DRAINAGE /EROSION STUDY REPORT
KESLER RESIDENCE
7840 E. CAREFREE DRIVE
CAREFREE, AZ 85377
A.P.N. 216-83-360

for

THE PORTION OF
LOWER GALLOWAY WASH
RIVER STA. 3.482 to 3.542
LOCATED COMPLETELY WITHIN LOT 366,
CAREFREE TOO SUBDIVSION,
CAREFREE, ARIZONA
MARICOPA COUNTY, ARIZONA

Prepared For: Mr. Hal Kesler
7840 E. Carefree Drive
Carefree, Az 85377-5203
(480) 488-1484

Prepared By: Bartholomew Engineering Inc.
P.O. Box 4809
Cave Creek, AZ 85327
Phone: (480) 488-9775
Fax: (480) 488-2681

March 31, 2008
Project No. 080203

Expires 3/31/11
Registered Professional Engineer (Civil)
CERTIFICATE NO. 6299
RICHARD F. BARTHOLOMEW
Date Signed 3/31/08
ARIZONA, U.S.A.

Richard F. Bartholomew

A285.301

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PLANS

Expires 3/31/11
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DRAINAGE STUDY PURPOSE

Mr. Kesler, the Owner of the Study Parcel had contracted to install 3' x 3' rock filled wire basket tied Gabions along the south side of the lower Branch of Galloway Wash (Wash) to protect his property from severe erosion from the drainage in the Wash.

On February 18, he was issued a Stop Order by the Town of Carefree, stopping this work until a permit for the erosion control measures could be issued. After discussion with Town officials, it was decided that a study should be completed to determine the effect of the construction of the Gabions on the hydrological capacity of the Wash.

The purpose of this study is to evaluate and determine the capacity change the installation of erosion control measures will have, if any, on the existing wash as given on the Flood Control Maps of Galloway Wash as shown on the FIRM Maps and administered by the MCFCD.

DESCRIPTION OF STUDY AREA

The study area is located in Lot 366 in the recorded subdivision of CAREFREE TOO. The subdivision is located at Section 35, Township 6N, Range 4E ;G&SRB&M, See Figures 1 and 2. The subdivision has been fully developed and all streets and roads are paved. The study area is an approximately 200 foot long section of the Wash which lies within the Study Parcel, from the private Foot Bridge downstream to the Wash Crossing over Mule Train Road, North of Carefree Drive. The Parcel is located within the 100 year Flood Plain of Galloway Wash and the residential home's finished floor is raised above the 100 years Flood Plain elevation.

STUDY PROCEDURE

Background Data

This study was conducted using the following resources:

- NATIONAL FLOOD INSURANCE PROGRAM: FIRM FLOOD INSURANCE RATE MAP, Panel 808 of 4350; Effective April 15, 1988 with Revisions through Dec. 3, 1993; (Appendix C)
- FLOODPLAIN DELINIATION STUDY OF ANDORA HILS & GALLOWAY WASHES, FCD 99-14, FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, October 2000; by JE Fuller Hydrology & Geomorphology, Inc: HEC-RAS Project Galloway Wash, Prepared May 17, 2002; pages 160-188; (Appendix D)

Site Data

To establish the actual ground contours and profile of the Wash study area as of this date, a ground survey was conducted by Bartholomew Engineering Inc., using the locations and the same elevation data from these studies. The Gabions were plotted per the construction layout as provided by the Owner and the Gabion contractor, Maccaferri Inc. (Appendix A). The 100 year flood data was provided from the aforementioned MCFCD Data.

STUDY METHODOLGY

Once the survey data had been plotted to scale, the cross-sections of the Wash were plotted at 50 foot intervals for this analysis. The cross-sections are shown of the attached Engineering Plans, page 2.

Using the MCFCD data for water elevations of the 100 year flood at each section of the Wash and the stated flow quantities in cubic feet per second (CFS) for each 50' section of the Wash between the existing Foot Bridge and the Mule Train Road Crossing, the Gabions Installation was analyzed to determine the channel capacity with the Gabions added. This analysis was based on the Manning Formula and the MCFCD channel data for Manning's "n". The results of these calculations are shown in Table 1.

In addition to the existing conditions analyzed in Table 1, the study was also analyzed using the MCFCD- JE FULLER Study water flow areas, wetted perimeters, slopes and "n" factors for comparison. This analysis was also based on the Manning Formula. The results of this analysis are shown in Table 2.

Table 3 compares the results of the two analyses in order to determine the relationship between the existing Wash conditions and the MCFCD data for the 100-year flood conditions.

RESULTS OF THE CHANNEL ANALYSIS

The comparison of the results shows that the existing conditions of the Wash, with the Gabions added, compares very closely to the same channel analysis using the MCFCD study parameters. The results of the two analysis show that the carrying capacity of the channel with the Gabions added, having the same water depth as given in the MCFCD study, has the same or more capacity than the 100 year flood flow. Thus, the Channel can carry the MCFCD 100 year flood flow with the Gabions at a lower water level elevation than given in the MCFCD study without impacting the carrying capacity of the Wash Section. Table 3 shows the method of analysis for the existing condition is very similar to the MCFCD 100 year flood study. The addition of the Gabions does not change the hydraulic or hydrological conditions of the Wash or change the 100 year flood study parameters.

SUMMARY AND RECOMMENDATIONS

Based upon this study the Gabions Erosion Protection can be constructed as shown on the attached plan and proposed by the Property owner without further studies or channel analysis by MCFCD.

It is, therefore, recommended that the Owner be granted a permit for the Gabions construction. No further studies should be required by the owner for the erosion protections effect on the Wash capacity or water level for a 100 year flood event.

TABLES & FIGURES

Table 1: Existing Channel Conditions
Table 2: MCFCD Analysis Using Manning Formula
Table 3: Comparison of Table 1 Results and Table 2
Figure 1: Vicinity Map
Figure 2: MCFCD Location Plan

KESLER CHANNEL CALCULATIONS

TABLE 1

JOB NO. 080203

DATE: 03/12/08

BY: RFB

File No. 080203ChannelCalcs.xls

CHANNEL SECTION CALCULATIONS FOR GABION INSTALLATION - SOUTH BANK - LOWER GALLOWAY WASH R.S. 3.504 TO 3.5428													
Use Mannings Equation : V, fps.=(1.49/n) (R)$^{.667}$ (S)$^{.50}$						n = 0.41 for channel section/ MCFCD					Wash Capacity		
											With Gabions		
	MCFCD										Manning's		
Section Sta.	River Sta.	n	Depth	A	WP	R=A/WP	S	(R).667	(S).50	V	Q=VA	Q-mcfcd	
0+00	3.504	0.041	4.09	205	96.2	2.13	0.0224	1.66	0.15	9.01	1847	1840	Foot Bridge
0+50	3.514	0.041	3.76	162.56	64.77	2.51	0.0262	1.85	0.16	10.87	1767	1750	
1+00	3.5229	0.041	3.66	212.15	82.87	2.56	0.0154	1.87	0.12	8.44	1791	1750	
1+50	3.5324	0.041	3.9	205.08	90.54	2.27	0.0336	1.73	0.18	11.49	2357	1750	
2+00	3.5428	0.041	3.63	177.1	64.49	2.75	0.0336	1.96	0.18	13.07	2314	1750	
SOURCE OF DATA		FLOOD CONTROL DISTRICT OF MARICOPA COUNTY-											
		FLOOD PLAIN DELINEATION STUDY OF ANDORA HILLS & GALLOWAY WASHES											
		FCD 99-14 BY JE FULLER -HYDROLOGY & GEOMORPHOLOGY INC. 4/12/02											

Exp. 3/31/11

Registered Professional Engineer (Civil)
CERTIFICATE NO. 6299
RICHARD F. BARTHOLOMEW
Date Signed 3/31/08
ARIZONA, U.S.A.

Richard F. Bartholomew

KESLER CHANNEL CALCULATIONS

TABLE 2

Using Manning's Formuls with MCFCD Data for Crossections, Slopes, Areas, W.P. and n values.

JOB NO. 080203

DATE: 03/26/08

BY: RFB

File No. 080203ChannelCalcs.xls

Sta.	R.S.	Description	Water surface Elevation	Elevation at CL	Water Depth,ft.	Distance upstream to next Section,ft.	Upstream slope ft/ft	Flowing Area s.f.	W.P. ft.	"n" Values	Location / "n"	R=A/WP	(R).667	(S).50	V	Q=VA	100 year event MCFCD cfs
0+00	3.503	Up Stream at Foot Bridge	2434.31	2430.15	4.16	58.08	0.026515152	303.42	295.54	0.0400	Channel	1.03	1.02	0.16	6.17	1873	1840
0+50	3.514	50 feet Upstream of Foot bridge	2434.91	2431.69	3.22	42.24	0.036458333	235.41	114.92	0.0510	Channel&OB	2.05	1.61	0.19	9.00	2119	1750
1+00	3.522	100 feet Upstream of Foot bridge	2436.12	2432.53	3.60	52.8	0.015828	226.52	103.96	0.0400	Channel	2.18	1.68	0.13	7.88	1785	1750
131.68	3.528		2436.61	2432.86	3.75	73.92	0.015827922	222.97	99.57	0.0400	Channel	2.24	1.71	0.13	8.02	1789	1750
1+50	3.532	150 feet Upstream of Foot bridge	2437.13	2433.50	3.63	52.8	0.034815062	223.30	100.54	0.0420	Channel&OB	2.22	1.70	0.19	11.27	2517	1750
2+00	3.542	200 feet Upstream of Foot bridge	2438.54	2435.24	3.30	305.6	0.034815062	224.20	103.17	0.0420	Channel&OB	2.17	1.68	0.19	11.11	2491	1750
305.6	3.562		2441.68	2439.11	2.57	179.52	0.034815062	227.90	114.00	0.0420	Channel&OB	2.00	1.59	0.19	10.51	2395	1750

SOURCE OF DATA - HEC-RAS DATA INPUT & OUTPUT FILE : Galloway wash : Galloway project File galloway.prj- See attached Cover Page

Exp. 3/31/11

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BARTHOLOMEW
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ARIZONA, U.S.A.

TABLE 3

KESLER CHANNEL CALCULATIONS COMPARISON OF CALCULATIONS - EXISTING CHANNEL AS OF 2008 (Table 1) and *MCFCD STUDY - 2002 (Italiczied)(Table 2)* -

JOB NO. 080203
DATE: 03/26/08
BY: RFB

File No. 080203ChannelCalcs.xls

Sta.	R.S.	Description	Water surface Elevation	Elevation at CL	Water Depth,ft.	Distance upstream to next Section,ft.	Upstream slope ft/ft	Flowing Area s.f.	W.P. ft.	"n" Values	Location / "n"	R=A/WP	(R).667	(S).50	V	Q=VA	100 year event MCFCD cfs
0+00	3.503	Up Stream at Foot Bridge	2434.31	2430.22	4.09	50	0.02240000	205	96.2	0.0410	Channel	2.13	1.66	0.15	9.01	1847	
0+00	*3.503*	*Up Stream at Foot Bridge*	*2434.31*	*2430.15*	*4.16*	*58.08*	*0.026515152*	*303.42*	*295.54*	*0.0400*	*Channel*	*1.03*	*1.02*	0.16	*6.17*	*1873*	*1840*
0+50	3.514	50 feet Upstream of Foot Bridge	2434.91	2431.15	3.76	50	0.02620000	162.56	64.77	0.0410	Channel&OB	2.51	1.85	0.16	10.87	1767	
0+50	*3.514*	*50 feet Upstream of Foot Bridge*	*2434.91*	*2431.69*	*3.22*	*42.24*	*0.036458333*	*235.41*	*114.92*	*0.0510*	*Channel&OB*	*2.05*	*1.61*	*0.19*	*9.00*	*2119*	*1750*
1+00	3.522	100 feet Upstream of Foot Bridge	2436.12	2432.46	3.66	50	0.01540000	212.15	82.87	0.0410	Channel	2.56	1.87	0.12	8.44	1791	
1+00	*3.522*	*100 feet Upstream of Foot Bridge**	*2436.12*	*2432.53*	*3.59*	*52.8*	*0.015909*	*226.52*	*103.96*	*0.0400*	*Channel*	*2.18*	*1.68*	*0.13*	*7.90*	*1789*	*1750*
1+50	3.532	150 feet Upstream of FootBridge	2437.13	2433.23	3.9	50	0.03360000	205.08	90.54	0.0410	Channel&OB	2.27	1.73	0.18	11.49	2357	
1+50	*3.532*	*150 feet Upstream of FootBridge**	*2437.13*	*2433.50*	*3.63*	*52.8*	*0.034815062*	*223.30*	*100.54*	*0.0420*	*Channel&OB*	*2.22*	*1.70*	*0.19*	*11.27*	2517	*1750*
2+00	3.542	200 feet Upstream of Foot Bridge	2438.54	2434.91	3.63	50	0.03360000	177.10	64.49	0.0410	Channel&OB	2.75	1.96	0.18	13.07	*2314*	
2+00	*3.542*	*200 feet Upstream of Foot Bridge**	*2438.54*	*2435.24*	*3.30*	*105.6*	*0.034815062*	*224.20*	*103.17*	*0.0420*	*Channel&OB*	*2.17*	*1.68*	*0.19*	*11.11*	*2491*	*1750*
		** Value was interpolated from R.S.'s given in MCFCD Study*															

Exp 3/31/11

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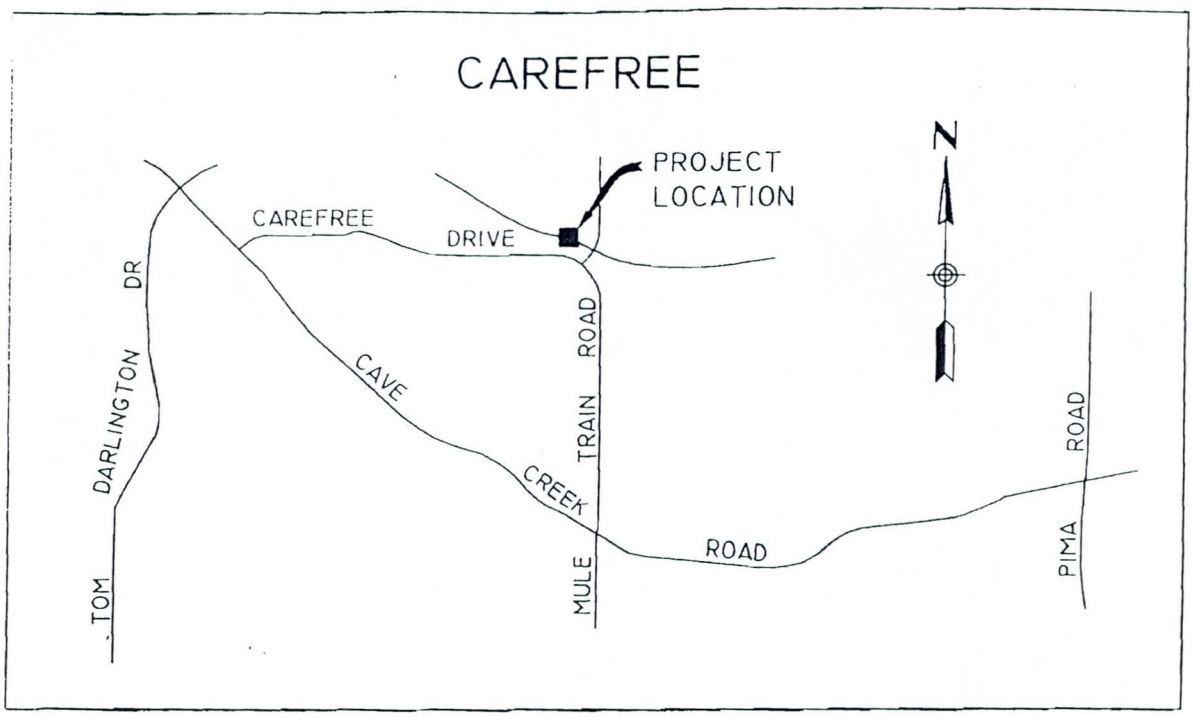


VICINITY MAP

NTS

N

OWNER:

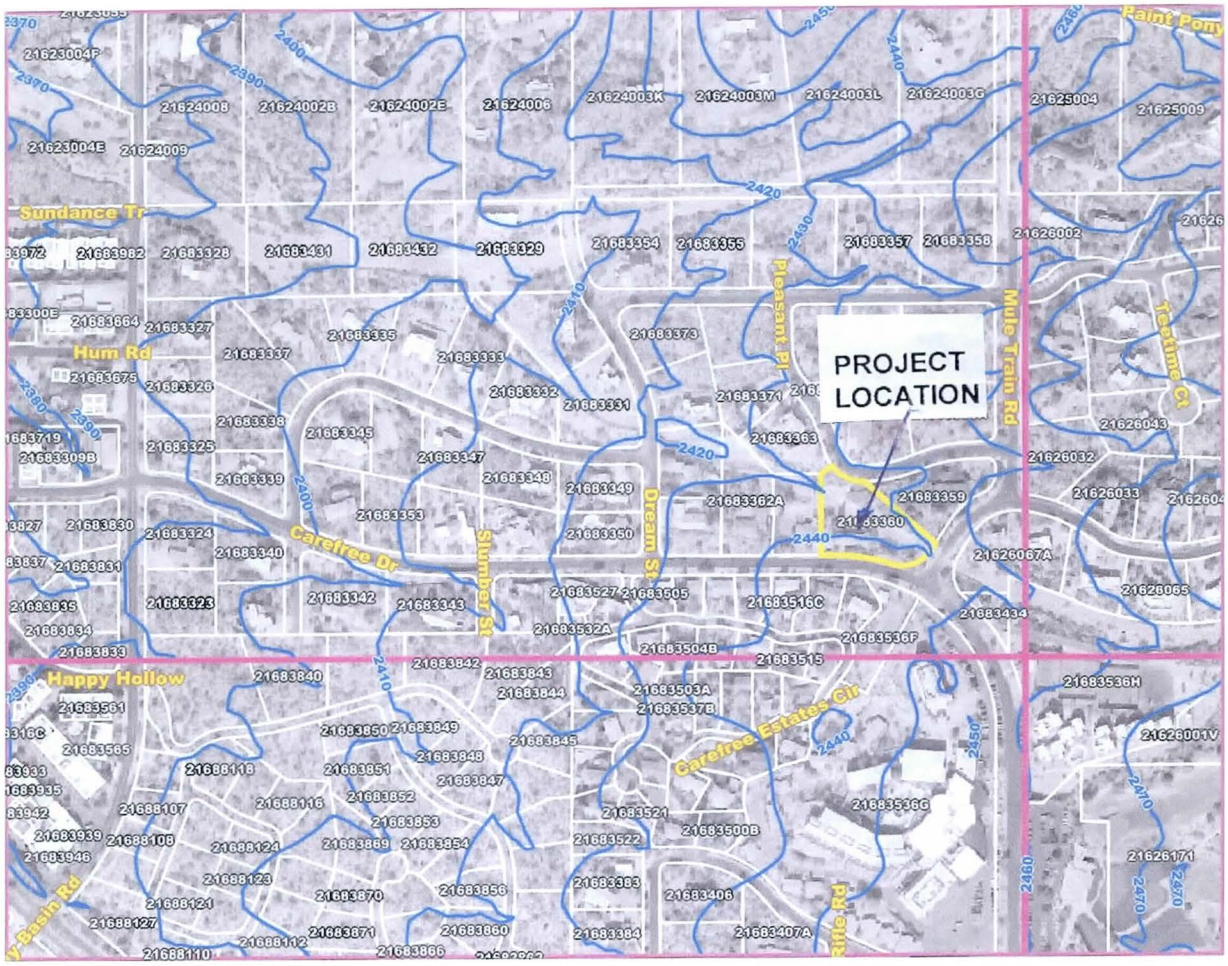
MR. AND MRS. HAROLD KESLER
P.O. BOX 5203
7840 E CAREFREE DRIVE
CAREFREE, ARIZONA 85377-5203
(480) 488-1484
APN -216-83-360

ENGINEER:

BARTHOLOMEW ENGINEERING INC.
PHYSICAL ADDRESS:
7518 EAST ELBOW BEND ROAD
SUITE B-1
CAREFREE, ARIZONA 85377

VICINITY MAP	*FIGURE 1*	*JOB NO. 080203* *NOT TO SCALE*
KESLER RESIDENCE *7840 E. CAREFREE DRIVE, CAREFREE AZ*	BARTHOLOMEW ENGINEERING, INC. *P. O. BOX 4809* *phone: 480-488-9775* *Cave Creek, AZ 85327* *fax: 480-488-2681*	

Flood Control District of Maricopa County (FCDMC) - Unofficial Document
FCDMC does not guarantee the positional accuracy of the parcel lines. The parcel lines are for illustration purposes only and are not intended to be used as a survey product.
Contours: 10' interval, NAVD88 vertical datum, captured 12/16/2000 through 2/21/2002, scale of capture 1"=500'.
Aerial year: FY 02/03



esday, February 26, 2008 5:41 PM

VICINITY MAP	**FIGURE 2**	**JOB NO. 080203** NOT TO SCALE
KESLER RESIDENCE 7840 E. CAREFREE DRIVE, CAREFREE AZ	**BARTHOLOMEW ENGINEERING, INC.** P. O. BOX 4809 Cave Creek, AZ 85327	phone: 480-488-9775 fax: 480-488-2681

APPENDICES

A: Maccaferri Gabion Section View

B: Maricopa County Parcel & MCFCD Maps

C: National Flood Insurance Program; Flood Insurance Rate Map

D: Floodplain Delineation Study of Andora Hills & Galloway Washes; Prepared by JE Fuller Hydrology & Geomorphology Inc; May 17, 2002; HEC-RAS Project Galloway Wash, pages 160-188

E: JE Fuller Hydrology & Geomorphology Inc; Flood Plain Study, Sheet 5 of 6

APPENDIX A

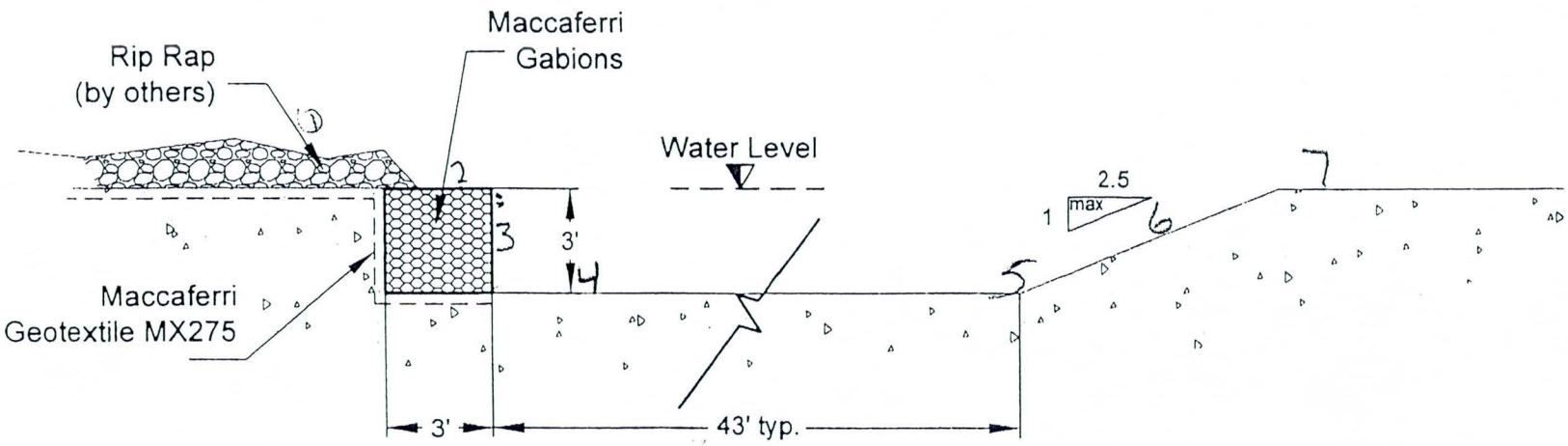
Maccaferri Gabion Section View

This drawing is stored in file:L:\Documents and Settings\Emma\Desktop\Galloway Wash at Cave Creek Lane.dwg

NOTES:

1. Gabion Mesh to ASTM A975.
2. Gabion Fill to ASTM D6711:
   - 2.1. Rock Size 4" to 8", D50 = 6"
   - 2.1. Rock Unit Weight 157 pcf min.
   - 2.2. Voids 30% max.
3. Maccaferri is not responsible for the Bearing Capacity of the Soil.

SECTION VIEW



1 3' TYPICAL CROSS SECTION

Maccaferri Gabion Bank Protection

Maccaferri Inc. assumes no responsibility for the drawings and calculations it provides, as they must be intended as a general indication to suggest the proper use of its products.

Rev:	Issue / Revision:	Drawn:	App:	Date:

MACCAFERRI
Maccaferri, Inc.
10303 Governor Lane Blvd.
Williamsport, MD 21795-3116 USA
Ph. (301) 223-6910 Fax (301) 223-6134

Designed:	Date:
RM	02/22/08
Drawn:	Date:
EG	02/25/08
Checked:	Date:
—	—

Project Title: GALLOWAY WASH AT CAVE CREEK LANE

Client:

NOT FOR CONSTRUCTION

Title: 3' Typical Cross Section
Maccaferri Gabion Bank Protection

Scale: NTS	Project No: —
Rev: —	Units: Feet
Printed on: 2/28/08	Drawing No: 1 / 1

Title:
Description:

Folder:
Date: 2/22/2008

Notice
Maccaferri is not responsible for the drawings and the calculations trasmitted, since they should be intended as general design outlines and advice,aiming only to the best use of the products.

Materials used

Description	Roughness	Allow. shear stress [lb/ft2]	V	Rock d50 [inch]	Thickness [ft]	Rockfill unit we [lb/ft3]	Time [h]	C Shields
Fine sand	0.0200	0.07	Y					
Sand and gravel	0.0200	0.32	Y					
GabionMats 12"	0.0301	7.01	N	5.90	0.98	165.51		0.140
Gabions 36"	0.0301	10.45	N	11.80	3.28	165.51		0.140
Riprap/Rock wall	0.0400	6.28	N	15.74	0.98	165.51		

Title:
Description: Assumed Flow - 4250 cfs
Based on Channel width of 45'
Slope 1.8%

Folder:
Date: 2/22/2008

Notice
Maccaferri is not responsible for the drawings and the calculations trasmitted, since they should be intended as general design outlines and advice,aiming only to the best use of the products.

Run n.1

Gradient [%]	1.80
Discharge [ft3/s]	4250.00
Water level [ft]	3.98
Average velocity [ft/s]	22.05

Froude number	2.09
Cross section [ft2]	192.72
Wetted perimeter [ft]	60.33
Hydraulic radius [ft]	3.19

Max. Developed Shear Force

ACTUAL FORCE

Stretch	Length [ft]	V [ft/s]	K	Vadm [ft/s]	Vb Material [ft/s]	V	tau max [lb/ft2]	tau adm [lb/ft2]	GeoFil
Bottom 1	0.89	0.00	1.00	2.50	7.52 Riprap/Rock wall	N	0.76	2.83	N
1.1	0.89								
2	3.00	4.74	1.00	2.50	1.30 GabionMats 12"	N	1.00	7.01	Y
2.1	3.00								
3	3.11	0.00	1.00	2.50	2.07 Gabions 36"	N	3.47	6.03	Y
3.1	3.11								
4	43.00	23.11	1.00	-	- Sand and gravel	N	4.56	0.32	N
4.1	43.00								
5	13.01	14.95	1.00	-	- Fine sand	N	3.47	0.07	N
5.1	13.01								
6	3.00	0.00	1.00	-	- Sand and gravel	N	-	-	N
6.1	3.00								
7	1.80	0.00	1.00	-	- Sand and gravel	N	-	-	N
7.1	1.80								

Top of Gabion Face

Bottom Flat

SHAPE OF CHANNEL

K

SOIL BLEND WITH EROSION

Velocity Under Gabions & Filter fabric

Max. Resistin Shear

1

VB UNDER GAB. & FAB. OVER TOP

APPENDIX B

Maricopa County Parcel & MCFCD Maps

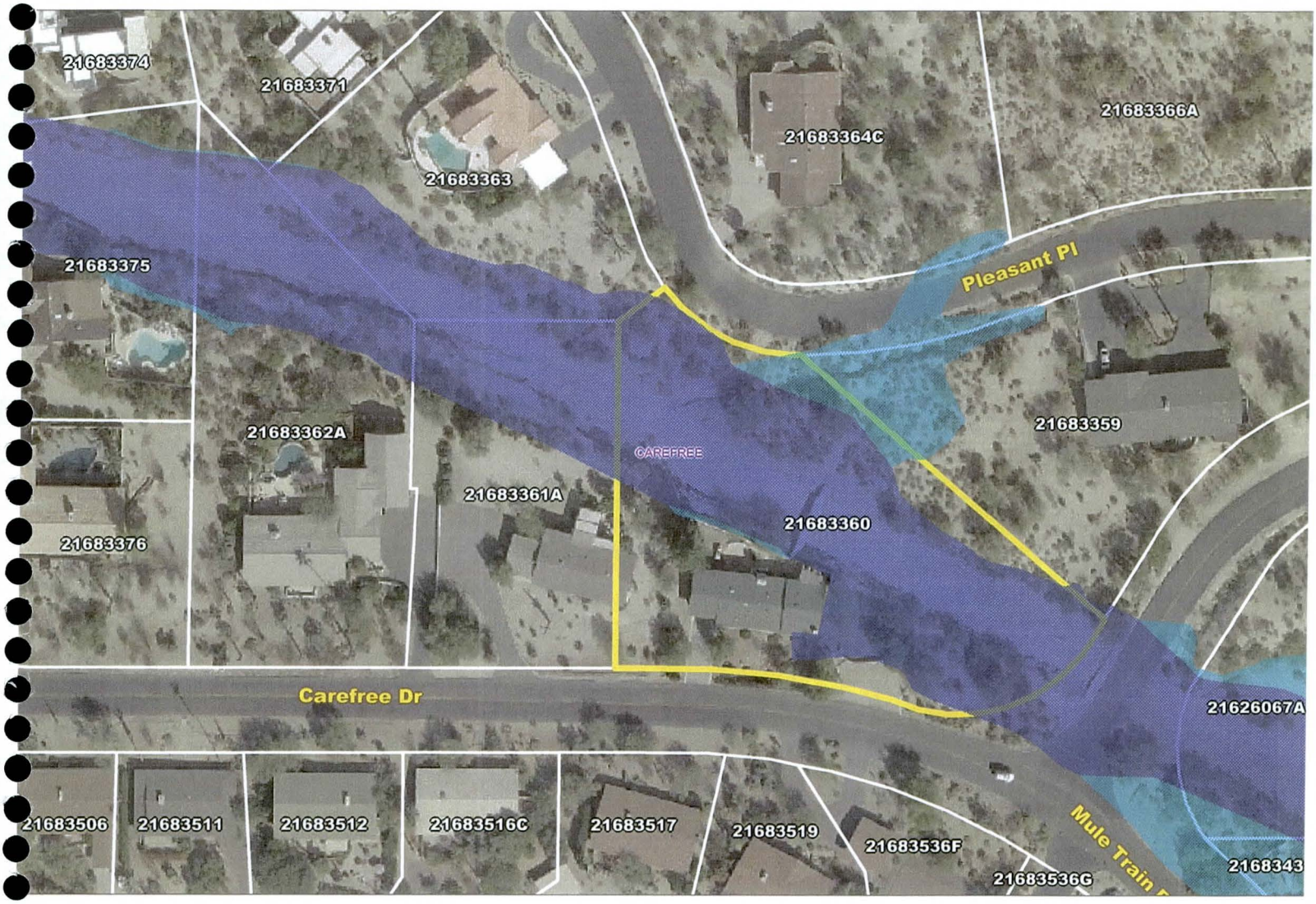
County Parcels

http://www.maricopa.gov/Assessor/GIS/Maps/assessor.mwf

Monday, March 24, 2008 1:53 PM

This document cannot be used for floodplain determinations. Current studies, erosion setbacks and other factors may also affect the floodplain status of the property. The information shown for pending floodplains are the best technical information available at this time to determine the 100-year floodplain and are subject to change. To get an official floodplain determination, call the "Contact" specified on the web page.

FCDMC does not guarantee the positional accuracy of the parcel lines. The parcel lines are for illustration purposes only and and are not intended to be used as a survey product.



SCALE 1 : 1,342

100 0 100 200 300

FEET

N

Flood Control District of Maricopa County (FCDMC) - Unofficial Document

This document cannot be used for floodplain determinations. Current studies, erosion setbacks and other factors may also affect the floodplain status of the property. The information shown for pending floodplains are the best technical information available at this time to determine the 100-year floodplain and are subject to change. To get an official floodplain determination, call the "Contact" specified on the web page.

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SCALE 1 : 671

50 0 50 100 150

FEET

N

Tuesday, February 26, 2008 10:41 AM

APPENDIX C

National Flood Insurance Program; Flood Insurance Rate Map

This map may incorporate approximate boundaries of Coastal Barrier Resource System Units and /or Otherwise Protected Areas established under the Coastal Barrier Improvement Act of 1990 (PL 101-591).

For community map revision history prior to countywide mapping, see Section 6.0 of the Flood Insurance Study Report.

For adjoining map panels and base map source see separately printed Map Index.

MAP REPOSITORY

Refer to Repository Listing on Map Index

EFFECTIVE DATE OF

COUNTYWIDE FLOOD INSURANCE RATE MAP:

APRIL 15, 1988

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL:

SEPTEMBER 29, 1989, SEPTEMBER 4, 1991, DECEMBER 3, 1993

Map revised July 19, 2001 to update corporate limits, to change base flood elevations, to add base flood elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to change zone designations, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 808 OF 4350

APPENDIX D

Floodplain Delineation Study of Andora Hills & Galloway Washes;
Prepared by JE Fuller Hydrology & Geomorphology Inc; May 17, 2002;
HEC-RAS Project Galloway Wash, pages 160-188

galloway.rep

HEC-RAS September 1998 Version 2.2
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
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X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
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PROJECT DATA
Project Title: Galloway Wash
Project File : galloway.prj
Run Date and Time: 5/17/2002 10:45:20 AM

Project in English units

Project Description:
Floodplain Delineation Study of Andora Hills & Galloway Washes, FCD 99-14
Flood Control District of Maricopa County, October, 2000
JE Fuller
Hydrology & Geomorphology, Inc., Tempe Az.

PLAN DATA

Plan Title: Plan 01
Plan File : x:\projects\Agency\FCDMC\Galloway\HECRAS\ras with fema comments\galloway.p01

Geometry Title: Galloway Wash
Geometry File : x:\projects\Agency\FCDMC\Galloway\HECRAS\ras with fema comments\galloway.g01

Flow Title : Galloway Wash
Flow File : x:\projects\Agency\FCDMC\Galloway\HECRAS\ras with fema comments\galloway.f01

Plan Summary Information:

Number of:	Cross Sections	= 158	Mulitple Openings	= 0
	Culverts	= 1	Inline Weirs	= 0
	Bridges	= 3		

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculaton tolerance = 0.01
Maximum number of interations = 20
Maximum difference tolerance = 0.3

APPENDIX D

HEC-RAS Project Galloway Wash

RS 3.493

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
LB 9993.50	10001.56	190.69	24.16	10.14	10.36	3.00	7.89
10001.56	10009.62	249.26	25.88	8.06	13.55	3.21	9.63
10009.62	10017.68	243.72	25.53	8.06	13.25	3.17	9.55
10017.68	10025.74	238.30	25.19	8.06	12.95	3.12	9.46
10025.74	10033.80	232.86	24.84	8.06	12.66	3.08	9.37
10033.80	10041.86	227.50	24.50	8.06	12.36	3.04	9.29
10041.86	RB 10049.92	170.02	20.81	8.30	9.24	2.58	8.17
10049.92	10090.65	250.24	63.22	40.78	13.60	1.55	3.96
10090.65	10131.38	37.40	11.35	9.65	2.03	1.37	3.29

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
energy was used.

CROSS SECTION RIVER: Galloway
REACH: Reach 6 RS: 3.493

INPUT
Description:
Station Elevation Data num= 33

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
9873.03	2434.66	9886.6	2432.48	9894.18	2432.75	9909.96	2433.02	9921.32	2432.65
9924.88	2432.72	9928.09	2432.61	9946.89	2432.32	9985.31	2432.22	9990.67	2431.08
9991.52	2430.86	9997.91	2429.18	10013.2	2429.31	10052.01	2429.63	10055.84	2430.17
10059.25	2430.69	10072.6	2430.53	10080.31	2430.51	10087.02	2430.83	10089.71	2430.22
10098.9	2428.31	10110.84	2430.05	10126.94	2432.57	10127.79	2432.71	10128.37	2432.77
10128.57	2432.79	10137.49	2432.86	10151.18	2433.23	10151.76	2433.24	10151.93	2433.24
10167.15	2433.22	10171.44	2434.43	10186.27	2438.33				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

```
 9873.03     .06  9991.5     .0410059.25     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        9991.510059.25               57      57      60            .1        .3

CROSS SECTION OUTPUT    Profile #Profile 1

  E.G. Elev (ft)            2432.79   Element                    Left OB    Channel
Right OB
  Vel Head (ft)                0.99   Wt. n-Val.                  0.060      0.040
   0.060
  W.S. Elev (ft)            2431.81   Reach Len. (ft)             57.00      57.00
   60.00
  Crit W.S. (ft)            2431.81   Flow Area (sq ft)            1.95     153.48
  101.82
  E.G. Slope (ft/ft)       0.019160   Area (sq ft)                 1.95     153.48
  101.82
  Q Total (cfs)             1840.00   Flow (cfs)                   3.89    1357.29
  478.81
  Top Width (ft)             134.84   Top Width (ft)               4.26      67.75
   62.83
  Vel Total (ft/s)             7.15   Avg. Vel. (ft/s)             2.00       8.84
    4.70
  Max Chl Dpth (ft)            3.51   Hydr. Depth (ft)             0.46       2.27
    1.62
  Conv. Total (cfs)         13293.1   Conv. (cfs)                  28.1     9805.7
  3459.2
  Length Wtd. (ft)           57.46   Wetted Per. (ft)             4.36      68.05
   63.37
  Min Ch El (ft)            2429.18   Shear (lb/sq ft)             0.53       2.70
    1.92
  Alpha                        1.24   Stream Power (lb/ft s)       1.07      23.86
    9.04
  Frctn Loss (ft)              1.01   Cum Volume (acre-ft)         1.40      21.22
    1.74
  C & E Loss (ft)              0.01   Cum SA (acres)               1.40       6.89
    1.55


Warning: The energy equation could not be balanced within the specified number of
iterations.  The
         program selected the water surface that had the least amount of error
between computed
         and assumed values.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and
previous cross
         section.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set
equal to
         critical depth, the calculated water surface came back below critical
depth.  This indicates
         that there is not a valid subcritical answer.  The program defaulted to
critical depth.

CROSS SECTION OUTPUT    Profile #Profile 2

  E.G. Elev (ft)            2433.26   Element                    Left OB    Channel
Right OB
  Vel Head (ft)                1.13   Wt. n-Val.                            0.040
   0.060
```

W.S. Elev (ft)	2432.14	Reach Len. (ft)	57.00	57.00
60.00				
Crit W.S. (ft)	2432.14	Flow Area (sq ft)		175.79
59.41				
E.G. Slope (ft/ft)	0.017022	Area (sq ft)		175.79
59.41				
Q Total (cfs)	1840.00	Flow (cfs)		1584.38
255.62				
Top Width (ft)	103.25	Top Width (ft)		67.75
35.50				
Vel Total (ft/s)	7.82	Avg. Vel. (ft/s)		9.01
4.30				
Max Chl Dpth (ft)	3.84	Hydr. Depth (ft)		2.59
1.67				
Conv. Total (cfs)	14102.9	Conv. (cfs)		12143.7
1959.2				
Length Wtd. (ft)	57.28	Wetted Per. (ft)		69.32
38.66				
Min Ch El (ft)	2429.18	Shear (lb/sq ft)		2.69
1.63				
Alpha	1.18	Stream Power (lb/ft s)		24.29
7.03				
Frctn Loss (ft)	0.95	Cum Volume (acre-ft)	0.76	21.21
0.72				
C & E Loss (ft)	0.03	Cum SA (acres)	0.71	6.89
0.72				

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.

FLOW DISTRIBUTION OUTPUT Profile #Profile 1

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
9967.81	9991.50	3.89	1.95	4.36	0.21	0.46	2.00
LB 9991.50	10001.18	163.40	20.01	9.90	8.88	2.07	8.16
10001.18	10010.86	236.80	24.78	9.68	12.87	2.56	9.56
10010.86	10020.54	224.35	23.99	9.68	12.19	2.48	9.35
10020.54	10030.21	212.41	23.22	9.68	11.54	2.40	9.15
10030.21	10039.89	200.80	22.45	9.68	10.91	2.32	8.95
10039.89	10049.57	189.41	21.67	9.68	10.29	2.24	

8.74						
10049.57	RB 10059.25	130.11	17.36	9.76	7.07	1.79
7.50						
10059.25	10084.65	113.92	31.15	25.41	6.19	1.23
3.66						
10084.65	10110.06	330.50	59.37	25.79	17.96	2.34
5.57						
10110.06	10135.46	34.39	11.31	12.17	1.87	0.94
3.04						

Warning: The energy equation could not be balanced within the specified number of iterations. The
program selected the water surface that had the least amount of error between computed
and assumed values.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.

FLOW DISTRIBUTION OUTPUT Profile #Profile 2

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
LB 9991.50	10001.18	181.52	23.20	11.17	9.86	2.40	7.82
10001.18	10010.86	272.76	27.97	9.68	14.82	2.89	9.75
10010.86	10020.54	260.03	27.18	9.68	14.13	2.81	9.57
10020.54	10030.21	247.81	26.40	9.68	13.47	2.73	9.39
10030.21	10039.89	235.88	25.63	9.68	12.82	2.65	9.20
10039.89	10049.57	224.15	24.86	9.68	12.18	2.57	9.02
10049.57	RB 10059.25	162.24	20.54	9.76	8.82	2.12	7.90
10059.25	10084.65	171.34	39.51	25.41	9.31	1.56	4.34
10084.65	10110.06	84.28	19.89	13.25	4.58	1.97	4.24

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set

APPENDIX D

HEC-RAS Project Galloway Wash

RS 3.503

Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
energy was used.

FLOW DISTRIBUTION OUTPUT Profile #Profile 2

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
9908.49	9929.24	21.45	14.42	20.16	1.17	0.72	1.49
9929.24	9950.00	57.57	26.39	20.75	3.13	1.27	2.18
9950.00	9970.75	49.27	24.03	20.75	2.68	1.16	2.05
9970.75	9991.50	38.55	20.95	21.26	2.10	1.01	1.84
LB 9991.50	9999.69	180.44	29.16	9.08	9.81	3.56	6.19
9999.69	10007.88	215.51	31.12	8.19	11.71	3.80	6.92
10007.88	10016.07	213.84	30.98	8.19	11.62	3.78	6.90
10016.07	10024.26	212.16	30.83	8.19	11.53	3.76	6.88
10024.26	10032.45	210.54	30.69	8.19	11.44	3.75	6.86
10032.45	10040.64	208.87	30.54	8.19	11.35	3.73	6.84
10040.64	RB 10048.83	166.07	26.85	8.37	9.03	3.28	6.18
10048.83	10090.18	258.77	84.54	41.36	14.06	2.04	3.06
10090.18	10131.53	6.96	2.45	1.34	0.38	1.83	2.84

Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
energy was used.

BRIDGE RIVER: Galloway
REACH: Reach 6 RS: 3.503

INPUT
Description: Private wooden foot bridge
Distance from Upstream XS = 2.6
Deck/Roadway Width = 4.8
Weir Coefficient = 2.6
Bridge Deck/Roadway Skew =
Upstream Deck/Roadway Coordinates
num= 4

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
9990.39	2433.76	2432.49	10014.8	2433.8	2432.54	10040.3	2433.83	2432.38

```
10048.83 2432.01 2430.55

Upstream Bridge Cross Section Data
Station Elevation Data    num=      41
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
  9887.74 2436.44  9894.4 2435.52  9904.9 2434.62 9927.76 2432.98 9977.19 2433.25
  9984.19 2433.29  9987.3 2433.37 9990.39 2433.76  9991.52432.618 9993.54 2430.52
  9993.99 2430.4710000.86 2430.5110042.78  2430.610047.04 2431.3710048.83 2432.01
 10062.01 2432.0610071.94 2432.4310091.52 2432.4910111.87 2431.9310114.86 2431.86
 10122.41 2432.3110133.22 2432.9510134.13 2432.52 10143.2 2429.2810143.74 2429.35
 10144.01 2429.4210160.37 2433.4210162.47 2433.5310168.99 2433.5910175.88 2433.81
 10179.16 2433.9210186.73 2434.2110192.43 2434.1510203.17 2434.0810205.95 2434.26
 10206.99 2434.3110212.15  2433.9 10213.3 2434.0210216.24 2434.3810236.16 2437.65
 10255.58 2442.84

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
  9887.74     .06  9991.5     .0410048.83     .06

Bank Sta: Left   Right    Coeff Contr.   Expan.
        9991.510048.83             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev
10091.5210255.58    2436
Left Levee      Station= 9990.39      Elevation= 2433.76

Downstream  Deck/Roadway Coordinates
    num=       4
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
  9991.48 2433.72 2432.3610015.89 2433.78 2432.4210041.39 2433.75 2432.37
 10049.92 2431.91 2430.53

Downstream Bridge Cross Section Data
Station Elevation Data    num=      43
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
  9870.39 2436.54 9880.32 2436.31 9884.76 2436.26 9884.83 2436.35 9888.42 2435.85
  9892.21 2435.46 9904.27 2434.55 9914.51 2433.86 9926.31 2433.02 9944.54 2433.12
  9987.47 2433.07 9991.48 2433.72  9993.52432.012  9995.7 2430.1510040.96 2430.39
 10045.48 2430.4310049.92 2431.9110052.56 2431.4210067.03 2431.9510099.86 2432.06
 10112.23 2431.7210120.58 2432.0210125.52 2432.3210130.75  2429.810132.74 2429.09
 10143.38 2430.4110148.75 2431.8110153.29 2432.9210159.82 2433.28 10162.1 2433.44
 10163.45 2433.4810164.02  2433.510179.26 2433.9810179.94 2433.9710184.21 2433.94
 10196.15 2433.8610200.25 2434.1310204.94 2435.1310207.26 2435.5110220.78 2437.32
  10231.7 2440.0110242.36 2441.7610253.56 2444.76

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
  9870.39     .06  9993.5     .0410049.92     .06

Bank Sta: Left   Right    Coeff Contr.   Expan.
        9993.510049.92             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev
10099.8610253.56    2436
Left Levee      Station= 9991.48      Elevation= 2433.72

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested
```

```
Number of Piers =  2

Pier Data
Pier Station     Upstream=   10015    Downstream=10016.48
Upstream     num=        2
    Width   Elev    Width   Elev
     .67    2430     .67  2432.6
Downstream     num=        2
    Width   Elev    Width   Elev
     .67    2430     .67  2432.6

Pier Data
Pier Station     Upstream=10039.55    Downstream=10040.64
Upstream     num=        2
    Width   Elev    Width   Elev
     1.5    2430     1.5  2432.5
Downstream     num=        2
    Width   Elev    Width   Elev
     1.5    2430     1.5  2432.5

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
       Momentum                Cd   =       2
       Yarnell                 KVal =    1.25
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Pressure and Weir flow
           Submerged Inlet Cd          =
           Submerged Inlet + Outlet Cd =       .8
           Max Low Cord                =

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream water surface

BRIDGE OUTPUT    Profile #Profile 1
Opening : Bridge #1


  E.G. US. (ft)                2434.88   Element                 Inside BR US
Inside BR DS
  W.S. US. (ft)                2434.31   E.G. Elev (ft)               2434.87
2434.70
  Q Total (cfs)                1840.00   W.S. Elev (ft)               2434.31
2434.12
  Q Bridge (cfs)                737.42   Crit W.S. (ft)               2434.16
2433.97
  Q Weir (cfs)                 1102.58   Max Chl Dpth (ft)               3.84
  3.97
  Weir Sta Lft (ft)            9901.93   Vel Total (ft/s)                6.06
  5.79
  Weir Sta Rgt (ft)           10091.52   Flow Area (sq ft)             303.42
317.88
  Weir Submerg                    0.25   Froude # Chl                    0.55
  0.52
  Weir Max Depth (ft)             2.86   Specif Force (cu ft)          774.56
```

Water Depth

807.22

Min Top Rd (ft)	2432.01	Hydr Depth (ft)	1.66
1.68			
Min El Prs (ft)	2432.54	W.P. Total (ft)	295.54
303.22			
Delta EG (ft)	0.36	Conv. Total (cfs)	
Delta WS (ft)	0.91	Top Width (ft)	306.54
289.50			
BR Open Area (sq ft)	94.50	Frctn Loss (ft)	
BR Open Vel (ft/s)	7.80	C & E Loss (ft)	
Coef of Q		Shear Total (lb/sq ft)	
Br Sel Method	Press/Weir	Power Total (lb/ft s)	

Note: Yarnell answer is not valid if the water surface is above the low chord or if there is weir flow.
The Yarnell answer has been disregarded.
Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir
flow. The momentum answer has been disregarded.
Note: The downstream water surface is above the minimum elevation for pressure flow. The
orifice equations were used for pressure flow.
Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.
Note: For the cross section inside the bridge at the upstream end, the water surface and energy
have been projected from the upstream cross section. The selected bridge modeling
method does not compute answers inside the bridge.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
energy was used.
Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.
Note: For the cross section inside the bridge at the downstream end, the water surface and energy
are based on critical depth over the weir.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
energy was used.

BRIDGE OUTPUT Profile #Profile 2
Opening : Bridge #1

E.G. US. (ft)	2434.88	Element	Inside BR US
Inside BR DS			
W.S. US. (ft)	2434.32	E.G. Elev (ft)	2434.88
2434.70			
Q Total (cfs)	1840.00	W.S. Elev (ft)	2434.32
2434.12			
Q Bridge (cfs)	735.60	Crit W.S. (ft)	2434.16
2433.97			
Q Weir (cfs)	1104.40	Max Chl Dpth (ft)	3.85

3.97			
Weir Sta Lft (ft)	9901.92	Vel Total (ft/s)	6.06
5.79			
Weir Sta Rgt (ft)	10091.52	Flow Area (sq ft)	303.82
317.60			
Weir Submerg	0.25	Froude # Chl	0.55
0.53			
Weir Max Depth (ft)	2.87	Specif Force (cu ft)	774.75
807.07			
Min Top Rd (ft)	2432.01	Hydr Depth (ft)	1.67
1.68			
Min El Prs (ft)	2432.54	W.P. Total (ft)	295.57
303.20			
Delta EG (ft)	0.35	Conv. Total (cfs)	
Delta WS (ft)	0.90	Top Width (ft)	306.59
289.45			
BR Open Area (sq ft)	94.50	Frctn Loss (ft)	
BR Open Vel (ft/s)	7.78	C & E Loss (ft)	
Coef of Q		Shear Total (lb/sq ft)	
Br Sel Method	Press/Weir	Power Total (lb/ft s)	

Note: Yarnell answer is not valid if the water surface is above the low chord or if there is weir flow.
The Yarnell answer has been disregarded.
Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir
flow. The momentum answer has been disregarded.
Note: The downstream water surface is above the minimum elevation for pressure flow. The
orifice equations were used for pressure flow.
Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.
Note: For the cross section inside the bridge at the upstream end, the water surface and energy
have been projected from the upstream cross section. The selected bridge modeling
method does not compute answers inside the bridge.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
energy was used.
Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.
Note: For the cross section inside the bridge at the downstream end, the water surface and energy
are based on critical depth over the weir.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
energy was used.

CROSS SECTION RIVER: Galloway
REACH: Reach 6 RS: 3.502

INPUT
Description: Private Foot Bridge

This cross section is 2.6 feet downstream of
a private footbridge, no sqew adjustment is applied

Station Elevation Data num= 43

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
9870.39	2436.54	9880.32	2436.31	9884.76	2436.26	9884.83	2436.35	9888.42	2435.85
9892.21	2435.46	9904.27	2434.55	9914.51	2433.86	9926.31	2433.02	9944.54	2433.12
9987.47	2433.07	9991.48	2433.72	9993.5	2432.012	9995.7	2430.15	10040.96	2430.39
10045.48	2430.43	10049.92	2431.91	10052.56	2431.42	10067.03	2431.95	10099.86	2432.06
10112.23	2431.72	10120.58	2432.02	10125.52	2432.32	10130.75	2429.81	10132.74	2429.09
10143.38	2430.41	10148.75	2431.81	10153.29	2432.92	10159.82	2433.28	10162.1	2433.44
10163.45	2433.48	10164.02	2433.51	10179.26	2433.98	10179.94	2433.97	10184.21	2433.94
10196.15	2433.86	10200.25	2434.13	10204.94	2435.13	10207.26	2435.51	10220.78	2437.32
10231.7	2440.01	10242.36	2441.76	10253.56	2444.76				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
9870.39	.06	9993.5	.04	10049.92	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
9993.5	10049.92	52	50	50	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev
10099.86	10253.56	2436

Left Levee Station= 9991.48 Elevation= 2433.72

CROSS SECTION OUTPUT Profile #Profile 1

E.G. Elev (ft)	2434.52	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.11	Wt. n-Val.	0.060	0.040
0.060				
W.S. Elev (ft)	2433.40	Reach Len. (ft)	52.00	50.00
50.00				
Crit W.S. (ft)	2433.40	Flow Area (sq ft)	1.15	170.43
75.41				
E.G. Slope (ft/ft)	0.013979	Area (sq ft)	1.15	170.43
191.21				
Q Total (cfs)	1840.00	Flow (cfs)	2.20	1547.38
290.42				
Top Width (ft)	169.74	Top Width (ft)	1.65	56.42
111.67				
Vel Total (ft/s)	7.45	Avg. Vel. (ft/s)	1.92	9.08
3.85				
Max Chl Dpth (ft)	4.31	Hydr. Depth (ft)	0.70	3.02
1.51				
Conv. Total (cfs)	15562.4	Conv. (cfs)	18.6	13087.5
2456.3				
Length Wtd. (ft)	50.00	Wetted Per. (ft)	2.16	57.34
50.00				
Min Ch El (ft)	2430.15	Shear (lb/sq ft)	0.46	2.59
1.32				
Alpha	1.29	Stream Power (lb/ft s)	0.89	23.55
5.07				
Frctn Loss (ft)	0.81	Cum Volume (acre-ft)	1.40	21.41
1.91				
C & E Loss (ft)	0.04	Cum SA (acres)	1.40	6.96
1.65				

Warning: The energy equation could not be balanced within the specified number of iterations. The

program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
energy was used.

CROSS SECTION OUTPUT Profile #Profile 2

E.G. Elev (ft)	2434.53	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.12	Wt. n-Val.		0.040	0.060
W.S. Elev (ft)	2433.41	Reach Len. (ft)	52.00	50.00	50.00
Crit W.S. (ft)	2433.41	Flow Area (sq ft)		170.90	74.58
E.G. Slope (ft/ft)	0.014397	Area (sq ft)		170.90	74.58
Q Total (cfs)	1840.00	Flow (cfs)		1552.35 ✓	287.65
Top Width (ft)	105.44	Top Width (ft)		56.42	49.02
Vel Total (ft/s)	7.50	Avg. Vel. (ft/s)		9.08 ✓	3.86
Max Chl Dpth (ft)	4.32	Hydr. Depth (ft)		3.03	1.52
Conv. Total (cfs)	15335.0	Conv. (cfs)		12937.6	2397.4
Length Wtd. (ft)	50.00	Wetted Per. (ft)		58.74	50.43
Min Ch El (ft)	2430.15	Shear (lb/sq ft)		2.61	1.33
Alpha	1.28	Stream Power (lb/ft s)		23.75	5.13
Frctn Loss (ft)	0.78	Cum Volume (acre-ft)	0.76	21.41	0.80
C & E Loss (ft)	0.00	Cum SA (acres)	0.71	6.96	0.77

Area total = 245.33 S.F. - channel area (170.90)
Area of S.S. = 74.43 S.F. = 37.21 on s.s. ea. side. D 3.03

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to

$\frac{D \times 3.03}{2} = 37.21$

$D = 24.56'$

$\frac{D}{2}$ 3.

critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Warning: The parabolic search method failed to converge on critical depth. The program will try the cross section slice/secant method to find critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

FLOW DISTRIBUTION OUTPUT Profile #Profile 1

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
9968.88	9993.50	2.20	1.15	2.16	0.12	0.70	1.92
LB 9993.50	10001.56	207.21	24.09	8.74	11.26	2.99	8.60
10001.56	10009.62	245.38	25.81	8.06	13.34	3.20	9.51
10009.62	10017.68	239.92	25.46	8.06	13.04	3.16	9.42
10017.68	10025.74	234.56	25.12	8.06	12.75	3.12	9.34
10025.74	10033.80	229.20	24.77	8.06	12.46	3.07	9.25
10033.80	10041.86	223.91	24.43	8.06	12.17	3.03	9.17
10041.86	RB 10049.92	167.20	20.74	8.30	9.09	2.57	8.06
10049.92	10090.65	245.45	62.89	40.78	13.34	1.54	3.90
10090.65	10131.38	44.96	12.53	9.21	2.44	1.36	3.59

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Warning: The parabolic search method failed to converge on critical depth. The program will try the cross section slice/secant method to find critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

FLOW DISTRIBUTION OUTPUT Profile #Profile 2

APPENDIX D

HEC-RAS Project Galloway Wash

RS 3.514

2.42						
9974.58	9987.25	76.11	22.24	12.69	4.35	1.76
3.42						
LB 9987.25	9995.07	197.79	23.53	8.01	11.30	3.01
8.41						
9995.07	10002.89	281.52	28.80	7.82	16.09	3.68
9.77						
10002.89	10010.71	266.89	27.90	7.82	15.25	3.57
9.57						
10010.71	10018.53	252.54	26.99	7.82	14.43	3.45
9.36						
10018.53	10026.35	238.52	26.08	7.82	13.63	3.33
9.15						
10026.35	10034.17	224.78	25.17	7.82	12.84	3.22
8.93						
10034.17	RB 10041.99	156.67	20.50	8.05	8.95	2.62
7.64						
10041.99	10065.54	10.95	5.02	7.12	0.63	0.72
2.18						

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.

31.81 - 3.514
30.15 - 3.514

CROSS SECTION RIVER: Galloway
REACH: Reach 6 RS: 3.514

INPUT
Description:
Station Elevation Data num= 31

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
9906.78	2435.9	9925.72	2435.17	9938.1	2434.24	9938.33	2434.21	9961.14	2433.82
9977.72	2433.12	9983.56	2432.45	9986.74	2431.94	10017.45	2431.81	10031.89	2431.69
10036.47	2432.4	10043.8	2433.43	10052.41	2433.86	10071.98	2434.64	10094.71	2433.94
10116.16	2433.57	10121.03	2433.66	10135.38	2434.21	10154.81	2434.58	10164.73	2434.83
10177.93	2435.2	10182.74	2433.11	10188.15	2430.59	10195.59	2433.01	10203.07	2435.38
10208.3	2435.24	10213.73	2435.22	10222.91	2435.55	10232.12	2435.91	10232.8	2435.91
10251.85	2435.87								

Manning's n Values num= 3

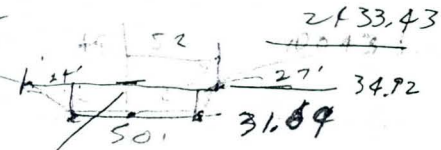
Sta	n Val	Sta	n Val	Sta	n Val
9906.78	.06	9977.72	.04	10043.8	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
9977.72	10043.8	49	50	52	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev
10071.98	10251.85	2436

2433.12 2433.43



CROSS SECTION OUTPUT Profile #Profile 1

S.S = 12:1

$\frac{24 \times 3.28}{2}$ = 39.36

3.28 × 1.79 = 164

$\frac{27 \times 3.28}{2}$ = 44.28

A_T = 247.54

V = 6.75 fps = 1670 cfs

E.G. Elev (ft)	2435.88	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.97	Wt. n-Val.	0.060	0.040	0.060
W.S. Elev (ft)	2434.91	Reach Len. (ft)	49.00	50.00	52.00
Crit W.S. (ft)	2434.91	Flow Area (sq ft)	47.58	187.83	23.90
E.G. Slope (ft/ft)	0.012483	Area (sq ft)	47.58	187.83	144.70
Q Total (cfs)	1750.00	Flow (cfs)	129.77	1561.03	59.19
Top Width (ft)	261.56	Top Width (ft)	48.58	66.08	146.90
Vel Total (ft/s)	6.75	Avg. Vel. (ft/s)	2.73	8.31	2.48
Max Chl Dpth (ft)	4.32	Hydr. Depth (ft)	0.98	2.84	0.85
Conv. Total (cfs)	15663.3	Conv. (cfs)	1161.5	13971.9	529.8
Length Wtd. (ft)	50.10	Wetted Per. (ft)	48.63	66.29	28.21
Min Ch El (ft)	2431.69	Shear (lb/sq ft)	0.76	2.21	0.66
Alpha	1.37	Stream Power (lb/ft s)	2.08	18.35	1.64
Frctn Loss (ft)	0.41	Cum Volume (acre-ft)	1.49	21.67	2.22
C & E Loss (ft)	0.12	Cum SA (acres)	1.49	7.04	1.87

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION OUTPUT Profile #Profile 2

E.G. Elev (ft)	2435.88	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.97	Wt. n-Val.	0.060	0.040	0.060

			Left OB	Channel
W.S. Elev (ft)	2434.91	Reach Len. (ft)	49.00	50.00
52.00				
Crit W.S. (ft)	2434.91	Flow Area (sq ft)	47.58	187.83
23.90				
E.G. Slope (ft/ft)	0.012483	Area (sq ft)	47.58	187.83
144.70				
Q Total (cfs)	1750.00	Flow (cfs)	129.77	1561.03
59.19				
Top Width (ft)	261.56	Top Width (ft)	48.58	66.08
146.90				
Vel Total (ft/s)	6.75	Avg. Vel. (ft/s)	2.73	8.31
2.48				
Max Chl Dpth (ft)	4.32	Hydr. Depth (ft)	0.98	2.84
0.85				
Conv. Total (cfs)	15663.3	Conv. (cfs)	1161.5	13971.9
529.8				
Length Wtd. (ft)	50.10	Wetted Per. (ft)	48.63	66.29
28.21				
Min Ch El (ft)	2431.69	Shear (lb/sq ft)	0.76	2.21
0.66				
Alpha	1.37	Stream Power (lb/ft s)	2.08	18.35
1.64				
Frctn Loss (ft)	0.41	Cum Volume (acre-ft)	0.85	21.67
1.11				
C & E Loss (ft)	0.12	Cum SA (acres)	0.80	7.04
0.99				

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

FLOW DISTRIBUTION OUTPUT Profile #Profile 1

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
9920.97	9935.16	1.27	1.36	6.03	0.07	0.23	0.93
9935.16	9949.34	21.96	10.59	14.20	1.26	0.75	2.07
9949.34	9963.53	36.81	14.44	14.19	2.10	1.02	

2.55						
9963.53	9977.72	69.73	21.19	14.20	3.98	1.49
3.29						
LB 9977.72	9987.16	161.82	22.32	9.52	9.25	2.36
7.25						
9987.16	9996.60	241.24	28.27	9.44	13.79	2.99
8.53						
9996.60	10006.04	246.65	28.65	9.44	14.09	3.03
8.61						
10006.04	10015.48	252.06	29.02	9.44	14.40	3.07
8.68						
10015.48	10024.92	259.24	29.52	9.44	14.81	3.13
8.78						
10024.92	10034.36	262.12	29.75	9.47	14.98	3.15
8.81						
10034.36	RB 10043.80	137.91	20.30	9.54	7.88	2.15
6.79						
10043.80	10085.41	59.19	23.90	28.21	3.38	0.85
2.48						

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

FLOW DISTRIBUTION OUTPUT Profile #Profile 2

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
9920.97	9935.16	1.27	1.36	6.03	0.07	0.23	0.93
9935.16	9949.34	21.96	10.59	14.20	1.26	0.75	2.07
9949.34	9963.53	36.81	14.44	14.19	2.10	1.02	2.55
9963.53	9977.72	69.73	21.19	14.20	3.98	1.49	3.29
LB 9977.72	9987.16	161.82	22.32	9.52	9.25	2.36	7.25
9987.16	9996.60	241.24	28.27	9.44	13.79	2.99	8.53

9996.60	10006.04	246.65	28.65	9.44	14.09	3.03
8.61						
10006.04	10015.48	252.06	29.02	9.44	14.40	3.07
8.68						
10015.48	10024.92	259.24	29.52	9.44	14.81	3.13
8.78						
10024.92	10034.36	262.12	29.75	9.47	14.98	3.15
8.81						
10034.36	RB 10043.80	137.91	20.30	9.54	7.88	2.15
6.79						
10043.80	10085.41	59.19	23.90	28.21	3.38	0.85
2.48						

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less
than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION RIVER: Galloway
REACH: Reach 6 RS: 3.504

INPUT
Description: Private Foot Bridge
This cross section is 2.6 feet upstream of a
private footbridge, no sqew adjustment is applied
Station Elevation Data num= 41

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
9887.74	2436.44	9894.4	2435.52	9904.9	2434.62	9927.76	2432.98	9977.19	2433.25
9984.19	2433.29	9987.3	2433.37	9990.39	2433.76	9991.52	2432.618	9993.54	2430.52
9993.99	2430.47	10000.86	2430.51	10042.78	2430.61	10047.04	2431.37	10048.83	2432.01
10062.01	2432.06	10071.94	2432.43	10091.52	2432.49	10111.87	2431.93	10114.86	2431.86
10122.41	2432.31	10133.22	2432.95	10134.13	2432.52	10143.2	2429.28	10143.74	2429.35
10144.01	2429.42	10160.37	2433.42	10162.47	2433.53	10168.99	2433.59	10175.88	2433.81
10179.16	2433.92	10186.73	2434.21	10192.43	2434.15	10203.17	2434.08	10205.95	2434.26
10206.99	2434.31	10212.15	2433.9	10213.3	2434.02	10216.24	2434.38	10236.16	2437.65
10255.58	2442.84								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
9887.74	.06	9991.5	.04	10048.83	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
9991.5	10048.83	10	10	10	.1	.3

Ineffective Flow num= 1

```
   Sta L    Sta R     Elev
10091.5210255.58     2436
Left Levee       Station= 9990.39       Elevation= 2433.76

CROSS SECTION OUTPUT    Profile #Profile 1


  E.G. Elev (ft)            2434.88   Element                    Left OB    Channel
Right OB
  Vel Head (ft)                0.56   Wt. n-Val.                  0.060      0.040
   0.060
  W.S. Elev (ft)            2434.31   Reach Len. (ft)              2.60       2.60
    2.60
  Crit W.S. (ft)            2433.84   Flow Area (sq ft)           85.61     210.05
   86.89
  E.G. Slope (ft/ft)       0.005907   Area (sq ft)                85.61     210.05
  275.22
  Q Total (cfs)             1840.00   Flow (cfs)                 166.51    1407.89
  265.61
  Top Width (ft)             306.54   Top Width (ft)              82.34      57.33
  166.87
  Vel Total (ft/s)              4.81   Avg. Vel. (ft/s)             1.94       6.70
    3.06
  Max Chl Dpth (ft)             5.03   Hydr. Depth (ft)             1.04       3.66
    2.04
  Conv. Total (cfs)         23940.5    Conv. (cfs)                2166.5   18318.2
  3455.8
  Length Wtd. (ft)              2.60   Wetted Per. (ft)            82.89      58.40
   42.70
  Min Ch El (ft)            2430.47    Shear (lb/sq ft)             0.38       1.33
    0.75
  Alpha                         1.56   Stream Power (lb/ft s)       0.74       8.89
    2.29
  Frctn Loss (ft)                      Cum Volume (acre-ft)         1.42      21.44
    1.97
  C & E Loss (ft)                      Cum SA (acres)               1.42       6.97
    1.68


Warning: The parabolic search method failed to converge on critical depth.  The
program will try the
         cross section slice/secant method to find critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth
with the lowest, valid,
         energy was used.

CROSS SECTION OUTPUT    Profile #Profile 2


  E.G. Elev (ft)            2434.88   Element                    Left OB    Channel
Right OB
  Vel Head (ft)                0.56   Wt. n-Val.                  0.060      0.040
   0.060
  W.S. Elev (ft)            2434.32   Reach Len. (ft)              2.60       2.60
    2.60
  Crit W.S. (ft)            2433.84   Flow Area (sq ft)           85.80     210.18
   86.99
  E.G. Slope (ft/ft)       0.005891   Area (sq ft)                85.80     210.18
  275.58
  Q Total (cfs)             1840.00   Flow (cfs)                 166.83    1407.44
  265.73
  Top Width (ft)             306.59   Top Width (ft)              82.37      57.33
```

166.89					
Vel Total (ft/s)	4.80	Avg. Vel. (ft/s)	1.94	6.70	3.05
Max Chl Dpth (ft)	5.04	Hydr. Depth (ft)	1.04	3.67	2.04
Conv. Total (cfs)	23972.1	Conv. (cfs)	2173.5	18336.5	3462.0
Length Wtd. (ft)	2.60	Wetted Per. (ft)	82.92	58.40	42.70
Min Ch El (ft)	2430.47	Shear (lb/sq ft)	0.38	1.32	0.75
Alpha	1.56	Stream Power (lb/ft s)	0.74	8.86	2.29
Frctn Loss (ft)		Cum Volume (acre-ft)	0.77	21.44	0.86
C & E Loss (ft)		Cum SA (acres)	0.73	6.97	0.80

Warning: The parabolic search method failed to converge on critical depth. The program will try the
cross section slice/secant method to find critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
energy was used.

FLOW DISTRIBUTION OUTPUT Profile #Profile 1

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
9908.49	9929.24	21.39	14.38	20.13	1.16	0.72	1.49
9929.24	9950.00	57.48	26.34	20.75	3.12	1.27	2.18
9950.00	9970.75	49.18	23.99	20.75	2.67	1.16	2.05
9970.75	9991.50	38.47	20.90	21.26	2.09	1.01	1.84
LB 9991.50	9999.69	180.49	29.14	9.08	9.81	3.56	6.19
9999.69	10007.88	215.58	31.11	8.19	11.72	3.80	6.93
10007.88	10016.07	213.92	30.96	8.19	11.63	3.78	6.91
10016.07	10024.26	212.24	30.81	8.19	11.53	3.76	6.89
10024.26	10032.45	210.61	30.67	8.19	11.45	3.75	6.87
10032.45	10040.64	208.94	30.53	8.19	11.36	3.73	6.84
10040.64	RB 10048.83	166.10	26.83	8.37	9.03	3.28	6.19
10048.83	10090.18	258.65	84.45	41.36	14.06	2.04	3.06
10090.18	10131.53	6.96	2.45	1.34	0.38	1.83	2.84

APPENDIX D

HEC-RAS Project Galloway Wash

RS 3.528

previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION RIVER: Galloway
REACH: Reach 6 RS: 3.528

INPUT
Description:
Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
9923.92	2438	9926.26	2437.71	9933.95	2437.18	9940.2	2436.85	9941.18	2436.86
9942.73	2436.64	9944.75	2436.31	9961.44	2435.96	9964.39	2435.78	9987.25	2434.5
9994.32	2432.86	9994.51	2432.86	10036.85	2433.49	10041.99	2435.03	10045.71	2436.01
10053.54	2437.47	10069.87	2440.47	10090.36	2437.55	10092.77	2437.12	10120.55	2437.03
10126.19	2437.17	10159.74	2441.52						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
9923.92	.06	9987.25	.04	10041.99	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
9987.25	10041.99	73	75	76	.1	.3

CROSS SECTION OUTPUT Profile #Profile 1

E.G. Elev (ft)	2437.79	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.18	Wt. n-Val.	0.060	0.040	0.060
W.S. Elev (ft)	2436.61	Reach Len. (ft)	73.00	75.00	76.00
Crit W.S. (ft)	2436.61	Flow Area (sq ft)	44.01	+ 178.96	- 222.97 5.02
E.G. Slope (ft/ft)	0.012343	Area (sq ft)	44.01	178.96	5.02
Q Total (cfs)	1750.00	Flow (cfs)	120.34	1618.71	10.95
Top Width (ft)	106.02	Top Width (ft)	44.34	54.74	6.94
Vel Total (ft/s)	7.68	Avg. Vel. (ft/s)	2.73	9.05	2.18
Max Chl Dpth (ft)	3.75	Hydr. Depth (ft)	0.99	3.27	0.72
Conv. Total (cfs)	15751.7	Conv. (cfs)	1083.2	14570.0	98.5
Length Wtd. (ft)	74.88	Wetted Per. (ft)	44.41	+ 55.16	= 99.57 7.12
Min Ch El (ft)	2432.86	Shear (lb/sq ft)	0.76	2.50	0.54
Alpha	1.29	Stream Power (lb/ft s)	2.09	22.61	1.18
Frctn Loss (ft)	0.93	Cum Volume (acre-ft)	1.57	21.98	2.35
C & E Loss (ft)	0.06	Cum SA (acres)	1.57	7.15	2.00

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Profile 2

E.G. Elev (ft)	2437.79	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.18	Wt. n-Val.	0.060	0.040	0.060
W.S. Elev (ft)	2436.61	Reach Len. (ft)	73.00	75.00	76.00
Crit W.S. (ft)	2436.61	Flow Area (sq ft)	44.01	178.96	5.02
E.G. Slope (ft/ft)	0.012343	Area (sq ft)	44.01	178.96	5.02
Q Total (cfs)	1750.00	Flow (cfs)	120.34	1618.71	10.95
Top Width (ft)	106.02	Top Width (ft)	44.34	54.74	6.94
Vel Total (ft/s)	7.68	Avg. Vel. (ft/s)	2.73	9.05	2.18
Max Chl Dpth (ft)	3.75	Hydr. Depth (ft)	0.99	3.27	0.72
Conv. Total (cfs)	15751.7	Conv. (cfs)	1083.2	14570.0	98.5
Length Wtd. (ft)	74.88	Wetted Per. (ft)	44.41	55.16	7.12
Min Ch El (ft)	2432.86	Shear (lb/sq ft)	0.76	2.50	0.54
Alpha	1.29	Stream Power (lb/ft s)	2.09	22.61	1.18
Frctn Loss (ft)	0.93	Cum Volume (acre-ft)	0.92	21.98	1.24
C & E Loss (ft)	0.06	Cum SA (acres)	0.88	7.15	1.12

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates

that there is not a valid subcritical answer. The program defaulted to critical depth.

FLOW DISTRIBUTION OUTPUT Profile #Profile 1

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
9936.59	9949.25	1.89	1.84	6.37	0.11	0.29	1.03
9949.25	9961.92	10.28	6.69	12.67	0.59	0.53	1.54
9961.92	9974.58	32.07	13.24	12.69	1.83	1.05	2.42
9974.58	9987.25	76.11	22.24	12.69	4.35	1.76	3.42
LB 9987.25	9995.07	197.79	23.53	8.01	11.30	3.01	8.41
9995.07	10002.89	281.52	28.80	7.82	16.09	3.68	9.77
10002.89	10010.71	266.89	27.90	7.82	15.25	3.57	9.57
10010.71	10018.53	252.54	26.99	7.82	14.43	3.45	9.36
10018.53	10026.35	238.52	26.08	7.82	13.63	3.33	9.15
10026.35	10034.17	224.78	25.17	7.82	12.84	3.22	8.93
10034.17	RB 10041.99	156.67	20.50	8.05	8.95	2.62	7.64
10041.99	10065.54	10.95	5.02	7.12	0.63	0.72	2.18

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

FLOW DISTRIBUTION OUTPUT Profile #Profile 2

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
9936.59	9949.25	1.89	1.84	6.37	0.11	0.29	1.03
9949.25	9961.92	10.28	6.69	12.67	0.59	0.53	1.54
9961.92	9974.58	32.07	13.24	12.69	1.83	1.05	

APPENDIX D

HEC-RAS Project Galloway Wash

RS 3.562

iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

FLOW DISTRIBUTION OUTPUT Profile #Profile 2

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
LB 9960.00	9972.14	237.65	29.61	14.55	13.58	2.44	8.03
9972.14	9984.29	273.78	29.98	12.14	15.64	2.47	9.13
9984.29	9996.43	267.96	29.59	12.14	15.31	2.44	9.05
9996.43	10008.57	263.73	29.31	12.14	15.07	2.41	9.00
10008.57	10020.71	265.21	29.41	12.14	15.15	2.42	9.02
10020.71	10032.86	267.06	29.54	12.14	15.26	2.43	9.04
10032.86	RB 10045.00	174.62	23.74	13.31	9.98	1.96	7.35

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION RIVER: Galloway
REACH: Reach 6 RS: 3.562

INPUT
Description:

Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
9844.22	2442.16	9895.85	2442.21	9902.31	2442.11	9904.58	2442.08	9908.16	2442.01
9923.82	2441.85	9940.21	2440.95	9951.76	2440.27	9963.31	2439.94	9986.77	2439.11
10002.23	2439.09	10029.68	2438.87	10031.21	2438.91	10031.31	2438.87	10040.9	2439.51
10049.91	2442.64	10057.47	2445.32	10057.54	2445.35	10068.71	2447.02		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
9844.22	.055	9963.31	.04	10040.9	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
9963.31	10040.9	182.11	178.3	175.33	.1	.3

CROSS SECTION OUTPUT Profile #Profile 1

E.G. Elev (ft)	2442.69	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.02	Wt. n-Val.	0.055	0.040	0.055
W.S. Elev (ft)	2441.68	Reach Len. (ft)	182.11	178.30	175.33
Crit W.S. (ft)	2441.68	Flow Area (sq ft)	35.25	192.65	6.75
E.G. Slope (ft/ft)	0.015112	Area (sq ft)	35.25	192.65	6.75
Q Total (cfs)	1750.00	Flow (cfs)	114.67	1612.57	22.76
Top Width (ft)	120.14	Top Width (ft)	36.32	77.59	6.23
Vel Total (ft/s)	7.46	Avg. Vel. (ft/s)	3.25	8.37	3.37
Max Chl Dpth (ft)	2.81	Hydr. Depth (ft)	0.97	2.48	1.08
Conv. Total (cfs)	14235.6	Conv. (cfs)	932.8	13117.7	185.2
Length Wtd. (ft)	178.53	Wetted Per. (ft)	36.36	77.64	6.60
Min Ch El (ft)	2438.87	Shear (lb/sq ft)	0.91	2.34	0.97
Alpha	1.18	Stream Power (lb/ft s)	2.98	19.60	3.25
Frctn Loss (ft)	2.43	Cum Volume (acre-ft)	1.73	22.75	2.37
C & E Loss (ft)	0.02	Cum SA (acres)	1.74	7.42	2.03

Conveyance wtd. = .042

227.90

= 114.00

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Profile 2

E.G. Elev (ft)	2442.96	Element	Left OB	Channel
Right OB Vel Head (ft)	1.27	Wt. n-Val.		0.040
W.S. Elev (ft)	2441.69	Reach Len. (ft)	182.11	178.30
175.33 Crit W.S. (ft)	2441.69	Flow Area (sq ft)		193.64
E.G. Slope (ft/ft)	0.018688	Area (sq ft)		193.64
Q Total (cfs)	1750.00	Flow (cfs)		1750.00
Top Width (ft)	77.59	Top Width (ft)		77.59
Vel Total (ft/s)	9.04	Avg. Vel. (ft/s)		9.04
Max Chl Dpth (ft)	2.82	Hydr. Depth (ft)		2.50
Conv. Total (cfs)	12801.5	Conv. (cfs)		12801.5
Length Wtd. (ft)	178.42	Wetted Per. (ft)		81.56
Min Ch El (ft)	2438.87	Shear (lb/sq ft)		2.77
Alpha	1.00	Stream Power (lb/ft s)		25.03
Frctn Loss (ft)	2.68	Cum Volume (acre-ft)	1.02	22.75
1.25 C & E Loss (ft)	0.03	Cum SA (acres)	0.97	7.42
1.14				

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.

FLOW DISTRIBUTION OUTPUT Profile #Profile 1

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
9915.67	9939.49	6.18	4.29	12.52	0.35	0.34	1.44
9939.49	9963.31	108.48	30.96	23.84	6.20	1.30	3.50
LB 9963.31	9974.39	150.70	21.41	11.09	8.61	1.93	

7.04						
9974.39	9985.48	205.06	25.76	11.09	11.72	2.32
7.96						
9985.48	9996.56	242.36	28.47	11.08	13.85	2.57
8.51						
9996.56	10007.65	246.46	28.76	11.09	14.08	2.59
8.57						
10007.65	10018.73	259.10	29.63	11.08	14.81	2.67
8.74						
10018.73	10029.82	273.62	30.62	11.09	15.64	2.76
8.94						
10029.82	RB 10040.90	235.27	28.00	11.11	13.44	2.53
8.40						
10040.90	10046.46	22.71	6.67	5.89	1.30	1.20
3.40						
10046.46	10052.02	0.06	0.08	0.71	0.00	0.12
0.72						

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.

FLOW DISTRIBUTION OUTPUT Profile #Profile 2

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
LB 9963.31	9974.39	152.53	21.55	12.84	8.72	1.94	7.08
9974.39	9985.48	228.42	25.90	11.09	13.05	2.34	8.82
9985.48	9996.56	269.73	28.61	11.08	15.41	2.58	9.43
9996.56	10007.65	274.28	28.90	11.09	15.67	2.61	9.49
10007.65	10018.73	288.27	29.77	11.08	16.47	2.69	9.68
10018.73	10029.82	304.34	30.76	11.09	17.39	2.78	9.89
10029.82	RB 10040.90	232.42	28.14	13.29	13.28	2.54	8.26

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and

```
previous cross
         section.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set
equal to
         critical depth, the calculated water surface came back below critical
depth.  This indicates
         that there is not a valid subcritical answer.  The program defaulted to
critical depth.

CROSS SECTION           RIVER: Galloway
REACH: Reach 6             RS: 3.528

INPUT
Description:
Station Elevation Data     num=      22
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9923.92    2438 9926.26 2437.71 9933.95 2437.18  9940.2 2436.85 9941.18 2436.86
 9942.73 2436.64 9944.75 2436.31 9961.44 2435.96 9964.39 2435.78 9987.25  2434.5
 9994.32 2432.86 9994.51 2432.8610036.85 2433.4910041.99 2435.0310045.71 2436.01
10053.54 2437.4710069.87 2440.4710090.36 2437.5510092.77 2437.1210120.55 2437.03
10126.19 2437.1710159.74 2441.52

Manning's n Values         num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9923.92     .06 9987.25     .0410041.99     .06

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       9987.2510041.99               73      75      76              .1       .3

CROSS SECTION OUTPUT    Profile #Profile 1


  E.G. Elev (ft)            2437.79   Element                   Left OB    Channel
Right OB
  Vel Head (ft)                1.18   Wt. n-Val.                 0.060      0.040
   0.060
  W.S. Elev (ft)            2436.61   Reach Len. (ft)            73.00      75.00
   76.00
  Crit W.S. (ft)            2436.61   Flow Area (sq ft)          44.01     178.96
    5.02
  E.G. Slope (ft/ft)       0.012343   Area (sq ft)               44.01     178.96
    5.02
  Q Total (cfs)             1750.00   Flow (cfs)                120.34    1618.71
   10.95
  Top Width (ft)             106.02   Top Width (ft)             44.34      54.74
    6.94
  Vel Total (ft/s)             7.68   Avg. Vel. (ft/s)            2.73       9.05
    2.18
  Max Chl Dpth (ft)            3.75   Hydr. Depth (ft)            0.99       3.27
    0.72
  Conv. Total (cfs)         15751.7   Conv. (cfs)               1083.2    14570.0
    98.5
  Length Wtd. (ft)            74.88   Wetted Per. (ft)           44.41      55.16
    7.12
  Min Ch El (ft)            2432.86   Shear (lb/sq ft)            0.76       2.50
    0.54
  Alpha                        1.29   Stream Power (lb/ft s)      2.09      22.61
    1.18
  Frctn Loss (ft)              0.93   Cum Volume (acre-ft)        1.57      21.98
    2.35
  C & E Loss (ft)              0.06   Cum SA (acres)              1.57       7.15
    2.00
```

APPENDIX D

HEC-RAS Project Galloway Wash

RS 3.596

```
9.14
9972.29      9983.71        270.93      29.30      11.43      15.48      2.56
9.25
9983.71      9995.14        274.44      29.53      11.43      15.68      2.58
9.29
9995.14      10006.57       277.93      29.75      11.43      15.88      2.60
9.34
10006.57     RB 10018.00    217.62      26.92      12.85      12.44      2.36
8.08


Warning: The energy equation could not be balanced within the specified number of
iterations.  The
         program used critical depth for the water surface and continued on with the
calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and
previous cross
         section.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set
equal to
         critical depth, the calculated water surface came back below critical
depth.  This indicates
         that there is not a valid subcritical answer.  The program defaulted to
critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth
with the lowest, valid,
         water surface was used.

CROSS SECTION          RIVER: Galloway
REACH: Reach 6            RS: 3.596

INPUT
Description: 80th St. Alignment
Station Elevation Data    num=      28
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9823.68  2448.7 9835.61 2447.65 9837.21 2447.74 9846.67 2447.05 9864.91 2445.95
 9882.89 2445.58 9891.94 2445.39 9892.78 2445.36  9893.5 2445.32 9897.61 2445.18
 9928.53  2443.6    9960  2443.5 9960.05  2443.5 9975.08 2443.43   10000  2443.5
10036.53 2443.47   100452444.85910046.04 2445.0310057.98 2446.8410078.08 2442.92
10078.98 2442.7410079.22 2442.82 10085.5 2444.8410091.16 2447.6810099.22 2450.94
10100.86 2451.7610106.67 2453.5410113.72 2453.66

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 9823.68    .055    9960     .04   10045    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          9960   10045           193.09  179.62  174.76             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev   Sta L   Sta R    Elev
 9823.68    9945    244710057.9810113.72 2446.84

CROSS SECTION OUTPUT    Profile #Profile 1


  E.G. Elev (ft)            2446.74   Element                    Left OB    Channel
Right OB
  Vel Head (ft)                1.05   Wt. n-Val.                  0.055      0.040
   0.055
  W.S. Elev (ft)            2445.69   Reach Len. (ft)            193.09     179.62
  174.76
  Crit W.S. (ft)            2445.69   Flow Area (sq ft)           32.48     182.42
```

2.21				
E.G. Slope (ft/ft)	0.018789	Area (sq ft)	111.97	182.42
37.54				
Q Total (cfs)	1750.00	Flow (cfs)	201.37	1544.16
4.48				
Top Width (ft)	196.13	Top Width (ft)	82.43	85.00
28.70				
Vel Total (ft/s)	8.06	Avg. Vel. (ft/s)	6.20	8.46
2.03				
Max Chl Dpth (ft)	2.95	Hydr. Depth (ft)	2.17	2.15
0.41				
Conv. Total (cfs)	12767.0	Conv. (cfs)	1469.0	11265.2
32.7				
Length Wtd. (ft)	180.80	Wetted Per. (ft)	15.00	85.11
5.45				
Min Ch El (ft)	2443.43	Shear (lb/sq ft)	2.54	2.51
0.48				
Alpha	1.04	Stream Power (lb/ft s)	15.75	21.28
0.96				
Frctn Loss (ft)	3.04	Cum Volume (acre-ft)	2.06	23.52
2.46				
C & E Loss (ft)	0.01	Cum SA (acres)	2.00	7.75
2.10				

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION OUTPUT Profile #Profile 2

E.G. Elev (ft)	2447.08	Element	Left OB	Channel
Right OB				
Vel Head (ft)	1.17	Wt. n-Val.		0.040
W.S. Elev (ft)	2445.91	Reach Len. (ft)	193.09	179.62
174.76				
Crit W.S. (ft)	2445.91	Flow Area (sq ft)		201.18
E.G. Slope (ft/ft)	0.018364	Area (sq ft)		201.18
Q Total (cfs)	1750.00	Flow (cfs)		1750.00
Top Width (ft)	85.00	Top Width (ft)		85.00
Vel Total (ft/s)	8.70	Avg. Vel. (ft/s)		8.70

Max Chl Dpth (ft)	3.17	Hydr. Depth (ft)		2.37
Conv. Total (cfs)	12913.7	Conv. (cfs)		12913.7
Length Wtd. (ft)	179.62	Wetted Per. (ft)		88.57
Min Ch El (ft)	2443.43	Shear (lb/sq ft)		2.60
Alpha	1.00	Stream Power (lb/ft s)		22.65
Frctn Loss (ft)	3.33	Cum Volume (acre-ft)	1.02	23.56
1.25				
C & E Loss (ft)	0.01	Cum SA (acres)	0.97	7.75
1.14				

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

FLOW DISTRIBUTION OUTPUT Profile #Profile 1

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
9932.74	9960.00	201.36	32.48	15.00	11.51	2.17	6.20
LB 9960.00	9972.14	232.28	26.93	12.14	13.27	2.22	8.63
9972.14	9984.29	237.65	27.30	12.14	13.58	2.25	8.71
9984.29	9996.43	232.11	26.91	12.14	13.26	2.22	8.62
9996.43	10008.57	228.08	26.63	12.14	13.03	2.19	8.56
10008.57	10020.71	229.49	26.73	12.14	13.11	2.20	8.58
10020.71	10032.86	231.25	26.86	12.14	13.21	2.21	8.61
10032.86	RB 10045.00	153.30	21.06	12.26	8.76	1.73	7.28
10045.00	10058.74	4.48	2.21	5.45	0.26	0.41	2.03

Warning: The energy equation could not be balanced within the specified number of

iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

FLOW DISTRIBUTION OUTPUT Profile #Profile 2

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
LB 9960.00	9972.14	237.65	29.61	14.55	13.58	2.44	8.03
9972.14	9984.29	273.78	29.98	12.14	15.64	2.47	9.13
9984.29	9996.43	267.96	29.59	12.14	15.31	2.44	9.05
9996.43	10008.57	263.73	29.31	12.14	15.07	2.41	9.00
10008.57	10020.71	265.21	29.41	12.14	15.15	2.42	9.02
10020.71	10032.86	267.06	29.54	12.14	15.26	2.43	9.04
10032.86	RB 10045.00	174.62	23.74	13.31	9.98	1.96	7.35

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid,
water surface was used.

CROSS SECTION RIVER: Galloway
REACH: Reach 6 RS: 3.562

INPUT
Description:

```
Station Elevation Data     num=       19
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 9844.22 2442.16 9895.85 2442.21 9902.31 2442.11 9904.58 2442.08 9908.16 2442.01
 9923.82 2441.85 9940.21 2440.95 9951.76 2440.27 9963.31 2439.94 9986.77 2439.11
10002.23 2439.0910029.68 2438.8710031.21 2438.9110031.31 2438.87 10040.9 2439.51
10049.91 2442.6410057.47 2445.3210057.54 2445.3510068.71 2447.02

Manning's n Values         num=        3
     Sta   n Val     Sta   n Val     Sta   n Val
 9844.22    .055 9963.31     .04 10040.9    .055

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       9963.31 10040.9            182.11   178.3  175.33              .1       .3

CROSS SECTION OUTPUT    Profile #Profile 1


  E.G. Elev (ft)            2442.69   Element                    Left OB    Channel
Right OB
  Vel Head (ft)                1.02   Wt. n-Val.                  0.055      0.040
   0.055
  W.S. Elev (ft)            2441.68   Reach Len. (ft)            182.11     178.30
  175.33
  Crit W.S. (ft)            2441.68   Flow Area (sq ft)           35.25     192.65
    6.75
  E.G. Slope (ft/ft)       0.015112   Area (sq ft)                35.25     192.65
    6.75
  Q Total (cfs)             1750.00   Flow (cfs)                 114.67    1612.57
   22.76
  Top Width (ft)             120.14   Top Width (ft)              36.32      77.59
    6.23
  Vel Total (ft/s)             7.46   Avg. Vel. (ft/s)             3.25       8.37
    3.37
  Max Chl Dpth (ft)            2.81   Hydr. Depth (ft)             0.97       2.48
    1.08
  Conv. Total (cfs)         14235.6   Conv. (cfs)                 932.8    13117.7
   185.2
  Length Wtd. (ft)           178.53   Wetted Per. (ft)            36.36      77.64
    6.60
  Min Ch El (ft)            2438.87   Shear (lb/sq ft)             0.91       2.34
    0.97
  Alpha                        1.18   Stream Power (lb/ft s)       2.98      19.60
    3.25
  Frctn Loss (ft)              2.43   Cum Volume (acre-ft)         1.73      22.75
    2.37
  C & E Loss (ft)              0.02   Cum SA (acres)               1.74       7.42
    2.03


Warning: The energy equation could not be balanced within the specified number of
iterations.  The
         program used critical depth for the water surface and continued on with the
calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and
previous cross
         section.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set
equal to
         critical depth, the calculated water surface came back below critical
depth.  This indicates
         that there is not a valid subcritical answer.  The program defaulted to
critical depth.
```

CROSS SECTION OUTPUT Profile #Profile 2

E.G. Elev (ft)	2442.96	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.27	Wt. n-Val.		0.040	
W.S. Elev (ft)	2441.69	Reach Len. (ft)	182.11	178.30	175.33
Crit W.S. (ft)	2441.69	Flow Area (sq ft)		193.64	
E.G. Slope (ft/ft)	0.018688	Area (sq ft)		193.64	
Q Total (cfs)	1750.00	Flow (cfs)		1750.00	
Top Width (ft)	77.59	Top Width (ft)		77.59	
Vel Total (ft/s)	9.04	Avg. Vel. (ft/s)		9.04	
Max Chl Dpth (ft)	2.82	Hydr. Depth (ft)		2.50	
Conv. Total (cfs)	12801.5	Conv. (cfs)		12801.5	
Length Wtd. (ft)	178.42	Wetted Per. (ft)		81.56	
Min Ch El (ft)	2438.87	Shear (lb/sq ft)		2.77	
Alpha	1.00	Stream Power (lb/ft s)		25.03	
Frctn Loss (ft)	2.68	Cum Volume (acre-ft)	1.02	22.75	1.25
C & E Loss (ft)	0.03	Cum SA (acres)	0.97	7.42	1.14

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.

FLOW DISTRIBUTION OUTPUT Profile #Profile 1

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
9915.67	9939.49	6.18	4.29	12.52	0.35	0.34	1.44
9939.49	9963.31	108.48	30.96	23.84	6.20	1.30	3.50
LB 9963.31	9974.39	150.70	21.41	11.09	8.61	1.93	

7.04						
9974.39	9985.48	205.06	25.76	11.09	11.72	2.32
7.96						
9985.48	9996.56	242.36	28.47	11.08	13.85	2.57
8.51						
9996.56	10007.65	246.46	28.76	11.09	14.08	2.59
8.57						
10007.65	10018.73	259.10	29.63	11.08	14.81	2.67
8.74						
10018.73	10029.82	273.62	30.62	11.09	15.64	2.76
8.94						
10029.82	RB 10040.90	235.27	28.00	11.11	13.44	2.53
8.40						
10040.90	10046.46	22.71	6.67	5.89	1.30	1.20
3.40						
10046.46	10052.02	0.06	0.08	0.71	0.00	0.12
0.72						

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross
section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to
critical depth, the calculated water surface came back below critical depth. This indicates
that there is not a valid subcritical answer. The program defaulted to critical depth.

FLOW DISTRIBUTION OUTPUT Profile #Profile 2

Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	% Conv.	Hydr D. (ft)	Velocity (ft/s)
LB 9963.31	9974.39	152.53	21.55	12.84	8.72	1.94	7.08
9974.39	9985.48	228.42	25.90	11.09	13.05	2.34	8.82
9985.48	9996.56	269.73	28.61	11.08	15.41	2.58	9.43
9996.56	10007.65	274.28	28.90	11.09	15.67	2.61	9.49
10007.65	10018.73	288.27	29.77	11.08	16.47	2.69	9.68
10018.73	10029.82	304.34	30.76	11.09	17.39	2.78	9.89
10029.82	RB 10040.90	232.42	28.14	13.29	13.28	2.54	8.26

Warning: The energy equation could not be balanced within the specified number of iterations. The
program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and

APPENDIX E

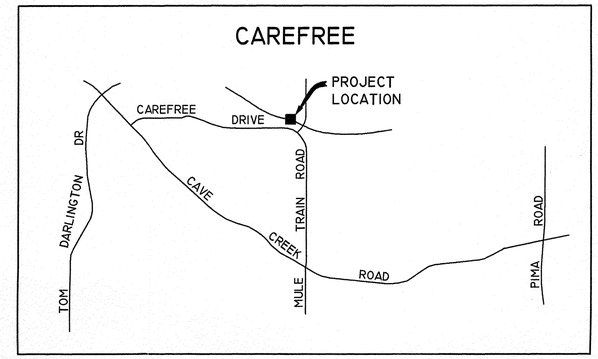
JE Fuller Hydrology & Geomorphology Inc; Flood Plain Study
Sheet 5 of 6

GALLOWAY WASH - R.S. 3.504 TO 3.5428
GABION EROSION PROTECTION STUDY
FOR
KESLER RESIDENCE

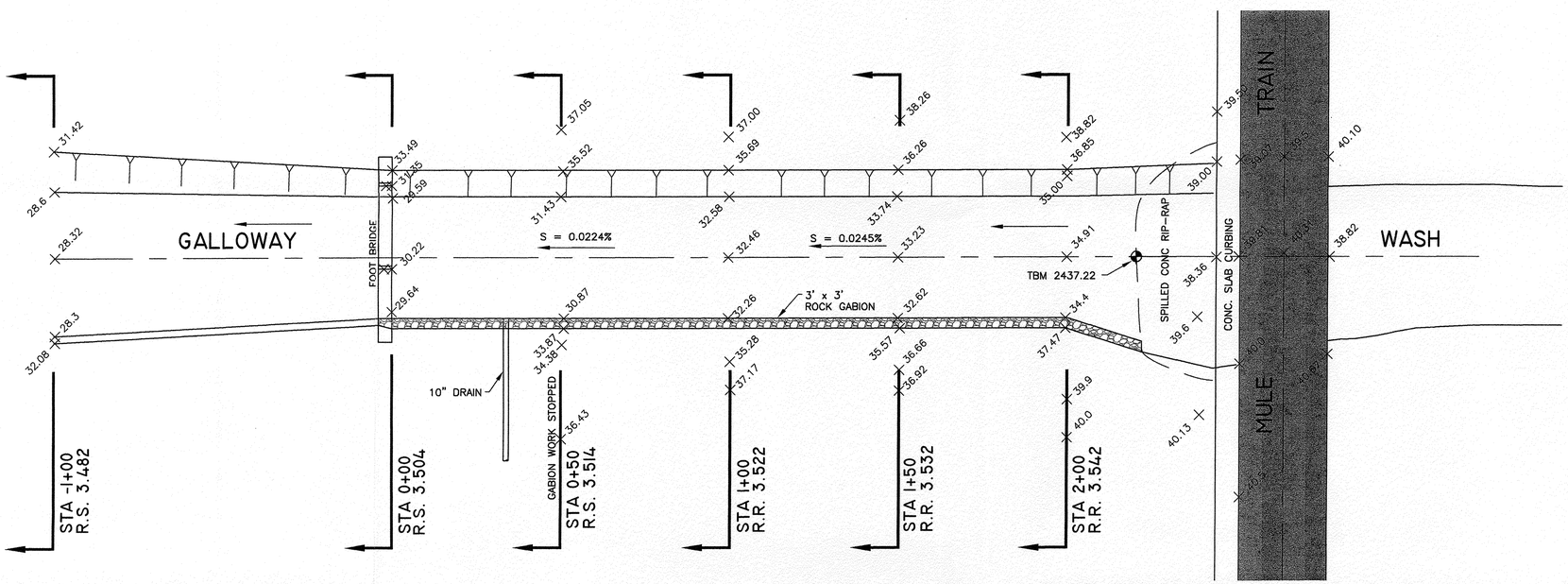
7840 E CAREFREE DRIVE
CAREFREE, ARIZONA

A.P.N.- 216-83-360

LOT 366 "CAREFREE TOO" SUBDIVISION



VICINITY MAP
NTS



SEE CROSS SECTIONS - SHEET 2 OF 2

N

OWNER:

MR. AND MRS. HAROLD KESLER
P.O. BOX 5203
7840 E CAREFREE DRIVE
CAREFREE, ARIZONA 85377-5203
(480) 488-1484
APN -216-83-360

ENGINEER:

BARTHOLOMEW ENGINEERING INC.
PHYSICAL ADDRESS:
7518 EAST ELBOW BEND ROAD
SUITE B-1
CAREFREE, ARIZONA 85377
PHONE: (480) 488-9775
FAX: (480) 488-2681
MOBILE: (602) 692-7650

MAILING ADDRESS:
P.O. BOX 4809
CAVE CREEK, ARIZONA 85327
EMAIL: BE@DOITNOW.COM

CONTACT: RICHARD F. BARTHOLOMEW, P.E.

SOURCE OF INFORMATION:

NATIONAL FLOOD INSURANCE PROGRAM
FIRM – FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA &
INCORPORATED AREAS
PANEL 808 OF 4350

AND

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FLOOD PLAIN DELINEATION STUDY OF
ANDORA HILLS & GALLOWAY WASHES
FCD 99-14 BY JE FULLER –
HYDROLOGY & GEOMORPHOLOGY, INC. 4/12/02

AND RELATED HEC-RAS-PROJECT DATA
FOR FLOOD DELINEATION OF GALLOWAY WASH

BENCHMARK:

TBM "+" PAINTED ON CONCRETE RIP-RAP
APPROXIMATELY 45 FEET WEST OF
C MULE TRAIN ROAD & C GALLOWAY WASH

DATUM:
MCFCD – FLOOD PLAIN DELINEATION
FCD-99-14 BY J.E. FULLER

SHEET INDEX

SHEET	NO.
COVER & SITE PLAN SHEET	1
CROSS SECTIONS	2

CALL TWO WORKING DAYS BEFORE YOU DIG
602-263-1100
OR
1-800-STAKE-IT

Date	Revision	By:

DRN: CDS DATE: 03-24-08
DES: RFB DATE: 03-24-08
CHD: RFB DATE: 03-24-08

BARTHOLOMEW ENGINEERING, INC.
CIVIL • SANITARY • ENVIRONMENTAL
PHYSICAL ADDRESS:
7518 EAST ELBOW BEND ROAD SUITE B-1
CAREFREE, ARIZONA 85377
PHONE: (480) 488-9775
MAILING ADDRESS:
P.O. BOX 4809
CAVE CREEK, ARIZONA 85327
FAX: (480) 488-2681

REGISTERED PROFESSIONAL ENGINEER (CIVIL) CERTIFICATE NO. 6299 RICHARD F. BARTHOLOMEW

GABION EROSION PROTECTION STUDY
FOR
KESLER RESIDENCE - CAREFREE AZ
GALLOWAY WASH RS 3.504 TO 3.5428
COVER & SITE PLAN SHEET

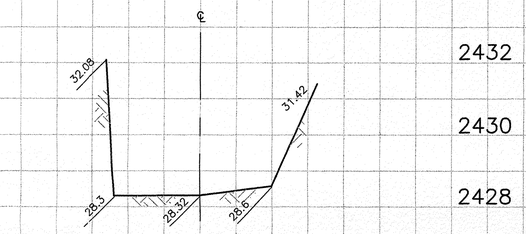
SCALE:
1"= 20' HORIZ.
1"= -- VERT.

JOB NO.
080203

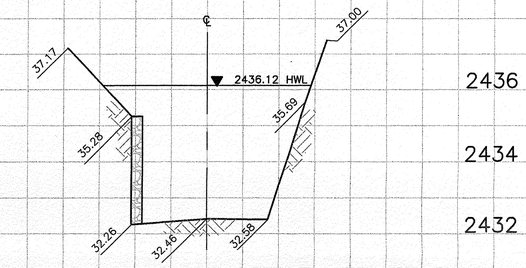
SHEET 1 OF 2

PLOTTED: 3-10-08

CROSS SECTIONS - LOOKING DOWNSTREAM



STA -1+00
R.S. 3.482



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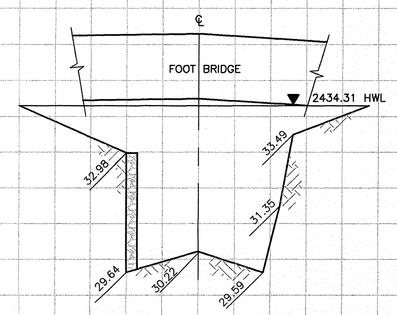
R.R. 3.522



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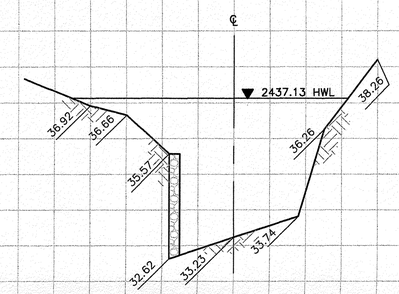
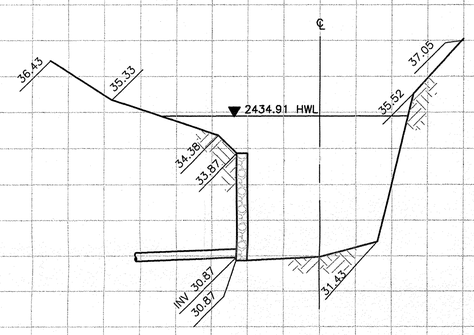
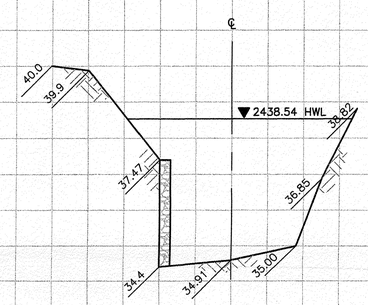
R.S. 3.503
4' FOOT BRIDGE



STA 1+50
R.R. 3.532



STA 0+50
R.S. 3.514



STA 2+00
R.R. 3.542

By:	Revision	Date

DRN: CDS DATE: 03-24-08
DES: RFB DATE: 03-24-08
CHD: RFB DATE: 03-24-08

BARTHOLOMEW ENGINEERING, INC.
CIVIL • SANITARY • ENVIRONMENTAL
PHYSICAL ADDRESS:
7518 EAST ELBOW BEND ROAD SUITE B-1
CAREFREE, ARIZONA 85377
PHONE: (480) 488-9775
MAILING ADDRESS:
P.O. BOX 4809
CAVE CREEK, ARIZONA 85327
FAX: (480) 488-2681

Registered Professional Engineer (Civil) CERTIFICATE NO. 6299 RICHARD F. BARTHOLOMEW Date Signed 3/31/08 Expires 3/31/11

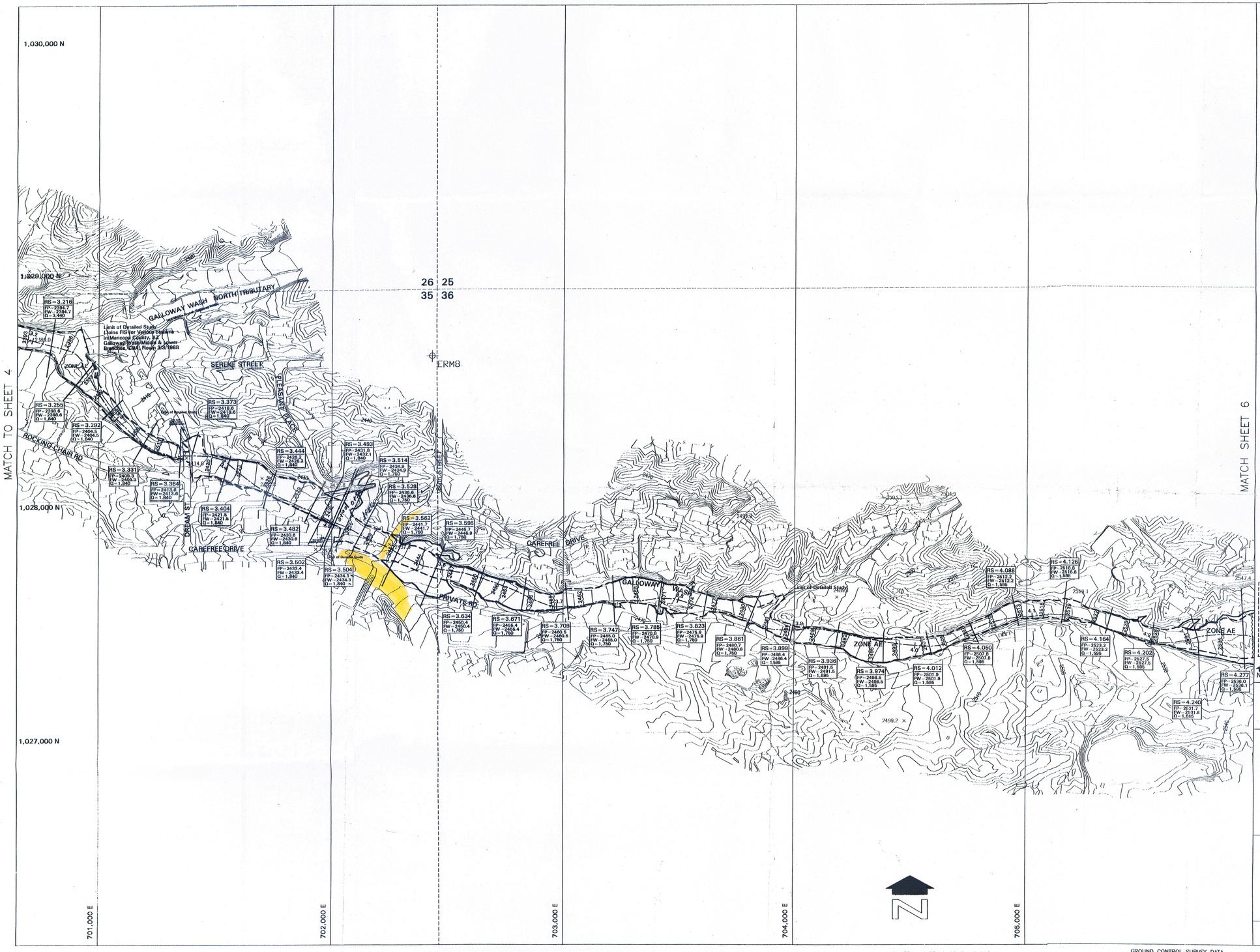
GABION EROSION PROTECTION STUDY
FOR
KESLER RESIDENCE - CAREFREE AZ
GALLOWAY WASH RS 3.504 TO 3.5428
CROSS SECTIONS

SCALE:
1"= 20' HORIZ.
1"= 2 VERT.

JOB NO.
080203

SHEET
2 OF 2

PLOTTED: 3-31-08



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOODPLAIN DELINEATION STUDY OF ANDORA HILLS & GALLOWAY WASHES FCD 99-14

APRIL, 2002

LEGEND

100-YR FLOODPLAIN BOUNDARY	
FLOODWAY BOUNDARY	
HYDRAULIC BASE LINE WITH RIVER MILE	1.2 — 1.3
CROSS SECTION	RS = 0.300 FP - 2061.0 FW - 2061.5 Q - 13,700
ELEVATION REFERENCE MARK	ERM 4
BASE FLOOD ELEVATIONS	2060
ZONE DESIGNATIONS	ZONE AE
CORPORATE LIMITS	TOWN OF CAVECREEK
SECTION LINE	

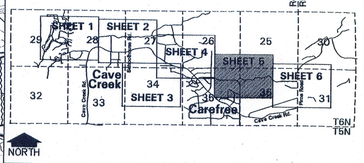
ELEVATION REFERENCE MARKS

I.D. NUMBER	ELEVATION (FT)	DESCRIPTION/LOCATION
ERM 8	2443.44	BC ON TOP OF SOUTH END OF CULVERT HEADWALL, LOCATED APPROX 25 FT N AND 25 FT W OF C/L INTERSECTION OF MULE TRAIN RD AND SERENE STREET, SECTION 35, T6N, R4E (N1028625.55, E702432.49)

NOTES

1. THE HYDRAULIC BASE LINE IS CROSS SECTION STATION 10,000 UNLESS NOTED OTHERWISE.
2. HORIZONTAL PROJECTION IS ARIZONA STATEPLANE, CENTRAL ZONE, NORTH AMERICAN DATUM OF 1983.
3. ALL ELEVATIONS ARE BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929. CONVERSION FACTOR: 1988 NGVD = 2.06 + 1929 NGVD

INDEX MAP



200 0' 200 400

SCALE: 1" = 200 FEET

CONTOUR INTERVAL = 2 FEET

REGISTERED PROFESSIONAL ENGINEER (CIVIL) CERTIFICATE NO. 24325 BRIAN R. ISERMAN Date Signed 4/19/02

REGISTERED LAND SURVEYOR CERTIFICATE NO. 24530 DAVID A. RHINE Date Signed 4/19/02

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

in association with

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS
Since 1962

THIS MAP WAS PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS FOR 1" = 200' HORIZONTAL SCALE AND 2' CONTOUR INTERVALS. FLIGHT DATE: 9/30/99

M&B AERIAL MAPPING COMPANY, LLC

GROUND CONTROL SURVEY DATA PROVIDED BY A TEAM PROFESSIONAL ASSOCIATES, INC.

PHOTOGRAPHS

PICTURE 1

WASH BEFORE STONES + BOULDE

1999

STOP

PLANS