State of California
The Resources Agency
Department of Water Resources
Division of Engineering

NORTH OF DELTA

OFFSTREAM STORAGE INVESTIGATIONS

SITES RESERVOIR

INUNDATION ANALYSIS

June 2005

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North of Delta
Offstream Storage Investigations

SITES RESERVOIR
INUNDATION ANALYSIS

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The Resources Agency
Department of Water Resources
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ENGINEERING CERTIFICATION

This report has been prepared under my direction as the professional engineer in direct responsible charge of the work, in accordance with the provisions of the Professional Engineer's Act of the State of California.

_____
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Registration No. 55261

Date:_____

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1. INTRODUCTION

At the request of the Division of Planning and Local Assistance (DPLA), the Division of Engineering (DOE) conducted separate studies simulating the catastrophic failures of Golden Gate Dam and Sites Dam on the Sites Reservoir. The purpose of the studies was to provide DPLA with maps depicting the area around Sites Reservoir subject to flooding.

2. PROJECT LOCATION

The proposed Sites Reservoir is located in north-central Colusa County and south-central Glenn County, approximately 10 miles west of the town of Maxwell. A vicinity map of the proposed Sites Reservoir is shown in Figure 1.

The Sites Reservoir watershed is located between the mountainous portion of the Coast Range foothills to the west and the Sacramento Valley to the east. The Coast Range Mountains are a series of rugged, north-south tending ridges dissected by narrow canyons containing steep gradients, and entrenched streams. A 3-mile-wide band of steep rolling foothill separates the proposed reservoir area from the Sacramento Valley. Elevation of the Sites Reservoir area ranges from 230 feet above mean sea level, while the foothills reach elevations above 2,000 feet.

3. PROJECT DESCRIPTION

The proposed Sites Reservoir will be impounded by Golden Gate Dam on Funks Creek, Sites Dam on Stone Corral Creek, and nine saddle dams on the northern end of the reservoir between the Funks Creeks and Hunters Creek watersheds. A project area map of the dams is shown on Figure 2. The reservoir currently under investigation has a storage capacity of 1.8 MAF, a maximum water surface elevation of 520 feet, and an inundation area of 14,000 acres. Figure 3 presents the area-capacity curve for Sites Reservoir.

Golden Gate Dam, Sites Dam, and the nine saddle dams will be designed to have crest elevations of 540 feet. Emergency draw down capability is through a pipeline bypassing the pumping plant that will provide an average outflow release of 21,400 cfs. A secondary emergency outlet consists of anywhere between two and seven 9-foot-diameter pipes located in the abutment of saddle dam No. 4. The pipe inverts are at Elevation 522 feet, 2 feet above maximum normal pool.

Sites Reservoir will serve as an offstream storage facility since the reservoir will receive very little natural runoff from its own small watershed (approximately 83 square miles).

The reservoir will be filled predominantly by diversions directly or indirectly from the Sacramento River using existing, enlarged, or new conveyances.

Additional information on the reservoir and its operation may be found in “North of the Delta Offstream Storage Investigation, Sites Reservoir Feasibility Study – Pumping Plants and Appurtenant Structures ” (DWR , July 2002).

4. SCOPE OF WORK

The work performed consisted of using three proprietary computer programs, BOSS BREACH (v1.1), BOSS DAMBRK (v3.0), and HEC-RAS (v3.01), on Golden Gate and Sites Dam to simulate a dam breach, route the resulting flood downstream and establish inundation boundaries to the Sacramento River. Impacts to the Sacramento River levees and areas downstream or east of the river were not included in this study. The limits of inundation due to the failure of Golden Gate Dam and Sites Dam were derived using guidelines outlined in the “General Criteria for Preparation of Inundation Maps” set by the Federal Energy Regulatory Commission (FERC). (See Appendix A).

5. BREACH ANALYSIS

BOSS BREACH simulates the breaching of an earthen dam by either overtopping or piping failure. An overtopping breach forms at the crest of the dam and erodes downward to the foundation. A piping breach forms a passage within the dam which increases in size until the material above or below the breach collapses. The final shape of each breach is governed by the FERC guidelines and by the potential of erosion through the embankments and foundation.

The failure mode used for this analysis was a catastrophic piping breach. Overtopping was eliminated as a failure mode as the storage in the proposed Sites Reservoir flood pool between Elevation 540 to El. 520 is 289,400 acre-feet, almost 3.7 times greater than the probable maximal flood estimated inflow volume.

Dam breach characteristics, such as time of formation, size, and shape of the breach are predicted by BOSS BREACH as well as the outflow hydrograph. Geometric properties of the embankment dam’s inner core and outer shell were found in “North of the Delta Offstream Storage Investigation, Sites Reservoir Feasibility Study – Golden Gate, Sites, and Saddle Dams” (DWR , July 2002). Embankment material properties, such as grain size of the inner and outer core, internal friction angles, porosity ratios, unit weights, and the cohesive strengths, were obtained from “North of the Delta Offstream Storage Investigation, Sites Reservoir Feasibility Study – Material Investigation, Testing, and Evaluation Program ” (DWR, June 2002). Parameters selected by the engineer include initial piping failure elevation and width, Manning

values of inner and outer cores and the vegetative cover on the downstream face of the dam. The input parameters used in the breach analysis are shown in Appendix B.

BOSS BREACH simulates an embankment failure in order to generate an outflow hydrograph to be used as the inflow hydrograph for the BOSS DAMBRK flood routing. Although BOSS DAMBRK is capable of predicting breach outflow hydrographs, BOSS BREACH was used since the software was specifically developed to model dam breach failures. The BOSS BREACH peak outflow (peak inflow for BOSS DAMBRK) is estimated at 4,812,000 cfs for Golden Gate Dam and 3,776,000 cfs for Sites Dam (See Appendix B).

6. INUNDATION ANALYSIS

Two programs, BOSS DAMBRK and HEC-RAS, were utilized to route the flow downstream from the dam breach. Because BOSS DAMBRK cannot model split flows accurately, HEC-RAS was considered more accurate for this analysis.

Flood path cross sections for BOSS DAMBRK and HEC-RAS were developed using electronic USGS 7.5 minute quadrangle maps. The basic channel Manning's roughness coefficients for the study were determined by field observations.

BOSS DAMBRK was used to model the flow through the narrow canyons of the Coast Range foothills. The program allows the user to input cross-sections for a single channel into the program using channel widths and elevations of adjacent cross sections to get an equivalent three-dimensional model. The BOSS DAMBRK model determines water surface profile, flow rates, flood wave arrival times, and peak flow arrival times for the downstream cross sections. BOSS DAMBRK output files and graphic plots for the piping breach are included for reference in Appendices C and D.

HEC-RAS was utilized after the water entered the Sacramento Valley. The program is used for steady, gradually varied flows to determine water surface profiles for river systems. Cross sections for both the Golden Gate Dam and Sites Dam breaches were used in the Sacramento Valley HEC-RAS analyses. The ouflow from each subsequent breach was used for each inundation plot. The arrival times are not computed in HEC-RAS. Therefore, average velocity rates were used to determine arrival times for the Sacramento Valley. HEC-RAS output files and graphic plots for the piping breach are included for reference in Appendices E and F.

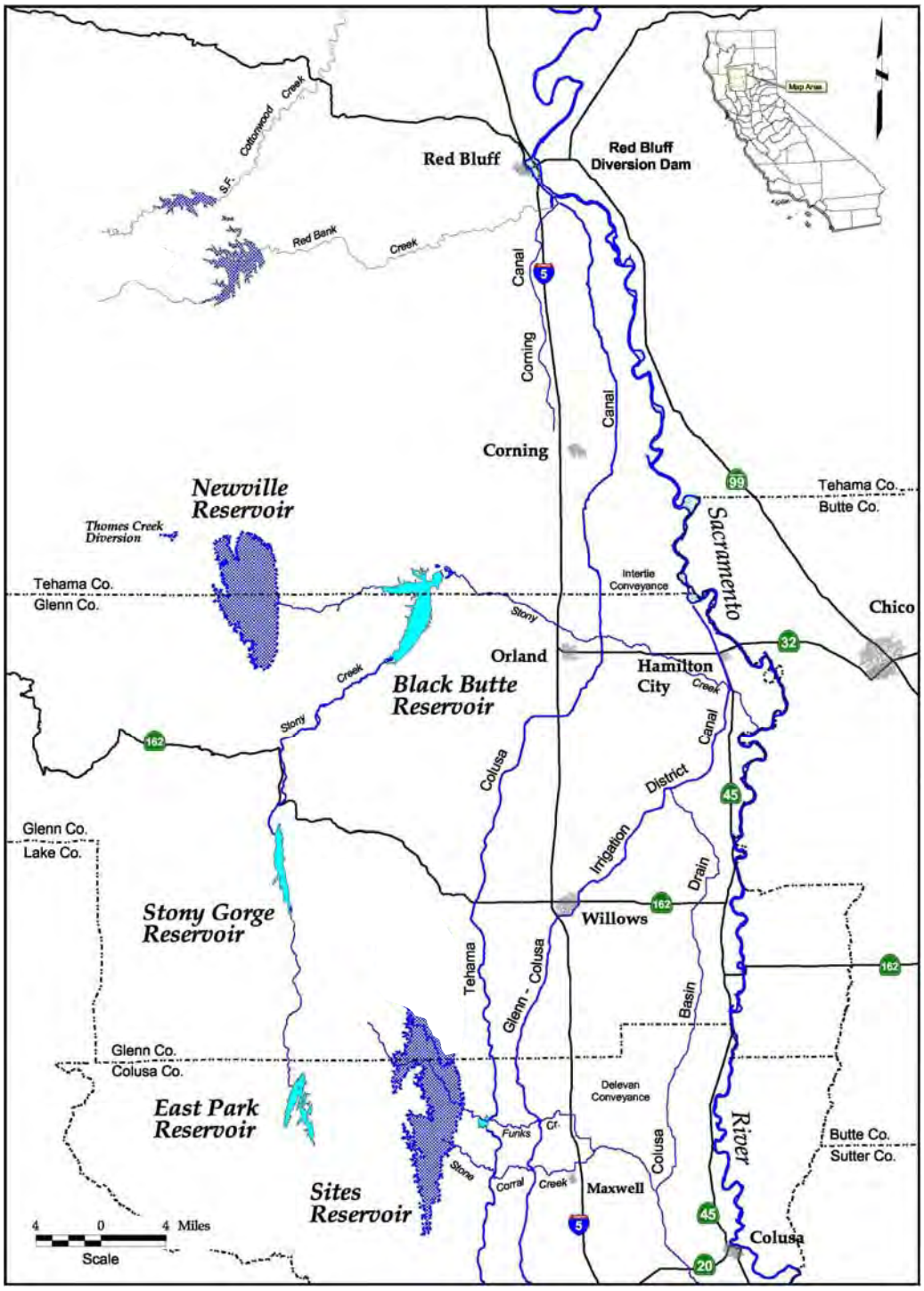
Table 1 shows a summary of depths, and arrival times of the flood wave at the cross-sections below Golden Gate Dam and Sites Dam. The peak outflow from the BOSS DAMBRK outflow analysis of Golden Gate Dam and Sites Dam is estimated at 1,636,000 cfs and 2,078,000 cfs, respectively. See Appendix C for the BOSS DAMBRK output files.

The area subject to flooding due to a breach in Golden Gate Dam is shown in Figures 4a and 4b. The area subject to flooding due to a breach in Sites Dam is shown in Figures 5a and 5b. The flow characteristics including velocity, wave arrival times, maximum flow depth, and time of peak flow are shown on the inundation maps. The maps show the dam break flood limits approximately 20 miles downstream from Sites Reservoir to the Sacramento River.

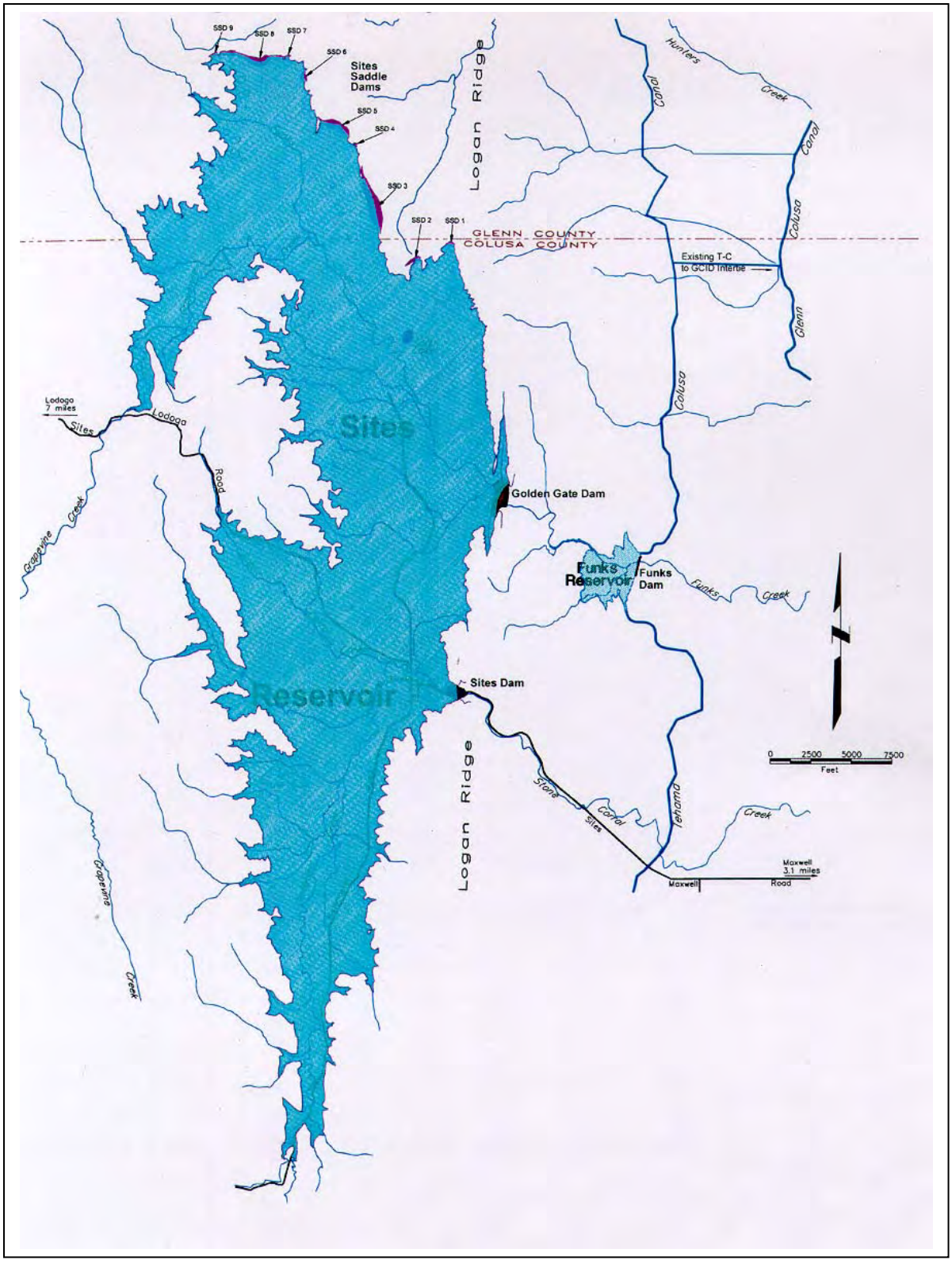
7. CONCLUSIONS

The flood wave resulting from a hypothetical breach of Golden Gate Dam or Sites Dam would present a significant hazard to both occupied and non-occupied structures downstream of Sites Reservoir. The peak outflow from a breach of the Sites Reservoir is estimated at 2,078,000 cfs. As shown on the inundation maps (Figures 4a, 4b, 5a, and 5b), the flood wave would travel east following the natural streambeds and would fan out to the relatively flat terrain of the Sacramento Valley before reaching the City of Maxwell and Interstate 5. The estimated flow velocity at Maxwell and Interstate 5 is 4.5 feet/second and the maximum depth is 10 feet. The flood wave then continues approximately 13 miles east to the city of Colusa and the Sacramento River. The flood wave would then be impeded by the west levee of the Sacramento River. The flood would reach a depth of 22 feet (upslope of the Sacramento River levee).

8. FIGURES



Sites Reservoir Vicinity Map
Figure 1



Site Reservoir Project Area Map

From: North of the Delta Offstream Storage Investigation
Progress Report, DWR, Draft, July 2000

FIGURE 2

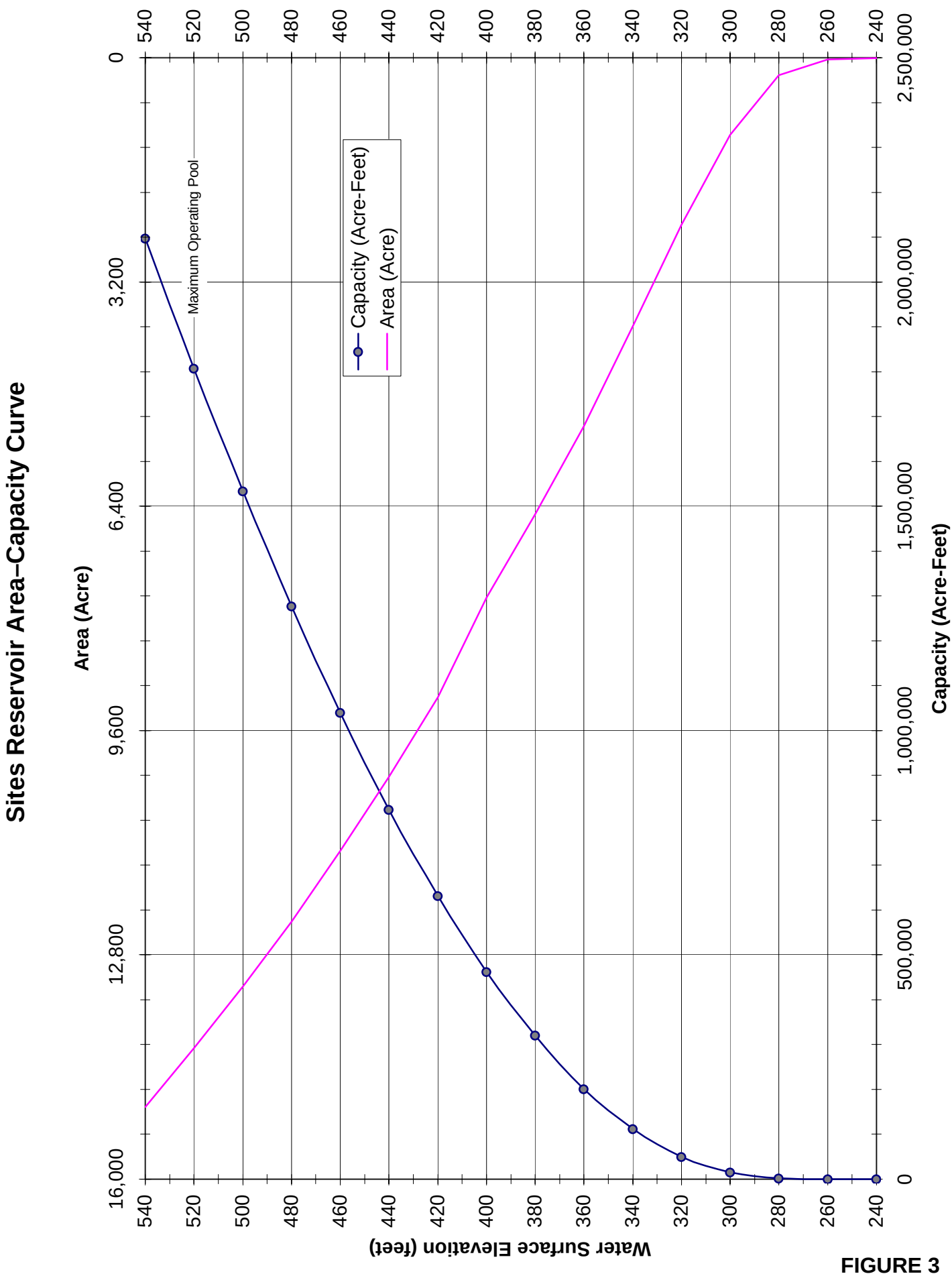
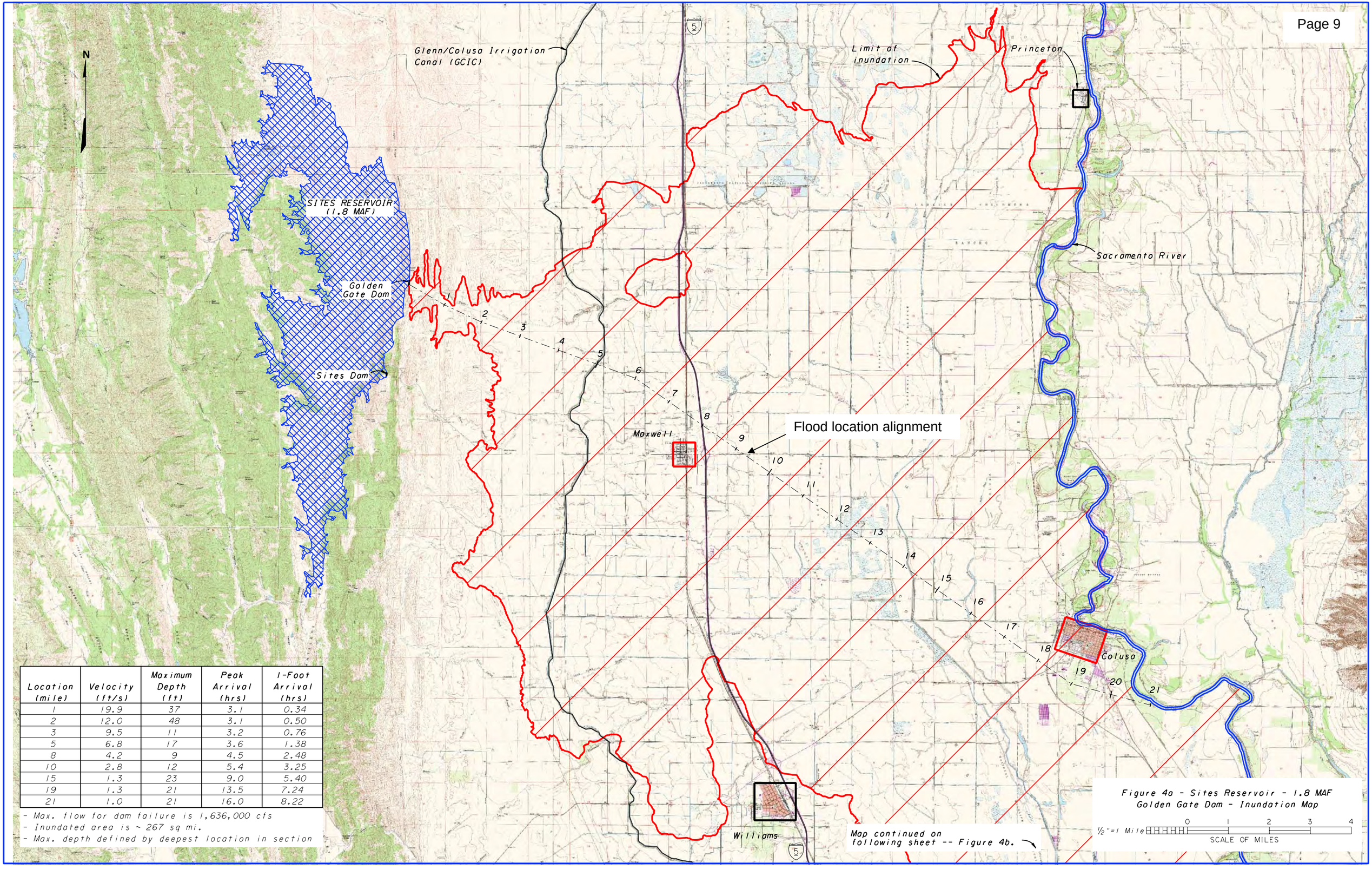

Sites Reservoir Area–Capacity Curve
Area (Acre)
Capacity (Acre-Feet)
Water Surface Elevation (feet)
Maximum Operating Pool
Capacity (Acre-Feet)
Area (Acre)
0
3,200
6,400
9,600
12,800
16,000
0
500,000
1,000,000
1,500,000
2,000,000
2,500,000
540
520
500
480
460
440
420
400
380
360
340
320
300
280
260
240

FIGURE 3



Location (mile)	Velocity (ft/s)	Maximum Depth (ft)	Peak Arrival (hrs)	1-Foot Arrival (hrs)
1	19.9	37	3.1	0.34
2	12.0	48	3.1	0.50
3	9.5	11	3.2	0.76
5	6.8	17	3.6	1.38
8	4.2	9	4.5	2.48
10	2.8	12	5.4	3.25
15	1.3	23	9.0	5.40
19	1.3	21	13.5	7.24
21	1.0	21	16.0	8.22

- Max. flow for dam failure is 1,636,000 cfs
- Inundated area is ~ 267 sq mi.
- Max. depth defined by deepest location in section

Figure 4a - Sites Reservoir - 1.8 MAF
Golden Gate Dam - Inundation Map

½"=1 Mile
0 1 2 3 4
SCALE OF MILES

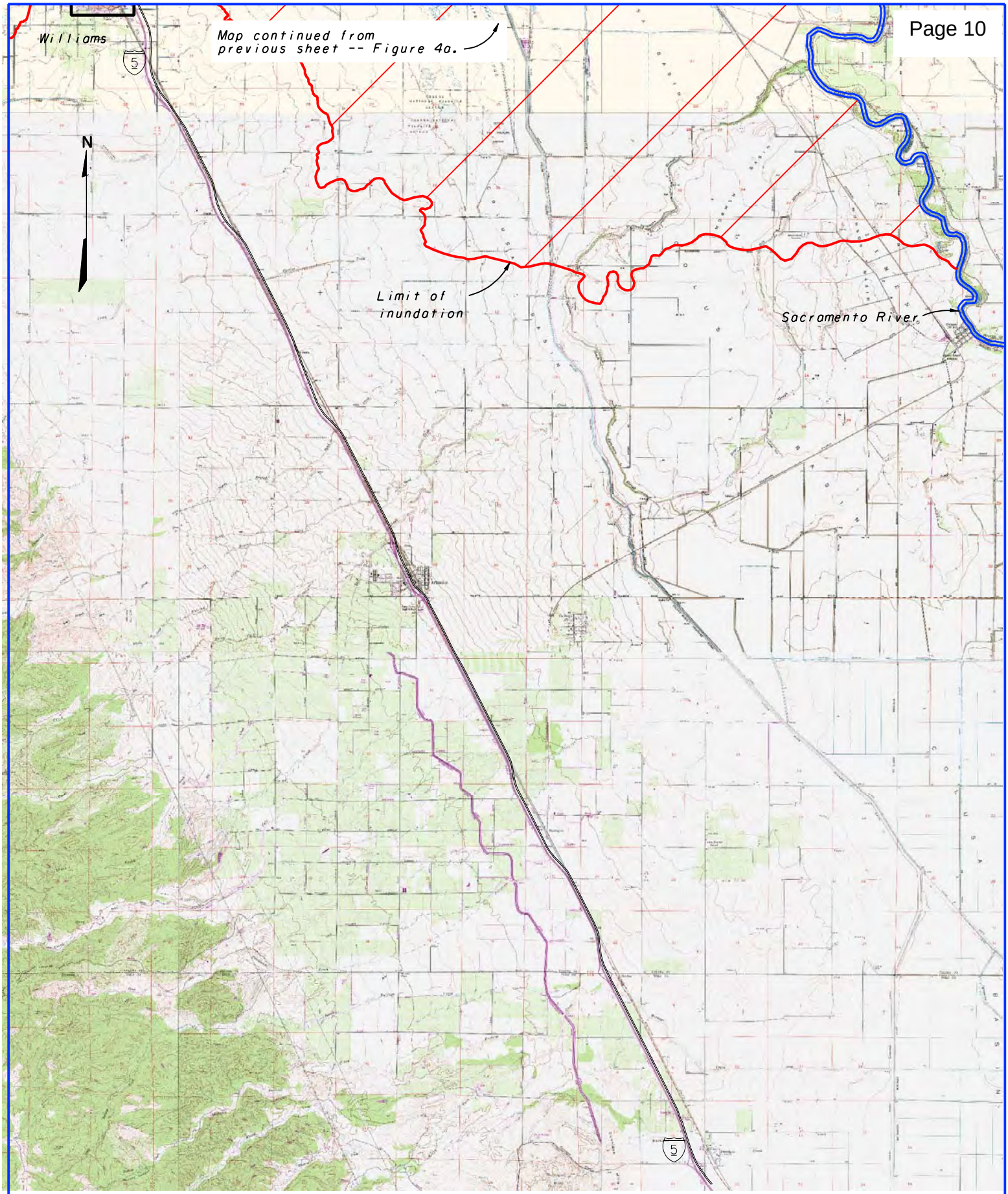
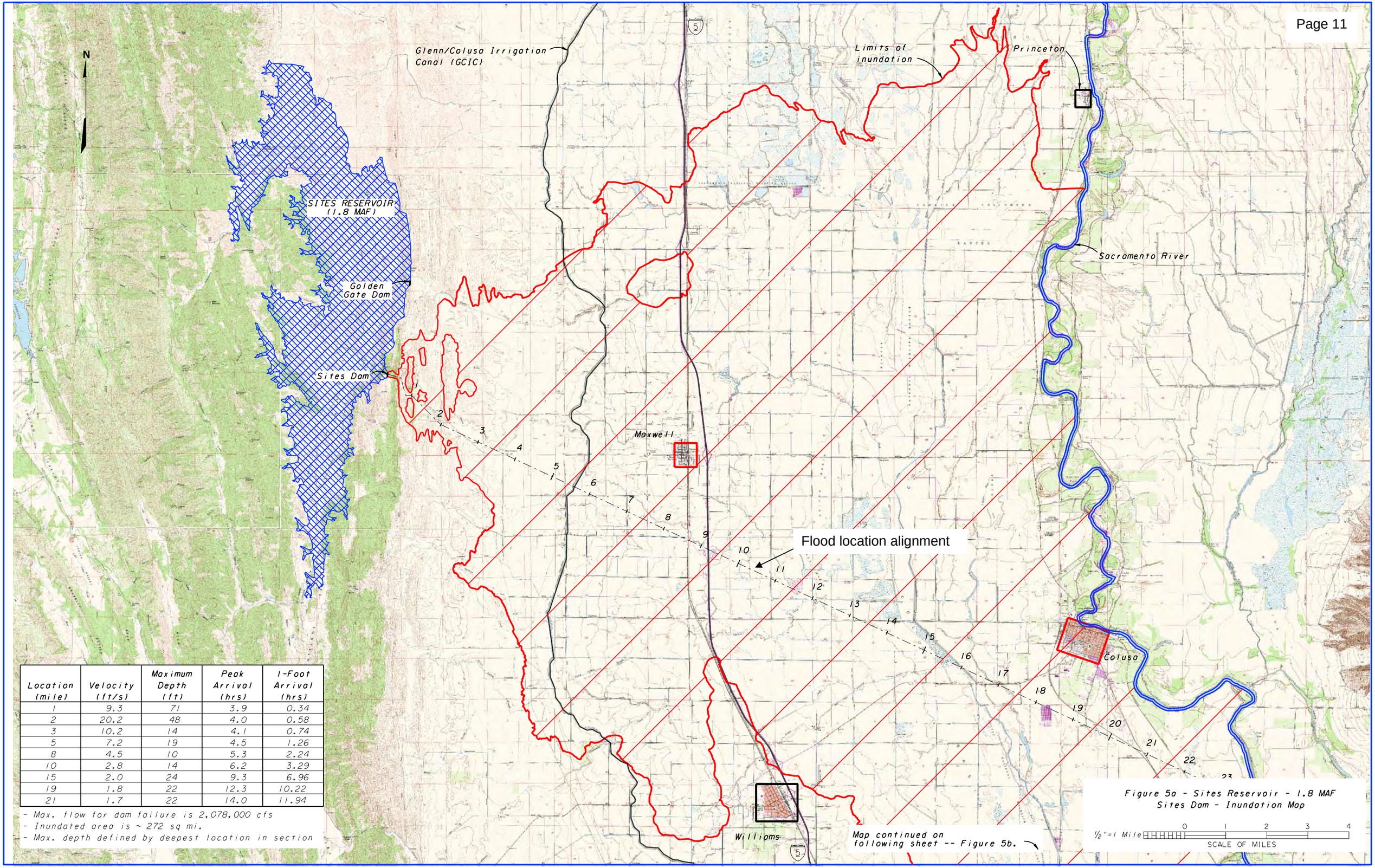


Figure 4b - Sites Reservoir - 1.8 MAF
Golden Gate Dam - Inundation Map

½"=1 Mile
0 1 2 3 4
SCALE OF MILES



Location (mile)	Velocity (ft/s)	Maximum Depth (ft)	Peak Arrival (hrs)	1-Foot Arrival (hrs)
1	9.3	71	3.9	0.34
2	20.2	48	4.0	0.58
3	10.2	14	4.1	0.74
5	7.2	19	4.5	1.26
8	4.5	10	5.3	2.24
10	2.8	14	6.2	3.29
15	2.0	24	9.3	6.96
19	1.8	22	12.3	10.22
21	1.7	22	14.0	11.94

- Max. flow for dam failure is 2,078,000 cfs
- Inundated area is ~ 272 sq mi.
- Max. depth defined by deepest location in section

Figure 5a - Sites Reservoir - 1.8 MAF
Sites Dam - Inundation Map

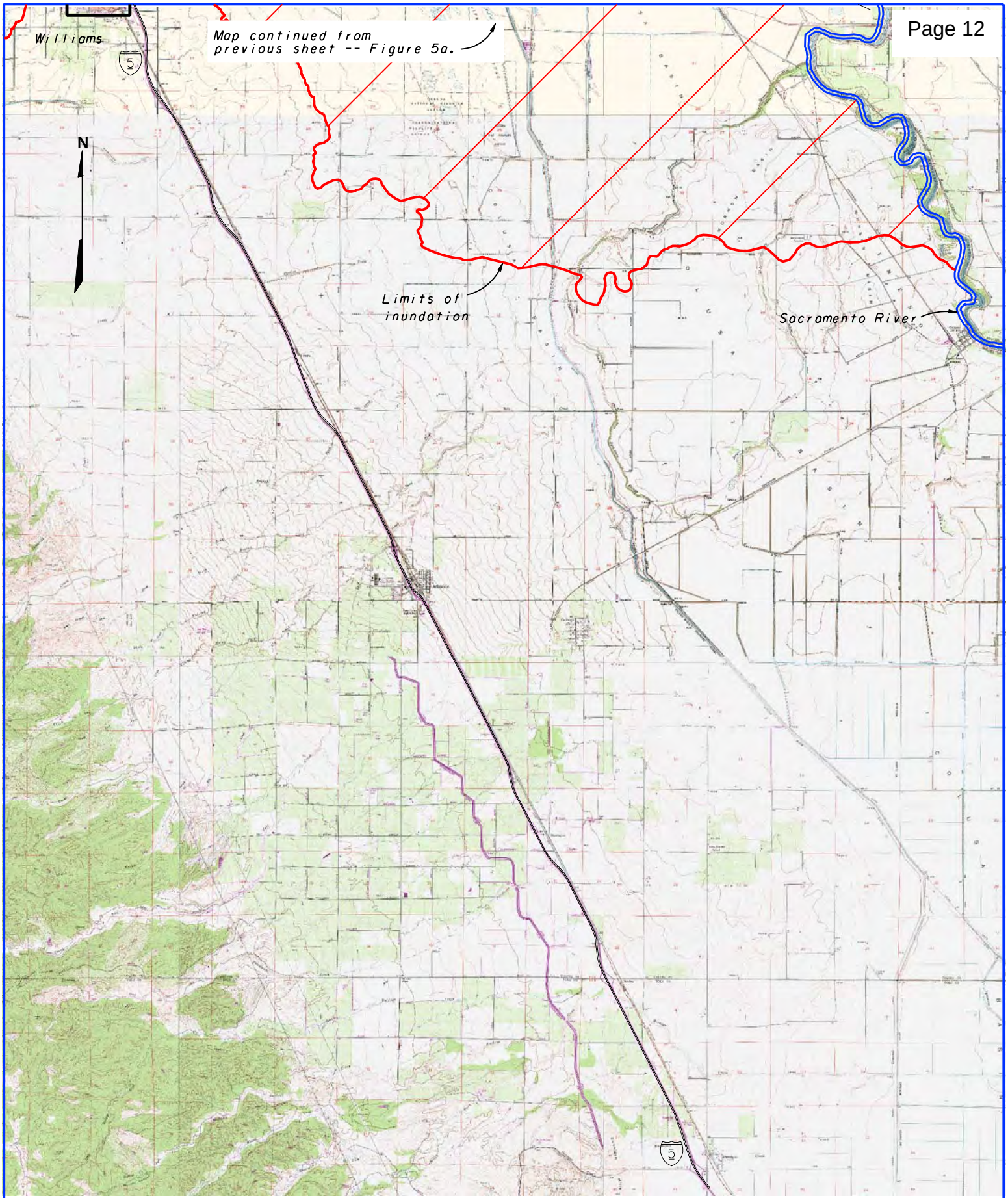


Figure 5b - Sites Reservoir - 1.8 MAF
Sites Dam - Inundation Map

½"=1 Mile
0 1 2 3 4
SCALE OF MILES

9. TABLE

Table 1 – Flood Wave Summary for DAMBRK and HEC-RAS Model Cross-Sections

Cross-Section Locations Mile	Peak Depth (ft)[a]	Peak Flow Arrival Time (hrs)	1-Foot Depth Arrival Time (hrs)
Golden Gate Dam[b]			
0.00	-	-	-
0.18	72	3.0	0.05
0.46	50	3.1	0.12
0.70	44	3.0	0.25
1.07	37	3.1	0.34
1.55	44	3.1	0.43
1.95	48	3.1	0.50
2.41	44	3.1	0.60
2.78	28	3.1	0.70
3.00	11	3.2	0.76
5.00	17	3.6	1.38
8.00	9	4.5	2.48
10.00	12	5.4	3.25
15.00	23	11.0	5.40
19.00	21	15.5	7.24
21.00	21	18.5	8.22
Sites Dam[c]			
0.00	-	-	-
0.24	178	3.9	0.10
0.62	42	3.9	0.22
1.00	71	3.9	0.34
1.45	44	3.9	0.46
1.94	48	4.0	0.58
2.37	37	4.0	0.70
3.32	24	4.1	0.82
3.40	12	4.0	0.94
5.00	19	4.5	1.26
8.00	10	5.3	2.24
10.00	14	6.2	3.29
15.00	24	9.9	6.96
19.00	22	13.1	10.22
21.00	22	14.8	11.94

Note:

a. Maximum depth defined by deepest location in section.

b. Max outflow from Golden Gate Dam failure is 1,636,000 cfs.

c. Max outflow from Sites Dam failure is 2,078,000 cfs.

10. APPENDICES

APPENDIX A

General Criteria for Preparation of Inundation Maps

INTRODUCTION

Maps of the potential flood areas below State Water Project dams were prepared in 1974 and 1975, in compliance with Senate Bill No. 896. Revised inundation maps have been prepared for the Department's dams in accordance with the criteria set forth in the Engineering Guidelines for the Evaluation of Hydropower Projects, Chapter VI - Emergency Action Plans issued by the Federal Energy Regulatory Commission (FERC) in November 1998.

FERC criteria are somewhat different from those used in 1974 and 1975, in that they characterize final breach size and time to dam failure instead of initial breach size and rate of erosion. Flood flow characteristics are to be shown on the inundation maps for critical locations.

As each dam-reservoir-stream system has its own characteristics, sometimes far different than the others, the general criteria presented herein may be modified to suit individual situations.

DAM FAILURE MECHANISM AND RESERVOIR OUTFLOW HYDROGRAPH

There are various factors that have caused dams to fail. Overtopping failures have been caused by spillways (especially their gates) not performing as designed, by the design flood being exceeded, and by slumping of the dam. Piping failures have been caused by concentrated leaks through the dam, and by piping along the foundation. Earthquake motions can cause cracking and lead to piping failures.

Conditions to be assumed at the dam, immediately prior to a hypothetical piping failure, are as follows:

1. The reservoir stage is at the maximum operating level.

2. The maximum downstream powerplant stream release is being made at the dam and is flowing down the watercourse.

3. Project water and stream inflow up to the inflow design flood (IDF) must be considered as flow into the reservoir and should be included in the flood routing of the dam reservoir stream system.

Concrete Gravity Dam Failure Mode

Time to failure of concrete dams is assumed to be between one tenth and three tenths of an hour, depending on the height of the dam and the reservoir size. The average breach width is less than or equal to one-half the crest length, and the breach is assumed to have vertical side slopes. The reservoir is routed through the breach resulting in an inflow hydrograph to the stream or floodplain below the dam.

Earth Dam Failure Mode

Earth dam failure generally involves piping or overtopping. Piping may develop from internal erosion or transverse cracking. Overtopping may be caused by slumping, abutment slides, or inadequate spillway capacity. Either type of failure can be approximated by a small initial breach enlarging to a specified final size in a specified amount of time.

The general criteria for the estimation of hydrographs through breached earth dams are as follows:

1. A very small initial breach is used at the dam crest for overtopping failures, and at any specified elevation below the water surface for piping failures.

2. The average final breach width is between one and five times the height of the dam (H_D), but usually between $2H_D$ and $4H_D$ depending on the height of the dam, the types of soils in the dam, and the reservoir size.

3. The breach develops by erosion as reservoir waters pass through. Time to failure of earth dams is generally between one tenth of an hour and one hour, depending on the height of the dam, the types of soils in the dam, and the reservoir size.

4. Breach side slopes are assumed to be between ¼:1 and 1:1 for overtopping failures, and 0:1 (vertical) for piping failures.

5. The reservoir is routed through a variable size breach, resulting in an inflow hydrograph to the stream or flood plain below the dam.

FLOOD ROUTING

The flood from the breach dam is to be routed through the downstream watercourse, taking stream storage into account, until the potential for loss of life and significant property damage appears limited. This point could occur when:

1. There is no habitable structures and future development is limited, or

2. The flood flows reach a body of water capable of containing its entire volume, or

3. The flood flows reach a bay or ocean, or

4. The flood flows stay entirely within the limits of the normal waterway channel.

Inundation limits can be based on the normal flow depth of peak discharge in well defined channels of low storage, and routing of the flood through valleys and basins containing substantial storage or having flow constrictions at their outlets.

The recommended method for a dam break analysis is the unsteady flow and dynamic routing method used in the national weather service dambreak model. Routing of the floods, in general, should be accomplished using the Manning equation or an equivalent relationship. Manning 'n' values will generally vary between 0.03 and 0.08. Values for various portions of individual watercourses should be determined from field evaluations and utilized in the model.

Limits of flooding are difficult to determine in broad, flat valleys or in deltas near the entrance to waterbodies (ground contours become essentially perpendicular to flow lines). Inundation limits must envelop all reasonable possible flow routes.

MISCELLANEOUS CONSIDERATIONS

Many factors outside of the assumptions and procedures presented above will affect the limits of flooding caused by a dam failure. The more significant factors which must be taken into account in establishment of inundation lines are as follows:

Downstream Dams on Tributary Systems

Failure or no failure of dams downstream in the path of floods must be determined based on the type of dam, degree of overtopping, or other factors relevant to this judgement. The state of the downstream reservoir is assumed to be at the maximum normal operating level. If failure occurs, the storage must be added to overtopping and on the general criteria listed above. If no failure is judged to occur, the flood is routed through the reservoir.

Dams on tributary streams could reasonably be assumed to fail if waters inundate their downstream toes to such a degree that damaging erosion could take place. Location of

the dam, embankment materials, and degree of inundation must be considered in this judgement.

Flood Momentum

Where necessary, limits of inundation must be expanded to account for the momentum of floodwaters as changes in direction of the watercourse are encountered.

Dams with Substantial Length and Saddle Dams

Situations can arise where the dam has sufficient length to yield different inundated areas depending on the assumed location of the initial breach. The inundation limits must envelope the flooded area resulting from breaching at all locations.

Saddle dams, or auxiliary dams, on any reservoir must be given the same treatment as a main dam; i.e. separate breaching and flood mapping studies must be performed in accordance with the criteria presented above.

Map Requirements

Inundation maps must conform to the requirements for mapping established in the guidelines. The inundation maps must clearly indicate the areas subject to flooding. The maximum elevation, increase in water surface elevation (maximum depth), peak discharge, the arrival time of the leading edge of the flood wave, and the arrival time of the peak of the flood wave should be shown on the map at critical locations.

APPENDIX B

BOSS BREACH Output Files

Golden Gate Dam

- Cross-Section Plots at 0 to 2.78 miles
- Breach Analysis, 16 pages
- BOSS BREACH Outflow Hydrograph

Sites Dam

- Cross-Section Plots at 0 to 3.4 miles
- Breach Analysis, 18 pages
- BOSS BREACH Outflow Hydrograph

APPENDIX C

BOSS DAMDRK Output Files

On CD-ROM

APPENDIX D

BOSS DAMBRK Graphic Plots

APPENDIX E

HEC-RAS Output Files

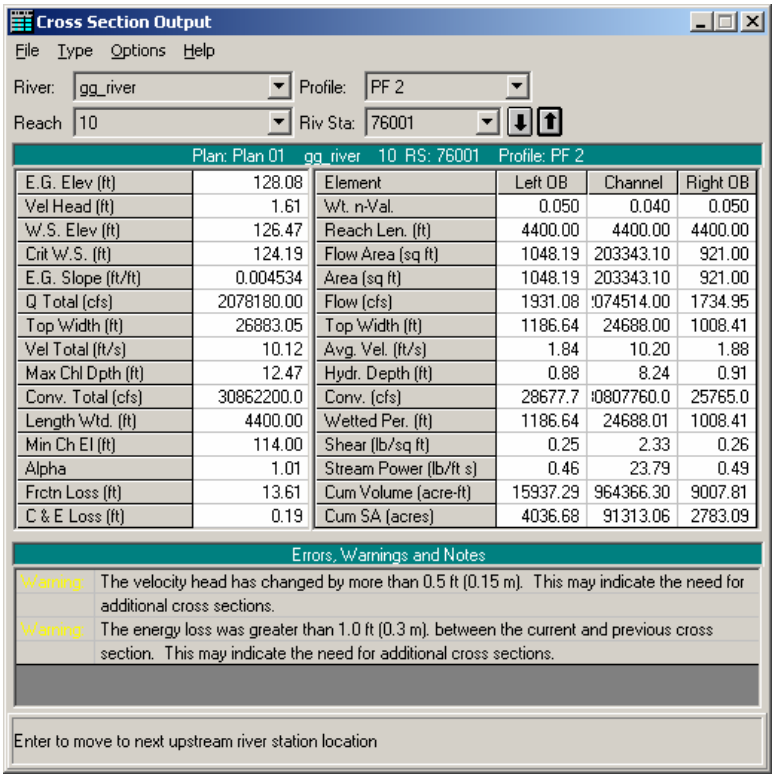
Profile Output Table - Standard Table 1

File Options Std. Tables Help

HEC-RAS Plan: Plan 01 River: gg_river Reach: 10 Profile: PF 2 | Reload Data

Reach	River Sta	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)	
10	76001	2078180.00	114.00	126.47	124.19	128.08	0.004534	10.20	205312.30	26883.05	0.63
10	75501	2078180.00	95.00	113.29		114.29	0.002245	8.01	259594.80	26758.79	0.45
10	69501	2078180.00	85.70	104.85		105.54	0.001480	6.84	330144.40	42751.88	0.37
10	62201	2078180.00	82.00	95.40		96.23	0.002782	7.63	306081.30	50872.89	0.49
10	55001	2078180.00	75.00	89.93		90.24	0.000830	4.48	478858.70	61988.05	0.27
10	48201	2078180.00	74.00	85.89		86.21	0.001316	4.58	453302.10	72239.54	0.32
10	42900	2078180.00	70.00	79.74		80.05	0.001491	4.45	466792.30	85479.49	0.34
10	38501	2078180.00	65.00	74.59		74.80	0.000701	3.72	559235.30	76151.58	0.24
10	34601	2078180.00	57.30	72.63		72.71	0.000168	2.32	894772.70	84555.13	0.13
10	30401	2078180.00	51.00	71.99		72.03	0.000059	1.62	1286560.00	95503.42	0.08
10	25701	2078180.00	50.00	71.61		71.64	0.000047	1.50	1389792.00	98496.33	0.07
10	20901	2078180.00	45.00	71.35		71.39	0.000040	1.63	1378941.00	96979.45	0.07
10	16501	2078180.00	60.00	70.02	68.76	71.25	0.006501	8.92	232960.90	45322.71	0.69

Total flow in cross section.



Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 76001

Plan: Plan 01 gg_river 10 RS: 76001 Profile: PF 2

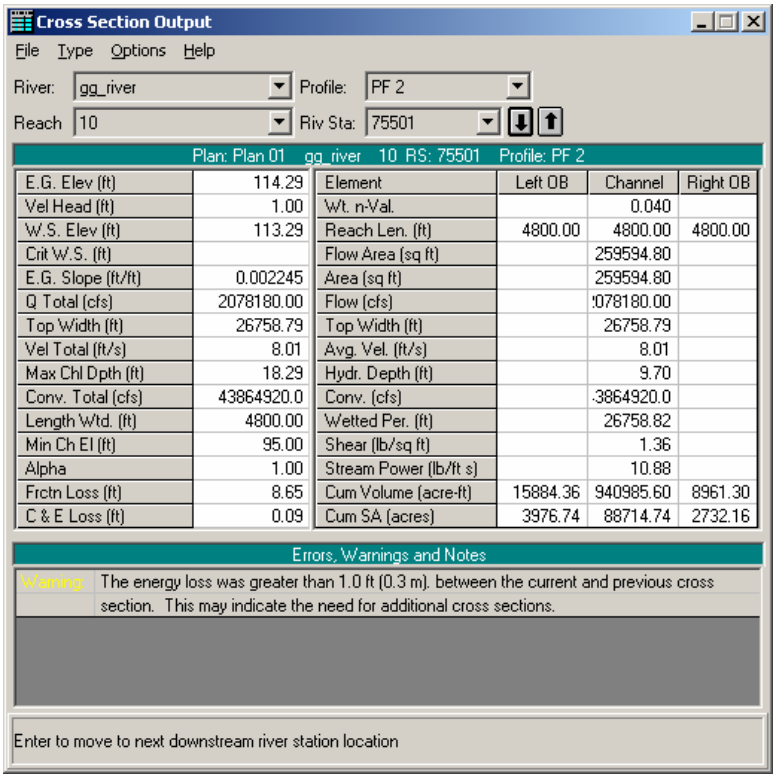
		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	128.08				
Vel Head (ft)	1.61	Wt. n-Val.	0.050	0.040	0.050
W.S. Elev (ft)	126.47	Reach Len. (ft)	4400.00	4400.00	4400.00
Crit W.S. (ft)	124.19	Flow Area (sq ft)	1048.19	203343.10	921.00
E.G. Slope (ft/ft)	0.004534	Area (sq ft)	1048.19	203343.10	921.00
Q Total (cfs)	2078180.00	Flow (cfs)	1931.08	2074514.00	1734.95
Top Width (ft)	26883.05	Top Width (ft)	1186.64	24688.00	1008.41
Vel Total (ft/s)	10.12	Avg. Vel. (ft/s)	1.84	10.20	1.88
Max Chl Dpth (ft)	12.47	Hydr. Depth (ft)	0.88	8.24	0.91
Conv. Total (cfs)	30862200.0	Conv. (cfs)	28677.7	30807760.0	25765.0
Length Wtd. (ft)	4400.00	Wetted Per. (ft)	1186.64	24688.01	1008.41
Min Ch El (ft)	114.00	Shear (lb/sq ft)	0.25	2.33	0.26
Alpha	1.01	Stream Power (lb/ft s)	0.46	23.79	0.49
Frctn Loss (ft)	13.61	Cum Volume (acre-ft)	15937.29	964366.30	9007.81
C & E Loss (ft)	0.19	Cum SA (acres)	4036.68	91313.06	2783.09

Errors, Warnings and Notes

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). 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.

Enter to move to next upstream river station location



Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 75501

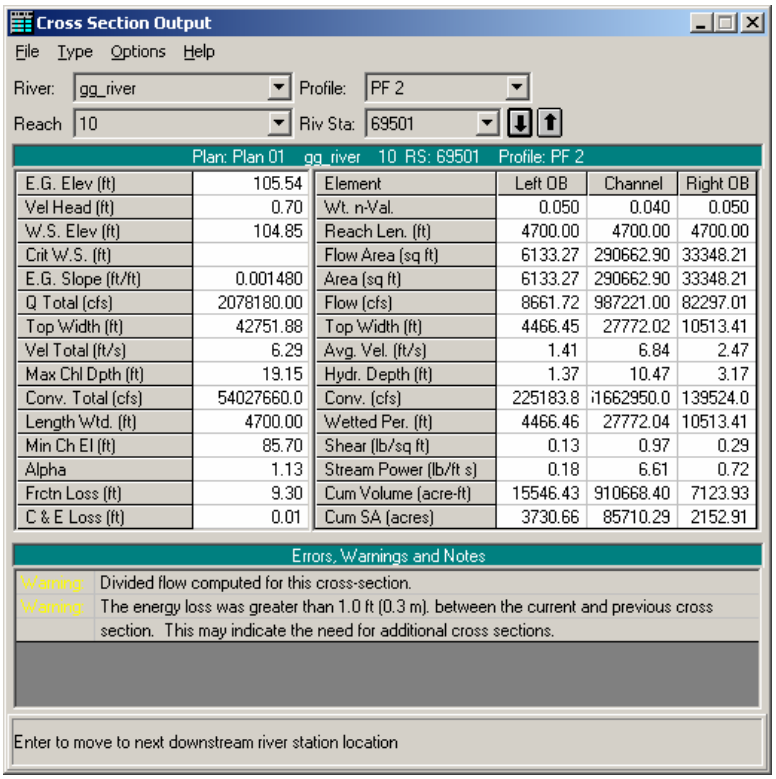
Plan: Plan 01 gg_river 10 RS: 75501 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	114.29				
Vel Head (ft)	1.00	Wt. n-Val.		0.040	
W.S. Elev (ft)	113.29	Reach Len. (ft)	4800.00	4800.00	4800.00
Crit W.S. (ft)		Flow Area (sq ft)		259594.80	
E.G. Slope (ft/ft)	0.002245	Area (sq ft)		259594.80	
Q Total (cfs)	2078180.00	Flow (cfs)		2078180.00	
Top Width (ft)	26758.79	Top Width (ft)		26758.79	
Vel Total (ft/s)	8.01	Avg. Vel. (ft/s)		8.01	
Max Chl Dpth (ft)	18.29	Hydr. Depth (ft)		9.70	
Conv. Total (cfs)	43864920.0	Conv. (cfs)		43864920.0	
Length Wtd. (ft)	4800.00	Wetted Per. (ft)		26758.82	
Min Ch El (ft)	95.00	Shear (lb/sq ft)		1.36	
Alpha	1.00	Stream Power (lb/ft s)		10.88	
Frctn Loss (ft)	8.65	Cum Volume (acre-ft)	15884.36	940985.60	8961.30
C & E Loss (ft)	0.09	Cum SA (acres)	3976.74	88714.74	2732.16

Errors, Warnings and Notes

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.

Enter to move to next downstream river station location



Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 69501

Plan: Plan 01 gg_river 10 RS: 69501 Profile: PF 2

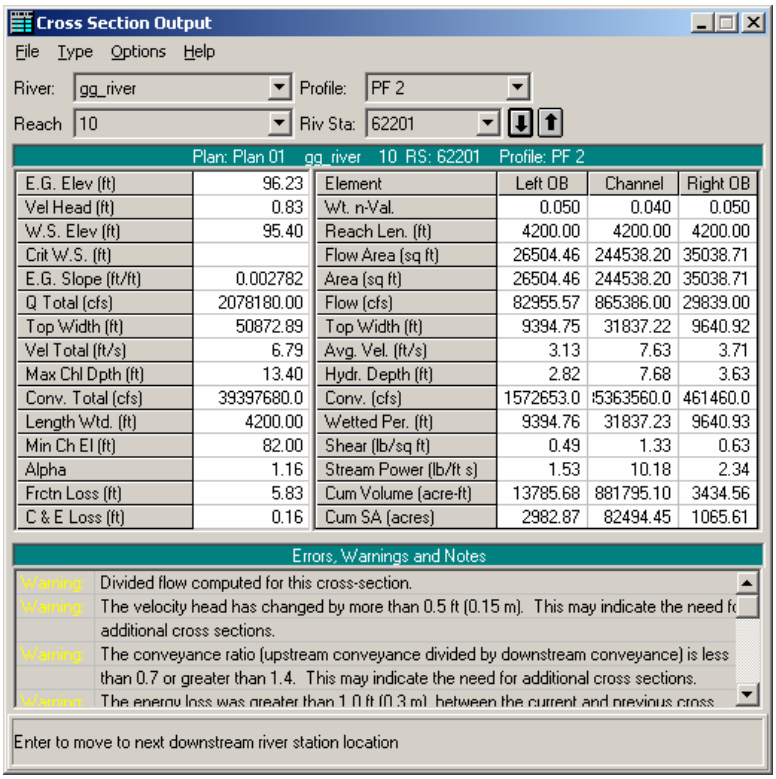
		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	105.54				
Vel Head (ft)	0.70	Wt. n-Val.	0.050	0.040	0.050
W.S. Elev (ft)	104.85	Reach Len. (ft)	4700.00	4700.00	4700.00
Crit W.S. (ft)		Flow Area (sq ft)	6133.27	290662.90	33348.21
E.G. Slope (ft/ft)	0.001480	Area (sq ft)	6133.27	290662.90	33348.21
Q Total (cfs)	2078180.00	Flow (cfs)	8661.72	987221.00	82297.01
Top Width (ft)	42751.88	Top Width (ft)	4466.45	27772.02	10513.41
Vel Total (ft/s)	6.29	Avg. Vel. (ft/s)	1.41	6.84	2.47
Max Chl Dpth (ft)	19.15	Hydr. Depth (ft)	1.37	10.47	3.17
Conv. Total (cfs)	54027660.0	Conv. (cfs)	225183.8	41662950.0	139524.0
Length Wtd. (ft)	4700.00	Wetted Per. (ft)	4466.46	27772.04	10513.41
Min Ch El (ft)	85.70	Shear (lb/sq ft)	0.13	0.97	0.29
Alpha	1.13	Stream Power (lb/ft s)	0.18	6.61	0.72
Frctn Loss (ft)	9.30	Cum Volume (acre-ft)	15546.43	910668.40	7123.93
C & E Loss (ft)	0.01	Cum SA (acres)	3730.66	85710.29	2152.91

Errors, Warnings and Notes

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.

Enter to move to next downstream river station location



Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 62201

Plan: Plan 01 gg_river 10 RS: 62201 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	96.23				
Vel Head (ft)	0.83	Wt. n-Val.	0.050	0.040	0.050
W.S. Elev (ft)	95.40	Reach Len. (ft)	4200.00	4200.00	4200.00
Crit W.S. (ft)		Flow Area (sq ft)	26504.46	244538.20	35038.71
E.G. Slope (ft/ft)	0.002782	Area (sq ft)	26504.46	244538.20	35038.71
Q Total (cfs)	2078180.00	Flow (cfs)	82955.57	865386.00	29839.00
Top Width (ft)	50872.89	Top Width (ft)	9394.75	31837.22	9640.92
Vel Total (ft/s)	6.79	Avg. Vel. (ft/s)	3.13	7.63	3.71
Max Chl Dpth (ft)	13.40	Hydr. Depth (ft)	2.82	7.68	3.63
Conv. Total (cfs)	39397680.0	Conv. (cfs)	1572653.0	35363560.0	461460.0
Length Wtd. (ft)	4200.00	Wetted Per. (ft)	9394.76	31837.23	9640.93
Min Ch El (ft)	82.00	Shear (lb/sq ft)	0.49	1.33	0.63
Alpha	1.16	Stream Power (lb/ft s)	1.53	10.18	2.34
Frctn Loss (ft)	5.83	Cum Volume (acre-ft)	13785.68	881795.10	3434.56
C & E Loss (ft)	0.16	Cum SA (acres)	2982.87	82494.45	1065.61

Errors, Warnings and Notes

Warning: Divided flow computed for this cross-section.

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need f additional cross sections.

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

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 55001

Plan: Plan 01 gg_river 10 RS: 55001 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	90.24				
Vel Head (ft)	0.31	Wt. n-Val.	0.050	0.040	0.050
W.S. Elev (ft)	89.93	Reach Len. (ft)	3900.00	3900.00	3900.00
Crit W.S. (ft)		Flow Area (sq ft)	15253.80	454434.90	9170.03
E.G. Slope (ft/ft)	0.000830	Area (sq ft)	15253.80	454434.90	9170.03
Q Total (cfs)	2078180.00	Flow (cfs)	23835.67	1036886.00	17458.09
Top Width (ft)	61988.05	Top Width (ft)	6188.15	53033.68	2766.23
Vel Total (ft/s)	4.34	Avg. Vel. (ft/s)	1.56	4.48	1.90
Max Chl Dpth (ft)	14.93	Hydr. Depth (ft)	2.47	8.57	3.31
Conv. Total (cfs)	72122340.0	Conv. (cfs)	827206.6	10689260.0	605875.6
Length Wtd. (ft)	3900.00	Wetted Per. (ft)	6188.16	53033.68	2766.24
Min Ch El (ft)	75.00	Shear (lb/sq ft)	0.13	0.44	0.17
Alpha	1.05	Stream Power (lb/ft s)	0.20	1.99	0.33
Frctn Loss (ft)	4.02	Cum Volume (acre-ft)	11772.54	848098.00	1303.28
C & E Loss (ft)	0.00	Cum SA (acres)	2231.62	78402.88	467.47

Errors, Warnings and Notes

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.

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 48201

Plan: Plan 01 gg_river 10 RS: 48201 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	86.21				
Vel Head (ft)	0.33	Wt. n-Val.		0.040	
W.S. Elev (ft)	85.89	Reach Len. (ft)	4400.00	4400.00	1000.00
Crit W.S. (ft)		Flow Area (sq ft)		453302.10	
E.G. Slope (ft/ft)	0.001316	Area (sq ft)		453302.10	
Q Total (cfs)	2078180.00	Flow (cfs)		1078180.00	
Top Width (ft)	72239.54	Top Width (ft)		72239.54	
Vel Total (ft/s)	4.58	Avg. Vel. (ft/s)		4.58	
Max Chl Dpth (ft)	11.89	Hydr. Depth (ft)		6.27	
Conv. Total (cfs)	57288120.0	Conv. (cfs)		57288120.0	
Length Wtd. (ft)	4400.00	Wetted Per. (ft)		72239.58	
Min Ch El (ft)	74.00	Shear (lb/sq ft)		0.52	
Alpha	1.00	Stream Power (lb/ft s)		2.36	
Frctn Loss (ft)	6.16	Cum Volume (acre-ft)	11089.69	807462.40	892.78
C & E Loss (ft)	0.01	Cum SA (acres)	1954.61	72794.92	343.64

Errors, Warnings and Notes

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.

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 42900

Plan: Plan 01 gg_river 10 RS: 42900 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	80.05				
Vel Head (ft)	0.31	Wt. n-Val.		0.040	0.050
W.S. Elev (ft)	79.74	Reach Len. (ft)	5300.00	5300.00	500.00
Crit W.S. (ft)		Flow Area (sq ft)		466777.30	14.95
E.G. Slope (ft/ft)	0.001491	Area (sq ft)		466777.30	14.95
Q Total (cfs)	2078180.00	Flow (cfs)		1078176.00	4.23
Top Width (ft)	85479.49	Top Width (ft)		85357.30	122.20
Vel Total (ft/s)	4.45	Avg. Vel. (ft/s)		4.45	0.28
Max Chl Dpth (ft)	9.74	Hydr. Depth (ft)		5.47	0.12
Conv. Total (cfs)	53821830.0	Conv. (cfs)		53821720.0	109.5
Length Wtd. (ft)	5300.00	Wetted Per. (ft)		85357.31	122.20
Min Ch El (ft)	70.00	Shear (lb/sq ft)		0.51	0.01
Alpha	1.00	Stream Power (lb/ft s)		2.27	0.00
Frctn Loss (ft)	5.23	Cum Volume (acre-ft)	11089.69	760993.70	892.60
C & E Loss (ft)	0.03	Cum SA (acres)	1954.61	64835.48	342.24

Errors, Warnings and Notes

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.

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 38501

Plan: Plan 01 gg_river 10 RS: 38501 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	74.80				
Vel Head (ft)	0.21	Wt. n-Val.		0.040	
W.S. Elev (ft)	74.59	Reach Len. (ft)	6800.00	6800.00	500.00
Crit W.S. (ft)		Flow Area (sq ft)		559235.30	
E.G. Slope (ft/ft)	0.000701	Area (sq ft)		559235.30	
Q Total (cfs)	2078180.00	Flow (cfs)		1078180.00	
Top Width (ft)	76151.58	Top Width (ft)		76151.58	
Vel Total (ft/s)	3.72	Avg. Vel. (ft/s)		3.72	
Max Chl Dpth (ft)	9.59	Hydr. Depth (ft)		7.34	
Conv. Total (cfs)	78488650.0	Conv. (cfs)		78488650.0	
Length Wtd. (ft)	6800.00	Wetted Per. (ft)		76151.59	
Min Ch El (ft)	65.00	Shear (lb/sq ft)		0.32	
Alpha	1.00	Stream Power (lb/ft s)		1.19	
Frctn Loss (ft)	2.06	Cum Volume (acre-ft)	11089.69	698575.60	892.52
C & E Loss (ft)	0.04	Cum SA (acres)	1954.61	55009.99	341.54

Errors, Warnings and Notes

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.

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 34601

Plan: Plan 01 gg_river 10 RS: 34601 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	72.71				
Vel Head (ft)	0.08	Wt. n-Val.		0.040	
W.S. Elev (ft)	72.63	Reach Len. (ft)	7200.00	7200.00	6700.00
Crit W.S. (ft)		Flow Area (sq ft)		894772.70	
E.G. Slope (ft/ft)	0.000168	Area (sq ft)		894772.70	
Q Total (cfs)	2078180.00	Flow (cfs)		078180.00	
Top Width (ft)	84555.13	Top Width (ft)		84555.13	
Vel Total (ft/s)	2.32	Avg. Vel. (ft/s)		2.32	
Max Chl Dpth (ft)	15.33	Hydr. Depth (ft)		10.58	
Conv. Total (cfs)	160212500.0	Conv. (cfs)		0212500.0	
Length Wtd. (ft)	7200.00	Wetted Per. (ft)		84555.15	
Min Ch El (ft)	57.30	Shear (lb/sq ft)		0.11	
Alpha	1.00	Stream Power (lb/ft s)		0.26	
Frctn Loss (ft)	0.67	Cum Volume (acre-ft)	11089.69	585085.50	892.52
C & E Loss (ft)	0.01	Cum SA (acres)	1954.61	42466.31	341.54

Errors, Warnings and Notes

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.

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 30401

Plan: Plan 01 gg_river 10 RS: 30401 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	72.03				
Vel Head (ft)	0.04	Wt. n-Val.		0.040	
W.S. Elev (ft)	71.99	Reach Len. (ft)	7300.00	7300.00	7300.00
Crit W.S. (ft)		Flow Area (sq ft)		286560.00	
E.G. Slope (ft/ft)	0.000059	Area (sq ft)		286560.00	
Q Total (cfs)	2078180.00	Flow (cfs)		078180.00	
Top Width (ft)	95503.42	Top Width (ft)		95503.42	
Vel Total (ft/s)	1.62	Avg. Vel. (ft/s)		1.62	
Max Chl Dpth (ft)	20.99	Hydr. Depth (ft)		13.47	
Conv. Total (cfs)	270586200.0	Conv. (cfs)		0586200.0	
Length Wtd. (ft)	7300.00	Wetted Per. (ft)		95503.44	
Min Ch El (ft)	51.00	Shear (lb/sq ft)		0.05	
Alpha	1.00	Stream Power (lb/ft s)		0.08	
Frctn Loss (ft)	0.38	Cum Volume (acre-ft)	11089.69	404810.10	892.52
C & E Loss (ft)	0.00	Cum SA (acres)	1954.61	27585.44	341.54

Errors, Warnings and Notes

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 25701

Plan: Plan 01 gg_river 10 RS: 25701 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	71.64				
Vel Head (ft)	0.03	Wt. n-Val.		0.040	0.050
W.S. Elev (ft)	71.61	Reach Len. (ft)	6000.00	6000.00	6000.00
Crit W.S. (ft)		Flow Area (sq ft)		388487.00	1304.16
E.G. Slope (ft/ft)	0.000047	Area (sq ft)		388487.00	1304.16
Q Total (cfs)	2078180.00	Flow (cfs)		077863.00	317.05
Top Width (ft)	98496.33	Top Width (ft)		97495.58	1000.75
Vel Total (ft/s)	1.50	Avg. Vel. (ft/s)		1.50	0.24
Max Chl Dpth (ft)	21.61	Hydr. Depth (ft)		14.24	1.30
Conv. Total (cfs)	303096800.0	Conv. (cfs)		3050600.0	46240.7
Length Wtd. (ft)	6000.00	Wetted Per. (ft)		97495.59	1000.75
Min Ch El (ft)	50.00	Shear (lb/sq ft)		0.04	0.00
Alpha	1.00	Stream Power (lb/ft s)		0.06	0.00
Frctn Loss (ft)	0.26	Cum Volume (acre-ft)	11089.69	180661.30	783.24
C & E Loss (ft)	0.00	Cum SA (acres)	1954.61	11413.57	257.68

Errors, Warnings and Notes

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 20901

Plan: Plan 01 gg_river 10 RS: 20901 Profile: PF 2

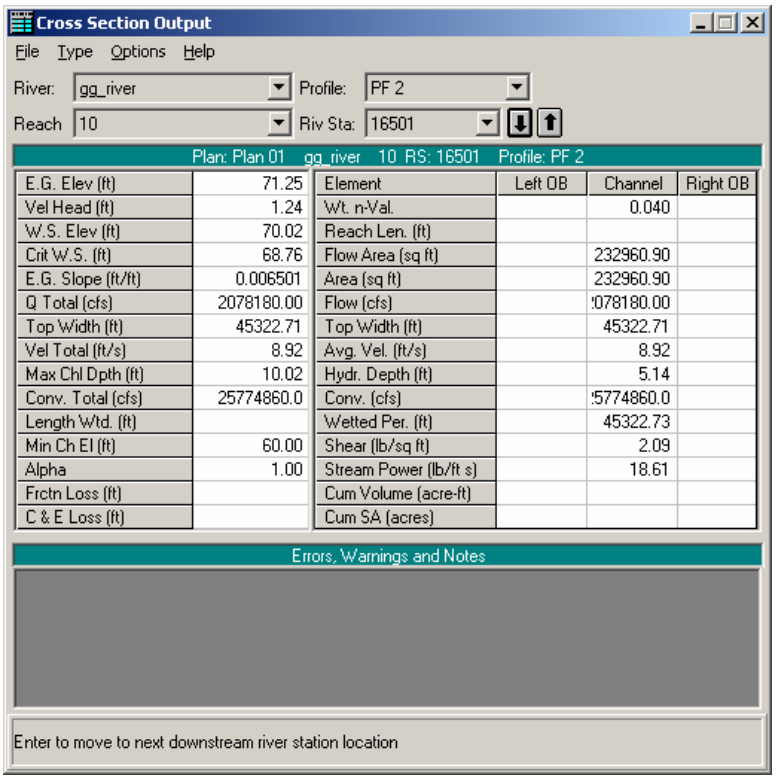
		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	71.39				
Vel Head (ft)	0.04	Wt. n-Val.	0.050	0.040	0.050
W.S. Elev (ft)	71.35	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)	158382.60	210655.00	9903.42
E.G. Slope (ft/ft)	0.000040	Area (sq ft)	158382.60	210655.00	9903.42
Q Total (cfs)	2078180.00	Flow (cfs)	95063.91	978667.00	4448.85
Top Width (ft)	96979.45	Top Width (ft)	27915.62	66368.00	2695.83
Vel Total (ft/s)	1.51	Avg. Vel. (ft/s)	0.60	1.63	0.45
Max Chl Dpth (ft)	26.35	Hydr. Depth (ft)	5.67	18.24	3.67
Conv. Total (cfs)	327320600.0	Conv. (cfs)	4972900.0	1647000.0	700709.7
Length Wtd. (ft)	100.00	Wetted Per. (ft)	27915.62	66368.05	2695.84
Min Ch El (ft)	45.00	Shear (lb/sq ft)	0.01	0.05	0.01
Alpha	1.13	Stream Power (lb/ft s)	0.01	0.08	0.00
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	181.80	1657.04	11.37
C & E Loss (ft)	0.12	Cum SA (acres)	32.04	128.20	3.09

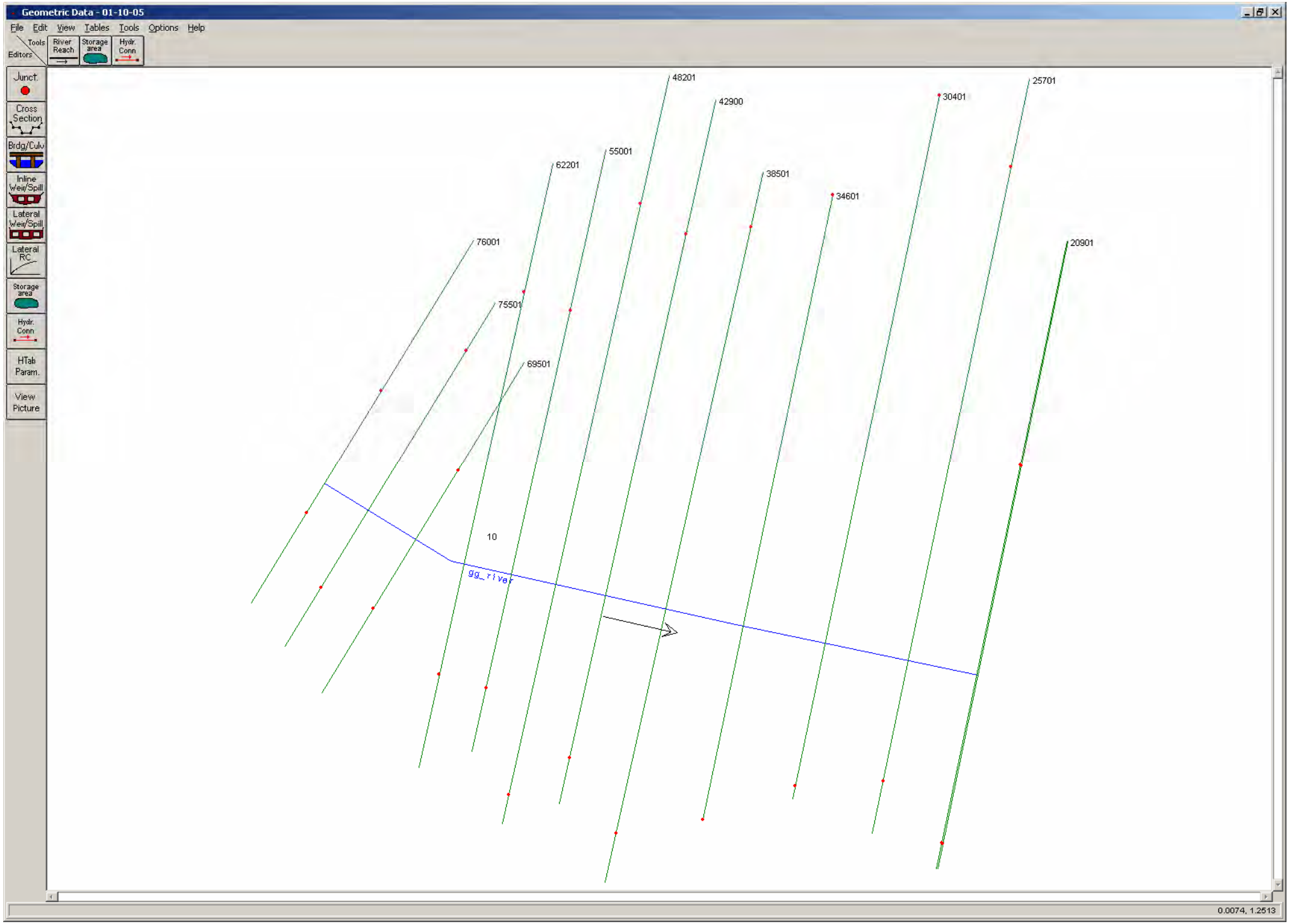
Errors, Warnings and Notes

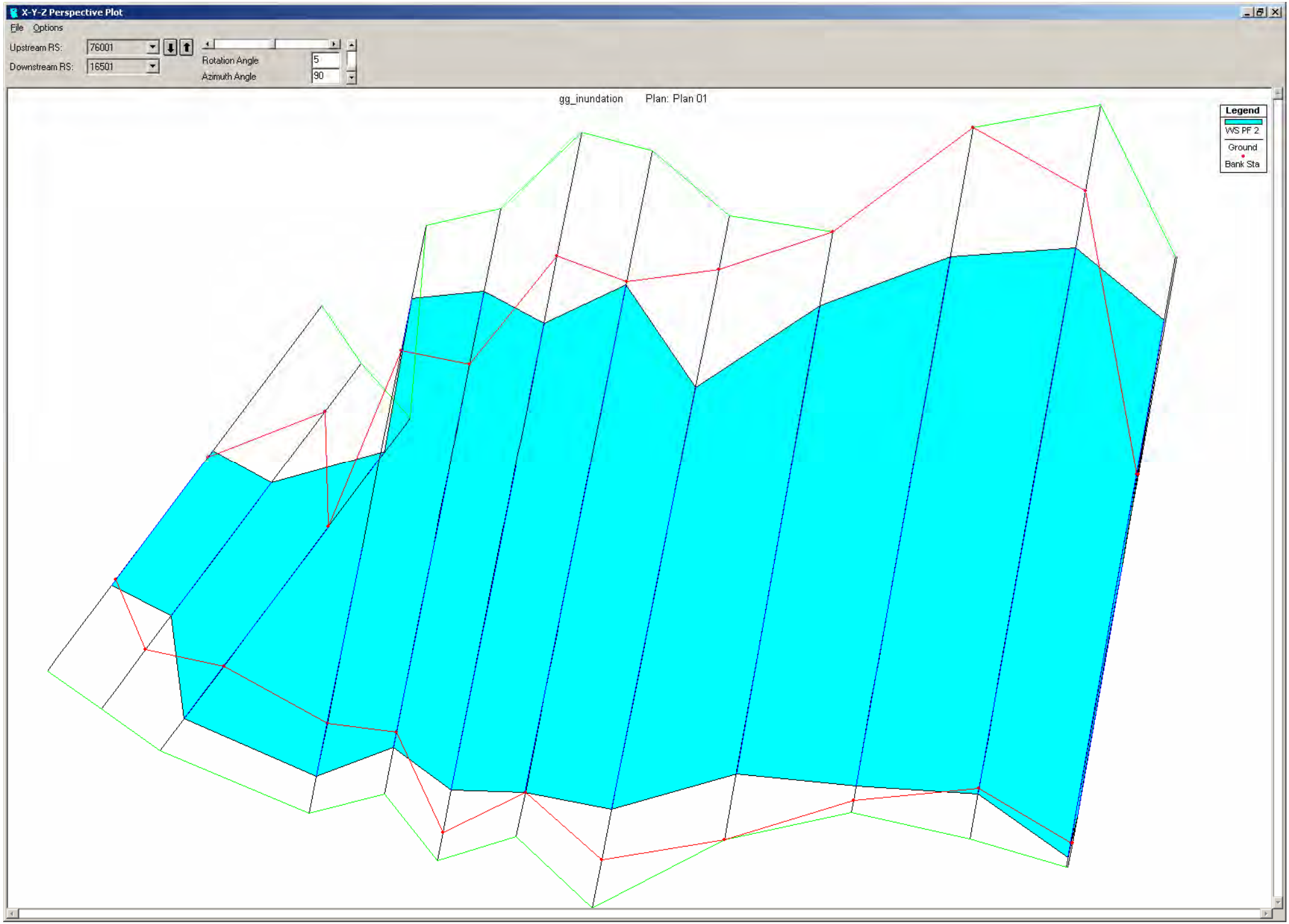
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

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.

Enter to move to next downstream river station location


Cross Section Output
File Type Options Help
River: gg_river
Profile: PF 2
Reach 10
Riv Sta: 16501
Plan: Plan 01 gg_river 10 RS: 16501 Profile: PF 2
E.G. Elev (ft) 71.25
Vel Head (ft) 1.24
W.S. Elev (ft) 70.02
Crit W.S. (ft) 68.76
E.G. Slope (ft/ft) 0.006501
Q Total (cfs) 2078180.00
Top Width (ft) 45322.71
Vel Total (ft/s) 8.92
Max Chl Dpth (ft) 10.02
Conv. Total (cfs) 25774860.0
Length Wtd. (ft)
Min Ch El (ft) 60.00
Alpha 1.00
Frctn Loss (ft)
C & E Loss (ft)
Element Left OB Channel Right OB
Wt. n-Val. 0.040
Reach Len. (ft)
Flow Area (sq ft) 232960.90
Area (sq ft) 232960.90
Flow (cfs) 078180.00
Top Width (ft) 45322.71
Avg. Vel. (ft/s) 8.92
Hydr. Depth (ft) 5.14
Conv. (cfs) 5774860.0
Wetted Per. (ft) 45322.73
Shear (lb/sq ft) 2.09
Stream Power (lb/ft s) 18.61
Cum Volume (acre-ft)
Cum SA (acres)
Errors, Warnings and Notes
Enter to move to next downstream river station location


Geometric Data - 01-10-05
File Edit View Tables Tools Options Help
Tools
Editors
River Reach
Storage area
Hydr. Conn
Junct.
Cross Section
Brdg/Culv
Inline Weir/Spill
Lateral Weir/Spill
Lateral RC
Storage area
Hydr. Conn
HTab Param.
View Picture
48201
42900
30401
25701
55001
62201
38501
34601
76001
20901
75501
69501
10
gg_river
0.0074, 1.2513


X-Y-Z Perspective Plot
File
Options
Upstream RS:
76001
Downstream RS:
16501
Rotation Angle
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Azimuth Angle
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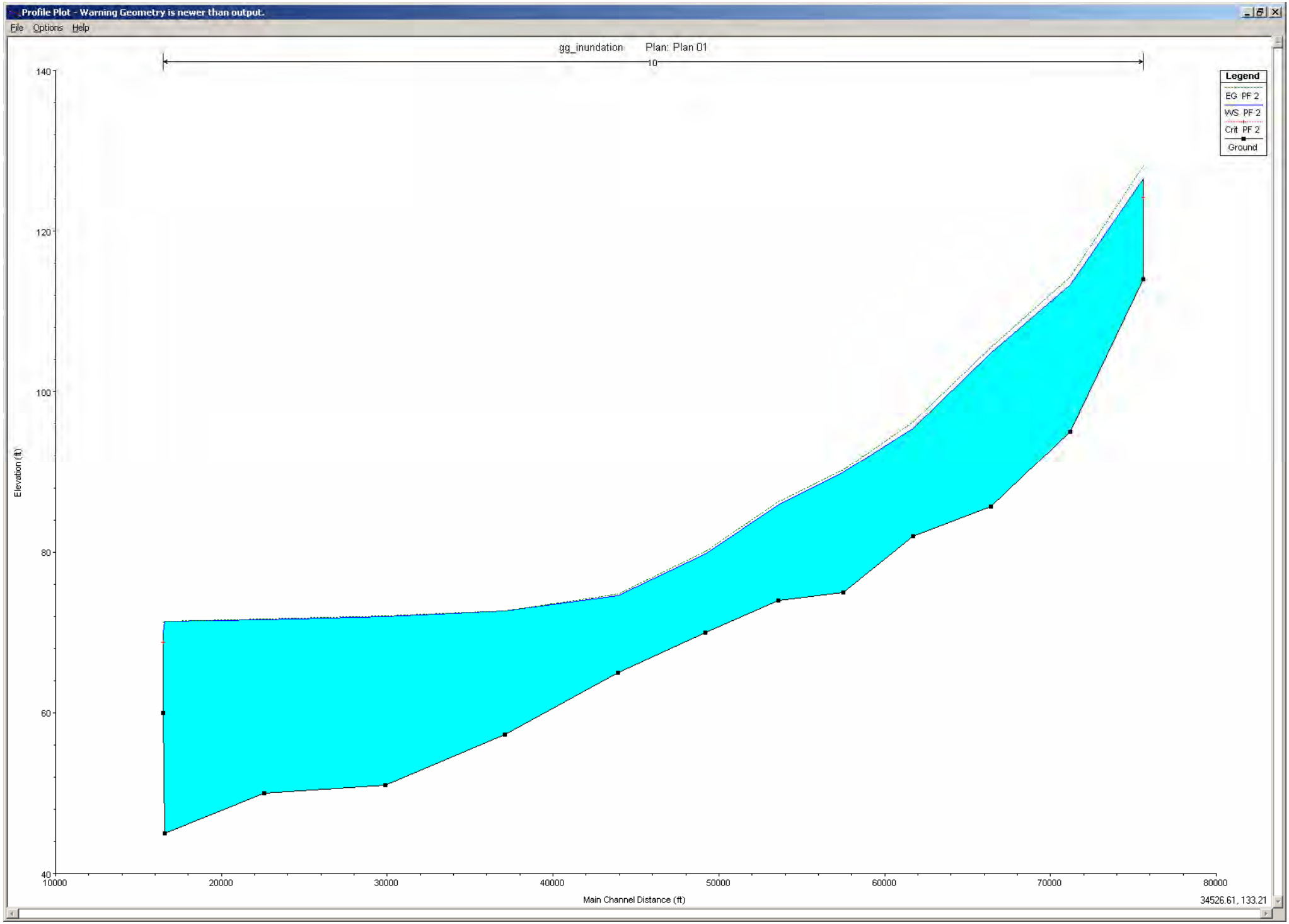
gg_inundation
Plan: Plan 01
Legend
WS PF 2
Ground
Bank Sta


Profile Plot - Warning Geometry is newer than output.
File Options Help
gg_inundation Plan: Plan 01
10
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Elevation (ft)
140
120
100
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50000
60000
70000
80000
Main Channel Distance (ft)
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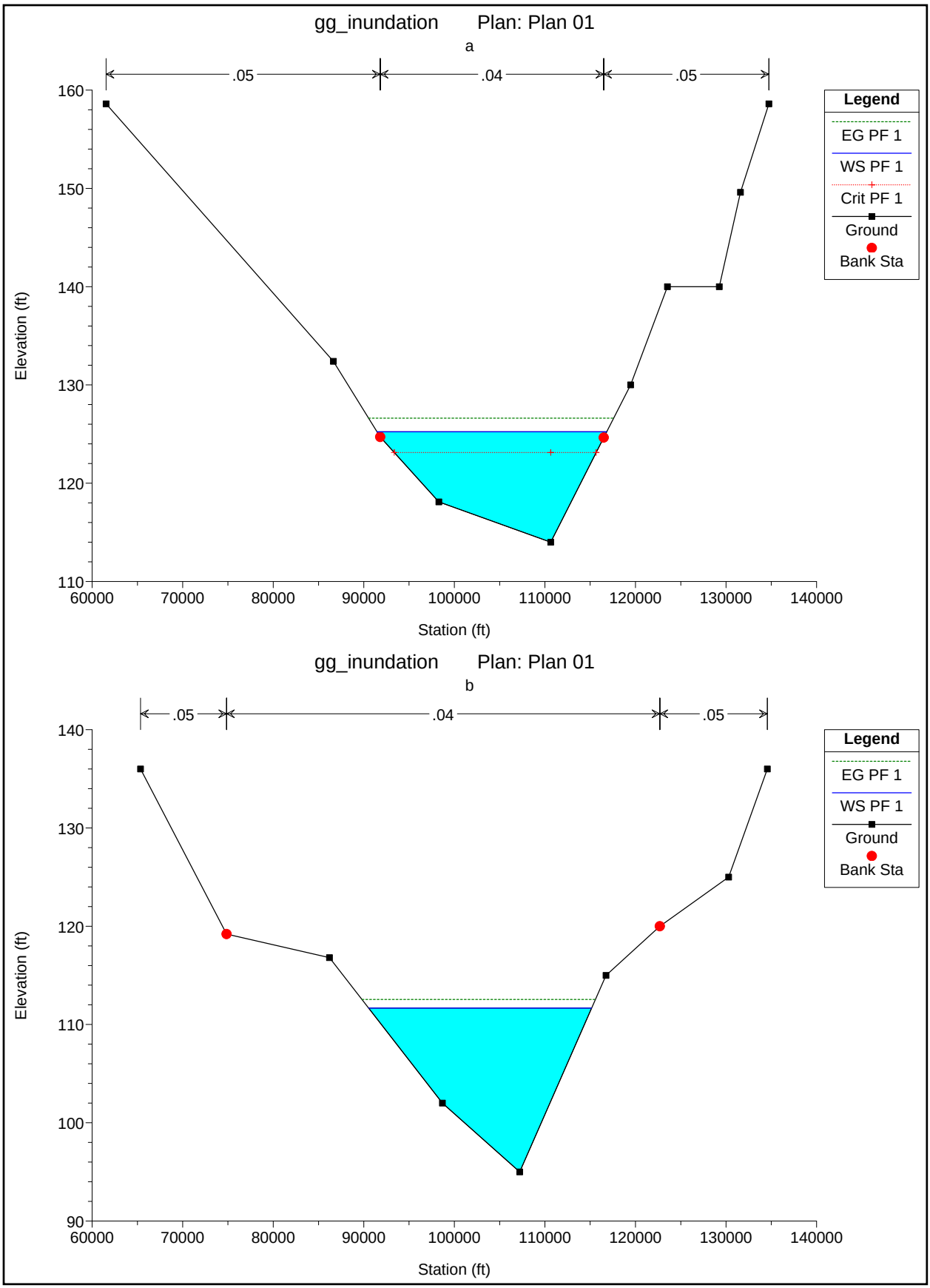
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Elevation (ft)
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Station (ft)
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Crit PF 1
Ground
Bank Sta
gg_inundation Plan: Plan 01
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Station (ft)
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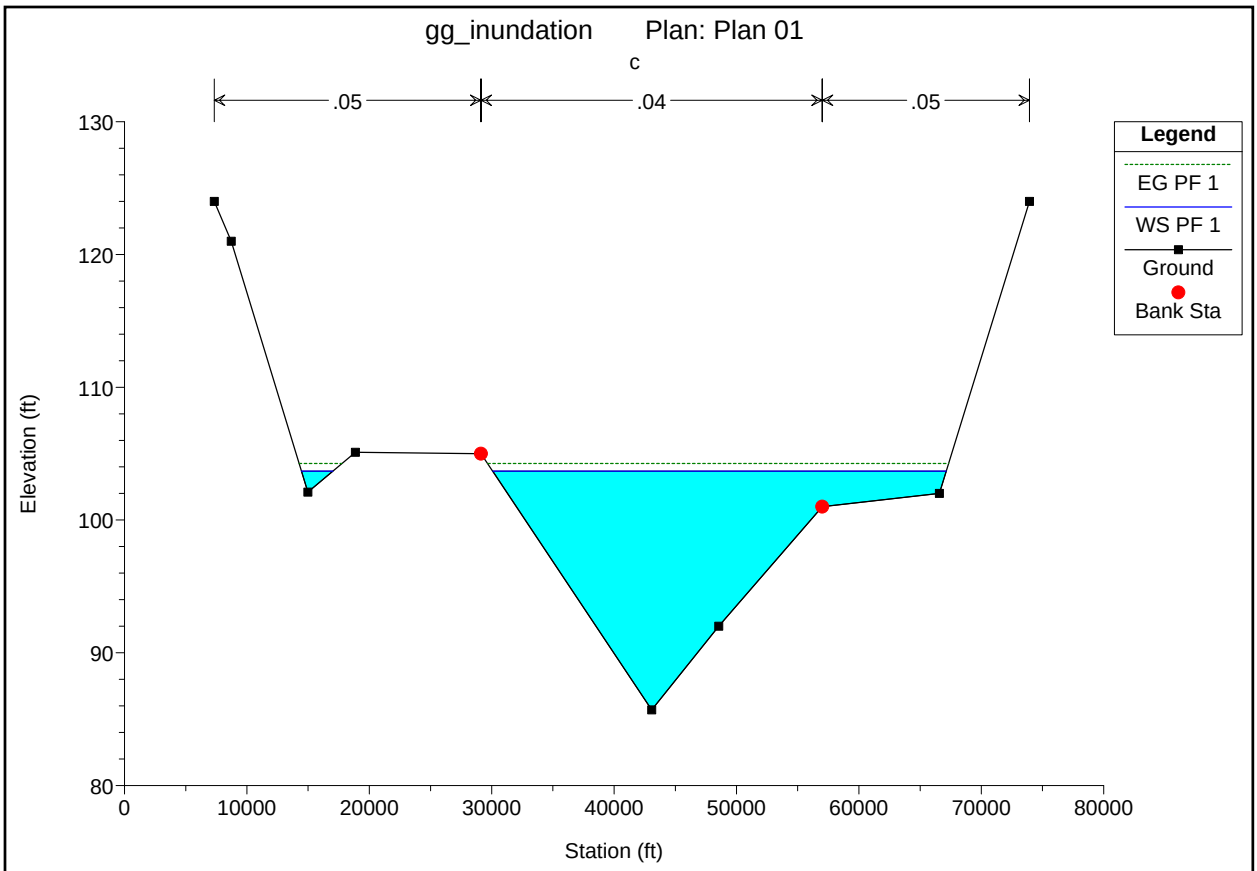
Ground
Bank Sta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Ground
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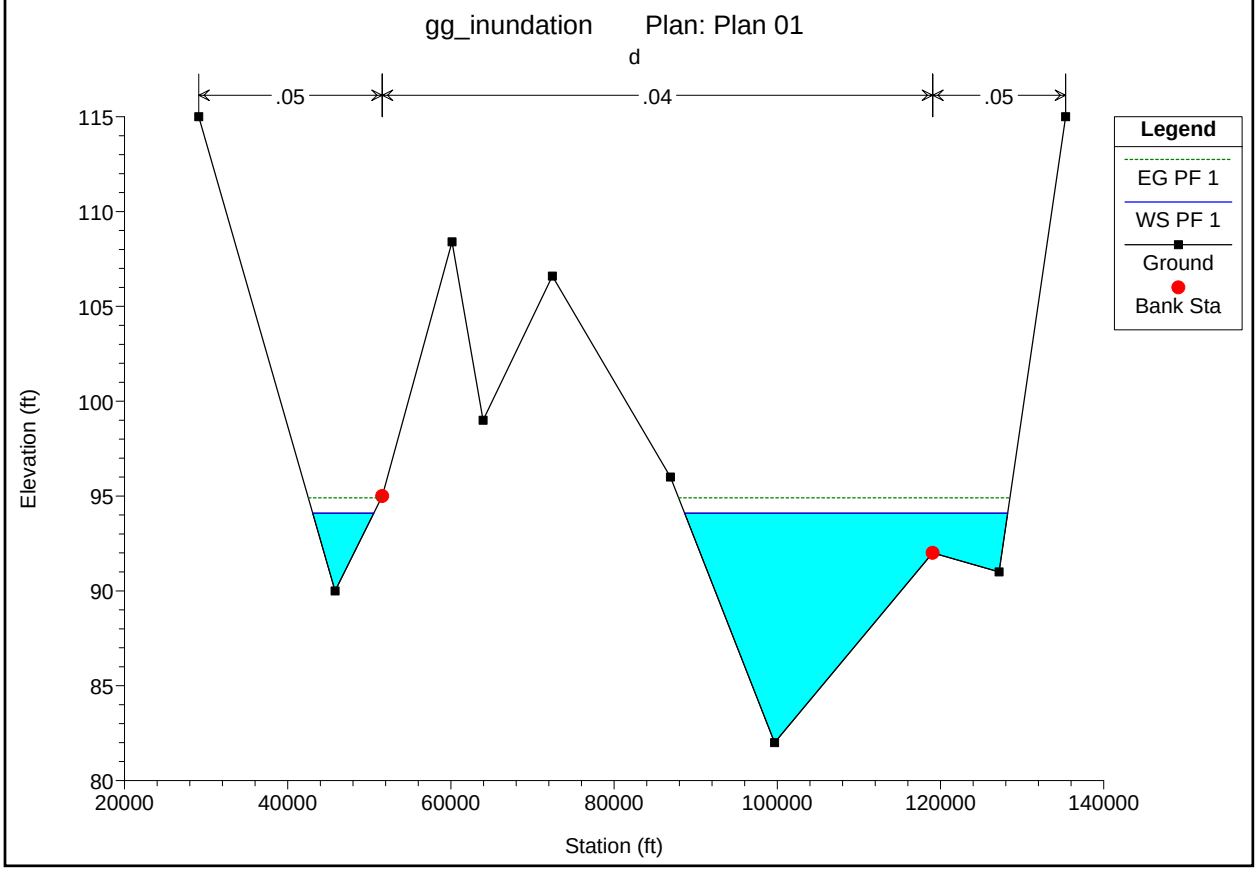
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Legend
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WS PF 1
Ground
Bank Sta
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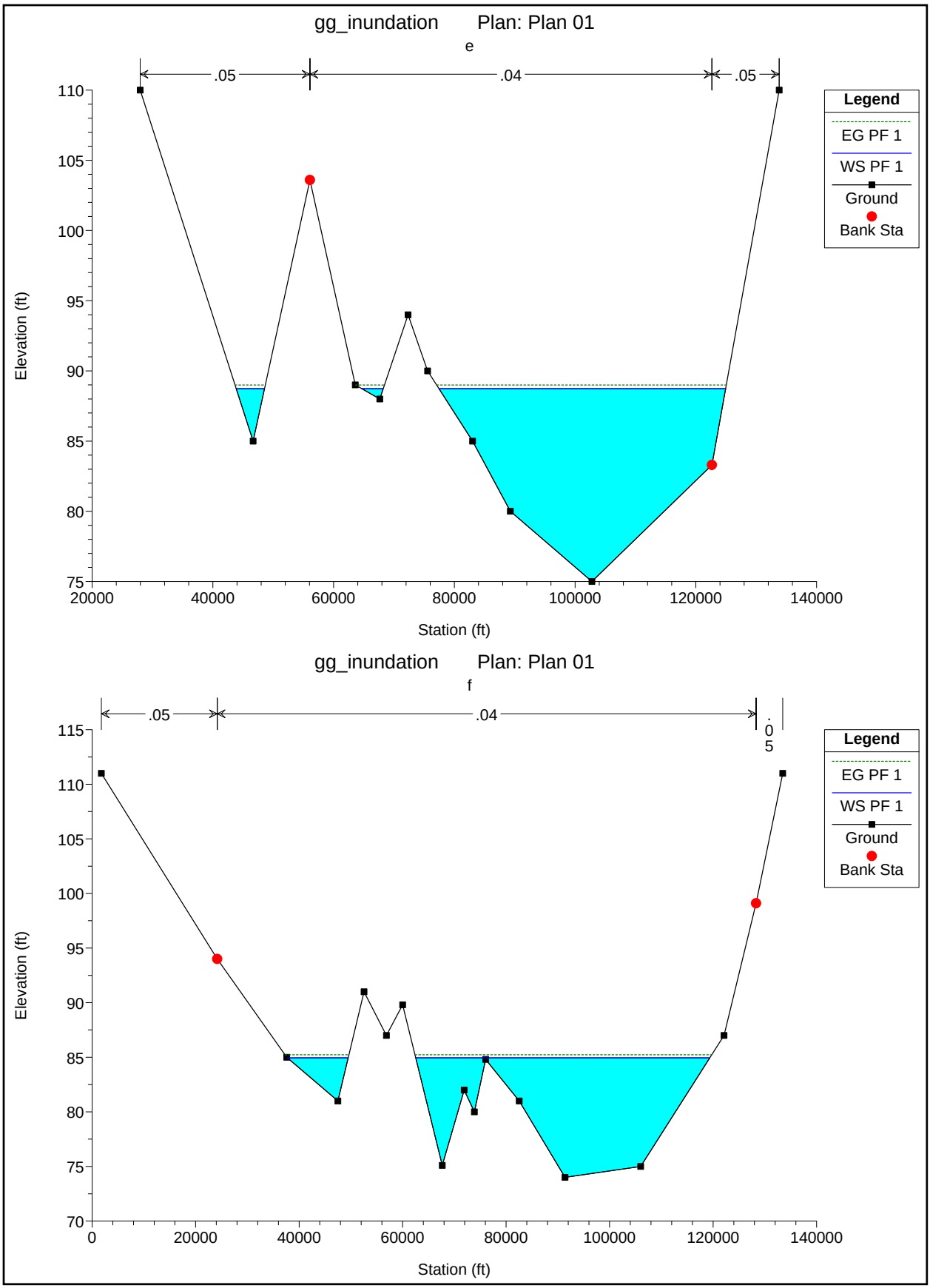
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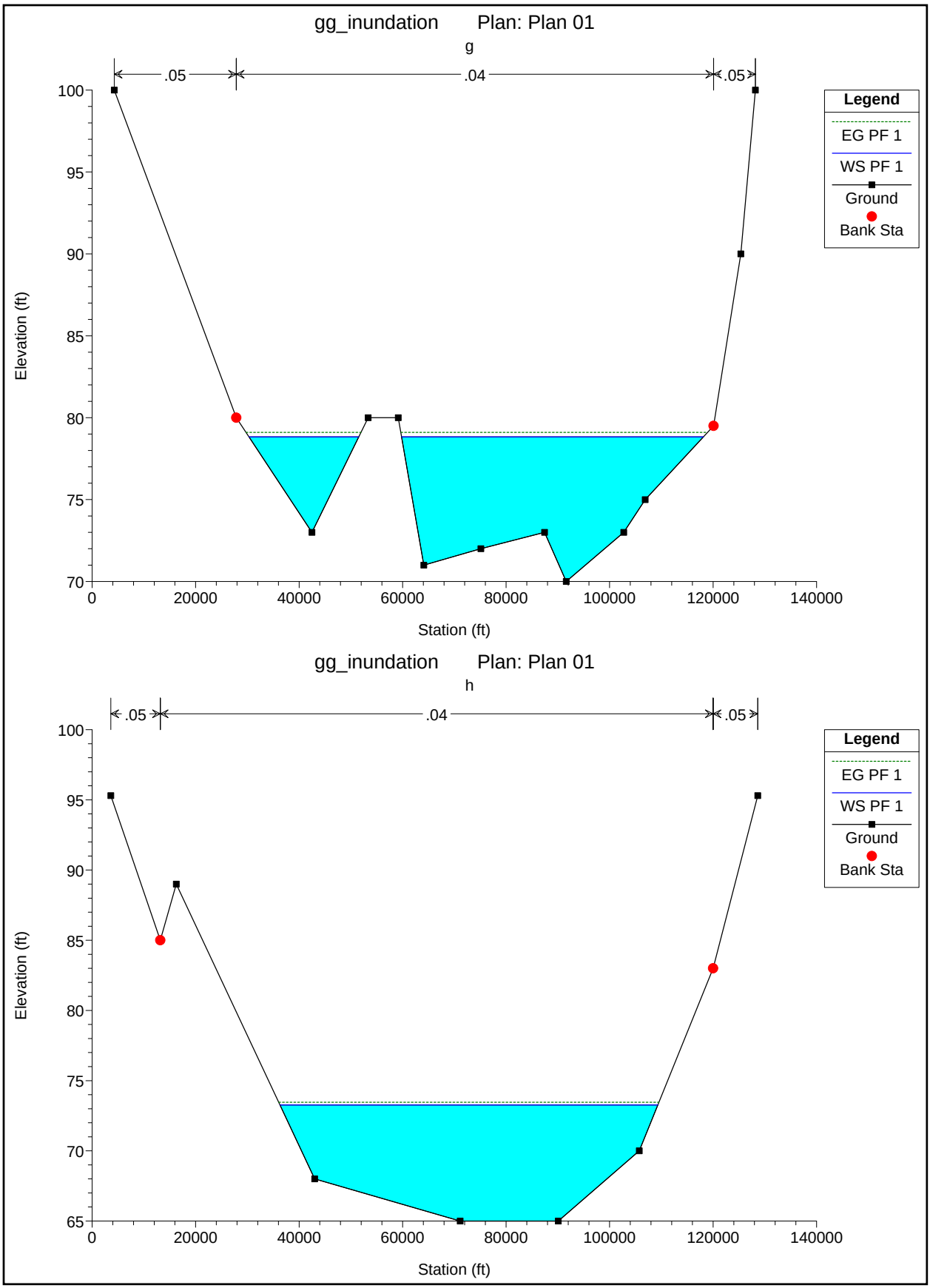
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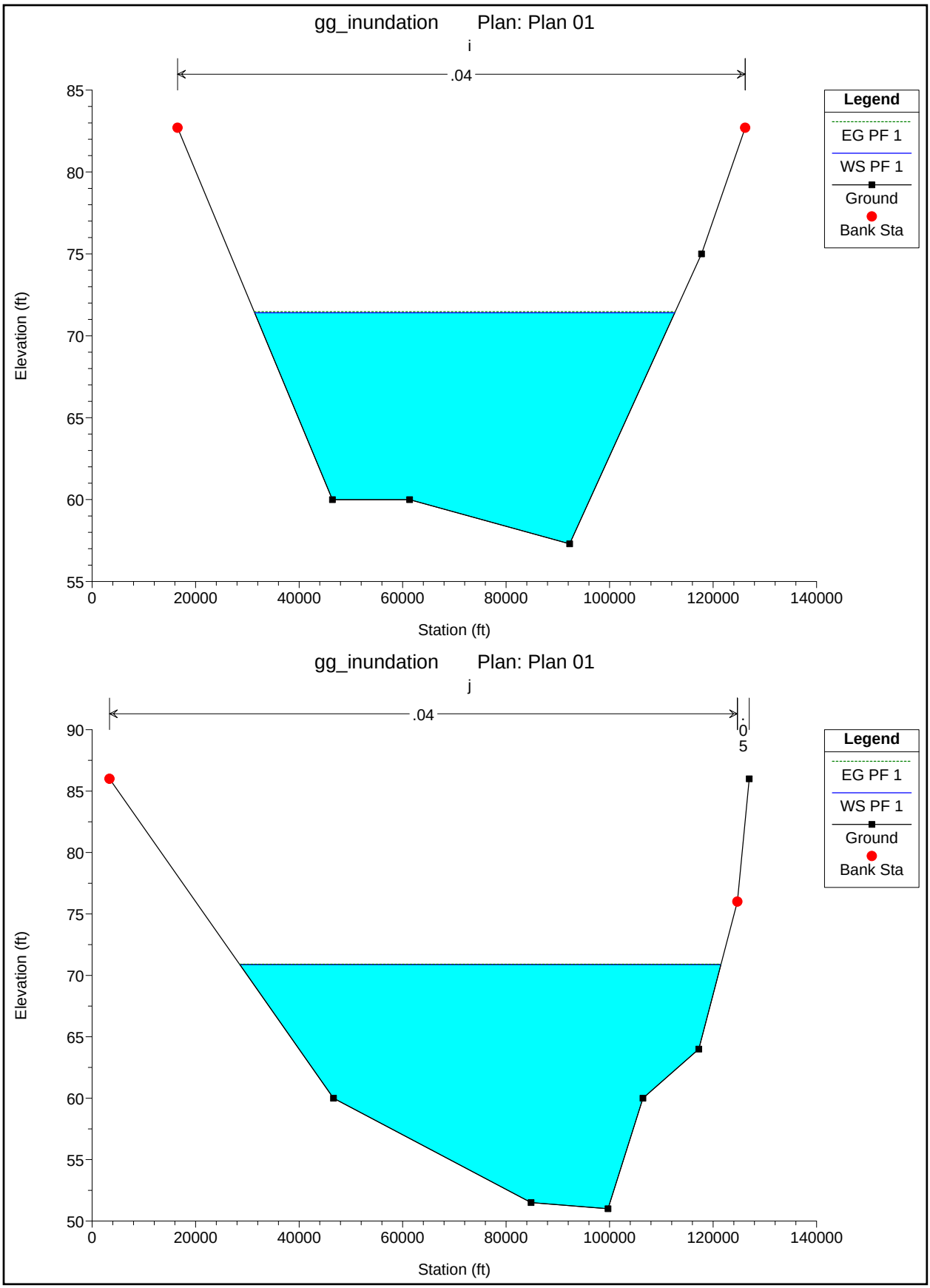
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gg_inundation Plan: Plan 01
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WS PF 1
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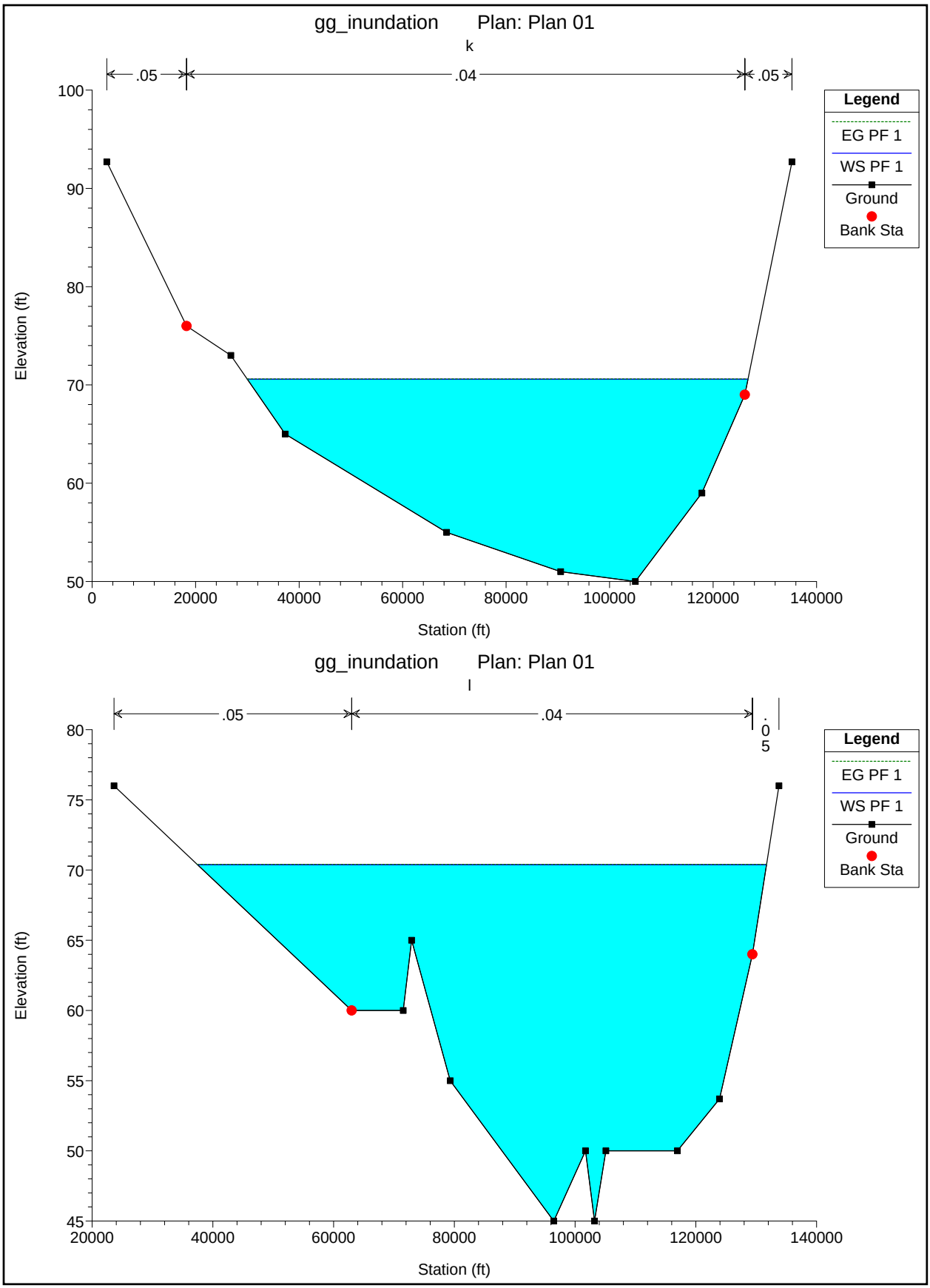
gg_inundation Plan: Plan 01
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WS PF 1
Ground
Bank Sta
gg_inundation Plan: Plan 01
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Elevation (ft)
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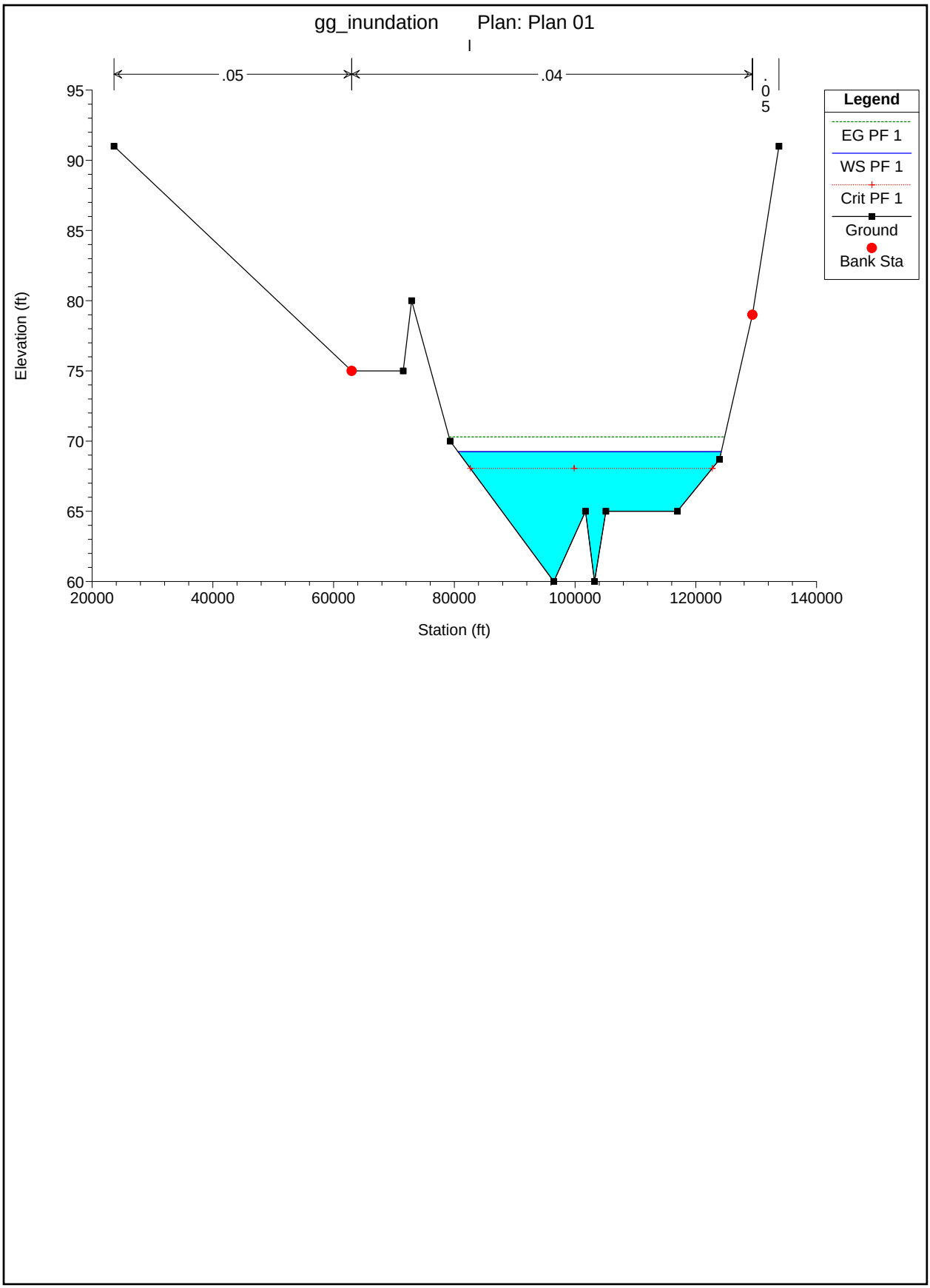
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


gg_inundation Plan: Plan 01
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.04
.05
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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75
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100000
120000
140000

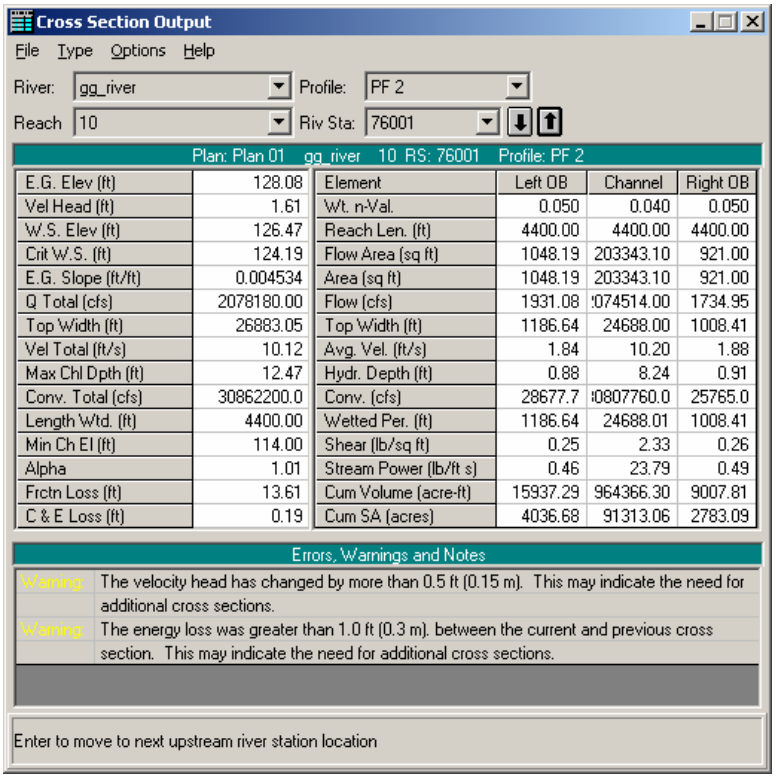
Profile Output Table - Standard Table 1

File Options Std. Tables Help

HEC-RAS Plan: Plan 01 River: gg_river Reach: 10 Profile: PF 2 | Reload Data

Reach	River Sta	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)	
10	76001	2078180.00	114.00	126.47	124.19	128.08	0.004534	10.20	205312.30	26883.05	0.63
10	75501	2078180.00	95.00	113.29		114.29	0.002245	8.01	259594.80	26758.79	0.45
10	69501	2078180.00	85.70	104.85		105.54	0.001480	6.84	330144.40	42751.88	0.37
10	62201	2078180.00	82.00	95.40		96.23	0.002782	7.63	306081.30	50872.89	0.49
10	55001	2078180.00	75.00	89.93		90.24	0.000830	4.48	478858.70	61988.05	0.27
10	48201	2078180.00	74.00	85.89		86.21	0.001316	4.58	453302.10	72239.54	0.32
10	42900	2078180.00	70.00	79.74		80.05	0.001491	4.45	466792.30	85479.49	0.34
10	38501	2078180.00	65.00	74.59		74.80	0.000701	3.72	559235.30	76151.58	0.24
10	34601	2078180.00	57.30	72.63		72.71	0.000168	2.32	894772.70	84555.13	0.13
10	30401	2078180.00	51.00	71.99		72.03	0.000059	1.62	1286560.00	95503.42	0.08
10	25701	2078180.00	50.00	71.61		71.64	0.000047	1.50	1389792.00	98496.33	0.07
10	20901	2078180.00	45.00	71.35		71.39	0.000040	1.63	1378941.00	96979.45	0.07
10	16501	2078180.00	60.00	70.02	68.76	71.25	0.006501	8.92	232960.90	45322.71	0.69

Total flow in cross section.



Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 76001

Plan: Plan 01 gg_river 10 RS: 76001 Profile: PF 2

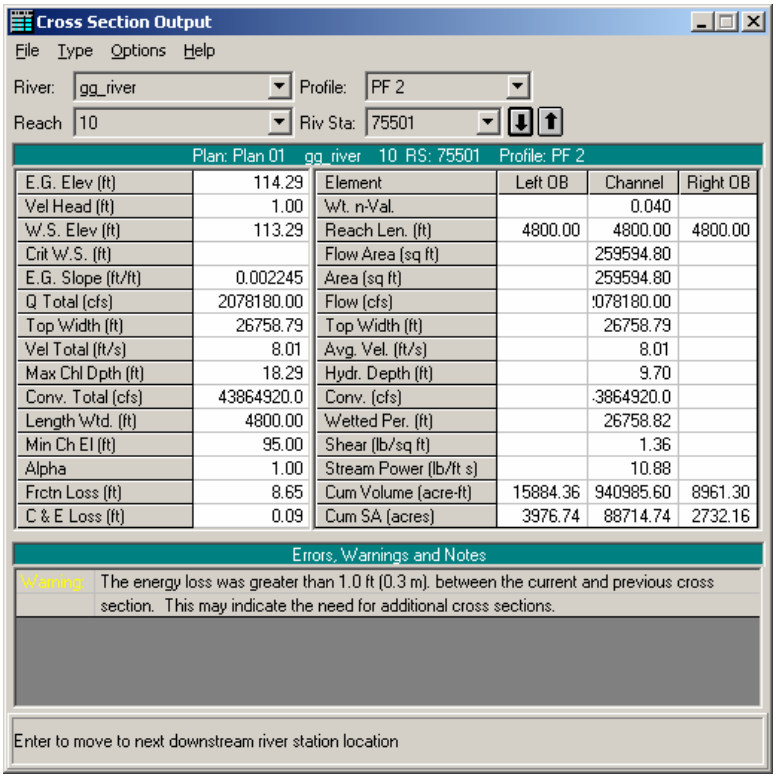
		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	128.08				
Vel Head (ft)	1.61	Wt. n-Val.	0.050	0.040	0.050
W.S. Elev (ft)	126.47	Reach Len. (ft)	4400.00	4400.00	4400.00
Crit W.S. (ft)	124.19	Flow Area (sq ft)	1048.19	203343.10	921.00
E.G. Slope (ft/ft)	0.004534	Area (sq ft)	1048.19	203343.10	921.00
Q Total (cfs)	2078180.00	Flow (cfs)	1931.08	2074514.00	1734.95
Top Width (ft)	26883.05	Top Width (ft)	1186.64	24688.00	1008.41
Vel Total (ft/s)	10.12	Avg. Vel. (ft/s)	1.84	10.20	1.88
Max Chl Dpth (ft)	12.47	Hydr. Depth (ft)	0.88	8.24	0.91
Conv. Total (cfs)	30862200.0	Conv. (cfs)	28677.7	30807760.0	25765.0
Length Wtd. (ft)	4400.00	Wetted Per. (ft)	1186.64	24688.01	1008.41
Min Ch El (ft)	114.00	Shear (lb/sq ft)	0.25	2.33	0.26
Alpha	1.01	Stream Power (lb/ft s)	0.46	23.79	0.49
Frctn Loss (ft)	13.61	Cum Volume (acre-ft)	15937.29	964366.30	9007.81
C & E Loss (ft)	0.19	Cum SA (acres)	4036.68	91313.06	2783.09

Errors, Warnings and Notes

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). 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.

Enter to move to next upstream river station location



Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 75501

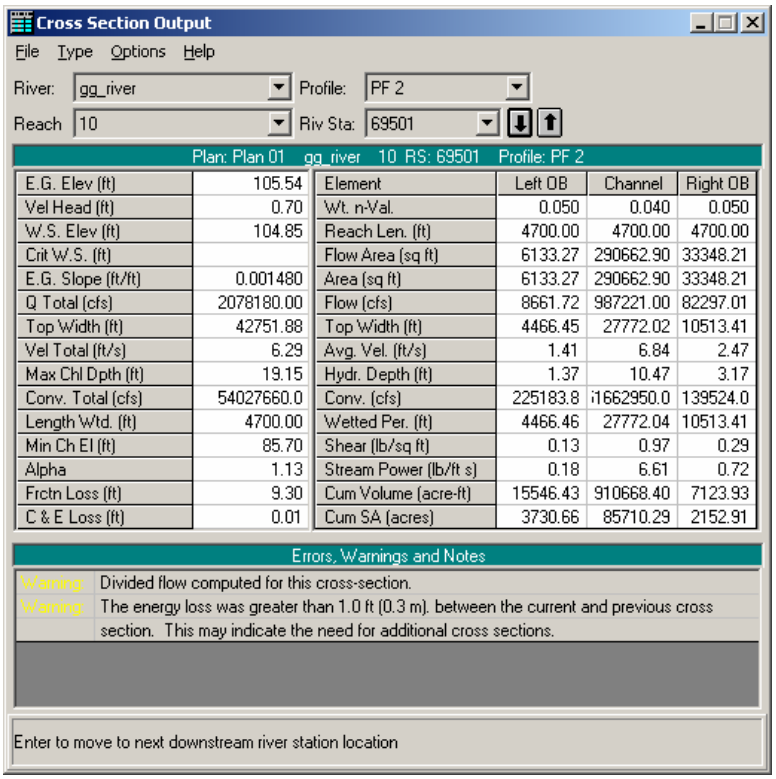
Plan: Plan 01 gg_river 10 RS: 75501 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	114.29				
Vel Head (ft)	1.00	Wt. n-Val.		0.040	
W.S. Elev (ft)	113.29	Reach Len. (ft)	4800.00	4800.00	4800.00
Crit W.S. (ft)		Flow Area (sq ft)		259594.80	
E.G. Slope (ft/ft)	0.002245	Area (sq ft)		259594.80	
Q Total (cfs)	2078180.00	Flow (cfs)		2078180.00	
Top Width (ft)	26758.79	Top Width (ft)		26758.79	
Vel Total (ft/s)	8.01	Avg. Vel. (ft/s)		8.01	
Max Chl Dpth (ft)	18.29	Hydr. Depth (ft)		9.70	
Conv. Total (cfs)	43864920.0	Conv. (cfs)		43864920.0	
Length Wtd. (ft)	4800.00	Wetted Per. (ft)		26758.82	
Min Ch El (ft)	95.00	Shear (lb/sq ft)		1.36	
Alpha	1.00	Stream Power (lb/ft s)		10.88	
Frctn Loss (ft)	8.65	Cum Volume (acre-ft)	15884.36	940985.60	8961.30
C & E Loss (ft)	0.09	Cum SA (acres)	3976.74	88714.74	2732.16

Errors, Warnings and Notes

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.

Enter to move to next downstream river station location



Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 69501

Plan: Plan 01 gg_river 10 RS: 69501 Profile: PF 2

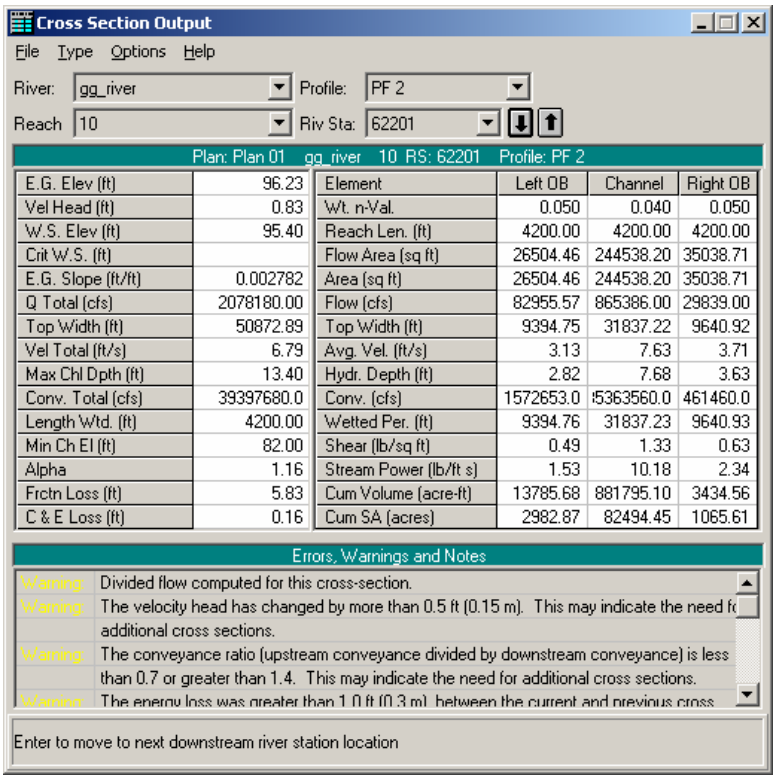
		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	105.54				
Vel Head (ft)	0.70	Wt. n-Val.	0.050	0.040	0.050
W.S. Elev (ft)	104.85	Reach Len. (ft)	4700.00	4700.00	4700.00
Crit W.S. (ft)		Flow Area (sq ft)	6133.27	290662.90	33348.21
E.G. Slope (ft/ft)	0.001480	Area (sq ft)	6133.27	290662.90	33348.21
Q Total (cfs)	2078180.00	Flow (cfs)	8661.72	987221.00	82297.01
Top Width (ft)	42751.88	Top Width (ft)	4466.45	27772.02	10513.41
Vel Total (ft/s)	6.29	Avg. Vel. (ft/s)	1.41	6.84	2.47
Max Chl Dpth (ft)	19.15	Hydr. Depth (ft)	1.37	10.47	3.17
Conv. Total (cfs)	54027660.0	Conv. (cfs)	225183.8	41662950.0	139524.0
Length Wtd. (ft)	4700.00	Wetted Per. (ft)	4466.46	27772.04	10513.41
Min Ch El (ft)	85.70	Shear (lb/sq ft)	0.13	0.97	0.29
Alpha	1.13	Stream Power (lb/ft s)	0.18	6.61	0.72
Frctn Loss (ft)	9.30	Cum Volume (acre-ft)	15546.43	910668.40	7123.93
C & E Loss (ft)	0.01	Cum SA (acres)	3730.66	85710.29	2152.91

Errors, Warnings and Notes

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.

Enter to move to next downstream river station location



Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 62201

Plan: Plan 01 gg_river 10 RS: 62201 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	96.23				
Vel Head (ft)	0.83	Wt. n-Val.	0.050	0.040	0.050
W.S. Elev (ft)	95.40	Reach Len. (ft)	4200.00	4200.00	4200.00
Crit W.S. (ft)		Flow Area (sq ft)	26504.46	244538.20	35038.71
E.G. Slope (ft/ft)	0.002782	Area (sq ft)	26504.46	244538.20	35038.71
Q Total (cfs)	2078180.00	Flow (cfs)	82955.57	865386.00	29839.00
Top Width (ft)	50872.89	Top Width (ft)	9394.75	31837.22	9640.92
Vel Total (ft/s)	6.79	Avg. Vel. (ft/s)	3.13	7.63	3.71
Max Chl Dpth (ft)	13.40	Hydr. Depth (ft)	2.82	7.68	3.63
Conv. Total (cfs)	39397680.0	Conv. (cfs)	1572653.0	35363560.0	461460.0
Length Wtd. (ft)	4200.00	Wetted Per. (ft)	9394.76	31837.23	9640.93
Min Ch El (ft)	82.00	Shear (lb/sq ft)	0.49	1.33	0.63
Alpha	1.16	Stream Power (lb/ft s)	1.53	10.18	2.34
Frctn Loss (ft)	5.83	Cum Volume (acre-ft)	13785.68	881795.10	3434.56
C & E Loss (ft)	0.16	Cum SA (acres)	2982.87	82494.45	1065.61

Errors, Warnings and Notes

Warning: Divided flow computed for this cross-section.

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need f additional cross sections.

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

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 55001

Plan: Plan 01 gg_river 10 RS: 55001 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	90.24				
Vel Head (ft)	0.31	Wt. n-Val.	0.050	0.040	0.050
W.S. Elev (ft)	89.93	Reach Len. (ft)	3900.00	3900.00	3900.00
Crit W.S. (ft)		Flow Area (sq ft)	15253.80	454434.90	9170.03
E.G. Slope (ft/ft)	0.000830	Area (sq ft)	15253.80	454434.90	9170.03
Q Total (cfs)	2078180.00	Flow (cfs)	23835.67	1036886.00	17458.09
Top Width (ft)	61988.05	Top Width (ft)	6188.15	53033.68	2766.23
Vel Total (ft/s)	4.34	Avg. Vel. (ft/s)	1.56	4.48	1.90
Max Chl Dpth (ft)	14.93	Hydr. Depth (ft)	2.47	8.57	3.31
Conv. Total (cfs)	72122340.0	Conv. (cfs)	827206.6	10689260.0	605875.6
Length Wtd. (ft)	3900.00	Wetted Per. (ft)	6188.16	53033.68	2766.24
Min Ch El (ft)	75.00	Shear (lb/sq ft)	0.13	0.44	0.17
Alpha	1.05	Stream Power (lb/ft s)	0.20	1.99	0.33
Frctn Loss (ft)	4.02	Cum Volume (acre-ft)	11772.54	848098.00	1303.28
C & E Loss (ft)	0.00	Cum SA (acres)	2231.62	78402.88	467.47

Errors, Warnings and Notes

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.

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 48201

Plan: Plan 01 gg_river 10 RS: 48201 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	86.21				
Vel Head (ft)	0.33	Wt. n-Val.		0.040	
W.S. Elev (ft)	85.89	Reach Len. (ft)	4400.00	4400.00	1000.00
Crit W.S. (ft)		Flow Area (sq ft)		453302.10	
E.G. Slope (ft/ft)	0.001316	Area (sq ft)		453302.10	
Q Total (cfs)	2078180.00	Flow (cfs)		1078180.00	
Top Width (ft)	72239.54	Top Width (ft)		72239.54	
Vel Total (ft/s)	4.58	Avg. Vel. (ft/s)		4.58	
Max Chl Dpth (ft)	11.89	Hydr. Depth (ft)		6.27	
Conv. Total (cfs)	57288120.0	Conv. (cfs)		57288120.0	
Length Wtd. (ft)	4400.00	Wetted Per. (ft)		72239.58	
Min Ch El (ft)	74.00	Shear (lb/sq ft)		0.52	
Alpha	1.00	Stream Power (lb/ft s)		2.36	
Frctn Loss (ft)	6.16	Cum Volume (acre-ft)	11089.69	807462.40	892.78
C & E Loss (ft)	0.01	Cum SA (acres)	1954.61	72794.92	343.64

Errors, Warnings and Notes

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.

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 42900

Plan: Plan 01 gg_river 10 RS: 42900 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	80.05				
Vel Head (ft)	0.31	Wt. n-Val.		0.040	0.050
W.S. Elev (ft)	79.74	Reach Len. (ft)	5300.00	5300.00	500.00
Crit W.S. (ft)		Flow Area (sq ft)		466777.30	14.95
E.G. Slope (ft/ft)	0.001491	Area (sq ft)		466777.30	14.95
Q Total (cfs)	2078180.00	Flow (cfs)		1078176.00	4.23
Top Width (ft)	85479.49	Top Width (ft)		85357.30	122.20
Vel Total (ft/s)	4.45	Avg. Vel. (ft/s)		4.45	0.28
Max Chl Dpth (ft)	9.74	Hydr. Depth (ft)		5.47	0.12
Conv. Total (cfs)	53821830.0	Conv. (cfs)		53821720.0	109.5
Length Wtd. (ft)	5300.00	Wetted Per. (ft)		85357.31	122.20
Min Ch El (ft)	70.00	Shear (lb/sq ft)		0.51	0.01
Alpha	1.00	Stream Power (lb/ft s)		2.27	0.00
Frctn Loss (ft)	5.23	Cum Volume (acre-ft)	11089.69	760993.70	892.60
C & E Loss (ft)	0.03	Cum SA (acres)	1954.61	64835.48	342.24

Errors, Warnings and Notes

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.

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 38501

Plan: Plan 01 gg_river 10 RS: 38501 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	74.80				
Vel Head (ft)	0.21	Wt. n-Val.		0.040	
W.S. Elev (ft)	74.59	Reach Len. (ft)	6800.00	6800.00	500.00
Crit W.S. (ft)		Flow Area (sq ft)		559235.30	
E.G. Slope (ft/ft)	0.000701	Area (sq ft)		559235.30	
Q Total (cfs)	2078180.00	Flow (cfs)		1078180.00	
Top Width (ft)	76151.58	Top Width (ft)		76151.58	
Vel Total (ft/s)	3.72	Avg. Vel. (ft/s)		3.72	
Max Chl Dpth (ft)	9.59	Hydr. Depth (ft)		7.34	
Conv. Total (cfs)	78488650.0	Conv. (cfs)		78488650.0	
Length Wtd. (ft)	6800.00	Wetted Per. (ft)		76151.59	
Min Ch El (ft)	65.00	Shear (lb/sq ft)		0.32	
Alpha	1.00	Stream Power (lb/ft s)		1.19	
Frctn Loss (ft)	2.06	Cum Volume (acre-ft)	11089.69	698575.60	892.52
C & E Loss (ft)	0.04	Cum SA (acres)	1954.61	55009.99	341.54

Errors, Warnings and Notes

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.

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 34601

Plan: Plan 01 gg_river 10 RS: 34601 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	72.71				
Vel Head (ft)	0.08	Wt. n-Val.		0.040	
W.S. Elev (ft)	72.63	Reach Len. (ft)	7200.00	7200.00	6700.00
Crit W.S. (ft)		Flow Area (sq ft)		894772.70	
E.G. Slope (ft/ft)	0.000168	Area (sq ft)		894772.70	
Q Total (cfs)	2078180.00	Flow (cfs)		078180.00	
Top Width (ft)	84555.13	Top Width (ft)		84555.13	
Vel Total (ft/s)	2.32	Avg. Vel. (ft/s)		2.32	
Max Chl Dpth (ft)	15.33	Hydr. Depth (ft)		10.58	
Conv. Total (cfs)	160212500.0	Conv. (cfs)		0212500.0	
Length Wtd. (ft)	7200.00	Wetted Per. (ft)		84555.15	
Min Ch El (ft)	57.30	Shear (lb/sq ft)		0.11	
Alpha	1.00	Stream Power (lb/ft s)		0.26	
Frctn Loss (ft)	0.67	Cum Volume (acre-ft)	11089.69	585085.50	892.52
C & E Loss (ft)	0.01	Cum SA (acres)	1954.61	42466.31	341.54

Errors, Warnings and Notes

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.

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 30401

Plan: Plan 01 gg_river 10 RS: 30401 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	72.03				
Vel Head (ft)	0.04	Wt. n-Val.		0.040	
W.S. Elev (ft)	71.99	Reach Len. (ft)	7300.00	7300.00	7300.00
Crit W.S. (ft)		Flow Area (sq ft)		286560.00	
E.G. Slope (ft/ft)	0.000059	Area (sq ft)		286560.00	
Q Total (cfs)	2078180.00	Flow (cfs)		078180.00	
Top Width (ft)	95503.42	Top Width (ft)		95503.42	
Vel Total (ft/s)	1.62	Avg. Vel. (ft/s)		1.62	
Max Chl Dpth (ft)	20.99	Hydr. Depth (ft)		13.47	
Conv. Total (cfs)	270586200.0	Conv. (cfs)		0586200.0	
Length Wtd. (ft)	7300.00	Wetted Per. (ft)		95503.44	
Min Ch El (ft)	51.00	Shear (lb/sq ft)		0.05	
Alpha	1.00	Stream Power (lb/ft s)		0.08	
Frctn Loss (ft)	0.38	Cum Volume (acre-ft)	11089.69	404810.10	892.52
C & E Loss (ft)	0.00	Cum SA (acres)	1954.61	27585.44	341.54

Errors, Warnings and Notes

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 25701

Plan: Plan 01 gg_river 10 RS: 25701 Profile: PF 2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	71.64				
Vel Head (ft)	0.03	Wt. n-Val.		0.040	0.050
W.S. Elev (ft)	71.61	Reach Len. (ft)	6000.00	6000.00	6000.00
Crit W.S. (ft)		Flow Area (sq ft)		388487.00	1304.16
E.G. Slope (ft/ft)	0.000047	Area (sq ft)		388487.00	1304.16
Q Total (cfs)	2078180.00	Flow (cfs)		077863.00	317.05
Top Width (ft)	98496.33	Top Width (ft)		97495.58	1000.75
Vel Total (ft/s)	1.50	Avg. Vel. (ft/s)		1.50	0.24
Max Chl Dpth (ft)	21.61	Hydr. Depth (ft)		14.24	1.30
Conv. Total (cfs)	303096800.0	Conv. (cfs)		3050600.0	46240.7
Length Wtd. (ft)	6000.00	Wetted Per. (ft)		97495.59	1000.75
Min Ch El (ft)	50.00	Shear (lb/sq ft)		0.04	0.00
Alpha	1.00	Stream Power (lb/ft s)		0.06	0.00
Frctn Loss (ft)	0.26	Cum Volume (acre-ft)	11089.69	180661.30	783.24
C & E Loss (ft)	0.00	Cum SA (acres)	1954.61	11413.57	257.68

Errors, Warnings and Notes

Enter to move to next downstream river station location

Cross Section Output

File Type Options Help

River: gg_river Profile: PF 2

Reach 10 Riv Sta: 20901

Plan: Plan 01 gg_river 10 RS: 20901 Profile: PF 2

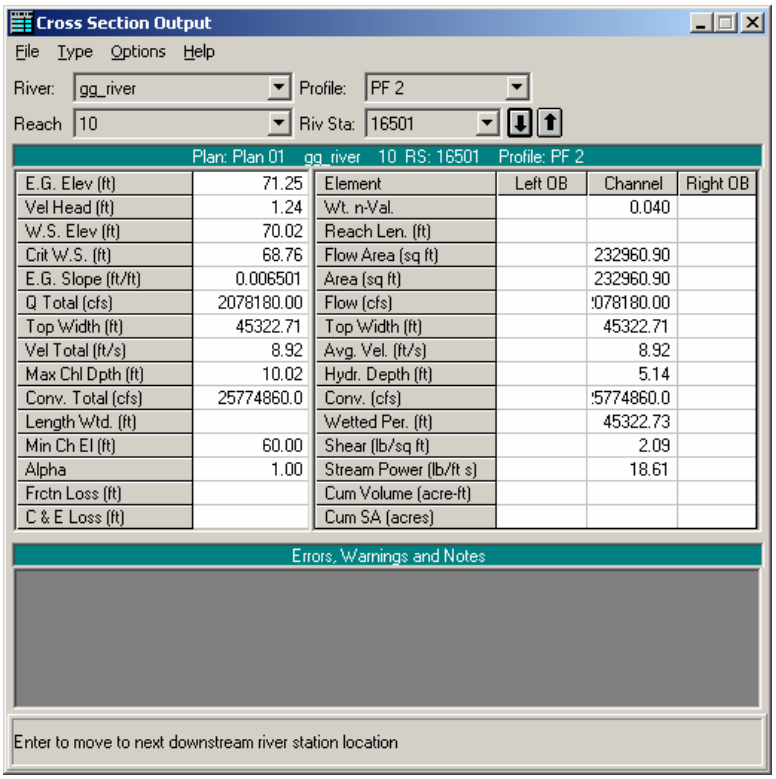
		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	71.39				
Vel Head (ft)	0.04	Wt. n-Val.	0.050	0.040	0.050
W.S. Elev (ft)	71.35	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)		Flow Area (sq ft)	158382.60	210655.00	9903.42
E.G. Slope (ft/ft)	0.000040	Area (sq ft)	158382.60	210655.00	9903.42
Q Total (cfs)	2078180.00	Flow (cfs)	95063.91	978667.00	4448.85
Top Width (ft)	96979.45	Top Width (ft)	27915.62	66368.00	2695.83
Vel Total (ft/s)	1.51	Avg. Vel. (ft/s)	0.60	1.63	0.45
Max Chl Dpth (ft)	26.35	Hydr. Depth (ft)	5.67	18.24	3.67
Conv. Total (cfs)	327320600.0	Conv. (cfs)	4972900.0	1647000.0	700709.7
Length Wtd. (ft)	100.00	Wetted Per. (ft)	27915.62	66368.05	2695.84
Min Ch El (ft)	45.00	Shear (lb/sq ft)	0.01	0.05	0.01
Alpha	1.13	Stream Power (lb/ft s)	0.01	0.08	0.00
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	181.80	1657.04	11.37
C & E Loss (ft)	0.12	Cum SA (acres)	32.04	128.20	3.09

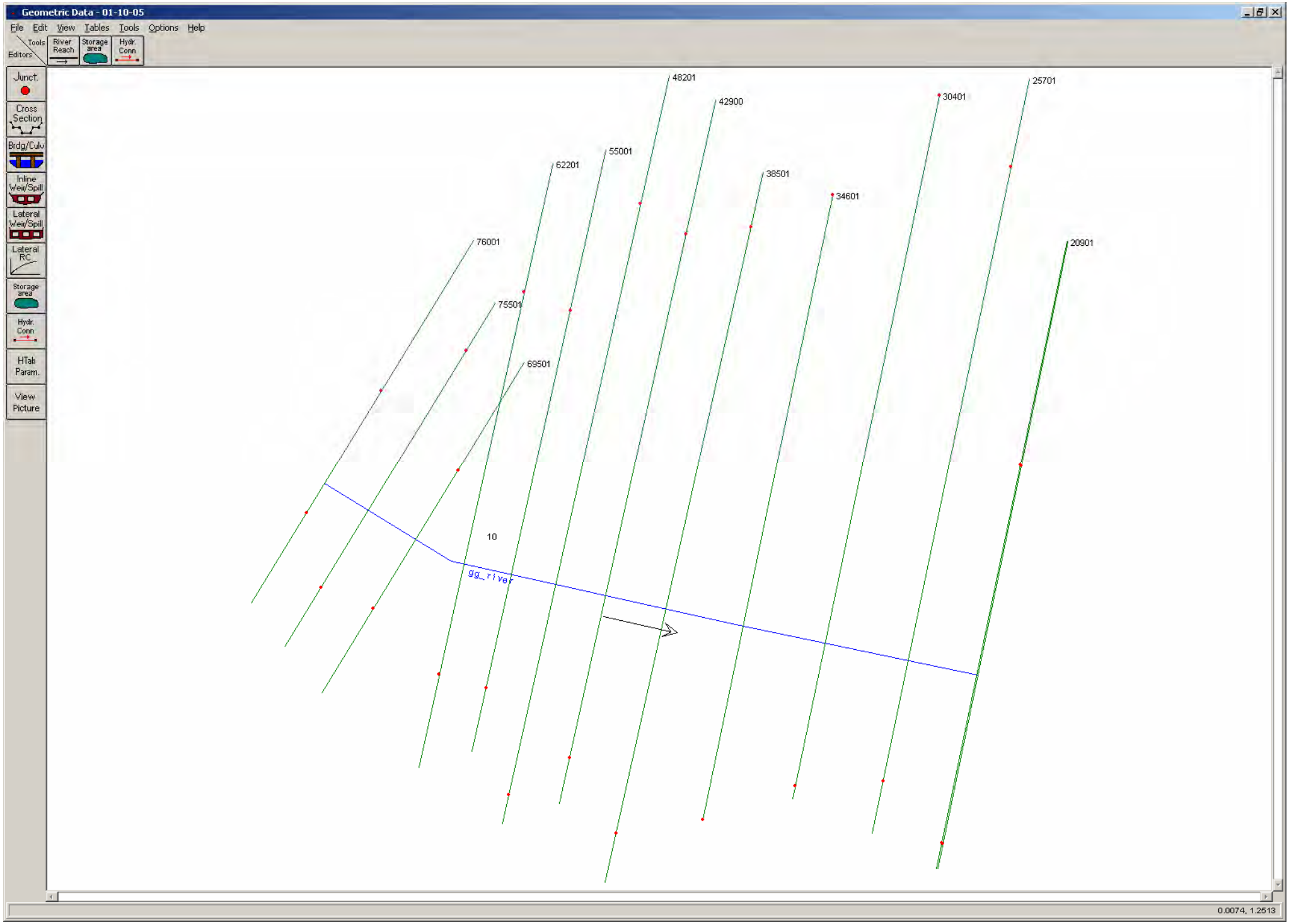
Errors, Warnings and Notes

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

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.

Enter to move to next downstream river station location


Cross Section Output
File Type Options Help
River: gg_river
Profile: PF 2
Reach 10
Riv Sta: 16501
Plan: Plan 01 gg_river 10 RS: 16501 Profile: PF 2
E.G. Elev (ft) 71.25
Vel Head (ft) 1.24
W.S. Elev (ft) 70.02
Crit W.S. (ft) 68.76
E.G. Slope (ft/ft) 0.006501
Q Total (cfs) 2078180.00
Top Width (ft) 45322.71
Vel Total (ft/s) 8.92
Max Chl Dpth (ft) 10.02
Conv. Total (cfs) 25774860.0
Length Wtd. (ft)
Min Ch El (ft) 60.00
Alpha 1.00
Frctn Loss (ft)
C & E Loss (ft)
Element Left OB Channel Right OB
Wt. n-Val. 0.040
Reach Len. (ft)
Flow Area (sq ft) 232960.90
Area (sq ft) 232960.90
Flow (cfs) 078180.00
Top Width (ft) 45322.71
Avg. Vel. (ft/s) 8.92
Hydr. Depth (ft) 5.14
Conv. (cfs) 5774860.0
Wetted Per. (ft) 45322.73
Shear (lb/sq ft) 2.09
Stream Power (lb/ft s) 18.61
Cum Volume (acre-ft)
Cum SA (acres)
Errors, Warnings and Notes
Enter to move to next downstream river station location


Geometric Data - 01-10-05
File Edit View Tables Tools Options Help
Tools
Editors
River Reach
Storage area
Hydr. Conn
Junct.
Cross Section
Brdg/Culv
Inline Weir/Spill
Lateral Weir/Spill
Lateral RC
Storage area
Hydr. Conn
HTab Param.
View Picture
48201
42900
30401
25701
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62201
38501
34601
76001
20901
75501
69501
10
gg_river
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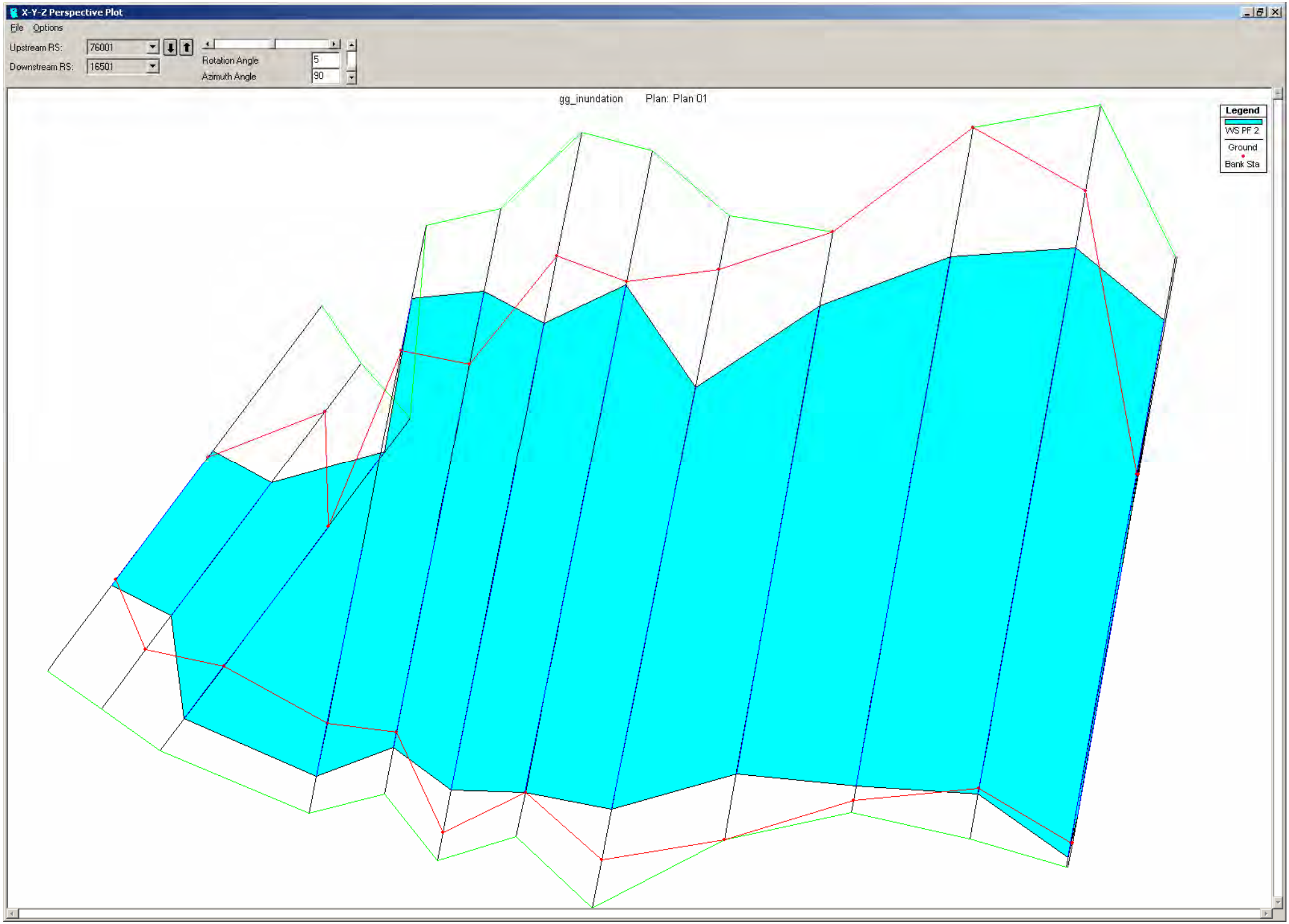
X-Y-Z Perspective Plot
File
Options
Upstream RS:
76001
Downstream RS:
16501
Rotation Angle
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Azimuth Angle
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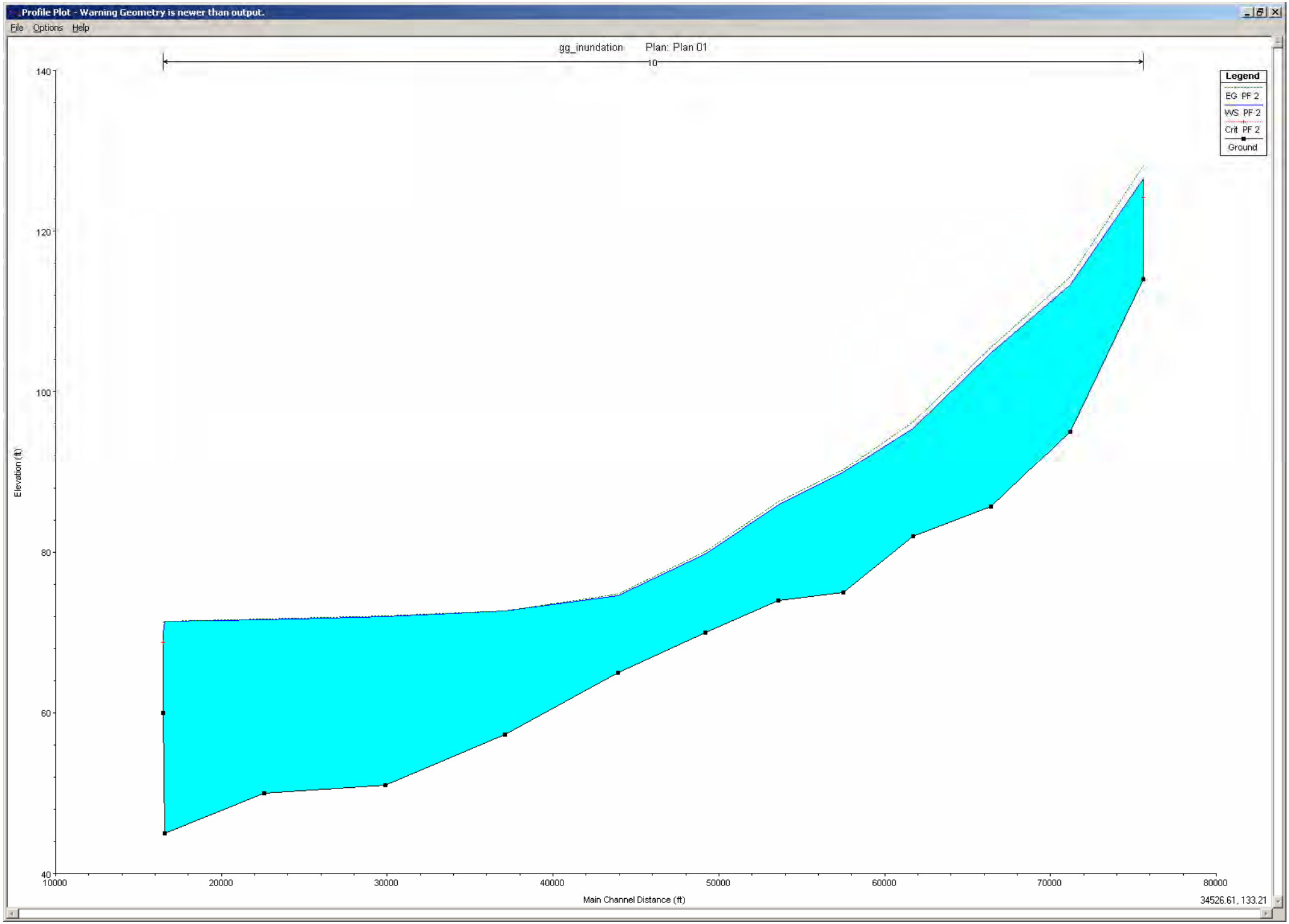
gg_inundation
Plan: Plan 01
Legend
WS PF 2
Ground
Bank Sta


Profile Plot - Warning Geometry is newer than output.
File Options Help
gg_inundation Plan: Plan 01
10
Legend
EG PF 2
WS PF 2
Crit PF 2
Ground
Elevation (ft)
140
120
100
80
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40
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80000
Main Channel Distance (ft)
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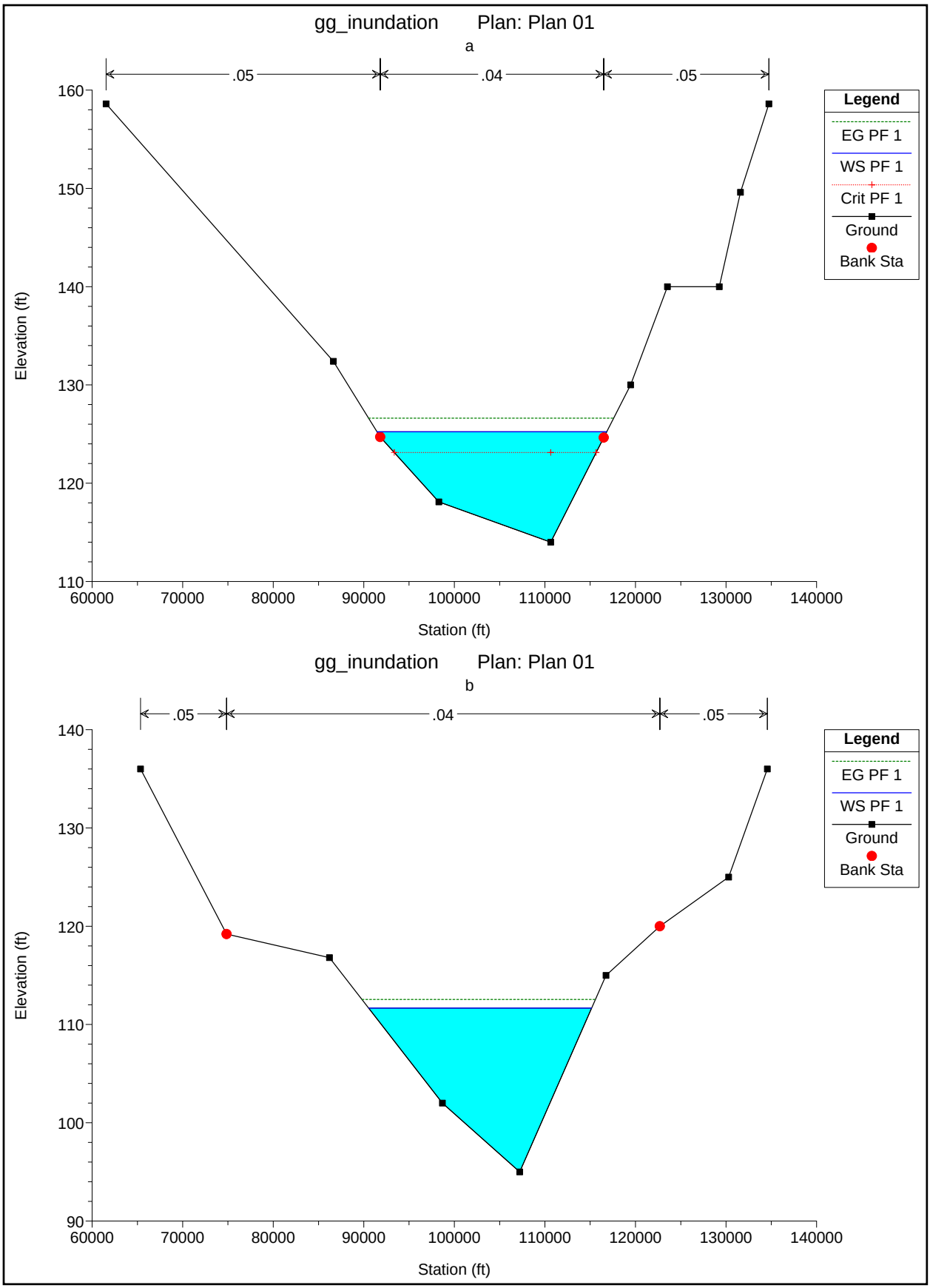
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110
Elevation (ft)
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140000
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
gg_inundation Plan: Plan 01
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130
120
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Elevation (ft)
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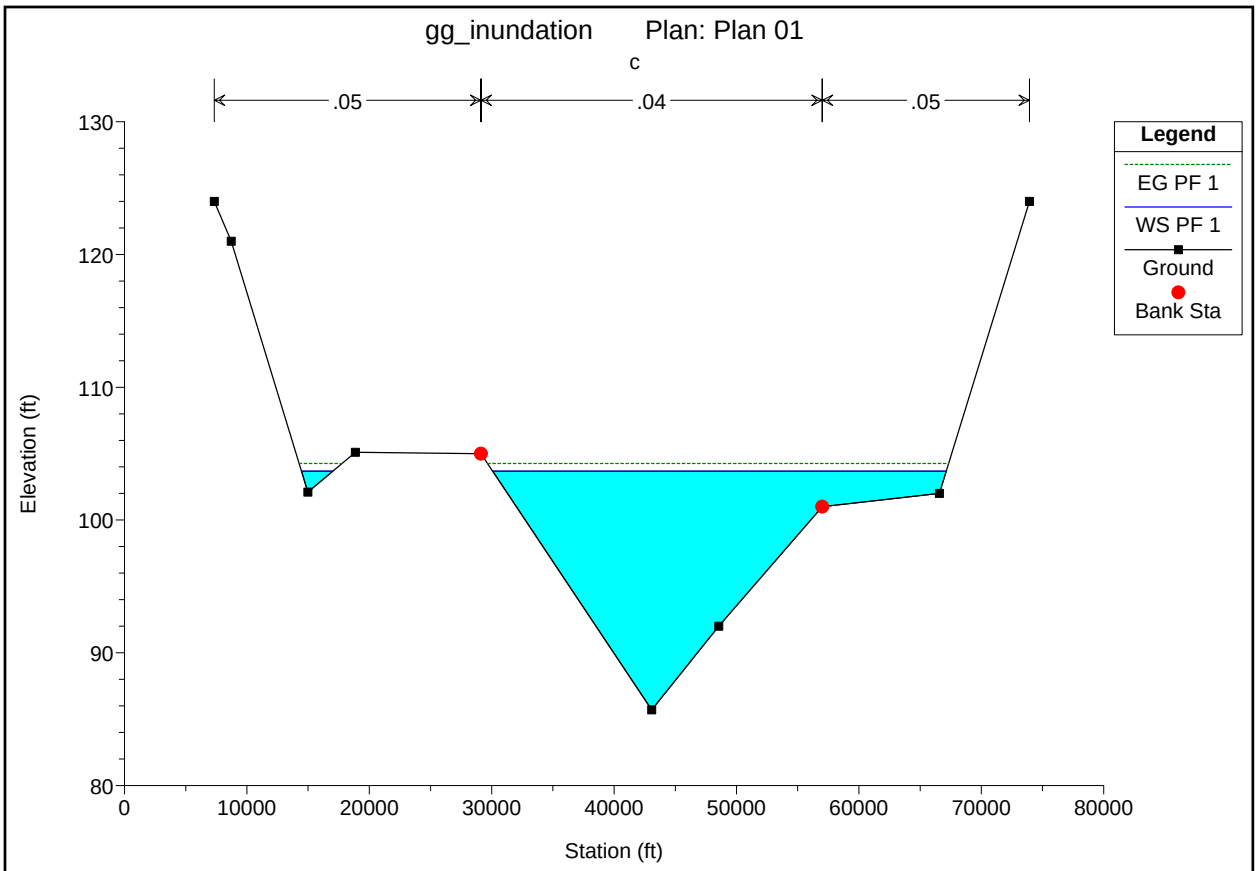
140000
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta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c
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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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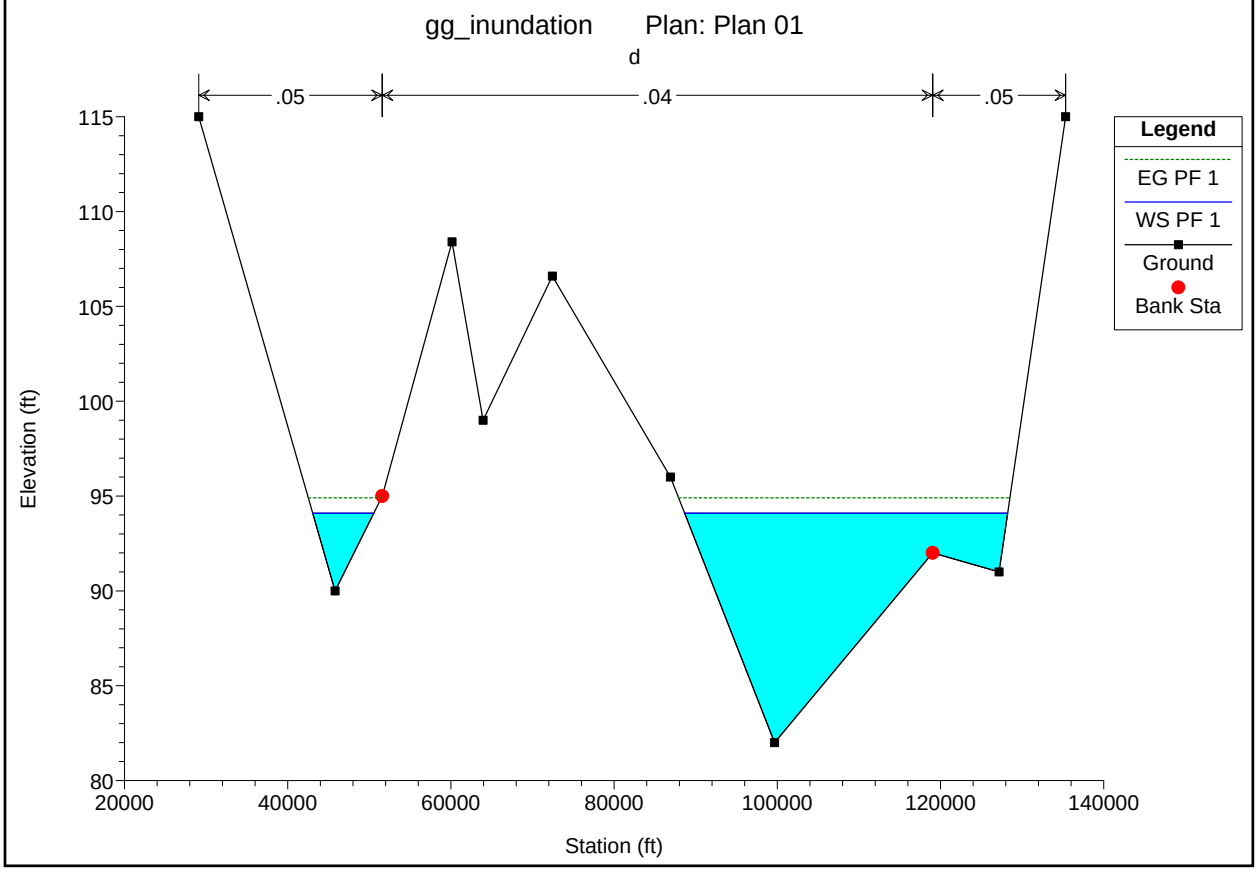
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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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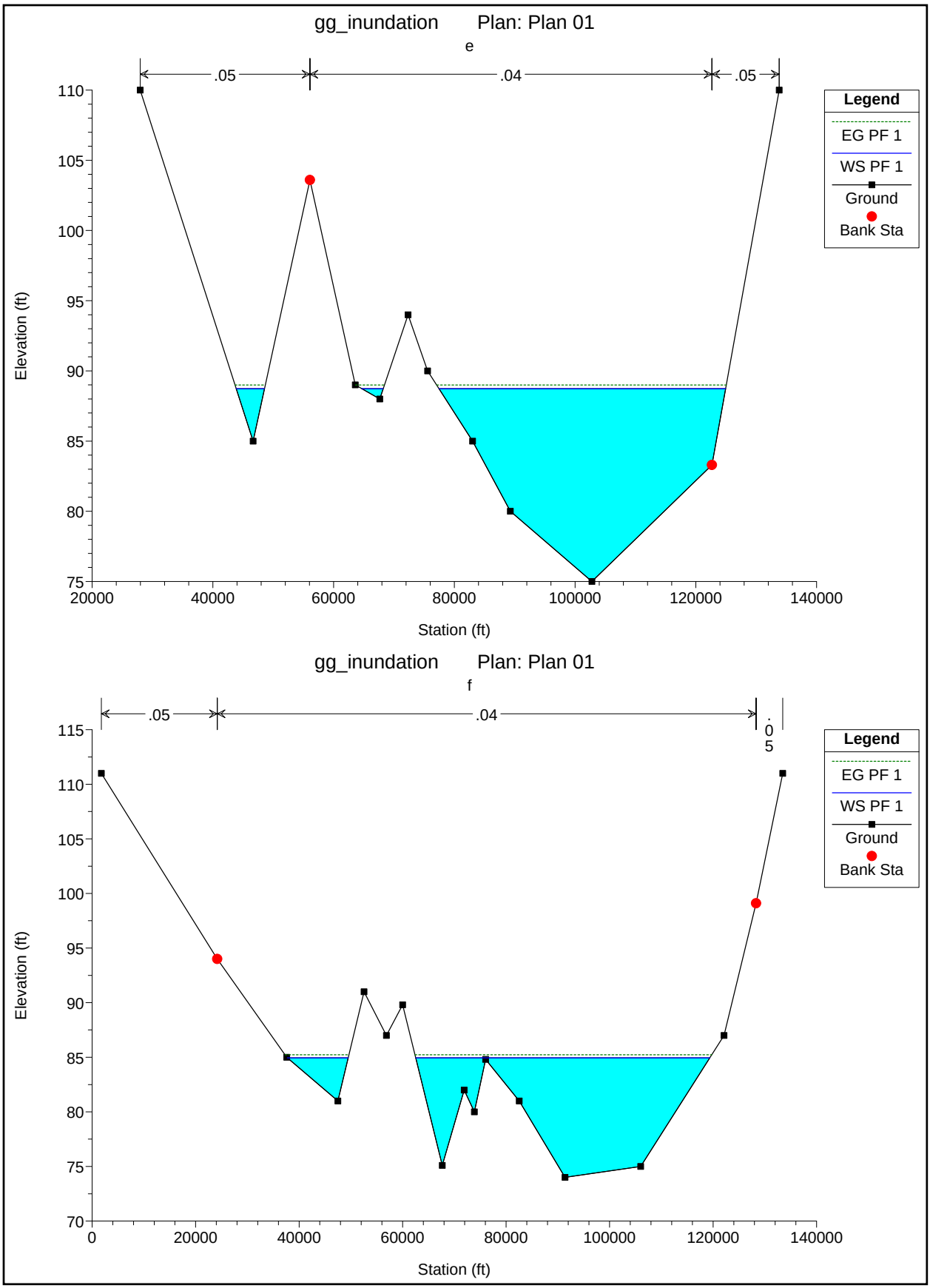
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WS PF 1
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Elevation (ft)
Station (ft)
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gg_inundation Plan: Plan 01
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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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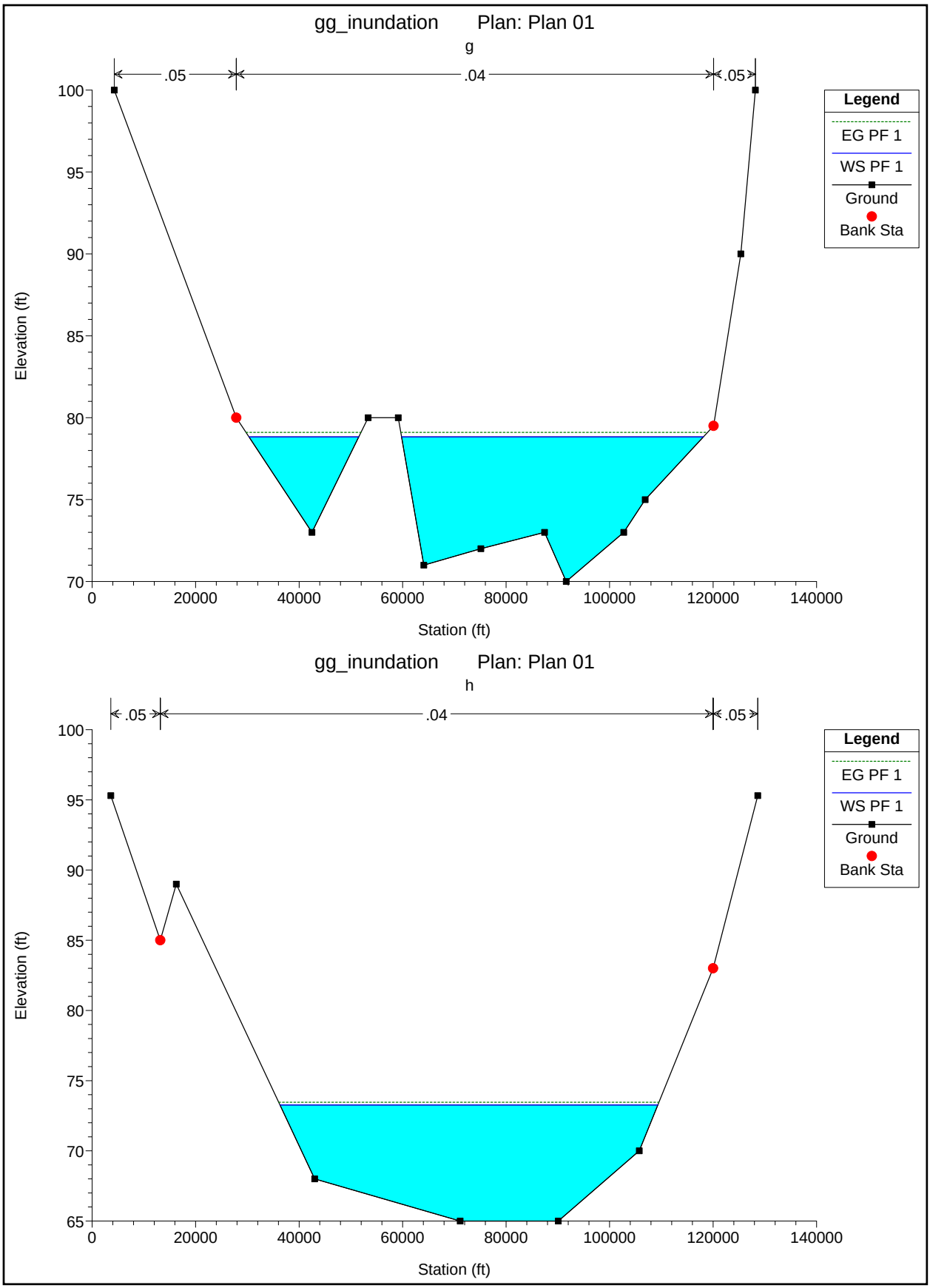
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Elevation (ft)
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Legend
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Elevation (ft)
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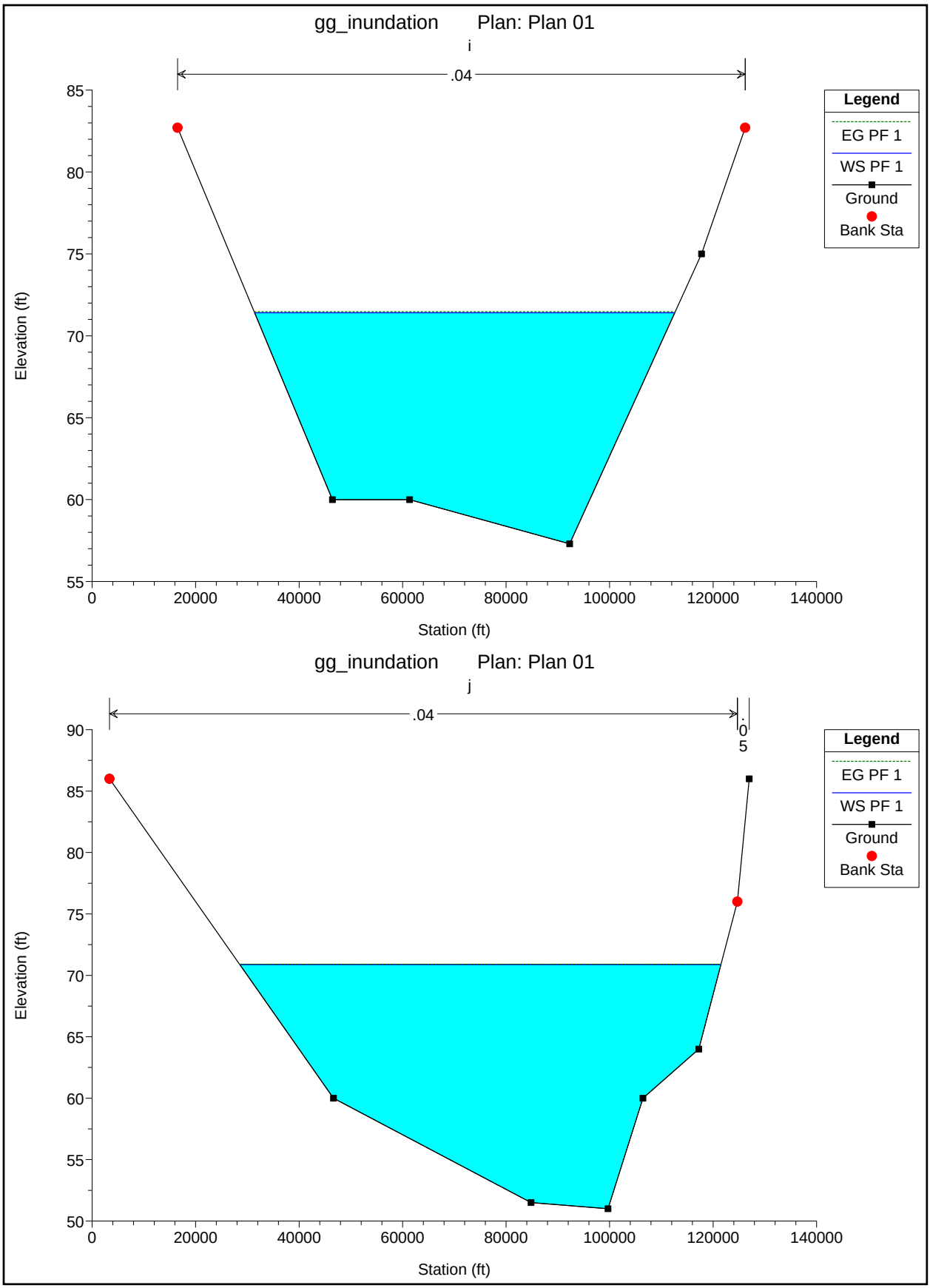
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Legend
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WS PF 1
Ground
Bank Sta
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Station (ft)
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120000
140000
gg_inundation Plan: Plan 01
j
.04
.05
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
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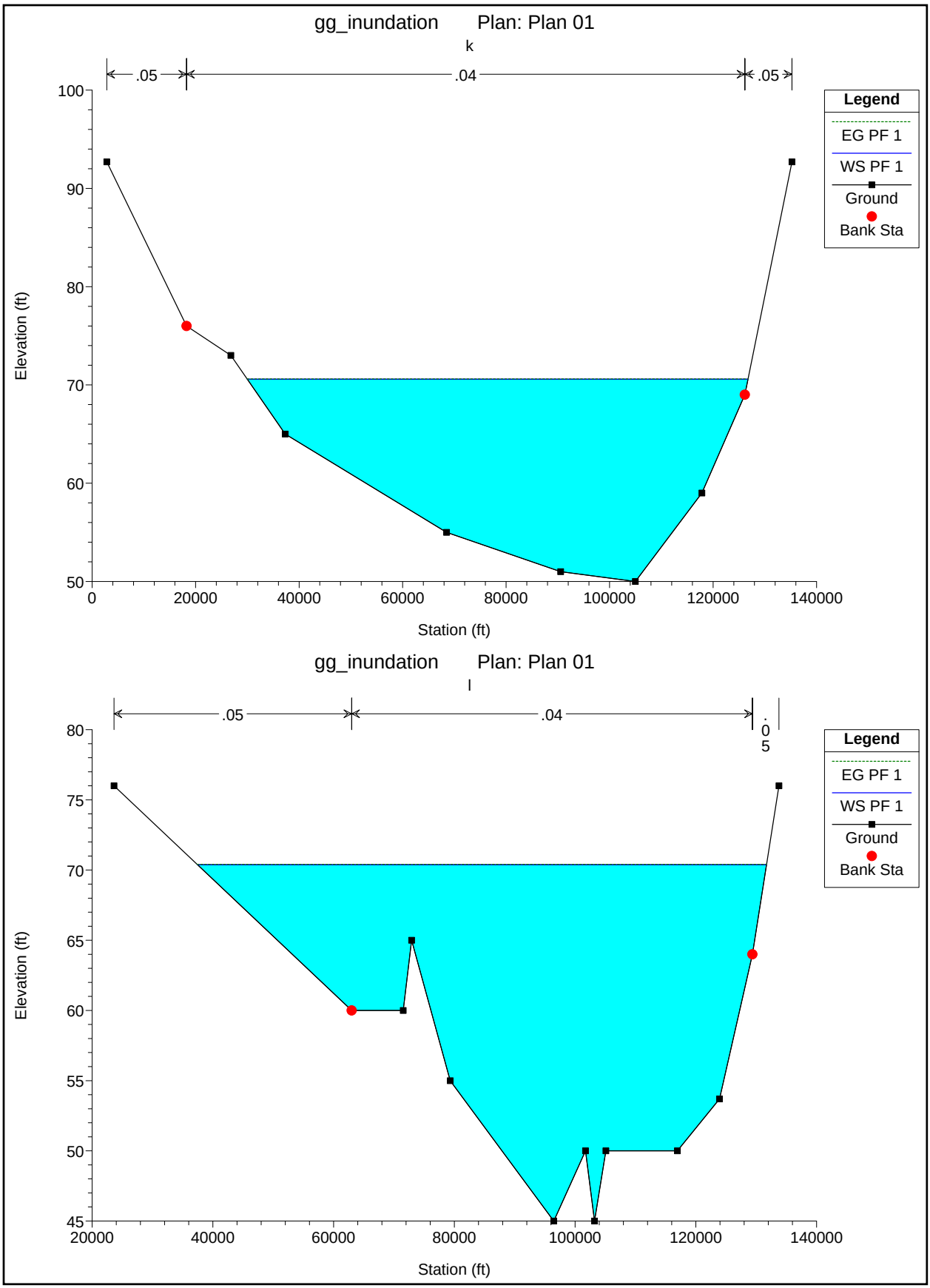
140000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90
80
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Elevation (ft)
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80000
100000
120000
140000
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
gg_inundation Plan: Plan 01
l
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.04
.05
80
75
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65
60
55
50
45
Elevation (ft)
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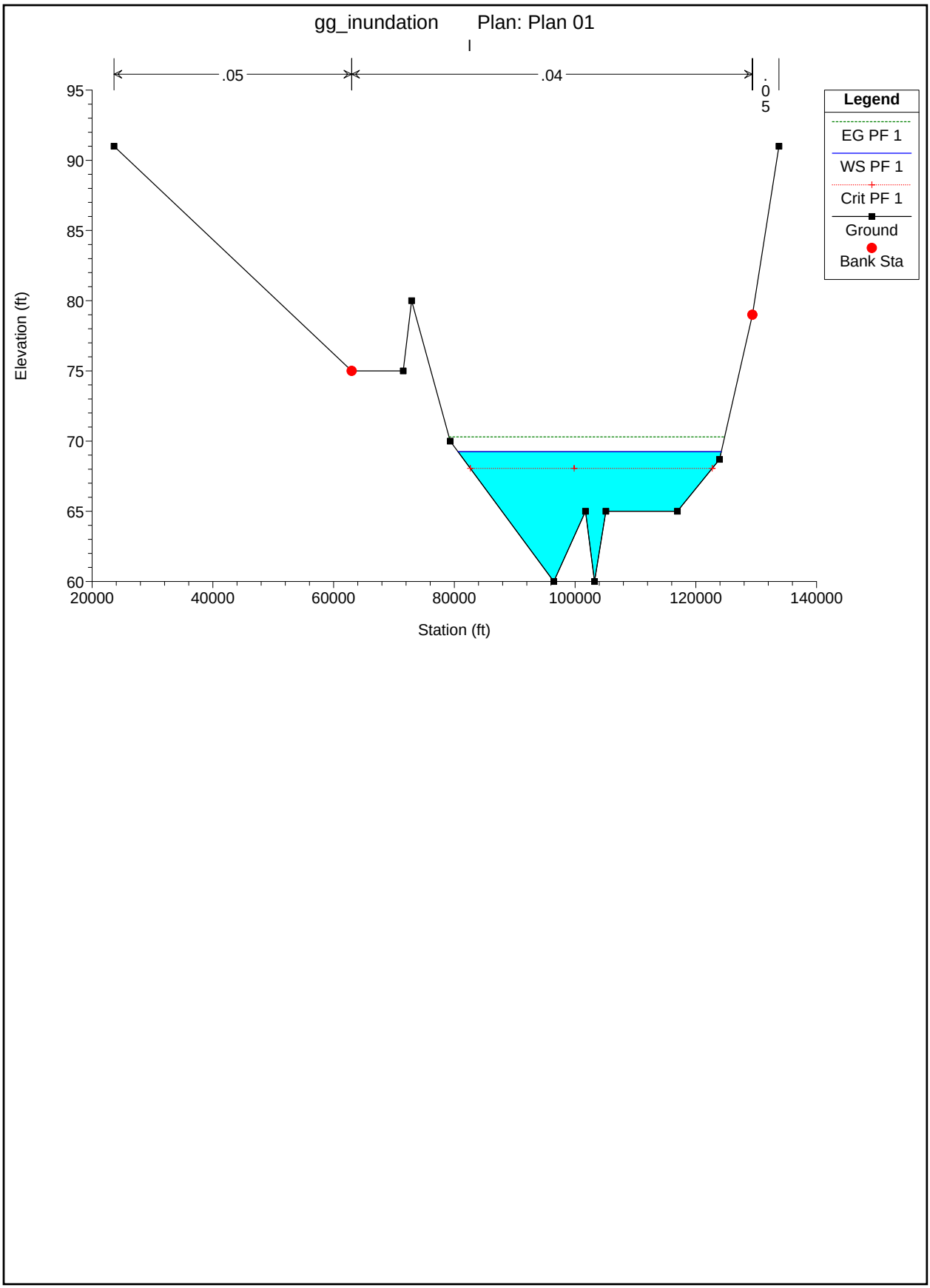
60000
80000
100000
120000
140000
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


gg_inundation Plan: Plan 01
.05
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.05
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
95
90
85
80
75
70
65
60
20000
40000
60000
80000
100000
120000
140000

APPENDIX F

HEC-RAS Graphic Plots