Murray Swamp Flow Analysis

FOR

RDA Mine
Seaboard Road
Andrews, South Carolina

Prepared For:
Kennedy Consulting Services, LLC
P.O. Box 364
Irmo, SC 29063

georgia civil
CIVIL ENGINEERING
LANDSCAPE ARCHITECTURE
LAND SURVEYING

Prepared By:
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Date: 11/20/17

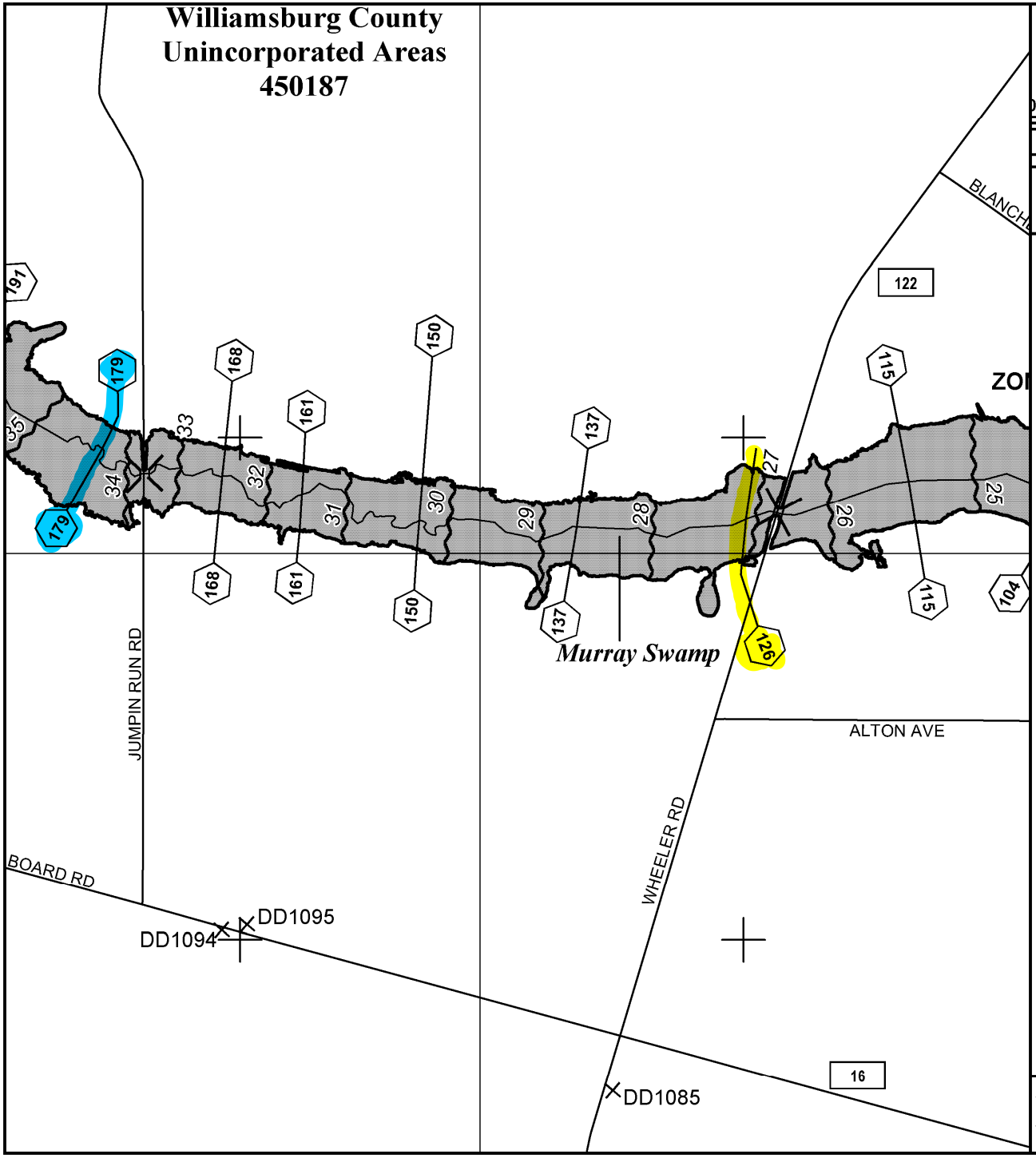
SOUTH CAROLINA
GEORGIA CIVIL, INC.
No. 4624
CERTIFICATE OF AUTHORIZATION
2017

SOUTH CAROLINA
LICENSED PROFESSIONAL ENGINEER
No. 26019
11-2017
STEPHENS P. OGLESBY

PROJECT NARRATIVE:

It is our understanding that the proposed RDA Mine will have a dewatering pump within the main pit to allow for pumping of groundwater and stormwater from the sand mine to facilitate the mining process. The pumped water will ultimately be released into the Murray Swamp creek basin that flows to the east, just downstream of the Jumpin Run Rd. crossing. When operated, the proposed pump is anticipated to have an average flow rate of 10.4 cfs and a maximum flow rate of 11.6 cfs. The purpose of this study is to analyze the downstream effects within the creek basin at a study point immediately upstream of the Wheeler Road bridge crossing, assuming that the pump is operating at the maximum 11.6 cfs discharge at the same time that the creek basin is experiencing the 100-yr flood discharge from the overall drainage basin contributing to the study point.

The current November 16, 2012 FEMA Flood Insurance Rate Map for this area indicates that this area has Base Flood Elevation information based on a Zone AE study information. See the included data the includes FEMA cross sections, flood discharge flow rates, and water surface elevations. Per the FEMA study cross sections, the one just upstream of the Wheeler Road bridge crossing is labeled as section #126. A flow rate of 1,053 cfs is listed along with a water surface elevation of 27.16. Using GeoHECRAS ® software, we have modeled the creek basin in this area, using the available FEMA cross section station data and 100-yr peak flow discharge of 1,053 cfs. Our calculated water surface elevation at cross section #126 is 27.85, very close to the FEMA elevation of 27.16. We ran the model again, using 1,064.6 cfs as the flow rate, which is the 1,053 cfs plus the 11.6 cfs maximum pump discharge. At cross section #126, the calculated water surface is 27.87, basically an unappreciable difference relative to a basin this size. Also, this study assumes that the mine pump would be discharging at the maximum rate at the same time that Murray Swamp is experiencing the 100-yr base flood stage. As a result, we do not anticipate any negative downstream flow rate effects based on the proposed pump discharge.



MAP SCALE 1" = 1000'

0 1000 2000 FEET

0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0610D

FIRM

FLOOD INSURANCE RATE MAP

WILLIAMSBURG COUNTY, SOUTH CAROLINA

AND INCORPORATED AREAS

PANEL 610 OF 700

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
WILLIAMSBURG COUNTY	450187	0610	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
45089C0610D

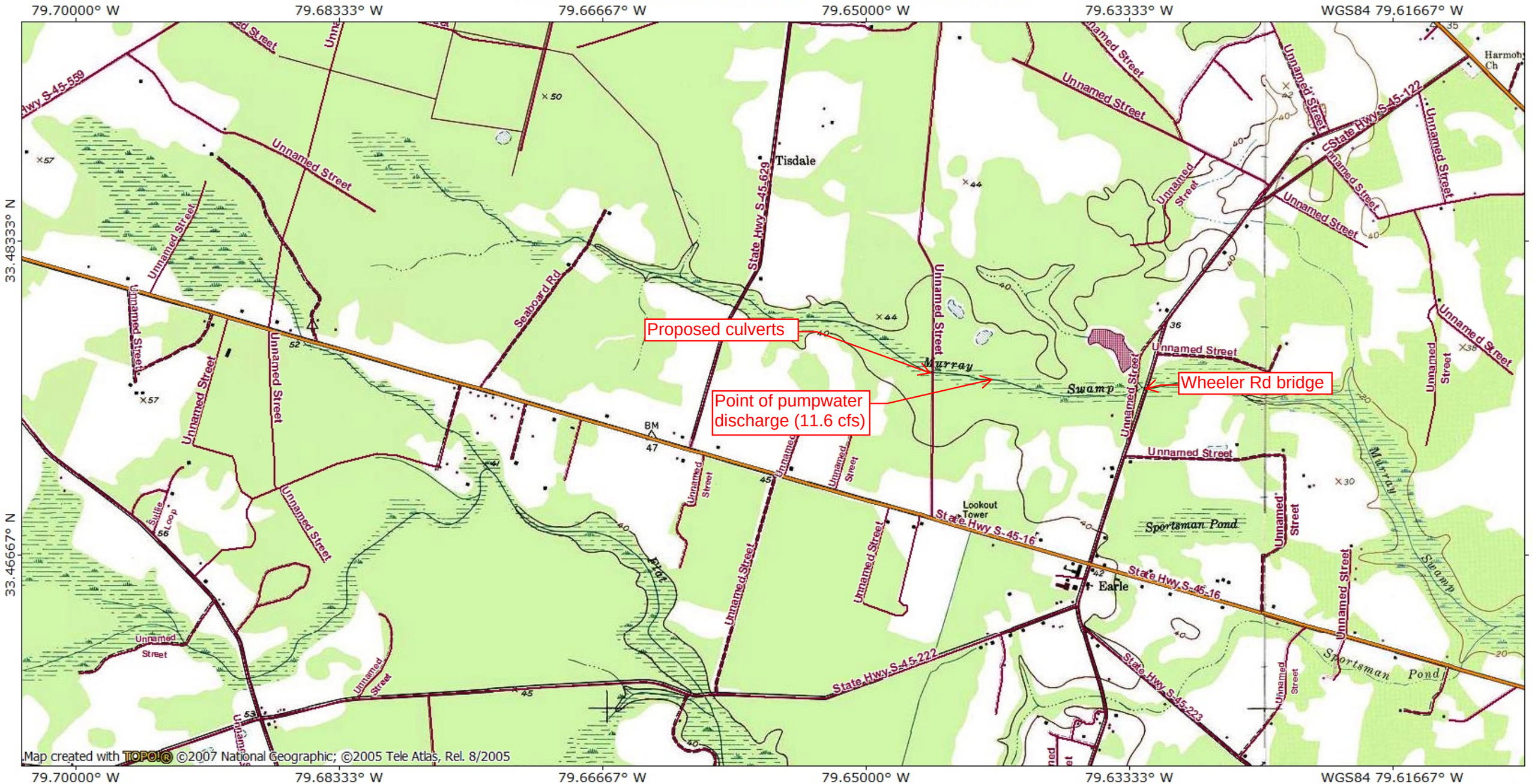
EFFECTIVE DATE
NOVEMBER 16, 2012

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

TABLE 4—Limited Detailed Flood Hazard Data			
Cross Section[1]	**Stream Station[2]**	**Flood Discharge (cfs)**	**1% Annual Chance Water-Surface Elevation (feet NAVD 88)**
MULBERRY BRANCH (continued)			
022	2247	766	50.89
026	2573	766	51.29
030	2970	766	51.82
MURRAY SWAMP			
011	1079	1,471	17.9[3]
017	1654	1,471	17.95
024	2412	1,471	18.38
029	2875	1,471	18.74
033	3282	1,471	19.09
038	3796	1,471	19.50
043	4341	1,471	19.98
050	4988	1,471	20.60
057	5736	1,300	21.22
064	6414	1,300	21.61
069	6870	1,300	21.81
075	7549	1,300	22.11
081	8050	1,175	22.40
086	8625	1,175	22.75
091	9137	1,175	23.16
098	9823	1,175	23.78
104	10414	1,175	24.32
109	10925	1,175	24.85
115	11500	1,175	25.44
121	12104	1,175	26.07
123	12331	1,175	26.32
125	12450	1,175	26.88
126	12606	1,053	27.16
132	13225	1,053	27.99
137	13745	1,053	28.51
144	14375	1,053	29.76
150	14985	1,053	30.30
155	15525	1,053	30.84
161	16100	1,053	31.58
168	16776	1,053	32.59
173	17279	1,053	33.19
174	17445	1,053	33.86
179	17910	1,053	34.45
184	18432	1,053	34.97
191	19051	883	35.65
196	19550	883	36.23
201	20070	883	36.76
206	20591	883	37.28

33.47521° N, 79.65590° W WGS84 Figure 1. Location Map



NATIONAL GEOGRAPHIC

0.0 0.5 1.0 miles
0.0 0.5 1.0 1.5 km

MN TN
8°
05/15/17

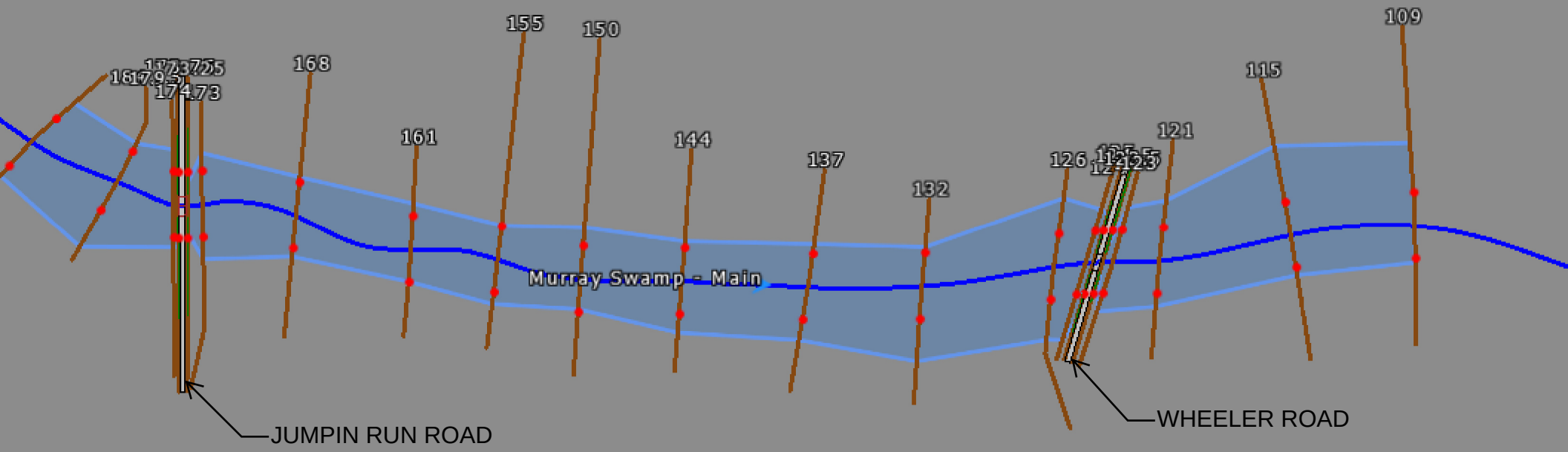
HEC-RAS Plan: FEMA River: Murray Swamp Reach: Main Profile: 100 Yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main	184	100 Yr	1053.00	32.00	34.00		34.05	0.001348	1.80	688.94	467.94	0.24
Main	179	100 Yr	1053.00	30.00	33.76		33.78	0.000343	1.20	1042.31	532.42	0.13
Main	174	100 Yr	1053.00	30.00	33.68		33.70	0.000292	1.15	1033.08	442.54	0.12
Main	173.75	100 Yr	1053.00	30.00	33.50	31.82	33.67	0.002143	3.31	318.35	394.26	0.33
Main	173.5		Culvert									
Main	173.25	100 Yr	1053.00	30.00	32.91	32.91	33.67	0.025903	6.98	150.89	217.20	1.00
Main	173	100 Yr	1053.00	30.00	32.43		32.48	0.001370	1.83	664.33	481.09	0.24
Main	168	100 Yr	1053.00	30.00	31.66		31.73	0.002265	2.16	512.35	361.73	0.30
Main	161	100 Yr	1053.00	28.00	30.56		30.62	0.001801	2.02	557.02	354.28	0.27
Main	155	100 Yr	1053.00	28.00	29.70		29.78	0.002506	2.19	517.42	357.10	0.31
Main	150	100 Yr	1053.00	26.00	29.16		29.20	0.000958	1.68	691.54	369.93	0.20
Main	144	100 Yr	1053.00	26.00	28.79		28.82	0.000721	1.52	763.86	413.19	0.18
Main	137	100 Yr	1053.00	24.00	28.48		28.50	0.000439	1.31	884.65	437.69	0.14
Main	132	100 Yr	1053.00	26.00	28.23		28.26	0.000522	1.29	1048.81	516.58	0.15
Main	126	100 Yr	1053.00	26.00	27.85		27.87	0.000795	1.40	1062.69	644.80	0.18
Main	125	100 Yr	1175.00	24.00	27.83		27.84	0.000103	0.82	1970.41	614.70	0.07
Main	124.5	100 Yr	1175.00	24.00	27.55	26.08	27.80	0.003212	4.06	289.35	500.90	0.40
Main	124		Bridge									
Main	123.5	100 Yr	1175.00	24.00	26.27	26.27	27.16	0.024378	7.53	155.95	115.05	1.00
Main	123	100 Yr	1175.00	24.00	25.88		25.92	0.001183	1.73	855.57	492.05	0.22
Main	121	100 Yr	1175.00	24.00	25.50		25.57	0.002548	2.19	670.86	482.49	0.31
Main	115	100 Yr	1175.00	22.00	24.57		24.61	0.001073	1.69	923.01	593.04	0.21
Main	109	100 Yr	1175.00	22.00	23.86	22.75	23.91	0.001403	1.87	798.73	542.89	0.24

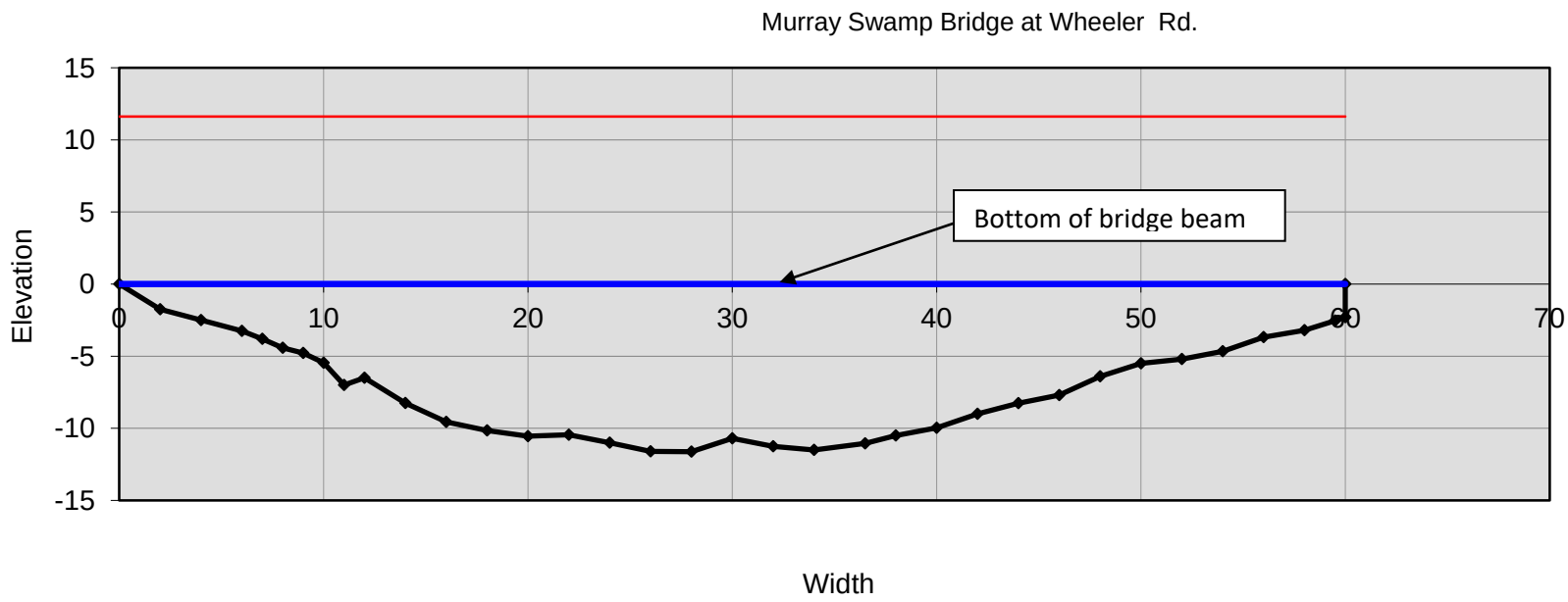
HEC-RAS Plan: Max flow River: Murray Swamp Reach: Main Profile: 100 Yr

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Main	184	100 Yr	1053.00	32.00	34.16		34.20	0.001013	1.64	760.95	476.49	0.21
Main	179	100 Yr	1053.00	30.00	33.97		33.99	0.000264	1.11	1157.69	561.33	0.11
Main	174	100 Yr	1053.00	30.00	33.91		33.92	0.000223	1.06	1137.07	457.58	0.11
Main	173.75	100 Yr	1053.00	30.00	33.76	31.82	33.90	0.001653	3.06	344.12	422.99	0.29
Main	173.25	100 Yr	1053.00	30.00	32.91	32.91	33.67	0.025903	6.98	150.89	217.20	1.00
Main	173	100 Yr	1053.00	30.00	32.44		32.49	0.001352	1.82	667.71	481.85	0.24
Main	168	100 Yr	1064.60	30.00	31.67		31.74	0.002261	2.16	516.41	362.44	0.30
Main	161	100 Yr	1064.60	28.00	30.57		30.63	0.001805	2.02	560.89	354.92	0.27
Main	155	100 Yr	1064.60	28.00	29.72		29.79	0.002487	2.20	522.27	357.95	0.31
Main	150	100 Yr	1064.60	26.00	29.18		29.22	0.000958	1.69	697.24	371.00	0.20
Main	144	100 Yr	1064.60	26.00	28.80		28.84	0.000719	1.52	770.51	414.23	0.18
Main	137	100 Yr	1064.60	24.00	28.49		28.52	0.000439	1.32	891.88	438.59	0.14
Main	132	100 Yr	1064.60	26.00	28.25		28.27	0.000520	1.29	1057.63	517.21	0.15
Main	126	100 Yr	1064.60	26.00	27.87		27.89	0.000782	1.40	1076.23	646.38	0.18
Main	125	100 Yr	1186.60	24.00	27.85		27.86	0.000103	0.82	1983.32	615.81	0.07
Main	124.5	100 Yr	1186.60	24.00	27.56	26.09	27.82	0.003212	4.08	291.04	501.56	0.40
Main	124		Bridge									
Main	123.5	100 Yr	1186.60	24.00	26.28	26.28	27.17	0.024513	7.58	156.61	115.95	1.00
Main	123	100 Yr	1186.60	24.00	25.89		25.93	0.001186	1.74	860.45	492.45	0.22
Main	121	100 Yr	1186.60	24.00	25.51		25.58	0.002542	2.20	675.56	482.96	0.31
Main	115	100 Yr	1186.60	22.00	24.58		24.62	0.001074	1.70	929.21	593.53	0.21
Main	109	100 Yr	1186.60	22.00	23.87	22.76	23.92	0.001403	1.88	804.40	544.16	0.24

CROSS SECTION - PLAN VIEW



Cross Section



Dimensions		Flood Dimensions		Materials	
454.7	x-section area (ft.sq.)	---	W flood prone area (ft)	---	D50 (mm)
60.0	width (ft)	---	entrenchment ratio	---	D84 (mm)
7.6	mean depth (ft)	---	low bank height (ft)	---	threshold grain size (mm):
11.6	max depth (ft)	---	low bank height ratio		
68.2	wetted perimeter (ft)				
6.7	hyd radi (ft)				
7.9	width-depth ratio				

Bankfull Flow		Flow Resistance		Forces & Power	
---	velocity (ft/s)	---	Manning's roughness	---	channel slope (%)
---	discharge rate (cfs)	---	D'Arcy-Weisbach fric.	---	shear stress

Seaboard Mine Flow Analysis.rep

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
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PROJECT DATA
Project Title: HEC-RAS Model
Project File : Seaboard Mine Flow Analysis.prj
Run Date and Time: 11/20/2017 1:06:06 PM

Project in English units

Project Description:
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PLAN DATA

Plan Title: Max flow
Plan File : G:\1Georgia Civil Jobs\Seaboard Mine\Flow Report\112017-Revised\Seaboard

Mine Flow Analysis.p03

Geometry Title: Max flow
Geometry File : G:\1Georgia Civil Jobs\Seaboard Mine\Flow Report\112017-Revised\Seaboard Mine Flow Analysis.g03

Flow Title : Max flow
Flow File : G:\1Georgia Civil Jobs\Seaboard Mine\Flow Report\112017-Revised\Seaboard Mine Flow Analysis.f03

Plan Description:
Default Scenario

Plan Summary Information:

Number of:	Cross Sections	= 21	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 1	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculation tolerance	=	0.01
Maximum number of iterations	=	20
Maximum difference tolerance	=	0.33
Flow tolerance factor	=	0.001

Computation Options

Critical depth computed only where necessary	
Conveyance Calculation Method:	At breaks in n values only
Friction Slope Method:	Average Conveyance
Computational Flow Regime:	Subcritical Flow

FLOW DATA

Flow Title: Max flow
Flow File : G:\1Georgia Civil Jobs\Seaboard Mine\Flow Report\112017-Revised\Seaboard Mine Flow Analysis.f03

Flow Data (cfs)

River	Reach	RS	100 Yr
Murray Swamp	Main	184	1053
Murray Swamp	Main	168	1064.6
Murray Swamp	Main	125	1186.6

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Murray Swamp	Main	100 Yr	Normal S = 0.001403	

GEOMETRY DATA

Geometry Title: Max flow
Geometry File : G:\1Georgia Civil Jobs\Seaboard Mine\Flow Report\112017-Revised\Seaboard Mine Flow Analysis.g03

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 184

INPUT
Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	40	87.07	40	124.06	38	160.33	36	171.15	35.31
191.53	34	287.34	32	302.54	32	397.19	32	429.39	32
432.55	32	452.54	32	506.69	32	602.54	33.26	659.21	34
721.62	35.54	740.52	36	784.04	38	920.13	40	981.33	40

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	302.54	.045	602.54	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
302.54	602.54	428.09	428.09	428.09	.1	.3

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 179

INPUT
Description:
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	40	124.24	40	159.74	38.84	184.22	38	218.56	36
240.74	34.55	249.09	34	304.51	32.8	341.68	32	386.5	30
392.52	30	394.9	30	413.18	30	454.51	30.38	604.51	31.75
632.31	32	814	34	826.74	34	861.92	34		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	304.51	.045	604.51	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
304.51	604.51	276.38	276.38	276.38	.1	.3

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 174

INPUT
Description:
Station Elevation Data num= 27

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	40	24.55	40	122.26	38	164.85	36	203.75	34
207.67	33.89	276.37	32	317.49	31.57	427.78	30.4	465.29	30
467.49	30	481.57	30	516.31	30	609.21	32	617.49	32.29
653.87	33.54	655.94	33.61	657.77	33.67	667.28	34	788.27	34
793.72	34	802.93	34	803.27	34	974.95	36	1057.38	38
1186.82	40	1239.02	40						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	317.49	.045	617.49	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
317.49	617.49	21.65	21.65	21.65	.1	.3

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 173.75

INPUT

Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
414.55	40	537.01	40	576.26	38	680	36	754.45	34
849.38	32.61	890.87	32	995.37	30	999.38	30	1015.17	30
1118.27	32	1149.38	32.72	1204.66	34	1504.92	36	1596.62	38
1739.42	40	1839.74	40						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
414.55	.1	849.38	.045	1149.38	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
849.38	1149.38	41.2	41.2	41.2	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
414.55	950	36	F
1050	1839.74	36	F

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 173.25

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
425.74	38	487.42	38	648.31	36	806.7	34	851.22	33.49
979.96	32	994.59	30	1001.22	30	1013.6	30	1028.39	32
1151.22	33.24	1225.77	34	1495.36	36	1729.13	38	1840.73	38

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
425.74	.1	851.22	.045	1151.22	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
851.22	1151.22	67.79	67.79	67.79	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
425.74	950	36	F
1050	1840.73	36	F

CROSS SECTION

RIVER: Murray Swamp

REACH: Main RS: 173

INPUT
Description:
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	40	33.36	40	58.94	38	98.24	36	160.26	34
187.12	33.35	242.47	32	308.45	31.18	403.72	30	414.25	30
435.72	30	458.45	30.19	608.45	31.43	676.6	32	728.72	32.77
811.31	34	851.85	36	978.42	38	1010.87	38.23	1263.88	40
1293.91	40								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	308.45	.045	608.45	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
308.45	608.45	433.89	433.89	433.89	.1	.3

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 168

INPUT
Description:
Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	40	16.64	40	172.01	38	276.33	36	356.33	34
376.83	34	395.73	34	428.43	33.01	437.15	32.75	461.86	32
497.33	30.71	516.9	30	624.04	30	647.33	30	773.69	30
797.33	30.66	845.33	32	902.26	34	1028.77	36	1079.42	38
1160.19	40	1196.74	40						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	497.33	.045	797.33	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
497.33	797.33	549.67	549.67	549.67	.1	.3

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 161

INPUT
Description:
Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	38	34.81	38	101.9	36	174.29	34	219.67	32
221.41	31.93	237.79	31.25	248.86	30.8	268.28	30	313.8	29.19
365	28.28	380.82	28	404.92	28	427.31	28	463.8	28.45
590.31	30	613.8	30.7	650.75	31.79	657.97	32	686.06	34
732.52	36	854.64	36						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	313.8	.045	613.8	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
313.8	613.8	397.97	397.97	397.97	.1	.3

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 155

INPUT
Description:
Station Elevation Data num= 24

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	38	107.43	38	165.78	36	232.06	34	268.79	32
444.78	32	726.41	32	822.48	30.08	826.72	30	844.61	30
860.7	30	879.81	29.56	942.33	28.12	947.33	28	1029.81	28
1110.15	28	1179.81	28	1197.74	28	1236.38	30	1269.16	32
1291.47	34	1318.73	36	1365.4	38	1428.52	38		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	879.81	.045	1179.81	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
879.81	1179.81	385.99	385.99	385.99	.1	.3

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 150

INPUT
Description:

Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	38	60.13	38	110.19	36	171.61	34	262.38	32
576.29	32	691.46	32	821.25	30.08	826.54	30	890.94	28
939.87	27.44	1030.7	26.41	1066.7	26	1072.36	26	1086.14	26
1089.87	26.08	1180.45	28	1239.87	29.6	1254.55	30	1258.67	30.3
1281.76	32	1314.05	34	1356.34	36	1401.37	38	1522.9	38

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	939.87	.045	1239.87	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
939.87	1239.87	458.43	458.43	458.43	.1	.3

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 144

INPUT
Description:
Station Elevation Data num= 24

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	38	78.28	38	198.01	36	269.3	34	331.73	32
360.68	30	361.18	29.99	379.97	29.56	397.97	29.15	446.47	28.05
448.76	28	537.54	26	573.35	26	596.47	26	626.23	26
634.46	26	746.47	27.27	811.04	28	852.19	30	874.91	32
899.91	34	929.45	36	969.42	38	1001.25	38		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	446.47	.045	746.47	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
446.47	746.47	569.81	569.81	569.81	.1	.3

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 137

INPUT
Description:
Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	32	41.06	32	295.37	30	329.16	28.8	351.58	28
351.62	28	352.86	27.97	385.42	27.3	448.35	26	504.61	24
519.84	24	535.42	24	549.19	24	561.31	26	601.78	26.4
685.42	27.23	760.96	27.98	763.13	28	816.7	30	885.93	32
954.96	34	1011.87	34						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	385.42	.045	685.42	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
385.42	685.42	514.89	514.89	514.89	.1	.3

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 132

INPUT
Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	36	23.71	36	71.48	34	125.34	32	177.97	30
223.32	28	246.71	26.49	254.23	26	396.71	26	437.52	26
465.06	26	546.71	26	675.32	26	731.28	28	735.82	28.32
759.4	30	794.76	32	838.11	34	912.2	36	925.32	36

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	246.71	.045	546.71	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
246.71	546.71	601.92	601.92	601.92	.1	.3

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 126

INPUT
Description:
Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	28	121.64	28	135.88	27.63	161.75	26.96	198.77	26
293.45	26	443.45	26	470.33	26	472.55	26	537.64	26
593.45	26	704.11	26	743.54	27.07	777.91	28	832.76	30

```
  833.48   30.04  865.06      32 1025.62   33.21    1131      34 1176.42      36
 1189.52      36

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0      .1  293.45    .045  593.45      .1

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        293.45  593.45           144.38  144.38  144.38             .1       .3

CROSS SECTION


RIVER: Murray Swamp
REACH: Main               RS: 125

INPUT
Description:
Station Elevation Data    num=      21
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0      34   24.27      34   98.14      32  156.79      30     221      28
  233.05   27.02  245.72      26  299.48      24  326.77      24  471.41      24
  471.72      24  476.77      24  552.42      24  626.77      24  717.61      24
  763.13      26  791.33   26.69  844.83      28  864.19      30  901.84      32
  926.72      32

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0      .1  326.77    .045  626.77      .1

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        326.77  626.77            35.77   35.77   35.77             .1       .3

CROSS SECTION


RIVER: Murray Swamp
REACH: Main               RS: 124.5

INPUT
Description:
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
   42.32      30  129.98      30  267.02      28  289.52      26     350      26
  396.56      26  449.33      26  465.09      24     500      24  524.57      24
  540.38      26     650      26  685.86      26   736.2      26  783.88      28
  867.83      30  949.15      32  954.21      32
```

```
Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
   42.32      .1     350    .045     650      .1

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           350     650             41.3    41.3    41.3             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
   42.32  452.67      29       F
  542.96  954.21      29       F

BRIDGE


RIVER: Murray Swamp
REACH: Main               RS: 124

INPUT
Description:
Distance from Upstream XS =     5.7
Deck/Roadway Width        =    24.5
Weir Coefficient          =     2.6
Upstream  Deck/Roadway Coordinates
    num=       9
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
   42.44   30.02          383.29   29.06             460   29.03      24
     460   29.03    27.5     540   29.01    27.5     540   29.01      24
  752.95   30.02          966.58   32.09          967.23   32.09

Upstream Bridge Cross Section Data
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
   42.32      30  129.98      30  267.02      28  289.52      26     350      26
  396.56      26  449.33      26  465.09      24     500      24  524.57      24
  540.38      26     650      26  685.86      26   736.2      26  783.88      28
  867.83      30  949.15      32  954.21      32

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
   42.32      .1     350    .045     650      .1

Bank Sta: Left   Right    Coeff Contr.   Expan.
           350     650             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
   42.32  452.67      29       F
  542.96  954.21      29       F
```

```
Downstream  Deck/Roadway Coordinates
    num=       9
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
   42.62   30.02          383.47   29.06             460   29.03      24
     460   29.03    27.5     540   29.01    27.5     540   29.01      24
  753.13   30.02          966.76   32.09          967.41   32.09

Downstream Bridge Cross Section Data
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
   57.27      28  238.98      28  350.17   26.99  458.59      26  478.46      24
  500.17      24  528.29      24  540.82      26  560.73      28  650.17   28.71
  813.08      30  967.28      30

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
   57.27      .1  350.17    .045  650.17      .1

Bank Sta: Left   Right    Coeff Contr.   Expan.
        350.17  650.17             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
   57.27  454.96      29       F
  542.96  967.28      29       F

Upstream Embankment side slope              =       3 horiz. to 1.0 vertical
Downstream Embankment side slope            =       3 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
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 =  3

Pier Data
Pier Station     Upstream=     475    Downstream=     475
Upstream     num=       2
    Width   Elev    Width   Elev
     2.5      24     2.5    27.5
Downstream     num=       2
    Width   Elev    Width   Elev
     2.5      24     2.5    27.5

Pier Data
Pier Station     Upstream=     500    Downstream=     500
Upstream     num=       2
    Width   Elev    Width   Elev
```

```
     2.5      24     2.5    27.5
Downstream     num=       2
    Width   Elev    Width   Elev
     2.5      24     2.5    27.5

Pier Data
Pier Station     Upstream=     525    Downstream=     525
Upstream     num=       2
    Width   Elev    Width   Elev
     2.5      24     2.5    27.5
Downstream     num=       2
    Width   Elev    Width   Elev
     2.5      24     2.5    27.5

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

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 energy grade line

CROSS SECTION


RIVER: Murray Swamp
REACH: Main               RS: 123.5

INPUT
Description:
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
   57.27      28  238.98      28  350.17   26.99  458.59      26  478.46      24
  500.17      24  528.29      24  540.82      26  560.73      28  650.17   28.71
  813.08      30  967.28      30

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
   57.27      .1  350.17    .045  650.17      .1
```

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
350.17	650.17	46.4	46.4	46.4	.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
57.27	454.96	29	F
542.96	967.28	29	F

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 123

INPUT
Description:
Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	28	100	28	145.95	26.4	157.37	26	207.25	24
268.64	24	418.64	24	432.43	24	436.82	24	458.15	24
568.64	24	623.33	24	654.09	26	658.51	26.33	680.8	28
712.71	30	748.98	32	850.02	34	895.42	36	908.18	36

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	268.64	.045	568.64	.1

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
268.64	568.64	210.1	210.1	210.1	.1	.3

CROSS SECTION

RIVER: Murray Swamp
REACH: Main RS: 121

INPUT
Description:
Station Elevation Data num= 24

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	30	67.12	30	154.05	28	256.26	26.04	257.98	26.01
258.61	26	259.95	25.94	263.65	25.79	307.16	24	396.84	24
518.8	24	525.2	24	546.84	24	625.12	24	696.84	24
716.48	24	759.78	25.78	762.23	25.88	765.05	26	765.85	26.05
800.38	28	843.49	30	966.12	32	982.55	32		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.1	396.84	.045	696.84	.1

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        396.84  696.84           605.27  605.27  605.27             .1       .3

CROSS SECTION


RIVER: Murray Swamp
REACH: Main               RS: 115

INPUT
Description:
Station Elevation Data    num=      22
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0      32   41.77      32  123.56      30  227.74      28  253.69      26
   269.3   25.55  292.03   24.89  322.62      24  563.08   22.55   636.2   22.11
  654.26      22  681.67      22  713.08    22.3  863.08   23.75  888.88      24
  893.64   24.37  904.06   25.19  914.43      26  947.64      28 1097.53      30
 1249.73      32 1276.41      32

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0      .1  563.08    .045  863.08      .1

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        563.08  863.08            564.1   564.1   564.1             .1       .3

CROSS SECTION


RIVER: Murray Swamp
REACH: Main               RS: 109

INPUT
Description:
Station Elevation Data    num=      22
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0      30   48.03      30   209.7      28  399.05      26  510.87      24
  731.51      22  752.98      22  786.35      22  807.31      22  808.12      22
  833.11      22  902.98      22 1047.06      22 1052.98    22.5 1070.75      24
 1079.57    24.7 1096.03      26 1118.36   27.16 1134.54      28 1247.87      30
 1373.69      32 1437.09      32

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0      .1  752.98    .045 1052.98      .1

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
```

752.98 1052.98 0 0 0 .1 .3

SUMMARY OF MANNING'S N VALUES

River:Murray Swamp

Reach	River Sta.	n1	n2	n3
Main	184	.1	.045	.1
Main	179	.1	.045	.1
Main	174	.1	.045	.1
Main	173.75	.1	.045	.1
Main	173.25	.1	.045	.1
Main	173	.1	.045	.1
Main	168	.1	.045	.1
Main	161	.1	.045	.1
Main	155	.1	.045	.1
Main	150	.1	.045	.1
Main	144	.1	.045	.1
Main	137	.1	.045	.1
Main	132	.1	.045	.1
Main	126	.1	.045	.1
Main	125	.1	.045	.1
Main	124.5	.1	.045	.1
Main	124	Bridge		
Main	123.5	.1	.045	.1
Main	123	.1	.045	.1
Main	121	.1	.045	.1
Main	115	.1	.045	.1
Main	109	.1	.045	.1

SUMMARY OF REACH LENGTHS

River: Murray Swamp

Reach	River Sta.	Left	Channel	Right
Main	184	428.09	428.09	428.09
Main	179	276.38	276.38	276.38
Main	174	21.65	21.65	21.65
Main	173.75	41.2	41.2	41.2
Main	173.25	67.79	67.79	67.79
Main	173	433.89	433.89	433.89

Main	168	549.67	549.67	549.67
Main	161	397.97	397.97	397.97
Main	155	385.99	385.99	385.99
Main	150	458.43	458.43	458.43
Main	144	569.81	569.81	569.81
Main	137	514.89	514.89	514.89
Main	132	601.92	601.92	601.92
Main	126	144.38	144.38	144.38
Main	125	35.77	35.77	35.77
Main	124.5	41.3	41.3	41.3
Main	124	Bridge		
Main	123.5	46.4	46.4	46.4
Main	123	210.1	210.1	210.1
Main	121	605.27	605.27	605.27
Main	115	564.1	564.1	564.1
Main	109	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Murray Swamp

Reach	River Sta.	Contr.	Expan.
Main	184	.1	.3
Main	179	.1	.3
Main	174	.1	.3
Main	173.75	.1	.3
Main	173.25	.1	.3
Main	173	.1	.3
Main	168	.1	.3
Main	161	.1	.3
Main	155	.1	.3
Main	150	.1	.3
Main	144	.1	.3
Main	137	.1	.3
Main	132	.1	.3
Main	126	.1	.3
Main	125	.1	.3
Main	124.5	.1	.3
Main	124	Bridge	
Main	123.5	.1	.3
Main	123	.1	.3
Main	121	.1	.3
Main	115	.1	.3
Main	109	.1	.3