Memorandum

To: PPO Subcommittee
From: Paul Woodward, Water Resources Engineer
Date: December 8, 2006
Re: Update on flooding issues in Forrest Run and Lyman Highlands Subdivisions near Gretna, NE

Last month, the Board requested that staff investigate the potential for a channel improvement project through the Forrest Run Subdivision near Gretna, NE to alleviate flooding problems. In response to the Board's action, District management retained Lamp, Rynearson & Associates (LRA) to prepare a preliminarily channel improvement design and cost estimate. They were also asked to compare potential flood inundation limits within the subdivision with and without a channel improvemetn. A copy of a preliminary grading plan and cost estimate for the channel design is enclosed along with a report of LRA's preliminary hydrologic and hydraulic evaluation.

The preliminary results show that the proposed channel will provide a corridor for small rains, but flooding is anticipated annually because it will not contain a 1-year flood event. There is minimal improvement in the 5-year flood event and no improvement in the 100-year flood event. Maps showing these inundation areas are included in the report. Preliminary plans also show that several existing trees and utilities will need to be relocated or replaced. Total cost of the project, including construction, relocation and engineering, is estimated at $133,648.00.

Before the District can make a decision on the project, additional information is needed. First, the staff has yet to meet with the City of Gretna or Sarpy County to discuss cost share for the project. Second, right-of-way allowing the District and/or other governmental agencies to construct and maintain the channel needs to be addressed. A decision will also need to be reached as to who should be responsible for operation and maintenance. Finally, the Board will need to determine the best approach for constructing the channel and meeting future maintenance demands.

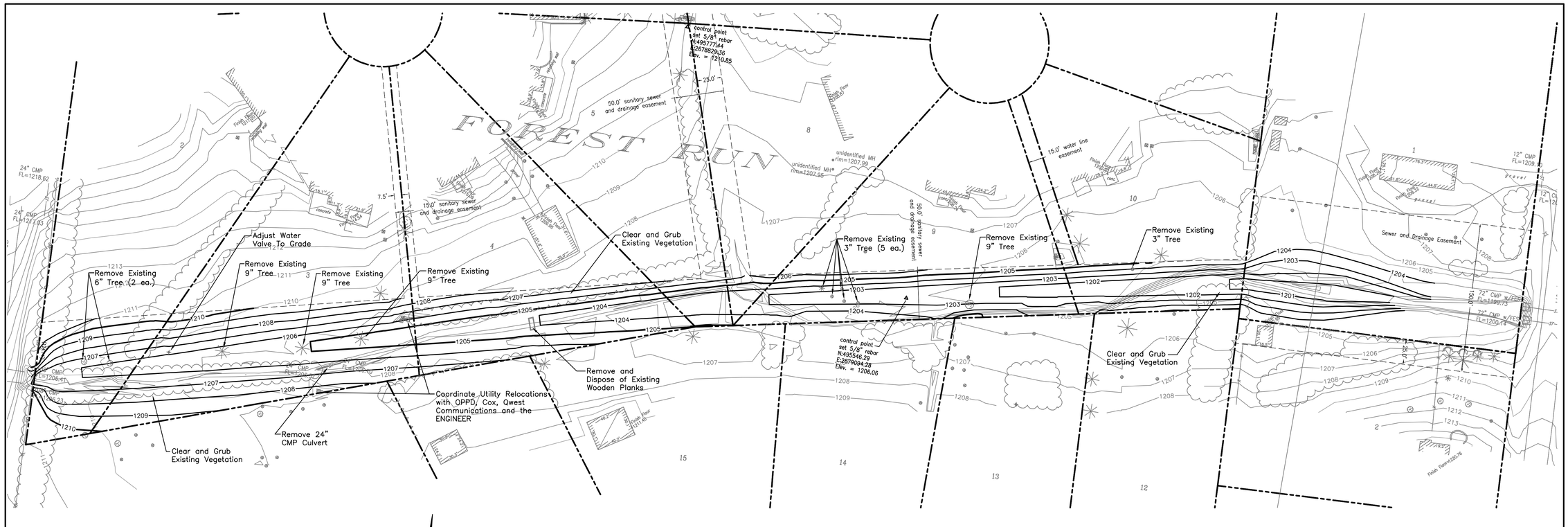
Once these issues have been addressed, the District will be able to make a well-informed decision of whether or not to proceed with final design, permits, and construction.

Site Design

Assumptions/Comments:

	Bid Item Description	Approximate Quantity	Unit	Unit Price	Total
1 .	CLEARING AND GRUBBING GENERAL	1	LS	$10,000.00	$10,000.00
2 .	CONSTRUCT EROSION CONTROL BLANKET	10,000	SY	$1.50	$15,000.00
3 .	DRAINAGEWAY SEEDING	2.2	AC	$1,500.00	$3,300.00
4 .	CONSTRUCT SILT FENCE DITCH CHECK	500	LF	$3.00	$1,500.00
5 .	EARTHWORK (CHANNEL GRADING)	6,900	CY	$6.00	$41,400.00
6 .	ADJUST WATER VALVE TO GRADE	1	EA	$500.00	$500.00
7 .	REPAIR ASPHALT ROAD	1	LS	$10,000.00	$10,000.00
8 .	CONTINGENCY	20	%		$16,340.00

	Estimated Construction Costs:	$98,040.00
20.00%	**Engineering Design and Construction Administration:**	$19,608.00
	Erosion Control Monitoring	$1,000.00
	Total Estimated Soft Costs:	$20,608.00
	UTILITY RELOCATION - QWEST (per Qwest)	$7,000.00
	UTILITY RELOCATION - OPPD (per OPPD)	$5,000.00
	UTILITY RELOCATION - COX	$3,000.00
	Total Estimated Costs:	$133,648.00



DISTURBED AREA = 2.20 ACRES

LEGEND

- PROPERTY LINE
- DRAINAGE EASEMENT
- CONTOUR
- PROPOSED GRADING
- BUILDING
- STORM SEWER
- MANHOLE
- FLARED END SECTION
- FIRE HYDRANT
- WATER METER
- WATER VALVE
- WATER SERVICE
- GAS METER
- GAS VALVE
- GAS SERVICE
- POWER METER
- POWER RISER
- POWER PULL BOX
- CONTROL POINT
- CHAIN LINK FENCE
- DECIDUOUS TREE
- CONIFEROUS TREE
- BUSH

SCHEDULE OF APPROXIMATE QUANTITIES

ITEM NO.	DESCRIPTION	APPROXIMATE QUANTITY		FINAL QUANTITY	
1.	Clearing & Grubbing General	1	LS		LS
2.	Construct Erosion Control Blanket	10,000	SY		SY
3.	Drainageway Seeding	2.2	AC		AC
4.	Construct Silt Fence	500	LF		LF
5.	Earthwork (Channel Grading)	6,900	CY		CY
6.	Adjust Water Valve to Grade	1	EA		EA
7.	Repair Asphalt Roads	1	LS		LS

NOTES

1. Contractor shall protect existing gardens, buildings, sheds, sprinkler systems and landscaped areas outside limits of grading. Modify the channel side slopes as necessary.
2. No areas shall be disturbed outside the existing sewer & drainage easements.
3. Site access shall be coordinated through the ENGINEER.
4. All disturbed channel and other areas shall receive erosion control matting and seeding.
5. SEED: Seed mix shall be Tuff Turf Type Tall Fescue mixture (90% Arid 3, Parasio and Quest Turf Type Tall Fescue and 10% Fineleaf Perennial) Seeding shall be applied at a rate of 12 lbs per 1000 sf.
6. Erosion Control Matting: Erosion Control Matting shall be North American Green DS75 or approved equal. Matting shall be installed per manufacturer's recommendations with a Type D Staple Pattern (3.4 staples per square yard).
7. All work shall be completed within the existing Santiray Sewer and Drainage Easement Limits shown on these plans. The CONTRACTOR shall obtain permission from the ENGINEER to work outside these limits.
8. The CONTRACTOR shall be responsible for cleaning out silt deposited in the downstream culverts or channel due to grading operations until the channel has been matted and seeded.
9. Clearing and Grubbing shall include removal of vegetation and trees up to 9 inches in diameter.
10. The CONTRACTOR shall coordinate utility relocations with Qwest, OPPD, Cox cable and the ENGINEER.
11. The CONTRACTOR shall repair any channel imporvement project–related damage to the asphalt haul roads as determined by the ENGINEER.
12. The CONTRACTOR shall haul excess channel excavation material to a stockpile located north of the Covington subdivision. Coordinate location with the ENGINEER. This haul work shall not be payed for separately but shall be considered incidental to "Earthwork (Channel Grading)".
13. Removals of CMP culvert and wooden plank bridge shall be incidental to "Earthwork (Channel Grading)".

GENERAL NOTES

1. The CONTRACTOR shall commence work within 5 days of receiving written notice to proceed. The time limit to complete all work shall be fifteen (15) working days.
2. The project specifications shall be the "City of Omaha Standard Specifications for Public Works Construction 2003 3rd Edition" and any current revisions or amendments thereto apply to this project. The Contractor shall perform this construction in accordance with this document.
3. All project procedures, bonds, and reserves shall conform to the specifications of the City of Omaha.
4. The CONTRACTOR shall notify all utility companies 48 hours before work is started to verify utility locations (One Call 344–3565).
5. The ENGINEER shall notify the City of Gretna's City Clerk, **PAM BUETHE (332–3336)**, 48 hours before the project kickoff meeting.
6. The CONTRACTOR shall notify **THOMAS A. LYNAM (339–4606),** Sarpy County Engineer, 48 hours prior to beginning work in county right–of–way.
7. The ENGINEER shall notify the City of Gretna's Engineer, **STEVE PERRY (399–8552)**, 48 hours before the project kickoff meeting.
8. The CONTRACTOR shall not perform any work within the County Right of Way until Owner has obtained a permit.
9. Barricades shall conform to Omaha Public Works "Barricading Standards Specifications, Methods & Materials" and/or the "Manual on Uniform Traffic Control Devices".
10. No trees shall be removed without approval of the ENGINEER, except as noted on these plans.
11. The locations of all aerial and underground utility facilities may not be indicated in these plans. Existing utilities are shown as a convenience for the CONTRACTOR. Underground utilities, whether indicated or not, will be located and flagged by the utility companies at the CONTRACTOR'S request. The CONTRACTOR shall notify all utility companies 48 hours before work is started to verify utility locations (One Call 344–3565). No excavation will be permitted in the area of the underground utilities until all facilities have been located and identified to the satisfaction of all parties and then only with extreme care to avoid any possibility of damages to the facilities. See Section 4.04 of the General Conditions for further information.
12. Elevations are referenced to N.A.V.D. 1988.

TYPICAL DITCH SECTION

NO SCALE

Retain the Location Request Number for YOUR Own Protection!

1 CALL
COVERS ALL PARTICIPATING MEMBERS
344-3565
(WWW.NE–DIGGERS.COM)

METROPOLITAN UTILITIES DISTRICT
OMAHA PUBLIC POWER DISTRICT
QWEST
CITY OF OMAHA
CABLEVISION
COX CABLE OF OMAHA
PEOPLES NATURAL GAS
NORTHERN NATURAL GAS
UNITED CABLE TELEVISION

PRELIMINARY PLAN
NOT FINAL – SUBJECT TO CHANGE

drawn by PWB
designed by MPM
reviewed by MPM

references
06099T000
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06099G100

filename
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Lamp, Rynearson & Associates, Inc.
14710 West Dodge Road, Suite 100
Omaha, Nebraska 68154-2027
WWW.LRA-INC.COM
(Ph) 402.496.2498
(Fax) 402.496.2730

FOREST RUN – CHANNEL IMPROVEMENTS
SARPY COUNTY, NEBRASKA

FOREST RUN
CHANNEL IMPROVEMENTS GRADING PLAN

job number-tasks
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book page

date
December 08, 2006

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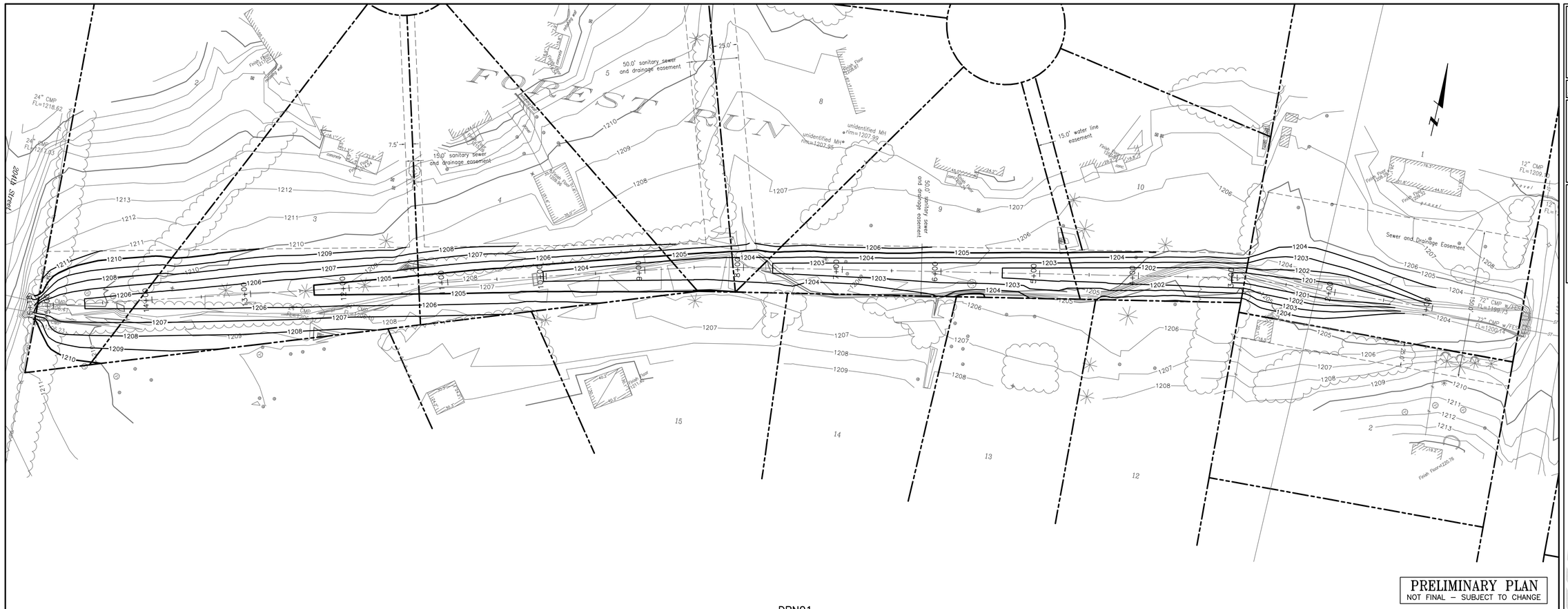
1 of 2



PRELIMINARY PLAN
NOT FINAL – SUBJECT TO CHANGE

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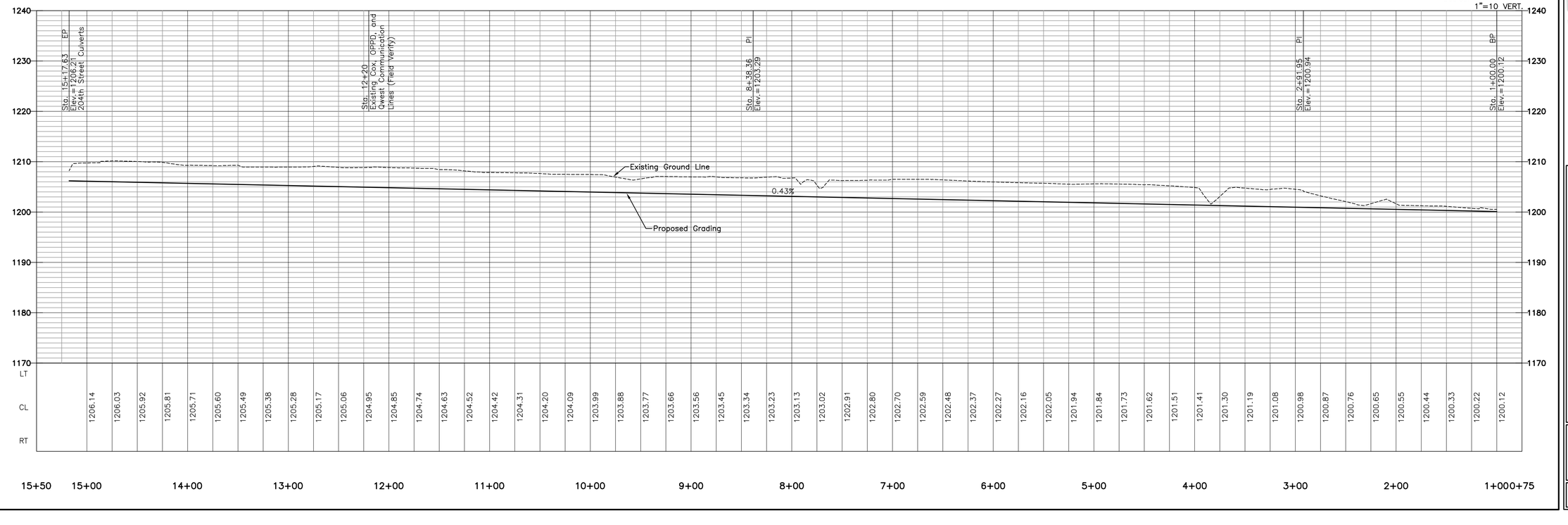
Scales: 1"=50 HOR.
1"=10 VERT.



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Omaha, Nebraska 68154-2027
WWW.LRA-INC.COM
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(Fax) 402.496.2730

FOREST RUN – CHANNEL IMPROVEMENTS
SARPY COUNTY, NEBRASKA

FOREST RUN CHANNEL IMPROVEMENTS
PLAN AND PROFILE

job number-tasks 06099.01–001
book page
date December 08, 2006
sheet 2 of 2

Preliminary Hydrology and Hydraulics Report

For the

Papio-Missouri River Natural Resources District

For

Forest Run Channel Improvements

Lamp, Rynearson & Associates, Inc.

LRA # 06099.01
December 8, 2006

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INTRODUCTION

The purpose of this hydrology and hydraulics report is to investigate the effects of the proposed improvements to the Forest Run channel. The channel is aligned west to east in the Forest Run subdivision. The Forest Run subdivision is located southeast of the intersection of 204th Street and Schram Road. The channel improvement limits extend from 204th Street on the west to the location where previous channel improvements stopped on the east. This is approximately 100 feet west of Iva Street.

The drainage basin for the Forest Run channel is approximately 794 acres and includes a large portion of southern and central Gretna. The extent of the basin is shown on the Drainage Map included with this report.

The existing channel is a narrow and shallow channel that meanders through an existing drainage easement. Based on previous studies, the channel is undersized for many storms and often floods outside the drainage easement limits.

There are several factors contributing to the flooding problems. First, the downstream culverts under Iva Street and Lewiston Lane do not have adequate capacity to convey the larger storm events. This causes the runoff to back up in the channel creating flooding conditions. The channel is very narrow and shallow and has a very slight longitudinal slope. The side slopes of the channel are very gradual and there is little elevation change from the channel bottom to the finish floor of some of the houses to the north. These characteristics also contribute to the flooding issues associated in this area. Finally, the drainage area contributing to the channel is very large and is gradually becoming more developed. This large drainage areas results in large runoff to the channel.

A larger scale solution will need to be investigated in order to solve all of these flooding problems; however, channel improvements can help the flooding problems during small and frequent storm events. These improvements will have a beneficial effect for small storm events with runoff rates well below the capacity of the existing culverts. The effects of these channel improvements are described in this report.

This report is a supplemental report to the Draft Drainage Investigation previously completed by Lamp, Rynearson & Associates (LRA) on October 31st, 2004. The hydrology and hydraulic methods described in the 2004 report have been used for analysis in the report.

FIELD INVESTIGATION

In 2005, a portion of this channel was re-graded, stabilized with erosion control blanket and seeded. Several trees and other vegetation were removed in the drainage way. In addition, the culverts under Schram Road, Lewiston Lane and Iva Street were cleared of silt and debris. The extents of the channel improvements were Schram Road on the east and approximately 100 feet west of Iva Street on the west.

A follow up field investigation was completed on November 28th, 2006. This field investigation verified that the culverts in Iva Street, Lewiston Lane and Schram Road are still clear of silt and debris. In addition, the grading completed in the channel downstream of Iva Street appears to still be in good condition. See Figures 1 and 2. It should be noted that the work completed on these downstream culverts improved conditions in the Forest Run channel by increasing the carrying capacity of the culverts.

The previous channel improvements terminated approximately 100 feet west of Iva Street. See Figure 3.

Figure 1: Iva Street Culverts Looking West

Figure 2: Channel Improvements Looking East from Iva Street

Figure 3: Channel Improvements Looking West from Iva Street.

FOREST RUN CHANNEL

The channel through the Forest Run subdivision has very little longitudinal slope. The channel meanders north and south through the subdivision. In many areas, the channel has a very narrow width and a shallow depth. Figure 4 shows the typical channel through the Forest Run subdivision. The side slopes on the south side of the channel slope up gradually until the slope becomes steeper near the houses. The side slopes on the north side of the channel slope up very gradually and continues gradually up to some of the houses. In one area there is less than three feet of elevation difference from the channel bottom to the finished floor of the adjacent house.

It is evident from the field investigations that water has flooded outside the designated drainage easements. Neighbors have reported water at or near some of the houses during large rain events. In addition, there are several utility boxes located near the channel. These include Cox Cable, OPPD and Qwest utility boxes. It is evident that these boxes become flooded during most rain events. During the field visit, it was noted that one large OPPD transformer had been relocated away from the channel to the north.

The channel from 204th Street downstream to approximately 300 feet east has dense and tall vegetation as shown in Figure 5. This vegetation includes wetland plants and other vegetation. In addition, there are several trees ranging in diameter from 3" to 9" located in the drainage easement, including mature coniferous trees, see Figure 6.

Figure 4: Typical Channel Looking West Through Forest Run

Figure 5: Forest Run Channel Looking East from 204th Street

Figure 6: Utility Boxes and Coniferous Trees in Drainage Easement

DESCRIPTION OF MODELS

A. Hydrology Models

The hydrological program used for this report is HEC-HMS, distributed by the US Army Corp of Engineers http://www.hec.usace.army.mil/software/hec-hms/hechms-hechms.html. HEC-HMS uses rainfall and land use data to determine surface water runoff rates and volumes for different storm events. The rainfall data used in the model was taken from Technical Paper 40 as published the in the City of Omaha Stormwater Design Manual.

Rainfall losses are the difference in the volume of the total rainfall and the volume of surface runoff at a specific location due to the rainfall. HEC-HMS has several methods available to model this rainfall loss rate. For this report, the Soil Conservation Service (SCS) method was used to model the rainfall loss rate. This procedure uses a Curve Number or CN to represent the runoff potential for a particular land use. Curve Numbers can range from 0 to 100 with higher curve numbers indicating a higher runoff potential.

The SCS method uses a Lag Time to represent the delay in time after a heavy rain before the runoff reaches a maximum peak. Lag time in this report is calculated as 0.6 x Time of Concentration. Time of concentration is defined as the time for water to travel from the remotest part of a basin to the point of interest. Time of concentration is dependent on the land characteristics.

Initial abstraction is all the losses before runoff begins. It includes water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. Initial abstraction is calculated in the model as $I_a = 0.2S$, where $S = 1000/CN - 10$. This is a standard formula for initial abstraction.

B. Hydraulic Model

The hydraulic program used to model the channel in this report is HEC-RAS, distributed by the US Army Corp of Engineers http://www.hec.usace.army.mil/software/hec-ras. HEC-RAS uses cross-sections inputted by the user to determine channel flow profiles. Existing cross sections were determined from a topographic survey completed by LRA. Other input parameters were determined from field investigations and from reference tables in Chow (1963). The topographic survey, cross section locations, and the cross sections used in the model are included in this report.

HYDROLOGY - DEVELOPED CONDITIONS

For the analysis in this report, it is assumed that the drainage basin has full build-out or developed conditions. In the full build-out condition, it is anticipated that the majority of the undeveloped land within the basin will be developed over the next several years.

Developed conditions were modeled assuming that all the existing seeded and agricultural land will be developed into ¼-acre lots with a CN value of 80. It is anticipated that some of the land will be developed into other uses such as commercial areas and parks; however these are assumed to average to a composite CN near 80. The CN values for areas already developed were calculated using standard engineering methods and are summarized in the following table:

Table 1 - Watershed Basins - Developed Conditions

WATERSHED BASIN	AREA (Acres)	Curve Number (CN)	DESCRIPTION
Southwest Gretna	286	80	Includes portions of southwest Gretna and Standing Stone subdivision.
Gretna	288	79	Includes portions of central Gretna and Willow Park subdivision.
West	88	73	Includes the Forest Run and Covington subdivisions
Central	102	71	Includes central portions of the Lyman Hylands and Covington subdivisions
East	30	78	Includes eastern portions of the Lyman Hylands and Covington subdivisions.

Using the HEC-HMS model, the 1, 2, 5, 10, 50 and 100-Year storm event runoff values were calculated at four locations, Junctions A, B, C, and D. These locations are shown on the Drainage Map included with this report. The runoff in cubic feet per second for each storm event are summarized in the following table:

Table 2 - Summary of Runoff for 1, 2, 5, 10, 50, and 100-Year Storm Events for Developed Conditions

Model	1 Year Runoff (cfs)	2 Year Runoff (cfs	5 Year Runoff (cfs)	10 Year Runoff (cfs)	50 Year Runoff (cfs)	100 Year Runoff (cfs)
Location						
Junction A	418	485	1,039	1,472	2,315	2,557
Junction B	438	509	1,102	1,570	2,484	2,794
Junction C	458	534	1,172	1,678	2,670	3,053
Junction D	462	540	1,186	1,711	2,726	3,131

PROPOSED IMPROVEMENTS

The proposed improvements in the Forest Run channel include channel grading, removal of vegetation and trees, relocation of utility boxes, seeding and erosion control blankets. The grading for the channel improvements will include a straight grade profile from the downstream culvert elevation at 204th Street to the upstream culvert elevation at Iva Street. The channel cross-section will be a typical section with a 10-foot flat bottom. The side slopes of the channel will vary to tie into the existing grades at the limits of the drainage easement. The centerline of the channel will be placed to follow the midpoint of the drainage easement. Preliminary construction plans and cost estimates have been completed and are included with this report.

Several trees and existing vegetation will need to be removed to allow for the grading work. It may be possible to relocate some of the more mature trees; however this would involve increased costs. Once the channel has been graded, the disturbed areas will be seeded and covered with erosion control blanket. Also, the existing utility boxes located near the channel will be relocated further outside the channel limits to provide additional separation from the channel.

HYDRAULICS

The existing channel and the proposed improvements were modeled hydraulically using HEC-RAS. The cross section locations used in the model are shown in Figure 7. The existing cross sections were cut from the topographic survey completed by LRA. The proposed channel improvements were modeled by taking cross-sections from the proposed grading contours.

The flow scenarios represented in the model include the 1-year, 2-Year, 5-year, 10-year, 50-year and 100-year storm events. In addition, a flow of 150 cfs, which is well below the 1-year storm event, representing a more frequent rain event was modeled.

The results of the model show the water surface elevations at each cross-section. The results for the 150 cfs event, the 1-year, 2-year, 5-year, 10-year, 50-year and 100-year events are summarized in the following tables:

Table 3: Surface Water Elevations for 150 cfs event

Channel Station	Existing Elevation	Elevation With Channel Improvements	Difference in Elevation (ft)
204th Street			
2800	1209.23	1207.13	2.10
2600	1208.33	1206.74	1.59
2400	1207.33	1205.51	1.82
2200	1207.00	1204.79	2.21
2000	1206.06	1204.28	1.78
1800	1205.64	1204.00	1.64
1600	1203.88	1203.99	-0.11
1451.95	1203.98	1203.98	0.00
Iva Street			

Table 4: Surface Water Elevations for 1-Year Event

Channel Station	Existing Elevation	Elevation With Channel Improvements	Difference in Elevation (ft)
204th Street			
2800	1209.85	1208.16	1.69
2600	1209.01	1207.72	1.29
2400	1208.09	1207.49	0.60
2200	1207.81	1207.43	0.38
2000	1207.50	1207.40	0.10
1800	1207.40	1207.38	0.02
1600	1207.37	1207.38	-0.01
1451.95	1207.36	1207.36	0.00
Iva Street			

Table 5: Surface Water Elevations for 2-Year Event

Channel Station	Existing Elevation	Elevation With Channel Improvements	Difference in Elevation (ft)
204th Street			
2800	1209.96	1208.60	1.36
2600	1209.14	1208.39	0.75
2400	1208.51	1208.31	0.20
2200	1208.41	1208.39	0.02
2000	1208.31	1208.28	0.03
1800	1208.29	1208.28	0.01
1600	1208.26	1208.26	0.00
1451.95	1208.24	1208.24	0.00
Iva Street			

Table 6: Surface Water Elevations for 5-Year Event

Channel Station	Existing Elevation	Elevation With Channel Improvements	Difference in Elevation (ft)
204th Street			
2800	1210.77	1210.14	0.63
2600	1210.23	1210.05	0.18
2400	1210.08	1210.01	0.07
2200	1210.04	1210.00	0.04
2000	1210.01	1209.98	0.03
1800	1209.99	1209.98	0.01
1600	1209.96	1209.96	0.00
1451.95	1209.93	1209.93	0.00
Iva Street			

Table 7: Surface Water Elevations for 10-Year Event

Channel Station	Existing Elevation	Elevation With Channel Improvements	Difference in Elevation (ft)
204th Street			
2800	1211.25	1210.66	0.59
2600	1210.74	1210.55	0.19
2400	1210.58	1210.50	0.08
2200	1210.54	1210.49	0.05
2000	1210.49	1210.46	0.03
1800	1210.47	1210.45	0.02
1600	1210.43	1210.43	0.00
1451.95	1210.37	1210.37	0.00
Iva Street			

Table 9: Surface Water Elevations for 50-Year Event

Channel Station	Existing Elevation	Elevation With Channel Improvements	Difference in Elevation (ft)
204th Street			
2800	1211.99	1211.43	0.56
2600	1211.49	1211.29	0.20
2400	1211.32	1211.23	0.09
2200	1211.27	1211.21	0.06
2000	1211.21	1211.16	0.05
1800	1211.17	1211.15	0.02
1600	1211.11	1211.11	0.00
1451.95	1211.01	1211.10	0.00
Iva Street			

Table 10: Surface Water Elevations for 100-Year Event

Channel Station	Existing Elevation	Elevation With Channel Improvements	Difference in Elevation (ft)
204th Street			
2800	1212.17	1211.63	0.54
2600	1211.68	1211.53	0.15
2400	1211.51	1211.42	0.09
2200	1211.46	1211.40	0.06
2000	1211.39	1211.34	0.05
1800	1211.36	1211.33	0.03
1600	1211.28	1211.28	0.00
1451.95	1211.18	1211.18	0.00
Iva Street			

RESULTS

Based on these results, the proposed channel improvements will have the most impact during smaller more frequent storm events. During the 150 cfs event, the water surface elevation drops over two (2) feet in some areas of the channel. The reason for this significant drop is that the culverts under Iva Street have adequate capacity for the smaller flows. During larger storm events, the Iva Street culverts no longer have adequate capacity and begin to be the controlling factor on the upstream channel water surface elevation.

The culverts begin to control the water surface elevations during a 1-year storm event. During the 1-year event the channel improvements have some benefit in the upstream portions of the channel near 204th Street. Closer to the Iva Street culverts, the benefits of the channel improvements begin to become negligible. During a 1-year event, flows still exceed the channel drainage easements.

During 5-year and greater storm events, the channel improvements have little to no influence on the water surface elevations throughout the entire stretch of the channel. The large flows from these events greatly exceed the Iva Street culvert capacity and the channel flows begin to overtop Iva Street. For the 5-year and greater storm events, the culverts and road elevation control the water surface elevations throughout the channel essentially making the effects of the channel improvements negligible.

Included in Appendix A of this report are water surface profiles for the 150 cfs, 1, 2, 5, 10, 50, and 100-year storm events. In addition, water surface elevation inundation maps are included for the 150 cfs, 1 year, 5 year and 100 year events. These events were chosen because they represent the range of inundation conditions.

CONCLUSIONS

The proposed Forest Run channel improvements will decrease the water surface elevations during small and more frequent storm events (less than a 5-year storm event). The results of these improvements will be less frequent flows that extend outside the channel's drainage easements. However, the channel improvements have little to no effect during storm events greater than a 5-year event. During these large storm events the flows in the channel still have the potential to extend outside the drainage easements and potentially flood structures.

Retain the Location Request Number for YOUR Own Protection!

CALL 344-3565 (WWW.NE-DIGGERS.COM)

COVERS ALL PARTICIPATING MEMBERS

METROPOLITAN UTILITIES DISTRICT
OMAHA PUBLIC POWER DISTRICT
QWEST
CITY OF OMAHA
COX CABLE OF OMAHA
SOUTHERN NATURAL GAS
NORTHERN NATURAL GAS
UNITED CABLE TELEVISION

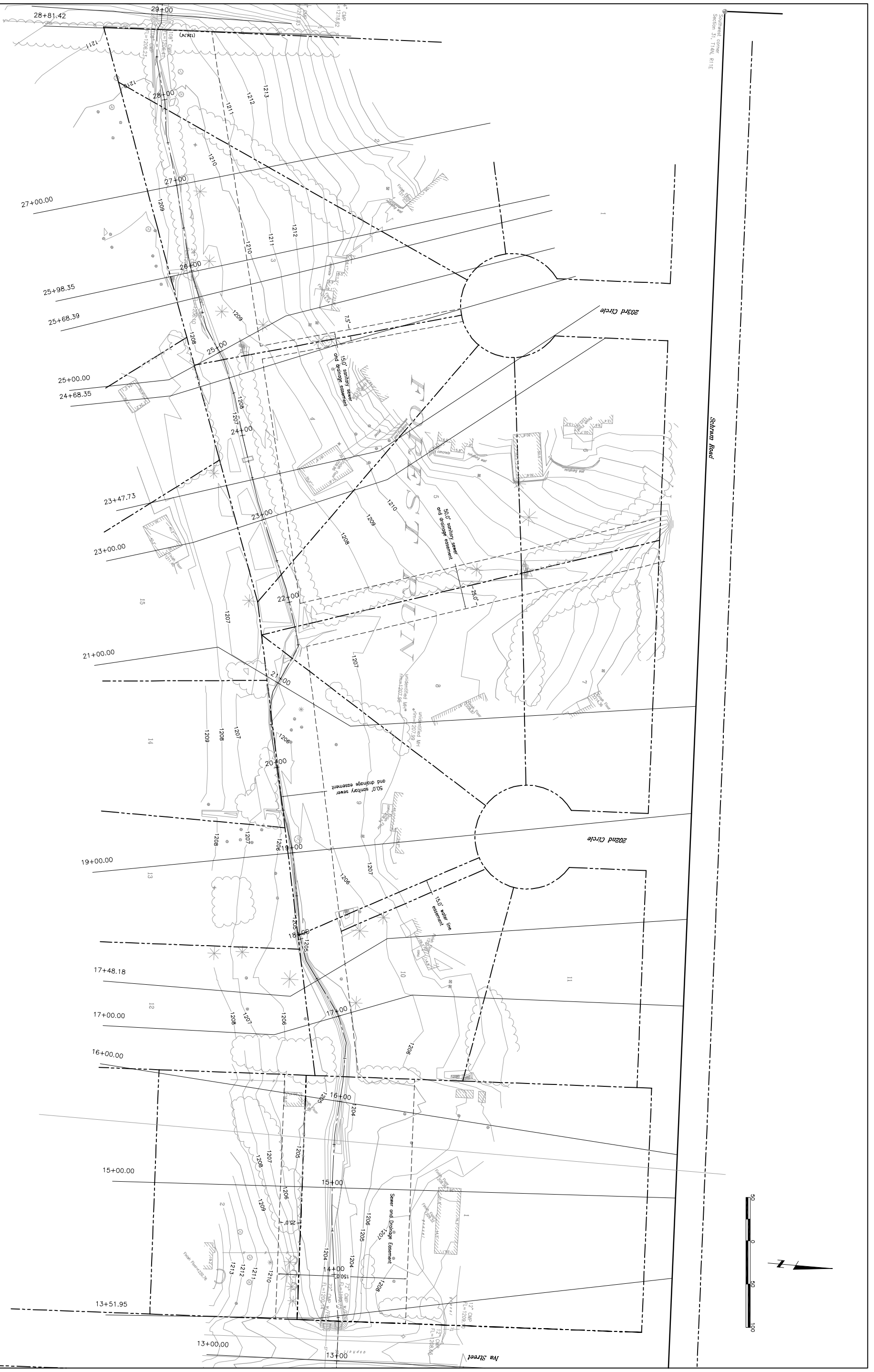

FIGURE 7–
CROSS SECTIONS LOCATIONS

Lamp, Rynearson & Associates, Inc.
14710 West Dodge Road, Suite 100
Omaha, Nebraska 68154-2027
WWW.LRA-INC.COM
(Ph) 402.496.2498
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SARPY COUNTY, NEBRASKA

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APPENDIX A:

HEC-RAS PROFILES

AND

WATER SURFACE ELEVATION INUNDATION MAPS

Existing Channel Profile Table

HEC-RAS Plan: EC River: Channel Reach: Forest Run

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)	
Forest Run	3200	10 Year	1472.00	1207.77	1216.81		1216.83	0.000090	0.92	1689.02	641.83	0.06
Forest Run	3200	50 Year	2315.00	1207.77	1217.57		1217.59	0.000109	1.09	2211.24	742.43	0.07
Forest Run	3200	100 Year	2557.00	1207.77	1217.77		1217.78	0.000112	1.12	2360.20	768.72	0.07
Forest Run	3200	1 Year	419.00	1207.77	1212.58		1212.89	0.010282	5.03	100.01	124.33	0.57
Forest Run	3200	5 Year	1039.20	1207.77	1216.12		1216.13	0.000093	0.87	1278.06	549.87	0.06
Forest Run	3200	150 cfs	150.00	1207.77	1211.40	1211.40	1211.91	0.026344	5.79	27.17	29.05	0.85
Forest Run	3200	2 Year	485.00	1207.77	1213.21		1213.30	0.002512	2.84	204.57	203.16	0.29
Forest Run	3077.14	10 Year	1472.00	1206.50	1216.79	1210.02	1216.81	0.000112	1.36	1305.33	362.79	0.08
Forest Run	3077.14	50 Year	2315.00	1206.50	1217.53	1211.24	1217.57	0.000155	1.68	1576.47	368.09	0.09
Forest Run	3077.14	100 Year	2557.00	1206.50	1217.73	1211.55	1217.77	0.000165	1.75	1647.87	369.48	0.09
Forest Run	3077.14	1 Year	419.00	1206.50	1212.67	1208.14	1212.70	0.000279	1.48	287.15	160.20	0.11
Forest Run	3077.14	5 Year	1039.20	1206.50	1216.10	1209.35	1216.12	0.000103	1.24	1057.82	357.89	0.07
Forest Run	3077.14	150 cfs	150.00	1206.50	1210.22	1207.40	1210.23	0.000234	0.97	155.26	47.35	0.09
Forest Run	3077.14	2 Year	485.00	1206.50	1213.18	1208.29	1213.21	0.000272	1.55	317.48	194.32	0.11
Forest Run	3050		Culvert									
Forest Run	2989.41	10 Year	1472.00	1206.41	1211.64		1212.03	0.003442	5.01	293.95	129.38	0.40
Forest Run	2989.41	50 Year	2315.00	1206.41	1212.29		1213.04	0.005598	6.94	333.34	150.49	0.52
Forest Run	2989.41	100 Year	2557.00	1206.41	1212.44		1213.31	0.006277	7.48	341.88	155.07	0.55
Forest Run	2989.41	1 Year	419.00	1206.41	1210.14		1210.21	0.000937	2.05	204.34	81.36	0.20
Forest Run	2989.41	5 Year	1039.20	1206.41	1211.16		1211.40	0.002415	3.92	265.28	114.02	0.33
Forest Run	2989.41	150 cfs	150.00	1206.41	1209.37		1209.39	0.000283	0.95	158.08	70.31	0.10
Forest Run	2989.41	2 Year	485.00	1206.41	1210.28		1210.36	0.001102	2.28	212.52	85.74	0.21
Forest Run	2800	10 Year	1472.00	1207.41	1211.25		1211.46	0.002209	3.27	404.44	188.18	0.30
Forest Run	2800	50 Year	2315.00	1207.41	1211.99		1212.27	0.002224	3.72	553.10	212.89	0.31
Forest Run	2800	100 Year	2557.00	1207.41	1212.17		1212.47	0.002222	3.82	593.31	219.10	0.32
Forest Run	2800	1 Year	419.00	1207.41	1209.85		1209.94	0.002365	2.43	171.57	145.39	0.29
Forest Run	2800	5 Year	1039.20	1207.41	1210.77		1210.94	0.002224	2.98	318.46	173.06	0.30
Forest Run	2800	150 cfs	150.00	1207.41	1209.23		1209.27	0.002058	1.81	88.83	113.94	0.26
Forest Run	2800	2 Year	485.00	1207.41	1209.96		1210.06	0.002387	2.53	188.16	148.77	0.29
Forest Run	2698.35	10 Year	1472.00	1206.25	1210.94		1211.20	0.002786	3.58	370.85	183.92	0.34
Forest Run	2698.35	50 Year	2315.00	1206.25	1211.69		1212.02	0.002681	3.99	518.53	212.22	0.34
Forest Run	2698.35	100 Year	2557.00	1206.25	1211.88		1212.22	0.002647	4.08	559.36	219.40	0.34
Forest Run	2698.35	1 Year	419.00	1206.25	1209.52		1209.65	0.003387	2.80	147.28	131.96	0.34

HEC-RAS Plan: EC River: Channel Reach: Forest Run (Continued)

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)	
Forest Run	2698.35	5 Year	1039.20	1206.25	1210.46		1210.68	0.002888	3.31	286.97	165.70	0.33
Forest Run	2698.35	150 cfs	150.00	1206.25	1208.97		1209.02	0.002858	2.10	79.41	113.26	0.30
Forest Run	2698.35	2 Year	485.00	1206.25	1209.62		1209.77	0.003469	2.93	160.92	135.41	0.35
Forest Run	2668.39	10 Year	1472.00	1206.25	1210.85		1211.12	0.003028	3.86	363.28	186.22	0.35
Forest Run	2668.39	50 Year	2315.00	1206.25	1211.61		1211.94	0.002770	4.17	514.18	213.52	0.35
Forest Run	2668.39	100 Year	2557.00	1206.25	1211.80		1212.14	0.002713	4.24	555.66	220.44	0.35
Forest Run	2668.39	1 Year	419.00	1206.25	1209.30		1209.50	0.006893	4.06	117.62	130.03	0.49
Forest Run	2668.39	5 Year	1039.20	1206.25	1210.36		1210.58	0.003390	3.71	275.06	168.21	0.36
Forest Run	2668.39	150 cfs	150.00	1206.25	1208.63	1208.59	1208.85	0.012469	4.28	43.40	80.82	0.61
Forest Run	2668.39	2 Year	485.00	1206.25	1209.41		1209.62	0.006550	4.09	131.95	133.95	0.48
Forest Run	2600	10 Year	1472.00	1206.50	1210.74		1210.95	0.001645	4.74	411.36	186.01	0.44
Forest Run	2600	50 Year	2315.00	1206.50	1211.49		1211.78	0.001709	5.47	559.95	209.19	0.46
Forest Run	2600	100 Year	2557.00	1206.50	1211.68		1211.99	0.001720	5.64	599.92	215.00	0.46
Forest Run	2600	1 Year	419.00	1206.50	1209.01		1209.18	0.003294	4.37	135.78	132.68	0.56
Forest Run	2600	5 Year	1039.20	1206.50	1210.23		1210.41	0.001650	4.30	321.84	170.52	0.43
Forest Run	2600	150 cfs	150.00	1206.50	1208.33		1208.44	0.003115	3.19	62.26	85.86	0.50
Forest Run	2600	2 Year	485.00	1206.50	1209.14		1209.32	0.003098	4.43	153.22	136.67	0.54
Forest Run	2568.35	10 Year	1472.00	1205.91	1210.74		1210.89	0.001037	3.94	503.77	221.40	0.35
Forest Run	2568.35	50 Year	2315.00	1205.91	1211.51		1211.71	0.001129	4.62	687.12	257.16	0.37
Forest Run	2568.35	100 Year	2557.00	1205.91	1211.70		1211.91	0.001142	4.78	737.58	266.16	0.38
Forest Run	2568.35	1 Year	419.00	1205.91	1209.01		1209.10	0.001146	2.82	190.31	140.58	0.33
Forest Run	2568.35	5 Year	1039.20	1205.91	1210.24		1210.35	0.000971	3.48	397.26	197.68	0.33
Forest Run	2568.35	150 cfs	150.00	1205.91	1208.34		1208.38	0.000708	1.75	107.38	107.14	0.25
Forest Run	2568.35	2 Year	485.00	1205.91	1209.14		1209.23	0.001202	3.00	208.20	146.39	0.34
Forest Run	2447.73	10 Year	1472.00	1205.38	1210.50		1210.72	0.001823	5.14	400.12	228.71	0.44
Forest Run	2447.73	50 Year	2315.00	1205.38	1211.21		1211.51	0.002101	6.11	552.07	288.75	0.48
Forest Run	2447.73	100 Year	2557.00	1205.38	1211.41		1211.72	0.002037	6.18	600.32	294.74	0.48
Forest Run	2447.73	1 Year	419.00	1205.38	1208.37	1208.37	1208.76	0.009207	7.33	92.80	107.92	0.88
Forest Run	2447.73	5 Year	1039.20	1205.38	1210.02		1210.20	0.001739	4.64	318.24	176.88	0.42
Forest Run	2447.73	150 cfs	150.00	1205.38	1207.92	1207.92	1208.16	0.007154	5.53	47.63	87.46	0.74
Forest Run	2447.73	2 Year	485.00	1205.38	1208.44	1208.44	1208.88	0.009877	7.76	100.34	110.33	0.91
Forest Run	2400	10 Year	1472.00	1205.40	1210.58		1210.64	0.000389	2.77	754.22	271.55	0.22
Forest Run	2400	50 Year	2315.00	1205.40	1211.32		1211.41	0.000466	3.33	960.26	286.32	0.25

HEC-RAS Plan: EC River: Channel Reach: Forest Run (Continued)

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)	
Forest Run	2400	100 Year	2557.00	1205.40	1211.51		1211.61	0.000478	3.46	1017.41	290.28	0.25
Forest Run	2400	1 Year	419.00	1205.40	1208.09		1208.17	0.001673	3.57	188.91	170.55	0.41
Forest Run	2400	5 Year	1039.20	1205.40	1210.08		1210.12	0.000349	2.44	621.05	261.55	0.21
Forest Run	2400	150 cfs	150.00	1205.40	1207.33		1207.39	0.002054	3.06	80.19	112.33	0.42
Forest Run	2400	2 Year	485.00	1205.40	1208.51		1208.57	0.000843	2.83	265.46	190.38	0.30
Forest Run	2200	10 Year	1570.00	1204.85	1210.54		1210.57	0.000224	1.92	1031.65	400.42	0.15
Forest Run	2200	50 Year	2484.00	1204.85	1211.27		1211.33	0.000288	2.37	1297.58	426.85	0.17
Forest Run	2200	100 Year	2794.00	1204.85	1211.46		1211.53	0.000311	2.51	1371.55	433.87	0.18
Forest Run	2200	1 Year	438.00	1204.85	1207.81		1207.87	0.001292	2.87	228.88	213.04	0.31
Forest Run	2200	5 Year	1101.80	1204.85	1210.04		1210.07	0.000187	1.64	862.70	382.54	0.13
Forest Run	2200	150 cfs	150.00	1204.85	1207.00		1207.04	0.001420	2.35	91.80	114.14	0.31
Forest Run	2200	2 Year	509.00	1204.85	1208.41		1208.44	0.000467	1.98	370.91	258.24	0.19
Forest Run	2012.13	10 Year	1570.00	1203.94	1210.50		1210.53	0.000220	1.92	1026.37	420.84	0.14
Forest Run	2012.13	50 Year	2484.00	1203.94	1211.21		1211.27	0.000288	2.38	1278.75	442.74	0.17
Forest Run	2012.13	100 Year	2794.00	1203.94	1211.40		1211.47	0.000313	2.52	1348.02	448.52	0.17
Forest Run	2012.13	1 Year	438.00	1203.94	1207.48		1207.58	0.001879	3.40	184.01	167.54	0.36
Forest Run	2012.13	5 Year	1101.80	1203.94	1210.01		1210.03	0.000181	1.64	863.98	405.98	0.13
Forest Run	2012.13	150 cfs	150.00	1203.94	1206.23		1206.48	0.008747	4.85	40.38	63.65	0.71
Forest Run	2012.13	2 Year	509.00	1203.94	1208.31		1208.34	0.000586	2.27	352.87	353.97	0.21
Forest Run	2000	10 Year	1570.00	1203.88	1210.49		1210.53	0.000211	1.96	995.44	385.47	0.14
Forest Run	2000	50 Year	2484.00	1203.88	1211.20		1211.27	0.000298	2.51	1222.91	412.79	0.17
Forest Run	2000	100 Year	2794.00	1203.88	1211.39		1211.47	0.000327	2.68	1286.06	419.99	0.18
Forest Run	2000	1 Year	438.00	1203.88	1207.50		1207.55	0.000607	2.11	272.11	186.99	0.21
Forest Run	2000	5 Year	1101.80	1203.88	1210.01		1210.03	0.000161	1.62	851.87	366.89	0.12
Forest Run	2000	150 cfs	150.00	1203.88	1206.34		1206.38	0.001401	2.33	93.17	119.42	0.30
Forest Run	2000	2 Year	509.00	1203.88	1208.31		1208.33	0.000213	1.46	440.20	256.57	0.13
Forest Run	1848.18	10 Year	1570.00	1202.19	1210.47		1210.50	0.000138	1.65	1158.76	402.75	0.11
Forest Run	1848.18	50 Year	2484.00	1202.19	1211.18		1211.23	0.000206	2.14	1395.65	429.19	0.14
Forest Run	1848.18	100 Year	2794.00	1202.19	1211.36		1211.42	0.000229	2.30	1460.91	436.13	0.15
Forest Run	1848.18	1 Year	438.00	1202.19	1207.44		1207.47	0.000474	2.07	316.20	302.54	0.19
Forest Run	1848.18	5 Year	1101.80	1202.19	1209.99		1210.01	0.000100	1.34	1008.05	384.82	0.09
Forest Run	1848.18	150 cfs	150.00	1202.19	1206.06		1206.15	0.001852	3.04	78.29	111.02	0.34
Forest Run	1848.18	2 Year	509.00	1202.19	1208.29		1208.31	0.000150	1.33	525.58	341.63	0.11

HEC-RAS Plan: EC River: Channel Reach: Forest Run (Continued)

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)	
Forest Run	1800	10 Year	1570.00	1201.80	1210.47		1210.50	0.000127	1.57	1238.53	358.33	0.10
Forest Run	1800	50 Year	2484.00	1201.80	1211.17		1211.22	0.000186	2.03	1501.60	388.68	0.13
Forest Run	1800	100 Year	2794.00	1201.80	1211.36		1211.41	0.000206	2.17	1574.17	396.65	0.14
Forest Run	1800	1 Year	438.00	1201.80	1207.40		1207.44	0.000567	2.27	300.17	226.39	0.20
Forest Run	1800	5 Year	1101.80	1201.80	1209.99		1210.01	0.000094	1.29	1071.62	337.86	0.09
Forest Run	1800	150 cfs	150.00	1201.80	1205.64	1205.64	1205.97	0.006367	5.17	40.85	67.62	0.61
Forest Run	1800	2 Year	509.00	1201.80	1208.28		1208.30	0.000165	1.40	531.35	289.87	0.11
Forest Run	1700	10 Year	1570.00	1201.62	1210.47		1210.48	0.000065	1.18	1506.23	354.64	0.08
Forest Run	1700	50 Year	2484.00	1201.62	1211.17		1211.20	0.000103	1.58	1760.88	371.22	0.10
Forest Run	1700	100 Year	2794.00	1201.62	1211.35		1211.39	0.000117	1.70	1829.52	375.57	0.10
Forest Run	1700	1 Year	438.00	1201.62	1207.40		1207.41	0.000092	0.98	556.85	261.58	0.08
Forest Run	1700	5 Year	1101.80	1201.62	1209.99		1210.00	0.000045	0.94	1339.32	343.30	0.06
Forest Run	1700	150 cfs	150.00	1201.62	1205.12	1204.81	1205.23	0.002833	3.32	66.60	100.18	0.41
Forest Run	1700	2 Year	509.00	1201.62	1208.28		1208.29	0.000043	0.76	795.50	286.89	0.06
Forest Run	1600	10 Year	1570.00	1201.28	1210.43		1210.47	0.000162	2.06	1010.96	292.74	0.13
Forest Run	1600	50 Year	2484.00	1201.28	1211.11		1211.18	0.000257	2.75	1195.92	313.18	0.17
Forest Run	1600	100 Year	2794.00	1201.28	1211.28		1211.37	0.000291	2.96	1245.96	318.46	0.18
Forest Run	1600	1 Year	438.00	1201.28	1207.37		1207.40	0.000209	1.68	353.16	159.58	0.14
Forest Run	1600	5 Year	1101.80	1201.28	1209.96		1209.99	0.000112	1.65	891.69	278.67	0.11
Forest Run	1600	150 cfs	150.00	1201.28	1203.88	1203.88	1204.58	0.018649	6.71	22.37	17.21	1.04
Forest Run	1600	2 Year	509.00	1201.28	1208.26		1208.28	0.000109	1.36	512.00	227.30	0.10
Forest Run	1451.95	10 Year	1570.00	1200.00	1210.37	1203.40	1210.44	0.000217	2.22	862.68	256.07	0.13
Forest Run	1451.95	50 Year	2484.00	1200.00	1211.01	1204.50	1211.13	0.000362	3.00	1035.48	283.60	0.17
Forest Run	1451.95	100 Year	2794.00	1200.00	1211.18	1204.82	1211.31	0.000414	3.25	1081.88	290.55	0.19
Forest Run	1451.95	1 Year	438.00	1200.00	1207.36	1201.50	1207.38	0.000078	1.12	391.53	88.78	0.08
Forest Run	1451.95	5 Year	1101.80	1200.00	1209.93	1202.72	1209.97	0.000143	1.73	752.67	234.89	0.11
Forest Run	1451.95	150 cfs	150.00	1200.00	1203.98	1200.75	1203.99	0.000091	0.78	192.01	56.57	0.07
Forest Run	1451.95	2 Year	509.00	1200.00	1208.24	1201.66	1208.26	0.000084	1.14	456.53	117.11	0.08
Forest Run	1400		Culvert									
Forest Run	1372.54	10 Year	1570.00	1200.00	1205.45		1205.98	0.003526	5.84	268.84	80.76	0.49
Forest Run	1372.54	50 Year	2484.00	1200.00	1205.77		1206.92	0.007015	8.62	288.02	90.24	0.69
Forest Run	1372.54	100 Year	2794.00	1200.00	1205.81		1207.25	0.008614	9.61	290.61	91.52	0.77
Forest Run	1372.54	1 Year	438.00	1200.00	1203.87		1203.96	0.000926	2.47	176.97	52.53	0.24

HEC-RAS Plan: EC River: Channel Reach: Forest Run (Continued)

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)	
Forest Run	1372.54	5 Year	1101.80	1200.00	1205.12		1205.42	0.002237	4.42	249.17	71.04	0.38
Forest Run	1372.54	150 cfs	150.00	1200.00	1201.86		1201.92	0.001310	1.91	78.62	45.51	0.26
Forest Run	1372.54	2 Year	509.00	1200.00	1204.29		1204.39	0.000929	2.54	200.21	57.26	0.24
Forest Run	1200	10 Year	1570.00	1198.90	1205.68		1205.72	0.000247	2.31	1008.86	394.68	0.18
Forest Run	1200	50 Year	2484.00	1198.90	1206.38		1206.45	0.000303	2.78	1296.69	423.33	0.20
Forest Run	1200	100 Year	2794.00	1198.90	1206.61		1206.68	0.000311	2.89	1394.44	432.63	0.21
Forest Run	1200	1 Year	438.00	1198.90	1203.85		1203.88	0.000197	1.55	401.82	247.36	0.15
Forest Run	1200	5 Year	1101.80	1198.90	1205.22		1205.26	0.000208	2.00	833.37	376.14	0.16
Forest Run	1200	150 cfs	150.00	1198.90	1201.35		1201.54	0.003988	3.42	43.87	37.50	0.56
Forest Run	1200	2 Year	509.00	1198.90	1204.30		1204.32	0.000142	1.43	520.82	289.45	0.13
Forest Run	1000	10 Year	1570.00	1197.49	1205.66		1205.68	0.000146	2.01	1213.81	389.32	0.13
Forest Run	1000	50 Year	2484.00	1197.49	1206.35		1206.40	0.000201	2.52	1495.53	417.62	0.16
Forest Run	1000	100 Year	2794.00	1197.49	1206.58		1206.63	0.000213	2.64	1591.09	425.10	0.17
Forest Run	1000	1 Year	438.00	1197.49	1203.84		1203.85	0.000075	1.18	599.74	279.26	0.09
Forest Run	1000	5 Year	1101.80	1197.49	1205.21		1205.23	0.000110	1.67	1043.54	367.50	0.12
Forest Run	1000	150 cfs	150.00	1197.49	1200.79		1200.93	0.002494	3.70	61.71	78.76	0.46
Forest Run	1000	2 Year	509.00	1197.49	1204.29		1204.30	0.000060	1.12	732.11	309.60	0.08
Forest Run	946.76	10 Year	1570.00	1197.27	1205.63		1205.67	0.000226	2.62	949.27	325.80	0.17
Forest Run	946.76	50 Year	2484.00	1197.27	1206.30		1206.38	0.000328	3.35	1158.19	351.04	0.21
Forest Run	946.76	100 Year	2794.00	1197.27	1206.53		1206.61	0.000352	3.54	1230.27	359.29	0.22
Forest Run	946.76	1 Year	438.00	1197.27	1203.83		1203.85	0.000107	1.49	484.27	248.37	0.11
Forest Run	946.76	5 Year	1101.80	1197.27	1205.19		1205.22	0.000165	2.15	822.64	309.40	0.15
Forest Run	946.76	150 cfs	150.00	1197.27	1200.32	1200.32	1200.71	0.006081	5.65	37.01	48.50	0.72
Forest Run	946.76	2 Year	509.00	1197.27	1204.28		1204.29	0.000086	1.42	587.50	269.24	0.10
Forest Run	800	10 Year	1678.00	1195.60	1205.61	1198.91	1205.65	0.000104	1.72	1139.80	266.33	0.12
Forest Run	800	50 Year	2670.00	1195.60	1206.27	1200.06	1206.35	0.000178	2.40	1325.06	301.61	0.16
Forest Run	800	100 Year	3053.00	1195.60	1206.48	1200.49	1206.57	0.000206	2.64	1390.77	318.56	0.17
Forest Run	800	1 Year	458.00	1195.60	1203.83	1197.05	1203.84	0.000028	0.72	711.72	219.82	0.06
Forest Run	800	5 Year	1171.70	1195.60	1205.18	1198.23	1205.20	0.000067	1.32	1027.76	251.17	0.09
Forest Run	800	150 cfs	150.00	1195.60	1199.57	1196.33	1199.58	0.000040	0.74	202.84	88.60	0.07
Forest Run	800	2 Year	534.00	1195.60	1204.28	1197.20	1204.29	0.000027	0.75	812.89	229.37	0.06
Forest Run	750		Culvert									

HEC-RAS Plan: EC River: Channel Reach: Forest Run (Continued)

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)	
Forest Run	702	10 Year	1678.00	1195.00	1203.09		1203.23	0.000599	2.93	581.48	173.68	0.27
Forest Run	702	50 Year	2670.00	1195.00	1203.73		1203.97	0.000887	3.96	695.98	187.42	0.33
Forest Run	702	100 Year	3053.00	1195.00	1203.92		1204.20	0.001000	4.32	732.04	191.55	0.35
Forest Run	702	1 Year	458.00	1195.00	1201.03		1201.06	0.000069	1.32	346.49	131.56	0.10
Forest Run	702	5 Year	1171.70	1195.00	1202.68		1202.76	0.000434	2.31	510.88	164.64	0.22
Forest Run	702	150 cfs	150.00	1195.00	1198.90		1198.91	0.000034	0.69	218.59	91.54	0.06
Forest Run	702	2 Year	534.00	1195.00	1201.78		1201.80	0.000063	1.37	391.06	145.71	0.09
Forest Run	600	10 Year	1678.00	1195.50	1203.12		1203.17	0.000224	2.36	1041.20	345.13	0.17
Forest Run	600	50 Year	2670.00	1195.50	1203.79		1203.87	0.000327	3.07	1285.30	381.25	0.21
Forest Run	600	100 Year	3053.00	1195.50	1204.00		1204.09	0.000364	3.31	1365.72	392.43	0.22
Forest Run	600	1 Year	458.00	1195.50	1201.02		1201.05	0.000240	1.82	398.49	256.02	0.17
Forest Run	600	5 Year	1171.70	1195.50	1202.69		1202.72	0.000166	1.94	895.69	329.72	0.15
Forest Run	600	150 cfs	150.00	1195.50	1198.68	1198.20	1198.88	0.003398	3.76	46.54	54.90	0.54
Forest Run	600	2 Year	534.00	1195.50	1201.78		1201.79	0.000104	1.35	608.26	297.69	0.11
Forest Run	400	10 Year	1711.00	1195.00	1203.02		1203.10	0.000586	2.69	800.39	320.19	0.19
Forest Run	400	50 Year	2726.00	1195.00	1203.65		1203.77	0.000743	3.23	1005.26	327.42	0.22
Forest Run	400	100 Year	3131.00	1195.00	1203.84		1203.98	0.000815	3.44	1067.54	329.59	0.23
Forest Run	400	1 Year	462.00	1195.00	1200.93		1200.98	0.000517	1.93	276.98	134.61	0.17
Forest Run	400	5 Year	1186.10	1195.00	1202.61		1202.66	0.000477	2.32	669.88	316.07	0.17
Forest Run	400	150 cfs	150.00	1195.00	1197.62		1197.84	0.009228	3.76	39.93	30.52	0.58
Forest Run	400	2 Year	540.00	1195.00	1201.73		1201.76	0.000285	1.61	411.25	224.85	0.13
Forest Run	386.77	10 Year	1711.00	1193.50	1203.01	1197.47	1203.09	0.000565	2.39	836.06	320.90	0.17
Forest Run	386.77	50 Year	2726.00	1193.50	1203.64	1198.54	1203.76	0.000818	3.07	1054.73	374.37	0.21
Forest Run	386.77	100 Year	3131.00	1193.50	1203.83	1198.91	1203.97	0.000915	3.30	1127.28	390.49	0.22
Forest Run	386.77	1 Year	462.00	1193.50	1200.95	1195.58	1200.97	0.000139	1.20	384.46	186.01	0.08
Forest Run	386.77	5 Year	1186.10	1193.50	1202.61	1196.80	1202.66	0.000390	1.90	720.65	298.32	0.14
Forest Run	386.77	150 cfs	150.00	1193.50	1197.76	1194.74	1197.77	0.000146	0.78	193.00	73.19	0.08
Forest Run	386.77	2 Year	540.00	1193.50	1201.73	1195.74	1201.75	0.000176	1.15	510.36	244.95	0.09
Forest Run	301		Culvert									
Forest Run	296.33	10 Year	1711.00	1193.00	1200.29		1200.60	0.001983	4.48	382.01	84.41	0.31
Forest Run	296.33	50 Year	2726.00	1193.00	1201.36		1201.90	0.004709	5.92	469.71	138.98	0.46
Forest Run	296.33	100 Year	3131.00	1193.00	1201.72		1202.31	0.004774	6.24	524.19	161.83	0.47
Forest Run	296.33	1 Year	462.00	1193.00	1198.35		1198.39	0.000487	1.74	265.39	69.10	0.15

HEC-RAS Plan: EC River: Channel Reach: Forest Run (Continued)

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)	
Forest Run	296.33	5 Year	1186.10	1193.00	1199.62		1199.81	0.001378	3.47	342.04	79.16	0.26
Forest Run	296.33	150 cfs	150.00	1193.00	1197.19		1197.20	0.000137	0.76	196.19	60.00	0.07
Forest Run	296.33	2 Year	540.00	1193.00	1198.53		1198.59	0.000581	1.95	276.44	70.55	0.16
Forest Run	200	10 Year	1711.00	1193.80	1200.25		1200.38	0.001600	3.62	626.83	186.24	0.27
Forest Run	200	50 Year	2726.00	1193.80	1201.35		1201.53	0.001791	4.33	842.67	213.52	0.30
Forest Run	200	100 Year	3131.00	1193.80	1201.74		1201.93	0.001782	4.48	925.30	217.35	0.30
Forest Run	200	1 Year	462.00	1193.80	1198.28		1198.33	0.001078	2.20	294.44	157.80	0.21
Forest Run	200	5 Year	1186.10	1193.80	1199.55		1199.65	0.001410	3.10	503.65	170.54	0.25
Forest Run	200	150 cfs	150.00	1193.80	1197.13		1197.17	0.001301	1.84	121.15	141.92	0.21
Forest Run	200	2 Year	540.00	1193.80	1198.46		1198.51	0.001115	2.31	323.14	159.61	0.21
Forest Run	100	10 Year	1711.00	1193.50	1199.74	1198.72	1200.09	0.005007	6.02	386.22	133.94	0.47
Forest Run	100	50 Year	2726.00	1193.50	1200.77	1199.37	1201.22	0.005004	6.82	527.96	142.15	0.49
Forest Run	100	100 Year	3131.00	1193.50	1201.13	1199.61	1201.62	0.005004	7.08	579.45	145.02	0.49
Forest Run	100	1 Year	462.00	1193.50	1197.90	1197.27	1198.11	0.005004	4.43	153.21	114.98	0.44
Forest Run	100	5 Year	1186.10	1193.50	1199.10	1198.31	1199.39	0.005002	5.49	301.73	128.79	0.46
Forest Run	100	150 cfs	150.00	1193.50	1196.77	1195.95	1196.93	0.005004	3.30	55.40	58.65	0.41
Forest Run	100	2 Year	540.00	1193.50	1198.07	1197.43	1198.29	0.005003	4.59	173.72	120.58	0.44

Proposed Channel Profile Table

HEC-RAS Plan: PC River: Channel Reach: Forest Run

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)	
Forest Run	3200	10 Year	1472.00	1207.77	1216.81		1216.83	0.000090	0.92	1689.02	641.83	0.06
Forest Run	3200	50 Year	2315.00	1207.77	1217.57		1217.58	0.000110	1.09	2209.07	742.04	0.07
Forest Run	3200	100 Year	2557.00	1207.77	1217.80		1217.81	0.000110	1.11	2382.97	772.66	0.07
Forest Run	3200	1 Year	419.00	1207.77	1212.58		1212.89	0.010230	5.02	100.24	124.58	0.57
Forest Run	3200	5 Year	1039.20	1207.77	1216.12		1216.13	0.000093	0.87	1278.06	549.87	0.06
Forest Run	3200	150 cfs	150.00	1207.77	1211.40	1211.40	1211.91	0.026344	5.79	27.17	29.05	0.85
Forest Run	3200	2 Year	485.00	1207.77	1213.21		1213.31	0.002511	2.84	204.59	203.18	0.29
Forest Run	3077.14	10 Year	1472.00	1206.50	1216.79	1210.02	1216.81	0.000112	1.36	1305.33	362.79	0.08
Forest Run	3077.14	50 Year	2315.00	1206.50	1217.53	1211.24	1217.57	0.000155	1.68	1575.39	368.07	0.09
Forest Run	3077.14	100 Year	2557.00	1206.50	1217.76	1211.55	1217.80	0.000161	1.74	1659.01	369.69	0.09
Forest Run	3077.14	1 Year	419.00	1206.50	1212.67	1208.14	1212.70	0.000279	1.48	287.21	160.26	0.11
Forest Run	3077.14	5 Year	1039.20	1206.50	1216.10	1209.35	1216.12	0.000103	1.24	1057.82	357.89	0.07
Forest Run	3077.14	150 cfs	150.00	1206.50	1210.19	1207.40	1210.21	0.000239	0.97	154.11	47.30	0.10
Forest Run	3077.14	2 Year	485.00	1206.50	1213.18	1208.29	1213.21	0.000272	1.55	317.48	194.32	0.11
Forest Run	3050		Culvert									
Forest Run	2989.41	10 Year	1472.00	1206.41	1210.73		1211.32	0.002447	6.14	239.67	100.29	0.54
Forest Run	2989.41	50 Year	2315.00	1206.41	1211.29		1212.41	0.003907	8.47	273.30	118.31	0.70
Forest Run	2989.41	100 Year	2557.00	1206.41	1211.40		1212.70	0.004400	9.13	279.94	121.87	0.75
Forest Run	2989.41	1 Year	419.00	1206.41	1208.70		1208.89	0.002142	3.57	117.37	63.37	0.45
Forest Run	2989.41	5 Year	1039.20	1206.41	1210.28		1210.65	0.001820	4.89	212.55	85.75	0.46
Forest Run	2989.41	150 cfs	150.00	1206.41	1207.72		1207.81	0.002073	2.46	61.02	53.37	0.41
Forest Run	2989.41	2 Year	485.00	1206.41	1208.96		1209.16	0.001884	3.64	133.15	66.06	0.43
Forest Run	2800	10 Year	1472.00	1205.45	1210.66		1210.91	0.001156	4.53	417.65	166.78	0.38
Forest Run	2800	50 Year	2315.00	1205.45	1211.43		1211.77	0.001353	5.45	554.76	191.89	0.42
Forest Run	2800	100 Year	2557.00	1205.45	1211.63		1211.99	0.001384	5.65	593.35	198.66	0.43
Forest Run	2800	1 Year	419.00	1205.45	1208.16		1208.41	0.002946	4.15	106.76	69.24	0.53
Forest Run	2800	5 Year	1039.20	1205.45	1210.14		1210.34	0.001053	3.98	333.62	158.34	0.35
Forest Run	2800	150 cfs	150.00	1205.45	1207.13		1207.29	0.003797	3.19	47.28	46.52	0.54
Forest Run	2800	2 Year	485.00	1205.45	1208.60		1208.81	0.001836	3.77	140.01	79.15	0.43
Forest Run	2698.35	10 Year	1472.00	1205.02	1210.61		1210.79	0.000805	3.96	488.02	189.02	0.32
Forest Run	2698.35	50 Year	2315.00	1205.02	1211.37		1211.63	0.000971	4.80	641.54	213.96	0.36
Forest Run	2698.35	100 Year	2557.00	1205.02	1211.57		1211.84	0.000999	4.98	684.52	220.44	0.37
Forest Run	2698.35	1 Year	419.00	1205.02	1207.90		1208.13	0.002473	3.94	111.80	67.81	0.49

HEC-RAS Plan: PC River: Channel Reach: Forest Run (Continued)

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)	
Forest Run	2698.35	5 Year	1039.20	1205.02	1210.10		1210.24	0.000694	3.40	395.79	172.30	0.29
Forest Run	2698.35	150 cfs	150.00	1205.02	1206.74		1206.90	0.003798	3.20	46.85	44.46	0.54
Forest Run	2698.35	2 Year	485.00	1205.02	1208.47		1208.64	0.001344	3.43	153.86	79.34	0.37
Forest Run	2668.39	10 Year	1472.00	1204.89	1210.58		1210.77	0.000826	4.05	481.20	190.23	0.32
Forest Run	2668.39	50 Year	2315.00	1204.89	1211.33		1211.60	0.000997	4.90	633.98	214.43	0.37
Forest Run	2668.39	100 Year	2557.00	1204.89	1211.53		1211.81	0.001025	5.08	676.85	220.74	0.37
Forest Run	2668.39	1 Year	419.00	1204.89	1207.83		1208.06	0.002354	3.89	112.81	66.59	0.48
Forest Run	2668.39	5 Year	1039.20	1204.89	1210.07		1210.22	0.000710	3.48	389.04	174.02	0.30
Forest Run	2668.39	150 cfs	150.00	1204.89	1206.61		1206.78	0.004244	3.31	45.25	43.28	0.57
Forest Run	2668.39	2 Year	485.00	1204.89	1208.44		1208.60	0.001243	3.36	156.46	77.56	0.36
Forest Run	2600	10 Year	1472.00	1204.60	1210.55		1210.71	0.000642	3.69	518.44	184.87	0.29
Forest Run	2600	50 Year	2315.00	1204.60	1211.29		1211.53	0.000825	4.58	663.21	205.37	0.33
Forest Run	2600	100 Year	2557.00	1204.60	1211.48		1211.74	0.000860	4.78	703.52	210.73	0.34
Forest Run	2600	1 Year	419.00	1204.60	1207.72		1207.91	0.001801	3.57	124.44	71.06	0.42
Forest Run	2600	5 Year	1039.20	1204.60	1210.05		1210.17	0.000527	3.12	429.65	171.08	0.26
Forest Run	2600	150 cfs	150.00	1204.60	1206.34		1206.50	0.003859	3.24	46.32	43.40	0.55
Forest Run	2600	2 Year	485.00	1204.60	1208.39		1208.52	0.000908	3.03	185.51	110.81	0.31
Forest Run	2568.35	10 Year	1472.00	1204.46	1210.55		1210.68	0.000515	3.37	588.37	218.81	0.26
Forest Run	2568.35	50 Year	2315.00	1204.46	1211.30		1211.49	0.000658	4.17	764.48	250.52	0.30
Forest Run	2568.35	100 Year	2557.00	1204.46	1211.50		1211.70	0.000684	4.34	814.60	258.83	0.31
Forest Run	2568.35	1 Year	419.00	1204.46	1207.68		1207.85	0.001531	3.41	133.65	87.55	0.39
Forest Run	2568.35	5 Year	1039.20	1204.46	1210.05		1210.14	0.000419	2.85	483.95	197.63	0.23
Forest Run	2568.35	150 cfs	150.00	1204.46	1206.23		1206.38	0.003541	3.13	47.90	44.15	0.53
Forest Run	2568.35	2 Year	485.00	1204.46	1208.38		1208.49	0.000691	2.73	213.63	127.61	0.28
Forest Run	2447.73	10 Year	1472.00	1203.94	1210.48		1210.62	0.000500	3.44	553.86	226.44	0.26
Forest Run	2447.73	50 Year	2315.00	1203.94	1211.17		1211.40	0.000728	4.49	701.21	287.70	0.32
Forest Run	2447.73	100 Year	2557.00	1203.94	1211.36		1211.61	0.000762	4.69	746.76	293.38	0.33
Forest Run	2447.73	1 Year	419.00	1203.94	1207.54		1207.68	0.001146	3.12	146.70	89.96	0.34
Forest Run	2447.73	5 Year	1039.20	1203.94	1210.00		1210.10	0.000377	2.81	473.05	175.13	0.22
Forest Run	2447.73	150 cfs	150.00	1203.94	1205.75		1205.93	0.003957	3.38	44.35	38.97	0.56
Forest Run	2447.73	2 Year	485.00	1203.94	1208.32		1208.41	0.000510	2.49	232.10	122.22	0.24
Forest Run	2400	10 Year	1472.00	1203.73	1210.50		1210.58	0.000313	2.76	749.97	270.02	0.20
Forest Run	2400	50 Year	2315.00	1203.73	1211.23		1211.34	0.000404	3.40	950.74	284.50	0.24

HEC-RAS Plan: PC River: Channel Reach: Forest Run (Continued)

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)	
Forest Run	2400	100 Year	2557.00	1203.73	1211.42		1211.54	0.000421	3.54	1006.26	288.38	0.24
Forest Run	2400	1 Year	419.00	1203.73	1207.49		1207.63	0.001055	3.04	152.05	96.78	0.33
Forest Run	2400	5 Year	1039.20	1203.73	1210.01		1210.07	0.000258	2.36	619.97	260.21	0.18
Forest Run	2400	150 cfs	150.00	1203.73	1205.51		1205.72	0.004720	3.69	40.64	35.72	0.61
Forest Run	2400	2 Year	485.00	1203.73	1208.31		1208.38	0.000433	2.34	260.76	161.88	0.22
Forest Run	2200	10 Year	1570.00	1202.90	1210.49		1210.53	0.000143	2.08	1114.16	398.64	0.14
Forest Run	2200	50 Year	2484.00	1202.90	1211.21		1211.27	0.000203	2.65	1374.03	424.61	0.17
Forest Run	2200	100 Year	2794.00	1202.90	1211.40		1211.47	0.000224	2.83	1445.84	431.47	0.18
Forest Run	2200	1 Year	438.00	1202.90	1207.43		1207.50	0.000351	2.15	254.52	175.84	0.20
Forest Run	2200	5 Year	1101.80	1202.90	1210.00		1210.03	0.000108	1.72	948.80	381.06	0.12
Forest Run	2200	150 cfs	150.00	1202.90	1204.79		1204.94	0.003110	3.09	48.58	40.87	0.50
Forest Run	2200	2 Year	509.00	1202.90	1208.29		1208.32	0.000155	1.65	440.89	250.15	0.14
Forest Run	2012.13	10 Year	1570.00	1202.07	1210.46		1210.50	0.000137	2.10	1063.92	384.25	0.14
Forest Run	2012.13	50 Year	2484.00	1202.07	1211.16		1211.23	0.000209	2.76	1286.11	411.06	0.18
Forest Run	2012.13	100 Year	2794.00	1202.07	1211.34		1211.43	0.000234	2.97	1347.37	418.08	0.19
Forest Run	2012.13	1 Year	438.00	1202.07	1207.40		1207.44	0.000202	1.74	331.19	180.98	0.15
Forest Run	2012.13	5 Year	1101.80	1202.07	1209.98		1210.01	0.000098	1.70	923.28	365.50	0.12
Forest Run	2012.13	150 cfs	150.00	1202.07	1204.32		1204.45	0.002192	2.93	51.12	35.52	0.43
Forest Run	2012.13	2 Year	509.00	1202.07	1208.28		1208.30	0.000097	1.38	510.87	254.37	0.11
Forest Run	2000	10 Year	1570.00	1202.07	1210.46		1210.50	0.000138	2.11	1063.40	384.18	0.14
Forest Run	2000	50 Year	2484.00	1202.07	1211.16		1211.23	0.000209	2.77	1285.22	410.96	0.18
Forest Run	2000	100 Year	2794.00	1202.07	1211.34		1211.42	0.000234	2.97	1346.38	417.97	0.19
Forest Run	2000	1 Year	438.00	1202.07	1207.40		1207.44	0.000202	1.74	330.73	180.83	0.15
Forest Run	2000	5 Year	1101.80	1202.07	1209.98		1210.01	0.000098	1.70	922.94	365.42	0.12
Forest Run	2000	150 cfs	150.00	1202.07	1204.28		1204.42	0.002336	3.00	49.93	35.14	0.44
Forest Run	2000	2 Year	509.00	1202.07	1208.28		1208.30	0.000097	1.38	510.60	254.29	0.11
Forest Run	1848.18	10 Year	1570.00	1201.44	1210.45		1210.48	0.000095	1.60	1279.46	401.96	0.10
Forest Run	1848.18	50 Year	2484.00	1201.44	1211.15		1211.20	0.000151	2.14	1512.56	428.05	0.13
Forest Run	1848.18	100 Year	2794.00	1201.44	1211.33		1211.38	0.000171	2.30	1576.49	434.87	0.14
Forest Run	1848.18	1 Year	438.00	1201.44	1207.39		1207.41	0.000132	1.34	432.46	300.05	0.11
Forest Run	1848.18	5 Year	1101.80	1201.44	1209.98		1209.99	0.000065	1.27	1130.88	384.43	0.08
Forest Run	1848.18	150 cfs	150.00	1201.44	1204.07		1204.14	0.001341	2.18	68.71	40.84	0.30
Forest Run	1848.18	2 Year	509.00	1201.44	1208.27		1208.28	0.000065	1.06	647.95	341.13	0.08

HEC-RAS Plan: PC River: Channel Reach: Forest Run (Continued)

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)	
Forest Run	1800	10 Year	1570.00	1201.23	1210.45		1210.47	0.000085	1.51	1378.41	357.51	0.10
Forest Run	1800	50 Year	2484.00	1201.23	1211.15		1211.19	0.000133	2.01	1637.45	387.48	0.12
Forest Run	1800	100 Year	2794.00	1201.23	1211.33		1211.37	0.000150	2.16	1708.64	395.32	0.13
Forest Run	1800	1 Year	438.00	1201.23	1207.38		1207.40	0.000131	1.33	439.08	230.48	0.11
Forest Run	1800	5 Year	1101.80	1201.23	1209.98		1209.99	0.000059	1.20	1213.70	337.55	0.08
Forest Run	1800	150 cfs	150.00	1201.23	1204.00		1204.08	0.001218	2.17	69.28	38.67	0.29
Forest Run	1800	2 Year	509.00	1201.23	1208.27		1208.28	0.000063	1.05	673.77	289.35	0.08
Forest Run	1700	10 Year	1570.00	1200.82	1210.45		1210.47	0.000051	1.48	1532.90	354.15	0.09
Forest Run	1700	50 Year	2484.00	1200.82	1211.14		1211.17	0.000084	2.00	1783.46	370.49	0.12
Forest Run	1700	100 Year	2794.00	1200.82	1211.32		1211.36	0.000096	2.17	1850.64	374.75	0.12
Forest Run	1700	1 Year	438.00	1200.82	1207.38		1207.39	0.000034	0.91	640.24	208.06	0.07
Forest Run	1700	5 Year	1101.80	1200.82	1209.97		1209.99	0.000034	1.17	1368.28	342.57	0.07
Forest Run	1700	150 cfs	150.00	1200.82	1204.00		1204.02	0.000213	1.22	137.55	89.58	0.14
Forest Run	1700	2 Year	509.00	1200.82	1208.27		1208.27	0.000025	0.85	844.37	264.63	0.06
Forest Run	1600	10 Year	1570.00	1200.39	1210.43		1210.46	0.000060	1.69	1293.02	293.20	0.10
Forest Run	1600	50 Year	2484.00	1200.39	1211.11		1211.16	0.000108	2.36	1477.94	313.41	0.13
Forest Run	1600	100 Year	2794.00	1200.39	1211.28		1211.35	0.000125	2.58	1527.87	318.62	0.14
Forest Run	1600	1 Year	438.00	1200.39	1207.38		1207.39	0.000032	0.93	621.16	190.65	0.07
Forest Run	1600	5 Year	1101.80	1200.39	1209.96		1209.98	0.000038	1.29	1173.62	279.28	0.08
Forest Run	1600	150 cfs	150.00	1200.39	1203.99		1204.00	0.000101	0.98	170.99	87.71	0.10
Forest Run	1600	2 Year	509.00	1200.39	1208.26		1208.27	0.000022	0.85	792.81	228.49	0.06
Forest Run	1451.95	10 Year	1570.00	1200.00	1210.37	1203.40	1210.44	0.000217	2.22	862.68	256.07	0.13
Forest Run	1451.95	50 Year	2484.00	1200.00	1211.01	1204.50	1211.13	0.000362	3.00	1035.48	283.60	0.17
Forest Run	1451.95	100 Year	2794.00	1200.00	1211.18	1204.82	1211.31	0.000414	3.25	1081.88	290.55	0.19
Forest Run	1451.95	1 Year	438.00	1200.00	1207.36	1201.50	1207.38	0.000078	1.12	391.53	88.78	0.08
Forest Run	1451.95	5 Year	1101.80	1200.00	1209.93	1202.72	1209.97	0.000143	1.73	752.67	234.89	0.11
Forest Run	1451.95	150 cfs	150.00	1200.00	1203.98	1200.75	1203.99	0.000091	0.78	192.01	56.57	0.07
Forest Run	1451.95	2 Year	509.00	1200.00	1208.24	1201.66	1208.26	0.000084	1.14	456.53	117.11	0.08
Forest Run	1400		Culvert									
Forest Run	1372.54	10 Year	1570.00	1200.00	1205.45		1205.98	0.003526	5.84	268.84	80.76	0.49
Forest Run	1372.54	50 Year	2484.00	1200.00	1205.77		1206.92	0.007015	8.62	288.02	90.24	0.69
Forest Run	1372.54	100 Year	2794.00	1200.00	1205.81		1207.25	0.008614	9.61	290.61	91.52	0.77
Forest Run	1372.54	1 Year	438.00	1200.00	1203.87		1203.96	0.000926	2.47	176.97	52.53	0.24

HEC-RAS Plan: PC River: Channel Reach: Forest Run (Continued)

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)	
Forest Run	1372.54	5 Year	1101.80	1200.00	1205.12		1205.42	0.002237	4.42	249.17	71.04	0.38
Forest Run	1372.54	150 cfs	150.00	1200.00	1201.86		1201.92	0.001310	1.91	78.62	45.51	0.26
Forest Run	1372.54	2 Year	509.00	1200.00	1204.29		1204.39	0.000929	2.54	200.21	57.26	0.24
Forest Run	1200	10 Year	1570.00	1198.90	1205.68		1205.72	0.000247	2.31	1008.86	394.68	0.18
Forest Run	1200	50 Year	2484.00	1198.90	1206.38		1206.45	0.000303	2.78	1296.69	423.33	0.20
Forest Run	1200	100 Year	2794.00	1198.90	1206.61		1206.68	0.000311	2.89	1394.44	432.63	0.21
Forest Run	1200	1 Year	438.00	1198.90	1203.85		1203.88	0.000197	1.55	401.82	247.36	0.15
Forest Run	1200	5 Year	1101.80	1198.90	1205.22		1205.26	0.000208	2.00	833.37	376.14	0.16
Forest Run	1200	150 cfs	150.00	1198.90	1201.35		1201.54	0.003988	3.42	43.87	37.50	0.56
Forest Run	1200	2 Year	509.00	1198.90	1204.30		1204.32	0.000142	1.43	520.82	289.45	0.13
Forest Run	1000	10 Year	1570.00	1197.49	1205.66		1205.68	0.000146	2.01	1213.81	389.32	0.13
Forest Run	1000	50 Year	2484.00	1197.49	1206.35		1206.40	0.000201	2.52	1495.53	417.62	0.16
Forest Run	1000	100 Year	2794.00	1197.49	1206.58		1206.63	0.000213	2.64	1591.09	425.10	0.17
Forest Run	1000	1 Year	438.00	1197.49	1203.84		1203.85	0.000075	1.18	599.74	279.26	0.09
Forest Run	1000	5 Year	1101.80	1197.49	1205.21		1205.23	0.000110	1.67	1043.54	367.50	0.12
Forest Run	1000	150 cfs	150.00	1197.49	1200.79		1200.93	0.002494	3.70	61.71	78.76	0.46
Forest Run	1000	2 Year	509.00	1197.49	1204.29		1204.30	0.000060	1.12	732.11	309.60	0.08
Forest Run	946.76	10 Year	1570.00	1197.27	1205.63		1205.67	0.000226	2.62	949.27	325.80	0.17
Forest Run	946.76	50 Year	2484.00	1197.27	1206.30		1206.38	0.000328	3.35	1158.19	351.04	0.21
Forest Run	946.76	100 Year	2794.00	1197.27	1206.53		1206.61	0.000352	3.54	1230.27	359.29	0.22
Forest Run	946.76	1 Year	438.00	1197.27	1203.83		1203.85	0.000107	1.49	484.27	248.37	0.11
Forest Run	946.76	5 Year	1101.80	1197.27	1205.19		1205.22	0.000165	2.15	822.64	309.40	0.15
Forest Run	946.76	150 cfs	150.00	1197.27	1200.32	1200.32	1200.71	0.006081	5.65	37.01	48.50	0.72
Forest Run	946.76	2 Year	509.00	1197.27	1204.28		1204.29	0.000086	1.42	587.50	269.24	0.10
Forest Run	800	10 Year	1678.00	1195.60	1205.61	1198.91	1205.65	0.000104	1.72	1139.80	266.33	0.12
Forest Run	800	50 Year	2670.00	1195.60	1206.27	1200.06	1206.35	0.000178	2.40	1325.06	301.61	0.16
Forest Run	800	100 Year	3053.00	1195.60	1206.48	1200.49	1206.57	0.000206	2.64	1390.77	318.56	0.17
Forest Run	800	1 Year	458.00	1195.60	1203.83	1197.05	1203.84	0.000028	0.72	711.72	219.82	0.06
Forest Run	800	5 Year	1171.70	1195.60	1205.18	1198.23	1205.20	0.000067	1.32	1027.76	251.17	0.09
Forest Run	800	150 cfs	150.00	1195.60	1199.57	1196.33	1199.58	0.000040	0.74	202.84	88.60	0.07
Forest Run	800	2 Year	534.00	1195.60	1204.28	1197.20	1204.29	0.000027	0.75	812.89	229.37	0.06
Forest Run	750		Culvert									

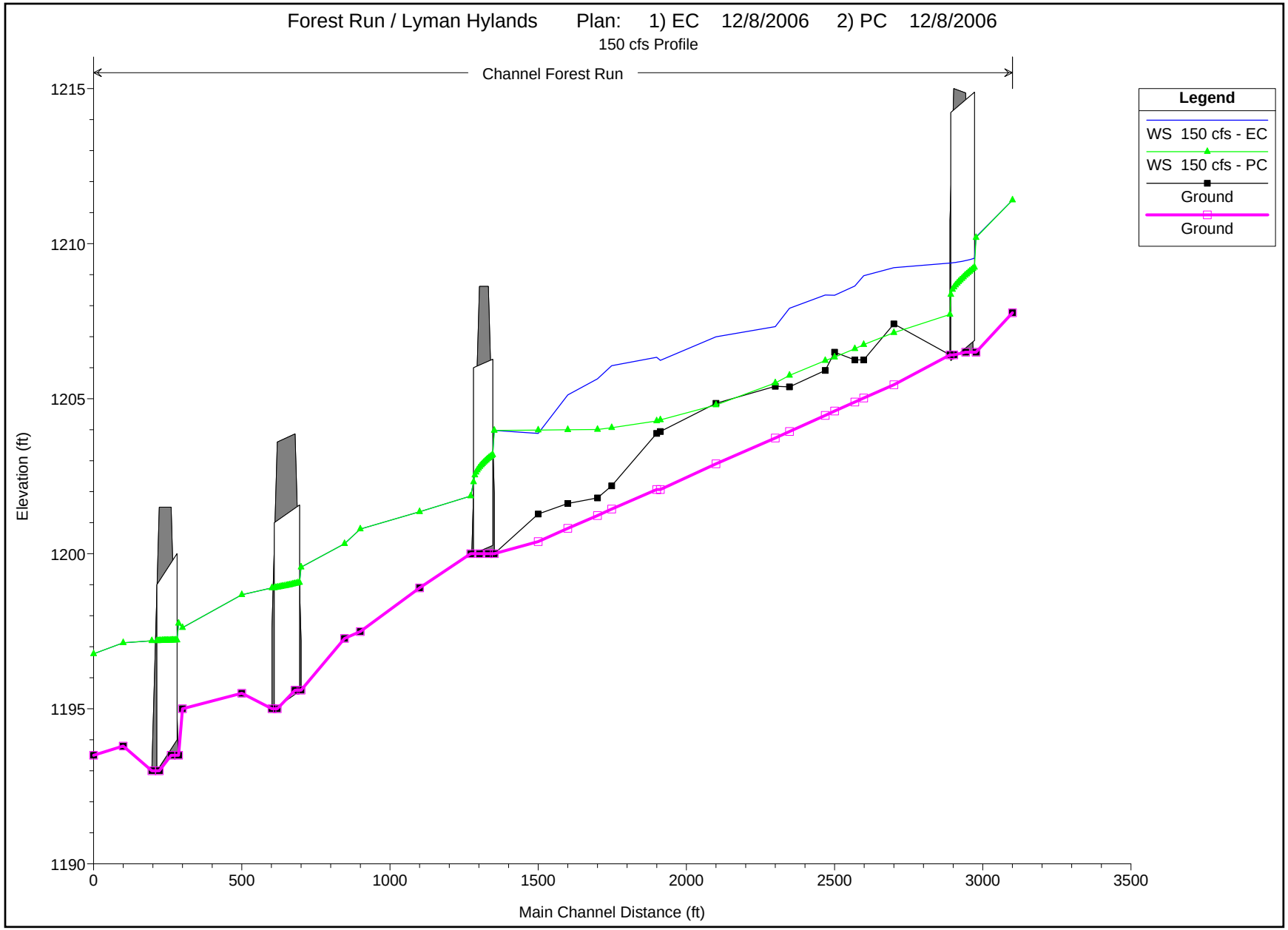
HEC-RAS Plan: PC River: Channel Reach: Forest Run (Continued)

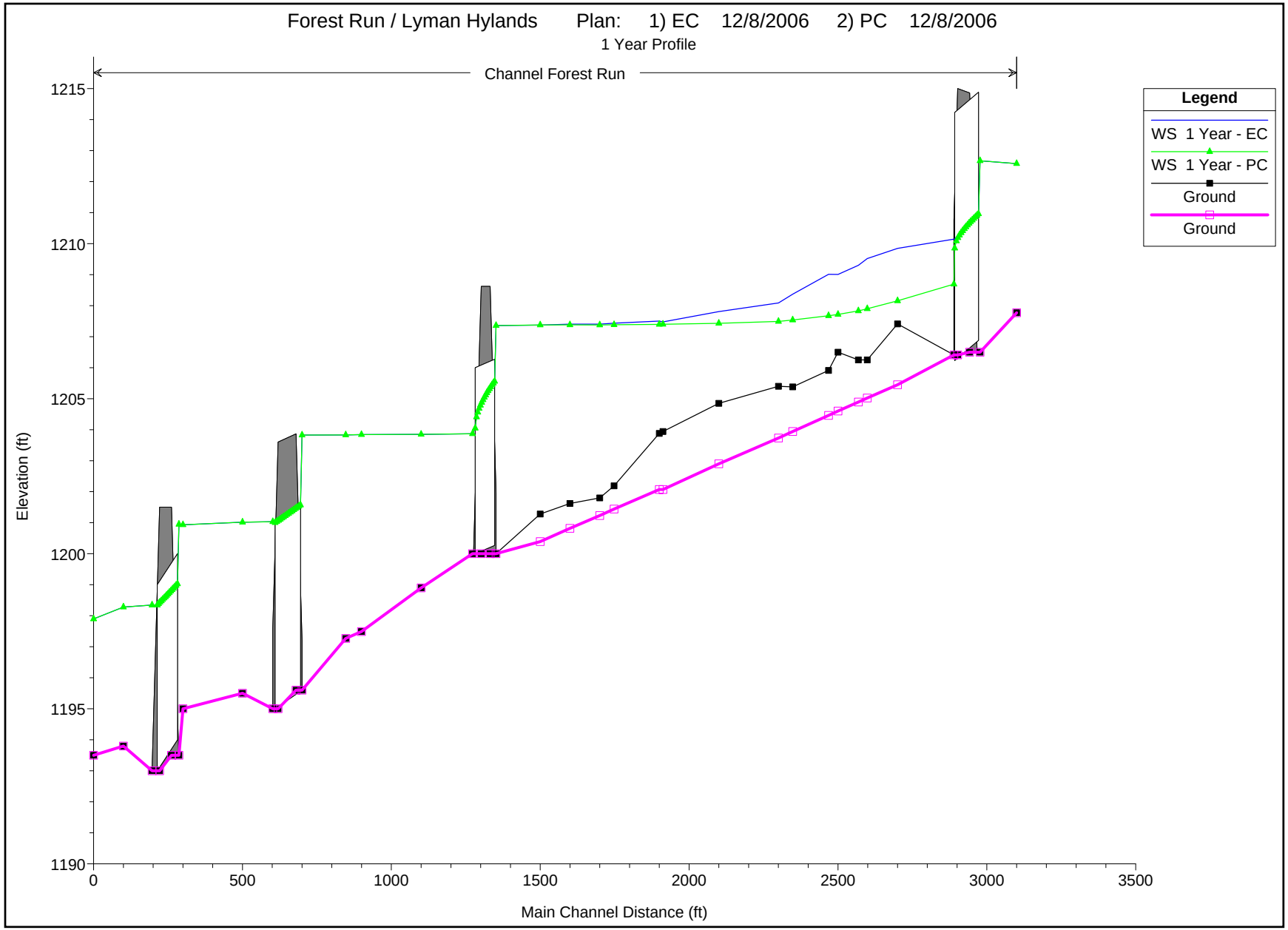
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Forest Run	702	10 Year	1678.00	1195.00	1203.09		1203.23	0.000599	2.93	581.48	173.68	0.27
Forest Run	702	50 Year	2670.00	1195.00	1203.73		1203.97	0.000887	3.96	695.98	187.42	0.33
Forest Run	702	100 Year	3053.00	1195.00	1203.92		1204.20	0.001000	4.32	732.04	191.55	0.35
Forest Run	702	1 Year	458.00	1195.00	1201.03		1201.06	0.000069	1.32	346.49	131.56	0.10
Forest Run	702	5 Year	1171.70	1195.00	1202.68		1202.76	0.000434	2.31	510.88	164.64	0.22
Forest Run	702	150 cfs	150.00	1195.00	1198.90		1198.91	0.000034	0.69	218.59	91.54	0.06
Forest Run	702	2 Year	534.00	1195.00	1201.78		1201.80	0.000063	1.37	391.06	145.71	0.09
Forest Run	600	10 Year	1678.00	1195.50	1203.12		1203.17	0.000224	2.36	1041.20	345.13	0.17
Forest Run	600	50 Year	2670.00	1195.50	1203.79		1203.87	0.000327	3.07	1285.30	381.25	0.21
Forest Run	600	100 Year	3053.00	1195.50	1204.00		1204.09	0.000364	3.31	1365.72	392.43	0.22
Forest Run	600	1 Year	458.00	1195.50	1201.02		1201.05	0.000240	1.82	398.49	256.02	0.17
Forest Run	600	5 Year	1171.70	1195.50	1202.69		1202.72	0.000166	1.94	895.69	329.72	0.15
Forest Run	600	150 cfs	150.00	1195.50	1198.68	1198.20	1198.88	0.003398	3.76	46.54	54.90	0.54
Forest Run	600	2 Year	534.00	1195.50	1201.78		1201.79	0.000104	1.35	608.26	297.69	0.11
Forest Run	400	10 Year	1711.00	1195.00	1203.02		1203.10	0.000586	2.69	800.39	320.19	0.19
Forest Run	400	50 Year	2726.00	1195.00	1203.65		1203.77	0.000743	3.23	1005.26	327.42	0.22
Forest Run	400	100 Year	3131.00	1195.00	1203.84		1203.98	0.000815	3.44	1067.54	329.59	0.23
Forest Run	400	1 Year	462.00	1195.00	1200.93		1200.98	0.000517	1.93	276.98	134.61	0.17
Forest Run	400	5 Year	1186.10	1195.00	1202.61		1202.66	0.000477	2.32	669.88	316.07	0.17
Forest Run	400	150 cfs	150.00	1195.00	1197.62		1197.84	0.009228	3.76	39.93	30.52	0.58
Forest Run	400	2 Year	540.00	1195.00	1201.73		1201.76	0.000285	1.61	411.25	224.85	0.13
Forest Run	386.77	10 Year	1711.00	1193.50	1203.01	1197.47	1203.09	0.000565	2.39	836.06	320.90	0.17
Forest Run	386.77	50 Year	2726.00	1193.50	1203.64	1198.54	1203.76	0.000818	3.07	1054.73	374.37	0.21
Forest Run	386.77	100 Year	3131.00	1193.50	1203.83	1198.91	1203.97	0.000915	3.30	1127.28	390.49	0.22
Forest Run	386.77	1 Year	462.00	1193.50	1200.95	1195.58	1200.97	0.000139	1.20	384.46	186.01	0.08
Forest Run	386.77	5 Year	1186.10	1193.50	1202.61	1196.80	1202.66	0.000390	1.90	720.65	298.32	0.14
Forest Run	386.77	150 cfs	150.00	1193.50	1197.76	1194.74	1197.77	0.000146	0.78	193.00	73.19	0.08
Forest Run	386.77	2 Year	540.00	1193.50	1201.73	1195.74	1201.75	0.000176	1.15	510.36	244.95	0.09
Forest Run	301		Culvert									
Forest Run	296.33	10 Year	1711.00	1193.00	1200.29		1200.60	0.001983	4.48	382.01	84.41	0.31
Forest Run	296.33	50 Year	2726.00	1193.00	1201.36		1201.90	0.004709	5.92	469.71	138.98	0.46
Forest Run	296.33	100 Year	3131.00	1193.00	1201.72		1202.31	0.004774	6.24	524.19	161.83	0.47
Forest Run	296.33	1 Year	462.00	1193.00	1198.35		1198.39	0.000487	1.74	265.39	69.10	0.15

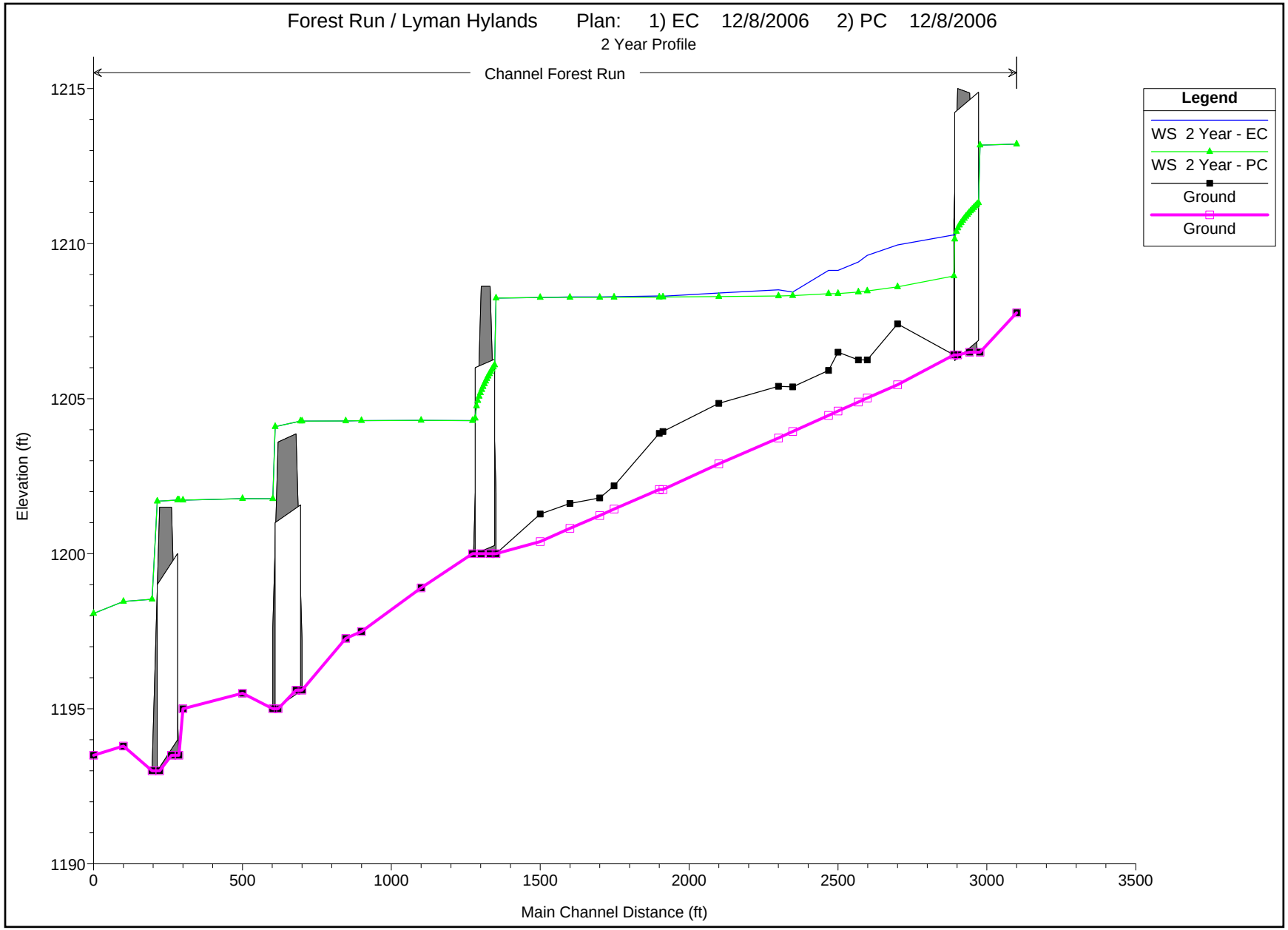
HEC-RAS Plan: PC River: Channel Reach: Forest Run (Continued)

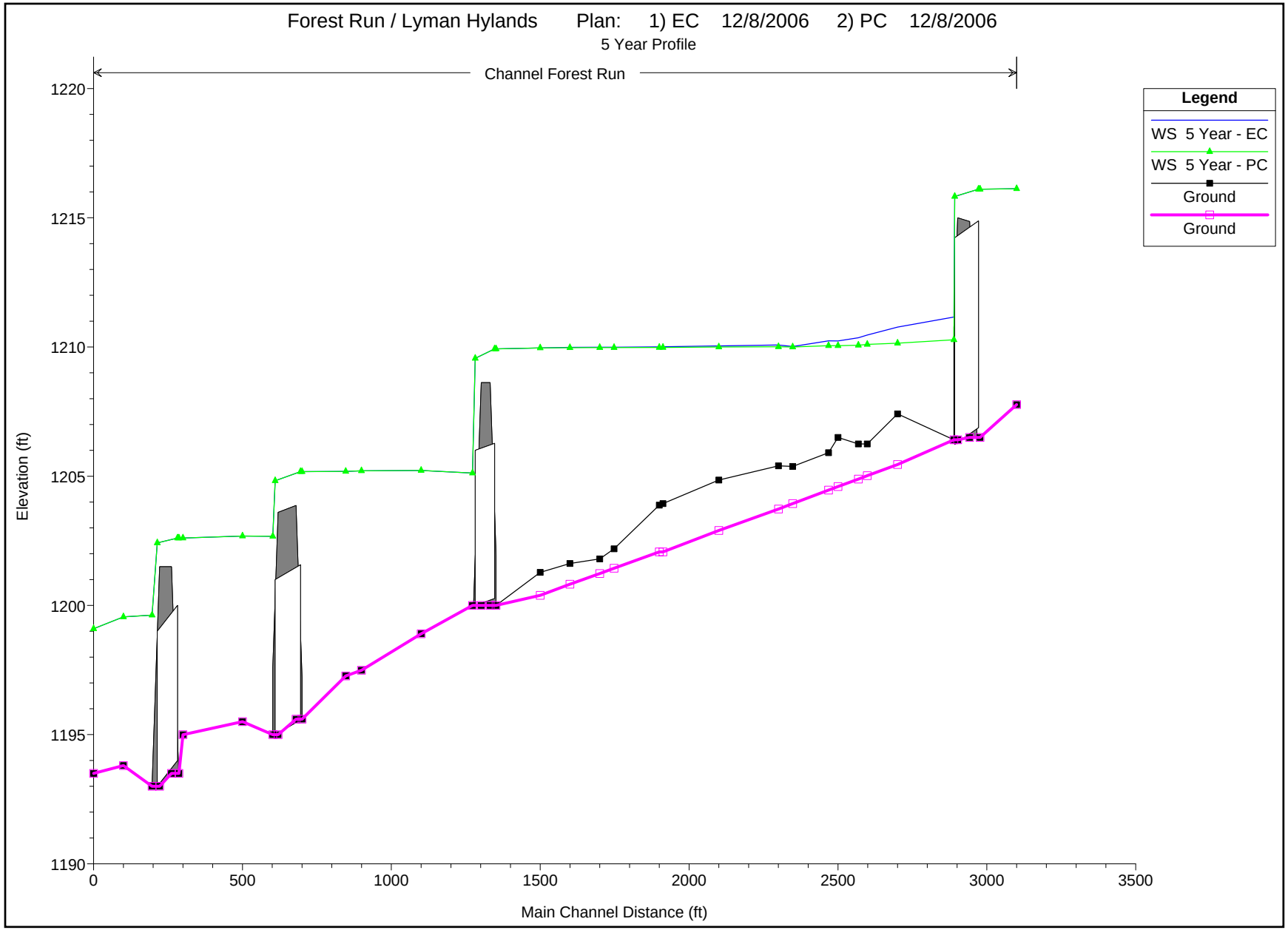
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Forest Run	296.33	5 Year	1186.10	1193.00	1199.62		1199.81	0.001378	3.47	342.04	79.16	0.26
Forest Run	296.33	150 cfs	150.00	1193.00	1197.19		1197.20	0.000137	0.76	196.19	60.00	0.07
Forest Run	296.33	2 Year	540.00	1193.00	1198.53		1198.59	0.000581	1.95	276.44	70.55	0.16
Forest Run	200	10 Year	1711.00	1193.80	1200.25		1200.38	0.001600	3.62	626.83	186.24	0.27
Forest Run	200	50 Year	2726.00	1193.80	1201.35		1201.53	0.001791	4.33	842.67	213.52	0.30
Forest Run	200	100 Year	3131.00	1193.80	1201.74		1201.93	0.001782	4.48	925.30	217.35	0.30
Forest Run	200	1 Year	462.00	1193.80	1198.28		1198.33	0.001078	2.20	294.44	157.80	0.21
Forest Run	200	5 Year	1186.10	1193.80	1199.55		1199.65	0.001410	3.10	503.65	170.54	0.25
Forest Run	200	150 cfs	150.00	1193.80	1197.13		1197.17	0.001301	1.84	121.15	141.92	0.21
Forest Run	200	2 Year	540.00	1193.80	1198.46		1198.51	0.001115	2.31	323.14	159.61	0.21
Forest Run	100	10 Year	1711.00	1193.50	1199.74	1198.72	1200.09	0.005007	6.02	386.22	133.94	0.47
Forest Run	100	50 Year	2726.00	1193.50	1200.77	1199.37	1201.22	0.005004	6.82	527.96	142.15	0.49
Forest Run	100	100 Year	3131.00	1193.50	1201.13	1199.60	1201.62	0.005004	7.08	579.45	145.02	0.49
Forest Run	100	1 Year	462.00	1193.50	1197.90	1197.28	1198.11	0.005005	4.43	153.20	114.98	0.44
Forest Run	100	5 Year	1186.10	1193.50	1199.10	1198.31	1199.39	0.005002	5.49	301.73	128.79	0.46
Forest Run	100	150 cfs	150.00	1193.50	1196.77	1195.95	1196.93	0.005004	3.30	55.40	58.65	0.41
Forest Run	100	2 Year	540.00	1193.50	1198.07	1197.43	1198.29	0.005003	4.59	173.72	120.58	0.44

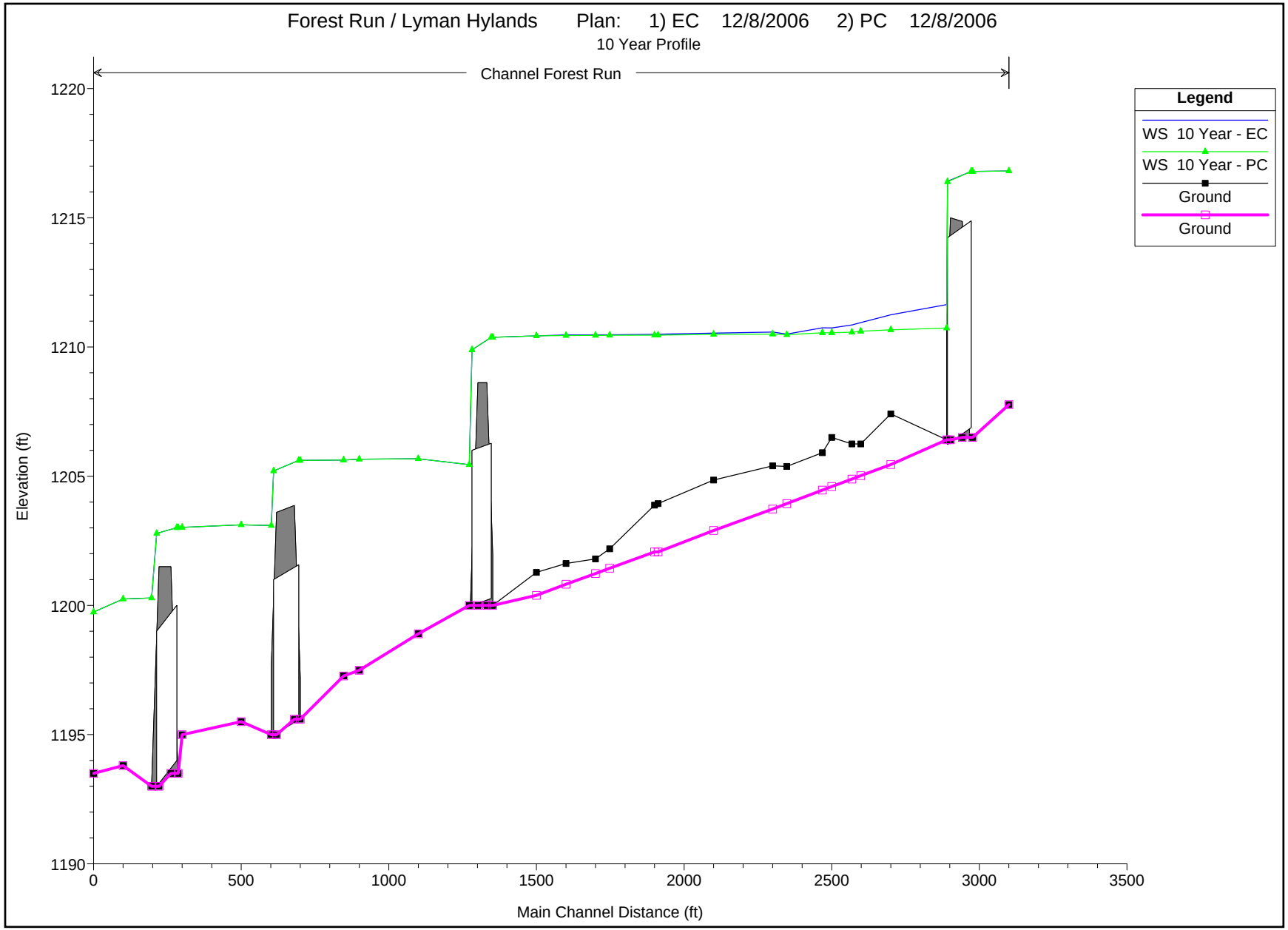
HEC-RAS Profiles

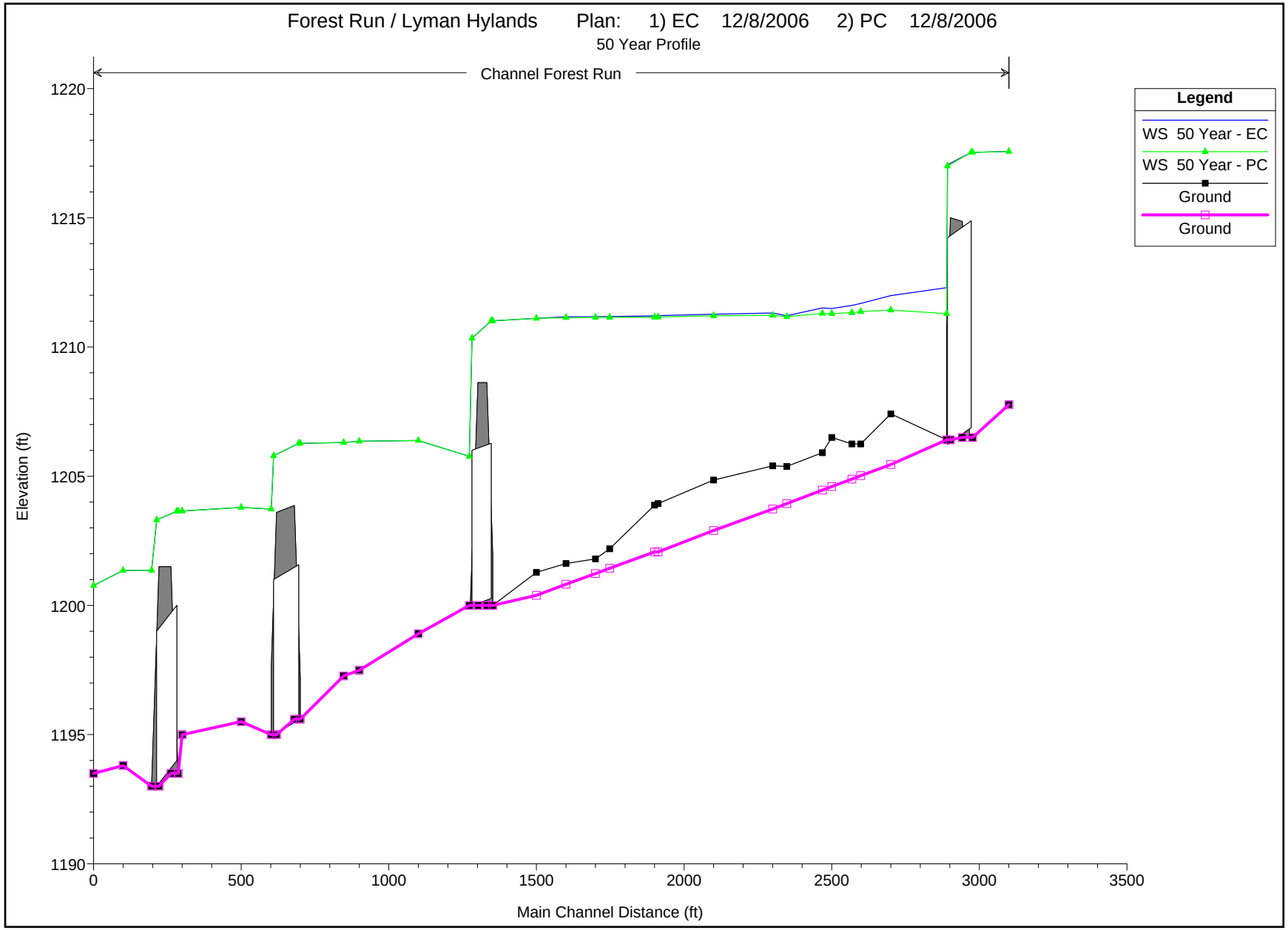

Forest Run / Lyman Hylands Plan: 1) EC 12/8/2006 2) PC 12/8/2006
150 cfs Profile
Channel Forest Run
Legend
WS 150 cfs - EC
WS 150 cfs - PC
Ground
Ground
Elevation (ft)
1215
1210
1205
1200
1195
1190
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (ft)

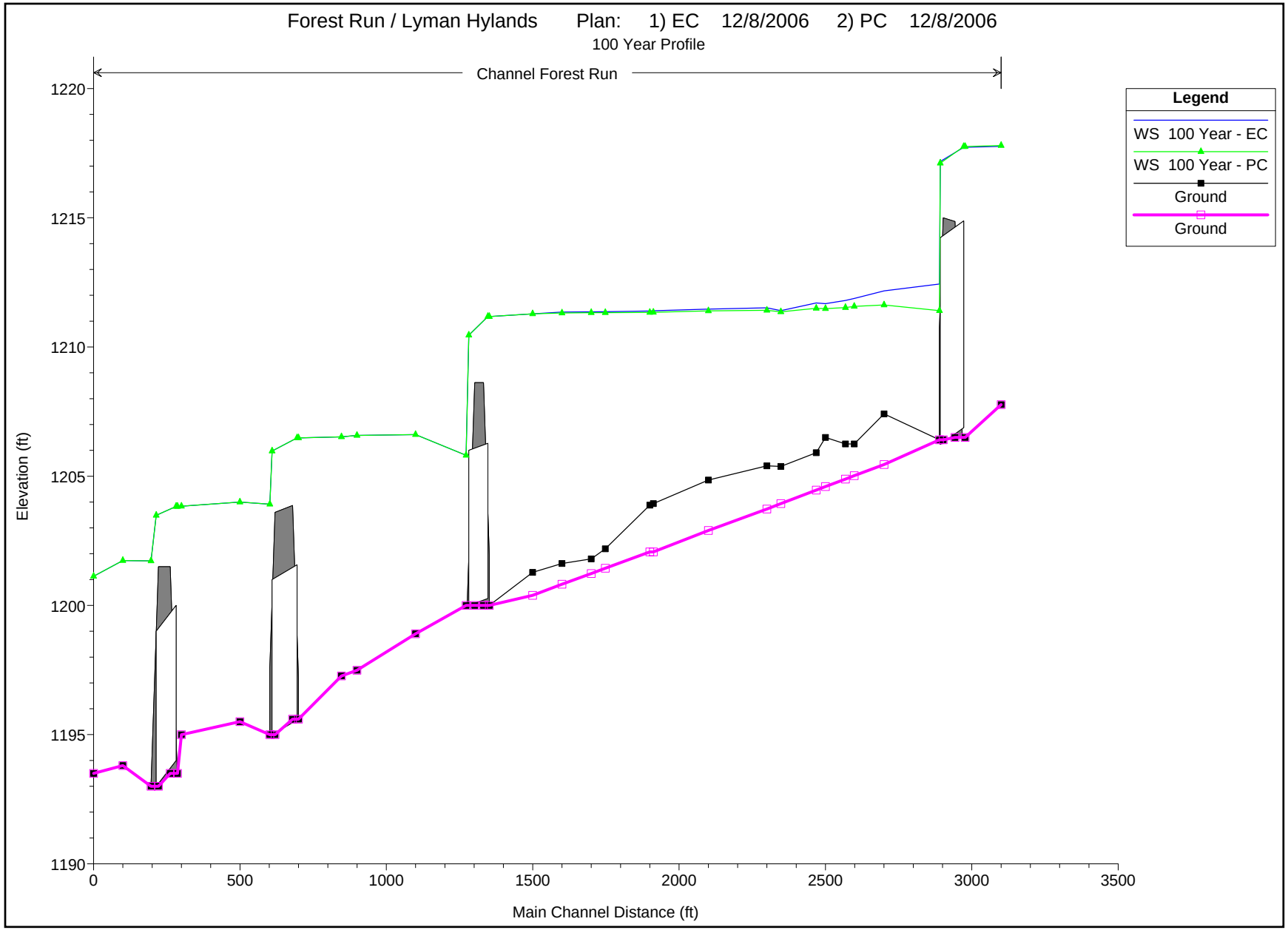

Forest Run / Lyman Hylands Plan: 1) EC 12/8/2006 2) PC 12/8/2006
1 Year Profile
Channel Forest Run
Legend
WS 1 Year - EC
WS 1 Year - PC
Ground
Ground
Elevation (ft)
1215
1210
1205
1200
1195
1190
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (ft)


Forest Run / Lyman Hylands Plan: 1) EC 12/8/2006 2) PC 12/8/2006
2 Year Profile
Channel Forest Run
Legend
WS 2 Year - EC
WS 2 Year - PC
Ground
Ground
Elevation (ft)
1215
1210
1205
1200
1195
1190
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (ft)

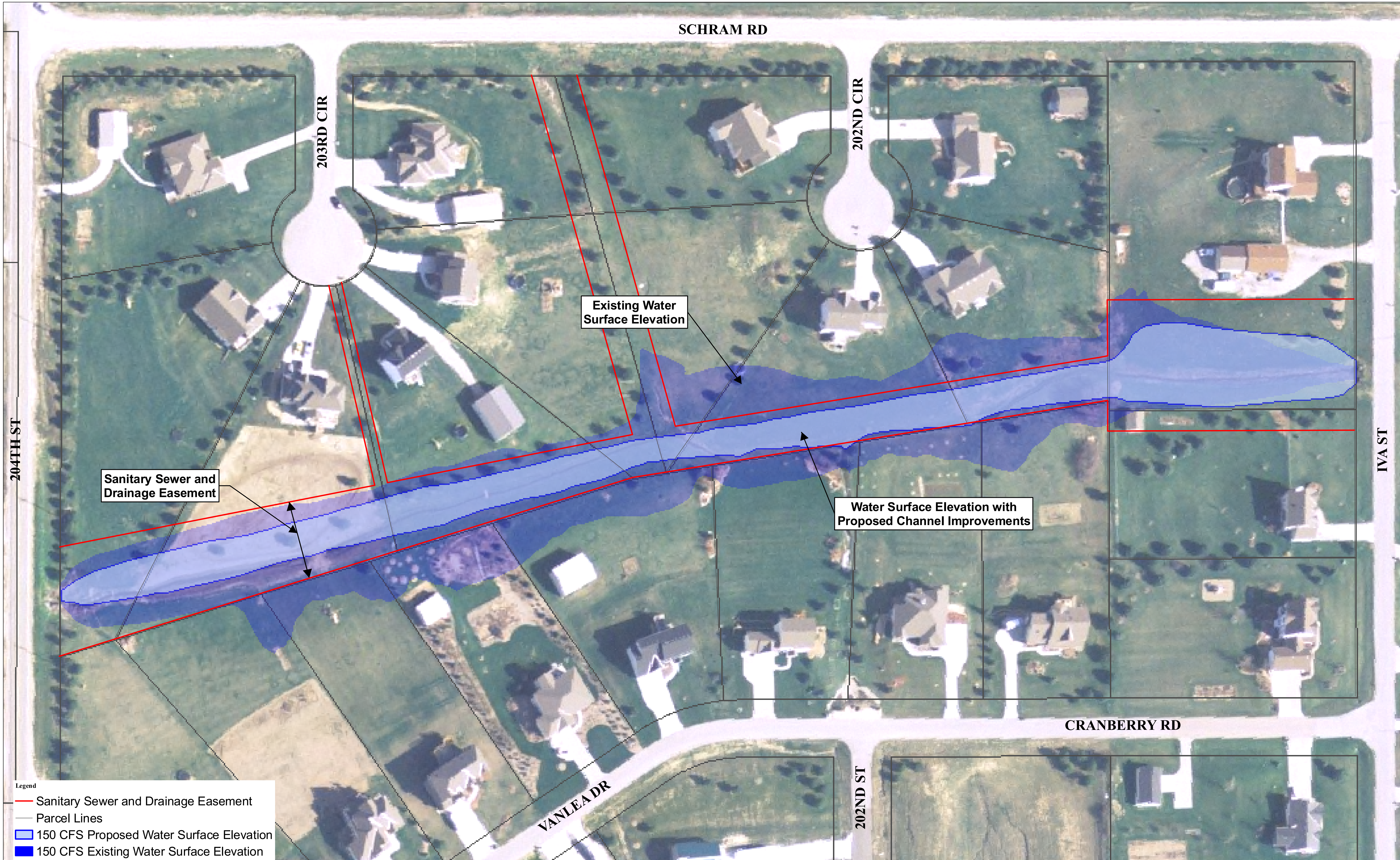

Forest Run / Lyman Hylands Plan: 1) EC 12/8/2006 2) PC 12/8/2006
5 Year Profile
Channel Forest Run
Legend
WS 5 Year - EC
WS 5 Year - PC
Ground
Ground
Elevation (ft)
1220
1215
1210
1205
1200
1195
1190
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (ft)


Forest Run / Lyman Hylands Plan: 1) EC 12/8/2006 2) PC 12/8/2006
10 Year Profile
Channel Forest Run
Legend
WS 10 Year - EC
WS 10 Year - PC
Ground
Ground
Elevation (ft)
1220
1215
1210
1205
1200
1195
1190
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (ft)


Forest Run / Lyman Hylands Plan: 1) EC 12/8/2006 2) PC 12/8/2006
50 Year Profile
Channel Forest Run
Legend
WS 50 Year - EC
WS 50 Year - PC
Ground
Ground
Elevation (ft)
1220
1215
1210
1205
1200
1195
1190
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (ft)


Forest Run / Lyman Hylands Plan: 1) EC 12/8/2006 2) PC 12/8/2006
100 Year Profile
Channel Forest Run
Legend
WS 100 Year - EC
WS 100 Year - PC
Ground
Ground
Elevation (ft)
1220
1215
1210
1205
1200
1195
1190
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (ft)

Water Surface Elevation Inundation Maps



Source: MAPA 2004, City of Omaha GIS, LRA

Lines are for graphical representation only. LRA assumes no responsibility for the accuracy of portrayed data.

N

0 100 200 FEET

1 INCH EQUALS 100 FEET

150 CFS Water Surface Elevations

Lamp, Rynearson & Associates, Inc.
14710 West Dodge Road
Omaha, Nebraska 68154
Phone: 402.496.2498
Fax: 402.496.2730
www.LRA-INC.com

Date: 12-06-2006; Map By: Jennifer P; Path: L:\GIS\GIS_project\04008.11\Flood_150_11x17.mxd

SCHRAM RD

203RD CIR

202ND CIR

204TH ST

IVA ST

Existing Water Surface Elevation

Sanitary Sewer and Drainage Easement

Water Surface Elevation with Proposed Channel Improvements

CRANBERRY RD

VANLEA DR

202ND ST

Legend

- Sanitary Sewer and Drainage Easement
- Parcel Lines
- 1 Year Proposed Water Surface Elevation
- 1 Year Existing Water Surface Elevation

Source: MAPA 2004, City of Omaha GIS, LRA

Lines are for graphical representation only. LRA assumes no responsibility for the accuracy of portrayed data.

N

0 100 200 FEET

1 INCH EQUALS 100 FEET

1 Year Water Surface Elevations

Lamp, Rynearson & Associates, Inc.
14710 West Dodge Road
Omaha, Nebraska 68154
Phone: 402-496-2498
Fax: 402-496-2730
www.LRA-INC.com

Date: 12-06-2006, Map By: Jennifer P. Path: L:\GISGIS_project\04008 10 Flood_1_11x17.mxd

SCHRAM RD

203RD CIR

202ND CIR

204TH ST

IVA ST

Existing Water Surface Elevation

Sanitary Sewer and Drainage Easement

Water Surface Elevation with Proposed Channel Improvements

CRANBERRY RD

VANLEA DR

202ND ST

Legend

- Sanitary Sewer and Drainage Easement
- Parcel Lines
- 5 Year Proposed Water Surface Elevation
- 5 Year Existing Water Surface Elevation

Source: MAPA 2004, City of Omaha GIS, LRA

Lines are for graphical representation only. LRA assumes no responsibility for the accuracy of portrayed data.

N

0 100 200 FEET

1 INCH EQUALS 100 FEET

5 Year Water Surface Elevations

Lamp, Rynearson & Associates, Inc.
14710 W. Dodge Road
Omaha, Nebraska 68154
Phone: 402-496-2498
Fax: 402-496-2730
www.LRA-INC.com

Date: 12-06-2006, Map By: Jennifer P. Path: L:\GISGIS_project\04008 11\Final_5_11x17.mxd

SCHRAM RD

203RD CIR

202ND CIR

204TH ST

IVA ST

CRANBERRY RD

VANLEA DR

202ND ST

Existing Water Surface Elevation

Sanitary Sewer and Drainage Easement

Water Surface Elevation with Proposed Channel Improvements

Legend

- Sanitary Sewer and Drainage Easement
- Parcel Lines
- 100 Year Existing Water Surface Elevation
- 100 Year Proposed Water Surface Elevation

Source: MAPA 2004, City of Omaha GIS, LRA

Lines are for graphical representation only. LRA assumes no responsibility for the accuracy of portrayed data.

N

0 100 200 FEET

1 INCH EQUALS 100 FEET

100 Year Water Surface Elevations

Lamp, Rynearson & Associates, Inc.
14710 West Dodge Road
Omaha, Nebraska 68154
Phone: 402.496.2498
Fax: 402.496.2730
www.LRA-INC.com

Date: 12-08-2006 Map By: Jennifer P. Path: L:\GIS\GIS_project\04008.11\Final_100_11x17.mxd

Drainage Basin Map

SubBasins Streams

N

0 500 1,000 FEET

1 INCH EQUALS 500 FEET

Source: MAPA 2004 Aerial Imagery, Sarpy Co GIS
Date: 12-08-06; Map by: Jennifer P; Path: L:\GIS\GIS_projects\04008.11\GretnaNE_updated.mxd
Lines are for graphical representation only. LRA assumes no responsibility for the accuracy of portrayed data.

Lamp, Rynearson & Associates, Inc.
14710 West Dodge Road
Omaha, Nebraska 68154
Phone 402.496.2498
Fax 402.496.2730
www.LRA-INC.com

Gretna
288 Acres

West
88 Acres

Southwest Gretna
286 Acres

Central
102 Acres

East
29 Acres

Junction A

Junction B

Junction C

Junction D