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
917.9	1059.9	111.5	80.9	84	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev
1059.9	1592	1351

Blocked Obstructions num= 1

Sta L	Sta R	Elev
832	912	1352

CROSS SECTION RIVER: New River
REACH: Terramar RS: 2.125

INPUT
Description:
Station Elevation Data num= 31

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
790.5	1353	794.5	1352	802.5	1351	810	1350	816.5	1349
825	1348	842.5	1347	851.5	1346	870	1346	871	1347
875	1348	878	1349	893.5	1349	906	1348	911.5	1347
918	1346	923	1345	969	1345	1029	1344	1038	1344
1043	1345	1045	1346	1048	1347	1050	1348	1054	1349
1060	1350	1079.5	1350	1103	1349	1111	1348	1131.5	1348
1140	1349								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
790.5	.05	923	.035	1054	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
923	1054	144	119.8	138	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev
1054	1140	1350

Blocked Obstructions num= 1

Sta L	Sta R	Elev

790.5 929 1352

CROSS SECTION RIVER: New River
REACH: Terramar RS: 2.120

INPUT
Description:
Station Elevation Data num= 59

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
872	1350	874	1349	876	1348	878	1347	880	1346
889	1345	896.5	1344	906.5	1343	911	1343	922	1344
930	1344.286	932.5	1345	970	1345	981	1344	1005	1343
1014.7	1342.5	1024.5	1343	1032.5	1343	1035	1343	1038	1343
1041	1343	1050.5	1343	1060.5	1343	1072.5	1349	1087	1348
1097	1347	1099	1347	1102	1348	1110	1349	1114	1349
1122	1348	1127	1348	1184	1348	1190	1347	1196	1347
1207	1348	1222	1349	1234	1350	1252	1351	1272	1350
1307	1349	1310	1349	1374	1349	1420	1350	1427	1349
1434	1348	1464	1347	1477	1347	1482	1348	1487	1349
1509	1349	1557	1348	1572	1348	1577	1347	1589	1347
1592	1348	1610	1349	1615	1349	1644	1350		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
872	.05	930	.035	1060.5	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
930	1060.5	113	67.1	47	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev
1060.5	1644	1352

Blocked Obstructions num= 1

Sta L	Sta R	Elev
872	925	1352

CROSS SECTION RIVER: New River
REACH: Terramar RS: 2.118

INPUT
Description:
Station Elevation Data num= 23

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
854.5	1350	867	1349	869	1348	871	1347	873	1346
874	1345	876	1344	916.5	1343	924	1344	945	1345
962	1345	974	1344	988	1343	1008.5	1342.5	1029	1342
1032	1342	1035	1342	1038.5	1342	1056	1342	1065.5	1342
1085	1342	1103	1348	1120	1348				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
854.5	.05	945	.035	1103	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
945	1103	125	77.7	49.5	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
854.5	941	1352

CROSS SECTION RIVER: New River
REACH: Terramar RS: 2.116

INPUT
Description:
Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
890	1352	896	1348	898	1347	903	1343	922	1342
933.5	1341.5	945	1342	948	1343	950	1343	968	1342
984	1341.5	1000	1342	1010	1343	1017.5	1344	1037.5	1344
1040.5	1344	1043.5	1344	1053.5	1344	1071.5	1344	1105	1344
1110	1347	1131	1347						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
890	.05	950	.035	1110	.05

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           950    1110             155.5   105.2      86              .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev
    1110    1131    1350
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
     890     952    1354

CROSS SECTION          RIVER: New River
REACH: Terramar           RS: 2.113

INPUT
Description:
Station Elevation Data    num=      17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     860    1351     875    1342     883    1342     889    1339     894  1338.5
     899    1339     908    1340     916    1341     932    1342     9501342.316
     989    1343    1104    1343  1106.5    1343    1110    1343  1113.5    1343
    1120    1347    1154    1347

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     860     .05     950    .035    1120     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           950    1120             205.7   131.8    49.6              .1       .3
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
     860     950    1354

CROSS SECTION          RIVER: New River
REACH: Terramar           RS: 2.1125

INPUT
Description:
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
   844.4    1349   851.1    1340   866.7    1340     907    1341   954.1    1341
   985.8    1341    1022    1342    1098    1342  1128.6    1343  1137.7    1346
  1142.1    1347    1169    1348

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
   844.4     .05   954.1    .035  1142.1     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         954.1  1142.1             102.6   134.6     108              .1       .3
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
   844.4   938.5    1351

CROSS SECTION          RIVER: New River
REACH: Terramar           RS: 2.112

INPUT
Description:
Station Elevation Data    num=      17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     822  1348.5     856    1348     870    1341   894.5    1341     901    1341
   943.5    1340     956    1339   968.5  1338.5     981    1339   997.5    1340
    1017    1341    1074    1341  1080.5    1342    1085    1343    1090    1344
    1094    1345    1096    1346

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     822     .05     901    .035    1017     .05

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           901    1017              38.5    54.7    191              .1       .3
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
     822     856    1352

CROSS SECTION          RIVER: New River
```

REACH: Terramar RS: 2.111

INPUT
Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
811.7	1348	844	1348	856	1342	866	1342	888	1342
896	1341	906	1341	932.5	1341	960	1340	974.5	1339
1006.5	1339	1027	1340	1154	1340	1187.5	1339	1190	1340
1201	1345	1209	1347						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
811.7	.05	866	.035	1201	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
866	1201	115	179.4	324	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
811.7	844	1352

CROSS SECTION RIVER: New River
REACH: Terramar RS: 2.110

INPUT
Description:
Station Elevation Data num= 26

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
784	1348	795	1347	800	1346	805	1345	811	1344
816.5	1343	829.5	1342	842	1341	861	1340	1035	1340
1105	1339	1119	1338	1124	1337	1134.5	1336	1143.5	1336
1152.5	1337	1162.5	1338	1165	1339	1167.5	1340	1169.5	1341
1172	1342	1176.5	1343	1185	1344	1191.5	1345	1205.5	1346
1217.5	1347								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
784	.05	842	.035	1169.5	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
842	1169.5	180	190	210	.1	.3

CROSS SECTION RIVER: New River
REACH: Terramar RS: 2.109

INPUT
Description: X-Sec 2.109 Corresponds to Section 15.519 of FIS
Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
685	1345	688	1344	689	1343	692	1342	780	1341
783	1340	785	1339	787	1338	798	1337	830	1338
847	1338	1045	1338	1068	1337	1080	1336	1112	1336
1115	1337	1120	1338	1124	1339	1128	1340	1132	1341
1136	1342	1140	1343						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
685	.05	787	.035	1120	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
787	1120	940	980	960	.1	.3

CROSS SECTION RIVER: New River
REACH: Terramar RS: 2.108

INPUT
Description: X-Sec 2.108 Corresponds to Section 15.333 of FIS
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
734	1339	770	1339	841	1339	855	1338	870	1337
890	1336	900	1336	910	1336	965	1336	1012	1336
1070	1335	1090	1334	1129	1335	1130	1336	1131	1337
1132	1338	1133	1339	1134	1340				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
734	.05	841	.035	1133	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
841	1133	150	150	150	.1	.3

CROSS SECTION RIVER: New River
REACH: Terramar RS: 2.107

INPUT
Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
515	1339	540	1338	620	1338	734	1337	747	1337
752	1338	885	1338	910	1337	914	1336	945	1335
966	1335	972	1334	995	1334	1067	1334	1127	1335
1129	1336	1131	1337	1134	1338	1137	1339	1140	1340

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
515	.05	885	.035	1134	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
885	1134	420	400	390	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev
515	885	1339

Blocked Obstructions num= 1

Sta L	Sta R	Elev
515	720	1340

CROSS SECTION RIVER: New River
REACH: Terramar RS: 2.106

INPUT
Description: X-Sec 2.106 near Happy Valley Road
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
266	1340	271	1338	274	1337	304	1336	549	1336
650	1336	710	1336	725	1336	738	1335	829	1335
880	1335	1044	1335	1047	1336	1050	1337	1053	1338
1140	1339								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
266	.05	710	.035	1053	.05

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
710	1053	0	0	0	.1	.3

Blocked Obstructions num= 1

Sta L	Sta R	Elev
266	720	1338

SUMMARY OF MANNING'S N VALUES

River:New River

Reach	River Sta.	n1	n2	n3
Terramar	2.16	.05	.035	.05
Terramar	2.150	.05	.035	.05
Terramar	2.140	.05	.035	.05
Terramar	2.135	.05	.035	.05
Terramar	2.130	.05	.035	.05
Terramar	2.125	.05	.035	.05
Terramar	2.120	.05	.035	.05
Terramar	2.118	.05	.035	.05
Terramar	2.116	.05	.035	.05

Terramar	2.113	.05	.035	.05
Terramar	2.1125	.05	.035	.05
Terramar	2.112	.05	.035	.05
Terramar	2.111	.05	.035	.05
Terramar	2.110	.05	.035	.05
Terramar	2.109	.05	.035	.05
Terramar	2.108	.05	.035	.05
Terramar	2.107	.05	.035	.05
Terramar	2.106	.05	.035	.05

SUMMARY OF REACH LENGTHS

River: New River

Reach	River Sta.	Left	Channel	Right
Terramar	2.16	870	761	465
Terramar	2.150	175	203.8	210
Terramar	2.140	156.4	193.4	236.6
Terramar	2.135	54	51.4	66
Terramar	2.130	111.5	80.9	84
Terramar	2.125	144	119.8	138
Terramar	2.120	113	67.1	47
Terramar	2.118	125	77.7	49.5
Terramar	2.116	155.5	105.2	86
Terramar	2.113	205.7	131.8	49.6
Terramar	2.1125	102.6	134.6	108
Terramar	2.112	38.5	54.7	191
Terramar	2.111	115	179.4	324
Terramar	2.110	180	190	210
Terramar	2.109	940	980	960
Terramar	2.108	150	150	150
Terramar	2.107	420	400	390
Terramar	2.106	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: New River

Reach	River Sta.	Contr.	Expan.
Terramar	2.16	.1	.3
Terramar	2.150	.1	.3
Terramar	2.140	.1	.3
Terramar	2.135	.1	.3
Terramar	2.130	.1	.3
Terramar	2.125	.1	.3
Terramar	2.120	.1	.3
Terramar	2.118	.1	.3
Terramar	2.116	.1	.3
Terramar	2.113	.1	.3
Terramar	2.1125	.1	.3
Terramar	2.112	.1	.3

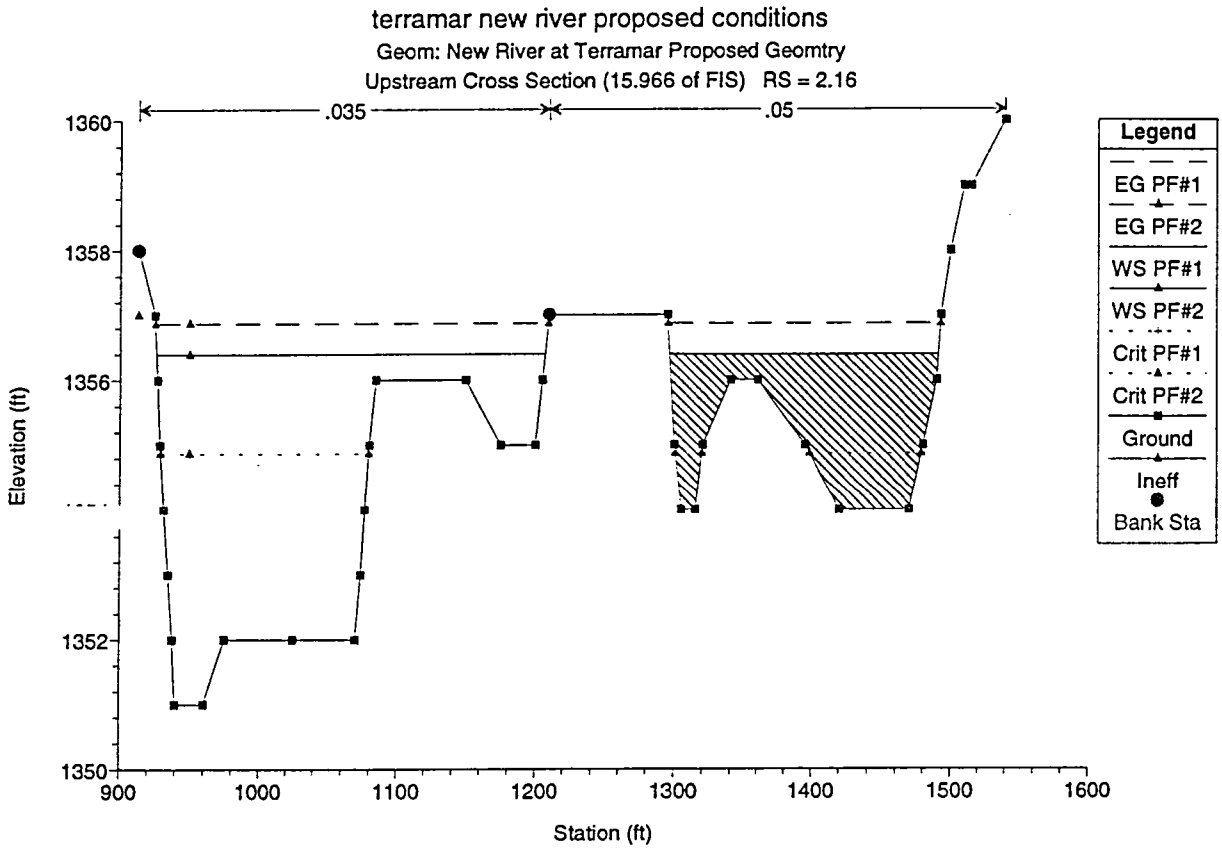
Terramar	2.111	.1	.3
Terramar	2.110	.1	.3
Terramar	2.109	.1	.3
Terramar	2.108	.1	.3
Terramar	2.107	.1	.3
Terramar	2.106	.1	.3

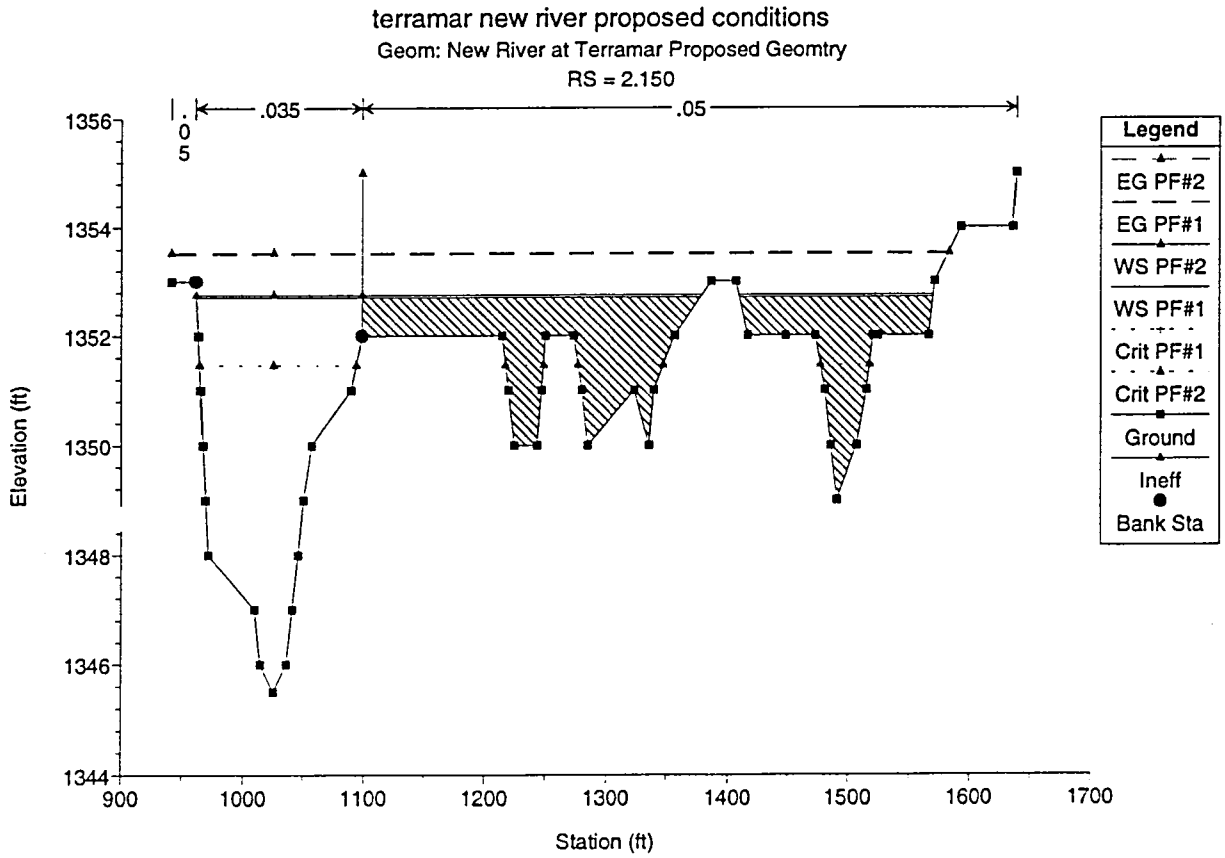
Profile Output Table - Standard Table 2

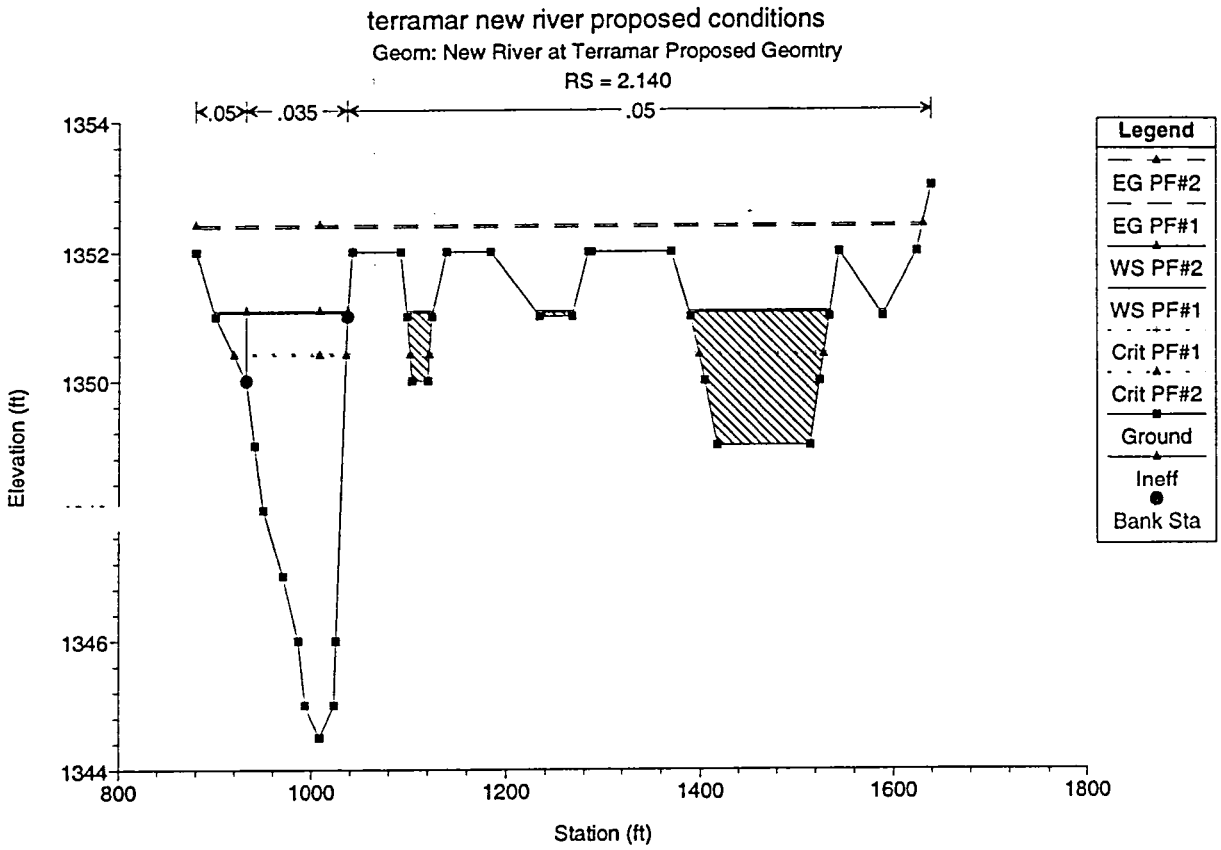
Reach	River Sta	E.G. Elev (ft)	W.S. Elev (ft)	Vel Head (ft)	Frctn Loss (ft)	C & E Loss (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Top Width (ft)
Terramar	2.16	1356.87	1356.40	0.48	3.33	0.03		4200.00		475.46
Terramar	2.16	1356.47	1356.39	0.48	3.29	0.03		4200.00		280.72
Terramar	2.150	1353.51	1352.70	0.81	1.08	0.05		4200.00		576.14
Terramar	2.150	1353.54	1352.75	0.79	1.07	0.05		4200.00		137.10
Terramar	2.140	1352.37	1351.06	1.32	1.42	0.06	29.93	4170.07	0.00	352.85
Terramar	2.140	1352.41	1351.08	1.33	1.46	0.05		4200.00		104.50
Terramar	2.135	1350.90	1349.77	1.12	0.37	0.03		4172.75	27.25	192.60
Terramar	2.135	1350.91	1349.74	1.17	0.39	0.03		4200.00		141.94
Terramar	2.130	1350.50	1349.47	1.03	0.68	0.05	3.83	4196.17		405.35
Terramar	2.130	1350.49	1349.43	1.06	0.66	0.04		4200.00		141.10
Terramar	2.125	1349.77	1348.25	1.53	1.07	0.11		4200.00		146.53
Terramar	2.125	1349.79	1348.36	1.43	1.11	0.06		4200.00		127.43
Terramar	2.120	1348.59	1347.43	1.16	0.28	0.19	64.78	4135.22		208.91
Terramar	2.120	1348.63	1347.38	1.25	0.30	0.21		4200.00		130.50
Terramar	2.118	1348.13	1347.58	0.54	0.28	0.03	22.18	4177.82		160.75
Terramar	2.118	1348.11	1347.56	0.56	0.29	0.03		4200.00		156.67
Terramar	2.116	1347.82	1347.02	0.80	0.78	0.04		4200.00		179.00
Terramar	2.116	1347.79	1346.97	0.82	0.72	0.03		4200.00		157.95
Terramar	2.113	1347.00	1345.78	1.22	1.42	0.07		4200.00		168.01
Terramar	2.113	1347.04	1345.97	1.07	0.83	0.12		4200.00		168.33
Terramar	2.1125	1345.51	1344.52	0.98	1.38	0.02	327.41	3872.59		194.72
Terramar	2.1125	1346.09	1345.42	0.67	0.95	0.10		4200.00		181.85
Terramar	2.112	1344.10	1342.90	1.20	0.37	0.25	292.81	3351.44	555.75	218.36
Terramar	2.112	1345.03	1343.33	1.71	0.34	0.40		4200.00		116.00
Terramar	2.111	1343.13	1342.77	0.36	1.08	0.04	11.63	4188.37		341.61
Terramar	2.111	1343.12	1342.75	0.37	1.07	0.04		4200.00		330.06
Terramar	2.110	1342.01	1341.25	0.76	0.63	0.16	0.31	4199.63	0.06	331.21
Terramar	2.110	1342.01	1341.29	0.73	0.63	0.15		4200.00		327.50
Terramar	2.109	1341.22	1341.00	0.21	1.87	0.01	12.43	4160.77	26.79	352.31
Terramar	2.109	1341.23	1341.02	0.22	1.89	0.01		4200.00		333.00
Terramar	2.108	1339.33	1339.01	0.32	0.31	0.01	0.09	4199.91		399.01
Terramar	2.108	1339.33	1339.02	0.32	0.31	0.01		4200.00		292.00
Terramar	2.107	1339.01	1338.71	0.30	1.12	0.01		4199.54	0.46	416.14
Terramar	2.107	1339.01	1338.72	0.30	1.12	0.01		4200.00		249.00
Terramar	2.106	1337.88	1337.44	0.44				4200.00		331.32
Terramar	2.106	1337.88	1337.44	0.44				4200.00		331.32

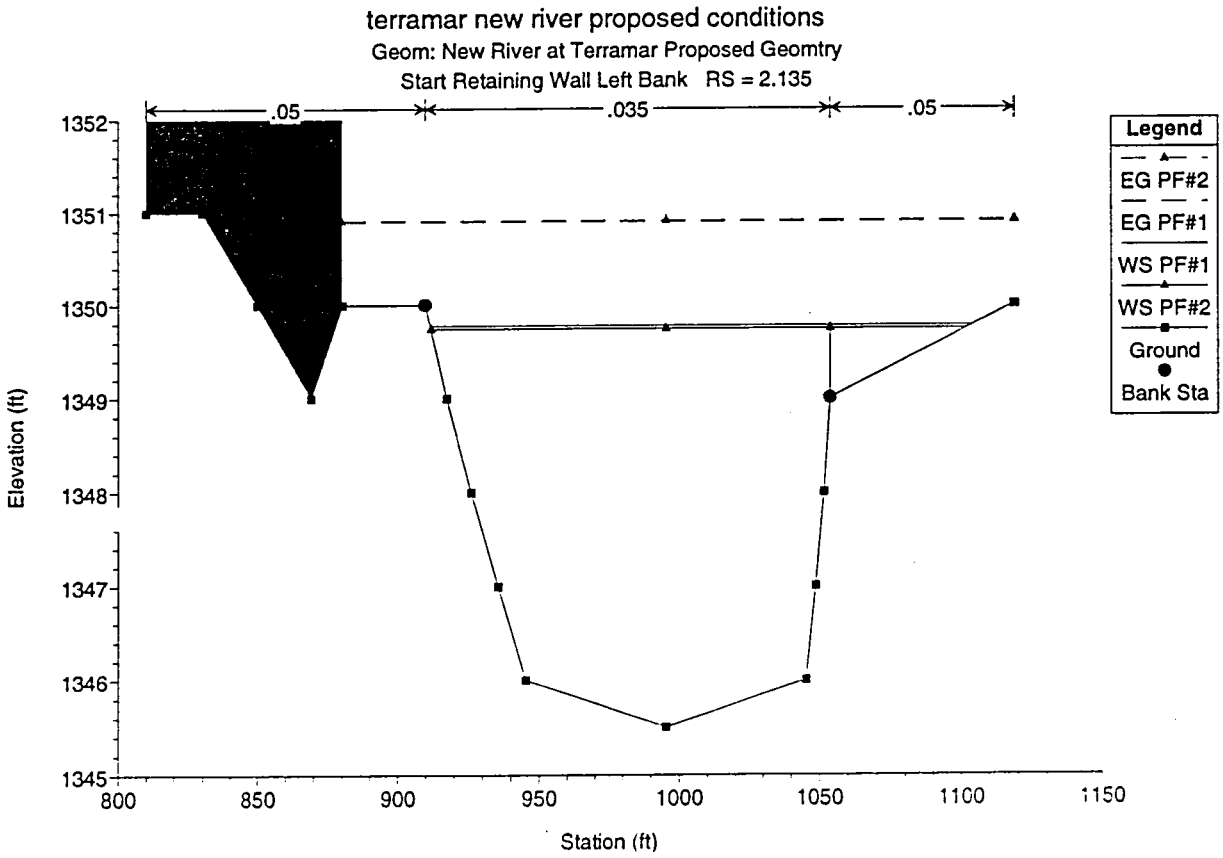
HEC-RAS Plan: Plan 01 River: New River Reach: Terramar

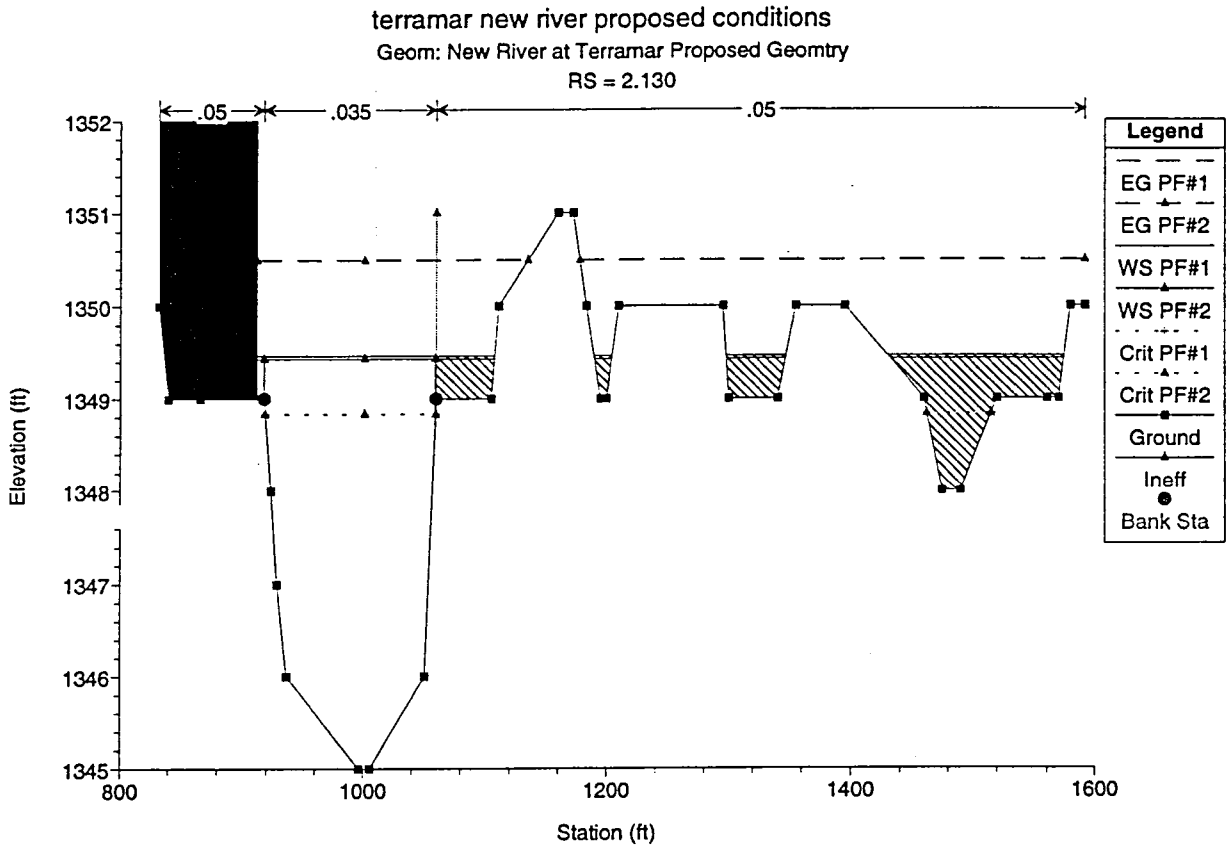
Reach	River Sta	Prof Delta WS	Top Wdth Act	K Perc L	Enc Sta L	Dist Center L	Center Station	Dist Center R	Enc Sta R	K Perc R	Encr WD
		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Terramar	2.16		280.78				1061.50				
Terramar	2.16	-0.01	280.72		913.00	148.50	1061.50	148.50	1210.00		297.00
Terramar	2.150		137.01				1029.70				
Terramar	2.150	0.05	137.10		960.90	68.80	1029.70	68.80	1098.50		137.60
Terramar	2.140		138.87				984.95				
Terramar	2.140	0.03	104.50	0.76	932.70	52.25	984.95	52.25	1037.20	0.00	104.50
Terramar	2.135		192.60				981.85				
Terramar	2.135	-0.03	141.94		909.90	71.95	981.85	71.95	1053.80	0.59	143.90
Terramar	2.130		147.90				988.90				
Terramar	2.130	-0.04	141.10	0.08	917.90	71.00	988.90	70.10	1059.00		141.10
Terramar	2.125		121.98				988.50				
Terramar	2.125	0.11	122.43		923.00	65.50	988.50	65.50	1054.00		131.00
Terramar	2.120		135.50				995.25				
Terramar	2.120	-0.05	130.50	1.54	930.00	65.25	995.25	65.25	1060.50		130.50
Terramar	2.118		160.75				1024.00				
Terramar	2.118	-0.03	156.67	0.53	945.00	79.00	1024.00	79.00	1103.00		158.00
Terramar	2.116		158.00				1030.00				
Terramar	2.116	-0.05	157.95		950.00	80.00	1030.00	80.00	1110.00		160.00
Terramar	2.113		168.01				1035.00				
Terramar	2.113	0.20	168.33		950.00	85.00	1035.00	85.00	1120.00		170.00
Terramar	2.1125		194.72				1048.10				
Terramar	2.1125	0.90	181.85	6.92	954.10	94.00	1048.10	94.00	1142.10		188.00
Terramar	2.112		218.36				959.00				
Terramar	2.112	0.42	116.00	7.66	901.00	58.00	959.00	58.00	1017.00	14.60	116.00
Terramar	2.111		341.61				1033.50				
Terramar	2.111	-0.01	330.06	0.27	866.00	167.50	1033.50	167.50	1201.00		335.00
Terramar	2.110		331.21				1005.75				
Terramar	2.110	0.04	327.50	0.01	842.00	163.75	1005.75	163.75	1169.50	0.00	327.50
Terramar	2.109		352.31				953.50				
Terramar	2.109	0.02	333.00	0.27	787.00	166.50	953.50	166.50	1120.00	0.64	333.00
Terramar	2.108		399.01				987.00				
Terramar	2.108	0.00	292.00	0.00	841.00	146.00	987.00	146.00	1133.00	0.00	292.00
Terramar	2.107		251.14				1009.50				
Terramar	2.107	0.00	249.00		885.00	124.50	1009.50	124.50	1134.00	0.01	249.00
Terramar	2.106		331.32				881.50				
Terramar	2.106	0.00	331.32		710.00	171.50	881.50	171.50	1053.00		343.00

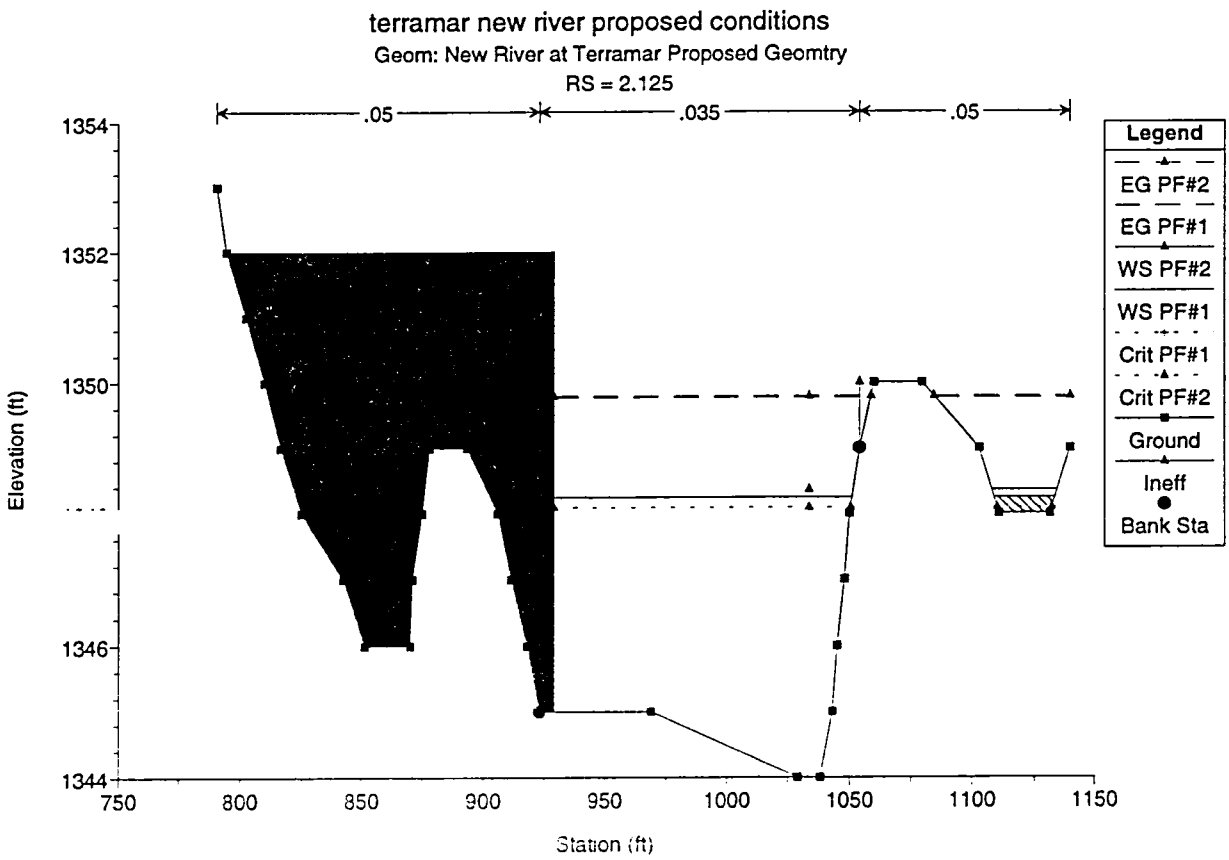

terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
Upstream Cross Section (15.966 of FIS) RS = 2.16
.035
.05
Elevation (ft)
Station (ft)
Legend
EG PF#1
EG PF#2
WS PF#1
WS PF#2
Crit PF#1
Crit PF#2
Ground
Ineff
Bank Sta

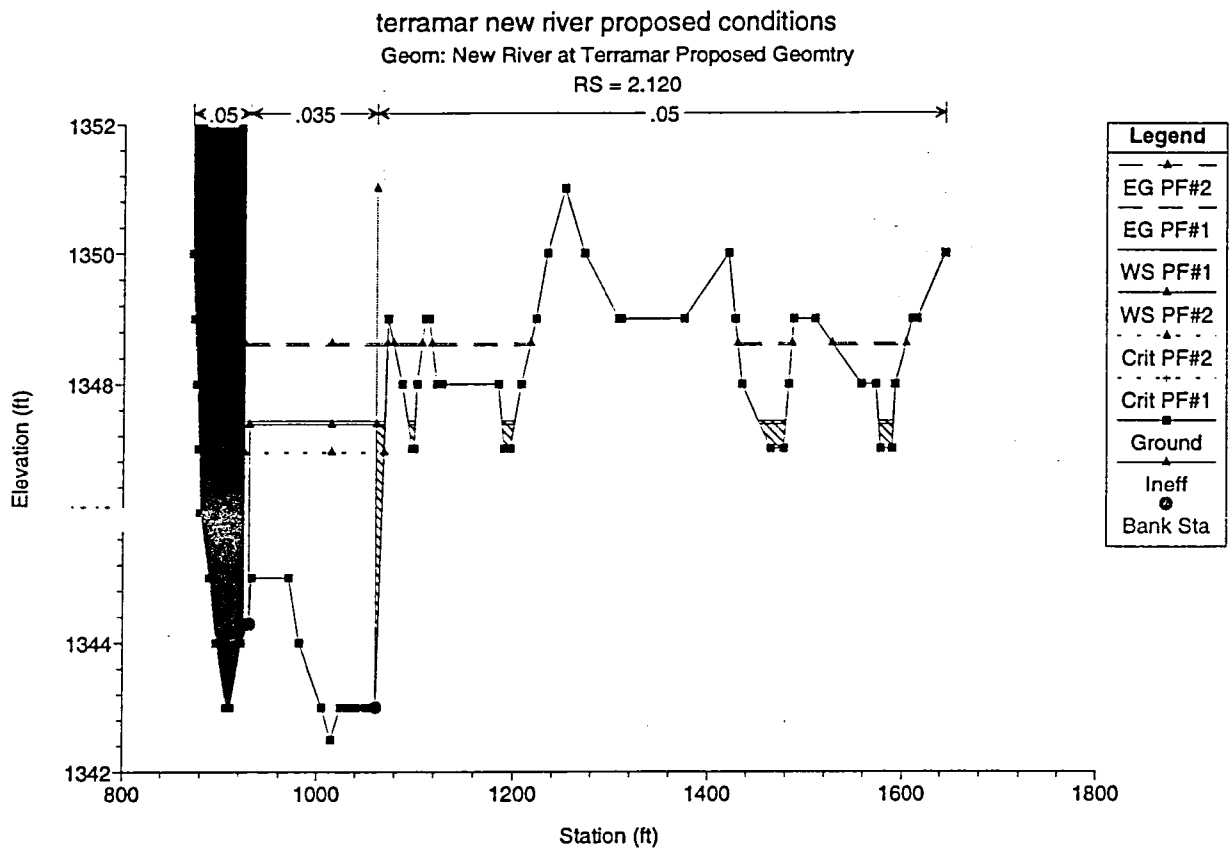

terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
RS = 2.150
.035
.05
Elevation (ft)
Station (ft)
Legend
EG PF#2
EG PF#1
WS PF#2
WS PF#1
Crit PF#1
Crit PF#2
Ground
Ineff
Bank Sta

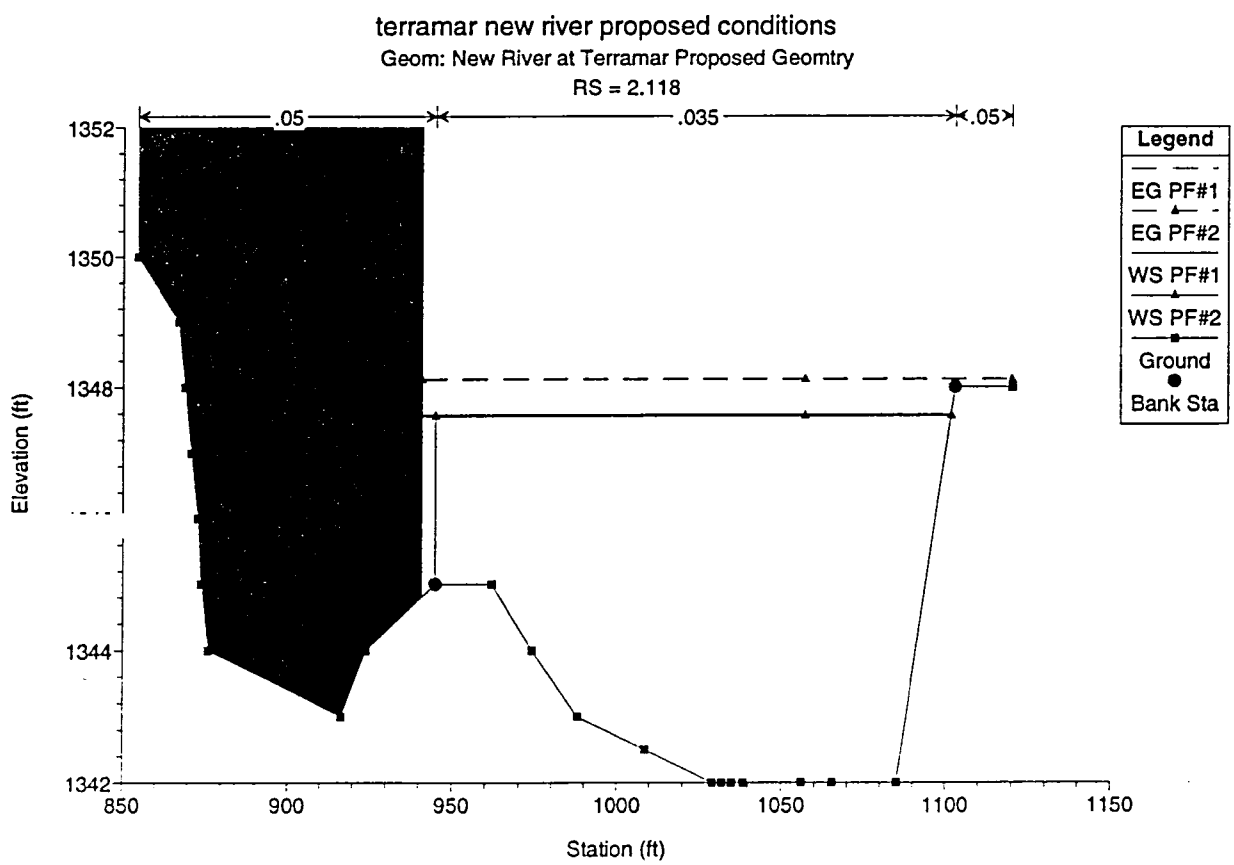

terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
RS = 2.140
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
EG PF#2
EG PF#1
WS PF#2
WS PF#1
Crit PF#1
Crit PF#2
Ground
Ineff
Bank Sta

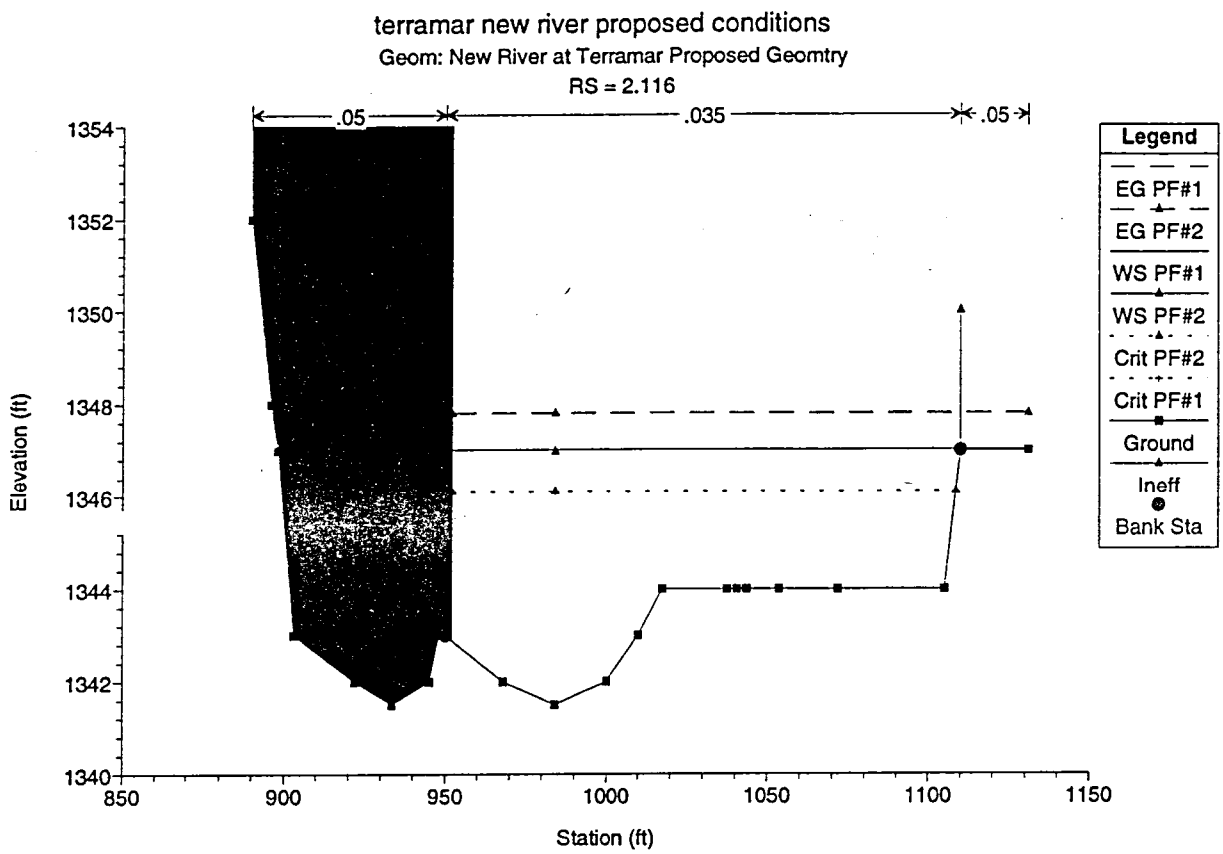

terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
Start Retaining Wall Left Bank RS = 2.135
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
EG PF#2
EG PF#1
WS PF#1
WS PF#2
Ground
Bank Sta

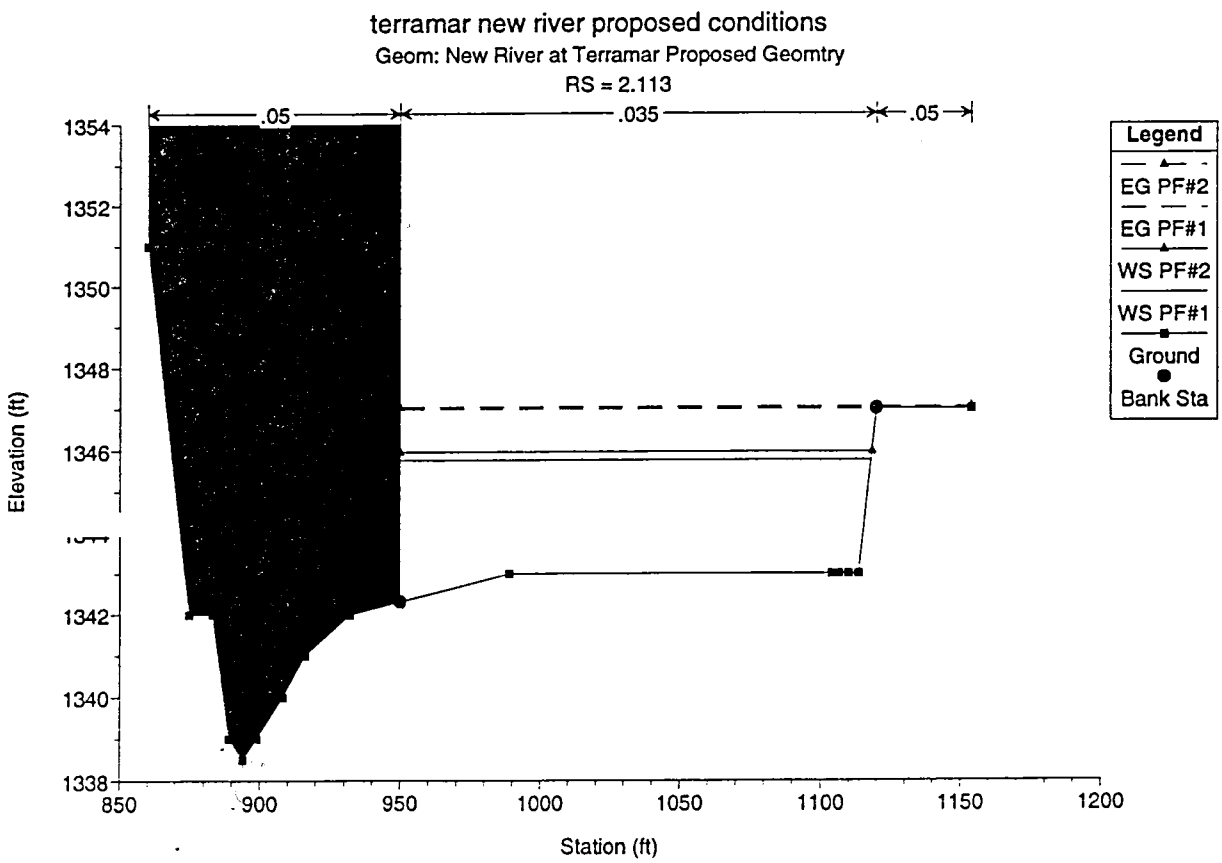

terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
RS = 2.130
.05
.035
.05
Legend
EG PF#1
EG PF#2
WS PF#1
WS PF#2
Crit PF#1
Crit PF#2
Ground
Ineff
Bank Sta
Elevation (ft)
1352
1351
1350
1349
1348
1347
1346
1345
800
1000
1200
1400
1600
Station (ft)

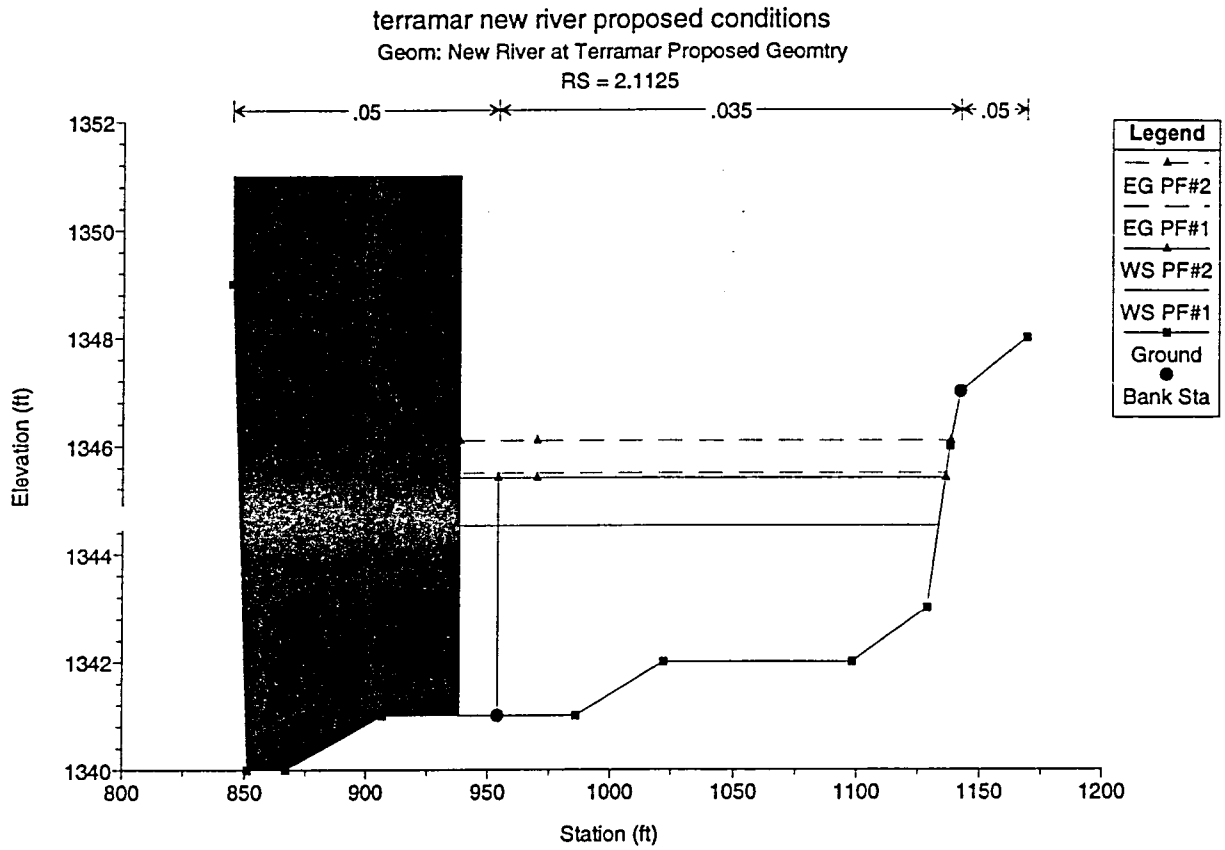

terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
RS = 2.125
.05
.035
.05
Legend
EG PF#2
EG PF#1
WS PF#2
WS PF#1
Crit PF#1
Crit PF#2
Ground
Ineff
Bank Sta
Elevation (ft)
1354
1352
1350
1346
1344
750
800
850
900
950
1000
1050
1100
1150
Station (ft)

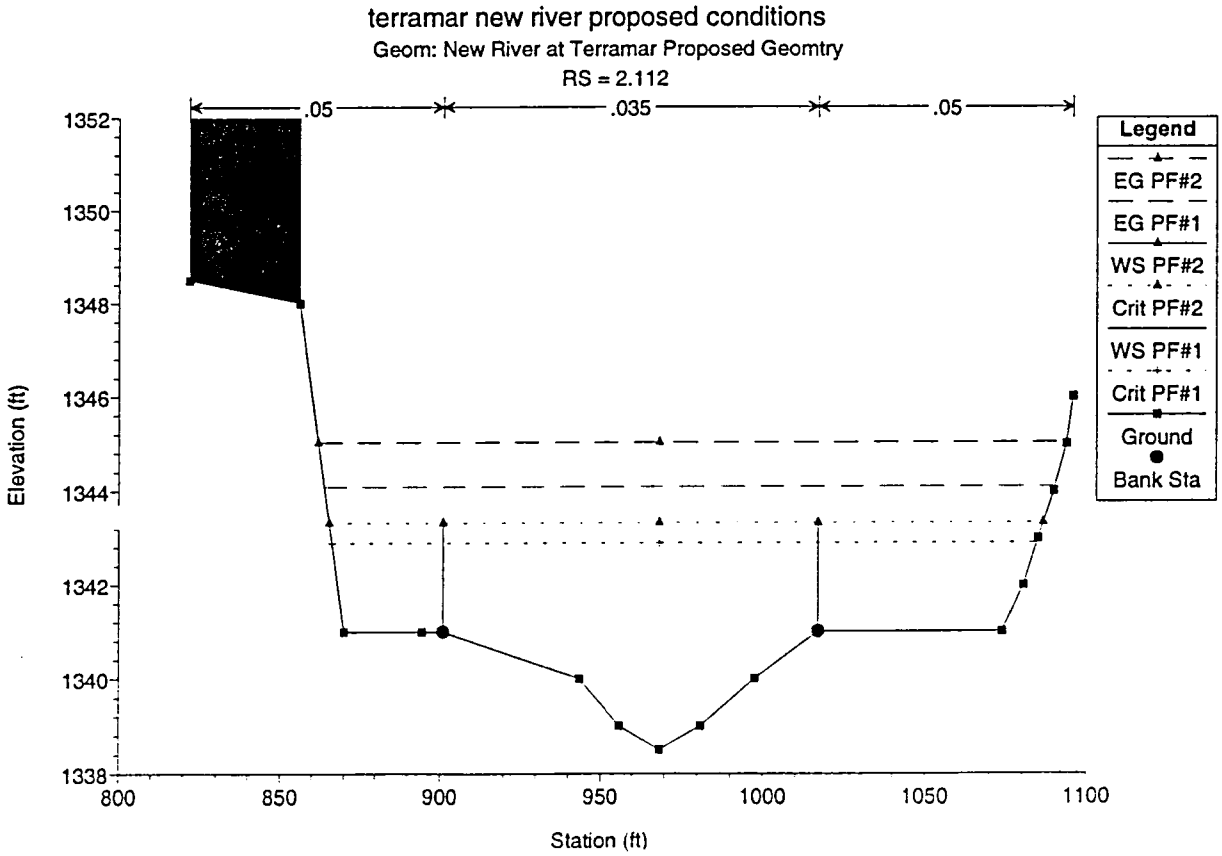

terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
RS = 2.120
.05
.035
.05
Elevation (ft)
1352
1350
1348
1344
1342
800
1000
1200
1400
1600
1800
Station (ft)
Legend
EG PF#2
EG PF#1
WS PF#1
WS PF#2
Crit PF#2
Crit PF#1
Ground
Ineff
Bank Sta

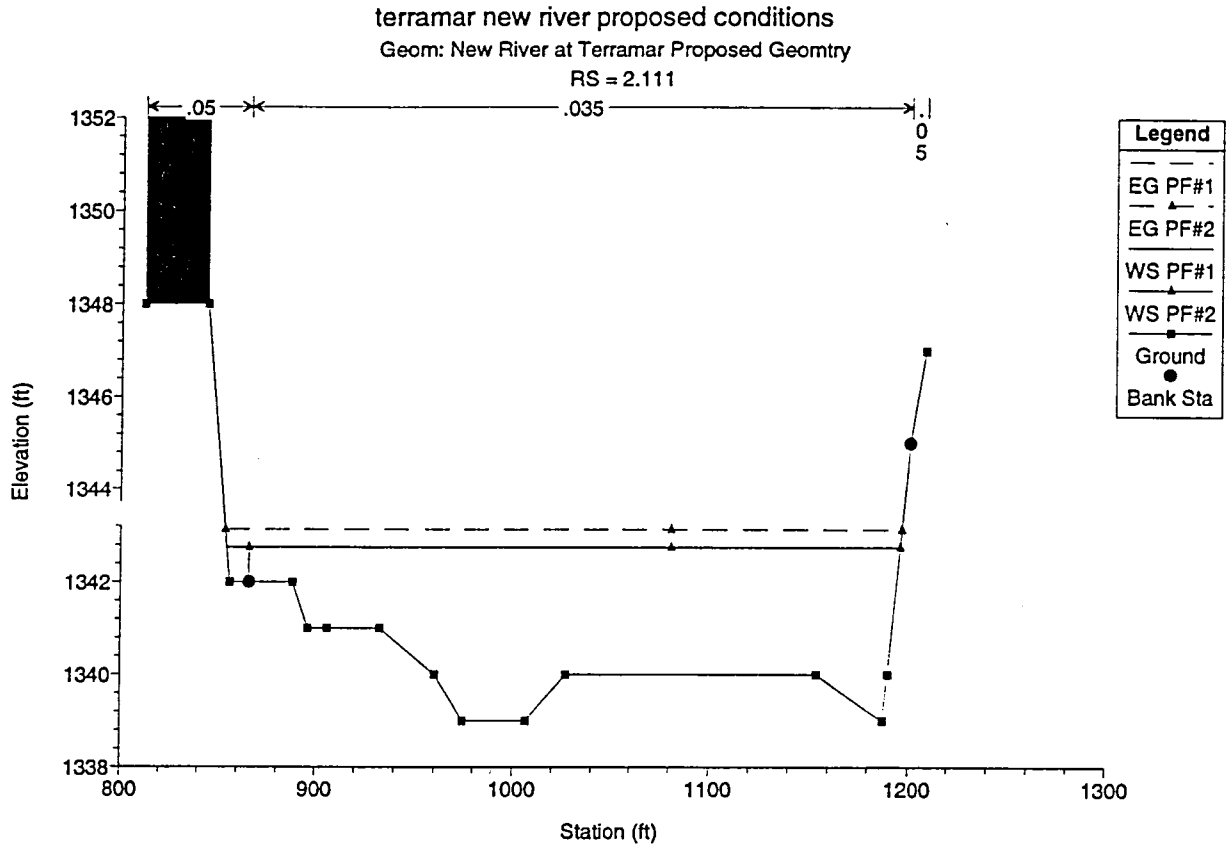

terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
RS = 2.118
.05
.035
.05
Elevation (ft)
1352
1350
1348
1344
1342
850
900
950
1000
1050
1100
1150
Station (ft)
Legend
EG PF#1
EG PF#2
WS PF#1
WS PF#2
Ground
Bank Sta

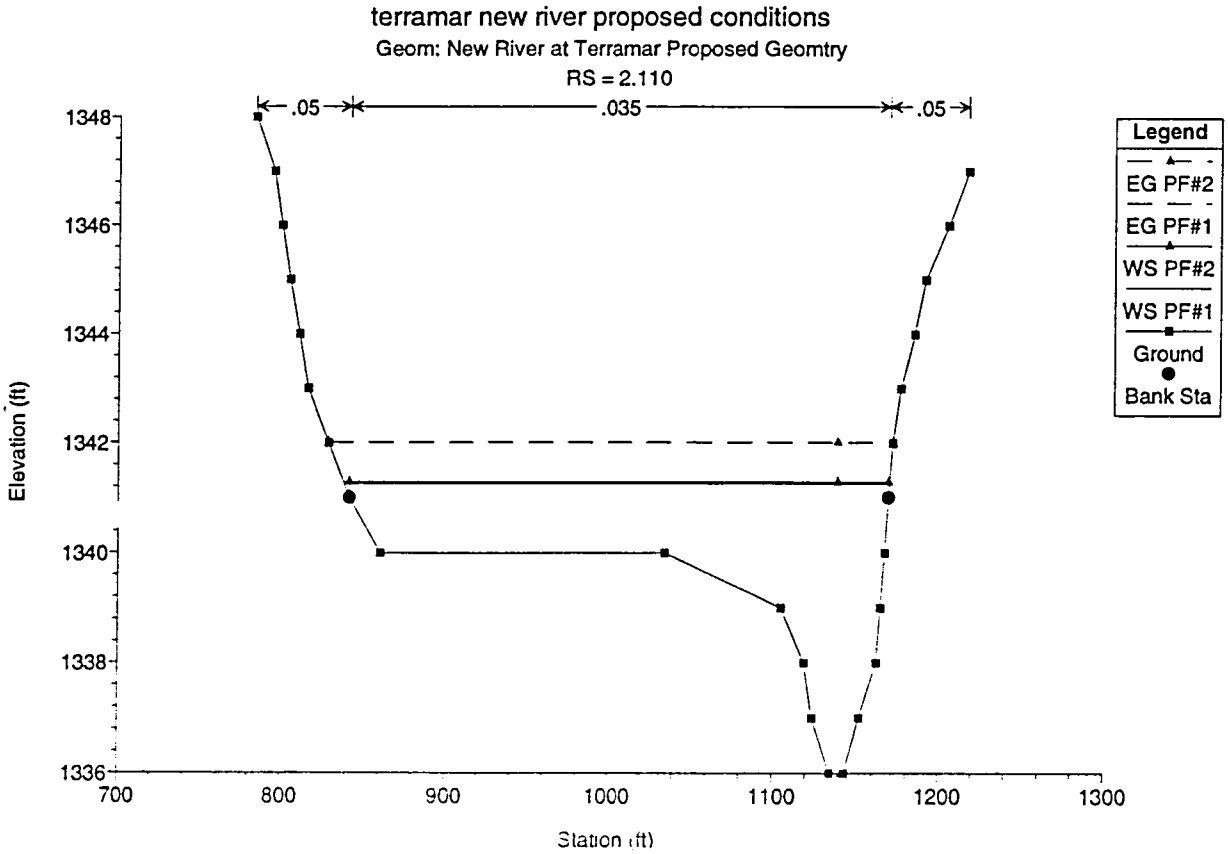

terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
RS = 2.116
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
EG PF#1
EG PF#2
WS PF#1
WS PF#2
Crit PF#2
Crit PF#1
Ground
Ineff
Bank Sta

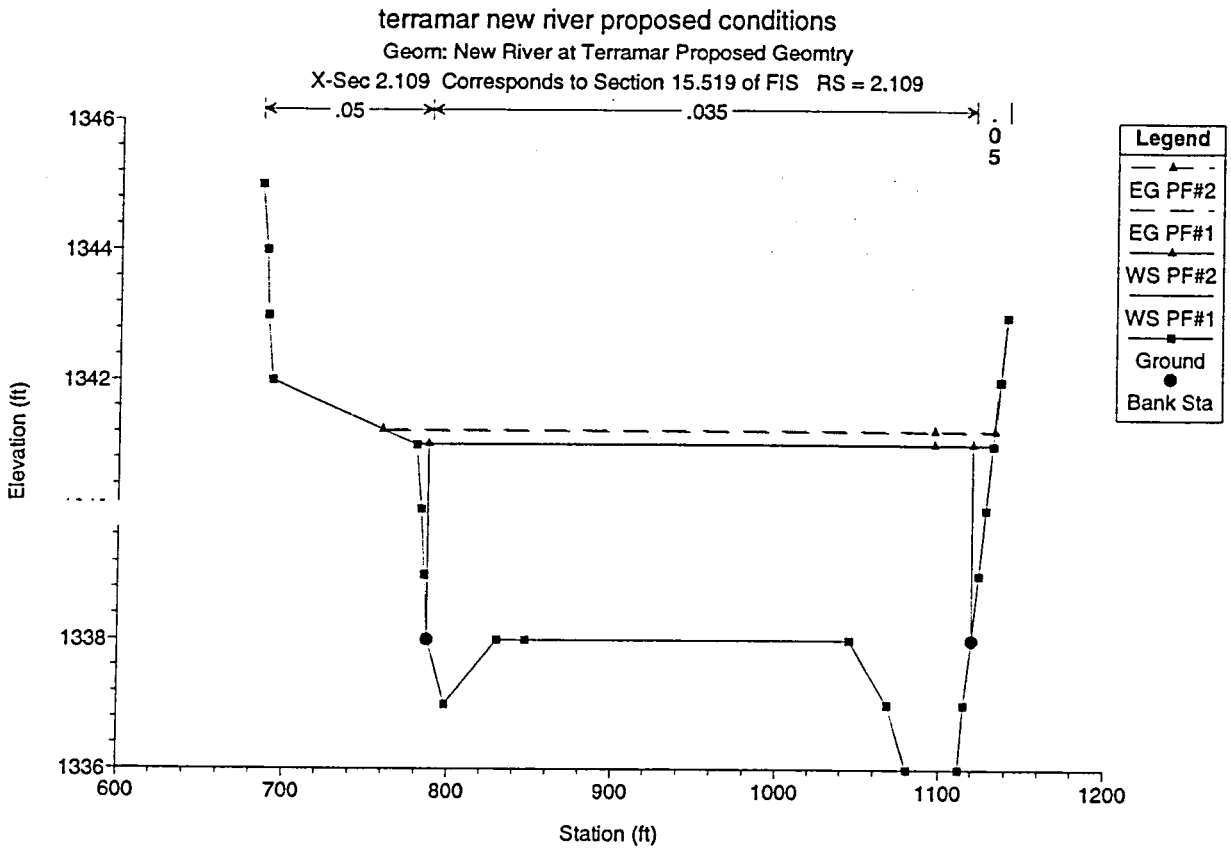

terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
RS = 2.113
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
EG PF#2
EG PF#1
WS PF#2
WS PF#1
Ground
Bank Sta

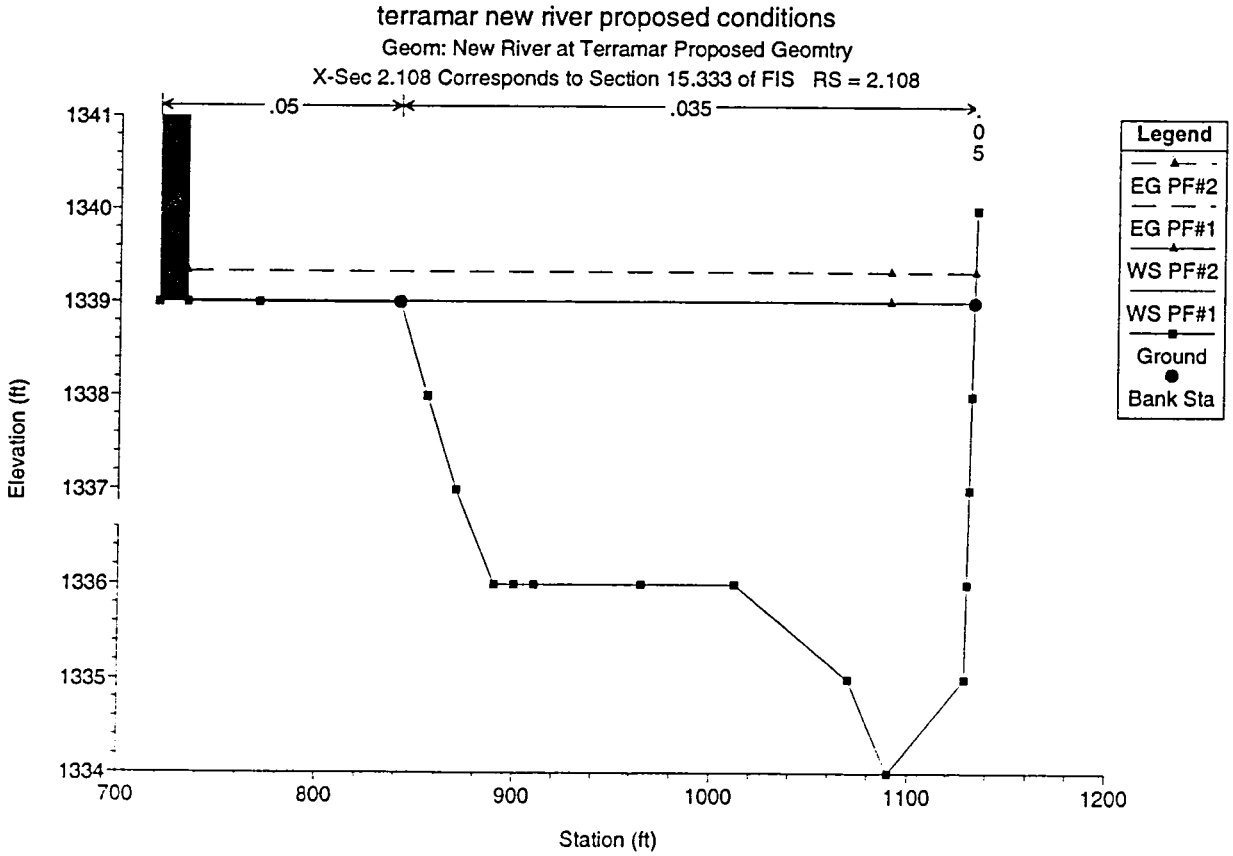

terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
RS = 2.1125
.05
.035
.05
Legend
EG PF#2
EG PF#1
WS PF#2
WS PF#1
Ground
Bank Sta
Elevation (ft)
1352
1350
1348
1346
1344
1342
1340
800
850
900
950
1000
1050
1100
1150
1200
Station (ft)

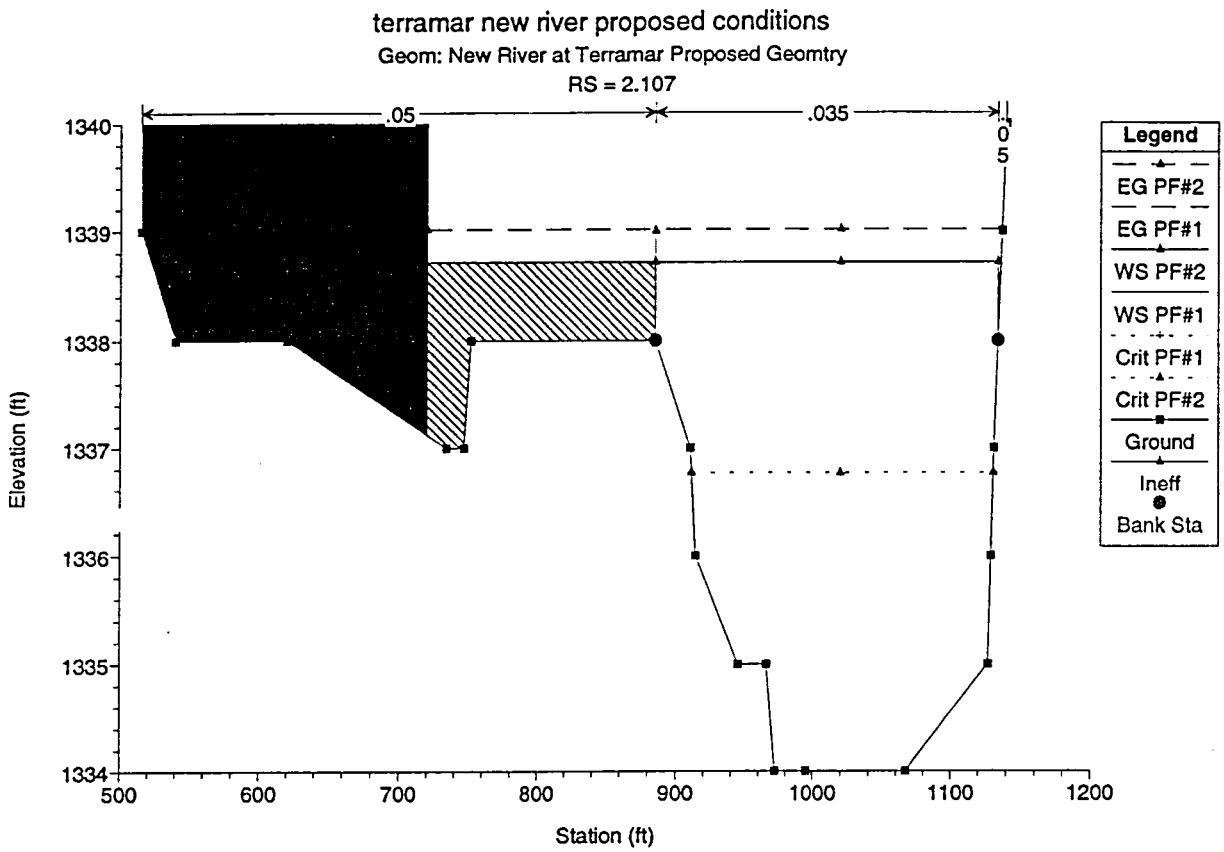

terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
RS = 2.112
.05
.035
.05
Legend
EG PF#2
EG PF#1
WS PF#2
Crit PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta
Elevation (ft)
1352
1350
1348
1346
1344
1342
1340
1338
800
850
900
950
1000
1050
1100
Station (ft)

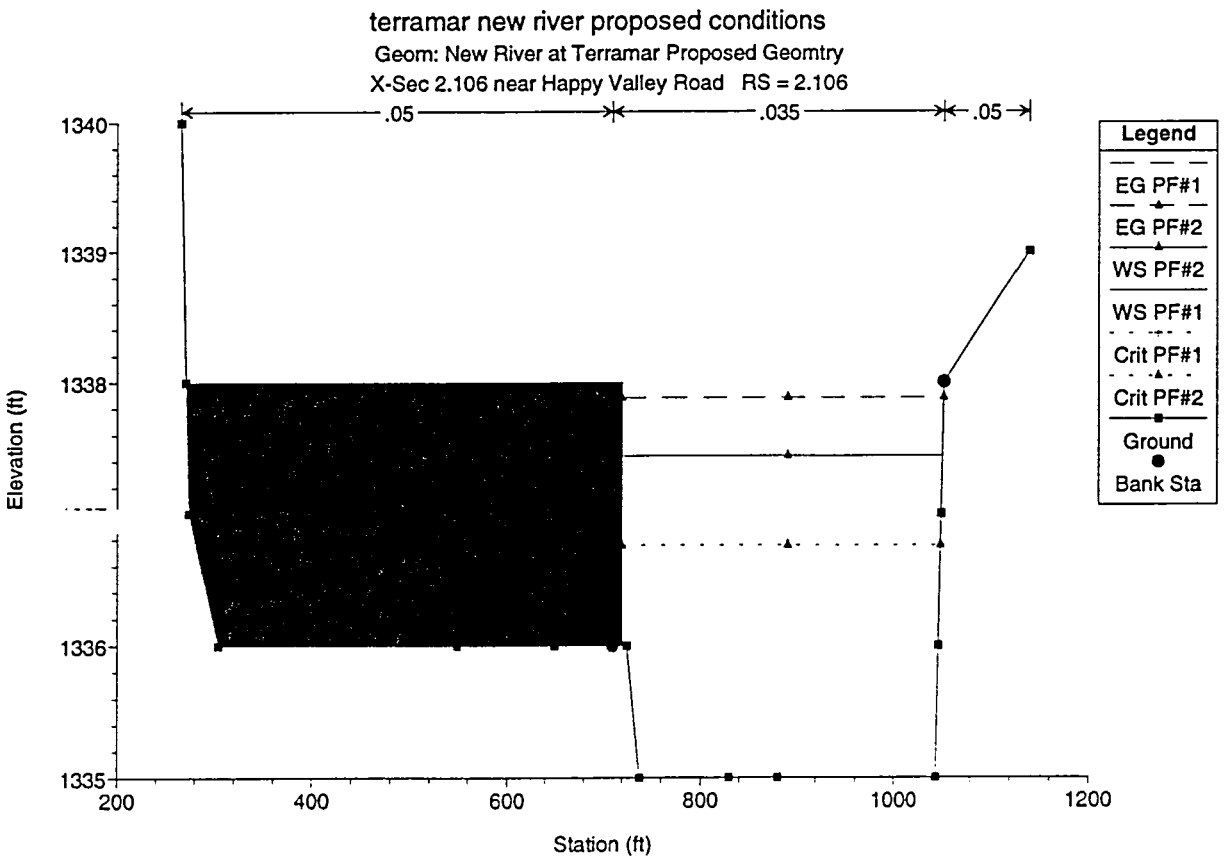

terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
RS = 2.111
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
EG PF#1
EG PF#2
WS PF#1
WS PF#2
Ground
Bank Sta

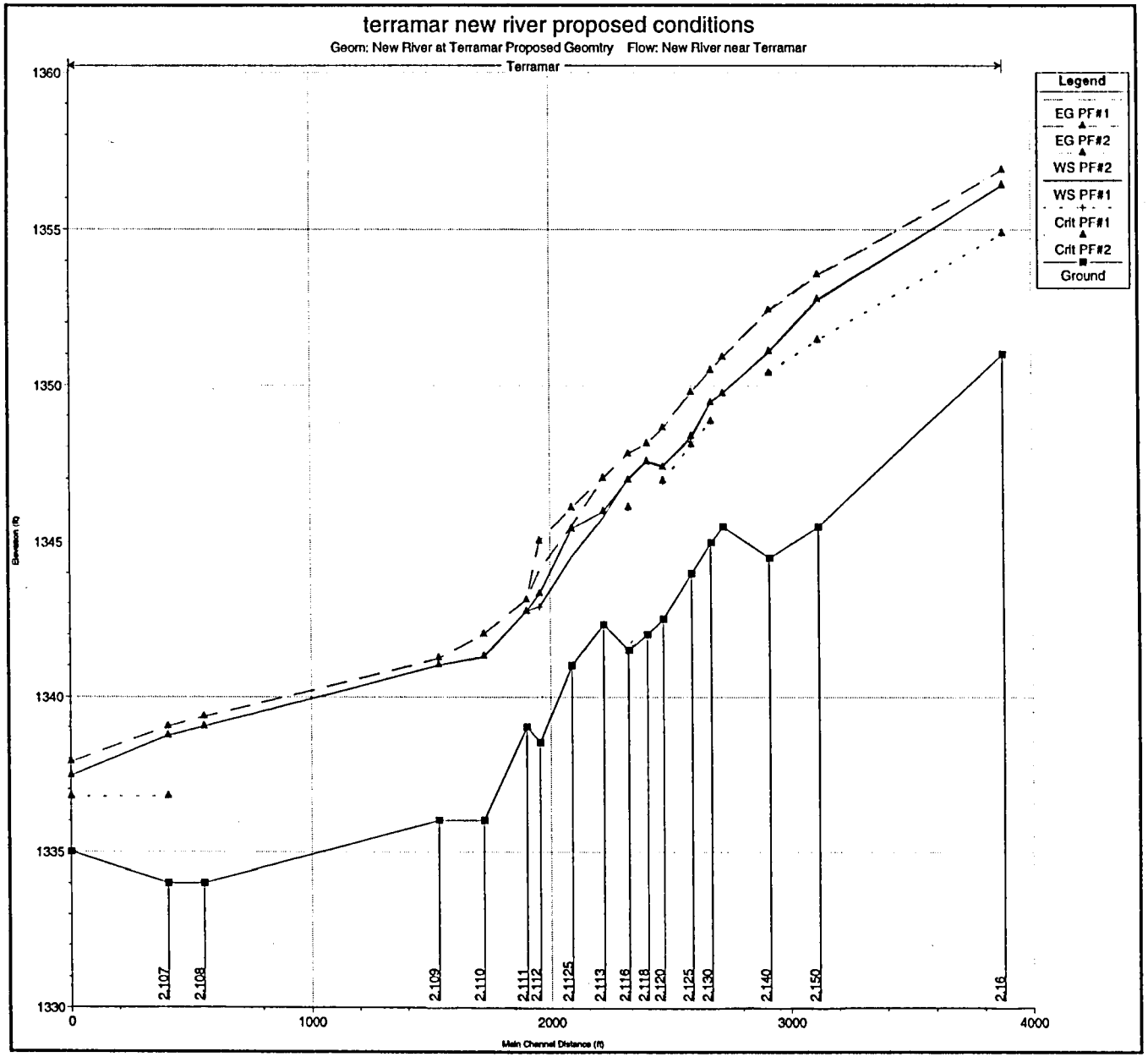

terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
RS = 2.110
.05
.035
.05
Elevation (ft)
Station (ft)
Legend
EG PF#2
EG PF#1
WS PF#2
WS PF#1
Ground
Bank Sta


terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
X-Sec 2.109 Corresponds to Section 15.519 of FIS RS = 2.109
.05
.035
.05
Elevation (ft)
1346
1344
1342
1338
1336
600
700
800
900
1000
1100
1200
Station (ft)
Legend
EG PF#2
EG PF#1
WS PF#2
WS PF#1
Ground
Bank Sta


terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
X-Sec 2.108 Corresponds to Section 15.333 of FIS RS = 2.108
.05
.035
.05
Elevation (ft)
1341
1340
1339
1338
1337
1336
1335
1334
700
800
900
1000
1100
1200
Station (ft)
Legend
EG PF#2
EG PF#1
WS PF#2
WS PF#1
Ground
Bank Sta


terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
RS = 2.107
.05
.035
0
5
Legend
EG PF#2
EG PF#1
WS PF#2
WS PF#1
Crit PF#1
Crit PF#2
Ground
Ineff
Bank Sta
Elevation (ft)
1340
1339
1338
1337
1336
1335
1334
500
600
700
800
900
1000
1100
1200
Station (ft)


terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry
X-Sec 2.106 near Happy Valley Road RS = 2.106
.05
.035
.05
Legend
EG PF#1
EG PF#2
WS PF#2
WS PF#1
Crit PF#1
Crit PF#2
Ground
Bank Sta
Elevation (ft)
1340
1339
1338
1336
1335
200
400
600
800
1000
1200
Station (ft)


terramar new river proposed conditions
Geom: New River at Terramar Proposed Geomtry Flow: New River near Terramar
Terramar
Legend
EG PF#1
EG PF#2
WS PF#2
WS PF#1
Crit PF#1
Crit PF#2
Ground
Elevation (ft)
1360
1355
1350
1345
1340
1335
1330
0
1000
2000
3000
4000
Main Channel Distance (ft)
2.107
2.108
2.109
2.110
2.111
2.112
2.1125
2.113
2.116
2.118
2.120
2.125
2.130
2.140
2.150
2.16

APPENDIX C

HEC-2 MODEL FOR WASH 2

```
*********************************************
*  HEC-2 WATER SURFACE PROFILES             *
*                                           *
*  Version   4.6.2;  May 1991               *
*                                           *
*  RUN DATE    14AUG98    TIME    10:54:59  *
*********************************************
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****************************************
*  U.S. ARMY CORPS OF ENGINEERS        *
*  HYDROLOGIC ENGINEERING CENTER       *
*  609 SECOND STREET, SUITE D          *
*  DAVIS, CALIFORNIA 95616-4687        *
*          (916) 756-1104              *
****************************************
```

```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X    X            X    X
X     X  X        X                      X
XXXXXXX  XXXX     X         XXXXX    XXXXX
X     X  X        X                 X
X     X  X        X    X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
```

THIS RUN EXECUTED 14AUG98 10:54:59

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************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.6.2;  May 1991
************************************


T1     TERRAMAR INFRASTRUCTURE - PROJECT NO. 96-0043
T2     WASH 2 - Q100   WASH 2 REALIGNED BEHIND NEW GABION WALL
T3     FILE N:\960043\HYDRO\HEC2\WASH2\NWASH2RV
T3     MODELLED 8/12/98 BY KA
T3      RE-ALIGNMENT FROM CROSS SECTION 99 TO 320

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ

      0        2        0        0       0.5       0       0.5      0       1350      0

J2  NPROF     IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE

      1        0       -1        0        0        0       -1       0        0        15


J3  VARIABLE CODES FOR SUMMARY PRINTOUT

     38       43        1        8        3        2       26       5       39       53
      4       54       37
       CROSS-SECTIONS PRESENTED FROM LOB TO ROB FACING DOWNSTREAM
       CROSS-SECTIONS PRESENTED WITH MOST DOWNSTREAM SECTION (SUBCRITICAL)
       EXPAN. & CONTRACT. COEFFICIENTS FOR ENERGY LOSS @ GRADUAL TRANSITIONS

NC    .040     .040     .035     0.1      0.3
QT      1      540
ET     99      9.1                                                          0      118
X1     99        5       .0     115      0.00     0.00     0.00
CI     40     1345               4        4       30
GR   1355       .0     1347      1     1346       20     1346       25     1345      115

X1    170        7        0     88       75       65       70
X3     10
CI     40     1346               4        4       30
GR   1355        0     1350      1     1349       88     1348       95     1347      160
GR   1346      190     1345    210

QT      1      493
ET    241      9.1                                                          0       41
X1    241        5       .0     135      80       70       75
CI     40   1346.5               4        4       30
GR   1356       .0     1351      1    1351.       35     1351       60     1351      135
```

ET	320	9.1							0	141.3
X1	320	6	.0	75	90	90	90			
CI	40	1347		4	4	30				
GR	1356	.0	1352	1	1352	5	1351.5	30	1352	75
GR	1352	90								
X1	360	10	0	115	50	35	40			
CI	40	1349		4	4	30				
GR	1356	0	1351.5	1	1351	20	1351	25	1350	28
GR	1349	31	1349	38	1350	40	1351	58	1352	115
ET	661	9.1							0	130.5
X1	661	13	.0	130.5	60	70	62			
CI	70	1352.0		4	4	40				
GR	1355.3	.0	1354.0	5.4	1354.0	37.7	1353.7	47.7	1353.0	66.9
GR	1352.0	70.3	1352.0	75.6	1352.5	79.6	1353.0	83.9	1353.0	88.5
GR	1355.0	96.1	1356.0	102.6	1356.0	130.5				
ET	850	9.1							0	132.6
X1	850	12	.0	132.6	188.91	188.91	188.91			
CI						0.01				
GR	1357.0	.0	1357.0	19.3	1356.0	28.3	1354.0	36.2	1354.0	43.9
GR	1355.0	48.7	1355.8	80.9	1356.0	93.1	1356.3	102.4	1357.1	114.4
GR	1357.0	117.9	1357.0	132.6						
QT	1	493								
ET	989	9.1							0	137.1
X1	989	14	.0	137.1	138.43	138.43	138.43			
GR	1359.0	.0	1359.0	35.1	1358.6	43.9	1358.0	57.8	1358.0	62.8
GR	1356.0	69.4	1355.0	73.6	1355.0	78.3	1357.0	85.0	1358.0	90.2
GR	1358.0	94.7	1358.8	112.7	1358.7	116.5	1358.6	137.1		
ET	1163	9.1							0	138.6
X1	1163	14	.0	138.6	174.55	174.55	174.55			
GR	1360.2	.0	1360.4	11.2	1361.0	15.8	1360.0	39.4	1359.7	44.6
GR	1359.0	51.3	1358.0	57.6	1358.0	83.2	1356.9	88.2	1356.0	90.8
GR	1356.0	96.9	1359.1	104.8	1360.0	107.8	1360.0	138.6		
QT	1	435								
ET	1559	9.1							0	174.8
X1	1559	11	.0	174.8	396.05	396.05	396.05			
GR	1363.0	.0	1363.0	63.8	1360.0	68.7	1360.0	77.9	1361.0	80.6
GR	1361.0	82.7	1361.7	97.4	1362.3	118.6	1362.8	138.8	1362.7	152.7
GR	1362.9	174.8								
ET	1879	9.1							0	132.5
X1	1879	11	.0	132.5	319.81	319.81	319.81			
GR	1366.0	.0	1366.0	9.7	1365.6	20.6	1365.0	27.7	1363.8	38.5
GR	1363.0	44.5	1363.0	49.8	1365.0	53.4	1366.0	66.5	1366.2	75.0
GR	1366.9	132.5								

QT	1	261								
ET	2095	9.1							0	116.3
X1	2095	8	.0	116.3	216.05	216.05	216.05			
GR	1367.0	.0	1367.0	56.1	1365.9	61.1	1365.0	74.6	1366.0	75.1
GR	1367.0	79.1	1368.0	87.2	1368.0	116.3				
QT	1	268								
ET	2238	9.1							0	120.8
X1	2238	9	.0	120.8	143.34	143.34	143.34			
GR	1369.5	.0	1369.4	8.1	1369.0	33.1	1369.0	61.2	1368.0	81.4
GR	1366.0	84.8	1366.0	95.6	1369.0	106.8	1369.0	120.8		
QT	1	275								
ET	2337	9.1							0	102.5
X1	2337	8	.0	102.5	99.02	99.02	99.02			
GR	1370.9	.0	1370.0	42.0	1369.0	56.4	1367.0	57.9	1367.0	68.8
GR	1369.0	79.0	1369.5	93.2	1370.0	102.5				
QT	1	283								
ET	2461	9.1							0	108.8
X1	2461	12	.0	108.8	123.99	123.99	123.99			
GR	1372.0	.0	1372.0	16.3	1371.5	39.3	1371.4	45.6	1371.7	61.7
GR	1371.7	71.2	1371.6	75.6	1371.0	85.1	1368.0	94.2	1368.0	96.3
GR	1369.6	102.5	1370.9	108.8						
QT	1	290								
ET	2570	9.1							0	113.7
X1	2570	9	.0	113.7	108.64	108.64	108.64			
GR	1372.0	.0	1372.0	50.4	1371.0	59.8	1370.0	63.3	1369.6	69.7
GR	1372.0	80.8	1372.0	97.3	1372.2	111.7	1372.1	113.7		
QT	1	297								
ET	2809	9.1							0	100.4
X1	2809	10	.0	100.4	238.62	238.62	238.62			
GR	1375.0	.0	1375.0	34.0	1374.0	43.5	1371.8	45.8	1371.0	47.3
GR	1371.2	51.8	1372.0	56.5	1374.0	65.3	1375.0	68.8	1375.0	100.4
QT	1	259								
ET	2977	9.1							0	105.2
X1	2977	10	.0	105.2	168.35	168.35	168.35			
GR	1376.2	.0	1376.5	9.9	1376.6	35.4	1376.5	43.2	1376.0	56.8
GR	1376.0	67.3	1373.0	73.3	1373.0	78.4	1376.0	88.5	1376.4	105.2
QT	1	213								
ET	3181	9.1							0	99.8
X1	3181	8	.0	99.8	203.6	203.6	203.60			
GR	1378.0	.0	1378.0	52.5	1375.0	55.1	1375.1	60.7	1377.1	67.7
GR	1378.0	70.2	1378.8	88.9	1378.8	99.8				

ET	3414	9.1							0	100
X1	3414	10	.0	100	233.47	233.47	233.47			
GR	1381.1	.0	1381.0	26.9	1380.3	42.2	1380.0	46.8	1378.0	51.4
GR	1378.0	57.0	1380.0	63.9	1380.5	81.4	1381.0	95.2	1381.0	100.0
ET	3590	9.1							0	129.6
X1	3590	10	.0	129.6	176.18	176.18	176.18			
GR	1382.3	.0	1382.0	20.9	1380.0	29.4	1380.0	35.9	1382.0	44.6
GR	1382.0	75.0	1381.4	78.2	1382.0	82.7	1382.0	94.7	1382.5	129.6
ET	3749	9.1							0	101.4
X1	3749	7	.0	101.4	158.66	158.66	158.66			
GR	1383.0	.0	1383.0	50.1	1381.0	55.8	1381.0	57.6	1383.0	65.8
GR	1384.0	92.0	1384.0	101.4						
ET	3820	9.1							0	99.9
X1	3820	11	.0	99.9	70.68	70.68	70.68			
GR	1383.9	.0	1384.0	10.4	1384.0	28.9	1383.6	43.0	1383.0	66.2
GR	1383.0	68.2	1382.0	71.9	1382.0	76.7	1383.0	79.1	1384.0	91.7
GR	1384.1	99.9								

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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

*PROF 1

CRITICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

CCHV=     .100 CEHV=     .300
*SECNO 99.000
CHIMP CLSTA=      40.00 CELCH=    1345.00 BW=      30.00 STCHL=        .00 STCHR=     115.00
EXCAVATION DATA
AEX=      28.8SQ-FT     VEXR=        .0K*CU-YD     VEXT=        .0K*CU-YD

3280 CROSS SECTION     99.00 EXTENDED      1.24 FEET

3720 CRITICAL DEPTH ASSUMED
    99.000      1.24   1346.24   1346.24       .00   1346.73       .49       .00       .00   1351.25
     540.0        .0     540.0        .0        .0      95.9        .0        .0        .0   1345.00
       .00       .00      5.63       .00      .000      .035      .000      .000   1345.00     15.50
   .018839        0.        0.        0.         0        11         8       .00     99.50    115.00


FLOW DISTRIBUTION FOR SECNO=     99.00          CWSEL=   1346.24

STA=      15.     115.
  PER Q=    100.0
   AREA=     95.9
    VEL=      5.6
  DEPTH=      1.0

*SECNO 170.000
CHIMP CLSTA=      40.00 CELCH=    1346.00 BW=      30.00 STCHL=        .00 STCHR=      88.00
EXCAVATION DATA
AEX=     158.3SQ-FT     VEXR=        .2K*CU-YD     VEXT=        .2K*CU-YD

3280 CROSS SECTION    170.00 EXTENDED      2.96 FEET

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=      1352.25 ELREA=      1349.00

   170.000      1.96   1347.96   1347.96       .00   1348.78       .82      1.20       .10   1352.25
     540.0        .0     540.0        .0        .0      74.2        .0        .1        .1   1349.00
       .00       .00      7.28       .00      .000      .035      .000      .000   1346.00     17.16
   .015601       75.       70.       65.         0        14         0       .00     45.69     62.84
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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

FLOW DISTRIBUTION FOR SECNO=    170.00          CWSEL=   1347.96

STA=      17.      88.
  PER Q=    100.0
   AREA=     74.2
    VEL=      7.3
  DEPTH=      1.6

*SECNO 241.000
CHIMP CLSTA=      40.00 CELCH=    1346.50 BW=      30.00 STCHL=        .00 STCHR=     135.00
EXCAVATION DATA
AEX=     217.1SQ-FT     VEXR=        .5K*CU-YD     VEXT=         .8K*CU-YD

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   241.000      3.35   1349.85   1349.85       .00   1351.06      1.21      1.20       .12   1352.75
     493.0        .0     493.0       .0        .0      55.8        .0        .2        .2 100000.00
       .01       .00      8.83       .00      .000      .035      .000      .000   1346.50     11.62
   .016527       80.       75.       70.         0        14         0       .00     23.38     35.00


FLOW DISTRIBUTION FOR SECNO=    241.00          CWSEL=   1349.85

STA=      12.     135.
  PER Q=    100.0
   AREA=     55.8
    VEL=      8.8
  DEPTH=      2.4

*SECNO 320.000
CHIMP CLSTA=      40.00 CELCH=    1347.00 BW=      30.00 STCHL=        .00 STCHR=      75.00
EXCAVATION DATA
AEX=     233.5SQ-FT     VEXR=        .8K*CU-YD     VEXT=        1.5K*CU-YD


1645 INT SEC ADDED BY RAISING SEC    320.00,   -.333 FT AND MULTIPLYING BY    .590


3301 HV CHANGED MORE THAN HVINS
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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.84

1.010	4.37	1351.03	1349.22	.00	1351.29	.25	.13	.10	1352.92
493.0	.0	493.0	.0	.0	122.2	.0	.3	.2	1351.67
.01	.00	4.04	.00	.000	.035	.000	.000	1346.67	4.45
.002043	30.	30.	30.	3	15	0	.00	38.29	42.74

FLOW DISTRIBUTION FOR SECNO= 1.01 CWSEL= 1351.03

STA= 4. 44.
PER Q= 100.0
AREA= 122.2
VEL= 4.0
DEPTH= 3.2

1645 INT SEC ADDED BY RAISING SEC 1.01, .167 FT AND MULTIPLYING BY 1.348

1.020	4.37	1351.20	1348.97	.00	1351.34	.14	.04	.01	1353.08
493.0	.0	493.0	.0	.0	164.7	.0	.4	.2	1351.83
.01	.00	2.99	.00	.000	.035	.000	.000	1346.83	5.99
.001094	30.	30.	30.	0	11	0	.00	51.61	57.60

FLOW DISTRIBUTION FOR SECNO= 1.02 CWSEL= 1351.20

STA= 6. 60.
PER Q= 100.0
AREA= 164.7
VEL= 3.0
DEPTH= 3.2

1645 INT SEC ADDED BY RAISING SEC 1.02, .167 FT AND MULTIPLYING BY 1.258

320.000	4.28	1351.28	1348.86	.00	1351.37	.09	.03	.00	1353.25
493.0	.0	493.0	.0	.0	201.7	.0	.5	.3	1352.00
.01	.00	2.44	.00	.000	.035	.000	.000	1347.00	7.88
.000737	30.	30.	30.	2	14	0	.00	64.24	72.12

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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

FLOW DISTRIBUTION FOR SECNO=    320.00          CWSEL=   1351.28

STA=       8.      75.
  PER Q=    100.0
   AREA=    201.7
    VEL=      2.4
  DEPTH=      3.1

*SECNO 360.000
CHIMP CLSTA=      40.00 CELCH=    1349.00 BW=      30.00 STCHL=        .00 STCHR=     115.00
EXCAVATION DATA
AEX=      44.4SQ-FT     VEXR=        .2K*CU-YD     VEXT=        1.7K*CU-YD


3301 HV CHANGED MORE THAN HVINS


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .23

   360.000      1.92   1350.92   1350.85       .00   1351.64       .71       .08       .19   1355.25
     493.0        .0     493.0        .0        .0      72.9        .0        .7        .3   1352.00
       .01       .00      6.76       .00      .000      .035      .000      .000   1349.00     17.27
   .013709       50.       40.       35.         4        12         0       .00     45.46     62.73


FLOW DISTRIBUTION FOR SECNO=    360.00          CWSEL=   1350.92

STA=      17.     115.
  PER Q=    100.0
   AREA=     72.9
    VEL=      6.8
  DEPTH=      1.6

*SECNO 661.000
CHIMP CLSTA=      70.00 CELCH=    1352.00 BW=      40.00 STCHL=        .00 STCHR=     130.50
EXCAVATION DATA
AEX=      58.2SQ-FT     VEXR=        .1K*CU-YD     VEXT=        1.8K*CU-YD

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   661.000      1.58   1353.58   1353.58       .00   1354.28       .70       .92       .00   1355.30
     493.0        .0     493.0        .0        .0      73.4        .0        .8        .4   1356.00
       .02       .00      6.72       .00      .000      .035      .000      .000   1352.00     43.66
   .016240       60.       62.       70.         0        12         0       .00     52.67     96.34
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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

FLOW DISTRIBUTION FOR SECNO=    661.00         CWSEL=   1353.58

STA=      44.     131.
  PER Q=    100.0
   AREA=     73.4
    VEL=      6.7
  DEPTH=      1.4

*SECNO 850.000
   850.000      2.59   1356.59   1356.44       .00   1357.00       .42      2.69       .03   1357.00
     493.0        .0     493.0        .0        .0      95.2        .0       1.1        .7   1357.00
       .03       .00      5.18       .00      .000      .035      .000      .000   1354.00     23.03
   .012592      189.      189.      189.         3        14         0       .00     83.67    106.69

FLOW DISTRIBUTION FOR SECNO=    850.00         CWSEL=   1356.59

STA=      23.     133.
  PER Q=    100.0
   AREA=     95.2
    VEL=      5.2
  DEPTH=      1.1

*SECNO 989.000

3265 DIVIDED FLOW

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   989.000      3.71   1358.71   1358.71       .00   1359.22       .50      2.14       .03   1359.00
     493.0        .0     493.0        .0        .0      86.6        .0       1.4       1.0   1358.60
       .03       .00      5.70       .00      .000      .035      .000      .000   1355.00     41.38
   .019381      138.      138.      138.         0        14         0       .00     90.56    137.10

FLOW DISTRIBUTION FOR SECNO=    989.00         CWSEL=   1358.71

STA=      41.     137.
  PER Q=    100.0
   AREA=     86.6
    VEL=      5.7
  DEPTH=      1.0
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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

*SECNO 1163.000

3265 DIVIDED FLOW


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  2.44

  1163.000      4.25   1360.25   1359.00       .00   1360.40       .15      1.15       .04   1360.20
     493.0        .0     493.0        .0        .0     158.7        .0       1.9       1.4   1360.00
       .05       .00      3.11       .00      .000      .035      .000      .000   1356.00       .00
   .003263      175.      175.      175.         4        15         0       .00    108.07    138.60


FLOW DISTRIBUTION FOR SECNO=   1163.00          CWSEL=   1360.25

STA=       0.     139.
  PER Q=    100.0
   AREA=    158.7
    VEL=      3.1
  DEPTH=      1.5

*SECNO 1559.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
  1559.000      2.62   1362.62   1362.62       .00   1363.18       .56      2.43       .12   1363.00
     435.0        .0     435.0        .0        .0      72.7        .0       3.0       2.2   1362.90
       .07       .00      5.98       .00      .000      .035      .000      .000   1360.00     64.42
   .018187      396.      396.      396.         0        15         0       .00     67.09    131.51


FLOW DISTRIBUTION FOR SECNO=   1559.00          CWSEL=   1362.62

STA=      64.     175.
  PER Q=    100.0
   AREA=     72.7
    VEL=      6.0
  DEPTH=      1.1

*SECNO 1879.000
3280 CROSS SECTION   1879.00 EXTENDED       .52 FEET
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   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.56

  1879.000      3.52   1366.52   1366.04       .00   1366.75       .23      3.54       .03   1366.00
     435.0        .0     435.0        .0        .0     111.9        .0       3.6       2.8   1366.90
       .09       .00      3.89       .00      .000      .035      .000      .000   1363.00       .00
   .007455      320.      320.      320.         4        11         0       .00    101.14    101.14


FLOW DISTRIBUTION FOR SECNO=   1879.00          CWSEL=   1366.52

STA=       0.     133.
  PER Q=    100.0
   AREA=    111.9
    VEL=      3.9
  DEPTH=      1.1

*SECNO 2095.000
3280 CROSS SECTION   2095.00 EXTENDED       .84 FEET

  2095.000      2.84   1367.84   1367.37       .00   1367.96       .11      1.19       .01   1367.00
     261.0        .0     261.0        .0        .0      96.0        .0       4.2       3.2   1368.00
       .11       .00      2.72       .00      .000      .035      .000      .000   1365.00       .00
   .003636      216.      216.      216.         3        18         0       .00     85.93     85.93


FLOW DISTRIBUTION FOR SECNO=   2095.00          CWSEL=   1367.84

STA=       0.     116.
  PER Q=    100.0
   AREA=     96.0
    VEL=      2.7
  DEPTH=      1.1

*SECNO 2238.000

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .53

  2238.000      2.44   1368.44   1368.30       .00   1369.01       .56       .91       .13   1369.50
     268.0        .0     268.0        .0        .0      44.5        .0       4.4       3.4   1369.00
       .12       .00      6.03       .00      .000      .035      .000      .000   1366.00     72.42
   .013640      143.      143.      143.         3        12         0       .00     32.31    104.73
```

```
   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

FLOW DISTRIBUTION FOR SECNO=   2238.00         CWSEL=   1368.44

STA=      72.     121.
  PER Q=    100.0
   AREA=     44.5
    VEL=      6.0
  DEPTH=      1.4

*SECNO 2337.000
  2337.000      2.78   1369.78   1369.37       .00   1370.07       .29      1.04       .03   1370.90
     275.0        .0     275.0        .0        .0      63.9        .0       4.5       3.5   1370.00
       .13       .00      4.30       .00      .000      .035      .000      .000   1367.00     45.13
   .008322       99.       99.       99.         3         8         0       .00     53.33     98.46

FLOW DISTRIBUTION FOR SECNO=   2337.00         CWSEL=   1369.78

STA=      45.     103.
  PER Q=    100.0
   AREA=     63.9
    VEL=      4.3
  DEPTH=      1.2

*SECNO 2461.000

1645 INT SEC ADDED BY RAISING SEC   2461.00,   -.500 FT AND MULTIPLYING BY   1.317

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
     1.010      2.69   1370.19   1370.19       .00   1370.91       .72       .70       .13   1371.50
     279.0        .0     279.0        .0        .0      41.0        .0       4.6       3.6   1370.40
       .13       .00      6.80       .00      .000      .035      .000      .000   1367.50    113.29
   .016285       62.       62.       62.         0         8         0       .00     28.59    141.89

FLOW DISTRIBUTION FOR SECNO=      1.01         CWSEL=   1370.19

STA=     113.     143.
  PER Q=    100.0
   AREA=     41.0
    VEL=      6.8
  DEPTH=      1.4
```

```
  SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
  Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
  TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
  SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


1645 INT SEC ADDED BY RAISING SEC      1.01,    .500 FT AND MULTIPLYING BY    .760

 2461.000      3.13   1371.13   1371.04       .00   1371.85       .72       .95       .00   1372.00
    283.0        .0     283.0        .0        .0      41.6        .0       4.6       3.6   1370.90
      .13       .00      6.80       .00      .000      .035      .000      .000   1368.00     82.99
  .014316       62.       62.       62.         2         8         0       .00     25.81    108.80


FLOW DISTRIBUTION FOR SECNO=   2461.00         CWSEL=   1371.13

STA=      83.     109.
  PER Q=    100.0
   AREA=     41.6
    VEL=      6.8
  DEPTH=      1.6

*SECNO 2570.000

1645 INT SEC ADDED BY RAISING SEC   2570.00,   -.800 FT AND MULTIPLYING BY    .675

3280 CROSS SECTION      1.01 EXTENDED       .93 FEET


3301 HV CHANGED MORE THAN HVINS


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.94

    1.010      3.33   1372.13   1371.62       .00   1372.27       .14       .37       .06   1371.20
    286.5        .0     286.5        .0        .0      95.3        .0       4.7       3.7   1371.30
      .14       .00      3.00       .00      .000      .035      .000      .000   1368.80       .00
  .003910       54.       54.       54.         2         9         0       .00     76.75     76.75


FLOW DISTRIBUTION FOR SECNO=      1.01         CWSEL=   1372.13

STA=       0.      77.
  PER Q=    100.0
   AREA=     95.3
    VEL=      3.0
  DEPTH=      1.2
```

```
  SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
  Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
  TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
  SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


1645 INT SEC ADDED BY RAISING SEC      1.01,    .800 FT AND MULTIPLYING BY   1.481

3280 CROSS SECTION   2570.00 EXTENDED       .43 FEET


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .63

  2570.000      2.82   1372.42   1372.23       .00   1372.61       .19       .32       .01   1372.00
     290.0        .0     290.0        .0        .0      84.0        .0       4.8       3.8   1372.10
       .14       .00      3.45       .00      .000      .035      .000      .000   1369.60       .00
   .010061       54.       54.       54.         3        13         0       .00    113.70    113.70


FLOW DISTRIBUTION FOR SECNO=   2570.00          CWSEL=   1372.42

STA=       0.     114.
  PER Q=    100.0
   AREA=     84.0
    VEL=      3.5
  DEPTH=       .7

*SECNO 2809.000
  2809.000      3.45   1374.45   1373.96       .00   1374.98       .53      2.27       .10   1375.00
     297.0        .0     297.0        .0        .0      50.9        .0       5.2       4.2   1375.00
       .15       .00      5.84       .00      .000      .035      .000      .000   1371.00     39.17
   .009028      239.      239.      239.         2         8         0       .00     27.73     66.90


FLOW DISTRIBUTION FOR SECNO=   2809.00          CWSEL=   1374.45

STA=      39.     100.
  PER Q=    100.0
   AREA=     50.9
    VEL=      5.8
  DEPTH=      1.8

*SECNO 2977.000

3265 DIVIDED FLOW
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```
   SECNO      DEPTH      CWSEL      CRIWS      WSELK      EG         HV         HL         OLOSS      L-BANK ELEV
   Q          QLOB       QCH        QROB       ALOB       ACH        AROB       VOL        TWA        R-BANK ELEV
   TIME       VLOB       VCH        VROB       XNL        XNCH       XNR        WTN        ELMIN      SSTA
   SLOPE      XLOBL      XLCH       XLOBR      ITRIAL     IDC        ICONT      CORAR      TOPWID     ENDST

3280 CROSS SECTION   2977.00 EXTENDED       .25 FEET

  2977.000      3.45   1376.45   1376.12       .00   1376.72       .28       1.71       .03   1376.20
     259.0        .0     259.0        .0        .0      61.4        .0        5.4       4.4   1376.40
       .16       .00      4.22       .00      .000      .035      .000       .000   1373.00       .00
   .011800      168.      168.      168.         1         8         0        .00     68.61    105.20

FLOW DISTRIBUTION FOR SECNO=   2977.00         CWSEL=   1376.45

STA=       0.     105.
  PER Q=    100.0
   AREA=     61.4
    VEL=      4.2
  DEPTH=       .9

*SECNO 3181.000
3280 CROSS SECTION   3181.00 EXTENDED       .45 FEET

  3181.000      3.44   1378.44   1377.62       .00   1378.59       .15       1.85       .01   1378.00
     213.0        .0     213.0        .0        .0      68.6        .0        5.7       4.7   1378.80
       .18       .00      3.11       .00      .000      .035      .000       .000   1375.00       .00
   .006896      204.      204.      204.         0        11         0        .00     80.65     80.65

FLOW DISTRIBUTION FOR SECNO=   3181.00         CWSEL=   1378.44

STA=       0.     100.
  PER Q=    100.0
   AREA=     68.6
    VEL=      3.1
  DEPTH=       .9

*SECNO 3414.000

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .66

  3414.000      2.63   1380.63   1380.54       .00   1380.99       .37       2.34       .06   1381.10
     213.0        .0     213.0        .0        .0      43.9        .0        6.0       5.1   1381.00
       .19       .00      4.85       .00      .000      .035      .000       .000   1378.00     34.93
   .015905      233.      233.      233.         2        13         0        .00     50.13     85.06
```

```
   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

FLOW DISTRIBUTION FOR SECNO=   3414.00         CWSEL=   1380.63

STA=      35.     100.
  PER Q=    100.0
   AREA=     43.9
    VEL=      4.9
  DEPTH=       .9

*SECNO 3590.000
3280 CROSS SECTION   3590.00 EXTENDED       .21 FEET


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.67

  3590.000      2.50   1382.50   1382.20       .00   1382.60       .09      1.58       .03   1382.30
     213.0        .0     213.0        .0        .0      86.9        .0       6.3       5.4   1382.50
       .21       .00      2.45       .00      .000      .035      .000      .000   1380.00       .00
   .005720      176.      176.      176.         3         9         0       .00    129.60    129.60


FLOW DISTRIBUTION FOR SECNO=   3590.00         CWSEL=   1382.50

STA=       0.     130.
  PER Q=    100.0
   AREA=     86.9
    VEL=      2.5
  DEPTH=       .7

*SECNO 3749.000
3280 CROSS SECTION   3749.00 EXTENDED       .60 FEET

  3749.000      2.60   1383.60   1383.42       .00   1383.78       .18      1.16       .03   1383.00
     213.0        .0     213.0        .0        .0      61.9        .0       6.6       5.8   1384.00
       .23       .00      3.44       .00      .000      .035      .000      .000   1381.00       .00
   .009658      159.      159.      159.         2        10         0       .00     81.60     81.60


FLOW DISTRIBUTION FOR SECNO=   3749.00         CWSEL=   1383.60

STA=       0.     101.
  PER Q=    100.0
   AREA=     61.9
    VEL=      3.4
  DEPTH=       .8
```

```
   SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
   Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
   TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
   SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

*SECNO 3820.000
3280 CROSS SECTION   3820.00 EXTENDED       .36 FEET

  3820.000      2.26   1384.26   1384.02       .00   1384.39       .14       .60       .00   1383.90
     213.0       .0     213.0        .0        .0      71.9        .0       6.7       6.0   1384.10
       .23       .00      2.96       .00      .000      .035      .000      .000   1382.00       .00
   .007638       71.       71.       71.         3        13         0       .00     99.90     99.90

FLOW DISTRIBUTION FOR SECNO=   3820.00          CWSEL=   1384.26

STA=       0.     100.
  PER Q=    100.0
   AREA=     71.9
    VEL=      3.0
  DEPTH=       .7
```

THIS RUN EXECUTED 14AUG98 10:54:59

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

RE-ALIGNMENT FROM CROSS

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	DEPTH	EG	CRIWS	VCH	10*KS	XLCH	SSTA	TOPWID	ENDST	TWA
*	99.000	540.00	1346.24	1.24	1346.73	1346.24	5.63	188.39	.00	15.50	99.50	115.00	.00
*	170.000	540.00	1347.96	1.96	1348.78	1347.96	7.28	156.01	70.00	17.16	45.69	62.84	.12
*	241.000	493.00	1349.85	3.35	1351.06	1349.85	8.83	165.27	75.00	11.62	23.38	35.00	.18
*	320.000	493.00	1351.28	4.28	1351.37	1348.86	2.44	7.37	90.00	7.88	64.24	72.12	.27
*	360.000	493.00	1350.92	1.92	1351.64	1350.85	6.76	137.09	40.00	17.27	45.46	62.73	.32
*	661.000	493.00	1353.58	1.58	1354.28	1353.58	6.72	162.40	62.00	43.66	52.67	96.34	.39
	850.000	493.00	1356.59	2.59	1357.00	1356.44	5.18	125.92	188.91	23.03	83.67	106.69	.68
*	989.000	493.00	1358.71	3.71	1359.22	1358.71	5.70	193.81	138.43	41.38	90.56	137.10	.96
*	1163.000	493.00	1360.25	4.25	1360.40	1359.00	3.11	32.63	174.55	.00	108.07	138.60	1.36
*	1559.000	435.00	1362.62	2.62	1363.18	1362.62	5.98	181.87	396.05	64.42	67.09	131.51	2.16
*	1879.000	435.00	1366.52	3.52	1366.75	1366.04	3.89	74.55	319.81	.00	101.14	101.14	2.77
	2095.000	261.00	1367.84	2.84	1367.96	1367.37	2.72	36.36	216.05	.00	85.93	85.93	3.24
*	2238.000	268.00	1368.44	2.44	1369.01	1368.30	6.03	136.40	143.34	72.42	32.31	104.73	3.43
	2337.000	275.00	1369.78	2.78	1370.07	1369.37	4.30	83.22	99.02	45.13	53.33	98.46	3.53
*	2461.000	283.00	1371.13	3.13	1371.85	1371.04	6.80	143.16	123.99	82.99	25.81	108.80	3.63
*	2570.000	290.00	1372.42	2.82	1372.61	1372.23	3.45	100.61	108.64	.00	113.70	113.70	3.81
	2809.000	297.00	1374.45	3.45	1374.98	1373.96	5.84	90.28	238.62	39.17	27.73	66.90	4.20

	SECNO	Q	CWSEL	DEPTH	EG	CRIWS	VCH	10*KS	XLCH	SSTA	TOPWID	ENDST	TWA
	2977.000	259.00	1376.45	3.45	1376.72	1376.12	4.22	118.00	168.35	.00	68.61	105.20	4.38
	3181.000	213.00	1378.44	3.44	1378.59	1377.62	3.11	68.96	203.60	.00	80.65	80.65	4.73
*	3414.000	213.00	1380.63	2.63	1380.99	1380.54	4.85	159.05	233.47	34.93	50.13	85.06	5.08
*	3590.000	213.00	1382.50	2.50	1382.60	1382.20	2.45	57.20	176.18	.00	129.60	129.60	5.44
	3749.000	213.00	1383.60	2.60	1383.78	1383.42	3.44	96.58	158.66	.00	81.60	81.60	5.83
	3820.000	213.00	1384.26	2.26	1384.39	1384.02	2.96	76.38	70.68	.00	99.90	99.90	5.98

SUMMARY OF ERRORS AND SPECIAL NOTES

```
CAUTION SECNO=     99.000  PROFILE=  1  CRITICAL DEPTH ASSUMED

CAUTION SECNO=    170.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    170.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=    241.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    241.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=    320.000  PROFILE=  1  INTERPOLATED X-SECTIONS USED

WARNING SECNO=    360.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=    661.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    661.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=    989.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    989.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

WARNING SECNO=   1163.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=   1559.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=   1559.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

WARNING SECNO=   1879.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   2238.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=   2461.000  PROFILE=  1  INTERPOLATED X-SECTIONS USED

CAUTION SECNO=   2570.000  PROFILE=  1  INTERPOLATED X-SECTIONS USED

WARNING SECNO=   3414.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   3590.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
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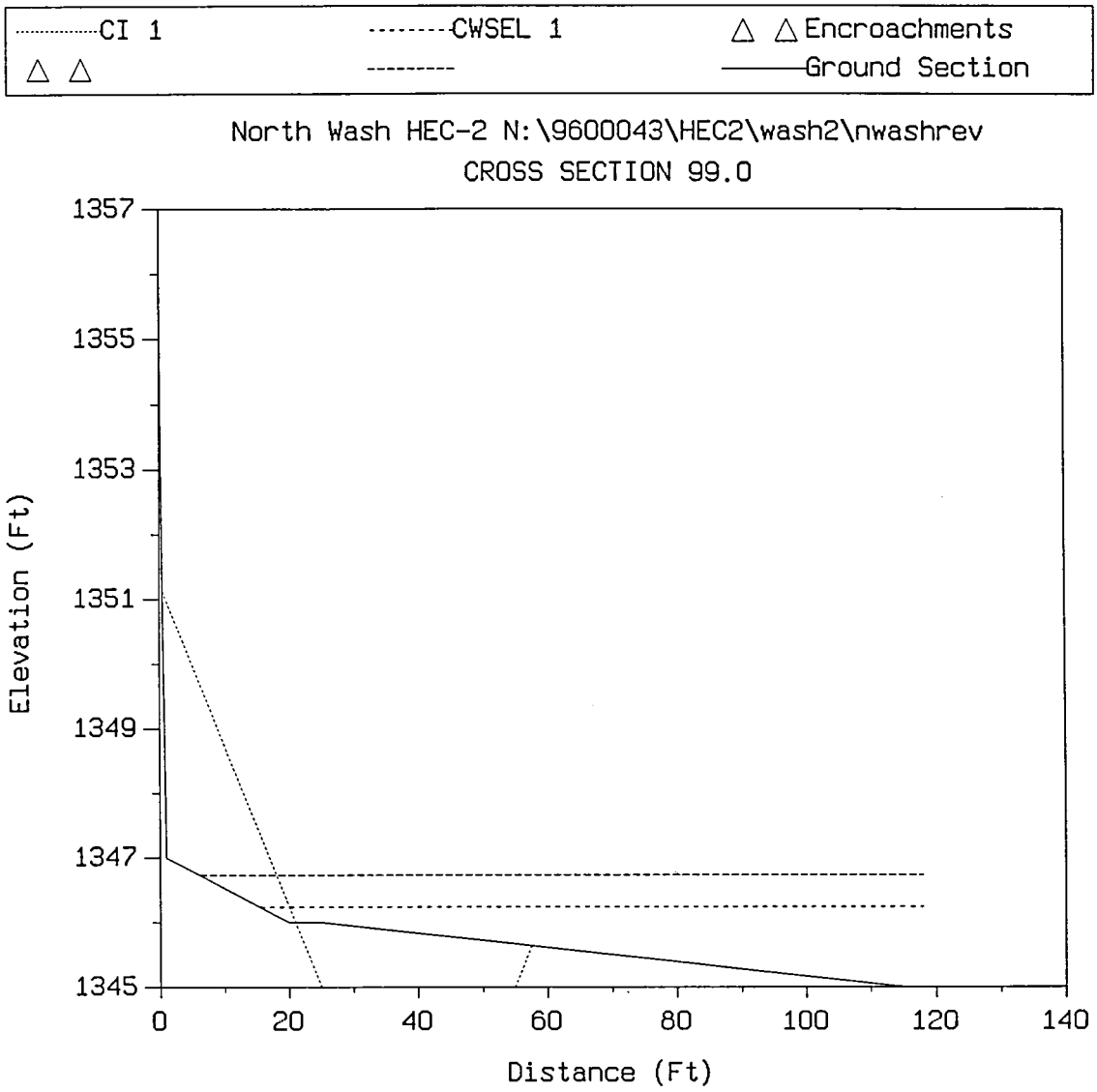
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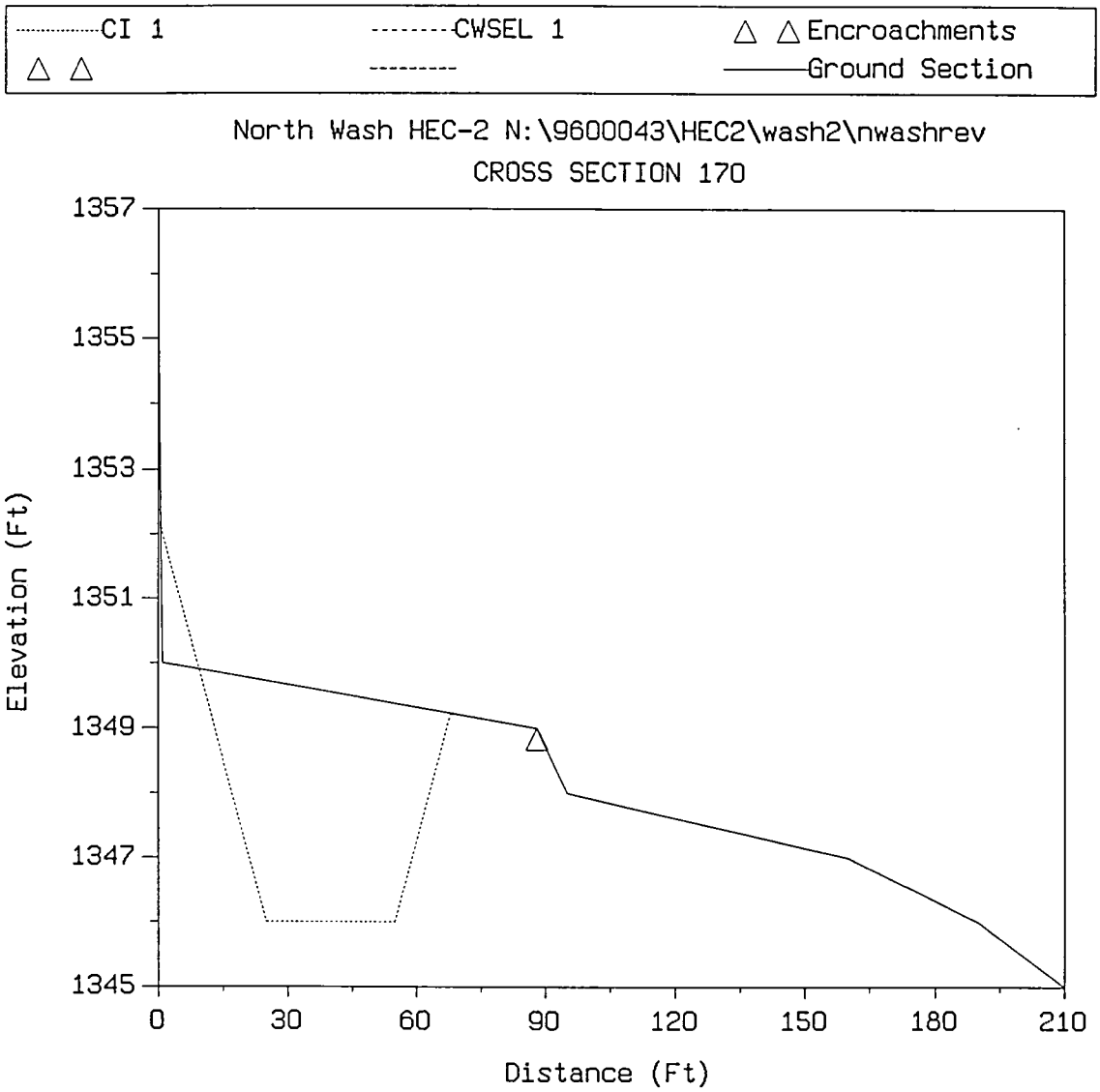
CWSEL 1
Encroachments
Ground Section
North Wash HEC-2 N:\9600043\HEC2\wash2\nwashrev
CROSS SECTION 99.0
Elevation (Ft)
1357
1355
1353
1351
1349
1347
1345
0
20
40
60
80
100
120
140
Distance (Ft)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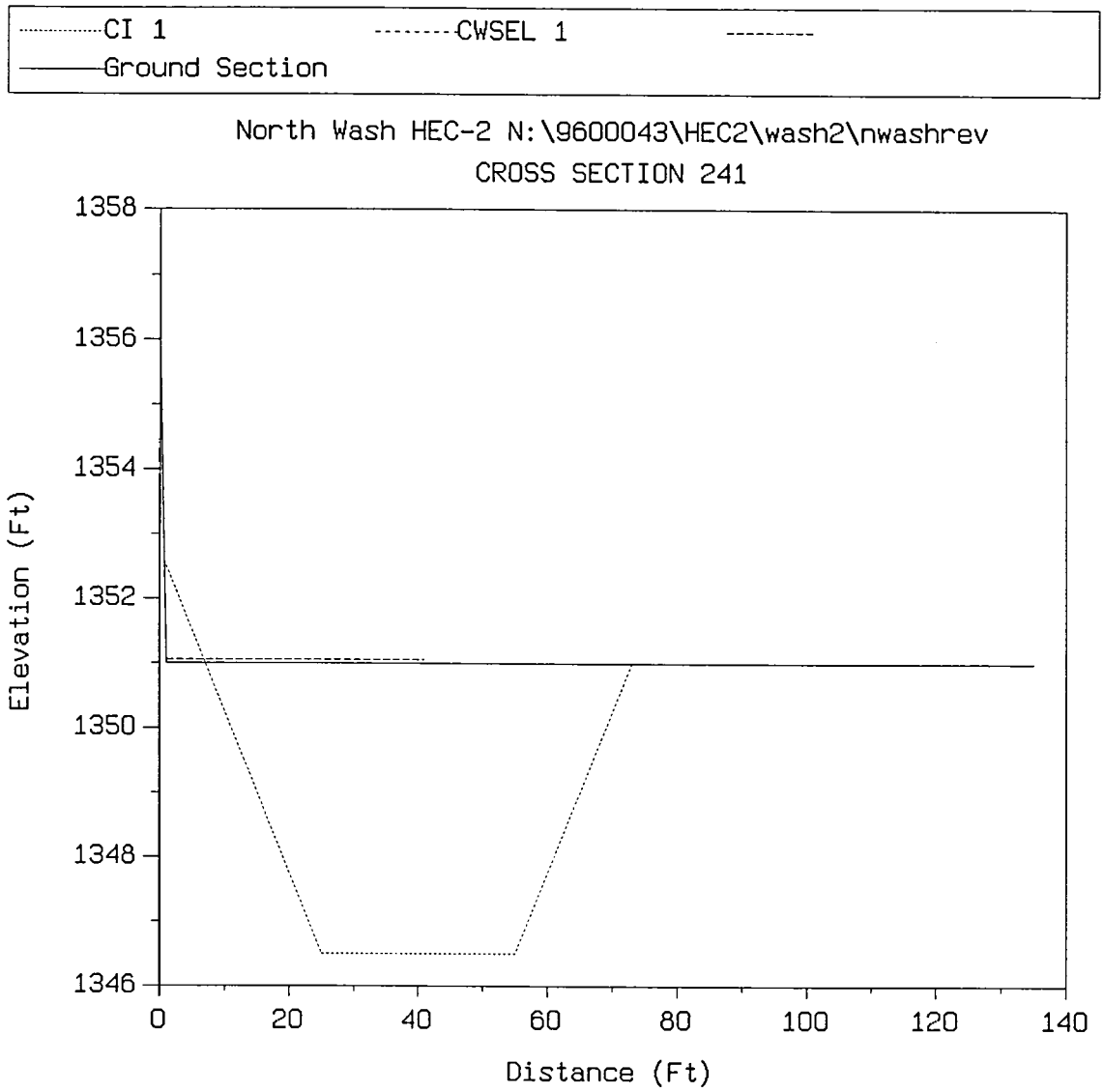
CWSEL 1
Encroachments
Ground Section
North Wash HEC-2 N:\9600043\HEC2\wash2\nwashrev
CROSS SECTION 170
Elevation (Ft)
1357
1355
1353
1351
1349
1347
1345
0
30
60
90
120
150
180
210
Distance (Ft)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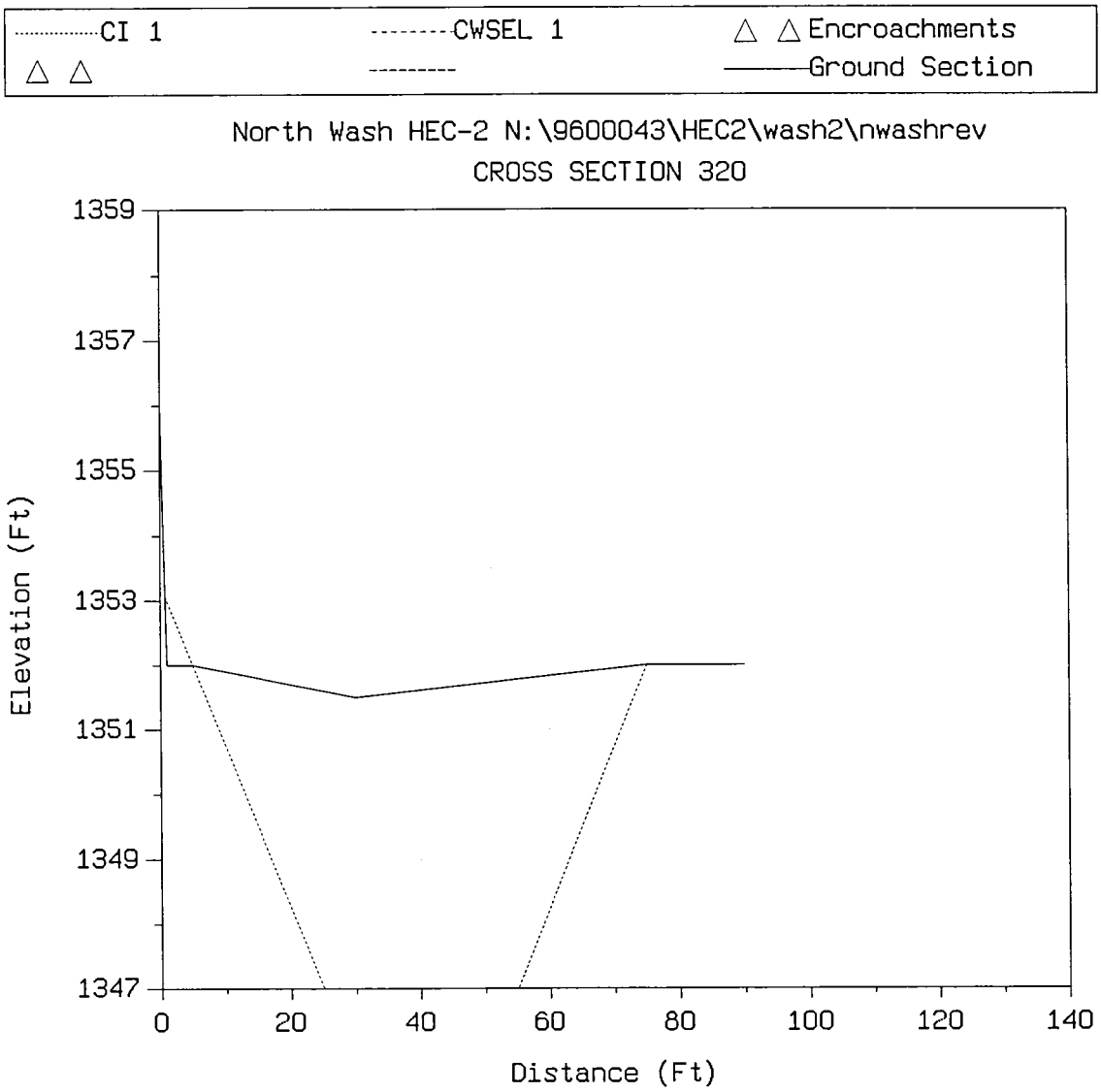
CWSEL 1
Ground Section
North Wash HEC-2 N:\9600043\HEC2\wash2\nwashrev
CROSS SECTION 241
Elevation (Ft)
1358
1356
1354
1352
1350
1348
1346
0
20
40
60
80
100
120
140
Distance (Ft)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CWSEL 1
Encroachments
Ground Section
North Wash HEC-2 N:\9600043\HEC2\wash2\nwashrev
CROSS SECTION 320
Elevation (Ft)
1359
1357
1355
1353
1351
1349
1347
0
20
40
60
80
100
120
140
Distance (Ft)

APPENDIX D

SCOUR ANALYSIS
AND
FREEBOARD CALCULATIONS

96.0043 .21

Project Number

CVL CALCULATIONS COVER SHEET

SCOUR ANALYSIS

Title of Calculations

Terramar - New River Bank

Project Title

Content	Performed By		Checked By		Rechecked By	
	Initials	Date	Initials	Date	Initials	Date
Statement of Purpose	KA	8/15/98	RN	10-6-98		
List of References	KA	8/15/98	RN	↓		
List of Assumptions	KA	8/15/98	RN	↓		
Methodology	KA	8/15/98	RN	↓		
Calculations	KA	8/15/98	RN	↓		
Summary/Conclusions	KA	8/15/98	RN	10-6-98		
Appendices						

Comments

Final Approval By: [signature]

Signature

10/7/98

Date

COE & VAN LOO
PLANNING • ENGINEERING
LANDSCAPE ARCHITECTURE

Project TERRAMAR - NEW RIVER
Project No. 96.004321
Sheet No. 1 of 9
Calculated by KA Date 8/15/98
Checked by _____ Date _____

(1) STATEMENT OF PURPOSE:

To calculate scour depth for determining the toe-down depth for New River Bank Protection (Gabion Retaining Walls) at Terramar

(2) LIST OF REFERENCES:

ⓐ Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona, Simons, Li, & Assoc. December 1989

ⓑ Design Manual for Engineering Analysis of Fluvial Systems: Arizona Department of Water Resources, by Simons, Li and Associates, March 1985

ⓒ Computing Degradation and Local Scour - Technical Guideline For Bureau of Reclamation, Jan 1984

ⓓ Coe & Van Loo Consultants, Feasibility Study New River Alignment at Terramar, November 1996

(3) LIST OF ASSUMPTION

ⓐ Design Flow of 4200 cfs split at X-Section 2.15, 3000 cfs routed through the project area, 1200 cfs bypasses the area and recombines with the system at X-Sec 2.110 (See Ref. d)

ⓑ Scour Components Computed are

ΔZ_{gs} = General Scour (Contraction)
ΔZ_{ls} = Local Scour (Bankline)
ΔZ_{bs} = Bend Scour
ΔZ_{deg} = Longterm Degradation
$\frac{1}{2} h_a$ = Bedform ($\frac{1}{2}$ Anti-dune height)
ΔZ_i = Low flow incisement = 2 feet
Safety Factor = 1.3

$\Delta Z_{total} = 1.3 (\Delta Z_{gs} + \Delta Z_{ls} + \Delta Z_{bs} + \Delta Z_{deg} + \Delta Z_i + \frac{1}{2}$

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4) METHODOLOGY

The most severe hydraulic parameters are taken as representative of entire reach. All hydraulic data taken from the proposed condition HEC-RAS model output in Appendix B of this report

5) CALCULATIONS

See attached Spreadsheet output.

6) SUMMARY / CONCLUSIONS

Total scour was computed as the sum of Longterm degradation (from equilibrium slope analysis) Local scour, bed form scour, bend scour and low flow incisement. A Safety factor of 1.3 was applied to the sum of the computed scour depth. Scour depths ranged from 12 feet to 20 feet.

TERRAMAR
New River Bank Protection
Equilibrium Slope Analysis

References: 1. Design Manual for Engineering Analysis of Fluvial Systems, Arizona Department of Water Resources, 1985

Equations Used:

1. Darcy-Weisbach Friction Factor, f =116.5*n^2/R^0.3 Ref 1. Eqn. 4.8 a

where n = Manning's friction factor

R = Hydraulic radius of channel

Boundary Shear Stress = Rho* f * V^2/8

Where Rho = Density of Water

f = Darcy-Weisbach friction factor

V = Velocity of flow (cfs)

Critical Shear Stress = 0.047*Dc*(Gs-G) Ref 1. Eqn. 5.5

Where Dc = Diameter of Sediment Particle

Gs = Specific Weight of Particle

G = Specific Weight of Water

0.047 = Shield's Parameter

Sediment Transport Capacity
Meyer-Peter & Muller (MPM)= 12.85(To - Tc)^1.5/(Gs*SQRT(Rho))

Where To = Boundary Shear Stress

Tc = Critical Shear Stress

Gs = Specific Weight of Particle

Rho = Density of Water

Reach No	Cross Section	Bottom Width (ft)	Channel Slope (ft)	Manning's 'n'	Reach Length	Mean Vel
1	2.106-2.113	150	0.011	0.035	502	8.03
2	2.113-2.120	60	0.012	0.035	370	11.42
3	2.120-2.135	105	0.011	0.035	132	9.18
4	2.135-2.150	50	0.006	0.035	397	9.64

Darcy-W

Reach No	Cross Sections	Boundary Shear	D50	Crit. Shear	Hyd. Depth	f- value
1	2.106-2.113	1.617	25	0.397	2.49	0.10561
2	2.113-2.120	2.715	25	0.397	4.38	0.08765
3	2.120-2.135	1.962	25	0.397	3.12	0.09804
4	2.135-2.150	1.723	25	0.397	6.22	0.07807

Reach No	Cross Sections	MPM Sed Q (cfs/ft)
1	2.106-2.113	0.0760
2	2.113-2.120	0.1989
3	2.120-2.135	0.1104
4	2.135-2.150	0.0861

D50 =	0.082	ft	25 mm
Spec. Wt of Sed=	165.4	lb/ft^3	
Density of Water =	1.9	lb-sec^2/ft^4	

Use MPM Method
Sediment Supply =0.0861cfs/ft

Terramar
New River Bank Protection
Equilibrium Slope Analysis -Hydraulics Worksheet

Reach No	Cross Sections	Bottom Width (ft)	Channel Slope (ft)	Manning's 'n'	Depth Y	R	V	Q	Diff Q
1	2.106-2.113	150	0.011	0.035	2.491	2.4109	8.0299	3000.4	-0.373
2	2.113-2.120	60	0.012	0.035	4.378	3.8205	11.417	2999.1	0.9315
3	2.120-2.135	105	0.011	0.035	3.12	2.945	9.1819	3008	-7.991
4	2.135-2.150	50	0.006	0.035	6.22	4.9808	9.6431	2999	1.0025
1	2.106-2.113	150	0.002	0.035	4.19	3.9683	4.7811	3004.9	-4.944
1	2.106-2.113	150	0.005	0.035	3.17	3.0414	6.3256	3007.8	-7.808
1	2.106-2.113	150	0.009	0.035	2.65	2.5596	7.5604	3005.2	-5.247
1	2.106-2.113	150	0.012	0.035	2.43	2.3537	8.2531	3008.3	-8.271
2	2.113-2.120	60	0.01	0.035	4.65	4.026	10.795	3011.7	-11.75
2	2.113-2.120	60	0.004	0.035	6.2	5.1381	8.0393	2990.6	9.3704
2	2.113-2.120	60	0.003	0.035	6.82	5.5568	7.3374	3002.5	-2.463
3	2.120-2.135	105	0.001	0.035	6.55	5.8235	4.3714	3006.4	-6.439
3	2.120-2.135	105	0.002	0.035	5.28	4.7975	5.4293	3010	-10.02
3	2.120-2.135	105	0.004	0.035	4.25	3.9317	6.7197	2998.7	1.3265
3	2.120-2.135	105	0.0085	0.035	3.37	3.1667	8.4736	2998.4	1.6075

Equilibrium Slope Determination for The Reaches

Sediment Discharge Computation Worksheet

Reach Number	Slope ft/ft	Velocity fps	Boundary Shear	Critical Shear	Sediment Discharge
1	0.002	4.7811	0.57335593356	0.396962	0.004178348
1	0.005	6.3256	1.00362647262	0.396962	0.026650291
1	0.009	7.5604	1.43369973002	0.396962	0.059536385
1	0.012	8.2531	1.70845235296	0.396962	0.084708454
2	0.007	9.6318	1.93121420206	0.396962	0.107182587
2	0.006	9.1684	1.7498573231	0.396962	0.088751438
2	0.003	7.3374	1.12072723299	0.396962	0.034727673
3	0.001	4.3714	0.44494672283	0.396962	0.000592835
3	0.002	5.4293	0.68636415669	0.396962	0.008780753
3	0.004	6.7197	1.05139688379	0.396962	0.029859241
3	0.0085	8.4736	1.67187126977	0.396962	0.081189155
4	0.002	6.7165	0.83675956602	0.396962	0.016449713
4	0.006	9.6431	1.72483671794	0.396962	0.086300787
4	0.0055	9.374	1.62991345996	0.396962	0.077214359

Summary of Results

Supply Reach's Sediment Discharge= 0.0861 cfs/ft

Reach	Equil. Slope (FT/FT)	Exist Slope (FT/FT)	Longterm Effect	Depth of Degrad/Agg (FT)
1	0.012	0.011	Aggrade	0.502
2	0.006	0.012	Degrade	-2.22
3	0.0085	0.011	Degrade	-0.33

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Scour Analysis For Bank Protection Toe Down Depth

References
1. Computing Degradation and Local Scour. Technical Guideline for Bureau of Reclamation, 1984
2. Design Manual for Engineering Analysis of Fluvial Systems, Arizona Department of Water Resources, 1985

1. General Scour

Zgs= Ymax [(0.0685Vm^0.8/Yh^0.4Se^0.3)-1]

where	Vm is Avg Velocity of flow, fps =	9.39
	Yh is Hydraulic Depth (ft) =	3.01
	Se is the energy slope (ft/ft) =	0.0118
	Ymax is maximum flow depth (ft)	4.76

Zgs = 0.00912601 feet

2. Bedform Scour

Zbf = 0.027Vm^2/2 *Ref. 2, Equation 4.25*

where	Vm is Avg Velocity of flow, fps =	9.39

Zbf = 1.19032335 feet

3. Local Scour

Zls = k*q^0.24 *Ref. 1 Equation 24*

where	k = constant	2.45
	q = unit discharge (cfs/ft)=Q/W	28.2618935
	Q = discharge (cfs)	3000
	W = channel width (ft)	106.15

Zls = 5.46329166 feet

4. Bend Scour

Zbs = 0.0685*Y*V^0.8[2.1(Sin^2aplha/2/Cos aplha)^0.2 -1)-1]/[Yh^0.4*Se^0.3 *Ref. 2 Equation 5.25*

where	V is Avg upstream flow velocity=	6.27
	Y is upstream flow depth (ft) =	4.69
	Yh is Hydraulic Depth (ft) =	3.87
	Se is the energy slope (ft/ft) =	0.0038
	alpha is the angle formed by the projection of the channel centerline from	45

the point of curvature (degrees)

Zbs1 = 4.32173349
Zbs2 = 0.79146366
Zbs = 3.420495 feet

5. Low Flow Incisement

Zlf = Field Inspection or typical value of 1.5 to 3.0 fe Use 2.0 feet 2

ZTOTAL = 15.7082068 feet

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Project No. 96004321

SUMMARY OF COMPUTED SCOUR

Cross Section Number	Longterm Degradation	Bed Form Scour	Local Scour	Bend Scour	Low Flow Incisement	Total Scour x 1.3 Safety Factor	Design Scour Depth (ft)
2.106-2.108	0	1.19	5.46	0	2	11.245	12
2.11	0	1.19	5.46	0	2	11.245	12
2.111	0	1.19	5.46	0	2	11.245	12
2.112	0	1.19	5.46	3.42	2	15.691	16
2.1125	0	1.19	5.46	3.42	2	15.691	16
2.113	0	1.19	5.46	3.42	2	15.691	16
2.116	2.2	1.19	5.46	3.42	2	18.551	20
2.118	2.2	1.19	5.46	3.42	2	18.551	20
2.12	2.2	1.19	5.46	3.42	2	18.551	20
2.125	0.3	1.19	5.46	0	2	11.635	12
2.13	0.3	1.19	5.46	0	2	11.635	12
2.135	0.3	1.19	5.46	0	2	9.035	12

96-0043-21
Project Number

CVL CALCULATIONS COVER SHEET

Freeboard Analysis
Title of Calculations

Terramar - New River
Project Title

Content	Performed By		Checked By		Rechecked By	
	Initials	Date	Initials	Date	Initials	Date
Statement of Purpose	KA	8/25/98	KCh	10-6-98		
List of References	KA		KCh			
List of Assumptions	KA		KCh			
Methodology	KA		KCh			
Calculations	KA		KCh			
Summary/Conclusions	KA		KCh	10-6-98		
Appendices						

Comments

Final Approval By: Trudy E Kelly
Signature

10/7/98
Date

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Project Terramar - New River
Project No. 96-0043-21
Sheet No. 1 of 4
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Checked by _____ Date _____

(1) STATEMENT OF PURPOSE

To calculate Freeboard Requirement for Bank Protection

(2) LIST OF REFERENCES

(a) Design Manual for Engineering Analysis of Fluvial Systems: Arizona Department of Water Resources, by Simons Li & Associates, Dec 1985

(b) Drainage Design Manual for Maricopa County, Volume II, Hydraulics - Flood Control District of Maricopa County, Jan 1996

(c) Coe and Van Loo Consultants, Inc., Feasibility Study New River Alignment at Terramar, November 1996.

(3) LIST OF ASSUMPTIONS

(a) water surface waves generated by wind forces are not significant

(4) METHODOLOGY

Freeboard is the sum of three components; full dune height, superelevation and sediment deposition height. All three components may not apply at all locations. Maricopa County Freeboard method applies to straight reaches only and is used here only as a check

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(5) CALCULATIONS

See attached spreadsheet

(6) SUMMARY / CONCLUSION

Design freeboard for straight reaches is 1.5 ft above computed water surface elevation. In curves, it is computed as 2.0 ft and 2.5 feet for sedimentation prone reaches

Terramar New River Bank Protection
Project No. 96004321

Freeboard Analysis

References
1. Drainage Design Manual for Maricopa County, Volume II, Hyadraulics, 1996
2. Design Manual for Engineering Analysis of Fluvial Systems, Arizona Department of Water Resources, 1985

1.Maricopa County Freeboard FBmc = 0.25*(Y+V^2/2g) *Ref. 1 Equation 6.10*

Where V = Mean Flow Velocity (fps)= 9.39

Y = Flow Depth (feet) = 3.01

FBmc = 1.0948 feet

Freeboard By Component Method (ADWR Method)

2. Dune-Antidune Height = 0.5(0.027*V^2) *Ref. 2, Equation 4.25*

Where V = Mean Flow Velocity (fps)= 9.39

FBdune = 1.1903 feet

3. Superelevation = c*V^2*W/(G*R) *Ref. 2 Equation 4.26c*

Where V = Mean Flow Velocity (fps)= 9.39

r = Radius of Curve (ft)= 300

W = Channel Width (ft)= 150

c = Coefficient from Table 4.3 of Ref. 0.5

FBsup= 0.6846 feet

4. Sediment Deposition (Aggradation)

Reach 1 Cross Sections 2.106 to 2.113

Add additional freeboard of 0.5 ft for aggradation

FB TOTAL = 1.8749 feet

Conclusion Use Freeboard By Component Mthd

Design Freeboard = 2.0 feet in Curve

1.5 feet in Straight Reaches

2.5 feet between cross sections 2.106 to 2.113

Terramar New River Bank Protection
Project No. 96004321

FREEBOARD AND TOP OF BANK ELEVATIONS

Cross Section Number	CWSEL	Computed Freeboard	Design Top of Bank Elev.
2.106	1337.4	2.5	1339.9
2.107	1338.7	2.5	1341.2
2.108	1339	2.5	1341.5
2.109	1341	2	1343
2.11	1341.3	2	1343.3
2.111	1342.8	2.5	1345.3
2.112	1343.3	2.5	1345.8
2.1125	1345.2	2.5	1347.7
2.113	1346	2.5	1348.5
2.116	1347	2	1349
2.118	1347.6	2	1349.6
2.12	1347.4	2	1349.4
2.125	1348.4	2	1350.4
2.13	1349.5	1.5	1351
2.135	1349.8	1.5	1351.3

APPENDIX E

GEOTECHNICAL REPORT

SOIL INVESTIGATION

PROJECT

TERRAMAR NEW RIVER BANK PROTECTION
NEW RIVER N/O HAPPY VALLEY ROAD
PEORIA, ARIZONA

PREPARED FOR

RICHFIELD INVESTMENT CORPORATION
C/O COE & VAN LOO CONSULTANTS, INC.
4550 N. 12TH STREET
PHOENIX, ARIZONA 85014-4291

Construction Inspection & Testing Co.

2002 WEST NORTH LANE
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(602)861-2002 FAX (602)861-9116

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SEPTEMBER 23, 1998

RICHFIELD INVESTMENT CORPORATION
C/O COE & VAN LOO CONSULTANTS, INC.
4550 N. 12TH STREET
PHOENIX, ARIZONA 85014-4291

RE: SOIL INVESTIGATION

PROJECT: TERRAMAR NEW RIVER BANK PROTECTION
NEW RIVER N/O HAPPY VALLEY ROAD
PEORIA, ARIZONA

PROJECT NO. 98-8588

ATTENTION: KUFI AWUMAH, PH. D., P. E.

IN ACCORDANCE WITH YOUR REQUEST, WE HAVE COMPLETED THE SOIL INVESTIGATION FOR THE SUBJECT PROJECT.

THE ACCOMPANYING REPORT INCLUDES THE RESULTS OF OUR FIELD INVESTIGATION AND LABORATORY TESTING ALONG WITH OUR CONCLUSIONS AND RECOMMENDATIONS.

RESPECTFULLY SUBMITTED,
CONSTRUCTION INSPECTION & TESTING CO.

Registered Professional Engineer (Civil)
CERTIFICATE NO. 26330
SCOTT R. SMITH
Date Signed 9/23/98
ARIZONA U.S.A.

SCOTT R. SMITH, P. E.

COPIES TO: ADDRESSEE (6)

PART I

REPORT

TERRAMAR NEW RIVER BANK PROTECTION
NEW RIVER N/O HAPPY VALLEY ROAD
PEORIA, ARIZONA

GENERAL:

THIS REPORT WAS PREPARED AT THE DIRECTION OF RICHFIELD INVESTMENT CORPORATION, C/O COE AND VAN LOO CONSULTANTS, INC., PHOENIX, ARIZONA, AND DESCRIBES THE SOIL CONDITIONS, LABORATORY FINDINGS AND A LOAD BEARING EVALUATION OF THE PROJECT IDENTIFIED AS TERRAMAR NEW RIVER BANK PROTECTION, LOCATED ALONG THE NEW RIVER, NORTH OF HAPPY VALLEY ROAD, PEORIA, ARIZONA. THE PURPOSE OF THE REPORT IS TO PRESENT GENERAL INFORMATION CONCERNING THE ENGINEERING CHARACTERISTICS OF THE SOIL AND TO SUBMIT RECOMMENDATIONS FOR THE DESIGN OF FOUNDATIONS AND SITE PREPARATION IN ACCORDANCE WITH FEMA/CITY OF PEORIA REQUIREMENTS.

PROPOSED CONSTRUCTION:

THIS INVESTIGATION WAS PERFORMED AND THE REPORT WAS PREPARED BASED ON THE FOLLOWING INFORMATION:

1. THE DEVELOPMENT WILL CONSIST OF GABION TYPE RETAINING WALLS/ BANK PROTECTION ALONG NEW RIVER.
2. CUTS AND FILLS WILL BE REQUIRED TO OBTAIN FINISH GRADES.

INVESTIGATION:

SEVEN (7) TEST HOLES WERE MADE AT THE LOCATIONS AS SHOWN ON THE ACCOMPANYING SITE PLAN. THE SOILS ENCOUNTERED WERE CONTINUOUSLY EXAMINED, CLASSIFIED, LOGGED AND SAMPLED WHERE APPLICABLE. THE GRADATION AND ATTERBERG LIMITS WERE DETERMINED ON SELECTED

SAMPLES. SAMPLING AND LABORATORY TESTING (DIRECT SHEAR AND CONSOLIDATION) OF UNDISTURBED SAMPLES REPRESENTATIVE OF THE BEARING SOIL MATERIAL ENCOUNTERED WERE NOT FEASIBLE DUE TO THE GRANULAR NATURE OF THE SOILS ENCOUNTERED.

RESULTS OF LABORATORY TESTS, FIELD INVESTIGATION AND CLASSIFICATION OF THE SUBSOILS WERE USED AS THE BASIS FOR THE CONCLUSIONS AND RECOMMENDATIONS CONTAINED IN THIS REPORT.

SITE CONDITIONS AND SOIL PROFILE

THE SITE ENCOMPASSES THE BANKS OF THE NEW RIVER. THE ACTIVE CHANNEL CONSISTS OF SAND, GRAVEL, AND COBBLE DEPOSITS TO AN APPROXIMATE DEPTH OF SEVEN (7) FEET AT BORING LOCATIONS ALONG THE BANKS. UNDERLYING THE SURFACE SOILS ARE CLAYEY SANDY GRAVEL AND COBBLES WHICH EXTEND TO DEPTHS DEEPER THAN EXPLORED. AT TEST HOLE 4 WITHIN THE CHANNEL THE UPPER SOILS EXTENDED TO 9.5 FEET DEPTH. RECOMMENDED SITE WORK PROCEDURES WILL BE PRESENTED LATER IN THIS REPORT.

AS SHOWN ON THE ACCOMPANYING LOG OF TEST HOLES AND LABORATORY TEST RESULTS, THE SUBSOIL PROFILE TO THE DEPTHS EXPLORED CONSISTS OF GRANULAR SOILS DISTRIBUTED IN A REGULAR MANNER ACROSS THE SITE. THE RIVER FLOWS IN A SOUTHERN DIRECTION ALONG THIS SECTION. THE

TERRAMAR NEW RIVER BANK PROTECTION
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PEORIA, ARIZONA

RIVER BANKS EXPOSE A RELATIVELY FINE GRAINED SOIL OVERLYING CLAYEY SAND, GRAVEL AND COBBLES. ACCORDING TO THE RECORDS OF THE ARIZONA DEPARTMENT OF WATER RESOURCES, THE DEPTH TO THE REGIONAL GROUNDWATER IN THE AREA IS APPROXIMATELY 290 FEET. LOCALIZED AREAS OF PERCHED WATER MAY EXIST FOLLOWING FLOW EVENTS WITHIN THE NEW RIVER CHANNEL. PARTIAL CONTROL OF WATER FLOW WITHIN THE NEW RIVER CHANNEL IS PROVIDED BY THE NEW RIVER DAM (FLOOD PROTECTION) LOCATED APPROXIMATELY ONE HALF MILE NORTH OF THE SITE.

DISCUSSION OF RESULTS:

IN GENERAL, THE IN-SITU MOISTURE CONTENT OF THE SUBSOILS WAS FOUND TO BE DAMP BEING WELL BELOW THE PLASTIC LIMIT OF THE SOILS. FOUNDATION SOILS WITHIN THE SITE RANGE FROM SOFT TO VERY HARD. THE SWELL POTENTIAL OF THE SURFACE SOILS IS RELATIVELY LOW WHEN COMPACTED AND SATURATED WHILE CONFINED BY LIGHT FLOOR SLAB LOADINGS.

CONCLUSIONS AND RECOMMENDATIONS

GENERAL:

(1) IT IS ANTICIPATED THAT CONSIDERABLE GRADING WILL BE REQUIRED OVER MOST OF THE SITE TO ACHIEVE FINISH GRADES. SINCE THIS IS THE CASE, RECOMMENDATIONS FOR CONTROLLED FILLS ARE INCLUDED IN THIS REPORT UNDER "EARTHWORK".

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(2) THE SUBSOILS TO SIGNIFICANT FOUNDATION STRESS INFLUENCE EXIST AT LOW TO HIGH DENSITIES AND EXHIBIT LOW TO MODERATE CONSOLIDATION POTENTIAL.

(3) ONSITE SOILS MAY BE USED AS FILL MATERIAL PROVIDED THAT THEY ARE COMPACTED AS SPECIFIED.

FOUNDATIONS:

GABIONS BEARING UPON FIRM, UNDISTURBED NATIVE SOILS BELOW SEVEN (7) FEET DEPTH ARE RECOMMENDED IN VIEW OF THE EXISTENT SUBSURFACE CONDITIONS AND POSSIBLE GRADING REQUIREMENTS. THE SEVEN (7) FEET DEPTH IS THE DEPTH TO THE CLAYEY SANDY GRAVEL AND COBBLES FOUND BELOW THE NON PLASTIC ACTIVE BED MATERIAL. A FLOOD CONTROL DAM IS PRESENT APPROXIMATELY ONE (1) MILE UPSTREAM FROM THE SITE. THE SCOUR POTENTIAL SHOULD BE CALCULATED AND THE GABIONS SHOULD BE FOUNDED AT A DEPTH SUFFICIENT TO PROVIDE SCOUR PROTECTION. RECOMMENDATIONS FOR BUILDING SITE PREPARATION FOR EARTHWORK ARE AS FOLLOWS:

SITE PREPARATION:

1. REMOVE VEGETATION AND DEBRIS. EXCAVATE FOUNDATION TRENCH TO A DEPTH A MINIMUM OF TWO (2) FEET BELOW THE CALCULATED SCOUR DEPTH OR SEVEN (7) FEET, WHICHEVER IS DEEPER.
2. SLOPING SURFACES SHOULD BE BENCHED TO PREVENT A SLIPPAGE PLANE BETWEEN CUT/FILL AREAS.

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COMPACTION OF SUBSOILS AND PLACEMENT AND COMPACTION OF ALL FILL ZONES SHOULD BE ACCOMPLISHED UNDER CONTROL. MATERIAL AND COMPACTION SPECIFICATIONS ARE PRESENTED IN THIS REPORT UNDER "EARTHWORK".

IT IS RECOMMENDED THAT THE GABIONS BE FOUNDED A MINIMUM OF 7 FEET BELOW EXISTING CHANNEL GRADE PROVIDED THE EARTHWORK IS ACCOMPLISHED IN ACCORDANCE WITH THE RECOMMENDATIONS IN THIS REPORT. A SAFE SOIL BEARING PRESSURE OF 4000 P. S. F. SHOULD NOT BE EXCEEDED IN THE DESIGN OF FOOTINGS AT OR BELOW THE RECOMMENDED MINIMUM DEPTH.

THE ESTIMATED FOOTING SETTLEMENTS SHOULD BE WITHIN TOLERABLE LIMITS (1/4 TO 1/2") IF CONSTRUCTED IN ACCORDANCE WITH THE RECOMMENDATIONS CONTAINED IN THIS REPORT.

IT IS RECOMMENDED THAT THE FOOTING EXCAVATIONS BE INSPECTED TO ENSURE THAT THEY ARE FREE OF LOOSE SOIL WHICH MAY HAVE BLOWN OR SLOUGHED INTO THE EXCAVATIONS AND THAT THE GABIONS WILL BEAR UPON FIRM NATIVE SOILS.

LATERAL LOADINGS:

THE FOLLOWING DESIGN PARAMETERS ARE PRESENTED FOR LATERAL

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STABILITY ANALYSIS:

FOUNDATION TOE PRESSURES:	1.33 X MAX. ALLOWABLE
LATERAL BACKFILL PRESSURES:	
UNRESTRAINED WALLS	35 PSF/FT
RESTRAINED WALLS	55 PSF/FT
LATERAL PASSIVE PRESSURES:	
CONTINUOUS WALLS OR FOOTINGS	475 PSF/FT
COEFFICIENT OF BASE FRICTION:	0.70

THE ABOVE VALUES FOR BACKFILL PRESSURES DO NOT INCLUDE TEMPORARY FORCES IMPOSED DURING COMPACTION OF THE BACKFILL, SWELLING PRESSURES DEVELOPED BY OVER-COMPACTED CLAYEY BACKFILL SOILS OR HYDROSTATIC PRESSURES FROM INUNDATION OF BACKFILLS. WALLS SHOULD BE SUITABLY BRACED DURING BACKFILLING TO PREVENT DAMAGE AND DEFLECTION.

OVERALL STABILITY ANALYSIS:

AN OVERALL STABILITY ANALYSIS OF EACH OF THE FOUR(4) WALL TYPES WAS PERFORMED USING THE ORDINARY METHOD OF SLICES. THE CALCULATED FACTOR OF SAFETY FOR THE 5 METER WALL WAS 1.63. THE CALCULATED FACTOR OF SAFETY FOR THE 6 METER WALL WAS 1.98. THE CALCULATED FACTOR OF SAFETY FOR THE 7 METER WALL WAS 2.21. THE CALCULATED FACTOR OF SAFETY FOR THE 8 METER WALL WAS 2.69. THE FACTOR OF SAFETY FOR ALL WALL TYPES AGAINST A SLIP BELOW THE WALL (GABIONS) WHEN FULL SCOUR CONDITIONS EXIST (COMPLETE EXPOSURE ABOVE THE FOOTING) IS IN EXCESS OF THE 1.3 MINIMUM FACTOR OF SAFETY TYPICALLY

TERRAMAR NEW RIVER BANK PROTECTION
NEW RIVER N/O HAPPY VALLEY ROAD
PEORIA, ARIZONA

USED FOR RETAINING WALL STRUCTURES.

STATEMENT REGARDING GEOLOGICAL FAULTS

THIS PROJECT IS NOT LOCATED OVER ANY KNOWN ACTIVE FAULTS OR FAULT-ASSOCIATED DISTURBED ZONES AND NO ADVERSE GEOLOGICAL PROBLEMS ARE PRESENT.

LIMITATIONS:

THE RECOMMENDATIONS CONTAINED IN THIS REPORT ARE BASED ON THE ASSUMPTION THAT THE SOIL CONDITIONS DO NOT DEVIATE APPRECIABLY FROM THOSE DISCLOSED BY THE TEST HOLES. SHOULD UNUSUAL MATERIAL OR CONDITIONS BE ENCOUNTERED DURING CONSTRUCTION, THE SOIL ENGINEER SHOULD BE NOTIFIED SO THAT HE MAY MAKE SUPPLEMENTAL RECOMMENDATIONS IF THIS SHOULD BE REQUIRED. THIS REPORT IS ISSUED WITH THE UNDERSTANDING THAT IT IS THE RESPONSIBILITY OF THE OWNER TO SEE THAT ITS PROVISIONS ARE CARRIED OUT OR BROUGHT TO THE ATTENTION OF THOSE CONCERNED.

THE FINDINGS OF THIS REPORT ARE CONSIDERED VALID AS OF THE PRESENT DATE. HOWEVER, CHANGES IN THE CONDITIONS OF THE SITE CAN OCCUR WITH THE PASSAGE OF TIME, WHETHER THEY BE DUE TO NATURAL EVENTS OR TO HUMAN ACTIVITIES ON THIS OR ADJACENT SITES. IN ADDITION, CHANGES IN APPLICABLE OR APPROPRIATE CODES AND STANDARDS MAY OCCUR, WHETHER THEY RESULT FROM LEGISLATION OR THE BROADENING OF KNOWLEDGE. ACCORDINGLY, THIS REPORT MAY BECOME INVALIDATED

TERRAMAR NEW RIVER BANK PROTECTION
NEW RIVER N/O HAPPY VALLEY ROAD
PEORIA, ARIZONA

WHOLLY OR PARTIALLY BY CHANGES OUTSIDE OUR CONTROL. THEREFORE, THIS REPORT IS SUBJECT TO REVIEW AND REVISION AS CHANGED CONDITIONS ARE IDENTIFIED.

EARTHWORK

TERRAMAR NEW RIVER BANK PROTECTION
NEW RIVER N/O HAPPY VALLEY ROAD
PEORIA, ARIZONA

SPECIFICATION FOR GRADING

1. CLEARING BUILDING AREAS:

   CLEAR AND PREPARE BUILDING SITES TO DEPTHS AND LIMITS DESIGNATED IN THIS REPORT UNDER THE HEADING "FOUNDATIONS" (PAGES 4 THRU 5).

2. FILL MATERIAL:

   ALL FILL MATERIAL SHALL BE FREE OF VEGETATIVE MATTER, DELETERIOUS OR FOREIGN MATERIAL ONSITE SOILS ARE SUITABLE FOR FILL BUT MAY CONTAIN OVERSIZED MATERIAL.

3. DEPTH AND MIXING OF FILL LAYERS:

   FILL MATERIAL SHALL BE PLACED IN LAYERS, WHICH WHEN COMPACTED SHALL NOT EXCEED 6 INCHES. EACH LAYER SHALL BE PLACED EVENLY AND THOROUGHLY MIXED DURING SPREADING TO ENSURE UNIFORMITY OF MOISTURE THROUGHOUT EACH LAYER.

4. MOISTURE CONTENT:

   FILL MATERIAL SHALL BE COMPACTED TO THE SPECIFIED DENSITY AT OR NEAR THE OPTIMUM MOISTURE CONTENT (PLUS OR MINUS 2%) FOR NATIVE AND APPROVED IMPORT LOW SWELL POTENTIAL SOILS.

5. AMOUNT OF COMPACTION:

   AFTER EACH LAYER HAS BEEN PLACED, MIXED AND SPREAD EVENLY, IT SHALL BE COMPACTED TO THE FOLLOWING DENSITIES:

MATERIAL	RECOMMENDED COMPACTION
APPROVED IMPORTED AND NATIVE LOW SWELL POTENTIAL SOILS:	95% MINIMUM

TERRAMAR NEW RIVER BANK PROTECTION
NEW RIVER N/O HAPPY VALLEY ROAD
PEORIA, ARIZONA

6. COMPACTION OF EACH LAYER:

COMPACTION EQUIPMENT SHALL BE OF SUCH DESIGN THAT IT WILL BE ABLE TO COMPACT THE FILL TO THE SPECIFIED DENSITY. COMPACTION OF EACH LAYER SHALL BE CONTINUOUS OVER ITS ENTIRE AREA AND THE COMPACTION EQUIPMENT SHALL MAKE SUFFICIENT TRIPS TO ENSURE THAT DENSITY HAS BEEN OBTAINED.

7. DENSITY TESTS:

A FIELD DENSITY TEST SHOULD BE TAKEN FOR EACH TWELVE (12) INCHES OF COMPACTED FILL OR AT THE DISCRETION OF THE INSPECTING ENGINEER.

8. OBSERVATION:

OBSERVATION BY THE GEOTECHNICAL ENGINEER SHOULD BE CONTINUOUS DURING THE GRADING OPERATIONS SO THAT HE MAY VERIFY THAT ALL CUT AND FILL AREAS WERE GRADED IN ACCORDANCE WITH THE SPECIFICATIONS. THIS OFFICE SHOULD BE NOTIFIED PRIOR TO EARTHWORK OPERATIONS SO THAT OBSERVATION CAN BE PROVIDED.

9. SEASONAL LIMITS:

WHEN WORK IS INTERRUPTED BY HEAVY RAINS, FILL OPERATIONS SHALL NOT BE RESUMED UNTIL THE GEOTECHNICAL ENGINEER INDICATES THAT THE MOISTURE CONTENT AND DENSITY OF THE PREVIOUSLY PLACED FILL ARE AS SPECIFIED.

10. FILLS CONSTRUCTED IN ACCORDANCE WITH THESE SPECIFICATIONS WILL SATISFY FEMA AND CITY OF PEORIA REQUIREMENTS.

TERRAMAR NEW RIVER BANK PROTECTION
NEW RIVER N/O HAPPY VALLEY ROAD
PEORIA, ARIZONA

11. AFTER THE GEOTECHNICAL ENGINEER HAS TERMINATED HIS OBSERVATION AND TESTING OF THE COMPLETED GRADING, NO FURTHER EXCAVATIONS AND/OR FILLING SHALL BE PERFORMED WITHOUT THE APPROVAL OF THE GEOTECHNICAL ENGINEER, IF THE ADDITIONAL EARTHWORK IS TO BE SUBJECT TO THE RECOMMENDATIONS OF THIS REPORT.

PART II

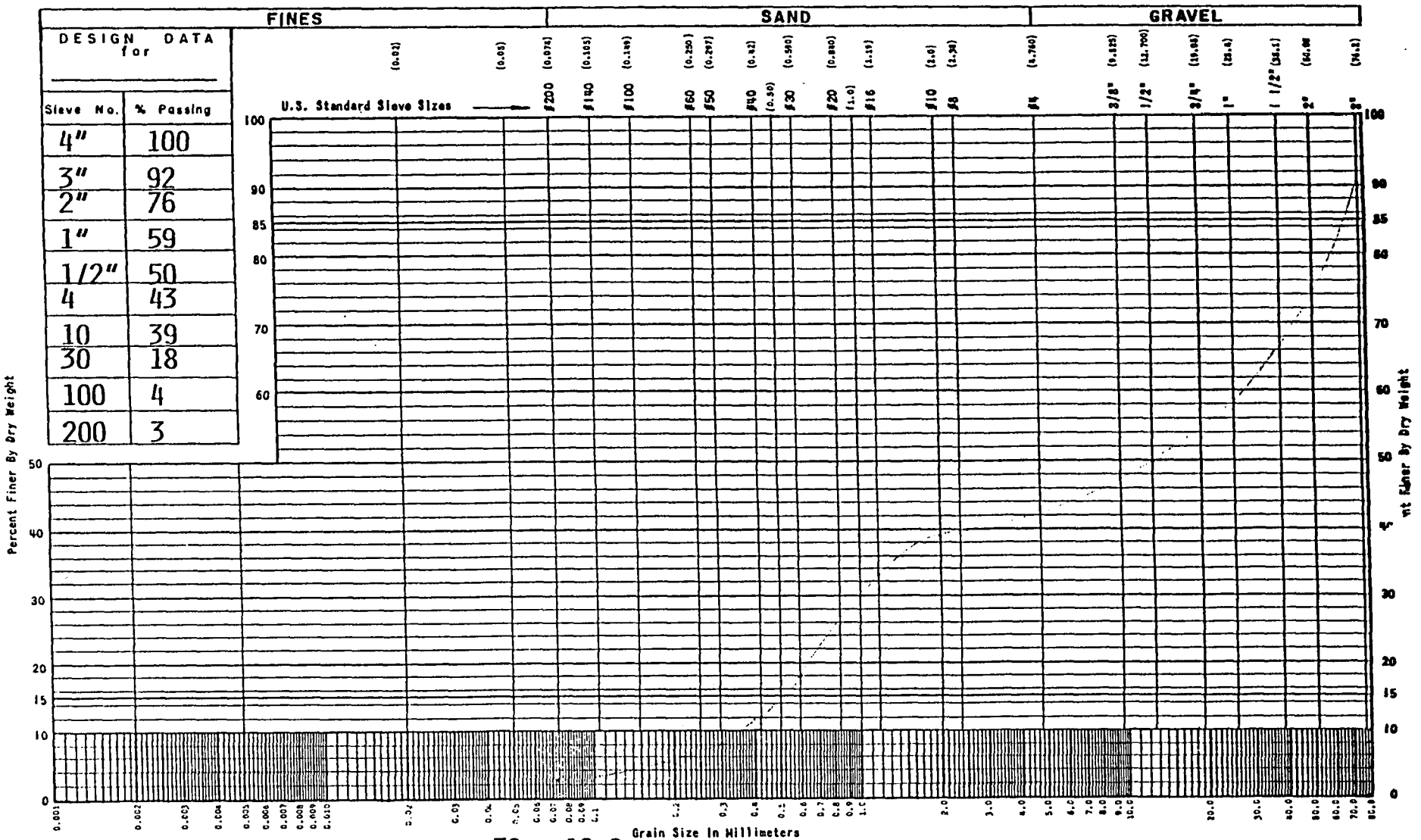
LABORATORY ANALYSIS

Construction Inspection & Testing Co.

GRAIN SIZE DISTRIBUTION GRAPH

Project TERRAMAR NEW RIVER BANK PROTECTION Location TH4 0-4'

DESIGN DATA for	
Sieve No.	% Passing
4"	100
3"	92
2"	76
1"	59
1/2"	50
4	43
10	39
30	18
100	4
200	3



LIQUID LIMIT - -

PLASTIC LIMITE - NP

PLASTICITY INDEX NP

D50 = 12.8 MM

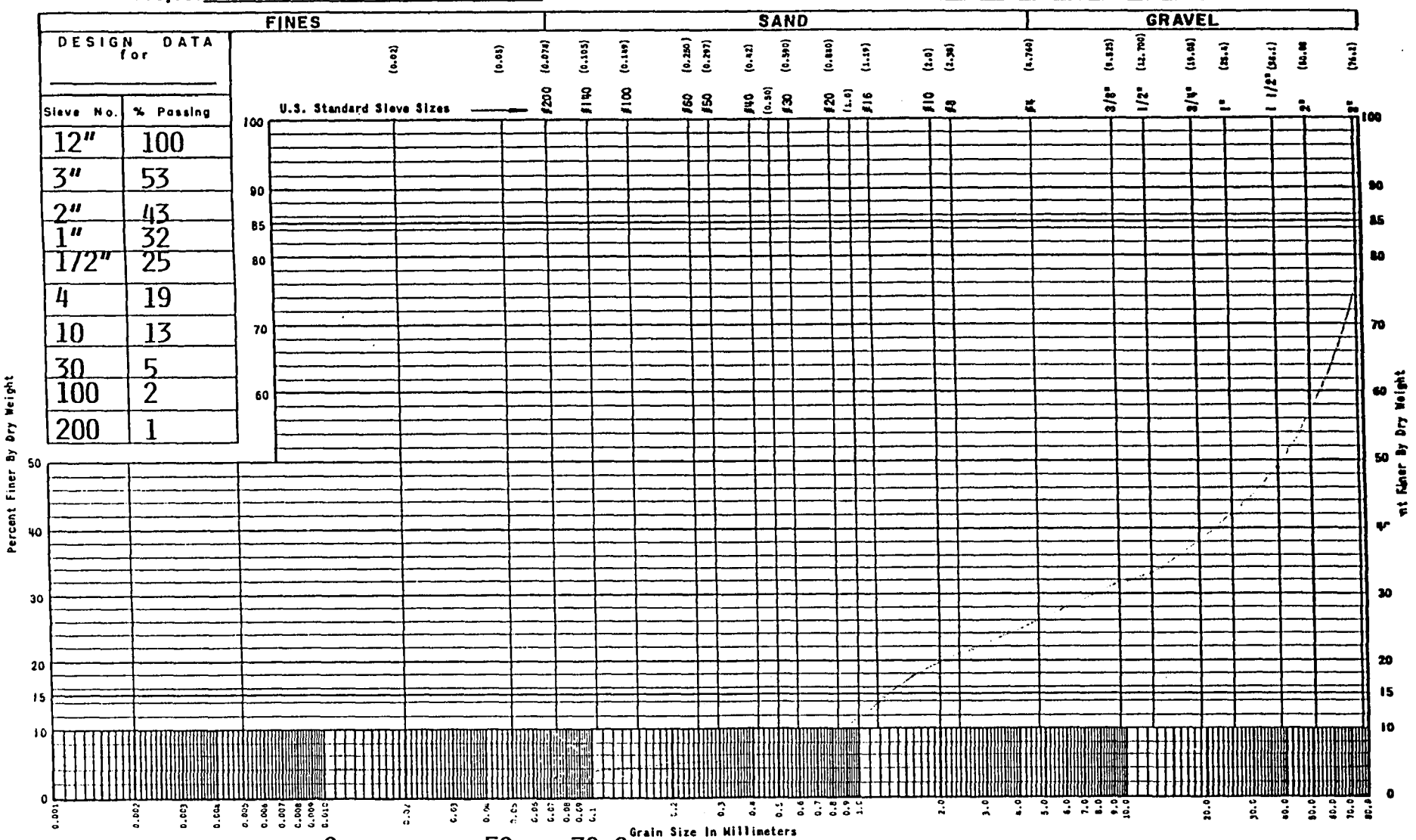
Sheet No.___of___

Construction Inspection & Testing Co.

GRAIN SIZE DISTRIBUTION GRAPH

Project TERRAMAR NEW RIVER BANK PROTECTION Location TH5 0-5'

DESIGN DATA for	
Sieve No.	% Passing
12"	100
3"	53
2"	43
1"	32
172"	25
4	19
10	13
30	5
100	2
200	1



LIQUID LIMIT - 0

PLASTIC LIMIT - NP

PLASTICITY INDEX NP

D50 = 70.0 MM

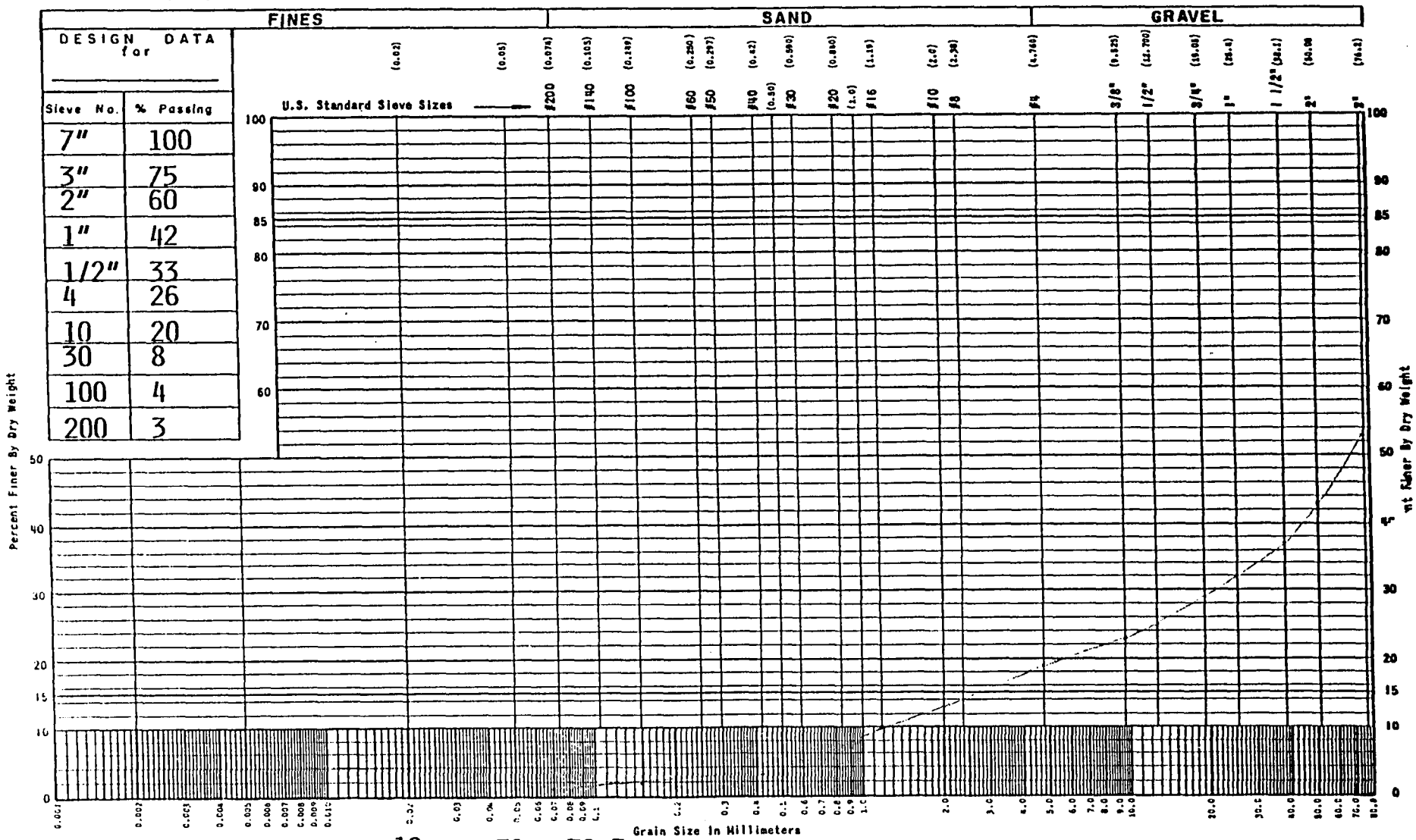
Sheet No.___of___

Construction Inspection & Testing Co.

GRAIN SIZE DISTRIBUTION GRAPH

Project TERRAMAR NEW RIVER BANK PROTECTION Location TH6 0-5'

DESIGN DATA for _____	
Sieve No.	% Passing
7"	100
3"	75
2"	60
1"	42
1/2"	33
4	26
10	20
30	8
100	4
200	3



LIQUID LIMIT - 18 D50 = 39.5 MM

PLASTIC LIMIT - 17

PLASTICITY INDEX 1

Sheet No.___of___

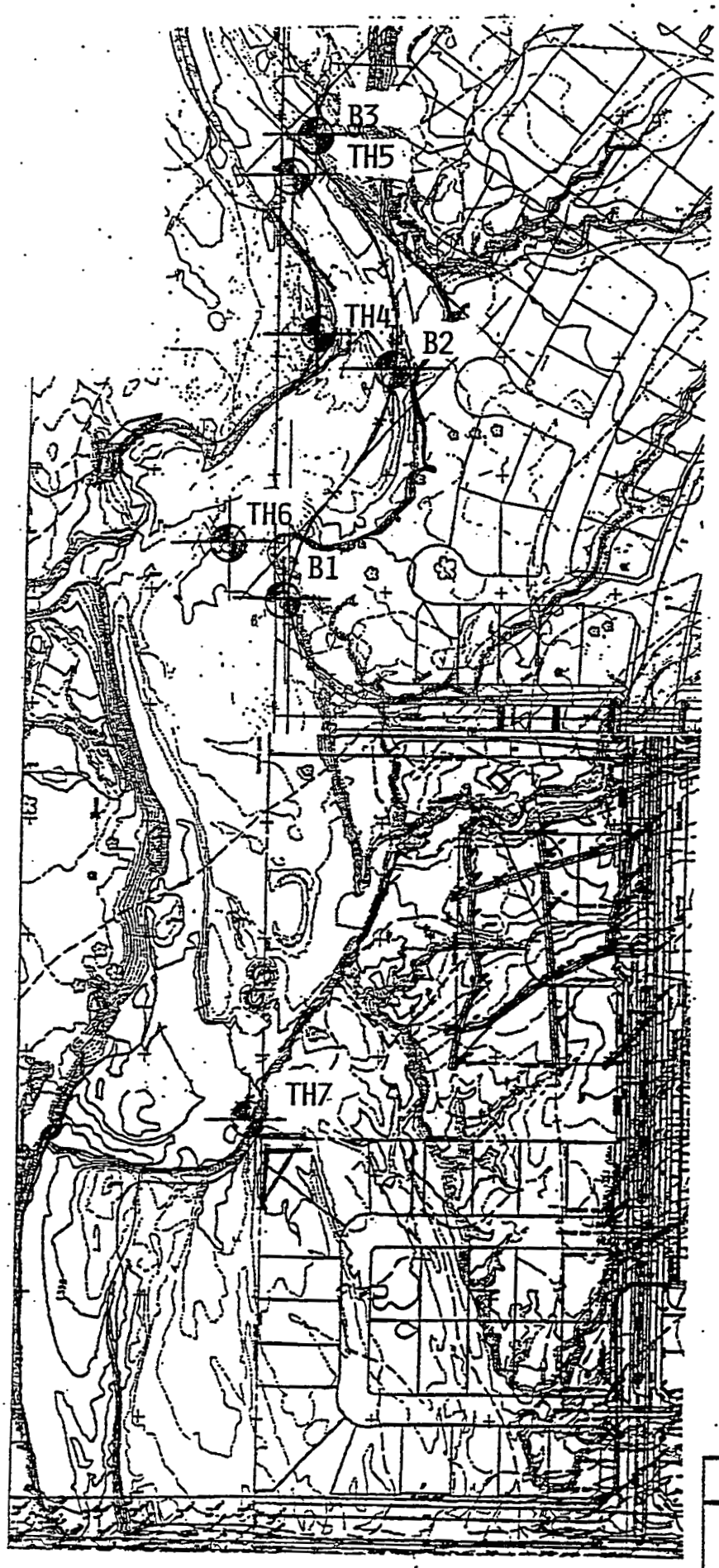
TERRAMAR NEW RIVER BANK PROTECTION
NEW RIVER N/O HAPPY VALLEY ROAD
PEORIA, ARIZONA

STANDARD PROCTOR

LOCATION	DEPTH	MAX. DRY DENSITY	OPTIMUM MOISTURE
B1	0-5'	129.5 PCF	9.2%
B3	0-5'	129.3 PCF	9.7%

PART III

SITE PLAN



SITE PLAN

TEST HOLE LOCATIONS

TERRAMAR NEW RIVER
BANK PROTECTION
NEW RIVER N/O HAPPY VALLEY
PEORIA, ARIZONA

PART IV

FIELD INVESTIGATION

Construction Inspection & Testing Co.

BORING LOG

FOR: RICHFIELD INV. CORP.
PROJECT: NEW RIVER CHANNEL
LOCATION OF PROJECT: NEW RIVER, N/O HAPPY VALLEY RD.

DATE: 7/13/98 PROJ. NO 98-7577
TYPE OF BORING: CME55 – 6 5/8" AUGER
FIELD PARTY:

BORING NO. B1
LOCATION: SEE SITE PLAN

1-		SAND, GRAVEL & COBBLES, NON PLASTIC, DAMP, GRAY
2-		CLAYEY SAND, GRAVEL & COBBLES, MEDIUM-LOW PI, DAMP, GRAY-BROWN HARD DRILLING
3-		
4-		
5-		
6-	50/ 3"	
	N	
7-		AUGER REFUSAL AT 7'
8-	50/ 3"	
	N	
9-		
10-		

BORING NO. B2
LOCATION: SEE SITE PLAN

1-		SAND W/GRAVEL & COBBLES, NON PLASTIC, MOIST, GRAY
2-		
3-		
4-		
5-		
6-	50/ 4"	
	N	AUGER REFUSAL AT 6'
7-		
8-		
9-		
10-		

Construction Inspection & Testing Co.

BORING LOG

FOR: RICHFIELD INV. CORP.
PROJECT: NEW RIVER CHANNEL
LOCATION OF PROJECT: NEW RIVER, N/O HAPPY VALLEY RD.
BORING NO. B3
LOCATION: SEE SITE PLAN

DATE: 7/13/98 PROJ. NO 98-7577
TYPE OF BORING: CME55 – 6 5/8" AUGER
FIELD PARTY:

		SAND & GRAVEL W/COBBLES, NON PLASTIC, MOIST, GRAY
1-		
2-		
3-		
4-		
5-		
		CLAYEY SAND, GRAVEL & COBBLES, LOW PI, DAMP, GRAY-BROWN
6-		
		AUGER REFUSAL AT 6.5'
7-		
8-		
9-		
10-		

BORING NO. TH4
LOCATION: SEE SITE PLAN

		SAND & GRAVEL, SOME SILT, NON PLASTIC, MOIST, GRAY
1-		
2-		
3-		
4-		WITH COBBLES BELOW 4'
5-		
		SAND W/SOME SILT & FINE GRAVEL, NON PLASTIC
6-		
7-		
8-		
		SAND & GRAVEL W/COBBLES, NON PLASTIC, MOIST, GRAY
9-		
10-		CLAYEY SAND & GRAVEL W/ COBBLES, MEDIUM PI, MOIST, BROWN
		BOTTOM AT 10.5'

Construction Inspection & Testing Co.

BORING LOG

FOR: RICHFIELD INV. CORP.
PROJECT: NEW RIVER CHANNEL
LOCATION OF PROJECT: NEW RIVER, N/O HAPPY VALLEY RD.
BORING NO. TH5
LOCATION: SEE SITE PLAN

DATE: 7/13/98 PROJ. NO 98-7577
TYPE OF BORING: CME55 – 6 5/8" AUGER
FIELD PARTY:
BORING NO. TH6
LOCATION: SEE SITE PLAN

1-		SAND, GRAVEL & COBBLES W/ SOME SILT, LOW PI, MOIST, GRAY
2-		
3-		SOME CLAY BALLS BELOW 3' DEPTH
4-		
5-		
6-		
7-		CLAYEY SAND, GRAVEL & COBBLES, MED-LOW PI, MOIST, BROWN
8-		BOTTOM AT 7'
9-		
10-		

1-		SAND & GRAVEL W/COBBLES, NON PLASTIC, MOIST, GRAY
2-		
3-		
4-		
5-		
6-		
7-		CLAYEY SAND, GRAVEL & COBBLES, MEDIUM PI, MOIST BROWN
8-		BOTTOM AT 7'
9-		
10-		

Construction Inspection & Testing Co.

BORING LOG

FOR: RICHFIELD INV. CORP.
PROJECT: NEW RIVER CHANNEL
LOCATION OF PROJECT: NEW RIVER, N/O HAPPY VALLEY RD.
BORING NO. TH7
LOCATION: SEE SITE PLAN

DATE: 7/13/98 PROJ. NO 98-7577
TYPE OF BORING: CME55 – 6 5/8" AUGER
FIELD PARTY:

BORING NO.
LOCATION:

1-		CLAYEY SILTY SAND, MEDIUM TO FINE, LOW PI, MOIST, BROWN
2-		CLAYEY SAND & GRAVEL W/ COBBLES, LOW PI, MOIST, BROWN
3-		
4-		CLAYEY SAND & GRAVEL & COBBLES, MEDIUM PI, MOIST, BROWN (HARD DIGGING)
5-		
6-		
7-		
8-		WEAK CEMENTATION BELOW 7' (HARD DIGGING)
9-		
10-		BOTTOM AT 10'

1-		
2-		
3-		
4-		
5-		
6-		
7-		
8-		
9-		
10-		

APPENDIX F

FLOODWALL STRUCTURAL CALCULATIONS

TERRAMAR FLOODWALL STRUCTURES
NEW RIVER NORTH OF HAPPY VALLEY ROAD
PEORIA, ARIZONA

STRUCTURAL CALCULATIONS

G&A Job No. 8182 S

GERVASIO & ASSOC., INC.
4527 NORTH 16TH STREET, SUITE 200
PHOENIX, ARIZONA 85016-5344

STRUCTURAL, FORENSIC, CIVIL ENGINEERS & SURVEYORS

GERVASIO & ASSOC., INC.
CONSULTING ENGINEERS
(602) 285-1720 • 4527 North 16th Street, Suite 200
Phoenix, Arizona 85016-5344

JOB NO.: 8182

BY: MB

CALCULATIONS

PROJECT: TERRAMAR FLOODWALL STRUCTURES
NEW RIVER N/O HAPPY VALLEY RD.
PEORIA, ARIZONA

CLIENT:

ITEM	SHEET
Design Criteria	D-1
6.5' retaining wall	W-1
7.5' retaining wall	W-6
10.33' retaining wall	W-8
15' retaining wall	W-12

These calculations are an instrument of service and are the property of GERVASIO & ASSOCIATES, INC. They are only for this project and location and may not be reproduced without written permission.

REGISTERED PROFESSIONAL ENGINEER (STRUCTURAL)
CERTIFICATE NO. 20385
RAYMOND E. BELTRAN
Date Signed
ARIZONA, U.S.A.
Raymond E. Beltran
4/29/98

GERVASIO & ASSOC., INC.
CONSULTING ENGINEERS
(602) 285-1720 • 4527 N. 16th ST., SUITE 200
PHOENIX, ARIZONA 85016

Date 9.98 Job No. 8182
By MB Sheet No. D1

GENERAL - DESIGN CRITERIA

CODE 1994 UBC

DESIGN CRITERIA

LATERAL LOADS: WIND: 70 MPH BASIC WIND SPEED EXPOSURE C

SEISMIC ZONE 2 Z = 0.075

ALLOWABLE STRESSES

CONCRETE: REGULAR WT. CONC. f'c = 3000 PSI

STRUCTURAL DESIGN BASED ON f'c = 2500 PSI
SPECIAL STRUCTURAL INSPECTION REQ'D

REINF. STEEL: ASTM A 615 - S1, GRADE 60, Fy = 60 KSI

SOIL: Q MAX = 3325 PSF @ 1.5' MIN. BELOW GRADE

SOIL REPORT BY CONSTRUCTION INSPECTION & TESTING

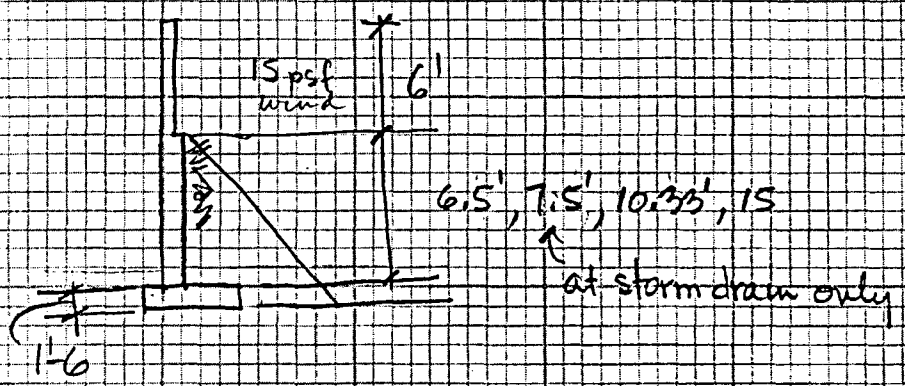
DATED SEPT 17, 1998 JOB # 98-8588

W/ SUPPLEMENTARY LETTER DATED SEPT. 17, 1998

GERVASIO & ASSOC. INC.
CONSULTING ENGINEERS
(602) 285-1720 • 4527 N. 16th Street, Suite 200
PHOENIX, ARIZONA 85016-5344

Date 9.98 Job No. 8182
By MB Sheet No. W.1

Design Criteria



$p = 2500 \times 1.33 = 3325$ psf

$p_a = 30$ psf/ft

$p_p = 250$ psf/ft

$\mu = 0.30$ w/ passive pressure

from Construction Inspection & Testing Co letter dated Sept. 17, 1998

Job No. 8182

Sheet No. W.2

ervasio & Associates, Inc.
ONSULTING ENGINEERS
527 N. 16th St. Suite 200
hoenix, AZ 85016
602) 285-1720

Title: terramar
Descr: 6'wall w/6'fence

Page of

Job #: 8182 By:mb Date: 9/21/98
RetainPro 3.1(c)1993 File:RETAINPR.RPF

CANTILEVERED RETAINING WALL DESIGN

SOIL DATA

Allowable Bearing	=	3,325 psf
Active Lateral EFP	=	30.0 psf
....Slope Active	=	0.0 psf
..Active Press Limit	=	N/A psf
Bkfill Slope(0=level)	=	0.0:1
Passive Lateral	=	250 pcf
Soil Density	=	110.0 pcf
Soil Ht over Toe	=	0.0 in

ADDED VERTICAL LOADS

Axial DL on Stem	=	0 plf
Axial LL on Stem	=	0 plf
..Ecc Left of Stem CL	=	0.00 in
Surcharge over Toe	=	0.0 psf
Surcharge over Heel	=	0.0 psf
Using Surcharge to resist overturning @ Heel	:	Yes
@ Toe	:	Yes

ADDED LATERAL LOADS

Lateral Load Acting On Stem Above Soil	=	15.00 psf
Add'l Lateral Load	=	0.0 plf
...height to stop	=	0.00 ft
...height to start	=	0.00 ft

ADJACENT FOOTING

Vertical load	=	0 plf
...Ecc. (Toe side +)	=	0.00 in
Footing Width (perp)	=	0.00 ft
Face Top Stem to Ftg. CL	=	0.00 ft
Ftg. Base Above/Below Soil At Wall Face [+/-]	=	0.00 ft
Footing Type	:	Line

WALL & FOOTING DATA

Retained Height	=	6.50 ft	Toe Width	=	1.00 ft
Wall Ht. above soil	=	6.00 ft	Heel Width	=	2.50 ft
Total Wall Height	=	12.50 ft			
Key Depth	=	12.00 in	Total Width	=	3.50 ft
Key Width	=	12.00 in	Thickness	=	12.00 in
Key Dist. to Toe	=	1.000 ft			

SUMMARY

Pressure @ Toe	=	2,133 psf	Factors of Safety:		
Pressure @ Heel	=	0 psf	Overturning	=	1.91 :1
Allowable Press.	=	3,325 psf	Sliding	=	1.52 :1
Eccentricity	=	9.81 in	Allowable Shear	=	76.03 psi
Resultant Outside Middle Third			1-Way Shear @ Toe	=	7.5 psi
Note: Pv Not Used for Soil Pres.			1-Way Shear @ Heel	=	19.5 psi

SLIDING CHECK

Ftg/Soil Friction	=	0.300	Tot Lateral Force*1.5	=	1,378.1 #
Soil @ Toe Not Used	=	0.00 in	(-)Passive Pressure	=	500.0 #
Factor of Safety	=	1.52	(-)Friction	=	895.1 #
			Add'l Force Req'd	=	0.0 #

FOOTING DESIGN

(Using ACI Factors)

		Toe	Heel	
ACI 9.1 Pressure	=	2,987	0	psf
Mu - Upward	=	1,315	0	ft-#
Mu - Downward	=	105	2,035	ft-#
Mu - Design	=	1,210	2,035	ft-#
One-Way Shear:				
vu	=	7.49	19.48	psi
vn=2(f'c)1/2*.85	=	76.03	76.03	psi
Rebar CL To Edge	=	3.00	2.00	in
Depth to steel	=	8.50	9.50	in
Ru = Mu/bd^2	=	0.0	25.1	
Min. Rebar Ratio	=	0.0000		

f'c	=	2,000 psi
Fy	=	60,000 psi

Upward soil pres negl'd on heel

Rebar Choices

	Toe(bot)	Heel(top)
#4	@Not Reqd in	37.62 in
#5	@Not Reqd in	48.00 in
#6	@Not Reqd in	48.00 in
#7	@Not Reqd in	48.00 in
#8	@Not Reqd in	48.00 in
#9	@Not Reqd in	48.00 in
#10	@Not Reqd in	48.00 in

Job No. 8182

Sheet No. W.3

ervasio & Associates, Inc.
CONSULTING ENGINEERS
527 N. 16th St. Suite 200
hoenix, AZ 85016
(602) 285-1720

Title: terramar
Descr: 6'wall w/6'fence

Page of
Job #: 8182 By:mb Date: 9/21/98
RetainPro 3.1(c)1993 File:RETAINPR.RPF

STEM DESIGN

(Values shown for concrete stems have been factored)

Stem Construction Data		Highest	|- Descending Stem Sections, Highest @ Left -| (use columns from left to right)	
DESIGN HT. ABOVE FTG.	=	6.50	0.00		ft
WALL TYPE ABOVE HT.	:	Masonry	Concrete		
Thickness (nominal)	=	6.00	8.00		in
Rebar Size	=	# 4	# 4		
Rebar Spacing	=	48.00	12.00		in
Rebar Placed at	:	Center	Edge		
DESIGN DATA.....					
fb/Fb + fa/Fa	=	0.971	0.700		
Lateral Load @ Design Ht	=	90	1,230		#
MOMENT..... Actual	=	270	3,788		ft-#
Allowable	=	278	5,413		ft-#
SHEAR..... Actual	=	2.93	16.41		psi
Allowable	=	22.33	85.00		psi
Embedment Length Req'd	=	19.23	6.49		
Wall Weight	=	58.0	100.0		psf
Rebar Placed at Depth 'd'	=	2.75	6.25		in
MASONRY DATA.....					
f'm	=	1,500			psi
Fs	=	24,000			psi
Grouting	:	Full			
Special Inspection	:	No			
n : Es / Em	=	25.78			
Short Term Increase	=	1.33			
CONCRETE DATA.....					
f'c	=		2,500		psi
Fy	=		60,000		psi

SUMMARY OF FORCES & MOMENTS

Origin of Force:		|- Overturning Moments -| #	ft	ft-#	|- Resisting Moments -| #	ft	ft-#
Heel Active Press.	=	844	2.50	2,109				
Soil over Heel	=				1,311	2.58	3,386
Toe Active Press.	=	-15	0.33	-5			
Soil over Toe	=				0	0.00	0
Sloped Soil @ Heel	=				0	0.00	0
Adjacent Ftg. Load	=	0	0.00	0	0	0.00	0
Surcharge @ Heel	=				0	0.00	0
Surcharge @ Toe	=	0	0.00	0	0	0.00	0
Axial Load on Wall	=			0	0	0.00	0
Load @ Proj. Wall	=	90	10.50	945			
Averaged Stem Wts.	=				998	1.30	1,302
Earth Behind Stem	=				0	0.00	0
Added Lateral Load	=	0	0.00	0			
Footing Weight	=				525	1.75	919
Key Weight	=				150	1.50	225
Vert. Componant of Active Press.	=				0	0.00	0
TOTALS	=	919		3,049	2,984		5,832

Totals used for Soil Pressure, Pv Not Included= 2,984 5,832

Job No. 8182
Sheet No. W.4

ervasio & Associates, Inc.
CONSULTING ENGINEERS
527 N. 16th St. Suite 200
hoenix, AZ 85016
(602) 285-1720

Title: terramar
Descr: 6.5'wall w/6'fence no wind
Page of
Job #: 8182 By:mb Date: 9/25/98
RetainPro 3.1(c)1993 File:RETAINPR.RPF

CANTILEVERED RETAINING WALL DESIGN

SOIL DATA

Allowable Bearing	=	3,325 psf
Active Lateral EFP	=	30.0 psf
....Slope Active	=	0.0 psf
..Active Press Limit	=	N/A psf
Bkfill Slope(0=level)	=	0.0:1
Passive Lateral	=	250 pcf
Soil Density	=	110.0 pcf
Soil Ht over Toe	=	0.0 in

ADDED VERTICAL LOADS

Axial DL on Stem	=	0 plf
Axial LL on Stem	=	0 plf
..Ecc Left of Stem CL	=	0.00 in
Surcharge over Toe	=	0.0 psf
Surcharge over Heel	=	0.0 psf
Using Surcharge to resist overturning @ Heel	:	Yes
@ Toe	:	Yes

ADDED LATERAL LOADS

Lateral Load Acting On Stem Above Soil	=	0.00 psf
Add'l Lateral Load	=	0.0 plf
...height to stop	=	0.00 ft
...height to start	=	0.00 ft

ADJACENT FOOTING

Vertical load	=	0 plf
...Ecc. (Toe side +)	=	0.00 in
Footing Width (perp)	=	0.00 ft
Face Top Stem to Ftg. CL	=	0.00 ft
Ftg. Base Above/Below Soil At Wall Face [+/-]	=	0.00 ft
Footing Type	:	Line

WALL & FOOTING DATA

Retained Height	=	6.50 ft	Toe Width	=	1.00 ft
Wall Ht. above soil	=	6.00 ft	Heel Width	=	2.50 ft
Total Wall Height	=	12.50 ft			
Key Depth	=	12.00 in	Total Width	=	3.50 ft
Key Width	=	12.00 in	Thickness	=	12.00 in
Key Dist. to Toe	=	1.000 ft			

SUMMARY

Pressure @ Toe	=	1,584 psf	Factors of Safety:		
Pressure @ Heel	=	121 psf	Overturning	=	2.77 :1
Allowable Press.	=	3,325 psf	Sliding	=	1.68 :1
Eccentricity	=	6.01 in	Allowable Shear	=	76.03 psi
Resultant Within Middle Third			1-Way Shear @ Toe	=	5.5 psi
Note: Pv Not Used for Soil Pres.			1-Way Shear @ Heel	=	19.5 psi

SLIDING CHECK

Ftg/Soil Friction	=	0.300	Tot Lateral Force*1.5	=	1,243.1 #
Soil @ Toe Not Used	=	0.00 in	(-)Passive Pressure	=	500.0 #
Factor of Safety	=	1.68	(-)Friction	=	895.1 #
			Add'l Force Req'd	=	0.0 #

FOOTING DESIGN

(Using ACI Factors)		Toe	Heel			
ACI 9.1 Pressure	=	2,218	169	psf	f'c	= 2,000 psi
Mu - Upward	=	1,012	0	ft-#	Fy	= 60,000 psi
Mu - Downward	=	105	2,035	ft-#	Upward soil pres negl'd on heel	
Mu - Design	=	907	2,035	ft-#	-------- Rebar Choices --------	
One-Way Shear:					Toe(bot)	Heel(top)
vu	=	5.50	19.48	psi	#4 @Not Reqd in	37.62 in
vn=2(f'c)1/2*.85	=	76.03	76.03	psi	#5 @Not Reqd in	48.00 in
Rebar CL To Edge	=	3.00	2.00	in	#6 @Not Reqd in	48.00 in
Depth to steel	=	8.50	9.50	in	#7 @Not Reqd in	48.00 in
Ru = Mu/bd^2	=	0.0	25.1		#8 @Not Reqd in	48.00 in
Min. Rebar Ratio	=	0.0000			#9 @Not Reqd in	48.00 in
					#10 @Not Reqd in	48.00 in

Job No. 8182

Sheet No. W.5

ervasio & Associates, Inc.
ONSULTING ENGINEERS
527 N. 16th St. Suite 200
oenix, AZ 85016
02) 285-1720

Title: terramar
Descr: 6.5'wall w/6'fence no wind
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Job #: 8182 By:mb Date: 9/25/98
RetainPro 3.1(c)1993 File:RETAINPR.RPF

STEM DESIGN

(Values shown for concrete stems have been factored) Pg 2 of 2

Stem Construction Data		Highest	
		|- Descending Stem Sections, Highest @ Left -| (use columns from left to right)	
DESIGN HT. ABOVE FTG.	=	6.50	0.00	ft
WALL TYPE ABOVE HT.	:	Masonry	Concrete	
Thickness (nominal)	=	6.00	8.00	in
Rebar Size	=	# 4	# 4	
Rebar Spacing	=	48.00	12.00	in
Rebar Placed at	:	Center	Edge	
DESIGN DATA.....				
fb/Fb + fa/Fa	=	0.000	0.431	
Lateral Load @ Design Ht	=	0	1,077	#
MOMENT..... Actual	=	0	2,334	ft-#
Allowable	=	278	5,413	ft-#
SHEAR..... Actual	=	0.00	14.37	psi
Allowable	=	22.33	85.00	psi
Embedment Length Req'd	=	12.00	6.00	
Wall Weight	=	58.0	100.0	psf
Rebar Placed at Depth 'd'	=	2.75	6.25	in
MASONRY DATA.....				
f'm	=	1,500		psi
Fs	=	24,000		psi
Grouting	:	Full		
Special Inspection	:	No		
n : Es / Em	=	25.78		
Short Term Increase	=	1.33		
CONCRETE DATA.....				
f'c	=	2,500		psi
Fy	=	60,000		psi

SUMMARY OF FORCES & MOMENTS

Origin of Force:		|- Overturning Moments -| #	ft	ft-#	|- Resisting Moments -| #	ft	ft-#
Heel Active Press.	=	844	2.50	2,109			
Soil over Heel	=				1,311	2.58	3,386
Toe Active Press.	=	-15	0.33	-5			
Soil over Toe	=				0	0.00	0
Sloped Soil @ Heel	=				0	0.00	0
Adjacent Ftg. Load	=	0	0.00	0	0	0.00	0
Surcharge @ Heel	=				0	0.00	0
Surcharge @ Toe	=	0	0.00	0	0	0.00	0
Axial Load on Wall	=			0	0	0.00	0
Load @ Proj. Wall	=	0	0.00	0			
Averaged Stem Wts.	=				998	1.30	1,302
Earth Behind Stem	=				0	0.00	0
Added Lateral Load	=	0	0.00	0			
Footing Weight	=				525	1.75	919
Key Weight	=				150	1.50	225
Vert. Componant of Active Press.	=				0	0.00	0
TOTALS	=	829		2,104	2,984		5,832
Totals used for Soil Pressure, Pv Not Included	=				2,984		5,832

Job No. 8182

Sheet No. W.7

ervasio & Associates, Inc.
CONSULTING ENGINEERS
527 N. 16th St. Suite 200
hoenix, AZ 85016
(602) 285-1720

Title: terramar
Descr: 7.5' wall w/6'fence

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Job #: 8182 By:mb Date: 9/25/98
RetainPro 3.1(c)1993 File:RETAINPR.RPF

STEM DESIGN

(Values shown for concrete stems have been factored)

Stem Construction Data		Highest	|- Descending Stem Sections, Highest @ Left -| (use columns from left to right)	
DESIGN HT. ABOVE FTG.	=	7.50	0.00		ft
WALL TYPE ABOVE HT.	:	Masonry	Concrete		
Thickness (nominal)	=	6.00	8.00		in
Rebar Size	=	# 4	# 5		
Rebar Spacing	=	48.00	12.00		in
Rebar Placed at	:	Center	Edge		
DESIGN DATA.....					
fb/Fb + fa/Fa	=	0.971	0.639		
Lateral Load @ Design Ht	=	90	1,587		#
MOMENT..... Actual	=	270	5,192		ft-#
Allowable	=	278	8,121		ft-#
SHEAR..... Actual	=	2.93	21.38		psi
Allowable	=	22.33	85.00		psi
Embedment Length Req'd	=	19.23	7.33		
Wall Weight	=	58.0	100.0		psf
Rebar Placed at Depth 'd'	=	2.75	6.19		in
MASONRY DATA.....					
f'm	=	1,500			psi
Fs	=	24,000			psi
Grouting	:	Full			
Special Inspection	:	No			
n : Es / Em	=	25.78			
Short Term Increase	=	1.33			
CONCRETE DATA.....					
f'c	=		2,500		psi
Fy	=		60,000		psi

SUMMARY OF FORCES & MOMENTS

Origin of Force:		|- Overturning Moments -| #	ft	ft-#	|- Resisting Moments -| #	ft	ft-#
Heel Active Press.	=	1,084	2.83	3,071					
Soil over Heel	=				2,338	3.08	7,207
Toe Active Press.	=	-15	0.33	-5			
Soil over Toe	=				0	0.00	0
Sloped Soil @ Heel	=				0	0.00	0
Adjacent Ftg. Load	=	0	0.00	0	0	0.00	0
Surcharge @ Heel	=				0	0.00	0
Surcharge @ Toe	=	0	0.00	0	0	0.00	0
Axial Load on Wall	=			0	0	0.00	0
Load @ Proj. Wall	=	90	11.50	1,035			
Averaged Stem Wts.	=				1,098	1.31	1,435
Earth Behind Stem	=				0	0.00	0
Added Lateral Load	=	0	0.00	0			
Footing Weight	=				675	2.25	1,519
Key Weight	=				150	1.50	225
Vert. Componant of Active Press.	=				0	0.00	0
TOTALS	=	1,159		4,101	4,260		10,386

Totals used for Soil Pressure, Pv Not Included= 4,260 10,386

Job No. 8182

Sheet No. W.8

Gervasio & Associates, Inc.
CONSULTING ENGINEERS
527 N. 16th St. Suite 200
Phoenix, AZ 85016
(602) 285-1720

Title: terramar
Descr: 10' wall w/6' fence

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Job #: 8182 By:mb Date: 9/21/98
RetainPro 3.1(c)1993 File:RETAINPR.RPF

CANTILEVERED RETAINING WALL DESIGN

SOIL DATA

Allowable Bearing	=	3,325 psf
Active Lateral EFP	=	30.0 psf
....Slope Active	=	0.0 psf
..Active Press Limit	=	N/A psf
Bkfill Slope(0=level)	=	0.0:1
Passive Lateral	=	250 pcf
Soil Density	=	110.0 pcf
Soil Ht over Toe	=	0.0 in

ADDED VERTICAL LOADS

Axial DL on Stem	=	0 plf
Axial LL on Stem	=	0 plf
..Ecc Left of Stem CL	=	0.00 in
Surcharge over Toe	=	0.0 psf
Surcharge over Heel	=	0.0 psf
Using Surcharge to resist overturning @ Heel	:	Yes
@ Toe	:	Yes

ADDED LATERAL LOADS

Lateral Load Acting On Stem Above Soil	=	15.00 psf
Add'l Lateral Load	=	0.0 plf
...height to stop	=	0.00 ft
...height to start	=	0.00 ft

ADJACENT FOOTING

Vertical load	=	0 plf
...Ecc. (Toe side +)	=	0.00 in
Footing Width (perp)	=	0.00 ft
Face Top Stem to Ftg. CL	=	0.00 ft
Ftg. Base Above/Below Soil At Wall Face [+/-]	=	0.00 ft
Footing Type	:	Line

WALL & FOOTING DATA

Retained Height	=	10.33 ft	Toe Width	=	1.00 ft
Wall Ht. above soil	=	6.00 ft	Heel Width	=	4.17 ft
Total Wall Height	=	16.33 ft			
Key Depth	=	20.00 in	Total Width	=	5.17 ft
Key Width	=	12.00 in	Thickness	=	16.00 in
Key Dist. to Toe	=	1.500 ft			

SUMMARY

Pressure @ Toe	=	3,194 psf	Factors of Safety:		
Pressure @ Heel	=	0 psf	Overturning	=	2.04 :1
Allowable Press.	=	3,325 psf	Sliding	=	1.50 :1
Eccentricity	=	14.03 in	Allowable Shear	=	76.03 psi
Resultant Outside Middle Third			1-Way Shear @ Toe	=	0.0 psi
Note: Pv Not Used for Soil Pres.			1-Way Shear @ Heel	=	36.6 psi

SLIDING CHECK

Ftg/Soil Friction	=	0.300	Tot Lateral Force*1.5	=	3,155.8 #
Soil @ Toe Not Used	=	0.00 in	(-)Passive Pressure	=	1,125.0 #
Factor of Safety	=	1.50	(-)Friction	=	2,035.1 #
			Add'l Force Req'd	=	0.0 #

FOOTING DESIGN

(Using ACI Factors)

		Toe	Heel	
ACI 9.1 Pressure	=	4,472	0	psf
Mu - Upward	=	2,060	0	ft-#
Mu - Downward	=	140	9,400	ft-#
Mu - Design	=	1,920	9,400	ft-#
One-Way Shear:				
vu	=	0.00	36.61	psi
vn=2(f'c)1/2*.85	=	76.03	76.03	psi
Rebar CL To Edge	=	3.00	2.00	in
Depth to steel	=	12.50	13.50	in
Ru = Mu/bd^2	=	0.0	57.3	
Min. Rebar Ratio	=	0.0000		

f'c	=	2,000 psi
Fy	=	60,000 psi

Upward soil pres negl'd on heel

Rebar Choices

	Toe(bot)	Heel(top)
#4	@Not Reqd in	11.46 in
#5	@Not Reqd in	17.77 in
#6	@Not Reqd in	25.22 in
#7	@Not Reqd in	34.39 in
#8	@Not Reqd in	45.28 in
#9	@Not Reqd in	48.00 in
#10	@Not Reqd in	48.00 in

Job No. 8182

Sheet No. W.9

Gervasio & Associates, Inc.
CONSULTING ENGINEERS
527 N. 16th St. Suite 200
Phoenix, AZ 85016
(602) 285-1720

Title: terramar
Descr: 10' wall w/6' fence

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Job #: 8182 By:mb Date: 9/21/98
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STEM DESIGN

(Values shown for concrete stems have been factored)

Stem Construction Data		Highest		-Descending Stem Sections, Highest @ Left-	(use columns from left to right)	
DESIGN HT. ABOVE FTG.	=	10.33	0.00			ft
WALL TYPE ABOVE HT.	:	Masonry	Concrete			
Thickness (nominal)	=	6.00	12.00			in
Rebar Size	=	# 4	# 5			
Rebar Spacing	=	48.00	10.00			in
Rebar Placed at	:	Center	Edge			
DESIGN DATA.....						
fb/Fb + fa/Fa	=	0.971	0.699			
Lateral Load @ Design Ht	=	90	2,874			#
MOMENT..... Actual	=	270	11,409			ft-#
Allowable	=	278	16,319			ft-#
SHEAR..... Actual	=	2.93	23.51			psi
Allowable	=	22.33	85.00			psi
Embedment Length Req'd	=	19.23	8.09			
Wall Weight	=	58.0	150.0			psf
Rebar Placed at Depth 'd'	=	2.75	10.19			in
MASONRY DATA.....						
f'm	=	1,500				psi
Fs	=	24,000				psi
Grouting	:	Full				
Special Inspection	:	No				
n : Es / Em	=	25.78				
Short Term Increase	=	1.33				
CONCRETE DATA.....						
f'c	=		2,500			psi
Fy	=		60,000			psi

SUMMARY OF FORCES & MOMENTS

Origin of Force:		|-Overturning Moments-| #	ft	ft-#	|-Resisting Moments-| #	ft	ft-#
Heel Active Press.	=	2,041	3.89	7,933					
Soil over Heel	=				3,602	3.59	12,913
Toe Active Press.	=	-27	0.44	-12			
Soil over Toe	=				0	0.00	0
Sloped Soil @ Heel	=				0	0.00	0
Adjacent Ftg. Load	=	0	0.00	0	0	0.00	0
Surcharge @ Heel	=				0	0.00	0
Surcharge @ Toe	=	0	0.00	0	0	0.00	0
Axial Load on Wall	=			0	0	0.00	0
Load @ Proj. Wall	=	90	14.66	1,320			
Averaged Stem Wts.	=				1,898	1.45	2,759
Earth Behind Stem	=				0	0.00	0
Added Lateral Load	=	0	0.00	0			
Footing Weight	=				1,034	2.59	2,673
Key Weight	=				250	2.00	500
Vert. Componant of Active Press.	=				0	0.00	0
TOTALS	=	2,104		9,241	6,784		18,846

Totals used for Soil Pressure, Pv Not Included= 6,784 18,846

Job No. [illegible]

Sheet No. W-10

Pervasio & Associates, Inc.
CONSULTING ENGINEERS
1527 N. 16th St. Suite 200
Phoenix, AZ 85016
(602) 285-1720

Title: terramar
Descr: 10'wall w/6' fence no wind
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Job #: 8182 By:mb Date: 9/25/98
RetainPro 3.1(c)1993 File:RETAINPR.RPF

CANTILEVERED RETAINING WALL DESIGN

SOIL DATA

Allowable Bearing	=	3,325 psf
Active Lateral EFP	=	30.0 psf
....Slope Active	=	0.0 psf
..Active Press Limit	=	N/A psf
Bkfill Slope(0=level)	=	0.0:1
Passive Lateral	=	250 pcf
Soil Density	=	110.0 pcf
Soil Ht over Toe	=	0.0 in

ADDED VERTICAL LOADS

Axial DL on Stem	=	0 plf
Axial LL on Stem	=	0 plf
..Ecc Left of Stem CL	=	0.00 in
Surcharge over Toe	=	0.0 psf
Surcharge over Heel	=	0.0 psf
Using Surcharge to resist overturning @ Heel	:	Yes
@ Toe	:	Yes

ADDED LATERAL LOADS

Lateral Load Acting On Stem Above Soil	=	0.00 psf
Add'l Lateral Load	=	0.0 plf
...height to stop	=	0.00 ft
...height to start	=	0.00 ft

ADJACENT FOOTING

Vertical load	=	0 plf
...Ecc. (Toe side +)	=	0.00 in
Footing Width (perp)	=	0.00 ft
Face Top Stem to Ftg. CL	=	0.00 ft
Ftg. Base Above/Below Soil At Wall Face [+/-]	=	0.00 ft
Footing Type	:	Line

WALL & FOOTING DATA

Retained Height	=	10.33 ft	Toe Width	=	1.00 ft
Wall Ht. above soil	=	6.00 ft	Heel Width	=	4.17 ft
Total Wall Height	=	16.33 ft			
Key Depth	=	20.00 in	Total Width	=	5.17 ft
Key Width	=	12.00 in	Thickness	=	16.00 in
Key Dist. to Toe	=	1.500 ft			

SUMMARY

Pressure @ Toe	=	2,808 psf	Factors of Safety:		
Pressure @ Heel	=	0 psf	Overturning	=	2.38 :1
Allowable Press.	=	3,325 psf	Sliding	=	1.57 :1
Eccentricity	=	11.69 in	Allowable Shear	=	76.03 psi
Resultant Outside Middle Third			1-Way Shear @ Toe	=	0.0 psi
Note: Pv Not Used for Soil Pres.			1-Way Shear @ Heel	=	36.6 psi

SLIDING CHECK

Ftg/Soil Friction	=	0.300	Tot Lateral Force*1.5	=	3,020.8 #
Soil @ Toe Not Used	=	0.00 in	(-)Passive Pressure	=	1,125.0 #
Factor of Safety	=	1.57	(-)Friction	=	2,035.1 #
			Add'l Force Req'd	=	0.0 #

FOOTING DESIGN

(Using ACI Factors)	Toe	Heel			
ACI 9.1 Pressure =	3,931	0	psf	f'c =	2,000 psi
Mu - Upward =	1,830	0	ft-#	Fy =	60,000 psi
Mu - Downward =	140	0	ft-#	Upward soil pres negl'd on heel	
Mu - Design =	1,690	9,370	ft-#		
One-Way Shear:		Mu=Stem!			
vu =	0.00	36.61	psi		
vn=2(f'c)1/2*.85=	76.03	76.03	psi		
Rebar CL To Edge =	3.00	2.00	in		
Depth to steel =	12.50	13.50	in		
Ru = Mu/bd^2 =	0.0	57.1			
Min. Rebar Ratio =	0.0000				

Rebar Choices

	Toe(bot)	Heel(top)
#4	@Not Reqd in	11.50 in
#5	@Not Reqd in	17.83 in
#6	@Not Reqd in	25.30 in
#7	@Not Reqd in	34.50 in
#8	@Not Reqd in	45.43 in
#9	@Not Reqd in	48.00 in
#10	@Not Reqd in	48.00 in

Job No. 8182

Sheet No. W-11

Pervasio & Associates, Inc.
CONSULTING ENGINEERS
1527 N. 16th St. Suite 200
Phoenix, AZ 85016
(602) 285-1720

Title: terramar
Descr: 10'wall w/6' fence no wind.

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Job #: 8182 By:mb Date: 9/25/98
RetainPro 3.1(c)1993 File:RETAINPR.RPF

STEM DESIGN

(Values shown for concrete stems have been factored) Pg 2 of 2

Stem Construction Data		Highest		-Descending Stem Sections, Highest @ Left-	(use columns from left to right)	
DESIGN HT. ABOVE FTG.	=	10.33	0.00			ft
WALL TYPE ABOVE HT.	:	Masonry	Concrete			
Thickness (nominal)	=	6.00	12.00			in
Rebar Size	=	# 4	# 5			
Rebar Spacing	=	48.00	10.00			in
Rebar Placed at	:	Center	Edge			
DESIGN DATA.....						
fb/Fb + fa/Fa	=	0.000	0.574			
Lateral Load @ Design Ht	=	0	2,721			#
MOMENT..... Actual	=	0	9,370			ft-#
Allowable	=	278	16,319			ft-#
SHEAR..... Actual	=	0.00	22.26			psi
Allowable	=	22.33	85.00			psi
Embedment Length Req'd	=	12.00	6.61			
Wall Weight	=	58.0	150.0			psf
Rebar Placed at Depth 'd'	=	2.75	10.19			in
MASONRY DATA.....						
f'm	=	1,500				psi
Fs	=	24,000				psi
Grouting	:	Full				
Special Inspection	:	No				
n : Es / Em	=	25.78				
Short Term Increase	=	1.33				
CONCRETE DATA.....						
f'c	=		2,500			psi
Fy	=		60,000			psi

SUMMARY OF FORCES & MOMENTS

Origin of Force:		-Overturning Moments- #	ft	ft-#	-Resisting Moments- #	ft	ft-#
Heel Active Press.	=	2,041	3.89	7,933			
Soil over Heel	=				3,602	3.59	12,913
Toe Active Press.	=	-27	0.44	-12			
Soil over Toe	=				0	0.00	0
Sloped Soil @ Heel	=				0	0.00	0
Adjacent Ftg. Load	=	0	0.00	0	0	0.00	0
Surcharge @ Heel	=				0	0.00	0
Surcharge @ Toe	=	0	0.00	0	0	0.00	0
Axial Load on Wall	=			0	0	0.00	0
Load @ Proj. Wall	=	0	0.00	0			
Averaged Stem Wts.	=				1,898	1.45	2,759
Earth Behind Stem	=				0	0.00	0
Added Lateral Load	=	0	0.00	0			
Footing Weight	=				1,034	2.59	2,673
Key Weight	=				250	2.00	500
Vert. Componant of Active Press.	=				0	0.00	0
TOTALS	=	2,014		7,921	6,784		18,846

Totals used for Soil Pressure, Pv Not Included= 6,784 18,846

Job No. 8182

Sheet No. W-12

ervasio & Associates, Inc.
ONSULTING ENGINEERS
27 N. 16th St. Suite 200
oenix, AZ 85016
602) 285-1720

Title: terramar
Descr: 15'wall w/6'fence

Page of
Job #: 8182 By:mb Date: 9/21/98
RetainPro 3.1(c)1993 File:RETAINPR.RPF

CANTILEVERED RETAINING WALL DESIGN

SOIL DATA

Allowable Bearing	=	3,325 psf
Active Lateral EFP	=	30.0 psf
....Slope Active	=	0.0 psf
..Active Press Limit	=	N/A psf
Bkfill Slope(0=level)	=	0.0:1
Passive Lateral	=	250 pcf
Soil Density	=	110.0 pcf
Soil Ht over Toe	=	0.0 in

ADDED LATERAL LOADS

Lateral Load Acting On Stem Above Soil	=	15.00 psf
Add'l Lateral Load	=	0.0 plf
...height to stop	=	0.00 ft
...height to start	=	0.00 ft

ADDED VERTICAL LOADS

Axial DL on Stem	=	0 plf
Axial LL on Stem	=	0 plf
..Ecc Left of Stem CL	=	0.00 in
Surcharge over Toe	=	0.0 psf
Surcharge over Heel	=	0.0 psf
Using Surcharge to resist overturning @ Heel	:	Yes
@ Toe	:	Yes

ADJACENT FOOTING

Vertical load	=	0 plf
...Ecc. (Toe side +)	=	0.00 in
Footing Width (perp)	=	0.00 ft
Face Top Stem to Ftg. CL	=	0.00 ft
Ftg. Base Above/Below Soil At Wall Face [+/-]	=	0.00 ft
Footing Type	:	Line

WALL & FOOTING DATA

Retained Height	=	15.00 ft	Toe Width	=	1.00 ft
Wall Ht. above soil	=	6.00 ft	Heel Width	=	8.17 ft
Total Wall Height	=	21.00 ft			
Key Depth	=	20.00 in	Total Width	=	9.17 ft
Key Width	=	12.00 in	Thickness	=	16.50 in
Key Dist. to Toe	=	1.000 ft			

SUMMARY

Pressure @ Toe	=	3,286 psf	Factors of Safety:		
Pressure @ Heel	=	328 psf	Overturning	=	3.33 :1
Allowable Press.	=	3,325 psf	Sliding	=	1.50 :1
Eccentricity	=	15.01 in	Allowable Shear	=	76.03 psi
Resultant Within Middle Third			1-Way Shear @ Toe	=	0.0 psi
Note: Pv Not Used for Soil Pres.			1-Way Shear @ Heel	=	110.9 psi

SLIDING CHECK

Ftg/Soil Friction	=	0.300	Tot Lateral Force*1.5	=	6,125.6 #
Soil @ Toe Not Used	=	0.00 in	(-)Passive Pressure	=	1,156.5 #
Factor of Safety	=	1.50	(-)Friction	=	4,970.9 #
			Add'l Force Req'd	=	0.0 #

FOOTING DESIGN

(Using ACI Factors)	Toe	Heel	
ACI 9.1 Pressure =	4,600	459	psf
Mu - Upward =	2,225	0	ft-#
Mu - Downward =	144	0	ft-#
Mu - Design =	2,081	31,442	ft-#
One-Way Shear:		Mu=Stem!	
vu =	0.00	110.91	psi
vn=2(f'c)1/2*.85=	76.03	76.03	psi
Rebar CL To Edge =	3.00	2.00	in
Depth to steel =	13.00	14.00	in
Ru = Mu/bd^2 =	0.0	178.2	
Min. Rebar Ratio =	0.0000		

f'c	=	2,000 psi
Fy	=	60,000 psi

Upward soil pres negl'd on heel

Rebar Choices

	Toe(bot)	Heel(top)
#4	@Not Reqd in	4.29 in
#5	@Not Reqd in	6.64 in
#6	@Not Reqd in	9.43 in
#7	@Not Reqd in	12.86 in
#8	@Not Reqd in	16.93 in
#9	@Not Reqd in	21.43 in
#10	@Not Reqd in	27.21 in

Job No. 8182

Sheet No. W.13

ervasio & Associates, Inc.
CONSULTING ENGINEERS
527 N. 16th St. Suite 200
hoenix, AZ 85016
(602) 285-1720

Title: terramar
Descr: 15'wall w/6'fence

Page of
Job #: 8182 By:mb Date: 9/21/98
RetainPro 3.1(c)1993 File:RETAINPR.RPF

STEM DESIGN

(Values shown for concrete stems have been factored)

Stem Construction Data		Highest	Descending Stem Sections, Highest @ Left (use columns from left to right)	
DESIGN HT. ABOVE FTG.	=	15.00	0.00	ft
WALL TYPE ABOVE HT.	:	Masonry	Concrete	
Thickness (nominal)	=	6.00	12.00	in
Rebar Size	=	# 4	# 6	
Rebar Spacing	=	48.00	6.00	in
Rebar Placed at	:	Center	Edge	
DESIGN DATA.....				
fb/Fb + fa/Fa	=	0.971	0.925	
Lateral Load @ Design Ht	=	90	5,891	#
MOMENT..... Actual	=	270	31,442	ft-#
Allowable	=	278	34,003	ft-#
SHEAR..... Actual	=	2.93	51.00	psi
Allowable	=	22.33	85.00	psi
Embedment Length Req'd	=	19.23	12.89	
Wall Weight	=	58.0	150.0	psf
Rebar Placed at Depth 'd'	=	2.75	9.63	in
MASONRY DATA.....				
f'm	=	1,500		psi
Fs	=	24,000		psi
Grouting	:	Full		
Special Inspection	:	No		
n : Es / Em	=	25.78		
Short Term Increase	=	1.33		
CONCRETE DATA.....				
f'c	=		2,500	psi
Fy	=		60,000	psi

SUMMARY OF FORCES & MOMENTS

Origin of Force:		Overturning #	Overturning ft	Overturning ft-#	Resisting #	Resisting ft	Resisting ft-#
Heel Active Press.	=	4,022	5.46	21,954			
Soil over Heel	=				11,831	5.59	66,073
Toe Active Press.	=	-28	0.46	-13			
Soil over Toe	=				0	0.00	0
Sloped Soil @ Heel	=				0	0.00	0
Adjacent Ftg. Load	=	0	0.00	0	0	0.00	0
Surcharge @ Heel	=				0	0.00	0
Surcharge @ Toe	=	0	0.00	0	0	0.00	0
Axial Load on Wall	=			0	0	0.00	0
Load @ Proj. Wall	=	90	19.38	1,744			
Averaged Stem Wts.	=				2,598	1.47	3,810
Earth Behind Stem	=				0	0.00	0
Added Lateral Load	=	0	0.00	0			
Footing Weight	=				1,891	4.59	8,672
Key Weight	=				250	1.50	375
Vert. Componant of Active Press.	=				0	0.00	0
TOTALS	=	4,084		23,685	16,570		78,930
Totals used for Soil Pressure, Pv Not Included	=				16,570		78,930

Job No. 8182

Sheet No. W.14

ervasio & Associates, Inc.
CONSULTING ENGINEERS
527 N. 16th St. Suite 200
hoenix, AZ 85016
(602) 285-1720

Title: terramar
Descr: 15'wall w/6'fence no wind
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Job #: 8182 By:mb Date: 9/25/98
RetainPro 3.1(c)1993 File:RETAINPR.RPF

CANTILEVERED RETAINING WALL DESIGN

SOIL DATA

Allowable Bearing	=	3,325 psf
Active Lateral EFP	=	30.0 psf
....Slope Active	=	0.0 psf
..Active Press Limit	=	N/A psf
Bkfill Slope(0=level)	=	0.0:1
Passive Lateral	=	250 pcf
Soil Density	=	110.0 pcf
Soil Ht over Toe	=	0.0 in

ADDED VERTICAL LOADS

Axial DL on Stem	=	0 plf
Axial LL on Stem	=	0 plf
..Ecc Left of Stem CL	=	0.00 in
Surcharge over Toe	=	0.0 psf
Surcharge over Heel	=	0.0 psf
Using Surcharge to resist overturning @ Heel	:	Yes
@ Toe	:	Yes

ADDED LATERAL LOADS

Lateral Load Acting On Stem Above Soil	=	0.00 psf
Add'l Lateral Load	=	0.0 plf
...height to stop	=	0.00 ft
...height to start	=	0.00 ft

ADJACENT FOOTING

Vertical load	=	0 plf
...Ecc. (Toe side +)	=	0.00 in
Footing Width (perp)	=	0.00 ft
Face Top Stem to Ftg. CL	=	0.00 ft
Ftg. Base Above/Below Soil At Wall Face [+/-]	=	0.00 ft
Footing Type	:	Line

WALL & FOOTING DATA

Retained Height	=	15.00 ft	Toe Width	=	1.00 ft
Wall Ht. above soil	=	6.00 ft	Heel Width	=	8.17 ft
Total Wall Height	=	21.00 ft			
Key Depth	=	20.00 in	Total Width	=	9.17 ft
Key Width	=	12.00 in	Thickness	=	16.50 in
Key Dist. to Toe	=	1.000 ft			

SUMMARY

Pressure @ Toe	=	3,161 psf	Factors of Safety:		
Pressure @ Heel	=	452 psf	Overturning	=	3.60 :1
Allowable Press.	=	3,325 psf	Sliding	=	1.53 :1
Eccentricity	=	13.75 in	Allowable Shear	=	76.03 psi
Resultant Within Middle Third			1-Way Shear @ Toe	=	0.0 psi
Note: Pv Not Used for Soil Pres.			1-Way Shear @ Heel	=	110.9 psi

SLIDING CHECK

Ftg/Soil Friction	=	0.300	Tot Lateral Force*1.5	=	5,990.6 #
Soil @ Toe Not Used	=	0.00 in	(-)Passive Pressure	=	1,156.5 #
Factor of Safety	=	1.53	(-)Friction	=	4,970.9 #
			Add'l Force Req'd	=	0.0 #

FOOTING DESIGN

(Using ACI Factors)		Toe	Heel			
ACI 9.1 Pressure	=	4,426	633	psf	f'c	= 2,000 psi
Mu - Upward	=	2,144	0	ft-#	Fy	= 60,000 psi
Mu - Downward	=	144	0	ft-#	Upward soil pres negl'd on heel	
Mu - Design	=	2,000	28,688	ft-#		
One-Way Shear:			Mu=Stem!			
vu	=	0.00	110.91	psi		
vn=2(f'c)1/2*.85	=	76.03	76.03	psi		
Rebar CL To Edge	=	3.00	2.00	in		
Depth to steel	=	13.00	14.00	in		
Ru = Mu/bd^2	=	0.0	162.6			
Min. Rebar Ratio	=	0.0000				

Rebar Choices

	Toe(bot)	Heel(top)
#4	@Not Reqd in	4.29 in
#5	@Not Reqd in	6.64 in
#6	@Not Reqd in	9.43 in
#7	@Not Reqd in	12.86 in
#8	@Not Reqd in	16.93 in
#9	@Not Reqd in	21.43 in
#10	@Not Reqd in	27.21 in

Job No. _____

Sheet No. W-15

ervasio & Associates, Inc.
CONSULTING ENGINEERS
527 N. 16th St. Suite 200
hoenix, AZ 85016
(602) 285-1720

Title: terramar
Descr: 15'wall w/6'fence no wind
Page of
Job #: 8182 By:mb Date: 9/25/98
RetainPro 3.1(c)1993 File:RETAINPR.RPF

STEM DESIGN

(Values shown for concrete stems have been factored) Pg 2 of 2

Stem Construction Data		Highest	|- Descending Stem Sections, Highest @ Left -| (use columns from left to right)	
DESIGN HT. ABOVE FTG.	=	15.00	0.00		ft
WALL TYPE ABOVE HT.	:	Masonry	Concrete		
Thickness (nominal)	=	6.00	12.00		in
Rebar Size	=	# 4	# 6		
Rebar Spacing	=	48.00	6.00		in
Rebar Placed at	:	Center	Edge		
DESIGN DATA.....					
fb/Fb + fa/Fa	=	0.000	0.844		
Lateral Load @ Design Ht	=	0	5,738		#
MOMENT..... Actual	=	0	28,688		ft-#
Allowable	=	278	34,003		ft-#
SHEAR..... Actual	=	0.00	49.68		psi
Allowable	=	22.33	85.00		psi
Embedment Length Req'd	=	12.00	11.64		
Wall Weight	=	58.0	150.0		psf
Rebar Placed at Depth 'd'	=	2.75	9.63		in
MASONRY DATA.....					
f'm	=	1,500			psi
Fs	=	24,000			psi
Grouting	:	Full			
Special Inspection	:	No			
n : Es / Em	=	25.78			
Short Term Increase	=	1.33			
CONCRETE DATA.....					
f'c	=		2,500		psi
Fy	=		60,000		psi

SUMMARY OF FORCES & MOMENTS

Origin of Force:		|- Overturning Moments -| #	ft	ft-#	|- Resisting Moments -| #	ft	ft-#
Heel Active Press.	=	4,022	5.46	21,954				
Soil over Heel	=				11,831	5.59	66,073
Toe Active Press.	=	-28	0.46	-13			
Soil over Toe	=				0	0.00	0
Sloped Soil @ Heel	=				0	0.00	0
Adjacent Ftg. Load	=	0	0.00	0	0	0.00	0
Surcharge @ Heel	=				0	0.00	0
Surcharge @ Toe	=	0	0.00	0	0	0.00	0
Axial Load on Wall	=			0	0	0.00	0
Load @ Proj. Wall	=	0	0.00	0			
Averaged Stem Wts.	=				2,598	1.47	3,810
Earth Behind Stem	=				0	0.00	0
Added Lateral Load	=	0	0.00	0			
Footing Weight	=				1,891	4.59	8,672
Key Weight	=				250	1.50	375
Vert. Componant of Active Press.	=				0	0.00	0
TOTALS	=	3,994		21,941	16,570		78,930
Totals used for Soil Pressure, Pv Not Included	=				16,570		78,930

APPENDIX G

GABION WALL STABILITY ANALYSIS

96-0043-21
Project Number

CVL CALCULATIONS COVER SHEET

GABION WALLS STABILITY ANALYSES
Title of Calculations

Terramar - New River
Project Title

Content	Performed By		Checked By		Rechecked By	
	Initials	Date	Initials	Date	Initials	Date
Statement of Purpose	KA	9/21/98	RDM	10-7-98		
List of References	KA		RDM			
List of Assumptions	KA		RDM			
Methodology	KA		RDM			
Calculations	KA		RDM			
Summary/Conclusions	KA	9/21/98	RDM	10-7-98		
Appendices						

Comments

Final Approval By: [signature]
Signature

10/7/98
Date

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Project Terramar- New River
Project No. 96-0043-21
Sheet No. 1 of 13
Calculated by KA Date 9/21/98
Checked by _____ Date _____

STATEMENT OF PURPOSE

To analyse the stability of the Gabion walls
To estimate the safety factors for stability against overturning, sliding and foundation failure

LIST OF REFERENCES

- "An introduction to Geotechnical Engineering", Robert D. Holtz, Ph.D, P.E. and William Kovacs, PhD, P.E. 1981
- "Soil Investigation, Terramar New River Bank Protection, New River North of Happy Valley Road, Peoria Arizona", Construction Inspection and Testing Co., Sept 1998.

LIST OF ASSUMPTIONS

- Soil assumed to be isotropic (uniform) and design soil parameters are assumed to be representative of the entire reach.
- Passive lateral earth pressure is ignored in these analyses
- Soil Bearing Capacity = 4000 psf

METHOLOGY

- Resisting Moment is given by the mass of the wall
- Overturning Moment is created by active earth pressure
- The wall is stable is resisting moment exceeds overturning moment
- Sliding Force is created by lateral earth pressure
- Resisting Force is due to the weight of the wall
- The system will not slide if the resisting force exceeds the sliding Force

- Pressure on foundation is the weight per unit area of the gabion wall
- Limiting pressure on the soil is given as 4000 lb/ft
- Foundation will not yield if the pressure due to the wall is less ~~than~~ the limiting pressure

CALCULATIONS

See attached sheets 3 through 13

SUMMARY / CONCLUSION

The wall was determined to be stable with respect to overturning, sliding and foundation failure and the safety factors ranged from 1.8 to 3.1

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Project TERRAMAR / NEW RIVER
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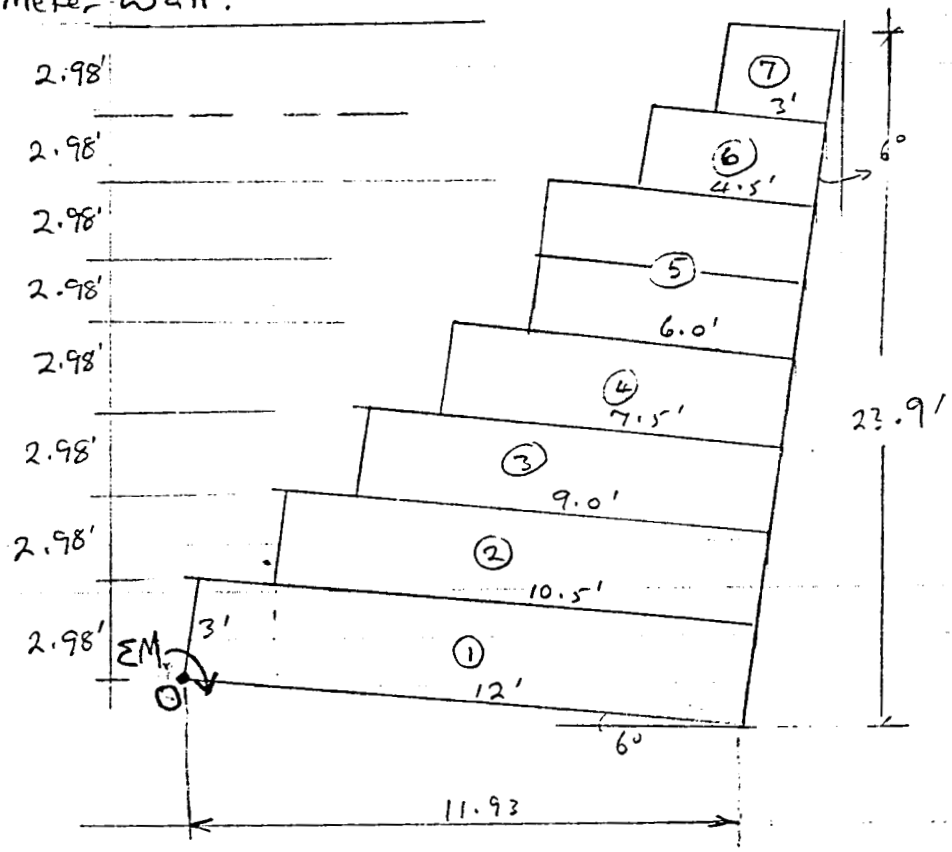
STABILITY ANALYSES

(1) 8-Meter Wall.



$C = 0$
$\phi = 35°$
$\gamma_{soil} = 129$ pcf
$\gamma_{rock} = 150$ pcf
$K_a = 0.27$

Max Bearing Pressure = 4000 psf
Coeff of Friction $\mu = 0.7$

(A) Moment Resisting Overturning, M_R

Part #	Area (ft^2)	Unit Wt (lb/ft^3)	Weight (lb)	Arm (ft)	Moment (lb)
1	12×3 = 36.0	150	5400	11.93/2 = 5.96	32,211
2	10.5×3 = 31.5	150	4725	1.5 + ½(10.5 cos 6°) = 6.72	31,752
3	9×3 = 27.0	150	4050	3 + ½(9 cos 6) = 7.47	30,254
4	7.5×3 = 22.5	150	3375	4.5 + ½(7.5 cos 6) = 8.23	27,776
5	6×6 = 36.0	150	5400	6 + ½(6 cos 6) = 8.98	48,492
6	4.5×3 = 13.5	150	2025	7.5 + ½(4.5 cos 6) = 9.74	19,723
7	3×3 = 9.0	150	1350	9 + ½(3 cos 6) = 10.49	14,161
			ΣWt = 26,325 lb		ΣM_R = 204,369

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Project No. 960043-21
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(B) Overturning Moment 'Mo'

Unit wt of Soil, $\gamma_1 = 129$ lb/ft³
Active Earth Pressure Coefficient $K_a = 0.27$

$$P_a = \frac{\gamma H^2}{2} K_a = \frac{129 \times 23.84^2}{2} \times 0.27 = 9{,}898 \text{ lb}$$

$$M_o = P_a \frac{H}{3} = \frac{9898 \times 23.84}{3} = 78{,}654 \text{ lb}$$

M_R (from Sht 1 of 3) = 204,369 lb

$M_R > M_o$ - - - ok

SAFETY FACTOR AGAINST OVERTURNING

$$SF_o = M_R / M_o = 204\,342 / 79{,}252 = 2.6 \text{ ok}$$

(C) SLIDING FORCE, F_s

Resisting Force $F_r = \Sigma W_t \times \tan\phi$

$= 0.7 \times 26{,}325$

$= 18{,}428$

Sliding Force P_a (Section (B)) = 9898

SAFETY FACTOR AGAINST SLIDING, $SF_s = F_r / P_a$

$$= \frac{18428}{9898} = 1.86 \text{ ok}$$

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Project Terramar - New River Bank Pro.
Project No. 960043 - 21
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(D) FOUNDATION BEARING CAPACITY

Weight (Load) = 26,325 lb

Add 6 ft Tall x 6 in thick Fence Wall

Total Weight = 26,325 + 150 PCF × 6' × 0.5 = 26,775 lb

$$\text{Pressure} = \frac{\text{Load}}{\text{Area}} = \frac{26{,}775 \text{ lb}}{12 \text{ ft}} = 2{,}231 \text{ PSF}$$

Allowable Soil Pressure (See Geotech Report)

$= 4000 \frac{\text{lb}}{\text{ft}^2} > 2231 \text{ lb/ft}^2$ ok.

SAFETY FACTOR AGAINST FAILURE OF FOUNDATIO

$$SF_f = \frac{4000}{2231} = 1.8 \text{ ok.}$$

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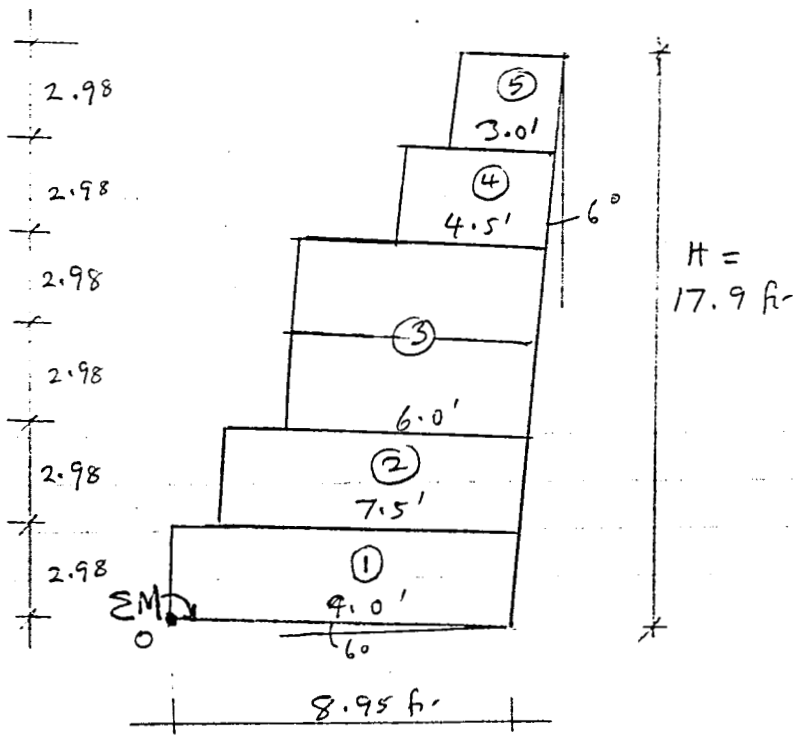
Project: TERRAMAR / NEW RIVER
Project No. 960043-21
Sheet No. 6 of 13
Calculated by: KA Date: 9/21/98
Checked by: _____ Date: _____

STABILITY ANALYSIS

(2) 6 Meter Wall System



$c = 0$
$\phi = 35°$
$\gamma = 125$ pcf
$\gamma_{rock} = 150$ pcf
$K_a = 0.27$
$\mu = 0.7$
Max Bearing Press = 4000

(A) Moment Resisting Overturning

Part #	Area (ft^2)	Unit Weight (lb/ft^3)	Weight (lb)/ft	Moment Arm from O (ft)	Moment lb-ft/ft
1	9×3 = 27.0	150	4050	8.95/2 = 4.48	18,125
2	7.5×3 = 22.5	150	3375	1.5 + ½(7.5(cos 6)) = 5.22	17,622
3	6×6 = 36.0	150	5400	3.0 + ½(6(cos 6)) = 5.97	32223
4	4.5×3 = 13.5	150	2025	4.5 + ½(4.5(cos 6)) = 6.71	13594
5	3×3 = 9.0	150	1350	6.0 + ½(3(cos 6)) = 7.46	10,070
			ΣW = 16,200		91,633

(B) Overturning Moment M_o

$$P_a = \frac{\gamma H^2}{2} K_a = \frac{129 \times 17.9^2}{2} \times 0.27 = 5580 \text{ lb}$$

$$M_o = P_a \frac{H}{3} = 5580 \times \frac{17.9}{3} = 33{,}294 \text{ lb-ft}$$

$\therefore M_R = 91{,}633$

$M_R > M_o$ ok

Safety Factor Against Overturning

$$SF_o = M_R / M_o = 91{,}633 / 33294 = 2.75 \text{ ok}$$

(C) SLIDING FORCE F_s

$$F_s = P_a = 5580 \text{ lb.}$$

F_R = Resisting Force $= \Sigma W = 16{,}200$

$F_R > F_s$ — ok.

Safety Factor Against Sliding $SF_s = \frac{F_R}{F_s}$

$$= \frac{16{,}200}{5550}$$

$SF_s = 2.9$ ok

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Project Terramar - New River
Project No. 96 C043-21
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(D) LOAD ON FOUNDATION

Dead Weight on Foundation = ΣW = 16,200 lb
Add 6' tall Fence Wall = 6' x 150 x 0.5 = 450 lb
Total Load = 16 650 lb

Pressure (lb / ft of wall) = $\frac{16650 \text{ lb}}{9 \text{ ft}}$ = 1850 lb/ft

Allowable Pressure = 4000 lb/ft => ok

Safety Factor against foundation failure

$$SF_f = \frac{4000}{1850} = 2.2 \text{ ok.}$$

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LANDSCAPE ARCHITECTURE

Project: Terramar-New River
Project No. 96 00 43-21
Sheet No. 9 of 13
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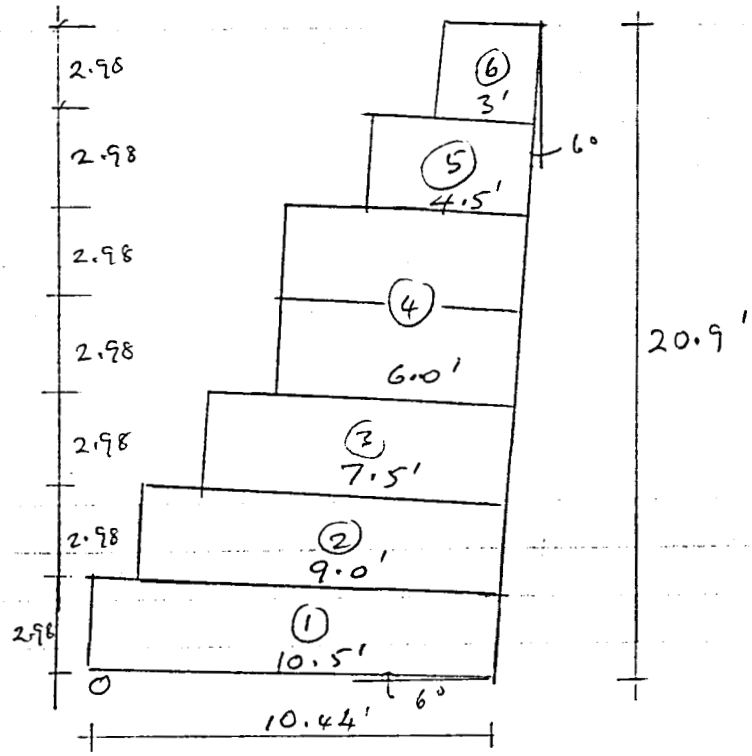
Checked by: _____ Date: _____

③ 7-M Wall System



$c = 0$
$\phi = 35°$
$\gamma = 125$ pcf
$\gamma_{rock} = 150$ pcf
$K_a = 0.27$
Bearing Press = 4000
$\mu = 0.7$

Ⓐ Moment Resisting Overturning, M_R

Part #	Area (ft^2)	Unit Wt (lb/ft^3)	Weight (lb)	Arm (ft)	Moment (lb-f
①	10.5 × 3 = 31.5	150	4725	10.4/2 = 5.20	24806
②	9. × 3 = 27.0	150	4050	$1.5 + \frac{1}{2}(9.(\cos 6) = 5.97$	24178
③	7.5 × 3 = 22.5	150	3375	$3 + \frac{1}{2}(7.5(\cos 6) = 6.73$	22714
④	6 × 6 = 36.0	150	5400	$4.5 + \frac{1}{2}(6(\cos 6) = 7.48$	40392
⑤	4.5 × 3 = 13.5	150	2025	$6 + \frac{1}{2}(4.5(\cos 6) = 8.24$	16686
⑥	3 × 3 = 9.0	150	1350	$7.5 + \frac{1}{2}(3(\cos 6) = 8.99$	12136
		ΣW	20,925	ΣM_R	140,913

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LANDSCAPE ARCHITECTURE

Project Terramar - New River
Project No. 960043-21
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Calculated by _____ Date _____
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(B) Overturning Moment M_o

$$P_a = \frac{\gamma H^2}{2} K_a = \frac{129 \times 20.9^2}{2} \times 0.27 = 7607$$

$$M_o = \frac{P_a H}{3} = \frac{7607 \times 20.9}{3} = 52,996 \text{ lb-ft}$$

$M_R = 140,913$ lb-ft

$M_R > M_o$ ... ok

Safety Factor Against Overturning $SF_o = \frac{M_R}{M_o}$

$SF_o = 140,913 / 52,996 = 2.6$ ok

(C) Sliding Force F_s

$F_s = P_a = 7607$ lb

Resisting Force $F_R = \Sigma W = 20,925$ lb

$F_R > F_s$ ok.

Safety Factor Against Sliding $SF_s = F_R / F_s$

$SF_s = 20925 / 7607$

$= 2.75$ ok.

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(D) Foundation Bearing Pressure

Load on Foundation = ΣW = 20,925 lb

Add 6 ft High x 0.5' Fence Wall (Concrete)

= 20,925 + 150 x 6 x 0.5

= 21,375 lb

Pressure on foundation P_f

= 21,375 / 10.5 = 2036 lb / ft^2

Allowable Pressure = 4000 lb / ft^2

Safety Factor against foundation failure SF_f

= 4000 / 2036

= 1.96 ok.

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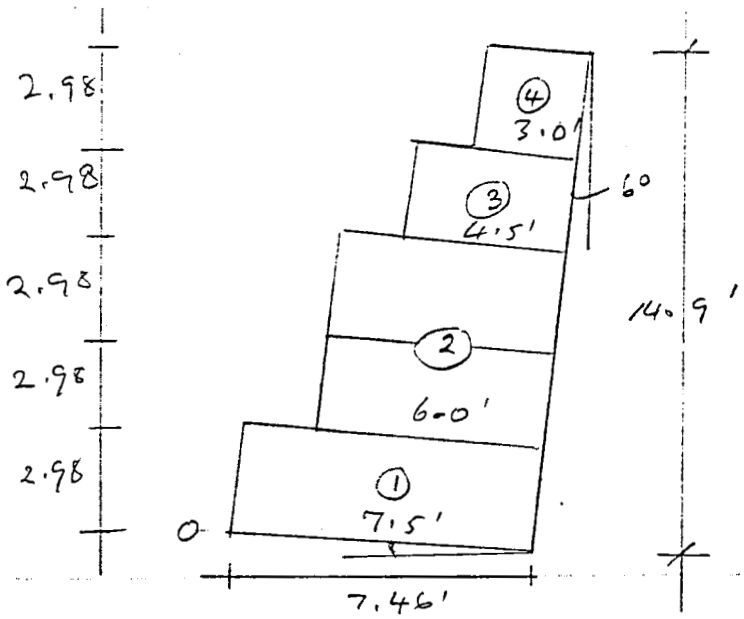
5-M Wall System



$c = 0$
$\phi = 35°$
$\gamma = 129$ lb/ft
$\gamma_{rock} = 150$ pcf
$K_a = 0.29$
$\mu = 0.7$
Max Press = 4000

(A) Moment Resisting Overturning - M_R

Part #	Area (ft²)	Unit Wt lb/ft³	Weight (lb)	Arm (ft)	Moment (lb-ft)
①	7.5 x 3 = 22.5	150	3375	7.46 / 2 = 3.73	12,589
②	6.0 x 6.0 = 36.0	150	5400	1.5 + ½ (6 cos 6) = 4.48	24,192
③	4.5 x 3 = 13.5	150	2025	2.0 + ½ (4.5 cos 6) = 5.24	10,611
④	3 x 3 = 9.0	150	1350	4.5 + ½ (3 cos 6) = 5.99	8,086
		ΣW	12,150	ΣM_R	55,478

(B) Overturning Moment, M_o

$$P_a = \frac{\gamma H^2}{2} K_a = \frac{129 \times 14.9^2}{2} \times 0.27 = 3866 \text{ lb}$$

$$M_o = \frac{P_a H}{3} = \frac{3866 \times 14.9}{3} = 19,201$$

$M_R > M_o$ ok

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Safety Factor Against Overturning, $SF_o = M_R / M_o$

$SF_o = 55,478 / 19,201 = 2.9$ ok.

(c) Sliding Force, F_s

$F_s = P_a = 3866$ lb.

Resisting Force $F_R = \Sigma W = 12,150$ lb.

$F_R > F_s$ ok.

SAFETY FACTOR AGAINST SLIDING SF_s

$= F_R / F_s = 12,150 / 3866 = 3.14$ ok

(D) Foundation Bearing Pressure

Load $= \Sigma W = 12,150$ lb.

Add 6 ft. × 0.5' Fence Wall $= 6 \times 150 \times 0.5 = 450$

Total Load $= 12,600$ lb

Pressure on foundation $= \frac{\text{Load}}{\text{Area}} = \frac{12600}{7.46} = 1689$ lb

Allowable Pressure $= 4000$ lb/ft

$SF_F = \frac{4000}{1689} = 2.4$ ok.

APPENDIX H

QUANTITY ESTIMATES

96-0043-21
Project Number

CVL CALCULATIONS COVER SHEET

QUANTITY ESTIMATES
Title of Calculations

Terramar New River
Project Title

Content	Performed By		Checked By		Rechecked By	
	Initials	Date	Initials	Date	Initials	Date
Statement of Purpose	KA	9/29/98	[illegible]	10/8/98		
List of References	↓	↓	[illegible]	10/8/98		
List of Assumptions			[illegible]	10/8/98		
Methodology			[illegible]	10/8/98		
Calculations			[illegible]	10/8/98		
Summary/Conclusions	KA	9/29/98	[illegible]	10/8/98		
Appendices						

Comments

Final Approval By: [illegible]
Signature

10/7/98
Date

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LANDSCAPE ARCHITECTURE

Project Terramar-New River
Project No. 960043-21
Sheet No. 1 of 5
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Checked by _____ Date _____

STATEMENT OF PURPOSE

- To estimate the quantities of materials for the gabion and concrete walls as shown on the construction plans.

LIST OF REFERENCES

- Terramar - New River, Bank Protection Plans, Coe & Van Loo Consultants, Inc., Phoenix, OCT 1998.
  Microstation File N:\960043\hydro\channel\chqnts09.dgn

- LIST OF ASSUMPTIONS

  Features assumed to be uniform between cross section stations

- METHODOLOGY

  Microstation software was used to determine areas at stations located at 100 feet intervals
  Areas were averaged between the stations
  End Area method was used to determine volumes
  Estimates for reinforcing steel was submitted by Gervasio & Assoc.

- CALCULATIONS

  See attached sheets.

- SUMMARY / CONCLUSION

  See Table 2 in text for a summary of the quantities

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Project: TERRAMAR - NEW RIVER
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Checked by: _____ Date: _____

FILL BEHIND GABION (INTERIM GRADING)

Station	Area (Ft²)	Avg. Area (ft²)	Length (ft)	Vol (ft³)
0	47.3			
		35.6	100	3560
100	24.0			
		25.8	100	2580
200	27.5			
		13.8	100	1380
300	0			
		48.3	100	4830
400	96.6			
		93.5	100	9350
500	90.4			
		132.2	100	13220
600	173.9			
		152.8	100	15280
700	131.8			
		107.6	100	10760
800	83.5			
		98.2	100	9820
900	112.9			
		97.0	100	9700
1000	81.1			
		43.6	100	4360
1100	6.0			
		6.0	100	600
1200	6.0			
		19.9	100	1990
1300	33.8			
		16.9	100	1690
1400	0			
		0		
1440	0			

Σ = 89,120 ft³

Vol of Fill = 3300 cy

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GABION WALL

From Sta	To STA	GABION TYPE	AREA (ft^2)	LENGTH (FT)	VOLUME (FT^3)
0+00	2+82.4	2	108.0	282.4	30,499
2+82.4	6+82.23	3	139.5	399.8	55,772
6+82.2	8+68.13	4	175.5	185.9	32,625
8+68.1	10+63.84	2	108.0	195.7	21,136
10+63.8	14+40.00	1	81.0	376.2	30,472

Σ 170,504 ft^3
= 6,315 cu.yd

CONCRETE BASE FOR GABION WALL

From Sta	To STA	THICKNESS (ft)	AREA (ft^2)	LENGTH (ft)	VOLUME (ft^3)
0+00	2+82.4	2	18	282.4	5083
2+82.4	6+82.2	2	21	399.8	8396
6+82.2	8+68.1	2.5	30	185.9	5577
8+68.1	10+63.8	2	18	195.7	3523
10+63.8	14+40.0	1.5	11.5	376.2	4326

26,905 ft^3
997 cu.yd

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Project: TERRAMAR - NEW RIVER
Project No. 96004321
Sheet No. 4 of 5
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GEO FABRIC.

From STA	To STA	GABION TYPE	BACK HEIGHT OF WALL (ft)	LENGTH (ft)	AREA (ft²)
0+00	2+82.4	2	18	282.4	5083
2+82.4	6+82.2	3	21	399.8	8396
6+82.2	8+68.1	4	24	185.9	4462
8+68.1	10+63.8	2	18	195.7	3523
10+63.8	14+40.0	1	15	376.2	5643

27,107 ft²
3012 sq yd.
Add 10% Overlap ≡ 3313 sq yd.

NORTH WASH EXCAVATION.

STATION	Area (ft²)	Avg. Area (ft²)	Length (ft)	Volume (ft³)
0	0			
		67.0	100	6700
100	134			
		161.0	50	8050
150	188			
		178.5	50	8925
200	169			
		144.5	50	7225
250	120			
		88.5	50	4425
300	57			
		28.5	21	598.5
321	0			

35,924 ft³
1330 CY

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FLOODWALL MATERIAL QUANTITIES

① CONCRETE

WALL TYPE	Area (ft^2)	Length (ft)	Volume ft^3
6 ft	$1\times1 + 3.5\times1 + 6\times\frac{8}{12} = 8.5$	529	4496
10 ft	$1\times1.67 + 1.33\times5.17 + 1.0\times10.33 = 18.88$	96	1813
15 ft	$1\times1.67 + 1.5\times9.17 + 1.0\times15 = 30.43$	156.5	4763
			11,072 ft^3
			410 cy.

② Reinforcement Bars

Quantity = 44,000 lbs

= 22 tons.

APPENDIX I

TECHNICAL SPECIFICATIONS FOR GABIONS

GABION RETAINING WALL SPECIFICATIONS

The gabion box and rock filler materials should meet the specifications of the manufacturer. The following specifications of Maccaferri Gabions, Inc. or equivalent should be used.

1. **The Box Gabion**

   Box gabion structure shall be made of hexagonal double twisted wire mesh as per ASTM A975-97. The box sizes shall be standard sizes and may be varied as necessary to fit the channel bank. The width of the box shall be 3.0 feet while the length or height may be varied as necessary. The gabion may be divided into cells by means of diaphram positioned at 3 feet centers.

   In order to reinforce the structure, all edges shall be selvedged with having wire having diameter of 3.9 mm. The following standard sizes may be available for use:

Length (ft)	Width (ft)	Height (ft)
6.0	3.0	1.0-1.5- 3.0
9.0	3.0	1.0-1.5- 3.0
12.0	3.0	1.0-1.5- 3.0
4.5	3.0	3.0

2. **The Wire Mesh**

   Mesh opening shall be 3.0 inches and wire diameter (thickness) shall be 3.0 millimeters and shall be a heavily zinc coated mild steel as per ASTM A641-92 (Type 8x10/Zn) or a zinc-5% aluminum-mischmetal alloy as per ASTM A856/A856M (Type 8x10/Zn-5%Al). The following specifications shall apply to wire types used for the gabion construction:

	Diameter mm (in)	Quantity of Zn. gm/m^2 (oz/yd^2)	Quantity of Zn-5%Al gm/m^2 (oz/yd^2)
Mesh wire	3.00 (0.12)	260 (0.85)	275 (0.90)
Selvedge wire	3.90 (0.146)	274 (0.90)	290 (0.95)
Lacing wire	2.20 (0.087)	214 (0.70)	240 (0.79)

   Tensile strength of all wires shall be 38 to 50 kg/mm^2 according to ASTM A641-92 for zinc coating and ASTM A856/A56M for zinc aluminum alloy coating.

   Elongation shall not be less than 12% per ASTM A370-92.

   Adhesion of zinc . The adhesion of the zinc coating to the wire should be such that, when the wire is wrapped six turns round on a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with bare fingers.

3.0 Rock Characteristics.

Rock to fill the gabion boxes shall be not be graded. The minimum rock size shall be 4 inches and maximum 10 inches in diameter. Rocks must be clean of fines, durable and non-friable. The rock must pass the durability index test, per ASTM C127, with durability index of 52 or greater.

4.0 Assembly and Erection

a). Unfold units, erect corners and diaphrams and bind them to the side panels. Use lacing wire supplied together with the gabions.

b) The lacing wire should be passed through each mesh, making a double twist every other mesh.

c) Fill the gabions with stones with the characteristics given above in section 3.0 Checkfilling at the corners. Compaction is not required.

d) Bind the lid down with lacing operation described above

e) All gabions must be connected to each other along all edges in contact with the same lacing operation.

5.0 Concrete Base

a) Concrete Quality: Confirm to ACI 301-89

b) Concrete regular weight (144 pcf) with type # cement per ASTM C150, aggregate per ASTM C33, and potable water. A maximum of 18% by weight of the total cementitious materials may be replaced by fly-ash, providing the fly-ash conforms to ASTM C618, type F.

c) Aggregate size: 1" minimum (size No. 5, 56 or 57)

d) Minimum 28-day compressive strength: 3000 psi

e) Maximum slump: 4-1/2"

f) Mechanically vibrate all concrete

g) No admixtures without approval. Admixtures containing chlorides shall not be used. Concrete shall not be in contact with aluminum.

h) Cure concrete members with polyethylene for 5 days with a curing compound approved by the engineer. Minimum concrete temperature shall be 40^0 F. during the 5-day cure.

i) Submit mix designs for review.

6.0 Geotextile Filter Fabric

Geotextile filter fabric material shall conform to the following specifications:

Min. permeability:	1.6×10^3 ft./sec.
Max. AOS:	0.6mm
Type:	Mirafti 140n. TYPAR 3401, TRIVERA Spunbound 1112 Or Approved Equal
Overlap:	18-inch minimum at Fabric Edge

8.0 Geotechnical Specifications

Reference: Terramar New River Bank Protection Design Report, Appendix C

1) Site Preparation:

Remove Vegetation and Debris. Excavate foundation trench to the toe down depths indicated on the plans.

Sloping surfaces should be benched to prevent slippage

2) Earthwork

See Section under "EARTHWORK" in the Soil Investigation Report in Appendix E of the design report for this project.

9.0 Structural Specifications (Reinforced Concrete Walls)

See Sheet S1 of the construction plans for details of the material construction requirements.

(January 1998)

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TECHNICAL SPECIFICATIONS

GABIONS

ZINC COATED BOX GABIONS

The box gabion is a structure made of hexagonal double twisted wire mesh (Fig. 1 and 2).
The wire used in the manufacture of the gabion is heavily zinc coated mild steel.
The standard combinations mesh/wire are shown in Tab.1.
In order to reinforce the structure, all edges are selvedged with a wire having greater diameter (Tab. 3).
The gabion can be divided into cells by means of diaphragms positioned at 3 ft. centers (Fig. 1).
Dimensions and tolerances on sizes are shown at Tab. 2.

Wire

1. Tensile strength: both the wire used for the manufacture of gabions and the lacing wire, shall have a tensile strength of 38-50 kg/mm^2 according to ASTM A641. Above values are referred to wire before manufacturing mesh.
   Tolerances of wire shown at Tab. 4 meet the requirements of ASTM A641-92.
   Elongation: the test must be carried out before manufacturing mesh on a sample at least 30 cm long.
   Elongation shall not be less than 12%, in accordance with ASTM A370-92.
3. Zinc coating and tolerances: minimum quantities of zinc, shown at Tab. 4 meet the requirements of ASTM A641-92.
4. Adhesion of zinc: the adhesion of the zinc coating to the wire should be such that, when the wire is wrapped six turns round on a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with the bare fingers.

ZINC COATED BOX GABION WITH PVC SLEEVE

More over when required in addition to the galvanization, the steel wire can be coated with a PVC sheath of a nominal thickness of 0.50 mm (0.02 in.). The technical characteristics and the resistance of the PVC to ageing meet the relevant standards. The main values for the PVC material are as follows:
Color: gray-RAL 7037 according to ASTM D 1482-67T;
Specific weight: between 1.30 and 1.35 dN/dm^3 in accordance with ASTM D2287-92, Table 1 when tested as specified in ASTM D792-91;
Hardness: between 50 and 60 Shore D, according to ASTM D 2240-91;
Tensile strength: not less than 210 dN/cm2, according to ASTM D412-92;
Elongation: between 200% and 280% according to ASTM D412-92;
Weight loss: less than 5% after 24 hours at 105°C, according to ASTM D2287-92;
Residual ashes: less than 2% according to ASTM D2124-62T;
Abrasion resistance: loss of weight shall not be more than 0.19 g, according to ASTM D1242-92.

The specific artificial ageing tests are:

salt spray test: test period 3,000 hours, test method ASTM-B 117-94;
exposure to UV rays: test period 3,000 hours at 63°C, test method ASTM G1499-92a and ASTM G23-93 apparatus type E;
exposure to high temperatures: test period 240 hours at 105°C, test method ASTM D1203-89 and ASTM D2287-92;
brittleness temperature: Cold Bend less than -30°C test method BS2782-104 A; Cold Flex less than +15°C in accordance with BS 2782-151A (84).

Fig. 1

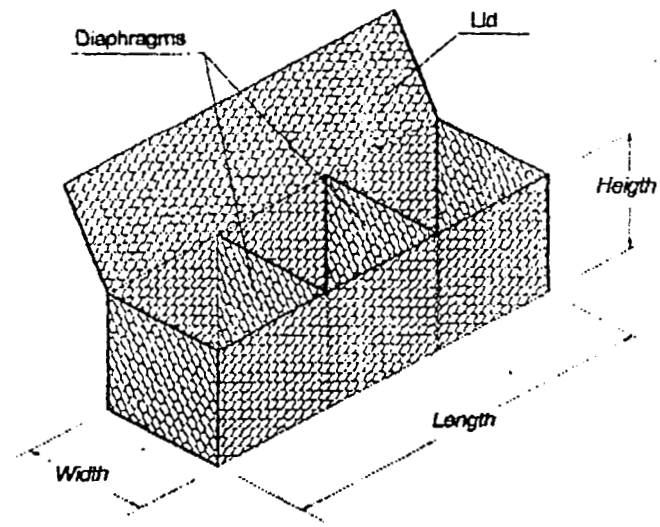
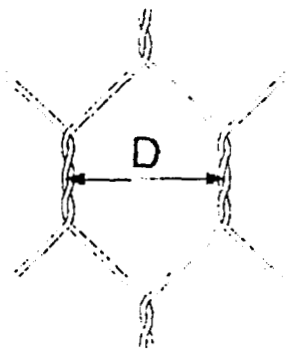


Fig. 2

MESH TOLERANCE
The tolerance on the opening of mesh "D" being the distance between the axes of twist, is according to ASTM 975-97



Tab. 1

STANDARD COMBINATION MESH-WIRE			
Type	D mm (in)	Tolerance	Φ Wire mm (in)
8x10/Zn	83 (3.25)	(+/-) 10%	3.0 (0.120)
8x10/Zn+PVC	83 (3.25)	(+/-) 10%	2.70/3.70 (0.106/0.146)

Tab. 2

STANDARD SIZES			
Length (ft)	Width (ft)	Height (ft)	Tolerance
6.0	3.0	1.0 - 1.5 - 3.0	length 5% width 5% height 5%
9.0	3.0	1.0 - 1.5 - 3.0	
12.0	3.0	1.0 - 1.5 - 3.0	
4.5	3.0	3.0	

Fig.3

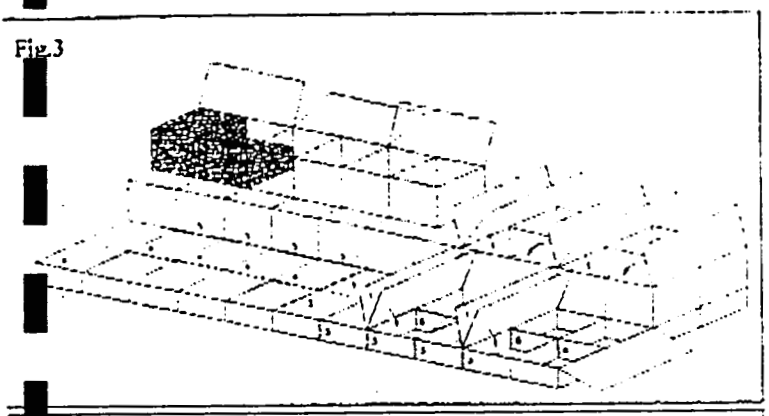


Fig.4

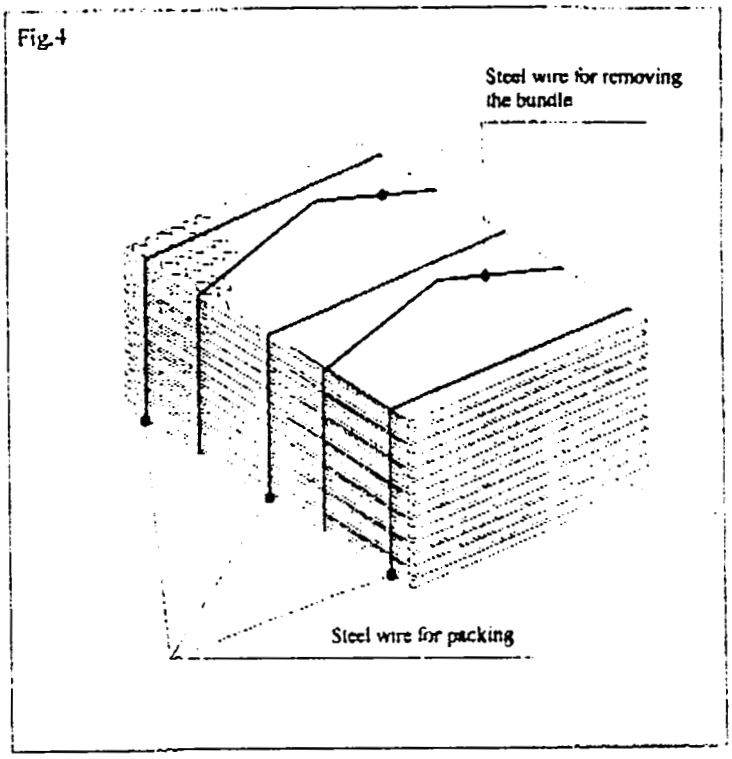
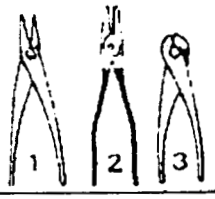


Fig.5



1) Pliers
2) Pliers with nipper
3) Nipper

Tab.3

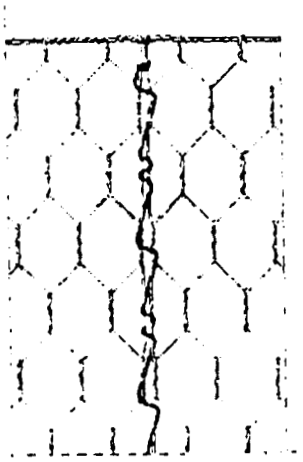
Mesh Wire	Φ mm (in)	2.70 (0.106)	3.00 (0.120)
Selvedge Wire	Φ mm (in)	3.40 (0.134)	3.90 (0.146)
Lacing Wire	Φ mm (in)	2.20 (0.087)	2.20 (0.087)

*Lacing wire is supplied at the rate of 5% on gabion weight

Tab.4

Mesh Diam.	Φ mm(in)	2.20 (0.087)	2.70 (0.106)	3.00 (0.120)	3.40 (0.134)	3.90 (0.153)
Wire Tolerance	(+/-) Φ mm (in)	0.10 (0.004)	0.10 (0.004)	0.10 (0.004)	0.10 (0.004)	0.10 (0.004)
Quantity of Zinc	gr/m^2 (oz/yd^2)	214 (0.70)	244 (0.80)	260 (0.85)	260 (0.85)	274 (0.90)

Fig.6

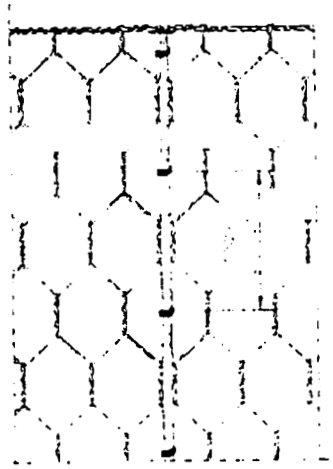


Assembly and Erection

1) Unfold the units, erect corners and diaphragms and bind them to the side panels. Lacing wire is supplied together with the gabions. For a correct lacing operation, the wire should be passed through each mesh, making a double twist every other mesh (Fig. 6).

2) Steel rings can be used instead of lacing wire (Fig.7-8), having the following specifications:

Fig.7



- diameter: 3.00 mm (0.12 in)
- tensile strength: 170 kg/mm^2 (241,400 psi)

Two types of rings are available:

a) heavily galvanized rings for zinc coated products
b) stainless steel rings for PVC coated products

3) Fill the gabion with stones, whose minimum size is not less than dimension "D" of mesh, and maximum size is about 2.5 times "D". Bigger stones are accepted, provided that their total volume does not exceed 5% of the overall rock size. Stones must be durable, non-friable and, in case of cold climate, non-porous.

4) Check filling at the corners. Compaction is not necessary.

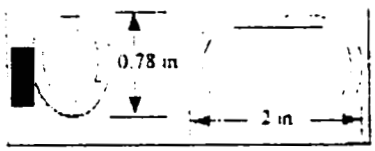
5) Bind the lid down with the usual lacing operation.

Note: all gabions must be connected to each other along all corners with the same lacing operation

Quantity Request: When requesting an order, please specify: quantities per each size:
- size of units (length x width x height, see fig. 1);
- type of mesh,
- wire diameter,

Example: No.100 gabions 8' x 6' x 3, - Mesh type 8x10 - Wire Φ 2.7 mm - zinc coated - with diaphragms.

Fig.8 - Rings



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Web Site www.maccaferri-usa.com

APPENDIX J

FEMA FORM FOR FLOODWALL SYSTEM

FEDERAL EMERGENCY MANAGEMENT AGENCY **LEVEE/FLOODWALL SYSTEM ANALYSES FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.0 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden, to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington, DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

Community Name: City of Peoria

Flooding Source: New River

Project Name/Identifier: New River Bank Protection at Terramar

REACH TO BE REVISED

Downstream limit: River Mile 15.144

Upstream limit: River Mile 15.977

This Levee/Floodwall analysis is based on:

☐ upgrading of an existing levee/floodwall system

☒ a newly constructed levee/floodwall system

☐ a reanalysis of an existing levee/floodwall system

LEVEE/FLOODWALL SYSTEM ELEMENTS

1. Levee elements and locations are:

☐ earthen embankment, dike, berm, etc. Station _____ to _____

☒ structural floodwall Station _____ to _____

☐ other (describe) _____ Station _____ to _____

Structural Type:

☒ monolithic cast-in place reinforced concrete

☐ reinforced concrete masonry block

☐ sheet piling

☐ other (describe) _____

2. Has this levee/floodwall system been certified by a Federal agency to provide protection against the 100-year flood event?

☐ Yes ☒ No

If yes, by which agency? _____

If yes, complete only the interior drainage section on pages 7 and 8 of this form and the operation and maintenance section of Revision Requestor and Community Official Form.

LEVEE/FLOODWALL SYSTEM ELEMENTS (Cont'd)

3. Attach certified drawings containing the following information (indicate drawing sheet numbers):

   a. Plan of the levee embankment and floodwall structures. Sheet Numbers S-1

   b. A profile of the levee/floodwall system showing the 100-year water surface elevation, levee and/or wall crest and foundation, and closure locations for the total levee system. Sheet Numbers S-1

   c. A profile of the 100-year water surface elevation, closure opening outlet and inlet invert elevations, type and size of opening, and kind of closure device. Sheet Numbers _____

   d. A layout detail for the embankment protection measures. Sheet Numbers _____

   e. Location, layout, and size and shape of the levee embankment features, foundation treatment, floodwall structure, closure structures, and pump stations. Sheet Numbers _____

FREEBOARD

1. The minimum freeboard provided above the 100-year water surface elevation is:

   Riverine

   3.0 feet or more at the downstream end and throughout ☐ Yes ☐ No

   3.5 feet or more at the upstream end ☐ Yes ☐ No

   4.0 feet immediately upstream of all structures and constrictions ☐ Yes ☐ No

   Coastal

   1.0 foot above the height of the one percent wave for the 100-year stillwater surge elevation or maximum wave runup (whichever is greater). ☐ Yes ☐ No

   2.0 feet above 100-year stillwater surge elevation ☐ Yes ☐ No

   Please note, occasionally exceptions are made to the minimum freeboard requirement. If an exception is requested, attach documentation addressing Part 65.10 (b) (1) (ii) of the National Flood Insurance Program regulations.

   If no is answered to any of the above, please explain where and why: _____

2. Is there an indication from historical records that ice-jamming can effect the 100-year water surface elevation?
   ☐ Yes ☒ No If yes, provide ice-jam analysis profile and evidence that the minimum freeboard discussed above still exists.

3. Tabulate the elevations at critical locations (tabulate values at each levee crest grade change)

Station	Location	100-Year Water Surface Elevation	Levee Crest	Freeboard (ft.)
	Upper end			
	Lower end			

(Extend table on an added sheet as needed and reference)

SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport (including scour and deposition) can affect the 100-year water surface elevations?

☐ Yes ☒ No

B. Based on the conditions (such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions), is there a potential for debris and sediment transport (including scour and deposition) to affect the 100-year water surface elevations and/or the freeboard for the levee/floodwall?

☐ Yes ☐ No

2. If the answer to either 1A or 1B is yes:

A. What is the estimated sediment (bed material) load?

_____ cfs (attach gradation curve)

Explain method used to estimate the sediment transport and the depth of scour and/or deposition

_____

_____

_____

_____

_____

B. Will sediment accumulate anywhere along the levee/floodwall (such as along any bends in the channel)?

☐ Yes ☐ No

If yes, what is the minimum freeboard at these locations? _____ feet.

CLOSURES

1. Openings through the levee system:

☐ exist ☐ do not exist

If openings exist, list all closures:

Channel Station	Left or Right Bank	Opening Type	Highest Elevation for Opening Invert	Type of Closure Device

(Extend table on an added sheet as needed and reference)

Geotechnical and geologic data:

In addition to the required detail analysis reports, data obtained during field and laboratory investigations and used in the design analysis for the following levee system features should be submitted in a tabulated summary form. (Reference U.S. Army Corps of Engineers EM-1110-2-1906 Form 2086).

EMBANKMENT PROTECTION

1. The maximum levee slope landside is _____

2. The maximum levee slope floodside is _____

3. The range of 100-year riverine flood velocities along the levee? _____ (min.) to _____ (max.)

4. Embankment material is protected by (describe the kind): _____

_____

_____

_____

5. Riprap Design Parameters: (Include references) ☐ Velocity ☐ Tractive stress

	Reach	Sideslope	Flow depth	Velocity	Curve or Straight	Stone Riprap D_{100} D_{50} Thickness	Depth of Toedown
Sta ____ to ____							
Sta ____ to ____							
Sta ____ to ____							

(Extend table on an added sheet as needed and reference)

6. Has a bedding/filter analysis and design been included? ☐ Yes ☐ No

Describe the analysis used for other kinds of protection used (include copies of the design analysis):

Note: Attach engineering analysis to support construction plans.

EMBANKMENT AND FOUNDATION STABILITY

1. Describe the basis for selection of critical location for analysis:

☐ Overall height: Sta _____, height _____ ft.

☐ Limiting foundation soil strength:

Sta _____, depth _____ to _____

strength ø = _____ degrees, c = _____ psf

☐ slope: SS = _____ (h) to _____ (v)

(Repeat as needed on an added sheet for additional locations)

2. Specify the embankment stability analyses methodology used (e.g. circular arc, sliding block, infinite slope, etc.): _____

_____

_____

3. Summary of stability analysis results:

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction	_____	1.3
II	Sudden drawdown	_____	1.0
III	Critical flood stage	_____	1.4
IV	Steady seepage at flood stage	_____	1.4
VI	Earthquake (Case I or III)	_____	1.0

(Reference: U.S. Army Corps of Engineers EM-1110-2-1913 Table 6-1)

4. Was a seepage analysis for the embankment performed? ☐ Yes ☐ No

Describe methodology used: _____

_____

5. Was a seepage analysis for the foundation performed? ☐ Yes ☐ No

Were uplift pressures at the embankment landside toe checked? ☐ Yes ☐ No

Were seepage exit gradients checked for piping potential? ☐ Yes ☐ No

6. The duration of 100-year flood hydrograph against the embankment is _____ Hrs.

Note: Attach engineering analysis to support construction plans.

EMBANKMENT AND FOUNDATION STABILITY

1. Describe analysis submittal based on Code:

☐ UBC (1988) or ☒ Other (specify) 1994 UBC

2. Stability analysis submitted provides for:

☒ Overturning ☒ Sliding; if not, explain _____

3. Loading included in the analyses were:

☒ Lateral earth @ P_A = 30 psf/ft, _____ psf; P_P = 250 psf/ft psf

☐ Surcharge-Slope @ 0, ☐ surface _____ psf

☒ Wind @ P_W = 15 psf

☐ Seepage (Uplift); ☐ Earthquake @ P_{eq} = _____%g

☐ 100-year significant wave height _____ ft.

☐ 100-year significant wave period _____ sec.

4. Summary of Stability Analysis Results: Factors of Safety. Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		~~Sta~~ 6 Ft. Overturn	~~To~~ 6 Ft. Sliding	~~Sta~~ 10 Ft. Overturn	~~To~~ 10 Ft. Sliding
	Overturn	Sliding				
Dead & Wind & Soil	1.5	1.5	1.91	1.52	2.04	1.5
Dead & Soil	1.5	1.5	2.77	1.68	2.38	1.57
Dead, Soil, Flood & Impact	1.5	1.5	N/A			
Dead, Soil & Seismic	1.3	1.3	N/A			

(Ref: FEMA 114 Sept 1986; COE EM 1110-2-2502)

(Note: Extend table on an added sheet as needed and reference)

15 Ft WALL

Overturn	Sliding
3.33	1.50
3.60	1.53

5. Foundation bearing strength for each soil type:

Bearing Pressure	Sustained Load		Short Term Load	
Computed design maximum	3161	psf	3286	psf
Maximum allowable	3325	psf	3325	psf

6. Foundation scour protection ☒ is, ☐ is not provided, (describe)

Toe down of walls get below computed scour depths.

Note: Attach engineering analysis to support construction plans.

SETTLEMENT

1. Anticipated potential settlement has been determined and incorporated into the specified construction elevations to maintain the established freeboard margin. ☐ Yes ☒ No

2. The computed range of settlement is ____1/4_____ in. to _____1/2_____ in.

3. Settlement of the levee crest is determined to be primarily from:

   ☐ Foundation consolidation

   ☐ Embankment compression

   ☐ Other (describe) ____N/A_____

4. Differential settlement of floodwalls

   ☒ has ☐ has not been accommodated in the structural design and construction.

Note: Attach engineering analysis to support construction plans.

INTERIOR DRAINAGE

1. Specify size of each interior watershed

   Draining to pressure conduit _____

   Draining to ponding area _____

2. Relationship Established

   Ponding elevation vs. storage ☐ Yes ☐ No

   Ponding elevation vs. gravity flow ☐ Yes ☐ No

   Differential head vs. gravity flow ☐ Yes ☐ No

3. The river flow duration curve is enclosed ☐ Yes ☐ No

4. Specify the discharge capacity of the head pressure conduit _____

5. Which Flooding Conditions Were Analyzed?

   - Gravity flow (Interior Watershed) ☐ Yes ☐ No
   - Common storm (River Watershed) ☐ Yes ☐ No
   - Historical ponding probability ☐ Yes ☐ No
   - Coastal wave overtopping ☐ Yes ☐ No

   If no, explain why: _____

6. Interior drainage has been analyzed based on joint probability of interior and exterior flooding and the capacities of pumping and outlet facilities to provide the established level of flood protection.

   ☐ Yes ☐ No

   If no, explain why: _____

7. The rate of seepage through the levee system for the 100-year flood is _____ cfs

INTERIOR DRAINAGE (Cont'd)

8. The length of levee system used to drive this seepage rate is _____ ft.

9. Will a pumping plant(s) be used for interior drainage? ☐ Yes ☐ No

If yes, include the number of pumping plants: _____

For each pumping plant, list:	Plant #1	Plant #2
The number of pumps		
The ponding storage capacity		
The maximum pumping rate		
The maximum pumping head		
The pumping starting elevation		
The pumping stopping elevation		
Is the discharge facility protected?		
Is there a flood warning plan?		
How much time is available between warning and flooding?		

Will the operations be automatic? ☐ Yes ☐ No

If the pumps are electric, are there backup power sources? ☐ Yes ☐ No

(Reference: U.S. Army Corps of Engineers EM-1110-2-3101, 3102, 3103, 3104, and 3105)

Note: Include a copy of supporting documentation of data and analysis. Provide a map showing the flooded area and maximum ponding elevations for all interior watersheds that result in flooding.

OTHER DESIGN CRITERIA

1. The following items have been addressed as stated:

Liquifaction ☐ is ☐ is not a problem.

Hydrocompaction ☐ is ☐ is not a problem.

Heave differential movement due to soils of high shrink/swell

☐ is ☐ is not a problem.

2. For each of these problems, state the basic facts and corrective action taken.

_____

_____

_____

_____

If the levee/floodwall is new or enlarged, will the structure adversely impact flood levels and/or flow velocities floodside of the structure? ☐ Yes ☐ No

Note: Attach supporting documentation.

The planned/installed works are in full compliance with NFIP regulations, Section 44 CFR Ch. 1.65.10

☐ Yes ☐ No

OPERATIONAL PLAN AND CRITERIA

1. The operation plan incorporates all the provisions for closure devices as required in Section 65.10(c)(1), of the NFIP regulations.

☐ Yes ☐ No

2. The operation plan incorporates all the provisions for interior drainage as required in Section 65.10(c)(2), of the NFIP regulations.

☐ Yes ☐ No

If no to either of the above, please explain.

_____

_____

_____

_____

APPENDIX K

CONSTRUCTION PLANS

GENERAL NOTES

All construction shall be completed in accordance with the Maricopa Association of Governments (M.A.G.) "Uniform Standard Specifications for Public Works Construction", 1992 Edition inclusive of the latest revisions and amendments, these Design Plans, and the Specifications on the Plans.

The Maricopa Association of Governments "Uniform Standard Details for Public Works Construction", with the latest revisions and amendments are the Standard Drawings for this project, are an integral part of the Contract, and these Design Plans.

A Geotechnical Report has been prepared by Construction Inspection & Testing. Copies of this report can be obtained at Coe & Van Loo Consultants, Inc.

The Contractor will be responsible for ensuring that all necessary permits have been obtained prior to construction. Dust shall be controlled in accordance with Federal, State, and local laws, ordinances and regulations. The Contractor shall obtain a permit from the Maricopa County Air Pollution Officer prior to start of construction.

All construction signing, barricading and traffic delineation shall conform to the MAG Stand Specifications and to the "Manual of Uniform Traffic Control Devices - 1984" and any of their latest revisions.

Clearing and Grubbing shall include the removal of all trash and debris within project work area. The removal of trees will not be measured or paid for separately, but considered as part of the clearing and grubbing work.

The Contractor shall take all precautionary measures necessary to protect existing improvements from damages and all such improvements or structures damaged by the Contractor's operations shall be repaired or reconstructed satisfactory to the engineer at the expense of the Contractor.

The construction plans are based on topo survey and cross-sections taken on approximately 100 feet increments 100 feet each side of the construction control lines shown on the plans.

In the event that a discrepancy is encountered on these plans or within the Specifications, the Contractor shall notify the Engineer immediately for advisement and prior to any construction activity.

Stations shown on the profile are along the construction control line. Earthwork cross-sections are stationed along the construction control line and are drawn perpendicular or radial to the construction control line. Cross-sections are provided as an aid in evaluating earthwork quantities only and should not be used for staking centerline control or grades.

There shall be no stockpiling of materials in the floodway during or after construction. After construction, the disturbed area in the Temporary Construction Easement should be restored to its original state.

Utility locations shown hereon are approximate only. It shall be the Contractor's responsibility to determine the exact vertical and horizontal location of all existing underground utilities prior to commencing construction. No representation is made that all existing utilities are shown hereon. The Engineer assumes no responsibility for utilities not shown or utilities not shown in their proper location. The Contractor shall notify Blue Stake and all utility companies at least 48 hours prior to commencing construction.

ENGINEER'S NOTES

All quantities shown are estimates only. The contractor is responsible to verify quantities for bidding purposes.

These plans are not to be used for construction purposes unless the approval block has been signed by the appropriate agencies. All work shall conform to the current M.A.G. specifications and standard details together with the supplement of the appropriate agency.

A thorough attempt has been made to show the locations of all underground obstructions and utility lines in the work area. However, the contractor shall be responsible for any damage to obstructions and utility lines encountered during construction and shall determine the exact location of utilities in the area.

The engineer makes no representation or guarantee regarding earthwork quantities or that the earthwork for this project will balance due to the varying field conditions. Changing soil types, allowable construction tolerances and construction methods that are beyond the control of the engineer.

Prior to bidding the work, the contractor shall thoroughly satisfy himself as to the actual conditions., Earthwork quantities, if any. No claim shall be made against the owner/developer or engineer for any excess or deficiency therein, actual or relative.

The contractor shall make no claim against the owner or the engineer regarding alleged inaccuracy of construction stakes set by the engineer unless all survey stakes set by the engineer are maintained intact and can be verified as to their origin. If, in the opinion of the engineer, the stakes are not maintained intact and cannot be verified as to their origin, any remedial work required to correct any item or improper construction work in this development shall be performed at the sole expense of the responsible contractor or subcontractor.

Nothing contained in the contract documents shall create, nor shall be construed to create, any contractual relationship between the engineer and the contractor or any subcontractor.

The engineer will not be responsible for construction means, methods, techniques, sequences or procedures or for safety precautions or programs utilized in connection with the work, and he will not be responsible for the contractor's failure to carry out the work in accordance with the contractor documents.

All earthwork construction shall conform to the latest Maricopa Association of Governments standard details and/or specifications including any supplements thereto and the soils report prepared by:

Construction Inspection & Testing Company
2002 West North Lane
Phoenix, Arizona 85021
Job #96-8588

APPROVAL

CITY OF PEORIA ENGINEER _____ DATE _____

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY _____ DATE _____

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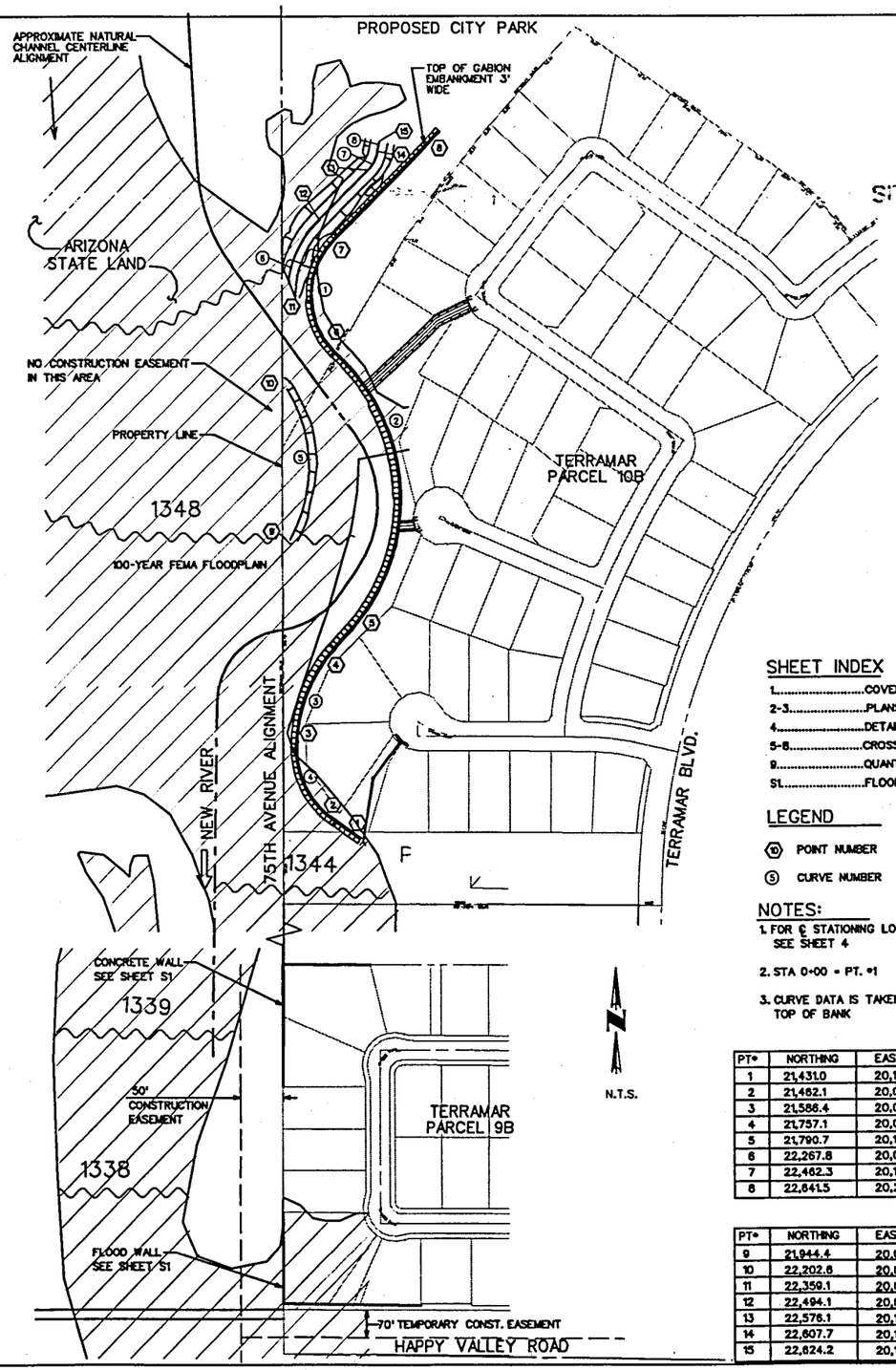
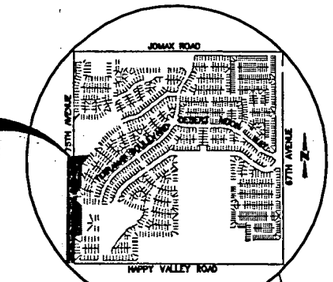
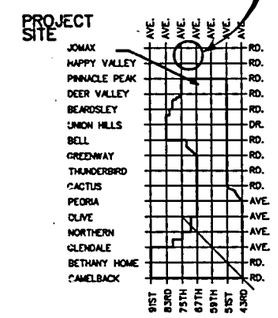




VICINITY MAP
N.T.S.



LOCATION MAP
N.T.S.

SHEET INDEX

1.....COVER SHEET
2-3.....PLANS
4.....DETAILS
5-8.....CROSS SECTIONS
9.....QUANTITIES & SPECS.
S1.....FLOOD WALL DETAILS

LEGEND

(10) POINT NUMBER

(5) CURVE NUMBER

NOTES:

1. FOR ℄ STATIONING LOCATION SEE SHEET 4
2. STA 0+00 = PT. #1
3. CURVE DATA IS TAKEN FROM TOP OF BANK

ENGINEER
COE & VAN LOO CONSULTANTS
4550 N. 12TH STREET
PHOENIX, ARIZONA 85014
(602) 264-6831

BENCHMARK

BRASS CAP IN HANDHOLE @ INTERSECTION OF 67TH AVENUE AND HAPPY VALLEY ROAD
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION
DATUM ELEVATION = 1379.61 (CITY OF PEORIA)

BASIS OF BEARINGS

THE SOUTH LINE OF THE SOUTHWEST QUARTER OF SEC. 1 T.4 N., R.1 E.
HAVING A BEARING OF N89° 44'28"W

PT#	NORTHING	EASTING	DIST.	BEARING
1	21,431.0	20,137.9		
			56.28'	S54° 55'33"E
2	21,462.1	20,093.6		
3	21,586.4	20,028.0		
4	21,757.1	20,094.5		
			45.54'	N42° 23'58"E
5	21,790.7	20,125.2		
6	22,267.8	20,095.3		
7	22,462.3	20,100.9		
			253.80'	N45° 03'02"E
8	22,641.5	20,280.6		

PT#	NORTHING	EASTING	DIST.	BEARING
9	21,944.4	20,017.1		
10	22,202.8	20,012.7		
11	22,359.1	20,013.6		
12	22,494.1	20,072.0		
			118.01'	N45° 03'02"E
13	22,576.1	20,154.1		
14	22,807.7	20,170.8		
15	22,824.2	20,173.9		

BC CURVE DATA

NO	RADIUS	DELTA	LENGTH	TANGENT
(1)	0134.85'	092°22'13"	0217.40'	0140.55'
(2)	0338.90'	089°43'09"	0530.69'	0337.25'
(3)	0253.37'	042°22'35"	0187.39'	0098.22'
(4)	0150.00'	055°51'31"	0146.24'	0079.52'
(5)	0249.97'	062°12'22"	0271.39'	0150.81'
(6)	0177.85'	048°52'13"	0151.70'	0080.81'
(7)	0059.15'	035°09'24"	0036.29'	0018.74'
(8)	0350.69'	002°45'00"	0016.83'	0008.42'
( )	'	° ' "	'	'
( )	'	° ' "	'	'

PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

Two working days before you dig BLUE STAKE 263-1100

TERRAMAR - NEW RIVER

COE & VAN LOO
PLANNING • ENGINEERING • LANDSCAPE ARCHITECTURE
4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
TELEPHONE (602) 264-6831

REVISIONS	DATE	BY

DESIGNED KA
DRAWN MH
CHECKED KA
DATE AUG. 98

BANK PROTECTION PLANS

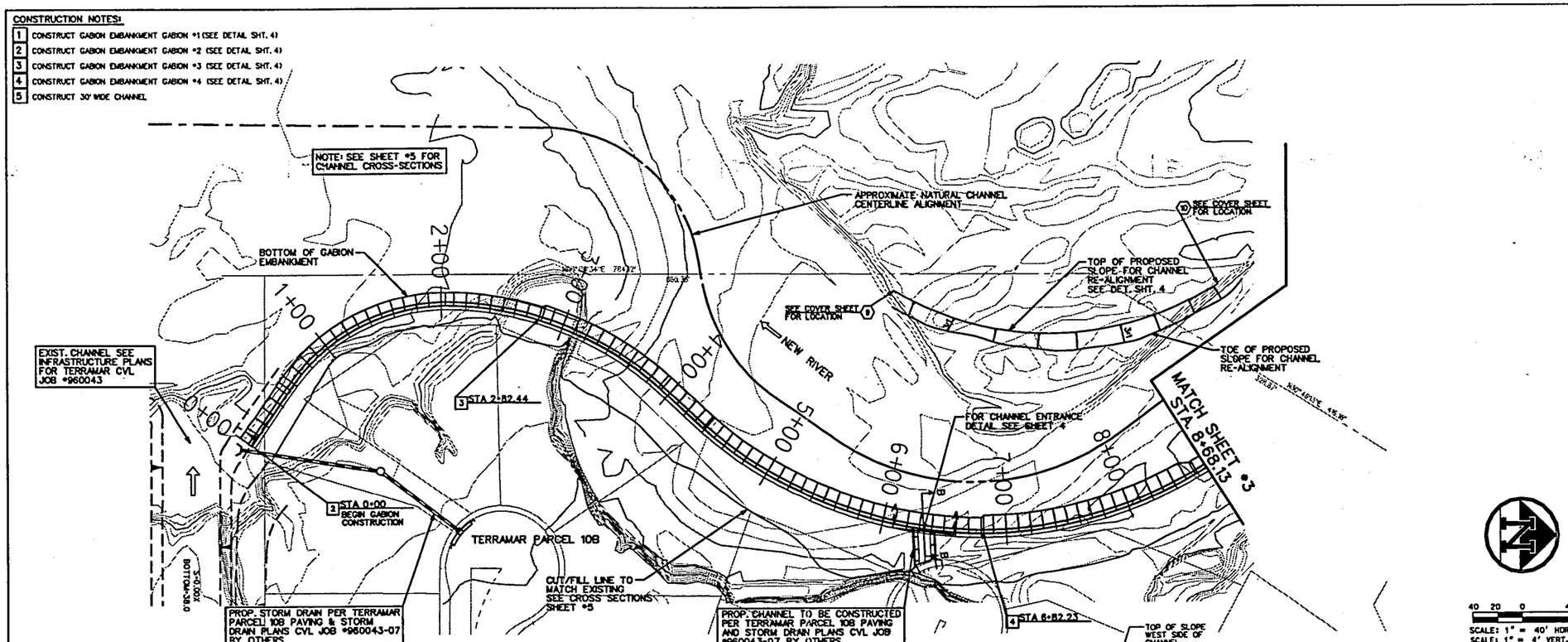
CVL

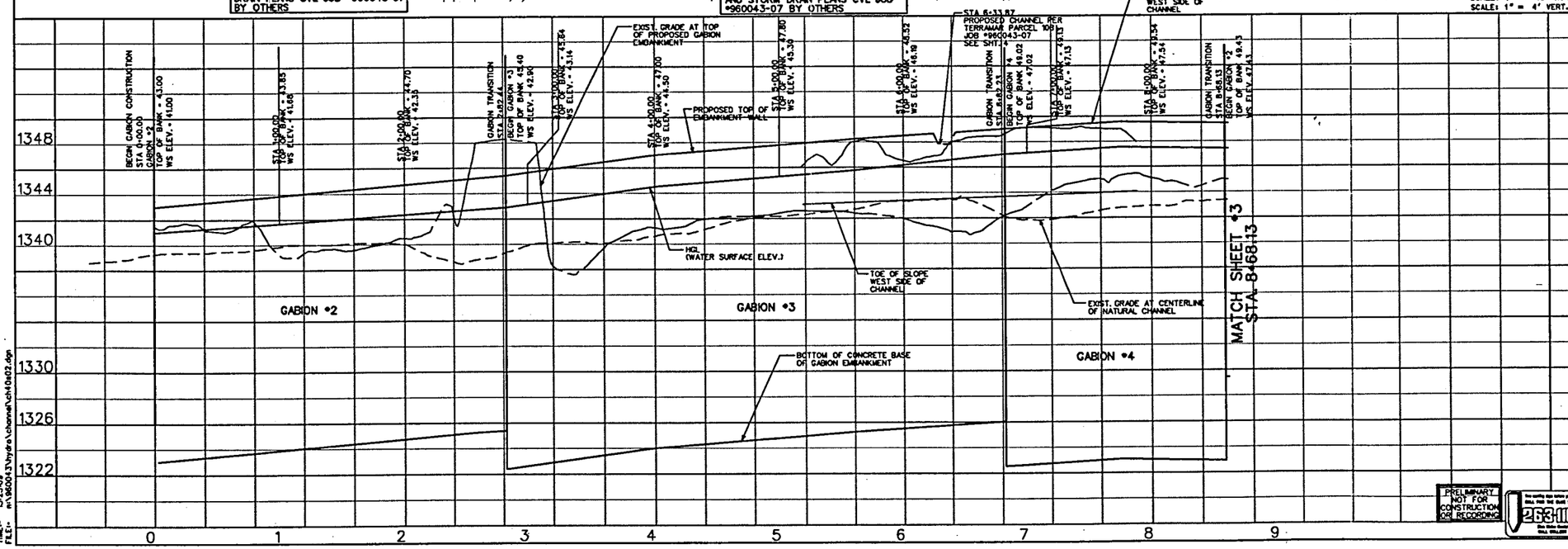
SHEET 1 OF 9

96-0043-PLAN

CONSTRUCTION NOTES:

1. CONSTRUCT GABION EMBANKMENT GABION #1 (SEE DETAIL SHT. 4)
2. CONSTRUCT GABION EMBANKMENT GABION #2 (SEE DETAIL SHT. 4)
3. CONSTRUCT GABION EMBANKMENT GABION #3 (SEE DETAIL SHT. 4)
4. CONSTRUCT GABION EMBANKMENT GABION #4 (SEE DETAIL SHT. 4)
5. CONSTRUCT 30' WIDE CHANNEL





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263-1100

TERRAMAR - NEW RIVER

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4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
TELEPHONE (602) 264-6831

REVISIONS	DATE	BY

DESIGNED	KA	
DRAWN	MH	
CHECKED	KA	
DATE	AUG. 98	

BANK PROTECTION PLANS

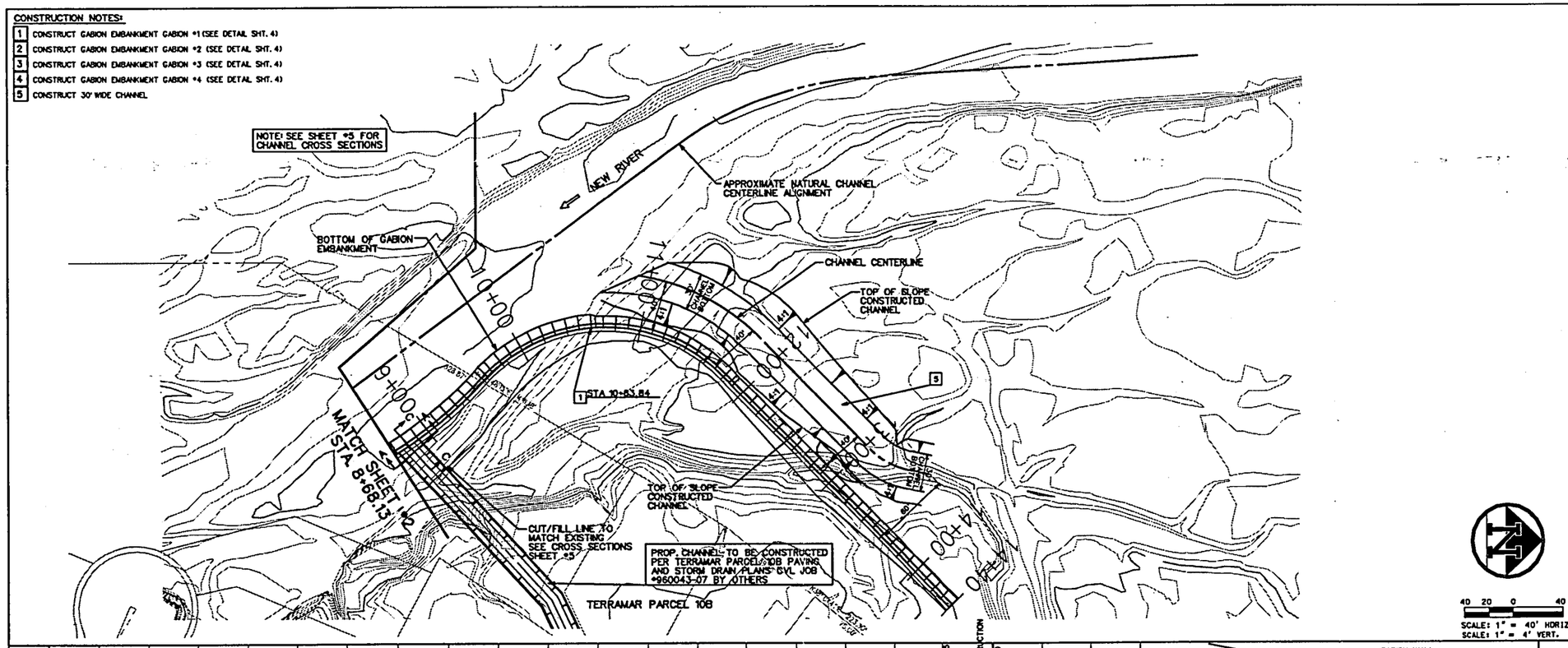
CVL

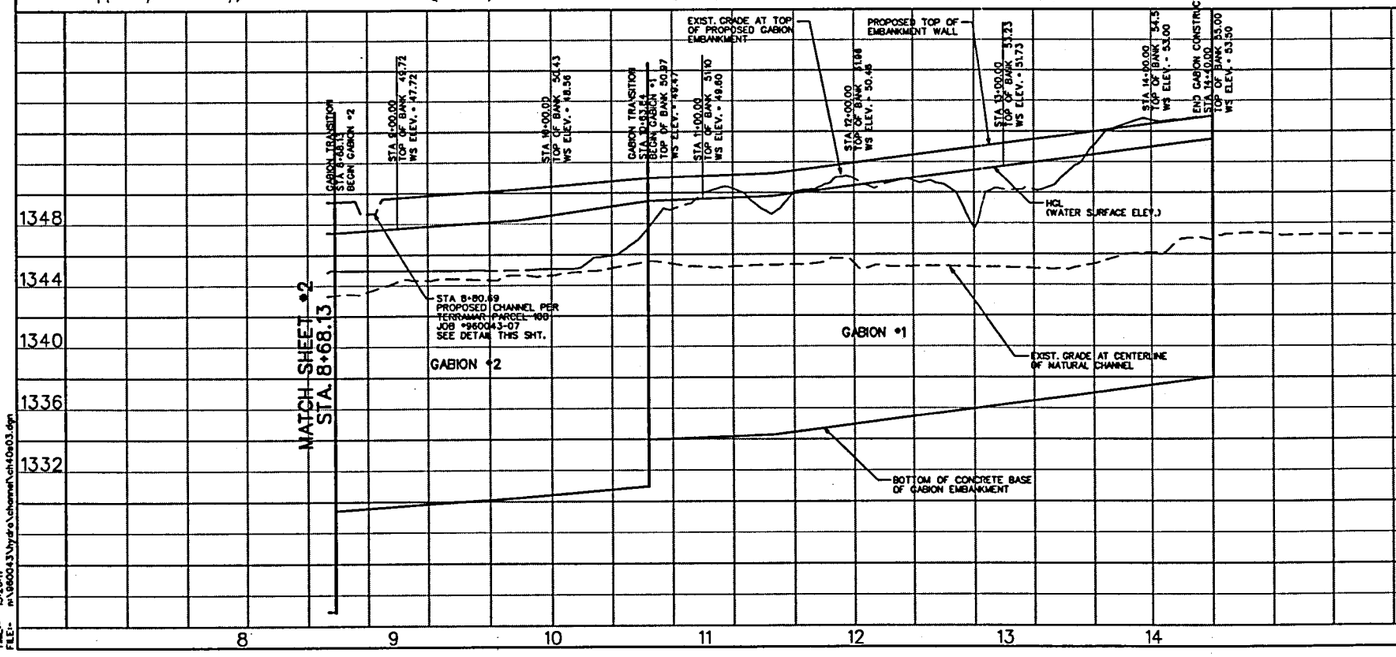
SHEET 2 OF 9

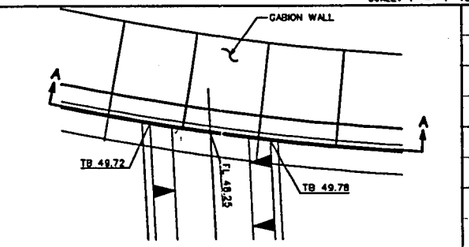
96-0043-PLAN

CONSTRUCTION NOTES:

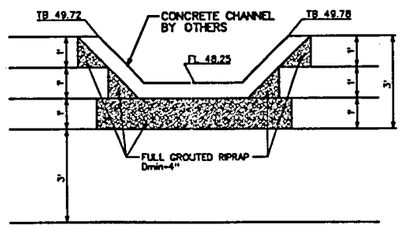
1. CONSTRUCT GABION EMBANKMENT GABION #1 (SEE DETAIL SHT. 4)
2. CONSTRUCT GABION EMBANKMENT GABION #2 (SEE DETAIL SHT. 4)
3. CONSTRUCT GABION EMBANKMENT GABION #3 (SEE DETAIL SHT. 4)
4. CONSTRUCT GABION EMBANKMENT GABION #4 (SEE DETAIL SHT. 4)
5. CONSTRUCT 30' WIDE CHANNEL







PLAN VIEW OF CHANNEL AT GABION WALL AT STA. 8+80.69



SECTION A-A OF CHANNEL AT GABION WALL

PRELIMINARY NOT FOR CONSTRUCTION OR RECORDING

263-1100

TERRAMAR - NEW RIVER

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PLANNING • ENGINEERING • LANDSCAPE ARCHITECTURE
4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
TELEPHONE (602) 264-6831

REVISIONS	DATE	BY

DESIGNED KA
DRAWN MRT
CHECKED KA
DATE AUG. 98

BANK PROTECTION PLANS

CVL

SHEET 3 OF 9

96-0043-PLAN

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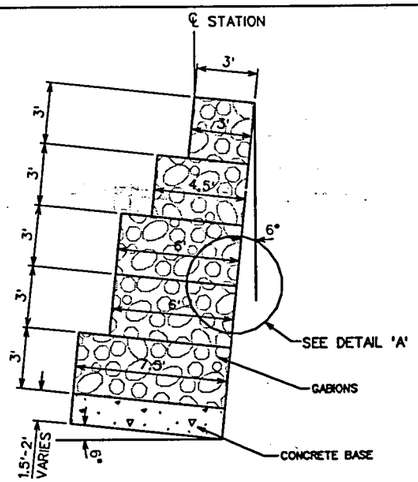

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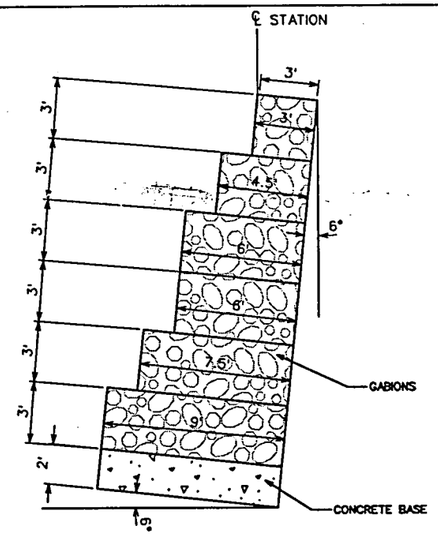

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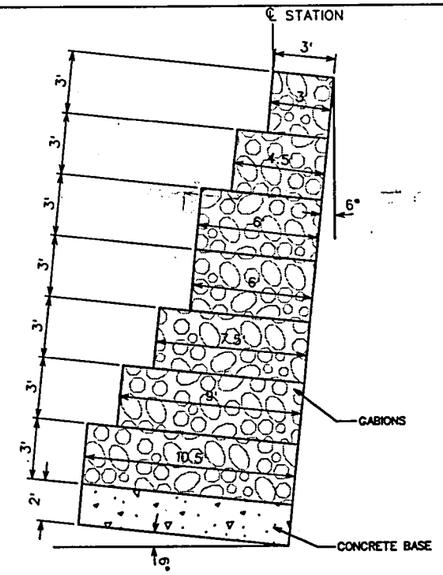

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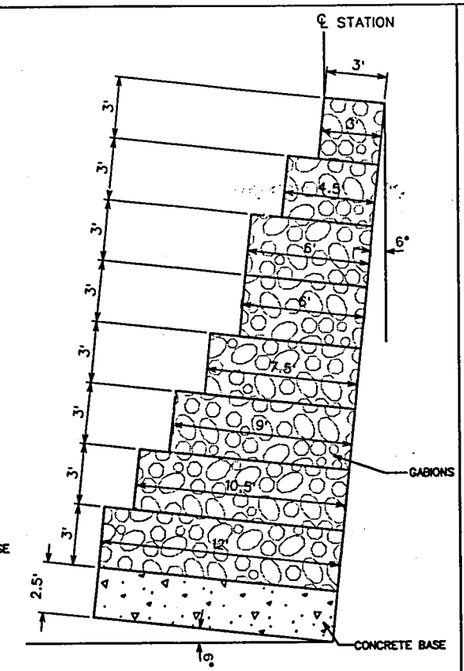

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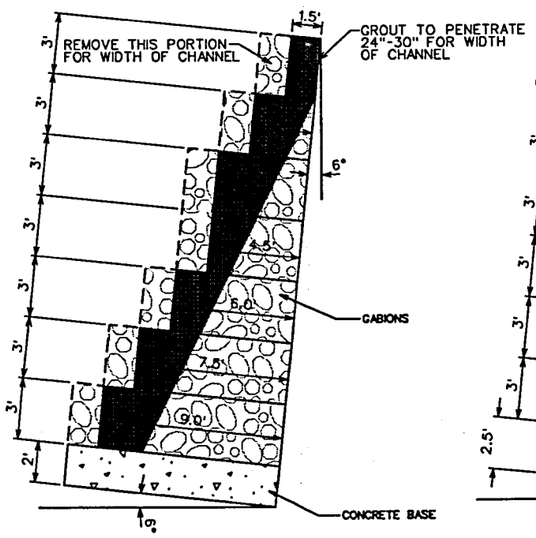
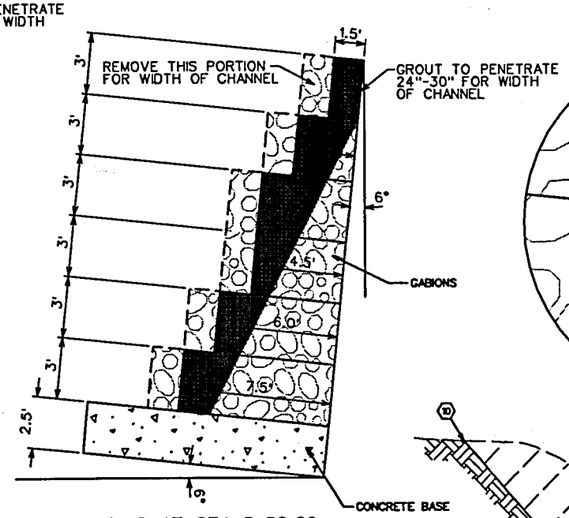


GABION #3 AT STA 6+33.87



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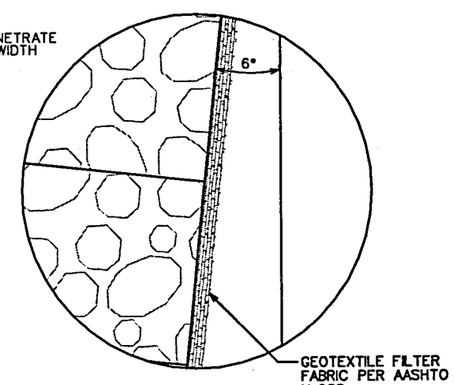

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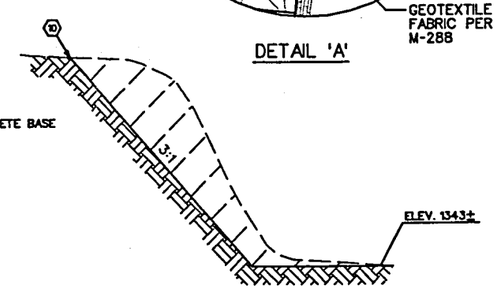
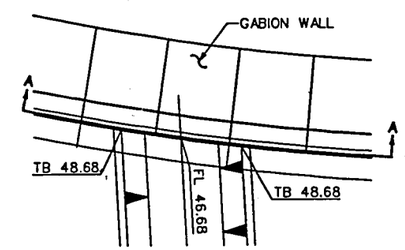
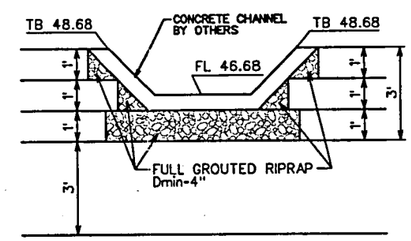


CHANNEL RE-ALIGNMENT GRADE



PLAN VIEW OF CHANNEL AT GABION WALL AT STA 6+33.87



SECTION A-A OF CHANNEL AT GABION WALL

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SHEET 4 OF 9

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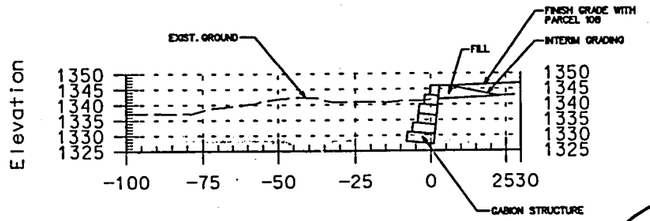

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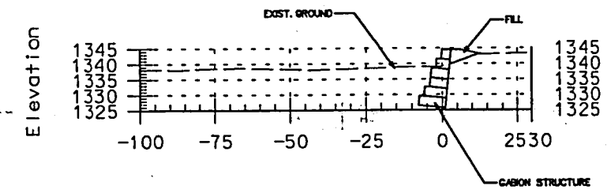

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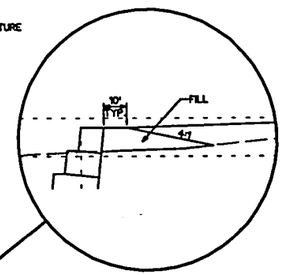

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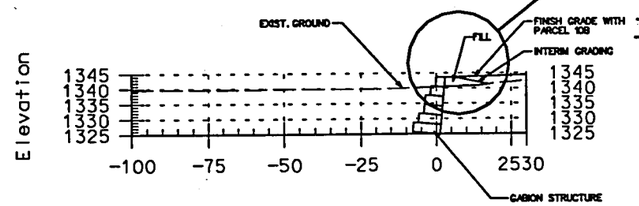

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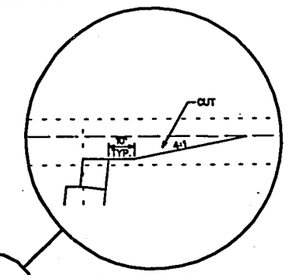

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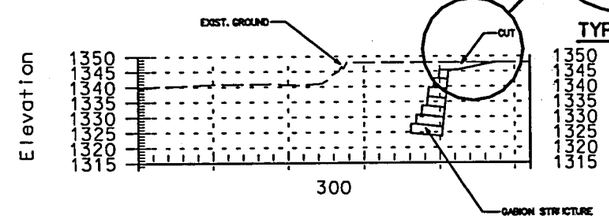

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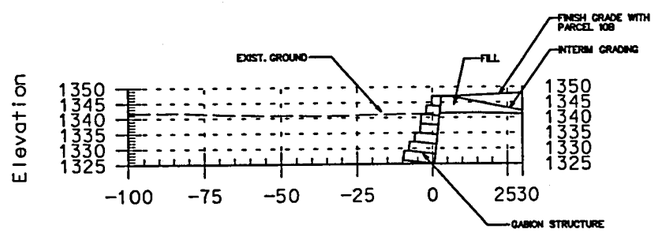

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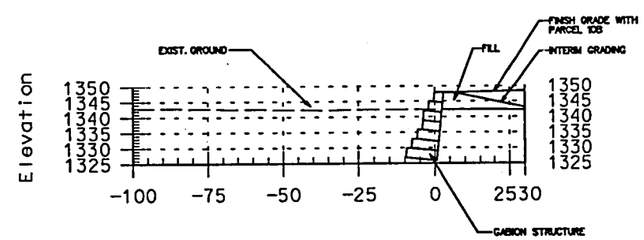

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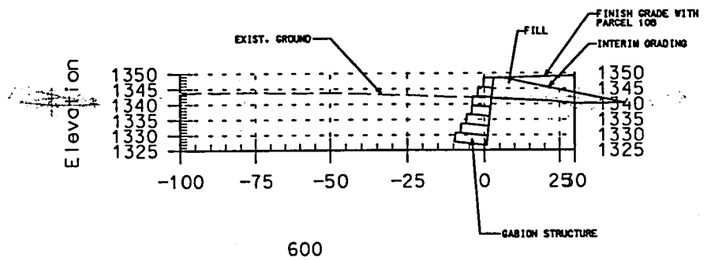

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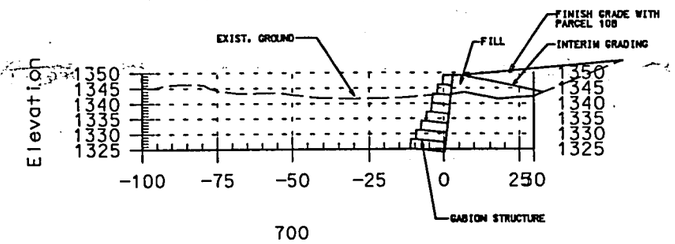

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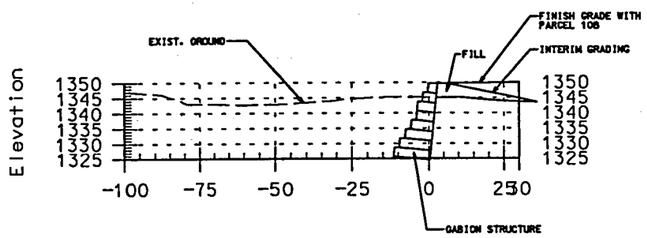

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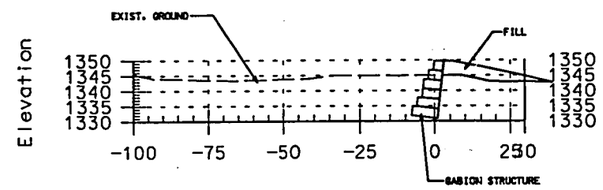

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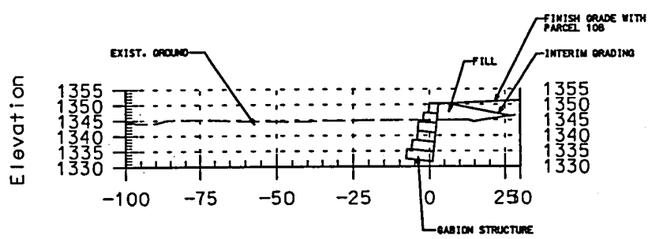

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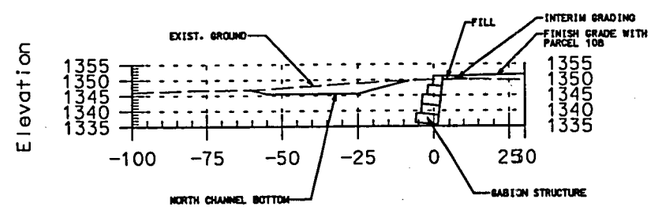

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20' 10' 0 20'
SCALE: 1" = 20'

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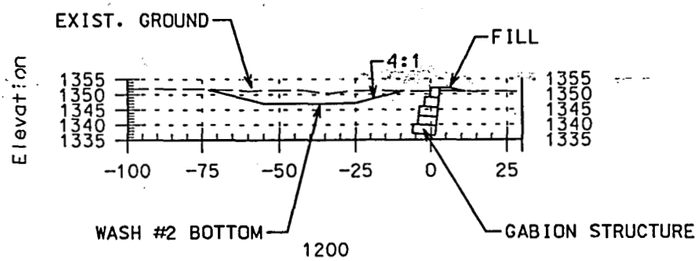

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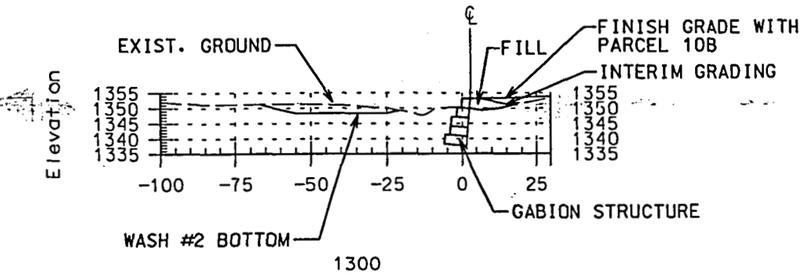

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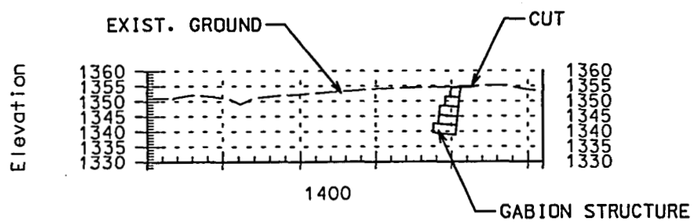

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SHEET 8 OF 9

96-0043-PLAN

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GABION RETAINING WALL SPECIFICATIONS

The gabion box and rock filler materials should meet the specifications of the manufacturer. The following specifications of Maccaferri Gabions, Inc. or equivalent should be used.

1. The Box Gabion

Box gabion structure shall be made of hexagonal double twisted wire mesh as per ASTM A975-97. The box sizes shall be standard sizes and may be varied as necessary to fit the channel bank. The width of the box shall be 3.0 feet while the length or height may be varied as necessary. The gabion may be divided into cells by means of diaphram positioned at 3 feet centers.

In order to reinforce the structure, all edges shall be selvedged with having wire having diameter of 3.9 mm. The following standard sizes may be available for use:

Length (ft)	Width (ft)	Height (ft)
6.0	3.0	1.0-1.5- 3.0
9.0	3.0	1.0-1.5- 3.0
12.0	3.0	1.0-1.5- 3.0
4.5	3.0	3.0

2. The Wire Mesh

Mesh opening shall be 3.0 inches and wire diameter (thickness) shall be 3.0 millimeters and shall be a heavily zinc coated mild steel as per ASTM A641-92 (Type 8x10/Zn) or a zinc-5% aluminum-mischmetal alloy as per ASTM A856/A856M (Type 8x10/Zn-5%Al). The following specifications shall apply to wire types used for the gabion construction:

	Diameter mm (in)	Quantity of Zn. gm/m2 (oz/yd2)	Quantity of Zn-5%Al gm/m2 (oz/yd2)
Mesh wire	3.00 (0.12)	260 (0.85)	275 (0.90)
Selvedge wire	3.90 (0.146)	274 (0.90)	290 (0.95)
Lacing wire	2.20 (0.087)	214 (0.70)	240 (0.79)

Tensile strength of all wires shall be 38 to 50 kg/mm2 according to ASTM A641-92 for zinc coating and ASTM A856/A56M for zinc aluminum alloy coating.

Elongation shall not be less than 12% per ASTM A370-92.

Adhesion of zinc . The adhesion of the zinc coating to the wire should be such that, when the wire is wrapped six turns round on a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with bare fingers.

3.0 Rock Characteristics.

Rock to fill the gabion boxes shall be not be graded. The minimum rock size shall be 4 inches and maximum 10 inches in diameter. Rocks must be clean of fines, durable and non-friable. The rock must pass the durability index test, per ASTM C127, with durability index of 52 or greater.

4.0 Assembly and Erection

a). Unfold units, erect corners and diaphrams and bind them to the side panels. Use lacing wire supplied together with the gabions.
b) The lacing wire should be passed through each mesh, making a double twist every other mesh.
c) Fill the gabions with stones with the characteristics given above in section 3.0 Checkfilling at the corners. Compaction is not required.
d) Bind the lid down with lacing operation described above
e) All gabions must be connected to each other along all edges in contact with the same lacing operation.

5.0 Concrete Base

a) Concrete Quality: Confirm to ACI 301-89
b) Concrete regular weight (144 pcf) with type # cement per ASTM C150, aggregate per ASTM C33, and potable water. A maximum of 18% by weight of the total cementitious materials may be replaced by fly-ash, providing the fly-ash conforms to ASTM C618, type F.
c) Aggregate size: 1" minimum (size No. 5, 56 or 57)
d) Minimum 28-day compressive strength: 3000 psi
e) Maximum slump: 4-1/2"
f) Mechanically vibrate all concrete
g) No admixtures without approval. Admixtures containing chlorides shall not be used. Concrete shall not be in contact with aluminum.
h) Cure concrete members with polyethylene for 5 days with a curing compound approved by the engineer. Minimum concrete temperature shall be 400 F. during the 5-day cure.
i) Submit mix designs for review.

6.0 Geotextile Filter Fabric

Geotextile filter fabric material shall conform to the following specifications:

Min. permeability: 1.6 x 103 ft./sec.
Max. AOS: 0.6mm
Type: Mirafi 140n.
TYPAR 3401,
TRIVERA Spunbound 1112
Or Approved Equal
Overlap: 18-inch minimum at Fabric Edge

Filter fabric overlaps shall be pinned using steel securing pins, 3/15 inch diameter, 18 inches long, pointed at one end and fitted with a 1.5 inch diameter metal washer at the other end. Pins shall be placed along the overlap at approximately three feet on center.

7.0 Grout

The grout shall consist of one part cement and three parts by volume of aggregate. The Portland Cement shall be Type II as specified in Section 725 of the MAG Standard Specifications, and the aggregate shall be two parts sand and one part gravel passing a 3/8-inch square mesh screen. The quality of the sand and gravel shall be specified in Section 701 of the MAG Standard Specifications.

THE QUANTITIES SHOWN ARE AN ESTIMATE ONLY THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ALL QUANTITIES BEFORE BIDDING.

GABION ESTIMATED QUANTITIES

DESCRIPTION	UNIT	QUANTITY
GABION #1	CY	1,128
GABION #2	CY	1,912
GABION #3	CY	2,065
GABION #4	CY	1,208
TOTAL GABIONS	CY	6,310
CONCRETE BASE	CY	1000
GEOFABRIC	SY	3425

THE QUANTITIES SHOWN ARE AN ESTIMATE ONLY THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ALL QUANTITIES BEFORE BIDDING.

CUT/FILL ESTIMATED QUANTITIES

DESCRIPTION	UNIT	QUANTITY
FILL *	CY	3,300
CUT (WEST BANK)	CY	1,400
CUT (NORTH CHANNEL)	CY	1,330
TOTAL VOLUME OF CUT *	CY	2,730
FLOODWALLS		
CONCRETE	CY	400
REINFORCEMENT BARS	LBS	44,000

The water content of the mix shall not exceed 8-1/2 gallons per sack of cement. In calculating total water content of the mix, the amount of moisture carried on the surfaces of aggregate particles shall be included. Slump of grout mix shall be between 5 and 10 inches for the first course, and between 7 and 8 inches for the second course. The grout shall be mixed in a concrete mixer in the manner specified for concrete, expect that time of mixing shall be as long as is required to produce a satisfactory mixture, and the grout shall be used in the work within a period of 30 minutes after mixing. Retempering of grout will not be permitted.

The consistency of the grout shall be such as to permit gravity flow into the interstices of the stones with the help of spading, rodding, and brooming in order to assure penetration of the grout for full depth of the riprap layer. Grout batches in the same course shall be uniform in mix, size, and consistency.

The grout shall be kept moist for a period of seven(7) days following placement or may be covered with a suitable curing material subject to the engineers approval. Any damage to the protective membrane provided by an approved curing material occurring within the initial 7 days of placement shall be repaired immediately to the satisfaction of the engineer.

Curing compounds shall be applied as soon as the free water disappears and shall be applied in a 2-coat continuous operation by approved power-spraying equipment at a rate not to exceed 200 square feet per gallon for the combined coats. The second coat shall be applied to overlap the first coat in a direction approximately at right angles to the direction of the first application.

Membrane curing compound shall be resin-base dissipating membrane-type conforming to CRD-C 300.

Whenever atmospheric temperatures are expected to drop below 30 degrees F, grouted riprap shall be protected from freezing for 7 days after is construction by a covering of loose earth, straw, or other suitable material approved by the engineer.

* NOTE: CUT AND FILL QUANTITIES DO NOT INCLUDE EXCAVATION FOR GABION AND CONCRETE WALLS OR BACKFILL. THESE QUANTITIES ARE CONSIDERED INCIDENTAL TO, THE CONSTRUCTION OF THESE STRUCTURES. THEREFORE, UNIT PRICES FOR THE GABION AND REINFORCED CONDRETE WALLS SHOULD REFLECT THESE COST ITEMS.

GEOTECHNICAL SPECIFICATIONS
Reference: Terramar New River Bank Protection Design Report, Appendix C

1) Site Preparation:
Remove Vegetation and Debris. Excavate foundation trench to the toe down depths indicated on the plans.

Sloping surfaces should be benched to prevent slippage

2) Earthwork
See Section under "EARTHWORK" in the Soil Investigation Report in Appendix E of the design report for this project.

STRUCTURAL SPECIFICATIONS (Reinforced Concrete Walls)
See Sheet S1 of the construction plans for details of the material construction requirements.

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STRUCTURAL NOTES

(APPLY UNLESS NOTED OTHERWISE ON DRAWINGS)

CODE

1. Comply with 1994 Uniform Building Code.

FOUNDATIONS

1. Soil report by Construction Inspection & Testing Co. dated September 17, 1996, Job No. 96-8568 with supplementary letter dated September 17, 1996.
2. Bear footings on firm, undisturbed native soil at 1.5' feet minimum below lowest adjacent finish or 3'-0" below natural grade, whichever is lower. Finished grade is defined as lowest adjacent grade within 5'-0" of exterior footings.
3. Place foundation concrete only on clean, firm, inspected, bearing material. All footing excavations must be inspected by a qualified geotechnical engineer to insure proper foundation bearing.
4. Allowable soil bearing pressures:
   a. Footings on native soil: 2500 psf
   b. Retaining wall foundation toe pressure : 1.33 x 2500 = 3325 psf.
5. Refer to soils report for site grading, subgrade soil preparation, and fill and compaction requirements.
6. Foundations are designed for dry conditions and must remain dry during construction.

CONCRETE

1. Concrete quality: Confirm to ACI 301-89.
2. Concrete regular weight (144 pcf) with type II cement per ASTM C150, aggregate per ASTM C33, and potable water. A maximum of 15% by weight of the total cementitious materials may be replaced by fly-ash, providing the fly-ash conforms to ASTM C618, Type F.
3. Aggregate size: 1" minimum (Size No. 5, 56 or 57) for footings, and other mass concrete and 3/4" minimum (Size No. 8) for other concrete.
4. Minimum 28-day compressive strength: 3000 psi
5. Maximum slump: 4-1/2"
6. Mechanically vibrate all concrete.
7. No admixtures without approval. Admixtures containing chlorides shall not be used. Concrete shall not be in contact with aluminum.
8. Do not cast walls in lengths over 80'-0".
9. Wait 48 hours between adjacent concrete castings.
10. Cure concrete members with polyethylene for 5 days or with a curing compound approved by the Engineer. Minimum concrete temperature shall be 40° F. during the 5-day cure.
11. Cold-weather concreting: Comply with ACI 306 R-88.
12. Submit mix designs for review.
13. Maximum free drop of any concrete 8'-0".

REINFORCING

1. ASTM A615, Grade 60, except as follows:
   a. #2 and #3 bars ASTM A615: Grade 40.
   b. Field bent and/or welded bars: ASTM A706.
2. Reinforcing bars deformed except #2 bars.
3. Concrete coverage for reinforcing bars (to face of bar including stirrups and ties) except as shown or noted:
   a. Unformed concrete in contact with earth: 3"
   b. Formed concrete in contact with earth: 2"
4. Lap splices in concrete: 36 bar diameters.
5. Splice reinforcing only at approved locations.
6. Reinforcing spacings given are maximum on center and all reinforcing is continuous unless otherwise noted.
7. Provide bent corner reinforcing to match and lap with horizontal reinforcing at corners and intersections of walls, beams and footings per A.C.I. Detailing Manual (SP-66).
8. Dowel all vertical reinforcing to foundations.
9. Securely tie all reinforcing embedded items in position before placing concrete or grout.
10. Submit placing drawings per A.C.I. Detailing Manual (SP-66). Fabricate after Engineer's review. Include elevations showing reinforcing steel at all concrete walls and footings.
11. Weld reinforcing bars in conformance with AWS D1.4-92. Use low hydrogen electrodes.
12. Place reinforcing per ACI 318-89 and C.R.S.I. Standards.

SUPPLEMENTARY NOTES

1. Verify all dimensions and conditions prior to starting work. Notify the Engineer of any discrepancies or inconsistencies.
2. Verify in field all existing conditions shown on drawings.
3. Provide all necessary temporary bracing, shoring, guying, or other means to avoid excessive stresses and to hold structural elements in place during construction.
4. Options are for the contractor's convenience. He shall be responsible for all changes necessary if he chooses an option and shall coordinate all details. The cost of additional design work necessitated by selection of an option shall be borne by the contractor. Options shall not delay construction schedule.
5. The cost of additional design work due to errors or omissions in construction shall be borne by the contractor.
6. Any engineering design provided by others and submitted for review shall bear the seal and signature of an Engineer registered in Arizona. If this engineering design requires special structural inspection, they shall be responsible for the inspection.
7. Details on the Structural Drawings are typical.

SPECIAL INSPECTION

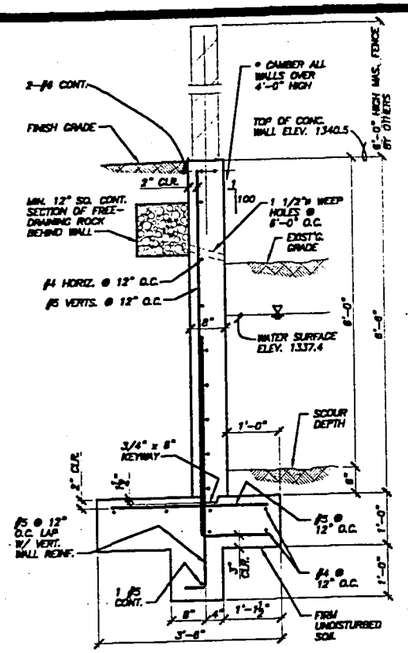
Special inspection is to be provided in addition to the inspections conducted by the Department of Building Safety and shall not be construed to relieve the Owner or his authorized agent from requesting the periodic and noted inspections required by Section 108 of the Uniform Building Code. The special inspector shall be approved by the City Building Official prior to starting work.

SPECIAL INSPECTION IS REQUIRED FOR THE FOLLOWING WORK:

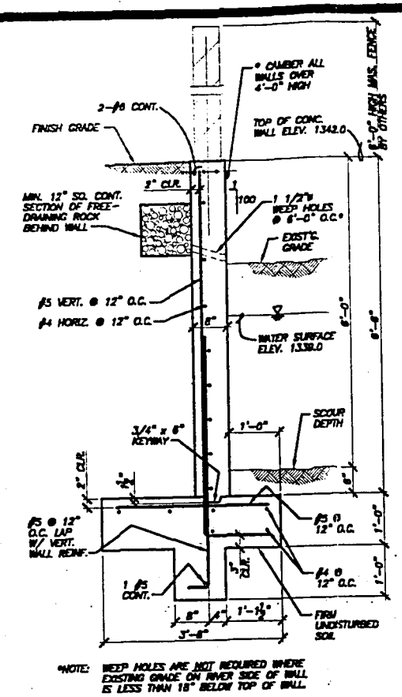
CONCRETE:
During the taking of test specimens and placing of reinforced concrete and prestressed concrete.

REINFORCING STEEL:
During placing of reinforcing steel for all concrete required to have special inspection.

SITE GRADING, EXCAVATION AND FILLING:
During earthwork excavations, grading and filling operations inspection to satisfy requirements of Chapter 18 and Appendix Chapter 33 of the 1994 UBC. A qualified geotechnical engineer shall be responsible for the special inspection.

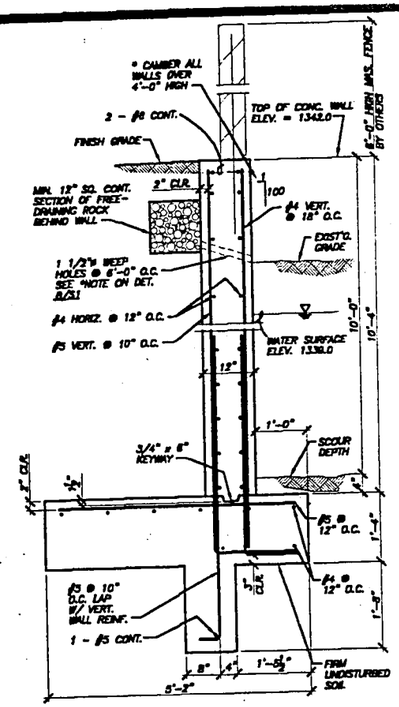


7 6'-0" CONCRETE RETAINING WALL 3/4"=1'-0"

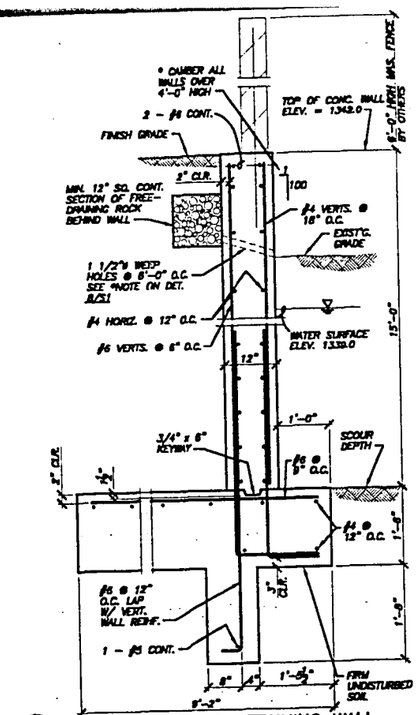


*NOTE: WEEP HOLES ARE NOT REQUIRED WHERE EXISTING GRADE ON INVER SIDE OF WALL IS LESS THAN 18" BELOW TOP OF WALL.

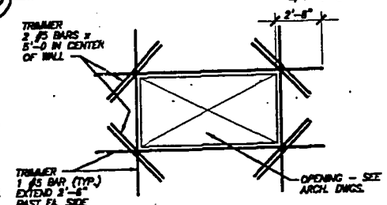
8 6'-0" CONCRETE RETAINING WALL 3/4"=1'-0"



9 10'-0" CONCRETE RETAINING WALL 3/4"=1'-0"



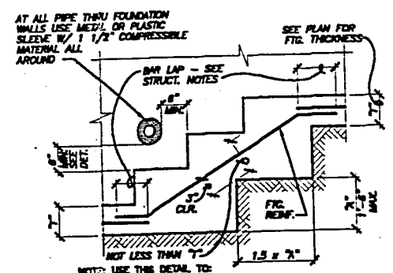
10 15'-0" CONCRETE RETAINING WALL 3/4"=1'-0"



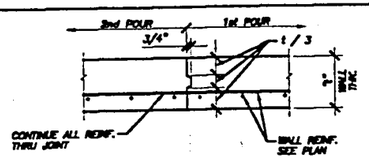
OPENINGS MAY HAVE ANY SHAPE OTHER THAN SHOWN HERE. USE CIRCUMSCRIBING RECTANGLE FOR REINFORCING APPLICATION.

NOTES:
1. PROVIDE 4 EXTRA VERTICAL BARS (NOT SHOWN) AT EACH SIDE OF OPENING. EXTEND FULL HEIGHT TO TOP OF WALL.
2. ALL TRIMMER BARS TO EXTEND 2'-6" PAST EDGE OF OPENING. HOOK BARS WHERE THIS CANNOT BE OBTAINED.

13 ADDED REINF. @ OPENING IN CONCRETE WALL 324

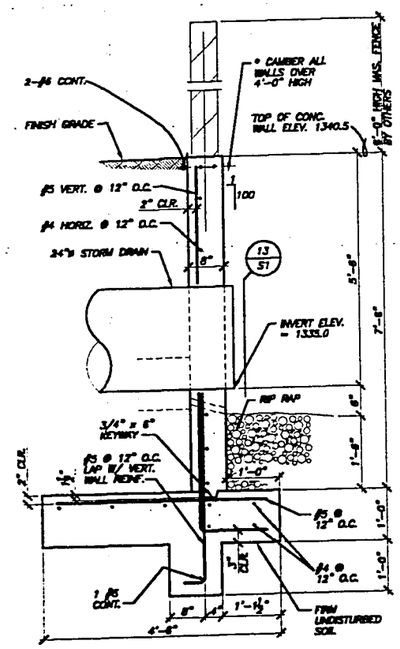


18 STEP IN WALL FOOTING 3-98 104

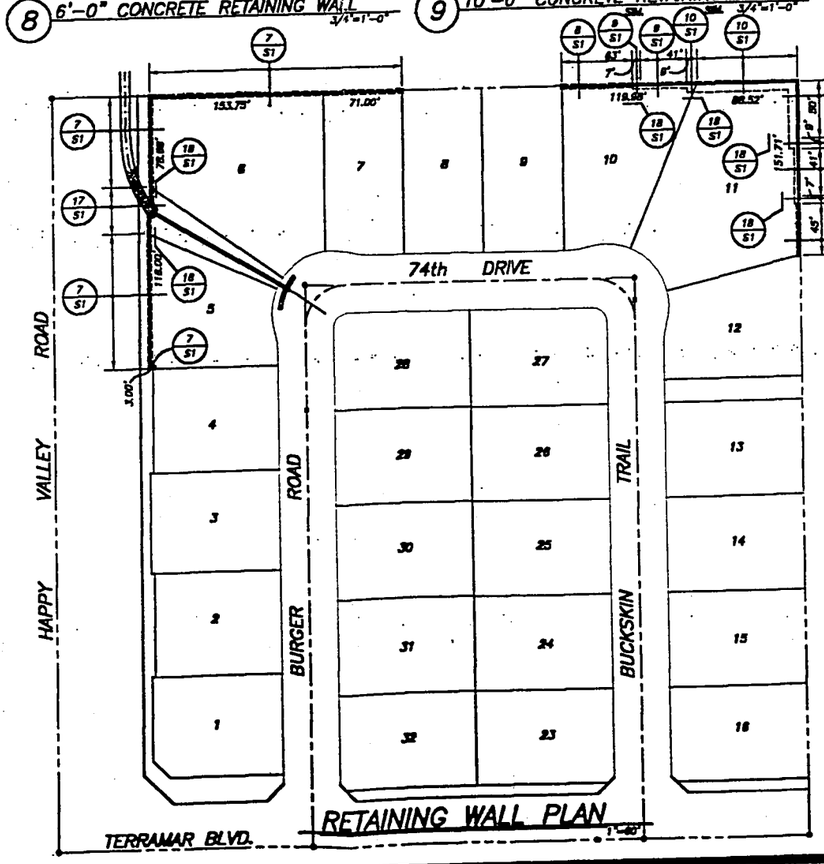


NOTE: LOCATION OF CONSTRUCTION JOINT IN WALL SUBJECT TO THE APPROVAL OF THE ENGINEER.

16 CONC. WALL CONSTR. JOINT 323



17 WALL AT STORM DRAIN 3/4"=1'-0"



RETAINING WALL PLAN 1"=60'

GERVASIO & ASSOC. INC.
CONSULTING ENGINEERS
4637 N. 16TH STREET, SUITE 200
PHOENIX, ARIZONA 85016
(602) 285-1720

TERRAMAR PARCEL 9B
INFRASTRUCTURE

COE & VAN LOO
PLANNING • ENGINEERING • LANDSCAPE ARCHITECTURE
4550 NORTH 12TH STREET
PHOENIX, ARIZONA 85014
TELEPHONE (602) 264-6831

	BY	DATE	REVISIONS
DESIGNED	MLB		
DRAWN	PDC		
CHECKED	MLB		
DATE	6/25/98		

FLOODWALLS & DETAILS

SHEET S-1 OF 1

95-0043-07

Coe & Van Loo Consultants, Inc.
4550 North 12th Street
Phoenix, Arizona 85014-4291
Phone: 602/264-6831 Fax: 602/264-0928

CVL

FAX TRANSMITTAL COVER SHEET

Date: 11/18/98

Time: 1:00p

To: Scot Schlund

Fax Number: 431-9562
Phone Number: 438-2200
Project Name: Terramar
Project Number: 980043-21

From: Kofi Awumah

Re: Terramar - New River

Pages, including cover: 6

Attached are CVL's response to your comments on the Terramar Bank Protection in New River.

There is a meeting scheduled for Tuesday November 24th in City of Peoria Engineering Conference Room at 10:00 am to discuss the Comments. You may attend if necessary.

Call me or Jim Geiser if you have any questions at 264-6831

If there are any problems with this transmission, please call (602) 264-6831.

CVL COE & VAN LOO CONSULTANTS, INC.

Land Planning · Civil Engineering · Water Resources Engineering · Environmental Sciences · Landscape Architecture · Surveying · Construction Management

COPY

November 16, 1998

Mr. Dan L. Nissen, P.E.
City of Peoria
Engineering Department
8401 W. Monroe St.
Peoria, AZ 85345

Re: Bank Protection Design Report for Terramar at New River
Response to Review Comments by Goldman Toy & Associates, Inc.
and Stantech Consultants, Inc.
CVL Project No: 96-0043-21

Dear Dan,

Coe & Van Loo Consultants, Inc. (CVL) has prepared this letter to respond to review comments by Goldman, Toy & Associates, Inc. (GTAI) and Stantech Consultants, Inc. (SCI). For ease of reference, CVL's responses are numbered the same as the review comments. Some of the concerns are due to a misunderstanding of the objectives of this project. The design objective is for Terramar to provide bank protection to proposed development on the east bank of New River without adversely impacting nearby property and not to address all bank erosion problems in the adjacent reach of the river.

A) CITY OF PEORIA/GTAI

Response to Comment # 1

The low flow channel (thalweg) within the main channel most likely changes somewhat with each flow and the assumed alignment is only for hydraulic modeling purposes. The thalweg defined on a floodplain map is a reference line for defining GR points in the hydraulic model and identifying bank stations. This reference line has no significant impact on the hydraulic analysis. The meanders reported by GTAI are not unusual and represent the lateral migration of the low flow channel. This low flow meander occurs within the general floodplain of the river and is typical of alluvial channels such as New River. There is no method of accurately predicting where the low flow channel will be at any time. The potential depth of the low flow channel is the important factor and this has been accounted for in the scour analysis and the design of the bank protection.

Response to Comment # 2

The "bank protection" along the west side of Parcel 9B has two segments for a reason. The bank protection walls along the southwest corner of Parcel 9B were designed to remove the

affected parcels from the FEMA floodplain. These walls will be used for the sole purpose of elevating the parcel pad above the 100-year floodplain. Some segments of these walls will be visible at this property line.

The walls along the northwest corner were designed to protect some of the lots of Parcel 9B from possible future bank migration at this location. These walls are not near the floodplain and will be completely buried.

The property line between these two walls has low probability of channel impingement and is not in the floodplain. A wall between the two proposed walls would serve no purpose.

Response to Comment # 3

The property owner adjacent to Terramar west of the 75th Avenue alignment is the Arizona State Land Department (ASLD). This property owner has been involved in the design review process for some time. ASLD had opportunity to comment on this project during the 404 permitting process and has issued easements for the New River grade control structure and wet utilities crossings at Happy Valley Road construction and for the construction of facilities along the west side of Terramar. There is no evidence that any erosion occurring on the west bank is being caused by flows from Channel 1. Channel 1 is an earthen channel designed for very low flow velocities. The outfall reach of Channel 1 has no slope and the velocity at the outfall into New River is only 3.2 feet per second. Channel 1 was designed with drop structures to slow down the water before reaching the outfall and the outfall is located at the historic outfall location of the wash. The New River channel banks are subject to erosion on both sides. Terramar cannot initiate or construct projects on the properties of others.

Response to Comment # 4

This location has not yet been addressed in detail due to proposed City of Peoria improvements (including a bridge crossing) to Happy Valley Road. The current discharge is close to the historic outfall location. Also, the existing flow direction of this wash is to the southwest, away from Parcel 9B. Further, the pad elevations are high enough, will be engineered and with perimeter fence, should hold under flow conditions of the interim condition.

Response to Comment # 5

The FEMA three feet freeboard condition does not apply in this case. The three feet of freeboard applies to levee condition and this design does not result in levee condition. FEMA has already granted the CLOMR and three feet freeboard was not one of its stipulations. The CLOMR package was submitted to FEMA on August 12, 1998 and it was approved on October 26, 1998.

CVL

Response to Comment # 6

This was already provided in the CLOMR report which was referenced in this report. However, we will comply with this request. We will provide the cross section locations on Sheet 1 only, since these plans are for construction purposes and not for floodplain analysis.

Response to Comment # 7

The hydrologic basis of this work is the FEMA's regulatory Flood Insurance Study. However, for the smaller washes within the development area, the hydrologic study of this area by Robert Ward was adopted and used. The report will include this information in the reference list.

Response to Comment # 8

The Drainage Reports for these parcels have already been reviewed and approved with Channel 1 design evaluated relative to the adjacent lots. Also see response to comment # 3.

Response to Comment # 9

Scour analyses for the retaining walls have been adequately completed to account for meander scour and all other scour components. It is CVL's opinion that water collecting in depressions in the river will be temporary due to the high infiltration rates, high evaporation rates and the ephemeral nature of these washes. It is therefore not necessary to provide any special treatment for the concrete and the MAG Specifications should be adequate for this design.

Response to Comment # 10

The hydraulic analysis did not support the assertion that the bank protection on the east side will cause severe erosion on the west banks. The existing channel in this reach was formed by previous larger discharges whose potential for recurrence has been reduced dramatically by the construction of New River Dam. The channel is therefore oversized for the current flow regime and reclaiming land on the east side does not result in significant increases in flow velocities. There is a summary table in the report comparing the hydraulic parameters of the existing condition with the proposed condition. There is no adverse effect on the river dynamics as a result of the bank protection. Further, the west bank is on the inside of the bend which tends to be a zone of deposition rather than erosion. Also, across a river channel, the bank that is 'hardened' tends to suffer bankline erosion due to the better conveyance properties near the bank protection.

Response to Comment # 11

There are no bank protection water surface elevations on Plate 3 of the Master Drainage Report because that report was completed prior to the bank protection analyses. The only water surface elevations on this Plate 3 were the FEMA FIS water surface elevations and

CVL

these are the same on the current design plans. There is a discontinuity in the lines on sheet 1 of the construction plans and this may be the cause of the misunderstanding.

Response to Comment # 12

This is an existing wash that extends past the 73rd Drive culvert. The objective of its re-alignment is to streamline the flows away from the bank protection, rather than allow it to impinge onto the gabion directly. The objective is not to channelize this wash between the river and the culvert. It was intended to leave this wash in its natural state through the proposed city park and enough buffer zone was left between it and the adjacent parcels. The bank protection along this wash is toe-downed deep enough (10 feet) so as not to be undermined by an unstable channel. Enough information was provided on the plans to enable this channelization to be constructed.

Response to Comment # 13

There will be six feet high fence walls set back about 10 feet from the edge of the gabions. Terramar does not intend to provide pathways or bikeways on top of the gabions. The City of Peoria did not request any trails, paths or railings along the top of the bank protection.

Response to Comment # 14

The retaining walls will be constructed first and the schedule for constructing the fence wall is not known at this time. Due to liability issues related to exposed rebars, rebars will be drilled and grouted into the retaining walls prior to the construction of the fence walls.

B. FLOOD CONTROL DISTRICT/SCI

Response to Comment #1

None required

Response to Comment # 2

See the response to Comment #2 in "A" above. In addition, the "gap" between the south end of the gabion system and the northwest corner of Parcel 9B exists because Terramar does not own this property and could not construct facilities on property it does not own. A continuous protection system would have provided a cost savings for this project but was not possible under these conditions.

Response to Comment # 3

3. See the response to Comment# 10 in "A" above.

Re: CLOMR for a Portion of New River
November 16, 1998
Page 5

Response to Comment # 4

A previous report addressing the FEMA regulatory floodplain issues (CLOMR package) was already prepared and submitted to FEMA, Flood Control District and City of Peoria. FEMA has approved this CLOMR package.

Response to Comment # 5

These FEMA forms are for the concrete floodwall only. All items that apply to this project have been taken care off.

Response to Comment # 6

The summary table 3 in the report provides all basic hydraulic parameter comparisons. Cross section comparisons were included in the CLOMR report.

If you need additional information or clarification on any issue of this report or plans, please call Kofi Awumah, Tim Kelly or myself at (602) 264-6831.

Sincerely,

COE & VAN LOO
Consultants, Inc.

George J. Geiser, P.E.
Director, Water Resources

GJG:mar

Doug Williams - FCDX
From: Doug Williams - FCDX
Sent: Tuesday, November 03, 1998 11:26 AM
To: Ed Raleigh - FCDX
Subject: FW: Terramar

Importance: High

FYI, I have forwarded this to Dave Moody and Dan Nissen at Peoria. Will keep you informed of subsequent revisions submitted by Terramar. Thanks.

-----Original Message-----

From: **Schlund, Scot [SMTP:SSchlund@stantec.com]**
Sent: Monday, November 02, 1998 10:49 AM
To: daw@mail.maricopa.gov
Cc: Ellison, Patrick
Subject: Terramar
Importance: High

Doug, Stantech has reviewed the Terramar "New River Bank Protection Design Report" dated 7 Oct. 1998 as you requested. We offer the following observations.

1. General engineering concept is acceptable.
2. It appears that the vertical floodwalls for Terramar Parcel 9B have a gap adjacent to the middle three lots. We question why the floodwall is not continuous. Similarly, it appears that erosion protection is not provided the entire length of the project. The Plan Sheet 1 indicates a "break line" north of Parcel 9B. An explanation may be needed.
3. We question the potential for erosional attack to the west bank of New River since erosion protection is only being placed on the east bank.
4. It is not clear how this project has encroached into the regulatory floodplain and floodway since this information by way of an exhibit was not provided.
5. FEMA forms that are provided are incomplete.
6. Hydraulic model appears acceptable, however, pre- and post-design cross-sections are not provided on an exhibit to check accuracy.

We intend to continue our coordination with the District to make sure future improvements along New River are addressed in the Master Plan.

Regards, Scot.

TRANSMITTAL

COE & VAN LOO

Mr. Edward Raleigh, P.E.
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, AZ 85009

Date: October 9, 1998
Project Name: Terramar at New River
Project Number: 96-0043-21
Transmitting Via: Delivery

THE FOLLOWING ARE SUBMITTED:

ORIGINALS	AS REQUESTED	FOR YOUR REPLY/ACTION
PRINTS	FOR YOUR INPUT	FOR YOUR INFORMATION/FILE
FEES (SEE BELOW)	FOR YOUR APPROVAL	
X OTHER (SEE BELOW)	FOR YOUR SIGNATURE	

NUMBER SUBMITTED	DATED	DESCRIPTION
2	10/7/87	Design Reports
2	8/98	Construction Plans

REMARKS OR REPLY:

FLOOD CONTROL DISTRICT
RECEIVED
OCT 13 1998

CHENG		P & PM	
PIO		REG	
ADMIN		PWLMGT	
FINANCE		FILE	
O & M			
ENGR			
REMARKS	EAR		

COPY TO:

SINCERELY,
COE & VAN LOO CONSULTANTS, INC.

Kofi Awumah

Kofi Awumah, P.E.

RECEIVED BY: _____ DATE: _____

COE & VAN LOO CONSULTANTS, INC. 4550 North 12th Street Phoenix, Arizona 85014-4291 (602) 264-6831 FAX (602) 264-0928

WHITE: ADDRESSEE COPY YELLOW: DELIVERY COPY PINK: FILE COPY

CVL COE & VAN LOO CONSULTANTS, INC.

Land Planning • Civil Engineering • Water Resources Engineering • Environmental Sciences • Landscape Architecture • Surveying • Construction Management

Founded in 1958 by
P.E. Coe, P.E. (1915-1977)
H.W. Van Loo, P.E.

COPY

October 9, 1998

Mr. Dan L. Nissen, P.E.
City of Peoria
Engineering Department
8401 W. Monroe St.
Peoria, AZ 85345

Re: Bank Protection Design Report for Terramar at New River
CVL Project No: 96-0043-21

Dear Dan,

Enclosed are two copies of the Design Report and Construction Plans for New River Bank Protection at Terramar. These are for your review and comments. Please expedite this review process to enable the construction to proceed as soon as possible. We would appreciate a two-week or less response time.

If you need additional information or clarification on any issue of this report or plans, please call Kofi Awumah or Tim Kelly at (602) 264-6831.

Sincerely,

COE & VAN LOO
Consultants, Inc.

George J. Geiser, P.E.
Director, Water Resources

GJG:mar

Encl.

c: Mr. Edward Raleigh, P.E.
Chief, Engineering Division
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, AZ 85009

N:\960043\ADMIN\43-617L.WP8

4550 NORTH 12TH STREET PHOENIX, ARIZONA 85014-4291 (602) 264-6831 FAX (602) 264-0928