FERBER ENGINEERING COMPANY

CONSULTING ENGINEERS AND LAND SURVEYORS
3471 STURGIS ROAD
RAPID CITY, SD 57702
PHONE: (605) 343-3311
FAX: (605) 343-3399

Hydraulic Model Summary
HEC-RAS Hydraulic Analysis
Select Auto Sales – 1316 Cambell Street, Rapid City, SD

The original building, which is now Select Auto Sales, was constructed in 1974 with the first floor elevation of 3162.9 ft-msl, which is above the 1981 FIRM BFE of 3162.4 ft-msl. In 1996 FEMA revised the floodway and floodplain mapping for Rapid City. With these changes, the BFE at the location listed above increased by approximately two feet to 3164.4 ft-msl.

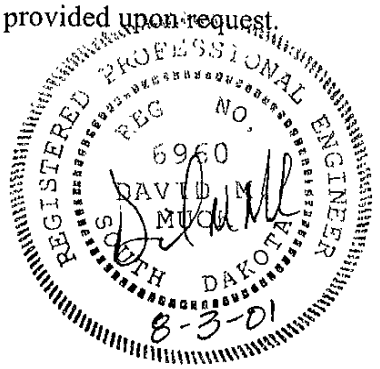
We used the original HEC-2 input file used to create the 1996 revised FIRM and Floodway maps currently used by Rapid City. We imported this data file into HEC-RAS 3.0 and ran the model to verify the results. All river stations in the new HEC-RAS model matched the original HEC-2 output files. At RS 407640 the FIS water surface elevations are 3164.4 ft-msl (with floodway) and 3164.5 ft-msl (without floodway). FEMA considers a reduction in flood elevation between calculations without floodway to calculations with floodway to be no change, therefore the BFE based on the original model is 3164.5 ft-msl. HEC-RAS is now the standard hydraulic model used by the USCOE and FEMA. FEMA requests that new models and updated models be completed using HEC-RAS.

In reviewing the existing model, we determined that the location of RS 407640 is within approximately 20 feet of the existing Select Auto Sales building. (An exact location is difficult to determine due to the small scale of the FIRM map.) Therefore, additional geometric data is not required for the model. However, the model did not provide for a blocked obstruction at the building location. We included the existing building as a 66-foot wide blocked obstruction. With this obstruction added to the existing conditions model, we ran the model to provide a "true" representation of the existing conditions. This approach is within the modeling approach prescribed by FEMA. The BFE increased 3164.70 ft-msl (without floodway) for existing conditions.

For the proposed building addition, as shown in Exhibit A, the obstruction width does not change from the existing conditions. Using the same flow conditions as above, the BFE did not change from our revised existing conditions model. The resultant BFE without the floodway was 3164.70 ft-msl. The model predicted no difference in water surface elevations at the upstream or downstream cross sections.

The model input and output information will be provided upon request.

Analysis Completed By:
FERBER ENGINEERING COMPANY
David M. Muck
South Dakota PE 6960



01SE001

HEC-RAS Version 3.0.1 Mar 2001
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

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X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X      X   X     X  X     X
X     X  X        X           X   X    X    X    X
XXXXXXX  XXXX     X       XXX XXXX     XXXXXX    XXXX
X     X  X        X           X  X     X    X        X
X     X  X        X    X      X   X    X    X        X
X     X  XXXXXX    XXXX       X    X   X    X   XXXXX
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PROJECT DATA
Project Title: Select Auto Sales
Project File : Select.prj
Run Date and Time: 8/1/01 9:51:29 AM

Project in English units

Project Description:
FEC 7-30-01 Placed blocked obstruction (66' wide) at station 407640. These are the "...modified" files -- *.p03, *.g03.

FEC 7-20-01 HEC-2 model
imported to HEC-RAS 3.0. Modifications were made by DMM to fix problems with bridge widths and bridge reach lengths. Added 1' to U/S reach length above bridge and removed 2' from bridge deck width. Model verified to MJB, Jr. results on 7-20-01.

same as orginal corps study except effective right areas
at 383665 & 385210
this run is same as orginal corps run except encroachment
stations on
right have been changed at 383665 and 385210 to reflect effective
areas
at these sections for the 100 year run. full sections are not effective
at
these two sections. this run also has cross section data at 385210
adjusted
to add certain elevations (from topo) that were missing in data.

THIS MODEL FURTHER MODIFIED BY MICHAEL BAKER JR, INC.
ET CARD ACTIVATED AT
SECTION 383665 (7.1 ADDED TO FIELD 2)
FLOODWAY WIDENED FROM SECTIONS 388450
TO 389550 TO MATCH EFFECTIVE FLOODWAY
STARTING WATER SURFACE ELEVATIONS FROM
PENNINGTON COUNTY F.I.S.
NEW LEVEE IN PLACE BELOW ST. PATRICK STREET
100-YEAR
LEVEE ASSUMMED IN PLACE BETWEEN MAPLE AND D.M.& E. R.R.

SPILLS TO LEFT BANK
COMPUTED BY FILES LOWQ.DAT AND LOW500Q.DAT
DISCHARGES IN THIS MODEL ADJUSTED
ACCORDINGLY
****

THIS IS THE FINAL RUN FOR THE 1993-1996 RAPID CREEK RESTUDY*

****
RAPID CITY,
SOUTH DAKOTA -1993-
RAPID CREEK (lower end)
100 YEAR FLOOD

01SE001

CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 407760

CROSS SECTION OUTPUT Profile #w/o FLOODWAY

E.G. Elev (ft)	3166.79	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.74	Wt. n-Val.	0.065	0.038	0.065
W.S. Elev (ft)	3166.05	Reach Len. (ft)	120.00	120.00	120.00
Crit W.S. (ft)		Flow Area (sq ft)	4.21	880.96	2609.58
E.G. Slope (ft/ft)	0.004470	Area (sq ft)	4.21	880.96	2609.58
Q Total (cfs)	14750.00	Flow (cfs)	1.28	8005.28	6743.44
Top Width (ft)	1324.38	Top Width (ft)	47.45	90.00	1186.93
Vel Total (ft/s)	4.22	Avg. Vel. (ft/s)	0.30	9.09	2.58
Max Chl Dpth (ft)	13.05	Hydr. Depth (ft)	0.09	9.79	2.20
Conv. Total (cfs)	220624.7	Conv. (cfs)	19.2	119739.8	100865.8
Length Wtd. (ft)	120.00	Wetted Per. (ft)	47.45	135.94	1186.95
Min Ch El (ft)	3153.00	Shear (lb/sq ft)	0.02	1.81	0.61
Alpha	2.69	Stream Power (lb/ft s)	0.01	16.43	1.59
Frctn Loss (ft)	0.58	Cum Volume (acre-ft)	1035.94	378.01	533.80
C & E Loss (ft)	0.19	Cum SA (acres)	472.34	52.58	186.02

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

CROSS SECTION OUTPUT Profile #w/ FLOODWAY

E.G. Elev (ft)	3167.40	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.49	Wt. n-Val.	0.065	0.038	0.065
W.S. Elev (ft)	3165.91	Reach Len. (ft)	120.00	120.00	120.00
Crit W.S. (ft)	3165.91	Flow Area (sq ft)	0.02	868.26	1340.45
E.G. Slope (ft/ft)	0.007453	Area (sq ft)	0.02	868.26	1340.45
Q Total (cfs)	14750.00	Flow (cfs)	0.00	10089.83	4660.17
Top Width (ft)	663.80	Top Width (ft)	3.80	90.00	570.00
Vel Total (ft/s)	6.68	Avg. Vel. (ft/s)	0.06	11.62	3.48
Max Chl Dpth (ft)	12.91	Hydr. Depth (ft)	0.00	9.65	2.35
Conv. Total (cfs)	170858.2	Conv. (cfs)	0.0	116876.6	53981.6
Length Wtd. (ft)	120.00	Wetted Per. (ft)	3.80	135.94	573.30
Min Ch El (ft)	3153.00	Shear (lb/sq ft)	0.00	2.97	1.09
Alpha	2.16	Stream Power (lb/ft s)	0.00	34.53	3.78
Frctn Loss (ft)	0.82	Cum Volume (acre-ft)	349.22	513.67	526.52
C & E Loss (ft)	0.06	Cum SA (acres)	79.92	58.09	128.55

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

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CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 407640

CROSS SECTION OUTPUT Profile #w/o FLOODWAY

			Left OB	Channel	Right OB
E.G. Elev (ft)	3166.02	Element			
Vel Head (ft)	1.37	Wt. n-Val.	0.065	0.038	0.065
W.S. Elev (ft)	3164.65	Reach Len. (ft)	370.00	390.00	150.00
Crit W.S. (ft)	3164.65	Flow Area (sq ft)	349.98	830.36	1652.20
E.G. Slope (ft/ft)	0.005309	Area (sq ft)	349.98	830.36	1652.20
Q Total (cfs)	14750.00	Flow (cfs)	675.83	9564.23	4509.94
Top Width (ft)	1170.10	Top Width (ft)	280.37	98.00	791.73
Vel Total (ft/s)	5.21	Avg. Vel. (ft/s)	1.93	11.52	2.73
Max Chl Dpth (ft)	12.65	Hydr. Depth (ft)	1.25	8.47	2.09
Conv. Total (cfs)	202433.5	Conv. (cfs)	9275.3	131262.4	61895.8
Length Wtd. (ft)	296.56	Wetted Per. (ft)	280.38	102.16	797.74
Min Ch El (ft)	3152.00	Shear (lb/sq ft)	0.41	2.69	0.69
Alpha	3.26	Stream Power (lb/ft s)	0.80	31.03	1.87
Frctn Loss (ft)	1.53	Cum Volume (acre-ft)	1035.45	375.65	527.93
C & E Loss (ft)	0.12	Cum SA (acres)	471.89	52.32	183.29

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

CROSS SECTION OUTPUT Profile #w/ FLOODWAY

			Left OB	Channel	Right OB
E.G. Elev (ft)	3166.17	Element			
Vel Head (ft)	1.68	Wt. n-Val.	0.065	0.038	0.065
W.S. Elev (ft)	3164.49	Reach Len. (ft)	370.00	390.00	150.00
Crit W.S. (ft)	3164.49	Flow Area (sq ft)	264.85	815.38	1134.42
E.G. Slope (ft/ft)	0.006271	Area (sq ft)	264.85	815.38	1134.42
Q Total (cfs)	14750.00	Flow (cfs)	679.70	10084.12	3986.18
Top Width (ft)	686.28	Top Width (ft)	156.00	98.00	432.28
Vel Total (ft/s)	6.66	Avg. Vel. (ft/s)	2.57	12.37	3.51
Max Chl Dpth (ft)	12.49	Hydr. Depth (ft)	1.70	8.32	2.62
Conv. Total (cfs)	186259.9	Conv. (cfs)	8583.2	127340.1	50336.7
Length Wtd. (ft)	301.47	Wetted Per. (ft)	156.91	102.16	440.26
Min Ch El (ft)	3152.00	Shear (lb/sq ft)	0.66	3.12	1.01
Alpha	2.44	Stream Power (lb/ft s)	1.70	38.65	3.54
Frctn Loss (ft)	1.59	Cum Volume (acre-ft)	348.85	511.36	523.11
C & E Loss (ft)	0.31	Cum SA (acres)	79.70	57.83	127.17

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The 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.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

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CROSS SECTION RIVER: RIVER-1
REACH: Reach-1 RS: 407250

CROSS SECTION OUTPUT Profile #w/o FLOODWAY

E.G. Elev (ft)	3163.48	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.13	Wt. n-Val.	0.075	0.038	0.075
W.S. Elev (ft)	3162.35	Reach Len. (ft)	190.00	190.00	170.00
Crit W.S. (ft)		Flow Area (sq ft)	570.41	573.76	2036.71
E.G. Slope (ft/ft)	0.005025	Area (sq ft)	570.41	573.76	2036.71
Q Total (cfs)	14750.00	Flow (cfs)	1017.68	6897.58	6834.75
Top Width (ft)	1009.71	Top Width (ft)	398.38	60.00	551.32
Vel Total (ft/s)	4.64	Avg. Vel. (ft/s)	1.78	12.02	3.36
Max Chl Dpth (ft)	12.35	Hydr. Depth (ft)	1.43	9.56	3.69
Conv. Total (cfs)	208077.7	Conv. (cfs)	14356.3	97303.9	96417.5
Length Wtd. (ft)	181.91	Wetted Per. (ft)	398.39	63.52	551.43
Min Ch El (ft)	3150.00	Shear (lb/sq ft)	0.45	2.83	1.16
Alpha	3.40	Stream Power (lb/ft s)	0.80	34.06	3.89
Frctn Loss (ft)	0.67	Cum Volume (acre-ft)	1031.54	369.36	521.58
C & E Loss (ft)	0.20	Cum SA (acres)	469.01	51.61	180.98

CROSS SECTION OUTPUT Profile #w/ FLOODWAY

E.G. Elev (ft)	3163.63	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.06	Wt. n-Val.	0.075	0.038	0.075
W.S. Elev (ft)	3162.58	Reach Len. (ft)	190.00	190.00	170.00
Crit W.S. (ft)		Flow Area (sq ft)	543.66	587.53	1833.28
E.G. Slope (ft/ft)	0.004498	Area (sq ft)	543.66	587.53	1833.28
Q Total (cfs)	14750.00	Flow (cfs)	1224.17	6788.85	6736.98
Top Width (ft)	700.00	Top Width (ft)	245.00	60.00	395.00
Vel Total (ft/s)	4.98	Avg. Vel. (ft/s)	2.25	11.55	3.67
Max Chl Dpth (ft)	12.58	Hydr. Depth (ft)	2.22	9.79	4.64
Conv. Total (cfs)	219933.6	Conv. (cfs)	18253.2	101226.9	100453.5
Length Wtd. (ft)	182.70	Wetted Per. (ft)	246.44	63.52	398.59
Min Ch El (ft)	3150.00	Shear (lb/sq ft)	0.62	2.60	1.29
Alpha	2.75	Stream Power (lb/ft s)	1.39	30.01	4.75
Frctn Loss (ft)	0.75	Cum Volume (acre-ft)	345.42	505.08	518.00
C & E Loss (ft)	0.01	Cum SA (acres)	78.00	57.13	125.75

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FIGURE 1. HYDRAULIC CROSS SECTION OF RAPID CREEK AT SELECT AUTO SALES

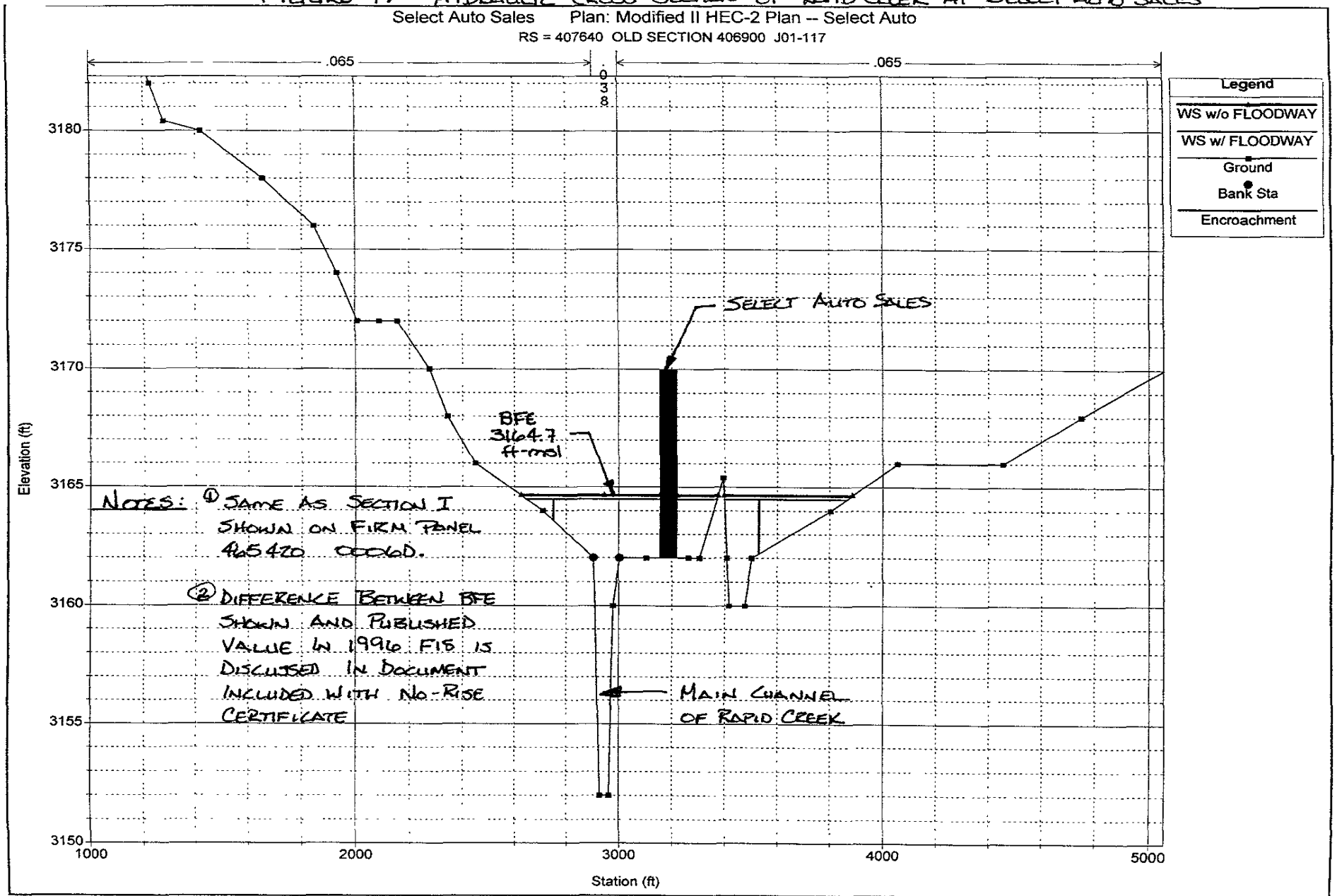

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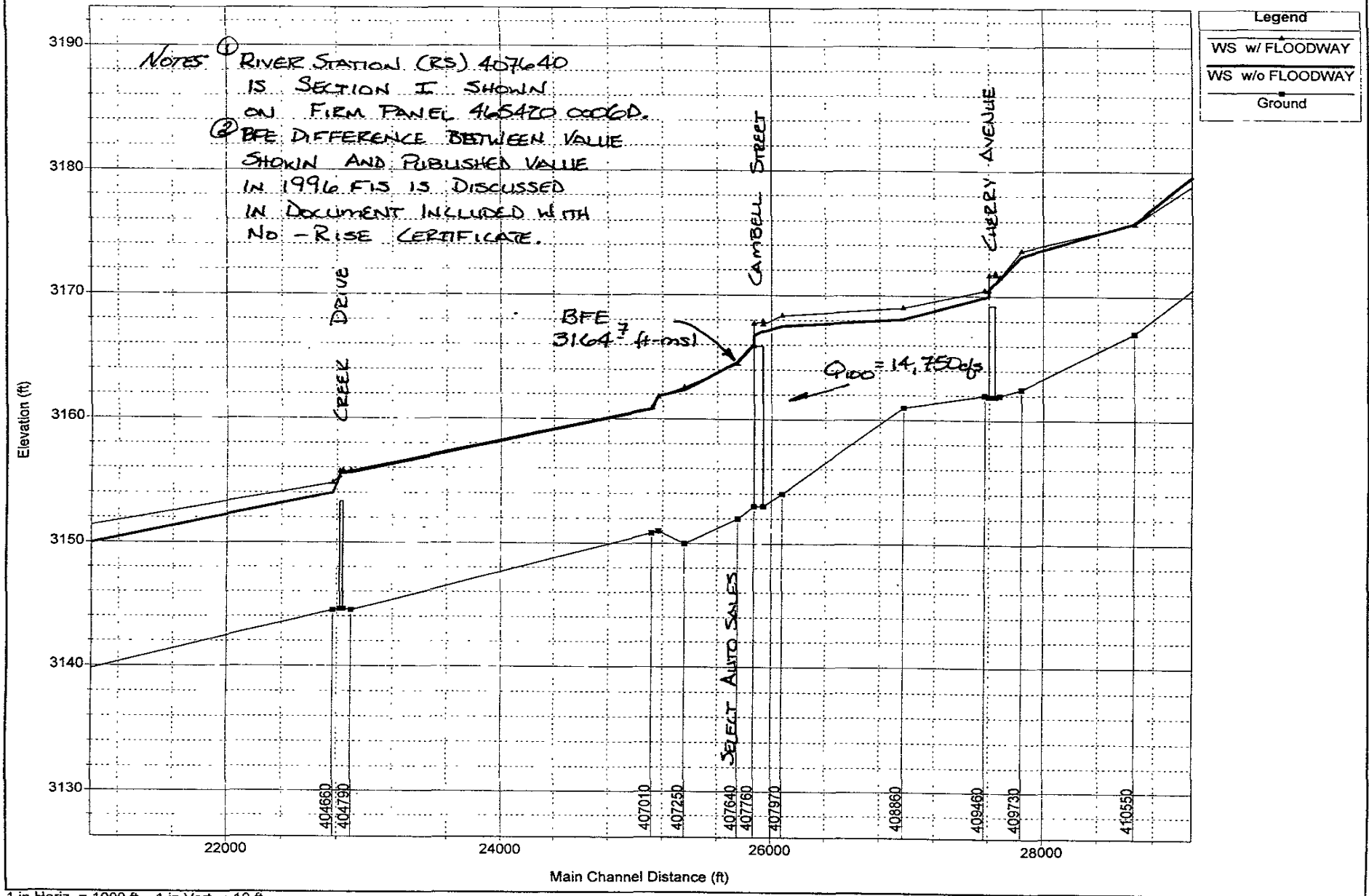
FIGURE 2. RAPID CREEK CHANNEL PROFILE -- CREEK DRIVE TO CHERRY AVENUE

Select Auto Sales Plan: Modified II HEC-2 Plan -- Select Auto

J01-117



1 in Horiz. = 1000 ft 1 in Vert. = 10 ft