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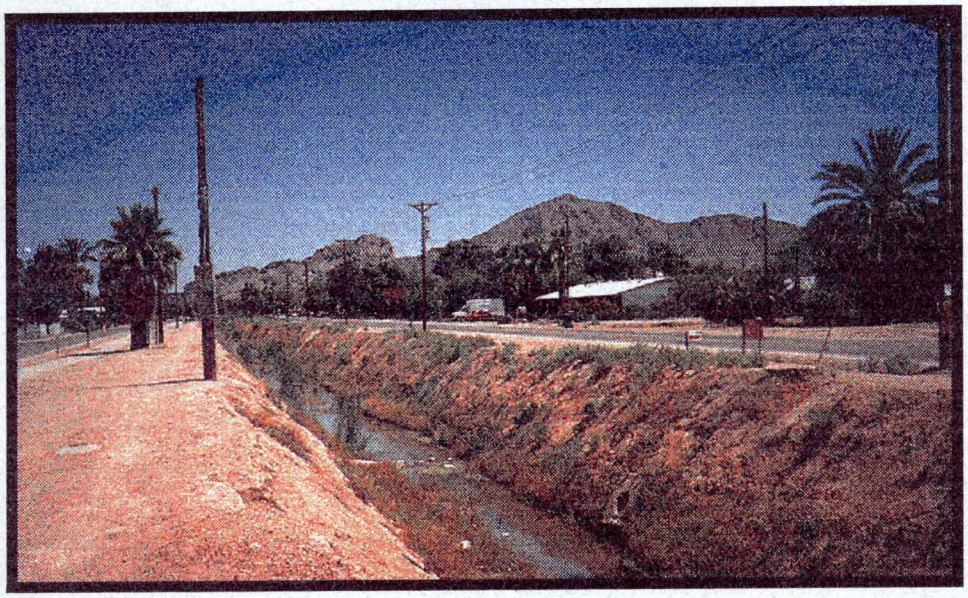
OLD CROSS CUT CANAL RECONSTRUCTION



BACKUP HYDRAULIC & SPILLWAY CALCULATIONS

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FCDMC PROJECT NO. 94-24
GREINER PROJECT NO. E002102
JANUARY 1995

A103.804

BACKUP HYDRAULIC CALCULATIONS

Beginning EG & HG Elevations for the STORM Program

Greiner

Job No. E002102 Project Old Cross Cut Canal Sheet 1 of

Subject Beginning Hydraulic Grade el. for STORM Program

By AJB Date 12/8/94 Checked By RHE Date 1-4-94

Purpose: Determine the appropriate beginning hydraulic grade line elevation (HGL) to use in the STORM Pgm.

Procedure: Using the EG computed at Sta 11+00 from the HEC-2 CHIMP model, file name: CH922-6A.DAT and EL. 1197.96 minus the velocity head of the box culvert plus the feet of head loss from the proposed double 18'x10' CBC to the open channel reach from Sta 11+00 to Sta 10+00.

Need to be revised since HEC-I pgm CHANGED

Calculations:

EGL at 11+00 = ~~1197.96~~ 1196.90

Box culvert velocity = $Q/A = 4170/(10)(18)(2) = 11.6$ fps

Box culvert velocity head = 2.09'

HGL = EGL − h_v = 1195.87 ⇒ 1196.90 − 2.09 = 94.81

Downstream velocity (Sta 10+99) = ~~0.92~~ 0.38 fps (From HEC-2)

$$h_e = K_e \frac{(V_D - V_U)^2}{2g}$$

$K_e = 3.50 (\tan \frac{\theta}{2})^{1.22}$ (Gibson Enlargers Standard of Hydraulic Institute)

$\tan \frac{\theta}{2} = \frac{5.42'}{100'} = 0.0542$ (see sheet 2)

$K_e = 3.50(0.0542)^{1.22} = 0.10$

$h_e = 0.10 \frac{(\cancel{0.92}\ 4.92 - 11.6)^2}{2g} = 0.177$ use 0.20', $h_e = 0.07$

Beginning HGL = $[(EGL + h_e) - h_v]$ = (1197.96 + 0.20) − 2.09' = 1196.07'

(96.90 + 0.20) − 2.09' = 1195.01'

Use 1196.07'

96.90 + .07 − 2.09 = 1194.88'

Junction Losses

JUNCTION LOSS CALCULATIONS

PROJECT NAME: OLD CROSS CUT CANAL
PROJECT NO.: E002102

DESIGNER: ALB
DATE: 1-3-95

CKED BY: RHF
DATE: 1-4-94

SECNO	STREET NAME	STORM PGM. MAINLINE NO.	DOWNSTREAM STRUCTURE Q (cfs)	NUMBER OF CULVERTS	WIDTH (ft.)	HEIGHT/ DIAMETER (ft.)	AREA (sq.ft.)	PERIMETER (ft.)	FRICTION SLOPE (ft/ft)	VELOCITY (fps)	VELOCITY HEAD (ft.)
19+00	GRANADA	2	4170	2	18	10	360.00	112.00	0.0021647	11.58	2.08
35+81	OAK	5	4170	2	18	10	360.00	112.00	0.0021647	11.58	2.08
62+49	THOMAS S.	10	3900	2	18	10	360.00	112.00	0.0018935	10.83	1.82
64+34	THOMAS N.	11	3900	2	18	10	360.00	112.00	0.0018935	10.83	1.82
75+85	EARLL	14	3800	2	18	10	360.00	112.00	0.0017976	10.56	1.73
83+00	RICHARDSON	17	3800	2	12	10	240.00	88.00	0.0050353	15.83	3.89
88+61	OSBORN S.	18	2780	2	12	10	240.00	88.00	0.0026949	11.58	2.08
90+50	OSBORN N.	19	2780	2	12	10	240.00	88.00	0.0026949	11.58	2.08
96+64	WHITTON	20	2750	2	12	10	240.00	88.00	0.0026371	11.46	2.04
100+22	WELDON	22	2420	2	12	10	240.00	88.00	0.0020421	10.08	1.58

SECNO	STREET NAME	STORM PGM. MAINLINE NO.	UPSTREAM STRUCTURE Q (cfs)	NUMBER OF CULVERTS	WIDTH (ft.)	HEIGHT/ DIAMETER (ft.)	AREA (sq.ft.)	PERIMETER (ft.)	FRICTION SLOPE (ft/ft)	VELOCITY (fps)	VELOCITY HEAD (ft.)
19+00	GRANADA	2	4113	2	18	10	360.00	112.00	0.0021060	11.43	2.03
35+81	OAK	5	3721	2	18	10	360.00	112.00	0.0017237	10.34	1.66
62+49	THOMAS S.	10	3894	2	18	10	360.00	112.00	0.0018877	10.82	1.82
64+34	THOMAS N.	11	3850	2	18	10	360.00	112.00	0.0018452	10.69	1.78
75+85	EARLL	14	2745	2	18	10	360.00	112.00	0.0009380	7.63	0.90
83+00	RICHARDSON	17	3765	2	12	10	240.00	88.00	0.0049429	15.69	3.82
88+61	OSBORN S.	18	2594	2	12	10	240.00	88.00	0.0023464	10.81	1.81
90+50	OSBORN N.	19	2730	2	12	10	240.00	88.00	0.0025988	11.38	2.01
96+64	WHITTON	20	2741	2	12	10	240.00	88.00	0.0026198	11.42	2.03
100+22	WELDON	22	2346	2	12	10	240.00	88.00	0.0019192	9.78	1.48

SECNO	STREET NAME	STORM PGM. MAINLINE NO.	LATERAL STRUCTURE Q (cfs)	NUMBER OF CULVERTS	WIDTH (ft.)	HEIGHT DIAMETER (ft.)	AREA (sq.ft.)	PERIMETER (ft.)	FRICTION SLOPE (ft/ft)	VELOCITY (fps)	VELOCITY HEAD (ft.)
19+00	GRANADA	2	57	1		3.5	9.62	11.00	0.003210	5.92	0.55
35+81	OAK	5	449	1	8	6	48.00	28.00	0.003264	9.35	1.36
62+49	THOMAS S.	10	6	1		3	7.07	9.42	0.000081	0.85	0.01
64+34	THOMAS N.	11	50	1		2.5	4.91	7.85	0.014860	10.19	1.61
75+85	EARLL	14	1055	1	12	10	120.00	44.00	0.001552	8.79	1.20
83+00	RICHARDSON	17	35	1		2.5	4.91	7.85	0.007281	7.13	0.79
88+61	OSBORN S.	18	186	1	6	6	36.00	24.00	0.001190	5.17	0.41
90+50	OSBORN N.	19	50	1		4	12.57	12.57	0.001212	3.98	0.25
96+64	WHITTON	20	9	1		1.5	1.77	4.71	0.007341	5.09	0.40
100+22	WELDON	22	74	1		4	12.57	12.57	0.002654	5.89	0.54

23
357
3100

SECNO	STREET NAME	STORM PGM. MAINLINE NO.	JUNC STR LGTH (ft.)	LAT ANGLE TO MAIN (deg.)	DELTA Y (ft.)	JUNC LOSS Hj (ft.)	Q IN D.S. LINE OF STORM PROGRAM	V IN D.S. LINE	hv IN D.S. LINE	LOSS COEF. Kj
19+00	GRANADA	2	4.04	60.0	0.107	0.0506	4170	11.58	2.08	0.02
35+81	OAK	5	36.96	12.5	0.567	0.1426	4170	11.58	2.08	0.07
62+49	THOMAS S.	10	3.46	60.0	0.018	0.0119	3900	10.83	1.82	0.01
64+34	THOMAS N.	11	2.89	60.0	0.076	0.0299	3900	10.83	1.82	0.02
75+85	EARLL	14	55.44	12.5	0.949	0.1220	3800	10.56	1.73	0.07
83+00	RICHARDSON	17	2.89	60.0	0.141	0.0696	3800	15.83	3.89	0.02
88+61	OSBORN S.	18	27.72	12.5	0.487	0.2179	2780	11.58	2.08	0.10
90+50	OSBORN N.	19	5.66	45.0	0.145	0.0710	2780	11.58	2.08	0.03
96+64	WHITTON	20	1.50	90.0	0.031	0.0173	2750	11.46	2.04	0.01
100+22	WELDON	22	4.00	90.0	0.198	0.1030	2420	10.08	1.58	0.07

REV. 12-14-94

OK

file:juncloss.wk3

Transition Losses

Greiner

Job No. E002102 Project Old Cross Cut Canal Sheet ____ of ____

Subject Transition Loss Calculations Sta 77+00 to 77+25

By ALB Date 12/16/94 Checked By RHF Date 1-4-94

Downstream		Upstream	
1900 cfs/CBC	(3800 total)	1900 cfs/CFS	(3800 total)
1-18'x10'	(2-18'x10')	1-12'x10'	(2-12'x10')
A = 180 ft²	(360 ft²)	A = 120 ft²	(240 ft²)
V = 10.55 fps	(10.55 fps)	V = 15.83 fps	(15.83 fps)

Length = 25'

Transition Calculations

Increasing velocity : $h_t = \frac{K_e}{2}(h_{vD} - h_{vu})$

Decreasing velocity : $h_t = K_e(h_{vu} - h_{vD})$

$K_e = 3.5(\tan \theta/2)^{1.22}$

$\tan \theta/2 = 6/25 = 0.24 \therefore K_e = 0.6137$

Decreasing velocity

$\therefore h_t = K_e(h_{vu} - h_{vD})$

$h_t = 0.6137(3.89 - 1.73) = 1.33$

K_t in Storm Program $= \frac{1.33}{\frac{(h_{vu} + h_{vd})}{2}} = 0.47$

Catch Basin Design

Greiner

Job No. E002102 Project Old Cross Cut Canal Sheet 1 of

Subject Grate Design

By RHF Date 10-25-94 Checked By ALB Date 10-26-94

Location: Granada Road.

Procedure: Re valuate the large inlet south of Granada Rd. at 48th St. for a smaller Q. Try to elevate the grate to a higher elevation.

Procedure: Use the FCDMC, Volume 2 - Hydraulics grate inlets in a sump condition pg 29. Evaluate using the weir & orifice equations. The computed greatest ponding elevation will be substracted from the adjace ground elevation to set the grate elevation.

$Q = 88$ cfs $L = 20.33'$ (weir)* $A = 2.5(4.25\ ft^2/grate)^* = 11.16$

Weir

$Q = 3Ld^{3/2}$

$d = \left(\frac{Q}{3L}\right)^{2/3}$

$d = \cancel{1.44'} = 1.28'$

Orifice,

$Q = 0.67A\sqrt{2gd}$

$d = \frac{\left(\frac{Q}{.67A}\right)^2}{2g}$

$d = 1.96'$ ✓

Use 2.0'

Adjacent Ground El. = 1201.8

Grate El. = 1199.80

* Note that clogging has been provided by the additional grate. Note that the small Type 'N' inlet in the R/W to the N. of Granada was considered to intercept no flow.

PROJECT: Old Cross Cut Canal
JOB NO.: E002102

FLOW SPLIT ANALYSIS FOR INLET DESIGN

LOCAL STORM DISCHARGE: 145 cfs

ROADWAY RATING: Granada Road and 48th Place

	Granada	48th Place	
Elevation	Weir Capacity	Roadway Capacity	Total Flow
1202.77	0.00	0.00	0.00
1202.88	0.02	1.26	1.28
1202.98	0.56	3.41	3.96
1203.08	2.61	5.93	8.55
1203.19	9.48	12.91	22.39
1203.30	22.09	22.93	45.02
1203.41	40.01	34.55	74.56
1203.51	59.84	43.30	103.41
1203.61	82.53	54.05	136.58
1203.71	108.78	69.89	178.67
1203.82	138.58	90.88	229.46

	Granada	48th Place	
Elevation	Weir Discharge	Roadway Discharge	Total Discharge
1203.63	88.0	57.0	145.0

Greiner

Job No. E00210Z Project Old Cross Cut Canal Sheet 1 of ___

Subject Analysis of Flow at Granada based on Upstream Flow Split.

By RHF Date 10-24-94 Checked By AUB Date 10-26-94

Channel Analysis (48th Place)

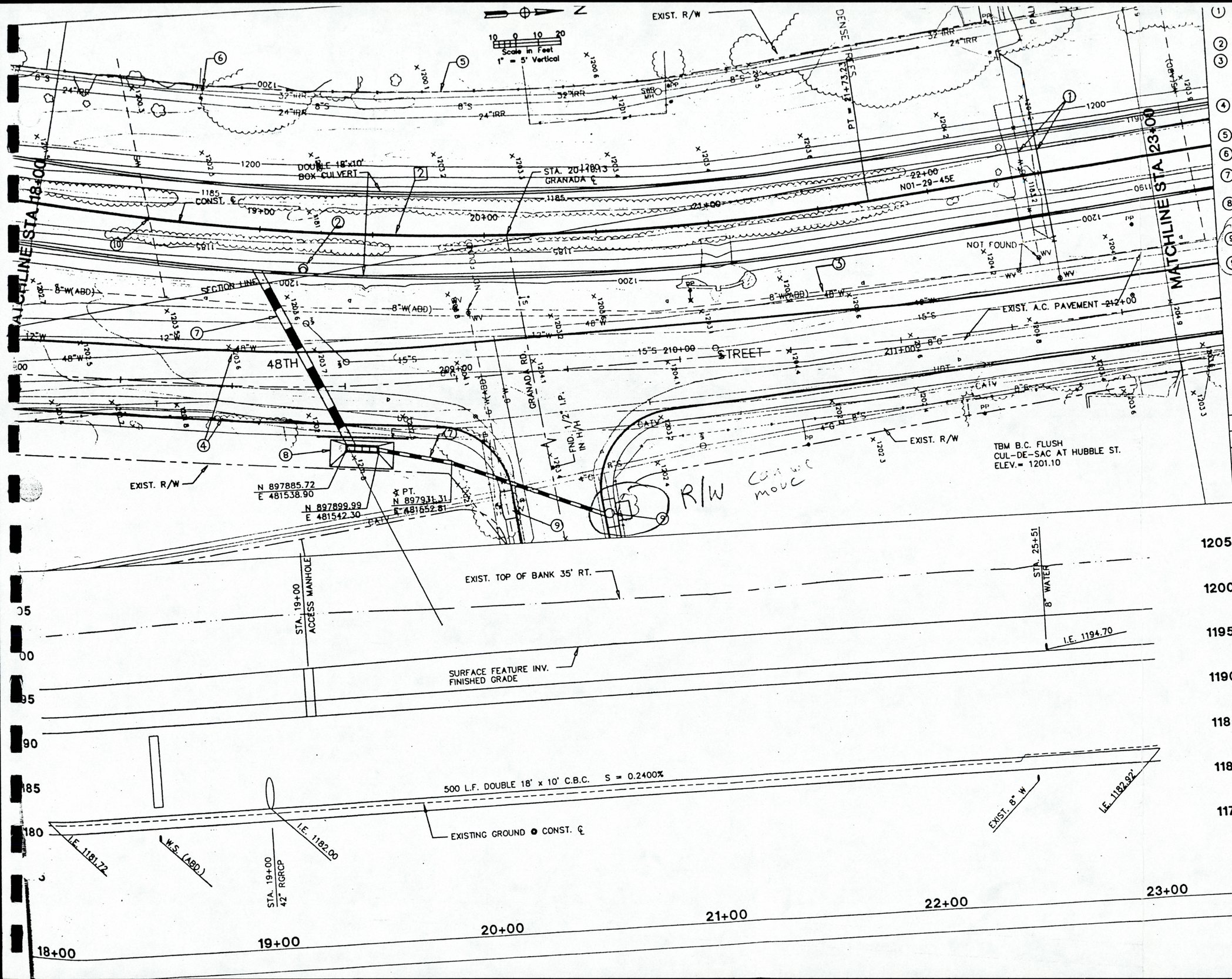
STA	El.	n
100	1203.62	.03
121	1203.36	.03
121	1203.05	.016
152	1202.67	.016
152	1202.96	.03
173	1203.10	.03

S = .0015 ft/ft.

Weir Section (Granada)

STA	El.
100	1203.10
120.8	1203.13
120.8	1202.84
140	1203.11
159.0	1202.96
159.0	1203.23
179	1203.25

Q_{100} = 145 cfs



1. RELOCATE EXISTING ... SERVICE UNTIL NEW LINE IS READY FOR TIE-IN. SEE SHEET C4-1
2. STA. 19+20 – INSTALL ACCESS MANHOLE.
3. CONTRACTOR SHALL USE EXTREME CAUTION DURING EXCAVATION AND BOX CULVERT CONSTRUCTION OPERATIONS NEAR 48" WATER LINE. PROTECT IN PLACE FROM GRANADA TO THOMAS.
4. 48TH STREET PAVEMENT IMPROVEMENTS. SEE ROADWAY SHEETS.
5. EXIST. FENCE P.I.P.
6. EXIST. POWER POLE P.I.P.
7. STA. 19+00, 91 L.F. 42" RGRCP & 109 L.F. 18" RGRCP. SEE SHEET C5-4
8. STA. 19+47.73, ~~95.03~~ RT. NEW C.B. INLET TYPE N, 4 GRATES, C.O.P. DET P-1570 W/ TYPE 'C' APRON SEE SHEETS C3-___ C5-4 AND C7-6.
9. NEW C.B. INLET AND SCUPPER. SEE ROADWAY SHEETS AND C5-4.
9. STA. 18+50, 1-CENTER WALL EQUALIZING OPENING

CONST. ℄ CURVE DATA

CURVE #	Δ	R	T	L
2	27-11-30	1150.00'	278.13'	545.77'

GENERAL NOTES

1. RIGHT OF WAY SHOWN WAS OBTAINED FROM CITY OF PHOENIX 1/4 SECTION MAPS.

NO.	REVISION	BY	DATE
3			
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

OLD CROSS CUT CANAL
McDOWELL RD. TO INDIAN SCHOOL R
PROJECT NO. 94-24

	BY	DA
DESIGNED	J.V.G.	7/18
DRAWN	J.E.B	7/18
CHECKED	S.E.S	7/19

PRELIMINARY NOT FOR CONSTRUCTION

BOX CULVERT PLAN AND PROFILE
STA. 18+00 TO STA. 23+00

SHEE

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S     E     S     C      A A  L          10-79
SSSSS EEEEE SSSSS C     A   A L
    S E         S C     AAAAA L        REVISED
SSSSS EEEEE SSSSS  CCCC A   A LLLLL      11-86
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COMPUTATIONAL HYDRAULIC DESIGN

USER : SHI-EN SHIAU

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*

The following conditions regulate the use of computer programs SESCAL developed by Shi-En Shiau.

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The program belong to Shi-En Shiau. Therefore, the recipient agree not to assert any proprietary rights thereto nor to represent the programs to any one as other than the author programs

The plotting program is furnished by Dr. Long-Cheng Huang.

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1

14:06:50 24-OCT-94

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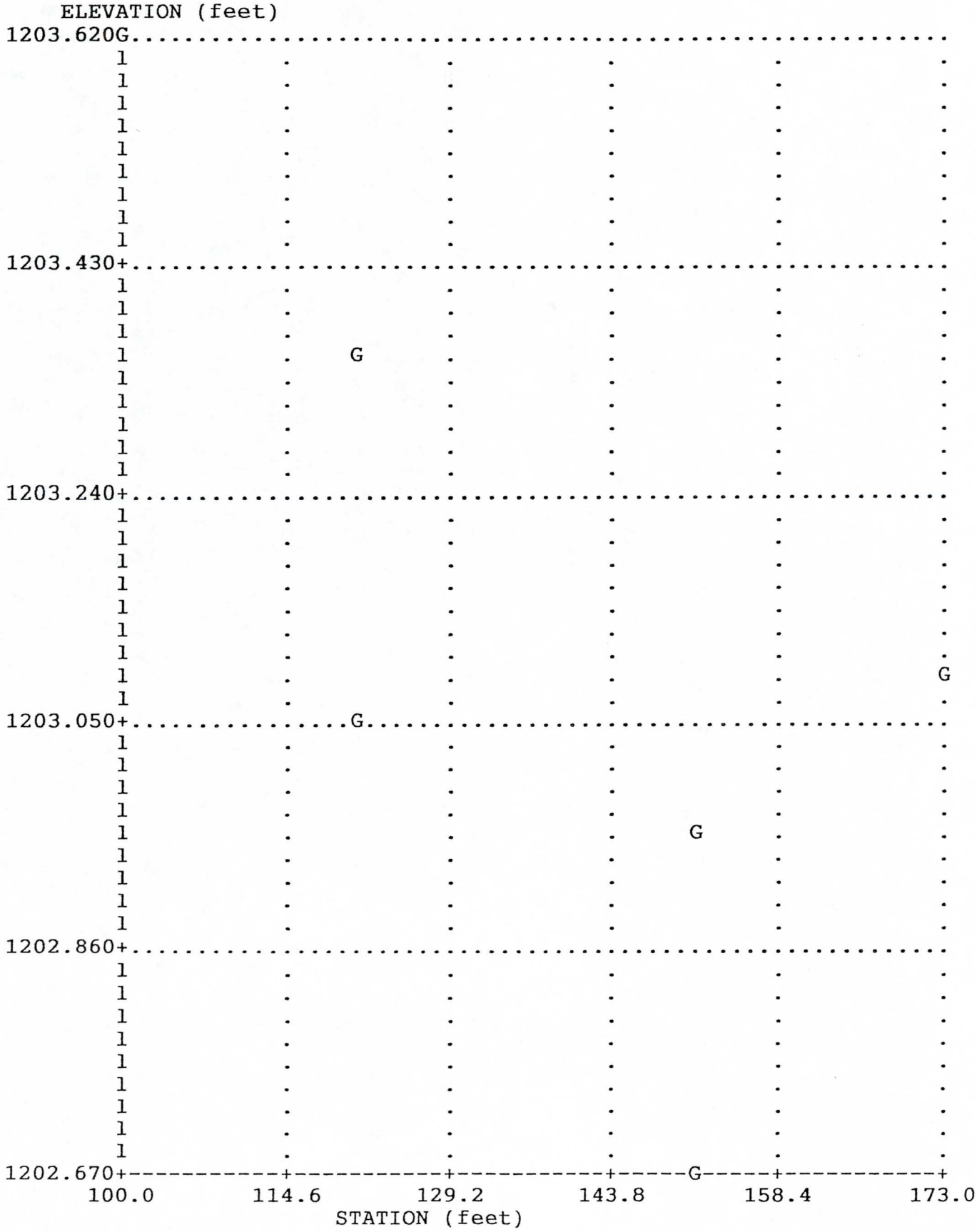
USER : SHI-EN SHIAU
****
E002102 - OLD CROSS CUT CANAL: GRANADA ROAD - FLOW SPLIT ANALYSIS TO DETERMINE THE FLOW DIRECTED TO THE INTERSECTION OF GRANADA AND 48th STREETS
ANALYSIS PERFORMED AT FIRST INTERSECTION EAST OF GRANADA AND 48th STREET
Q=143 cfs

****

IRREGULAR CROSS SECTION

STA.	100.00	121.00	121.00	152.00	152.00	173.00
ELEV.	1203.62	1203.36	1203.05	1202.67	1202.96	1203.10
N	0.030	0.016	0.016	0.016	0.030	0.030

Q (cfs)



G : CROSS SECTION GROUND POINT

1

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.10	8.16	0.41	0.0:1	0.0:1	8.26

FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.38	0.49	0.00150	0.20	0.01600	0.07	1.05

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.20	16.31	1.63	0.0:1	0.0:1	16.51
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.43	0.77	0.00150	1.26	0.01600	0.14	1.52

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.30	26.00	3.68	0.0:1	0.0:1	26.29
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.43	0.93	0.00150	3.41	0.01600	0.21	1.85

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.40	47.51	7.42	0.0:1	0.0:1	47.83
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.36	0.80	0.00150	5.93	0.01600	0.27	2.07

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.50	52.00	12.55	0.0:1	0.0:1	52.48
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.37	1.03	0.00150	12.91	0.01992	0.37	2.15

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.60	52.00	17.75	0.0:1	0.0:1	52.68
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.39	1.29	0.00150	22.93	0.02162	0.44	2.42

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.70	52.81	22.95	0.0:1	0.0:1	53.68
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.40	1.51	0.00150	34.55	0.02162	0.50	2.78

0.00	0.80	60.89	28.64	0.0:1	0.0:1	61.87
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.39	1.51	0.00150	43.30	0.02162	0.54	2.99

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	0.90	68.97	35.14	0.0:1	0.0:1	70.04
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.38	1.54	0.00150	54.05	0.02162	0.58	3.22

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.00	73.00	42.33	0.0:1	0.0:1	74.22
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.38	1.65	0.00150	69.89	0.02163	0.64	3.51

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.10	73.00	49.63	0.0:1	0.0:1	74.42
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.39	1.83	0.00150	90.88	0.02202	0.72	3.77

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.20	73.00	56.93	0.0:1	0.0:1	74.62
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.40	2.00	0.00150	113.95	0.02293	0.81	3.90

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.30	73.00	64.24	0.0:1	0.0:1	74.82
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.41	2.16	0.00150	139.01	0.02361	0.89	4.03

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.40	73.00	71.53	0.0:1	0.0:1	75.02
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.50	73.00	78.83	0.0:1	0.0:1	75.22
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.42	2.47	0.00150	194.60	0.02404	1.02	4.41

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.60	73.00	86.13	0.0:1	0.0:1	75.42
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.42	2.61	0.00150	225.00	0.02405	1.09	4.63

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.70	73.00	93.43	0.0:1	0.0:1	75.62
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.43	2.75	0.00150	257.05	0.02406	1.15	4.84

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.80	73.00	100.74	0.0:1	0.0:1	75.82
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.43	2.89	0.00150	290.72	0.02407	1.21	5.04

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	1.90	73.00	108.03	0.0:1	0.0:1	76.02
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.44	3.02	0.00150	325.89	0.02408	1.27	5.24

BW	YN	TOP WIDTH	AREA	L.B. SLOPE	R.B. SLOPE	PERIMETER
0.00	2.00	73.00	115.33	0.0:1	0.0:1	76.22
FROUDE #	VELOCITY	SLOPE	DISCHARGE	N VALUE	YC	VC
0.44	3.14	0.00150	362.54	0.02409	1.34	5.43

ELEVATION - DISCHARGE CURVE

0.00	0.00	1.26	0.20
3.41	0.30	5.93	0.40
12.91	0.50	22.93	0.60
34.55	0.70	43.30	0.80
54.05	0.90	69.89	1.00
90.88	1.10	113.95	1.20
139.01	1.30	165.92	1.40
194.60	1.50	225.00	1.60
257.05	1.70	290.72	1.80
325.89	1.90	362.54	2.00

DISCHARGE	EG/YN	DISCHARGE	EG/YN
0.00	1202.77	1.26	1202.88
3.41	1202.98	5.93	1203.08
12.91	1203.19	22.93	1203.30
34.55	1203.41	43.30	1203.51
54.05	1203.61	69.89	1203.71
90.88	1203.82	113.95	1203.93
139.01	1204.04	165.92	1204.15
194.60	1204.26	225.00	1204.38
257.05	1204.49	290.72	1204.60
325.89	1204.71	362.54	1204.82

IRREGULAR WEIR GEOMETRY
COEFICIENT = 2.80

ELEVATION 1203.1 1203.1 1202.8 1203.1 1203.0 1203.2 1203.3

STATION 100.00 120.80 120.80 140.00 159.00 159.00 179.00

WEIR FLOW ELEVATION-DISCHARGE CURVE

DISCHARGE	EG	DISCHARGE	EG
0.00	1202.77	0.02	1202.88
0.56	1202.98	2.61	1203.08
9.48	1203.19	22.09	1203.30
40.01	1203.41	59.84	1203.51
82.53	1203.61	108.78	1203.71
138.58	1203.82	170.85	1203.93
205.49	1204.04	242.27	1204.15
281.16	1204.26	322.03	1204.38
364.83	1204.49	409.48	1204.60
455.87	1204.71	504.01	1204.82

STAGE-DISCHARGE CURVE

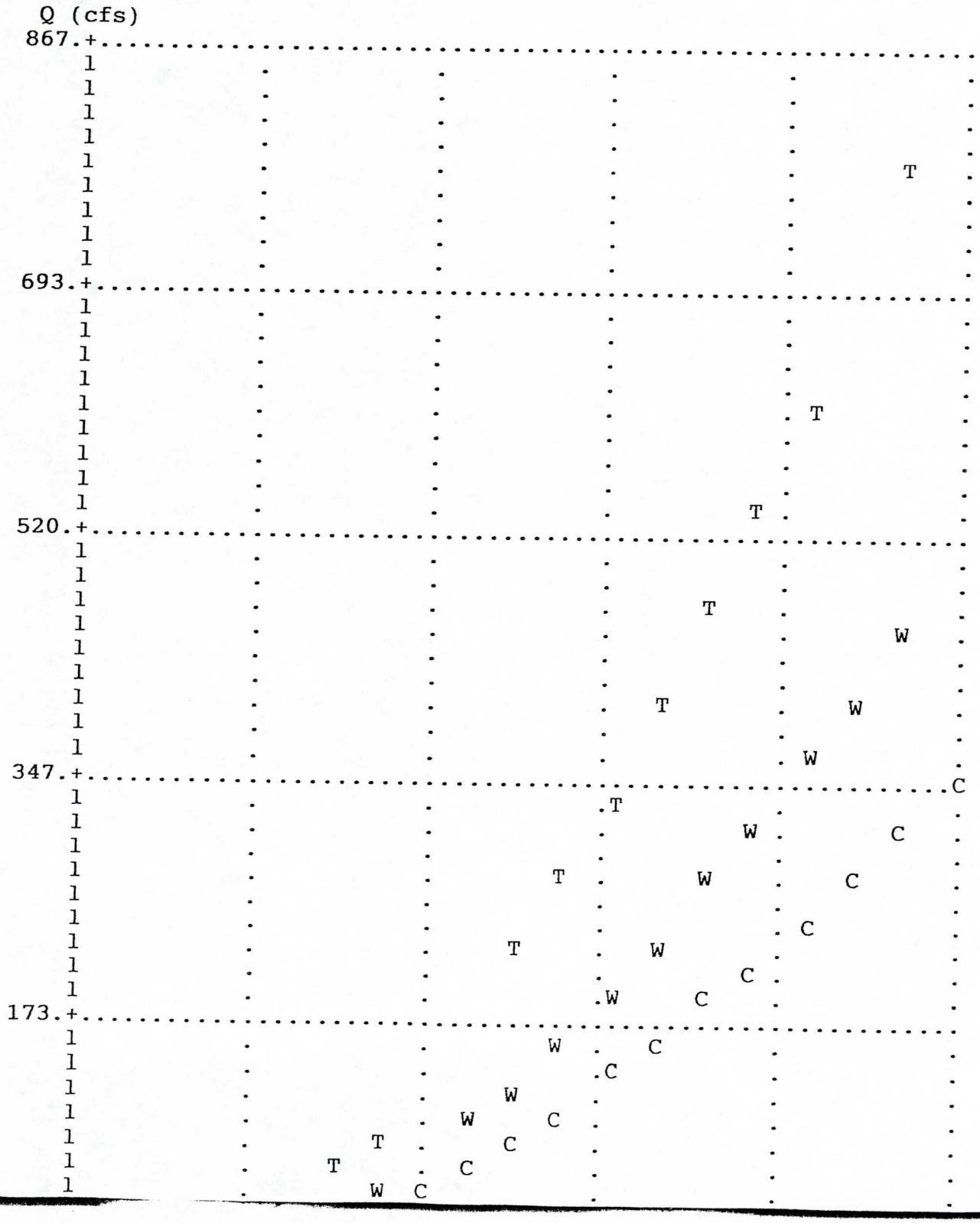
LAKE LEVEL	CHANNEL Q (48th PL.)	WEIR Q (To Granada)	TOTAL Q
1202.77	0.00	0.00	0.00
1202.88	1.26	0.02	1.28
1202.98	3.41	0.56	3.96
1203.08	5.93	2.61	8.55
1203.19	12.91	9.48	22.39

1203.51	43.30		59.84	103.14
1203.61	54.05		82.53	136.58
1203.71	69.89	57 cfs	108.78	178.67
1203.82	90.88		138.58	229.46
1203.93	113.95		170.85	284.80
1204.04	139.01		205.49	344.50
1204.15	165.92		242.27	408.18
1204.26	194.60		281.16	475.76
1204.38	225.00		322.03	547.04
1204.49	257.05		364.83	621.88
1204.60	290.72		409.48	700.20
1204.71	325.89		455.87	781.76
1204.82	362.54		504.01	866.54

1203.63

88 cfs

145 cfs



```
0.C--C--C-C---C-----------+-----------+-----------+-----------+
1202.774    1203.184    1203.594    1204.004    1204.414    1204.823
                    ELEVATION (feet)

          T : TOTAL Q, W : WEIR Q, C : CULVERT/CHANNEL Q
1
    14:06:50   24-OCT-94

SESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCALSESCAL

                                                USER : SHI-EN SHIAU
1
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STORM Output File
7SD1294.DAT

PROJECT NAME: OLD CROSS CUT CANAL

PROJECT NUMBER: FCDMC 94-24; GREINER E002102

RE: Modification To STORM Program Results Due To Inappropriate Internal Loss Calculation for Velocity Changes.

This section contains the output from the STORM Program and a correction table. It was determined that the STORM Program was inappropriately computing additional losses when the velocity changed. The table repeats the information from the STORM Program output along with a energy computation. It also computes the correct energy and hydraulic grade elevations at all locations. The table corrects the problems and the results from the table were used in all calculations.

Refer to the following table and specifically the line for Cambridge which is the first location that this occurs. The STORM Program computes an hydraulic grade elevation (HG2) for the line for Virginia of 1204.76 and velocity head of 2.09'. The energy grade elevation (EG2) for the line for Virginia is computed as 1206.85. The velocity for the line for Cambridge at V1 is 10.9 fps and the STORM Program computes the hydraulic grade elevation (HG1) at Cambridge to be 1205.26. However, this would cause the energy to be 1207.10. This does not equal the energy at EG2 for the line for Virginia which can not be true. The hydraulic grade line elevation at this location should be 1205.01. The losses for the line from Virginia to Cambridge are 0.93' and the energy grade elevation at Cambridge (EG2) should be 1207.78 and the hydraulic grade elevation (HG2) should be 1205.94. The last three columns of the table show the correct computed results. These values should be used for all calculations.

PROJECT NAME: Old Cross Cut Canal
PROJECT NO.: E002102

CORRECTED STORM PROGRAM RESULTS FOR THE GENERAL STORM

DESIGN BY: ACB
DATE: 1/3/95

CHECKED BY: RHF
DATE: 1-4-95

STREET NAME	BOX STATION	V1	HG1	Hv1	EG1	V2	HG2	Hv2	EG2	LENGTH	SF	KM	CORRECTED EG2	COMPUTED Hv2	COMPUTED HG2
OUTLET	11+00	-	-	-	-	11.6	1196.07	2.09	1198.16				1198.16	2.09	1196.07
GRANADA	19+00	11.6	1196.07	2.09	1198.16	11.6	1197.84	2.09	1199.93	800	0.00216	0.02	1199.93	2.09	1197.84
HOLLY	27+17	11.6	1197.84	2.09	1199.93	11.6	1199.61	2.09	1201.70	817	0.00216	0	1201.70	2.09	1199.61
S. CEMETARY DR.	33+57	11.6	1199.61	2.09	1201.70	11.6	1201.00	2.09	1203.09	640	0.00216	0	1203.09	2.09	1201.00
OAK	35+81	11.6	1201.00	2.09	1203.09	11.6	1201.63	2.09	1203.72	224	0.00216	0.07	1203.72	2.09	1201.63
N. CEMETARY DR.	40+57	11.6	1201.63	2.09	1203.72	11.6	1202.66	2.09	1204.75	476	0.00216	0	1204.75	2.09	1202.66
VIRGINIA	50+26	11.6	1202.66	2.09	1204.75	11.6	1204.76	2.09	1206.85	969.2	0.00216	0	1206.85	2.09	1204.76
CAMBRIDGE	55+17	10.9	1205.26	1.84	1207.10	10.9	1206.19	1.84	1208.03	490.73	0.0019	0	1207.78	1.84	1205.94
WINDSOR	57+90	10.9	1206.19	1.84	1208.03	10.9	1207.04	1.84	1208.88	273.07	0.0019	0.18	1208.63	1.84	1206.79
S. OF THOMAS	62+49	10.8	1207.06	1.81	1208.87	10.8	1207.95	1.81	1209.76	459	0.00189	0.01	1209.52	1.81	1207.71
N. OF THOMAS	64+34	10.8	1207.95	1.81	1209.76	10.8	1208.34	1.81	1210.15	185	0.00189	0.02	1209.90	1.81	1208.09
PINCHOT	71+37	10.8	1208.34	1.81	1210.15	10.8	1209.67	1.81	1211.48	703.32	0.00189	0	1211.23	1.81	1209.42
GRADE BREAK	75+00	10.6	1209.85	1.74	1211.59	10.6	1210.50	1.74	1212.24	362.68	0.0018	0	1211.89	1.74	1210.14
EARLL	75+85	10.6	1210.50	1.74	1212.24	10.6	1210.78	1.74	1212.52	85	0.0018	0.07	1212.16	1.74	1210.42
BEGIN TRANSITION	77+00	10.6	1210.78	1.74	1212.52	10.6	1210.98	1.74	1212.72	115	0.0018	0	1212.37	1.74	1210.62
END TRANSISTION	77+25	15.8	1208.91	3.88	1212.79	15.8	1210.86	3.88	1214.74	25	0.00504	0.47	1214.32	3.88	1210.44
RICHARDSON	83+00	15.8	1210.86	3.88	1214.74	15.8	1213.84	3.88	1217.72	575	0.00504	0.02	1217.29	3.88	1213.42
S. OF OSBORN	88+61	11.6	1217.46	2.09	1219.55	11.6	1219.18	2.09	1221.27	561	0.00269	0.1	1219.01	2.09	1216.92
N. OF OSBORN	90+50	11.6	1219.18	2.09	1221.27	11.6	1219.75	2.09	1221.84	189	0.00269	0.03	1219.58	2.09	1217.49
WHITTON	96+64	11.5	1219.84	2.05	1221.89	11.5	1221.48	2.05	1223.53	614	0.00264	0.01	1221.22	2.05	1219.17
GRADE BREAK	97+00	10.1	1222.40	1.58	1223.98	10.1	1222.47	1.58	1224.05	36	0.00204	0	1221.30	1.58	1219.71
WELDON	100+22	10.1	1222.47	1.58	1224.05	10.1	1223.24	1.58	1224.82	322	0.00204	0.06	1222.05	1.58	1220.46
BEGIN TRANSITION	101+00	10	1223.26	1.55	1224.81	10	1223.42	1.55	1224.97	78	0.00203	0	1222.21	1.55	1220.65
END TRANSISTION	101+10	12.1	1222.74	2.27	1225.01	12.1	1223.18	2.27	1225.45	10	0.00328	0.18	1222.65	2.27	1220.38
S. OF INDIAN SCHOOL	111+25	12.1	1219.05	2.27	1221.32	12.1	1231.21	2.27	1233.48	1015	0.00328	0	1225.98	6.56	1219.42
N. OF INDIAN SCHOOL	116+83	20.1	1223.77	6.27	1230.04	15.7	1230.23	3.83	1234.06	558	0.00328	0	1227.81	6.56	1221.25
INLET	117+50	13.3	1231.47	2.75	1234.22	15.6	1230.70	3.78	1234.48	67	0.00314	0.5	1229.91	6.56	1223.35

Note: A subscript of 1 means downstream orientation and a subscript of 2 means upstream, i.e., V1 is downstream velocity and V2 means upstream.

file name: stgcorr2.wk3

PROJECT: OCCC EG=1197.96 SUBMIT 12-94 BEGIN STA. 11+00
DESIGNER: ALB 7SD1294.DAT

CD	L2	MAX Q	ADJ Q	LENGTH	FL 1	FL 2	CTL/TW	D	W	S	KJ	KE	KM	LC	L1	L3	L4	A1	A3	A4	J	N
8	1						1196.07															
2	2	2085.0	2085.0	800.00	1180.04	1181.96	1197.90	120.	216.	3	0.00	0.00	0.02	1	3	0	0	0.	0.	0.	0.00	0.013
2	3	2085.0	2085.0	817.00	1181.96	1183.92	1199.40	120.	216.	3	0.00	0.00	0.00	0	4	0	0	0.	0.	0.	0.00	0.013
2	4	2085.0	2085.0	640.00	1183.92	1185.46	1201.21	120.	216.	3	0.00	0.00	0.00	0	5	0	0	0.	0.	0.	0.00	0.013
2	5	2085.0	2085.0	224.00	1185.46	1186.00	1202.00	120.	216.	3	0.00	0.00	0.07	0	6	0	0	0.	0.	0.	0.00	0.013
2	6	2085.0	2085.0	476.00	1186.00	1187.14	1202.19	120.	216.	3	0.00	0.00	0.00	0	7	0	0	0.	0.	0.	0.00	0.013
2	7	2085.0	2085.0	969.20	1187.14	1189.46	1205.20	120.	216.	3	0.00	0.00	0.00	0	8	0	0	0.	0.	0.	0.00	0.013
2	8	1955.0	1955.0	490.73	1189.46	1190.64	1206.40	120.	216.	3	0.00	0.00	0.00	0	9	0	0	0.	0.	0.	0.00	0.013
2	9	1955.0	1955.0	273.07	1190.64	1191.30	1206.80	120.	216.	3	0.00	0.00	0.18	0	10	0	0	0.	0.	0.	0.00	0.013
2	10	1950.0	1950.0	459.00	1191.30	1192.40	1208.08	120.	216.	3	0.00	0.00	0.01	0	11	0	0	0.	0.	0.	0.00	0.013
2	11	1950.0	1950.0	185.00	1192.40	1192.84	1208.65	120.	216.	3	0.00	0.00	0.02	0	12	0	0	0.	0.	0.	0.00	0.013
2	12	1950.0	1950.0	703.32	1192.84	1194.53	1210.24	120.	216.	3	0.00	0.00	0.00	0	13	0	0	0.	0.	0.	0.00	0.013
2	13	1900.0	1900.0	362.68	1194.53	1195.40	0.00	120.	216.	3	0.00	0.00	0.00	0	14	0	0	0.	0.	0.	0.00	0.013
2	14	1900.0	1900.0	85.00	1195.40	1195.79	1210.50	120.	216.	3	0.00	0.00	0.07	0	15	0	0	0.	0.	0.	0.00	0.013
2	15	1900.0	1900.0	115.00	1195.79	1196.32	0.00	120.	216.	3	0.00	0.00	0.00	0	16	0	0	0.	0.	0.	0.00	0.013
2	16	1900.0	1900.0	25.00	1196.32	1196.44	0.00	120.	144.	3	0.00	0.00	0.47	0	17	0	0	0.	0.	0.	0.00	0.013
2	17	1900.0	1900.0	575.00	1196.44	1199.08	1218.72	120.	144.	3	0.00	0.00	0.02	0	18	0	0	0.	0.	0.	0.00	0.013
2	18	1390.0	1390.0	561.00	1199.08	1201.66	1222.05	120.	144.	3	0.00	0.00	0.10	0	19	0	0	0.	0.	0.	0.00	0.013
2	19	1390.0	1390.0	189.00	1201.66	1202.53	1222.22	120.	144.	3	0.00	0.00	0.03	0	20	0	0	0.	0.	0.	0.00	0.013
2	20	1375.0	1375.0	614.00	1202.53	1205.35	1227.17	120.	144.	3	0.00	0.00	0.01	0	21	0	0	0.	0.	0.	0.00	0.013
2	21	1210.0	1210.0	36.00	1205.35	1205.52	0.00	120.	144.	3	0.00	0.00	0.00	0	22	0	0	0.	0.	0.	0.00	0.013
2	22	1210.0	1210.0	322.00	1205.52	1208.29	1230.00	120.	144.	3	0.00	0.00	0.07	0	23	0	0	0.	0.	0.	0.00	0.013
2	23	1205.0	1205.0	78.00	1208.29	1208.96	0.00	120.	144.	3	0.00	0.00	0.00	0	24	0	0	0.	0.	0.	0.00	0.013
2	24	1205.0	1205.0	10.00	1208.96	1209.05	0.00	120.	120.	3	0.00	0.00	0.18	0	25	0	0	0.	0.	0.	0.00	0.013
2	25	1205.0	1205.0	1015.00	1209.05	1217.78	1243.31	120.	120.	3	0.00	0.00	0.00	0	26	0	0	0.	0.	0.	0.00	0.013

PROJECT: OCCC EG=1197.96 SUBMIT 12-94 BEGIN STA. 11+00
DESIGNER: ALB 7SD1294.DAT

	CD	L2	MAX Q	ADJ Q	LENGTH	FL 1	FL 2	CTL/TW	D	W	S	KJ	KE	KM	LC	L1	L3	L4	A1	A3	A4	J	N
10583	2	26	1205.0	1205.0	558.00	1217.78	1222.57	1242.50	120. 10	120. 10	3	0.00	0.00	0.00	0	27	0	0	0.	0.	0.	0.00	0.013
10650	2	27	1180.0	1180.0	67.00	1222.57	1223.15	0.00	120. 10	120. 10	1	0.00	0.50	0.00	0	0	0	0	0.	0.	0.	0.00	0.013

PROJECT: OCCC EG=1197.96 SUBMIT 12-94 BEGIN STA. 11+00
DESIGNER: ALB 7SD1294.DAT

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
1	HYDRAULIC GRADE LINE CONTROL = 1196.07																	
2	2085.0	120	216	7.93	7.46	FULL	0.00216	11.6	11.6	1180.04	1181.96	1196.07	1197.84	16.03	15.88	0.00	0.00	
3	2085.0	120	216	7.93	7.46	FULL	0.00216	11.6	11.6	1181.96	1183.92	1197.84	1199.61	15.88	15.69	0.00	0.00	
4	2085.0	120	216	7.92	7.46	FULL	0.00216	11.6	11.6	1183.92	1185.46	1199.61	1201.00	15.69	15.54	0.00	0.00	
5	2085.0	120	216	7.91	7.46	FULL	0.00216	11.6	11.6	1185.46	1186.00	1201.00	1201.63	15.54	15.63	0.00	0.00	
6	2085.0	120	216	7.93	7.46	FULL	0.00216	11.6	11.6	1186.00	1187.14	1201.63	1202.66	15.63	15.52	0.00	0.00	
7	2085.0	120	216	7.93	7.46	FULL	0.00216	11.6	11.6	1187.14	1189.46	1202.66	1204.76	15.52	15.30	0.00	0.00	0.5'
8	1955.0	120	216	7.55	7.15	FULL	0.00190	10.9	10.9	1189.46	1190.64	1205.26	1206.19	15.80	15.55	0.00	0.00	
9	1955.0	120	216	7.54	7.15	FULL	0.00190	10.9	10.9	1190.64	1191.30	1206.19	1207.04	15.55	15.74	0.00	0.00	0.24' Bub
10	1950.0	120	216	7.55	7.14	FULL	0.00189	10.8	10.8	1191.30	1192.40	1207.06	1207.95	15.76	15.55	0.00	.02' 0.00	
11	1950.0	120	216	7.57	7.14	FULL	0.00189	10.8	10.8	1192.40	1192.84	1207.95	1208.34	15.55	15.50	0.00	0.00	
12	1950.0	120	216	7.54	7.14	FULL	0.00189	10.8	10.8	1192.84	1194.53	1208.34	1209.67	15.50	15.14	0.00	0.00	
13	1900.0	120	216	7.40	7.01	FULL	0.00180	10.6	10.6	1194.53	1195.40	1209.85	1210.50	15.32	15.10	0.00	0.18' 0.00	
14	1900.0	120	216	5.86	7.01	FULL	0.00180	10.6	10.6	1195.40	1195.79	1210.50	1210.78	15.10	14.99	0.00	0.00	0.28' Bub
15	1900.0	120	216	5.85	7.01	FULL	0.00180	10.6	10.6	1195.79	1196.32	1210.78	1210.98	14.99	14.66	0.00	0.00	
16	1900.0	120	144	8.62	9.19	FULL	0.00504	15.8	15.8	1196.32	1196.44	1208.91	1210.86	12.59	14.42	0.00	2.07' 0.00	
17	1900.0	120	144	8.77	9.19	FULL	0.00504	15.8	15.8	1196.44	1199.08	1210.86	1213.84	14.42	14.76	0.00	0.00	
18	1390.0	120	144	6.87	7.46	FULL	0.00269	11.6	11.6	1199.08	1201.66	1217.46	1219.18	18.38	17.52	0.00	3.62' 0.00	
19	1390.0	120	144	6.87	7.46	FULL	0.00269	11.6	11.6	1201.66	1202.53	1219.18	1219.75	17.52	17.22	0.00	0.00	
20	1375.0	120	144	6.82	7.41	FULL	0.00264	11.5	11.5	1202.53	1205.35	1219.84	1221.48	17.31	16.13	0.00	0.09' 0.00	
21	1210.0	120	144	6.12	6.80	FULL	0.00204	10.1	10.1	1205.35	1205.52	1222.40	1222.47	17.05	16.95	0.00	0.92' 0.00	
22	1210.0	120	144	4.91	6.80	FULL	0.00204	10.1	10.1	1205.52	1208.29	1222.47	1223.24	16.95	14.95	0.00	0.00	
23	1205.0	120	144	4.89	6.78	FULL	0.00203	10.0	10.0	1208.29	1208.96	1223.26	1223.42	14.97	14.46	0.00	0.02' 0.00	
24	1205.0	120	120	5.76	7.66	FULL	0.00328	12.1	12.1	1208.96	1209.05	1222.74	1223.18	13.78	14.13	0.00	0.68' 0.00	

trans.

transition

PROJECT: OCCC EG=1197.96 SUBMIT 12-94 BEGIN STA. 11+00
DESIGNER: ALB 7SD1294.DAT

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
25	1205.0	120	120	5.86	7.66	FULL	0.00328	12.1	12.1	1209.05	1217.78	1219.05	1231.21	10.00	13.43	0.00	0.00	HJ @ UJT
																	7.44'	
26	1205.0	120	120	5.87	7.66	PART	0.00328	20.1	15.7	1217.78	1222.57	1223.77	1230.23	5.99	7.66	0.00	0.00	
																	1.24'	
27	1180.0	120	120	5.75	7.55	PART	0.00314	13.3	15.6	1222.57	1223.15	1231.47	1230.70	8.90	7.55	1236.39	0.00	HYD JUMP

X = 0.00 X(N) = 0.00 X(J) = 32.61 F(J) = 866.29 D(BJ) = 6.84 D(AJ) = 8.33

V 1, FL 1, D 1 AND HG 1 REFER TO DOWNSTREAM END
V 2, FL 2, D 2 AND HG 2 REFER TO UPSTREAM END
X - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE HG INTERSECTS SOFFIT IN SEAL CONDITION
X(N) - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE WATER SURFACE REACHES NORMAL DEPTH BY EITHER DRAWDOWN OR BACKWATER
X(J) - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE HYDRAULIC JUMP OCCURS IN LINE
F(J) - THE COMPUTED FORCE AT THE HYDRAULIC JUMP
D(BJ) - DEPTH OF WATER BEFORE THE HYDRAULIC JUMP (UPSTREAM SIDE)
D(AJ) - DEPTH OF WATER AFTER THE HYDRAULIC JUMP (DOWNSTREAM SIDE)
SEAL INDICATES FLOW CHANGES FROM PART TO FULL OR FROM FULL TO PART
HYD JUMP INDICATES THAT FLOW CHANGES FROM SUPERCRITICAL TO SUBCRITICAL THROUGH A HYDRAULIC JUMP
HJ @ UJT INDICATES THAT HYDRAULIC JUMP OCCURS AT THE JUNCTION AT THE UPSTREAM END OF THE LINE
HJ @ DJT INDICATES THAT HYDRAULIC JUMP OCCURS AT THE JUNCTION AT THE DOWNSTREAM END OF THE LINE

EOJ 12/16/1994 13:51

Latest Greiner CHIMP HEC-2
CHFINMOD.DAT

```
1*********************************************
 *  HEC-2 WATER SURFACE PROFILES             *
 *                                           *
 *  Version   4.6.2;  May 1991               *
 *                                           *
 *  RUN DATE    30DEC94    TIME    08:59:50  *
 *********************************************
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*************************************
*  U.S. ARMY CORPS OF ENGINEERS
*  HYDROLOGIC ENGINEERING CENTER
*  609 SECOND STREET, SUITE D
*  DAVIS, CALIFORNIA 95616-4687
*          (916) 756-1104
*************************************
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```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
```

1

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THIS RUN EXECUTED 30DEC94 08:59:50

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*************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.6.2;  May 1991
*************************************
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```
T1      Old Cross Cut Canal - CHIMP FILE: CHFINMOD.DAT; n=0.045; Between
T2      Between 90% and 100% Grading Model with 4:1 Side Slopes,20' Notch
T3      Sta. 11+00 to Sta. 20+00 (6:1 Side Slope-East,4:1 Side Slope-West)
T4      Analysis for Stations 0+00 to 75+00 with weir flow @ Thomas Rd.
T5      CHIMP Analysis for Design Discharges (Draft Letter Q to FDCMC 10-7-93)
T6      Some of the cross sections are revised. McDowell Rd. weir = 1194.0
T7      Q @ 5270; Modeled from east R/W to west R/W
T8      For west top of bank elevation :
T9      Water surface to be contained upto Sta. 43+00 per existing condition.
T10     A 1' maximum freeboard is used upstream of Sta. 44+00.

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ

      0        2        0        0     .00532      0        0        0       180       0

J2  NPROF     IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE

      1        0       -1        0        0        0       -1        0        0        0

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

    38       43       39        4       25       26       23       24        1       42
     3

J5  LPRNT    NUMSEC                 ********REQUESTED SECTION NUMBERS********

   -10      -10

NC    .035     .035     .015     .1       .3
QT       1     5270
```

```
X1        0         7    999.99   1016.01         0         0         0
X3       10                          1000                  1016
GR   184.67    950.00    184.67    999.99    170.00   1000.00    169.67   1008.00    170.00   1016.00
GR   184.67   1016.01    184.67   1066.00

X1      384         7    999.99   1016.01       374       394       384
X3       10
GR   186.71    950.00    186.71    999.99    172.04   1000.00    171.71   1008.00    172.04   1016.00
GR   186.71   1016.01    186.71   1066.00
1
   30DEC94      08:59:50                                                                          PAGE    2


X1      434         7    999.99   1016.01        49        51        50
X3       10
GR   188.36    950.00    188.36    999.99    172.31   1000.00    171.98   1008.00    172.31   1016.00
GR   188.36   1016.01    188.36   1066.00

X1      484         7    999.99   1016.01        49        51        50
X3       10
GR   190.00    950.00    190.00    999.99    173.13   1000.00    172.80   1008.00    173.13   1016.00
GR   190.00   1016.01    190.00   1066.00

NC                                     .3        .5
X1      684         7    999.99   1026.01       200       200       200
GR   190.00    950.00    190.00    999.99    176.50   1000.00    176.07   1013.00    176.50   1026.00
GR   190.00   1026.01    190.00   1076.00

X1      726         7      1000      1026        42        42        42
X3       10                                                          189       189
GR   192.00    950.00    189.00    999.99    177.11   1000.00    177.11   1013.00    177.11   1026.00
GR   189.00   1026.01    192.00   1076.00
```

The discharges d/s of McDowell Road are 500, 750, 1000 cfs less than the u/s discharges for 25, 50, 100-yr event, respectively. This is due to the assumption that those amount of discharges do not join the d/s channel flowing west along the McDowell Road.

```
SC     2.014        .2       2.6                10        12       274       9.2    179.85    177.11
X1      1000        10       987      1013       274       274       274
X2                           2    189.85
X3        10                                                          194       194
BT        -8       966    194.00               972    194.00               975    194.00
BT                 985    194.00              1027    194.00              1041    194.00
BT                1070    194.00              1116    194.00
GR       193       970       193       979     193.9    984.99    193.89    986.9    179.80       987
GR    179.80      1013    193.89    1013.1       194      1024    193.90      1041    193.90      1070

NC      .035      .035      .045      .015       .1        .3
QT         1      1170
X1      1099        10       900      1037        99        99        99
GR    195.80       900    191.00       930    190.00       935    190.00       964    192.29     981.4
GR    180.04     981.5    180.04      1000    180.04    1018.5    192.29    1018.6    194.50      1037
NC      .035      .035      .045        .1        .5
X1      1100         9       900      1037         1         1         1
GR    195.80       900    191.00       930    190.00       935    190.00       964    192.29     981.5
GR    192.29      1000    192.29    1018.5    194.50      1037    194.00      1055                 1551

X1      1200        10       892    1042.1        92        85        90
GR    198.00       892    190.03       940    190.03       960    194.03       976    194.03      1000
GR    194.03      1042    198.20    1042.1    195.64   1043.00    195.30      1058    195.00      1063
1
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check ele. of the invert

Vertical wall on West side

X1	1300	9	894	1042.1	104	96	100			
GR	198.00	894	190.27	940	190.27	960	194.27	976	194.27	1000
GR	194.27	1042	198.20	1042.1	196.32	1043	195.9	1058		
X1	1400	9	895	1039.6	107	96	100			
GR	198.00	895	190.51	940	190.51	960	194.51	976	194.51	1000
GR	194.50	1039.5	198.20	1039.6	197.00	1040.5	196.70	1055.5		
X1	1500	9	895	1037.1	107	96	100			
GR	198.20	895	190.75	940	190.75	960	194.75	976	194.75	1000
GR	194.75	1037	198.20	1037.1	197.70	1038	197.60	1053		
X1	1600	9	901	1037.1	104	98	100			
GR	199.20	901	192.20	943.5	192.20	963.5	194.99	976	194.99	1000
GR	194.99	1037.0	198.64	1037.1	198.14	1038	198.30	1053		
X1	1700	15	927.4	1040.1	105	96	100			
GR	199.55	794.6	200.22	873.2	199.72	873.3	200.70	921.4	201.45	921.5
GR	201.45	927.4	193.60	959	193.60	967	195.00	984	195.73	986
GR	195.73	1000	195.73	1040	199.08	1040.1	198.58	1041	199.0	1056
X1	1800	14	940.4	1044.1	105	96	99			
GR	200.02	886.0	201.63	906.8	201.13	906.9	202.16	937.9	202.91	938.0
GR	202.91	940.4	195.10	964	195.10	970.5	196.47	976	196.47	1000
GR	196.47	1044	199.52	1044.1	199.02	1045	199.60	1060		
QT	1	950								
X1	1900	13	948.8	1046.6	104	96	100			
GR	200.50	894.0	203.42	913.5	202.92	913.6	202.76	944.7	203.51	944.8
GR	203.57	948.8	196.50	970	196.50	973	197.21	1000	197.21	1046.5
GR	199.96	1046.6	199.46	1047.5	199.80	1062.5				
X1	2000	12	954.96	1049.1	104	96	100			
GR	202.1	884.7	203.24	905.3	202.74	905.4	202.96	952.4	203.71	952.5
GR	203.71	954.96	197.95	978	197.95	1000	197.95	1049	200.71	1049.1
GR	200.21	1050	200.80	1065						
X1	2100	12	960.72	1048	104	95	100			
GR	202.32	893.4	203.73	919.6	203.23	919.7	202.50	955.4	203.25	955.5
GR	203.26	960.72	198.19	981	198.19	1000	198.19	1036	201.20	1048
GR	201.20	1050	201.00	1067						
X1	2200	12	954.44	1053	102	97	100			
GR	203.0	898.0	204.06	919.1	203.56	919.1	202.82	950.1	203.57	950.2
GR	203.57	954.44	198.43	975	198.43	1000	198.43	1039.5	201.80	1053
GR	201.80	1055	201.00	1072						
X1	2300	11	952.16	1054	100	100	100			
GR	203.26	899.8	203.87	916.6	203.13	947.4	203.88	947.5	203.88	952.16
GR	198.67	973	198.67	1000	198.67	1039.5	202.20	1054	202.20	1056
GR	200.90	1071								

Vertical wall on West side

158'

TC 3.33

TC 3.83

168.5'

TC 3.71

TC 3.26

NG

OK

171'

1

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X1	2400	11	951.44	1053.5	100	100	100			
GR	203.86	901.7	203.77	914.1	203.04	945	203.79	945	203.80	951.44
GR	198.91	971	198.91	1000	198.91	1039.5	202.40	1053.5	202.40	1055.5
GR	201.60	1062								
X1	2500	13	948.44	1043	100	100	100			
GR	203.86	903.4	204.01	916.0	203.51	916.1	202.78	946.9	203.53	947
GR	203.54	948.44	199.15	966	199.15	1000	199.15	1014	199.15	1028
GR	202.80	1043	202.80	1045	201.60	1062				

160'

159'

Put X3 Card.

TC = 1202.95

X1	2600	11	950.44	1054	100	100	100			
GR	203.9	903.3	203.26	916.8	202.53	947.6	203.28	947.7	203.28	950.44
GR	199.39	966	199.39	1000	199.39	1039	203.20	1054	203.20	1056
GR	201.80	1062								

Is there a levee on west side?

1202.70'

QT	1	880								
X1	2700	12	952.5	1054	100	100	100			
GR	204.1	880.5	204.07	895.7	203.57	895.8	202.28	948.4	203.03	948.5
GR	203.03	952.5	199.63	966	199.63	1000	199.63	1039	203.30	1054
GR	203.30	1056	201.90	1061						

181'

X1	2800	12	952.44	1051.5	100	100	100			
GR	204.9	903.1	203.74	918.2	203.24	918.3	202.51	949.1	203.26	949.2
GR	203.26	952.44	199.87	966	199.87	1000	199.87	1037.5	203.40	1051.5
GR	203.40	1053.5	202.0	1060						

X1	2900	12	952.08	1052	100	100	100			
GR	204.4	903.0	204.06	918.9	203.56	919.0	202.83	949.8	203.58	949.8
GR	203.59	952.08	200.11	966	200.11	1000	200.11	1037.5	203.70	1052
GR	203.70	1054	202.00	1059						

X1	3000	12	951.8	1051.5	100	100	100			
GR	204.4	903.0	204.38	918.8	203.88	918.9	203.15	949.7	203.90	949.8
GR	203.90	951.8	200.35	966	200.35	1000	200.35	1037.5	203.90	1051.5
GR	203.90	1053.5	202.80	1058.5						

X1	3100	12	951.56	1051.5	100	100	100			
GR	204.5	902.9	204.7	917.9	204.2	918	203.45	948.8	204.2	948.9
GR	204.20	951.56	200.59	966	200.59	1000	200.59	1037.5	204.10	1051.5
GR	204.10	1053.5	202.60	1085						

182'

X1	3200	12	950.9	1051	100	100	100			
GR	204.5	902.8	205.02	917.0	204.52	917.1	203.79	947.9	204.54	948
GR	204.54	950.9	200.83	966	200.83	1000	200.83	1037.5	204.2	1051
GR	204.20	1053	202.7	1084						

X1	3300	12	951.36	1051	100	100	100			
GR	205.0	902.7	205.2	917.1	204.7	917.2	203.97	948.1	204.72	948.1
GR	204.73	951.36	201.07	966	201.07	1000	201.07	1037.5	204.40	1051
GR	204.40	1053	203.50	1082.5						

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X1	3400	12	952.44	1051	100	100	100			
GR	205.1	902.6	205.17	918.8	204.67	918.9	203.95	949.8	204.70	949.8
GR	204.70	952.44	201.31	966	201.31	1000	201.31	1037.5	204.70	1051
GR	204.70	1053	203.50	1082						

178'

QT	1	810								
X1	3500	12	952.36	1051	100	100	100			
GR	204.8	902.5	205.43	919.1	204.93	919.2	204.21	951.4	204.96	951.5
GR	204.96	952.36	201.55	966 BW	201.55	1000	201.55	1037.5 BW	204.90	1051
GR	204.90	1053	203.40	1081						

TW = 98.64
BW = 71.5'

X1	3600	12	955.2	1042.5	100	100	100			
GR	205.0	902.5	205.67	918.4	205.17	918.5	204.43	953.1	205.18	953.2
GR	205.18	955.2	201.79	969 BW	201.79	1000	201.79	1029 BW	205.10	1042.5
GR	205.10	1044.5	203.2	1061						

TW = 87.3
BW = 60'

X1	3700	11	957.84	1042.5	100	100	100			
GR	204.96	904	204.91	918.7	204.07	954.8	204.82	954.9	204.82	957.84
GR	202.03	969 BW	202.03	1000	202.03	1029 BW	205.40	1042.5	205.40	1044.5
GR	203.80	1061								

TW = 84.66
BW = 60'

205.3

X1	3800	12	957.08	1044.5	100	100	100				
GR	205.1	905.5	205.20	918.8	204.70	918.9	204.25	955.2	205.00	955.3	TW = 87.42'
GR	205.00	957.08	202.27	968	202.27	1000	202.27	1031	205.60	1044.5	BW = 73.92'
GR	205.60	1046.5	203.10	1086							

205.4

X1	3900	12	957.52	1045	100	100	100				
GR	205.1	905.7	205.45 ok	922.9	204.95	923	204.38	181' 955.4	205.13	955.5	TW = 87.5'
GR	205.13	957.52	202.51	968	202.51	1000	202.51	1032	205.80	1045	BW = 64'
GR	205.80	1047	202.40	1087							

X1	4000	12	959.48	1046	100	100	100				
GR	205.1	905.9	205.19 ok	924.7	204.69	924.8	204.13	955.6	204.88	955.7	TW = 86.5'
GR	204.88	959.48	202.75	968	202.75	1000	202.75	1032	206.00	1046	BW = 64'
GR	206.00	1048	202.50	1087.5							

X1	4100	12	960.6	1046	100	100	100				
GR	205.1	906.1	205.16 ok	924.9	204.66	925	204.09	955.8	204.84	955.9	TW = 85.4'
GR	204.84	960.6	202.99	968	202.99	1000	202.99	1033	206.20	1046	BW = 65'
GR	206.20	1048	202.45	1087							

X1	4200	12	960.56	1046	100	100	100				
GR	205.1	906.3	205.41	925.1	204.91	925.2	204.34	956	205.09	956.1	
GR	205.09	960.56	203.23	968	203.23	1000	203.23	1033	206.40	1046	
GR	206.40	1048	202.80	1088							

X1	4300	12	960.52	1046.5	100	100	100				
GR	205	906.5	205.66 ok	925.3	205.16	925.3	204.59	956.2	205.34	956.3	TW = 86' 181
GR	205.34	960.52	203.47	968	203.47	1000	203.47	1034	206.65	1046.5	BW = 66'
GR	206.65	1048.5	202.50	1087.5							

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X1	4400	12	962.24	1046.5	100	100	100				
GR	205.3	906.7	205.47 ok	925.5	204.97	925.5	204.40	956.4	205.15	956.5	TW = 84.3'
GR	205.15	962.24	203.71	968	203.71	1000	203.71	1036	205.85	1046.5	BW = 68' 181
GR	205.85	1048.5	202.80	1088							

X1	4500	11	962.84	1044.5	100	100	100				
GR	205.5	906.9	205.09	926.1	204.49	956.9	205.24	957	205.24	962.84	
GR	203.95	968	203.95	1000	203.95	1036	206.05	1044.5	206.05	1046.5	BW = 68' 181
GR	203.50	1088									

X1	4600	12	962.56	1044.5	100	100	100				
GR	205.7	906.5	205.87	926.7	205.37	926.7	204.80	957.6	205.55	957.7	
GR	205.55	962.56	204.19	968	204.19	1000	204.19	1036	206.25	1044.5	BW = 68' 181.5
GR	206.25	1046.5	203.5	1088							

QT	1	740									
X1	4700	12	962.4	1045	100	100	100				
GR	205.9	907	206.15	927.3	205.65	927.4	205.08	958.2	205.83	958.3	181'
GR	205.83	962.4	204.43	968	204.43	1000	204.43	1036	206.50	1045	BW = 68' 181.5
GR	206.50	1047	203.2	1088.5							

X1	4800	12	962.24	1045	100	100	100				
GR	206.15	907.5	206.43	927.2	205.93	927.2	205.36	958.7	206.11	958.7	
GR	206.11	962.24	204.67	968	204.67	1000	204.67	1036	206.70	1045	BW = 68' 181'
GR	206.70	1047	203.7	1088.5							

X1	4900	12	962.6	1045	100	100	100				
GR	206.0	908.0	206.58	922.7	206.08	922.8	205.51	958.4	206.26	958.5	
GR	206.26	962.6	204.91	968	204.91	1000	204.91	1036	206.90	1045	BW = 68' 181
GR	206.90	1047	203.95	1088.5							

X1	5000	11	964.56	1045	100	100	100

overtoping on West & East Banks

GR	206.39	909.4	205.89	909.5	205.26	958.2	206.01	958.3	206.01	964.56	
GR	205.15	968	205.15	1000	205.15	1037	207.10	1045	207.10	1047	BW = 69'
GR	204.35	1088.5									
QT	1	130									
X1	5100	12	961.72	1043	100	100	100				
GR	206.9	901.8	206.62	917.3	206.12	917.4	205.46	954.5	206.21	954.5	
GR	206.21	961.72	205.39	965	205.39	1000	205.39	1035	207.30	1043	BW = 70'
GR	207.30	1045	204.7	1085							
X1	5200	12	951.24	1041	100	100	100				
GR	207.15	898.6	207.06	916.5	206.56	916.6	205.82	949	206.57	949.1	
GR	206.57	951.24	205.63	955	205.63	1000	205.63	1036	207.30	1042.5	BW = 81'
GR	207.30	1044.5	205.1	1082							
X1	5300	12	953.76	1047	100	100	100				
GR	207.4	898.4	207.41	918.5	206.91	918.6	206.18	949.4	206.93	949.5	
GR	206.93	953.76	205.87	958	205.87	1000	205.87	1041	207.30	1047	BW = 83'
GR	207.30	1049	205.9	1081							

X1	5400	12	954.28	1041	100	100	100				
GR	207.2	898.8	207.77	919.3	207.27	919.3	206.54	950.2	207.29	950.2	TW = 87'
GR	207.29	954.28	206.11	959	206.11	1000	206.11	1036	207.35	1041	BW = 77'
GR	207.35	1043	206.1	1081							
QT	1	120									
X1	5500	12	953.8	1040	100	100	100				
GR	207.9	899	208.13	919.9	207.63	920	206.90	950.8	207.65	950.9	182'
GR	207.65	953.8	206.35	959	206.35	1000	206.35	1036	207.35	1040	
GR	207.35	1042	206.8	1081							
X1	5600	12	953.6	1040	100	100	100				
GR	208.25	899.3	208.42	917.5	207.92	917.6	207.19	948.4	207.94	948.5	
GR	207.94	953.6	206.59	959	206.59	1000	206.59	1036	207.40	1040	
GR	207.40	1042	206.8	1081							
X1	5700	12	953.12	1041.5	100	100	100				
GR	208.6	894.1	208.78	915	208.28	915.1	207.55	945.9	208.30	946	
GR	208.30	953.12	206.83	959	206.83	1000	206.83	1037	207.80	1041	
GR	207.80	1043	207.4	1081							
X1	5800	12	951.64	1041.5	100	100	100				
GR	208.95	898.8	209.39	912.8	208.89	912.9	208.16	943.8	208.91	943.8	TW = 90'
GR	208.91	951.64	207.07	959	207.07	1000	207.07	1037	208.20	1041.5	BW = 78'
GR	208.20	1043.5	207.6	1081.5							
X1	5900	12	952.28	1041.5	100	100	100				
GR	209.3	900.1	209.72	912	209.22	912.1	208.49	950.8	209.24	950.9	181'
GR	209.24	952.28	207.31	960	207.31	1000	207.31	1037	208.40	1041.5	
GR	208.40	1043.5	207.5	1081							
X1	6000	12	960	1041.5	100	100	100				
GR	209.7	900.4	209.97	911.2	209.47	911.3	208.74	959.1	209.49	959.2	TW = 81.5'
GR	209.49	960.24	207.55	968	207.55	1000	207.55	1037	208.70	1041.5	BW = 69'
GR	208.70	1043.5	208.1	1081							
X1	6100	11	974.16	1028	100	100	100				
GR	210.5	900.6	210.23	909.9	209.73	909.9	208.99	964.3	209.74	964.4	TW = 54'
GR	209.74	974.16	207.79	982	207.79	1000	207.79	1018	209.50	1028	BW = 36'
GR	208.9	1081									
X1	6200	11	974.4	1028	100	100	100				

181'

```
GR     210.5      900.9     210.47     908.4     209.97     908.5     209.1      963.3     209.86     963.3
GR     209.86     974.7     208.03     982       208.03     1000      208.03     1018      210.20     1028
GR     209.3      1082

X1     6300       11        973        1030      100        100       100
GR     210.1      896       210.53     907.3     210.03     907.4     210.04     972.5     210.79     972.51
GR     210.79     973.0     210.68     990       210.51     1000      210.51     1013      210.30     1030
GR     210.1      1083
```

CHK 185'

The following 4 stations (6305,6307,6386 & 6387) are for the weir flow condition at Thomas Road.

1

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```
X1     6305       5         972        1030      5          5         5
GR     210.20     972       210.66     990       210.70     1000      210.66     1013      210.20     1030
```

58'

```
X1     6307       5         970        1030      2          2         2
GR     210.20     970       210.70     990       210.74     1000      210.70     1010.8    210.20     1030
```

60'

```
X1     6386       5         970        1025      79         79        79
GR     210.10     970       210.60     980       210.65     1000      210.60     1010.8    210.5      1025
```

55'

```
X1     6387       5         970        1025      1          1         1
GR     210.10     970       210.60     980       210.63     1000      210.50     1018      210.45     1025
```

55'

```
QT     1          60
X1     6400       11        968.2      1027      13         13        13
GR     210.3      896       210.91     903.7     210.41     903.8     210.20     967.6     210.70     967.7
GR     210.70     968.2     210.0      991       209.30     1000      209.00     1018      209.50     1027
GR     209.5      1073
```

TW = 59'
BW =

```
X1     6500       11        973.6      1026      100        100       100
GR     210.5      896.7     211.13     905.4     210.63     905.5     209.86     967.5     210.36     967.6
GR     210.55     973.8     208.75     981       208.75     1000      208.75     1018      210.60     1026
GR     209.7      1073
```

TW = 52'
BW = 37'
176'

```
X1     6600       12        972.6      1026      100        100       100
GR     213.0      899.2     211.5      907       211        907.1     210.09     966.6     210.59     966.7
GR     210.59     972.6     208.99     979       208.99     1000      208.99     1018      211.00     1026
GR     211.30     1035      211.9      1077

X1     6700       11        973.3      1028      100        100       100
GR     213        900.7     211.81     908.6     211.31     908.7     210.41     963.6     210.91     963.7
GR     210.91     973.3     209.23     980       209.23     1000      209.23     1018      211.40     1028
GR     212.5      1079
```

179'

```
X1     6800       11        972        1026      100        100       100
GR     213.53     902.3     212.05     910.2     211.55     910.3     210.72     960.5     211.22     960.6
GR     211.22     972       209.47     979       209.47     1000      209.47     1018      211.50     1026
GR     212.8      1082

X1     6900       11        969.6      1025      100        100       100
GR     213.75     903.9     212.31     913.1     211.81     913.2     211.05     958.5     211.55     958.6
GR     211.55     969.6     209.71     977       209.71     1000      209.71     1018      211.50     1025
GR     212.5      1085

X1     7000       11        969.4      1028      100        100       100
GR     212.58     903.7     212.56     918.2     212.06     918.3     211.35     958.1     211.85     958.2
GR     211.85     969.4     209.95     977       209.95     1000      209.95     1018      212.50     1028
GR     212.1      1084
```

1

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```
QT        1        20
X1     7100        11     970.4      1027       100       100       100
GR    212.1     902.4    211.94     915.2    211.44     915.3    211.10     957.6    211.60     957.7
GR   211.60     970.4    210.19       976    210.19      1000    210.19      1018    212.40      1027
GR    212.0      1086

X1     7200        11     970.2      1027       100       100       100
GR   212.58     903.1    212.45     917.2    211.95     917.3    211.39     957.1    211.89     957.2
GR   211.89     970.2    210.43       976    210.43      1000    210.43      1018    212.60      1027
GR    213.8      1084

X1     7300        11     967.5      1036       100       100       100
GR    212.8     902.8    213.11     916.7    212.61     916.8    212.05     956.6    212.55     957.7
GR   212.55     967.5    210.67       975    210.67      1000    210.67      1018    212.30      1036
GR    212.0      1084

X1     7400        13     965.8      1038       100       100       100
GR    213.2     902.5    213.77     916.2    213.27     916.2    212.71     956.1    213.21     956.2
GR   213.21     965.8    210.91       975    210.91      1000    210.91      1018    212.20      1038
GR    214.0      1070     211.0      1085     209.0      1089

X1     7500        13     963.2      1034       100       100       100
GR      214     902.1    214.43     915.9    213.93     915.9    213.36     955.8    213.86     955.9
GR   213.86     963.2    211.15       974    211.15      1000    211.15      1023    212.30      1034
GR   212.80      1060     213.7      1078     211.0      1085
```

184

211-84

211.86

CW. 211.88

NO OT

183

1

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THIS RUN EXECUTED 30DEC94 08:59:55

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

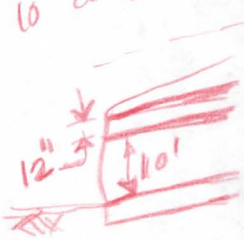
Sta. 11+00 to Sta. 20+00

SUMMARY PRINTOUT

	SECNO	Q	XLCH	TOPWID	AREA	VCH	XLBEL	RBEL	CWSEL	ELMIN	EG
	.000	5270.00	.00	16.00	242.32	21.75	100000.00	100000.00	184.98	169.67	192.33
*	384.000	5270.00	384.00	116.00	909.70	9.97	186.71	186.71	192.51	171.71	193.54
	434.000	5270.00	50.00	116.00	668.32	12.81	188.36	188.36	191.88	171.98	193.88
*	484.000	5270.00	50.00	116.00	545.31	14.59	190.00	190.00	192.35	172.80	195.21
*	684.000	5270.00	200.00	126.00	994.99	8.43	190.00	190.00	195.07	176.07	195.95
	726.000	5270.00	42.00	126.00	897.07	9.91	177.11	177.11	194.85	177.11	196.18
*	1000.000	5270.00	274.00	100.00	500.42	12.95	179.80	179.80	195.13	179.80	197.68

CWSEL

It should be more than 10' diff.



*	1099.000	1170.00	99.00	137.00	1271.17	.92	195.80	194.50	197.94	180.04	197.96
*	1100.000	1170.00	1.00	155.00	881.97	1.34	195.80	194.50	197.93	190.00	197.96
	1200.000	1170.00	90.00	170.56	751.88	1.58	198.00	198.20	197.95	190.03	197.98
	1300.000	1170.00	100.00	163.70	694.36	1.71	198.00	198.20	197.97	190.27	198.02
	1400.000	1170.00	100.00	160.35	647.23	1.83	198.00	198.20	198.01	190.51	198.06
	1500.000	1170.00	100.00	156.84	599.73	1.97	198.20	198.20	198.05	190.75	198.11
	1600.000	1170.00	100.00	129.43	470.43	2.49	199.20	198.64	198.10	192.20	198.20
*	1700.000	1170.00	100.00	99.49	282.47	4.14	201.45	199.08	198.17	193.60	198.44
*	1800.000	1170.00	99.00	90.70	203.27	5.76	202.91	199.52	198.61	195.10	199.13
	1900.000	950.00	100.00	93.93	212.60	4.48	203.57	199.96	199.63	196.50	199.95

1

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EAST WEST

	SECNO	Q	XLCH	TOPWID	AREA	VCH	XLBEL	RBEL	CWSEL	ELMIN	EG
	2000.000	950.00	100.00	82.15	176.03	5.40	203.71	200.71	200.27	197.95	200.73
	2100.000	950.00	100.00	91.54	198.90	4.80	203.26	201.20	201.15	198.19	201.51
*	2200.000	950.00	100.00	106.86	263.66	3.66	203.57	201.80	201.74	198.43	201.95
	2300.000	950.00	100.00	107.33	279.56	3.45	203.88	202.20	202.06	198.67	202.24
	2400.000	950.00	100.00	101.75	282.81	3.38	203.80	202.40	202.33	198.91	202.50
	2500.000	950.00	100.00	103.83	267.77	3.61	203.54	202.80	202.58	199.15	202.78
	2600.000	950.00	100.00	120.07	308.05	3.12	203.28	203.20	202.88	199.39	203.03
	2700.000	880.00	100.00	142.42	318.17	2.86	203.03	203.30	203.10	199.63	203.22
	2800.000	880.00	100.00	138.70	306.96	2.97	203.26	203.40	203.28	199.87	203.41
	2900.000	880.00	100.00	129.65	296.98	3.04	203.59	203.70	203.47	200.11	203.61
	3000.000	880.00	100.00	123.97	288.91	3.10	203.90	203.90	203.68	200.35	203.83
	3100.000	880.00	100.00	143.73	302.24	3.04	204.20	204.10	203.90	200.59	204.04
	3200.000	880.00	100.00	141.34	302.01	3.04	204.54	204.20	204.12	200.83	204.26
	3300.000	880.00	100.00	140.06	289.68	3.14	204.73	204.40	204.33	201.07	204.48
	3400.000	880.00	100.00	148.91	295.43	3.12	204.70	204.70	204.56	201.31	204.71
	3500.000	810.00	100.00	149.44	299.30	2.84	204.96	204.90	204.80	201.55	204.92
	3600.000	810.00	100.00	128.40	256.04	3.31	205.18	205.10	204.99	201.79	205.16
	3700.000	810.00	100.00	153.05	280.72	3.14	204.82	205.40	205.26	202.03	205.41
	3800.000	810.00	100.00	176.78	335.76	2.65	205.00	205.60	205.51	202.27	205.60
	3900.000	810.00	100.00	177.29	345.17	2.53	205.13	205.80	205.67	202.40	205.76

Do we have this much R/W ?

4000.000	810.00	100.00	176.94	357.64	2.42	204.88	206.00	205.83	202.50	205.91
4100.000	810.00	100.00	175.65	362.65	2.35	204.84	206.20	205.97	202.45	206.05
4200.000	810.00	100.00	175.29	346.18	2.48	205.09	206.40	206.11	202.80	206.20
4300.000	810.00	100.00	173.89	345.15	2.45	205.34	206.65	206.27	202.50	206.36
4400.000	810.00	100.00	181.30	379.61	2.15	205.15	205.85	206.43	202.80	206.50
4500.000	810.00	100.00	181.10	363.49	2.26	205.24	206.05	206.56	203.50	206.63

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The CHIMP IS NOT THIS WIDE

	SECNO	Q	XLCH	TOPWID	AREA	VCH	XLBEL	RBEL	CWSEL	ELMIN	EG
	4600.000	810.00	100.00	181.50	343.61	2.40	205.55	206.25	206.71	203.50	206.79
	4700.000	740.00	100.00	181.50	340.60	2.16	205.83	206.50	206.88	203.20	206.95
	4800.000	740.00	100.00	181.00	320.49	2.34	206.11	206.70	207.03	203.70	207.11
	4900.000	740.00	100.00	180.50	317.45	2.34	206.26	206.90	207.21	203.95	207.29
	5000.000	740.00	100.00	179.10	337.34	2.09	206.01	207.10	207.38	204.35	207.46
	5100.000	130.00	100.00	183.20	311.06	.41	206.21	207.30	207.52	204.70	207.52
	5200.000	130.00	100.00	183.40	269.39	.49	206.57	205.63	207.53	205.10	207.53
	5300.000	130.00	100.00	182.60	215.01	.63	206.93	207.30	207.54	205.87	207.55
	5400.000	130.00	100.00	174.44	174.67	.79	207.29	207.35	207.56	206.10	207.57
*	5500.000	120.00	100.00	156.69	133.94	.97	207.65	207.35	207.61	206.35	207.62
	5600.000	120.00	100.00	147.51	118.61	1.07	207.94	207.40	207.69	206.59	207.71
	5700.000	120.00	100.00	137.15	90.45	1.41	208.30	207.80	207.81	206.83	207.84
	5800.000	120.00	100.00	112.53	83.83	1.48	208.91	208.20	208.03	207.07	208.06
	5900.000	120.00	100.00	115.74	87.33	1.43	209.24	208.40	208.25	207.31	208.28
	6000.000	120.00	100.00	100.86	73.18	1.70	209.49	208.70	208.50	207.55	208.54
*	6100.000	120.00	100.00	46.86	45.61	2.63	209.74	209.50	208.89	207.79	209.00
*	6200.000	120.00	100.00	69.59	58.85	2.10	209.86	210.20	209.39	208.03	209.45
*	6300.000	120.00	100.00	136.32	40.41	.80	210.79	210.30	210.43	210.03	210.58
*	6305.000	120.00	5.00	58.00	29.30	4.10	210.20	210.20	211.03	210.20	211.29
*	6307.000	120.00	2.00	60.00	40.13	2.99	210.20	210.20	211.21	210.20	211.35
*	6386.000	120.00	79.00	55.00	64.79	1.85	210.10	210.50	211.73	210.10	211.78
	6387.000	120.00	1.00	55.00	66.11	1.82	210.10	210.45	211.73	210.10	211.78
*	6400.000	60.00	13.00	177.00	332.02	.16	210.70	209.50	211.79	209.00	211.79
	6500.000	60.00	100.00	176.30	334.42	.19	210.36	210.60	211.79	208.75	211.79

*	6600.000	60.00	100.00	163.76	232.00	.29	210.59	211.00	211.79	208.99	211.79
	6700.000	60.00	100.00	137.52	186.85	.36	210.91	211.40	211.79	209.23	211.79

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	SECNO	Q	XLCH	TOPWID	AREA	VCH	XLBEL	RBEL	CWSEL	ELMIN	EG
	6800.000	60.00	100.00	128.46	152.96	.44	211.22	211.50	211.80	209.47	211.80
	6900.000	60.00	100.00	129.43	125.22	.54	211.55	211.50	211.80	209.71	211.81
	7000.000	60.00	100.00	81.84	96.21	.65	211.85	212.50	211.82	209.95	211.82
	7100.000	20.00	100.00	109.47	106.71	.21	211.60	212.40	211.83	210.19	211.83
*	7200.000	20.00	100.00	85.92	74.94	.28	211.89	212.60	211.84	210.43	211.84
	7300.000	20.00	100.00	60.59	60.63	.33	212.55	212.30	211.84	210.67	211.85
	7400.000	20.00	100.00	69.61	58.32	.32	213.21	212.20	211.85	209.00	211.86
*	7500.000	20.00	100.00	60.95	39.54	.51	213.86	212.30	211.87	211.00	211.88

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SUMMARY OF ERRORS AND SPECIAL NOTES

```
WARNING SECNO=    384.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=    484.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=    484.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

WARNING SECNO=    684.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   1000.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   1099.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   1100.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   1700.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   1800.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   2200.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   5500.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   6100.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   6200.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=   6300.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=   6300.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=   6305.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=   6305.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY
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WARNING SECNO=   6307.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   6386.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   6400.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   6600.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   7200.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=   7500.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
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BACKUP SPILLWAY CALCULATIONS

PROJECT NAME: Old Cross Cut Canal

PROJECT NO. : E002102

SPILLWAY ANALYSIS FOR HYDRAULIC JUMP

LOCATION			(CFS) LOCAL STORM DISCHARGE (Q)	(FT) SPILLWAY WIDTH (4:1 EXP.)	(FT) ELEVATION DIFFERENCE TOP TO TOE (H)	(FT) UPSTREAM DEPTH (Y1)	(FPS) UPSTREAM APPROACH VELOCITY (V1)	(FT) SPILLWAY TOE DEPTH	(FPS) SPILLWAY TOE VELOCITY	(FT) SPILLWAY CONJUGATE DEPTH (Y4)	(FT) SPILLWAY CONJUGATE VELOCITY (V4)	(FPS) LOCAL Q CHIMP DEPTH (TW)	(FT) LENGTH OF JUMP			
STREET NAME	STATION BOX	STATION ROAD											TAILRACE (Lab)	JUMP (Lbc)	TOTAL	DEPRESSED BASIN TOTAL
HOLLY	27+17	216+41.93	142	132	3.8	0.74	3.94	0.06	17.44	1.05	1.03	1.10	0.0	6.6	7.0	-
S. CEMETARY*	33+57	222+82.59	229	48	2.6	0.71	9.96	0.28	17.04	2.1	2.27	1.52	43.3	7.6	50.9	14.0
N. CEMETARY	40+57	229+81.63	239	64	1.1	0.79	6.88	0.306	12.204	1.53	2.44	1.57	0.0	9.0	9.0	-
VIRGINIA	50+25	238+49.37	570	149	1.1	1.14	4.96	0.31	12.2	1.55	2.46	2.40	0.0	13.8	14.0	-
WINDSOR	56+74	245+96.85	108	67	1.2	0.72	4.57	0.14	11.65	1.01	1.6	0.90	5.3	5.2	11.0	-
PINCHOT	71+37	260+61.58	38	105	0.7	0.63	2.19	0.04	9.39	0.44	0.83	0.75	0.0	4.6	5.0	-
EARLL	76+64	265+89	1509	96	4.75	1.3	13.6	0.68	23.05	4.43	3.55	**	0.0	25.9	25.9	-
RICHARDSON	83+24	272+48.95	66	65	2.31	0.61	5.02	0.07	14.51	0.91	1.12	**	0.0	5.72	5.72	-
						Y_0	Y_0	Y_1	V_1	Y_4	V_4	Y_{TW}				

* NOTE: S. Cemetary spillway location is the only location with a depressed basin to force a hydraulic jump.
S. CEMETARY - DEPRESS 0.70'

** NO CHIMP

Holly, if $Y_{TW} > Y_4$ Tail Race = 0
S. Cemmet. $Y_{TW} < Y_4$ Tail Race = 43.3'
N. Cement $Y_{TW} < Y_4$ Tail Race = 0
Virginia $Y_{TW} > Y_4$ No Tail Rce = 0
Windsor $Y_{TW} < Y_4$, No Tail Race
Pinchot $Y_{TW} > Y_4$, Tail Race = 0,
EARLL No Tail Race.
Richardson, No Tail Race

COMPARISON OF HYDRAULIC JUMP ANALYSIS TO SCOUR ANALYSIS

LOCATION	(FT) HYDRAULIC JUMP LENGTH	(FT) SCOUR LENGTH	(FT) EXTENT OF CONCRETE FROM SPILLWAY TOE	(FT) EXTENT OF GRASSCRETE FROM EDGE OF CONC.
HOLLY	7	50	12	38
S. CEMETARY*	14	60	14	46
N. CEMETARY	9	55	12	43
VIRGINIA	14	68	14	54
WINDSOR	11	41	12	29
PINCHOT	5	27	12	15
EARLL	26	TO TOP OF BERM	26	TO TOP OF BERM
RICHARDSON	6	TO TOP OF BERM	6 (MIN)	TO TOP OF BERM

NOTE: The extent of concrete is equal to the hydraulic jump length unless this length is less than 12'. The minimum extent for concrete is 12' to tie into the bike path. The minimum extent of grasscrete is equal to the scour length minus the extent of concrete. Grasscrete length is from the edge of concrete to the west.

PROJECT NAME: OLD CROSS CUT CANAL
PROJECT NO.: E002102

SPILLWAY OUTLET LENGTH

SCOUR LENGTH CALCULATIONS FOR SPILLWAYS:

DESIGN BY: ALB
DATE: 12/3/94

CKED BY: JVG
DATE: 12/6/94

STREET NAME	STATION	DISCHARGE	VELOCITY AT TOE	AREA	Ye	D.I.	Ls/Ye	Ls	CONC. PROTECTION FROM EAST TOE OF CHIMP WEST (Lj or 12'min.)	WIDTH OF GRASSCRETE FROM END OF SPILLWAY (Ls - Lj)
HOLLY	27+17.00	142	✓ 17.44	8.1444	2.02	4.33	24.60	49.64	12'	38'
S. CEMETARY DR.	33+57.34	229	17.04	12.4128	2.49	4.12	23.76	59.20	14'	46'
N. CEMETARY DR.	40+57.36	239	12.204	16.7316	2.89	2.96	18.79	54.35	12'	43'
VIRGINIA	50+24.83	570	✓ 12.2	46.786	4.84	1.95	13.98	67.64	14'	54'
WINDSOR	56+95.72	108	✓ 11.65	8.4889	2.06	3.12	19.52	40.22	12'	29'
PINCHOT	71+37.34	38	✓ 9.39	3.6972	1.36	3.11	19.45	26.44	12'	15'
EARLL	76+64	1509	✓ 23.05	65.472	5.72	3.40	20.72	118.53	26'	TO TOP OF BERM
RICHARDSON	83+05	66	✓ 14.51	4.55	1.51	4.16	23.94	36.11	6'	TO TOP OF BERM

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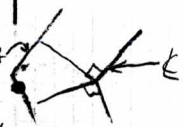
Job No. 600 2102 Project OCCC Sheet 1 of 1

Subject Spillways (Permanent Concrete)

By VG Date 12/3/94 Checked By ALB Date 12/6/94

Side Street	℄ of Spillway Back of Curb (48th ℄)	(CBC ℄)	Spillway Width	Spillway length from Toe (W)	(48th ST ℄) Center of Curb Opening	Curb Opening Width	(AT TOE) Spillway Depresion	(from spillway west) Grasscrete Length
Holly	216+41.55	27+17	132'	12'	216+41.51	20'	—	38'
S. Cemetary	222+81.73	33+57	48'	14'	222+80	27'	0.7'	46'
Oak	226+36.80± *	37+12	96'	—	226+36.76	92'	—	—
N. Cemetary	229+81.54	40+57	64'	12'	229+82	38'	—	43'
Virginia	239+50.47	50+26**	149'	14'	239+50.84	75'	—	54'
Windsor	245+98.17	56+74	67'	12'	246+00.08	18'	—	29'
Pinchot	260+61.80	71+37	105	12'	260+62.25	6'	—	15'
Earll	265+88.95	76+64	96'	26'	265+88.86	92'	—	Top of Berm
Richardson	272+48.95	83+24	65'	***6' MIN	272+25.67	8'	—	Top of Berm
C&G low PT	209+92.56	20+74.68	8'	12'	209+92.78	3'	—	—
C&C low PT	233+49.82	44+25.28	8'	12'	233+50	3'	—	—

* STA. @ OAK is in "no-mans Land" at ∢ PT → 

** Need more than Station Control here. Spillway is on the CBC ℄ ∢ PT. Spillway will be ⊥ & ∥ to southern Bearing. S. Edge @ STA. 49+51.48

*** Concrete in this sump location to go beyond inlet by 4'.

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Job No. E002102 Project Old Cross Cut Canal Sheet 1 of 2

Subject Normal Depth of Flow in CHIMP - Local Storm

By ALB Date 12/1/94 Checked By JUG Date 12/6/94

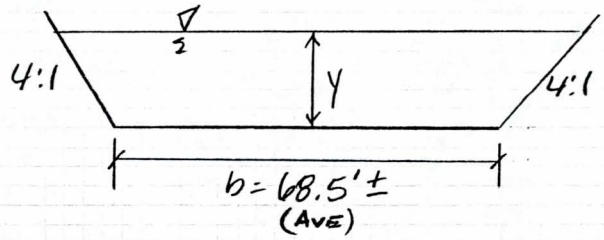
S. Cemetery (Box Sta 33+57)

For a tailwater of a spillway

From latest HEC-2 CH922-6A.DAT

Sta 33+00 $b = 1037.5 - 970 = 67.5'$ ✓

34+00 $b = 1037.5 - 968 = 69.5'$ ✓



$S = 0.0024$ ✓
$n = 0.045$ ✓
$z = 4$ ✓

$Q_{local} = 229$ cfs ✓

$$Q = \frac{1.49}{n} A R^{2/3} \sqrt{S}$$

$$A = (b + zy)y$$

$$P = b + 2y\sqrt{1+z^2}$$

$$R = A/P$$

$$AR^{2/3} = \frac{Qn}{1.49\sqrt{S}}$$

$$AR^{2/3} = \frac{(229)(0.045)}{1.49\sqrt{0.0024}} = 141.17 \checkmark$$

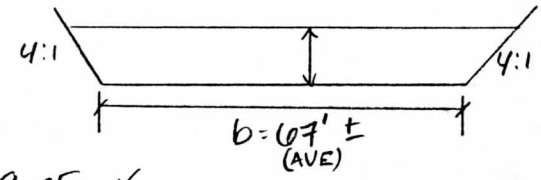
By iteration, $\underline{\underline{y = 1.52'}}$

N. Cemetery (Box Sta 40+57)

From latest HEC-2 CH922-6A.DAT

Sta 40+00 $b = 1032 - 967 = 65'$ ✓

41+00 $b = 1033 - 964 = 69'$ ✓



$S = 0.0024$ ✓
$n = 0.045$ ✓
$z = 4$ ✓

$Q_{local} = 239$ cfs ✓

$$AR^{2/3} = \frac{Qn}{1.49\sqrt{S}}$$

$$AR^{2/3} = \frac{(239)(0.045)}{1.49\sqrt{0.0024}} = 147.34 \checkmark$$

By iteration, $\underline{\underline{y = 1.57'}}$

S. CEMETERY: STA 33+57

Y=	1.516076 ✓	AR^2/3=	141.1745
		VALUE=	141.1745

Q=	229	A=	113.0451 ✓
b=	68.5	P=	81.00188 ✓
z=	4	R=	1.395586 ✓
S=	0.0024		
n=	0.045		

N. CEMETERY: STA 40+57

Y=	1.574347 ✓	AR^2/3=	147.3393
		VALUE=	147.3393

Q=	239	A=	115.3955 ✓
b=	67	P=	79.9824 ✓
z=	4	R=	1.442761 ✓
S=	0.0024		
n=	0.045		

S. Cemetery Drive

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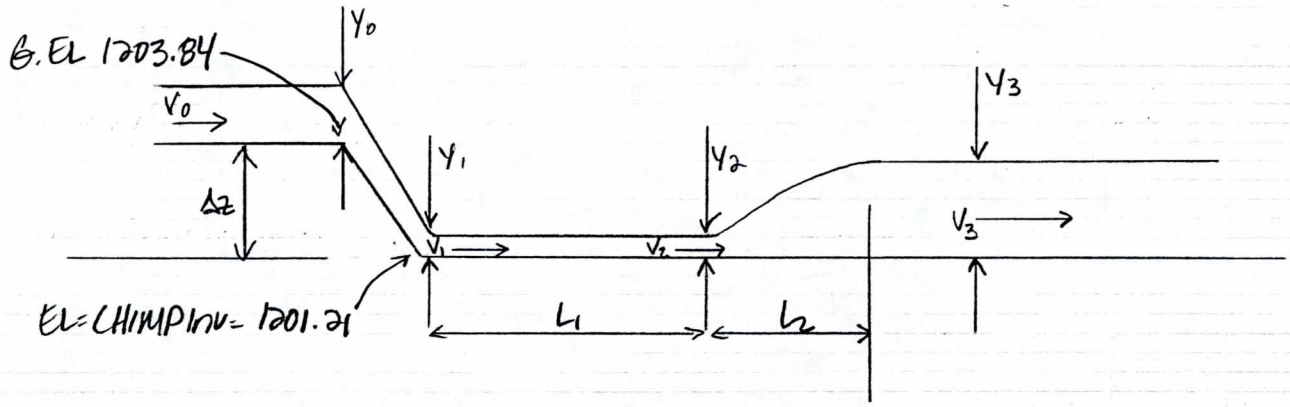
Job No. E002102 Project Old Cross Cut Canal Sheet 1 of 7

Subject Spillway at S. Cemetery - Hydraulic Jump

By ALB Date 11/30/94 Checked By JVG Date 12/6/94

S. Cemetery - Sta 222+82.59 (Box Sta 33+57) (Ph.1 Sta 222+80 G.EL=1203.8
Ph.2 Sta 222+80 G.EL=1203.8



Previously calculated: $Q = 229$ cfs ✓

$y_0 = 0.71'$ ✓

$V_0 = 9.96$ fps ✓

Topwidth = 48' ✓

Energy Eqn. $y_0 + \frac{V_0^2}{2g} + \Delta z = y + \frac{\left(\frac{Q}{A_1}\right)^2}{2g}$ ✓

$\Delta z = 1203.84 - 1201.21 = 2.63'$ ✓

$A_1 = y_1 b$

$b = 48'$ same as

$y_0 + \frac{V_0^2}{2g} + \Delta z = 0.71' + \frac{(9.96)^2}{2g} + 2.63' = 4.8804'$

$4.8804' = y_1 + \frac{\left(\frac{229}{48 y_1}\right)^2}{2g}$

y_1	EG
0.26	5.49
0.30	4.23
→ 0.28 ✓	4.7880 ✓
0.277	4.8832

Use $\boxed{y_1 = 0.28' \checkmark \quad V_1 = 17.04 \text{ fps} \checkmark}$ by trial & Error

Assume $y_1 = y_2$

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Job No. E002102 Project OCCC Sheet 2 of 7

Subject Spillway at S. Cemetery - Hydraulic Jump

By ALB Date 12/1/94 Checked By JVG Date 12/6/94

Y_3 = Sequent depth 1) When tailwater in CHIMP $\geq Y_3$, $L_1 = 0$
2) When " $< Y_3$, use the tailwater depth for Y_3

TW = 1.55' (Local Q CHIMP depth) (From HEC-II RUN)

$$F_1 = \frac{V_1}{\sqrt{gy_1}} = \frac{17.04}{\sqrt{g(0.28)}} = 5.675$$

$$J = \frac{Y_3}{Y_1} = 7.5$$ (HEC-14, Figure VI-4, Page VI-17)

$Y_3 = 2.1' > 1.55'$ according to cond. 2 $\therefore$ Use $Y_3 = 1.55'$ (Assumption disproved $Y_1 \neq Y_2$)

↑ Required sequent depth

Assume rectangular channel, find conjugate depth of $Y_3 = 1.55'$

$$\frac{Y_3}{Y_2} = \frac{1}{2}\left(\sqrt{1+8(F_2)^2} - 1\right)$$

Ref: Hydraulic Design of Stilling Basins and Energy Dissipators, U.S. Bureau of Reclamation (BOR) Pg. 6-7 (Jan 1978)

$$F_2 = \frac{V_2}{\sqrt{gY_2}} = \frac{Q/A_2}{\sqrt{gY_2}} = \frac{\frac{229}{(48Y_2)}}{\sqrt{32.2Y_2}}$$

$$= \frac{4.77/Y_2}{5.67\sqrt{Y_2}} = \frac{4.77}{Y_2}\left(\frac{1}{5.67\sqrt{Y_2}}\right) = \frac{0.84}{(Y_2)^{1.5}}$$

$$Y_3 = \frac{1}{2}\left(\sqrt{1+8(F_2)^2} - 1\right)Y_2$$

$$1.52 = \frac{1}{2}\left(\sqrt{1+8\left(\frac{0.84}{(Y_2)^{1.5}}\right)^2} - 1\right)Y_2$$

By Iteration

$Y_2 = 0.47'$

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Job No. E002102 Project OCC Sheet 3 of 7

Subject Spillway at S. Cemetery - Hydraulic Jump

By ALB Date 12/1/94 Checked By JVG Date 12/6/94

-OR- Check y_2 calc using the following equation

$$\frac{q^2}{g} = \frac{1}{2} y_2 y_3 (y_2 + y_3) \qquad q = \frac{Q}{b} = \frac{229}{48} = 4.77 \text{ cfs/ft}$$

$$\frac{(4.77)^2}{32.2} = \frac{1}{2} y_2 (1.52)(y_2 + 1.52)$$

$$0.9297 = y_2(y_2 + 1.52) \Rightarrow y_2^2 + 1.52 y_2 - 0.9297 = 0$$

$$y_2 = 0.467 \quad \underline{\text{Checks OK}}$$

$y_1 = 0.28$ ✓ $V_1 = 17.04$ fps ✓

$$R_1 = \frac{A_1}{P_1} = \frac{48(.28)}{48 + 2(.28)} = 0.28 \checkmark$$

$y_2 = 0.47$ ✓ $V_2 = \frac{Q}{A_2} = 10.15$ fps

$$R_2 = \frac{A_2}{P_2} = \frac{(\overset{b}{48})(\overset{y}{.47})}{48 + 2(.47)} = 0.46 \checkmark$$

$$R_{AVE} = \frac{0.28 + 0.46}{2} = 0.37 \checkmark$$

$$V_{AVE} = \frac{17.04 + 10.15}{2} = 13.595 \text{ fps} \checkmark$$

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

$$V = \frac{Q}{A} = \frac{1.486}{n} R^{2/3} S^{1/2}$$

$$S_{AVG} = \left[\frac{V_{AVG}\, n}{1.486 \times R_{AVG}^{2/3}}\right]^2 = 0.06143 \text{ ft/ft}$$

Friction Slope, Mannings $n = 0.014$ for apron

$$V = \frac{Q}{A} = \frac{1.49 R^{2/3}}{n} S^{1/2}$$

$$S_{AVE} = \left[\frac{V_{avg}}{R_{avg}^{2/3}} \times \frac{n}{1.49}\right]^2 = \left[\frac{13.595}{(0.37)^{2/3}} \times \frac{0.014}{1.49}\right]^2 = 0.06143 \checkmark$$

Length of tailrace, L_1, before jump

$$L = \frac{\left(\frac{V_2^2}{2g} + y_2\right) - \left(\frac{V_1^2}{2g} + y_1\right)}{S_o - S_{avg}}$$

$$L_1 = \frac{\left(\frac{V_2^2}{2g} + y_2\right) - \left(\frac{V_1^2}{2g} + y_1\right)}{S_o - S_{AVE}}$$

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Job No. E002102 Project OCCC Sheet 4 of 7

Subject Spillway at S. Cemetery - Hydraulic Jump

By ALB Date 12/1/94 Checked By JVG Date 12/6/94

$$L_1 = \frac{\left(\frac{(10.15)^2}{2g} + 0.47\right) - \left(\frac{(17.04)^2}{2g} + 0.28\right)}{(0 - 0.06143)}$$

$$= \frac{2.0697 - 4.789}{-0.06143} = \underline{\underline{44.27 \text{ feet}}} \checkmark$$

$$F_2 = \frac{V_2}{\sqrt{gy_2}} = \frac{10.15}{\sqrt{0.47g}} = 2.609$$

$\frac{L_2}{y_2} = 16.0$ Figure 6 pg 13 BOR $L_2 = 16.0\, y_2 = 7.52'$ ✓

$\frac{L_2}{y_3} = 5.0$ Figure 7 pg 14 BOR $L_2 = 5.0\, y_3 = \underline{\underline{7.6'}}$ ✓

$L_{total} = L_1 + L_2 = 44.27' + 7.6' = 51.87'$ ✓

Check w/ spreadsheet $= 50.90'$ ✓

BOR = Bureau of Reclamation

HYDRAULIC JUMP CALCULATION

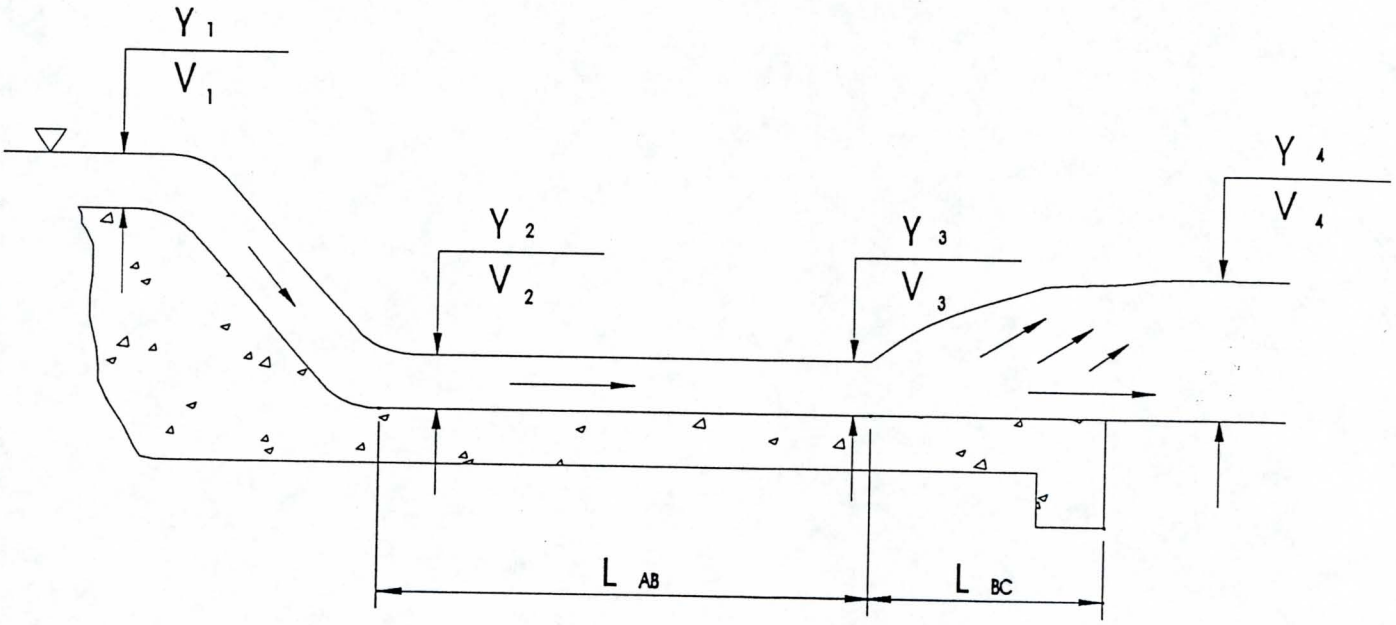

FIGURE 1.1 - HYDRAULIC JUMP

PROJECT NAME:	OLD CROSS CUT CANAL
PROJECT NUMBER:	E002102
DATE CREATED:	12/1/94
ENGINEER/DESIGNER:	A.L.B.

LOCATION:S. CEMETARY

Q=	229	Yc=	0.890898
W=	48	Y3=	0.467875
TW =	1.52	V3=	10.19681
Y4=	2.1	R3=	0.458928
V4=	2.27	F3=	2.62707
Y2=	0.28	Vave.=	13.6184
V2=	17.04	Rave.=	0.36785
R2=	0.276771	Segl=	0.062498
N=	0.014		
L/Y4=	5	Lab=	43.30
		Lbc=	7.60

APRON LENGTH= 50.90

NOTE:
THE VALUE FOR L/Y4 MUST COME FROM THE U.S. BUREAU OF RECLAMATION CHART

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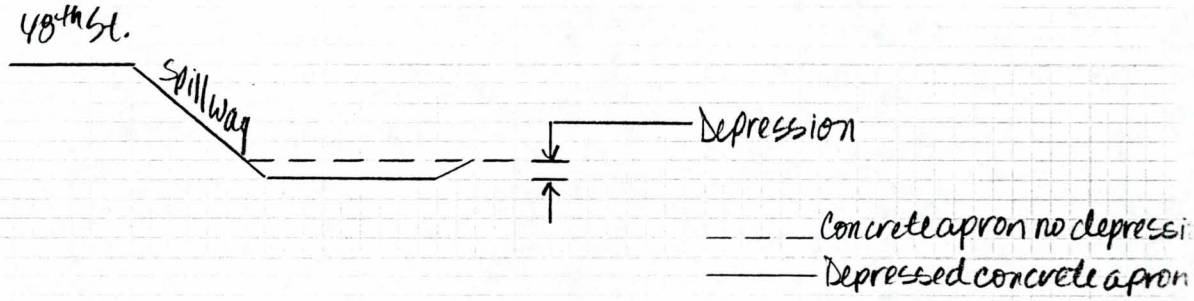
Job No. E002102 Project Old Cross Cut Canal Sheet 6 of 7

Subject Spillway at S. Cemetery - Hydraulic Jump

By ALB Date 12/1/94 Checked By JVG Date 12/6/94

Note: To eliminate tailrace and force a hydraulic jump to occur, depress the concrete apron below the CHIMP Inv. First attempt of depression is the difference between the local flow depth and sequent depth.



Local flow depth = $TW' = 1.52'$ ✓

Req. sequent depth = $Y_3 = 2.1'$ ✓

Initial depression = $Y_3 - TW' = 2.1 - 1.52 = 0.58'$ ✓ And $TW = TW' + 0.58 = 2.1'$

$Q = 229$ CFS

Energy Eqn. $Y_0 + \frac{V_0^2}{2g} + \Delta Z = Y_1 + \frac{(Q/A_1)^2}{2g}$

$\Delta Z = 2.63' + 0.58' = 3.21'$

$Y_0 + \frac{V_0^2}{2g} + \Delta Z = 0.71 + \frac{(9.96)^2}{2g} + 3.21' = 5.4604$ ✓

$5.4604 = Y_1 + \frac{\left(\frac{Q}{4BY_1}\right)^2}{2g}$ ✓

Y_1	EG
0.26	5.4882
0.265	5.2978
0.261	5.4493
0.2605	5.4687
→ 0.2607	5.4609 ✓

use $Y_1 = 0.2607'$ ✓

$V_1 = 18.30$ fps ✓

Assume $Y_1 = Y_2$

Y_3 = sequent depth $F_1 = \frac{V_1}{\sqrt{gY_1}} = 6.316$ ✓

$J = \frac{Y_3}{Y_1} = 8.5$ ✓ ∴ $Y_3 = 2.22' > TW = 2.1'$ ✓

No good

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Job No. E002107 Project Old Cross Cut Canal Sheet 7 of 7

Subject Spillway at S. Cemetery – Hydraulic Jump

By ALB Date 12/1/94 Checked By JVG Date 12/6/94

Try additional depression

$TW' = 1.52$

$Y_3 = 2.22'$

Depression $= Y_3 - TW' = 2.22 - 1.52 = 0.70$ And $TW = TW' + 0.70 = 2.22'$

Energy Eqn.

$$Y_0 + \frac{V_0^2}{2g} + \Delta Z = Y_1 + \frac{(Q/A_1)^2}{2g}$$

$\Delta Z = 2.63' + 0.70' = 3.33'$

$$Y_0 + \frac{V_0^2}{2g} + \Delta Z = 0.41 + \frac{(9.96)^2}{2g} + 3.33 = 5.5804 \checkmark$$

$$5.5804 = Y_1 + \frac{\left(\frac{Q}{48Y_1}\right)^2}{2g}$$

Y_1	EG
0.25	5.9049
0.26	5.4882
0.257	5.6080
0.258	5.5676
→ 0.2575	5.5877 ✓

Use $Y_1 = 0.2575'$ ✓

$V_1 = 18.5275$ fps ✓

Assume $Y_1 = Y_2$,

Y_3 = sequent depth

$$F_1 = \frac{V_1}{\sqrt{gY_1}} = \frac{18.5275}{\sqrt{.2575g}} = 6.434 \checkmark$$

$J = Y_3/Y_1 = 8.5$ ✓ $\therefore$ $Y_3 = 2.19'$ $< TW = 2.22'$ ✓

When TW with HIMP $\geq Y_3$, $L_1 = 0$
(no tailrace)

OK

$F_1 = 6.434$

$L/Y_1 = 52.5$ ✓ (Figure VI-11, page VI-24 HEC-14)

Length of jump $= L = \underline{13.52'}$ ✓

← length of depressed basin
(Depression $= 0.70'$) ✓

N. Cemetery Drive

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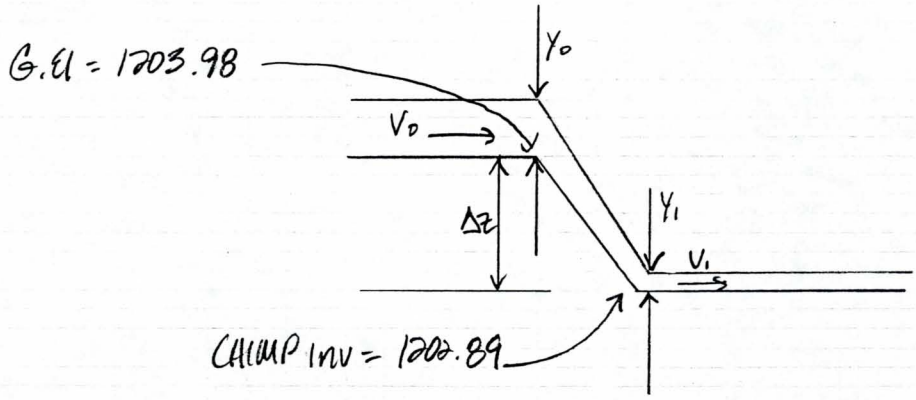
Job No. E002102 Project Old Cross Cut Canal Sheet 1 of 3

Subject Spillway at N. Cemetery - Hydraulic Jump

By ALB Date 12/1/94 Checked By JUG Date 12/6/94

N. Cemetery - Sta. 229+81.63 (Box Sta 40+57) (Ph.1 Sta 229+82 GEL = 1204.[illegible] Ph.2 Sta 229+82 GEL = 1203.9[illegible])



Previously Calculated: $Q = 239$ cfs

$Y_0 = 0.79'$

$V_0 = 6.88$ fps

Topwidth $b = 64'$

1203.98
1202.89
1.09'

Energy Eqn.

$$Y_0 + \frac{V_0^2}{2g} + \Delta z = Y_1 + \frac{(Q/A_1)^2}{2g}$$

$\Delta z = 1203.98 - 1202.89 = 1.09'$ ✓

$A_1 = Y_1 b$

$b = 64'$

$$Y_0 + \frac{V_0^2}{2g} + \Delta z = 0.79 + \frac{(6.88)^2}{2g} + 1.09 = 2.615'$$ ✓

$$2.615' = Y_1 + \frac{\left(\frac{Q}{64 Y_1}\right)^2}{2g}$$

Y_1	EG
0.4	1.753
0.3	2.706
0.31	2.563
0.305	2.633
→ 0.306	2.619 ✓

use $Y_1 = 0.306'$ ✓

$V_1 = 12.204$ fps ✓

Assume $Y_1 = Y_h$

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Job No. E002102 Project Old Cross Cut Canal Sheet 2 of 3

Subject Spillway at N. Cemetery - Hydraulic Jump

By AWB Date 12/1/94 Checked By JVG Date 12/6/94

Y_3 = sequent depth

1) When tailwater in CHIMP $\geq Y_3$, $L_1 = 0$
2) When " $< Y_3$, use the tailwater depth for Y_3 (tailrace occurs)

$TW = 1.57'$ (Local @ CHIMP depth) ← from HEC II

$$F_1 = \frac{V_1}{\sqrt{gY_1}} = \frac{12.204}{\sqrt{0.306g}} = 3.89$$

$$J = \frac{Y_3}{Y_1} = 5.0$$ (HEC-14, Figure VI-4, Pg. VI-17)

$Y_3 = 1.53' < 1.57'$ ∴ No tailrace, $L_1 = 0$ & $Y_1 = Y_2$

$F_1 = 3.89$

$$\frac{L}{Y_1} = 28$$ (HEC-14, Figure VI-11, Pg VI-24)

$L = 28Y_1 = \underline{\underline{8.57'}}$ ← Length of hydraulic jump

Length of jump

HYDRAULIC JUMP CALCULATION

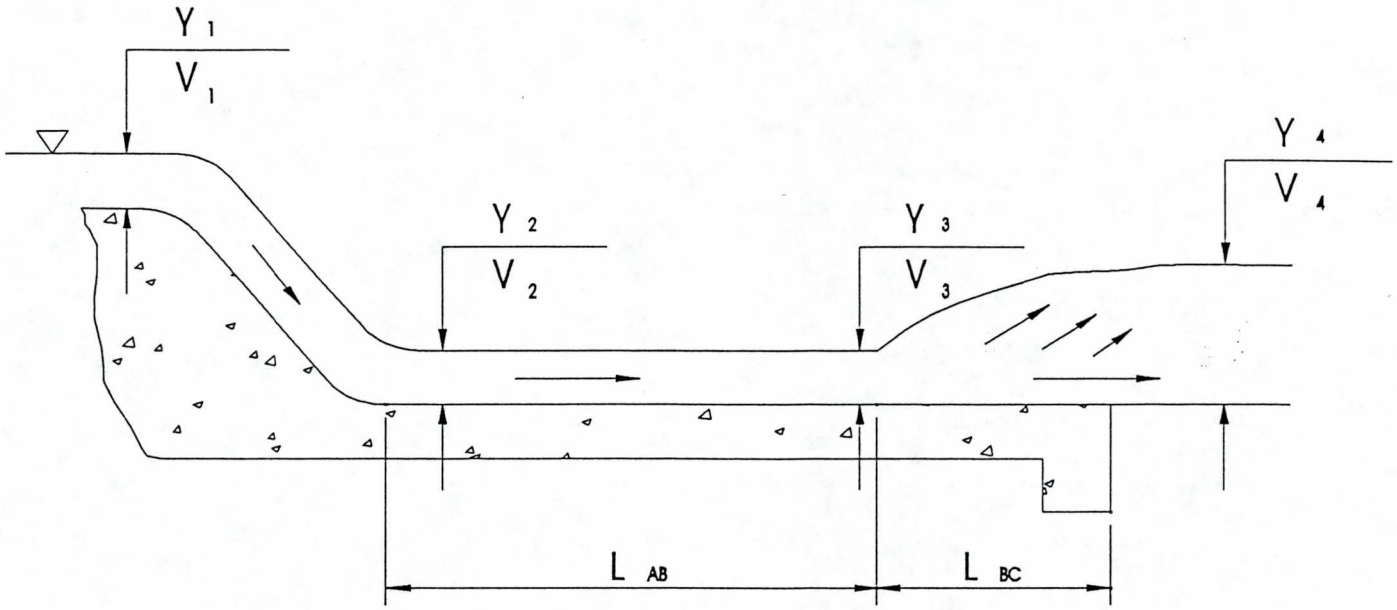


FIGURE 1.1 - HYDRAULIC JUMP

PROJECT NAME:	OLD CROSS CUT CANAL
PROJECT NUMBER:	E002102
DATE CREATED:	12/1/94
ENGINEER/DESIGNER:	A.L.B.

LOCATION:N. CEMETARY

Q=	239	Yc=	0.7568
W=	64	Y3=	0.29571
TW =	1.57	V3=	0
Y4=	1.53	R3=	0
V4=	2.4408	F2=	3.9
Y2=	0.306	Vave.=	0
V2=	12.204	Rave.=	0
R2=	0.303102	Segl=	0
N=	0.014		
L/Y4=	5.7	Lab=	NO TAILRACE
		Lbc=	8.95

APRON LENGTH= 8.95 ok

NOTE:
THE VALUE FOR L/Y4 MUST COME FROM THE U.S. BUREAU OF RECLAMATION CHART

Earll Drive

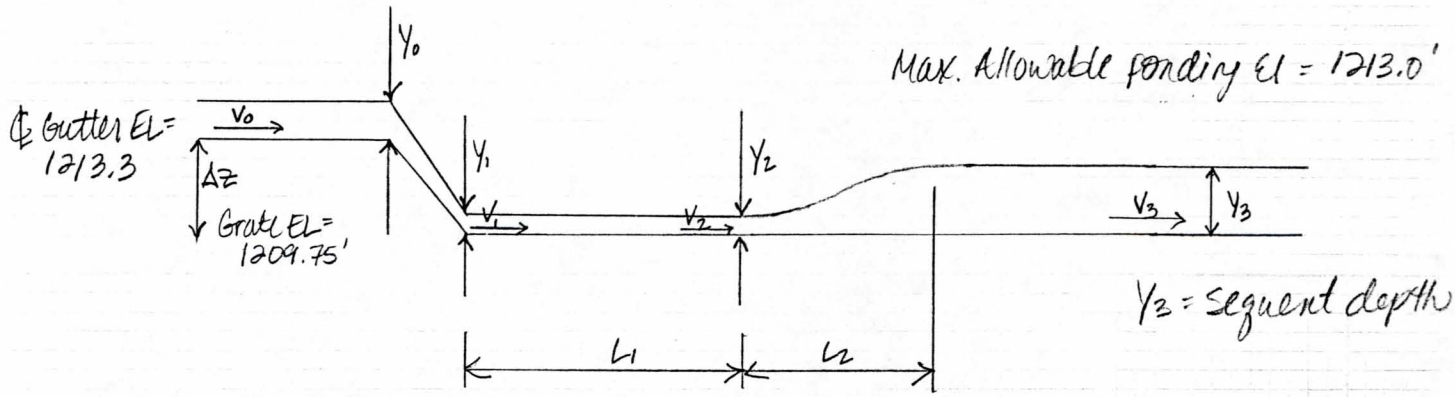
Greiner

Job No. E002102 Project OCCC-Spillways Sheet 1 of 5

Subject Hydraulic Jump

By ALB Date 11/10/94 Checked By JVG Date 12/6/94

Earll Drive:



Previously Calculated: $Y_0 = 1.30'$ ✓ Local Storm $Q = 1509$ cfs

$V_0 = 13.63$ fps *NO CHIMP

b = Top width = 96'

$V_0 = \frac{13.63}{\sqrt{32.2 \times 24}}$

Energy Equation: From Section 0 – Section 1

$$Y_0 + \frac{V_0^2}{2g} + \Delta Z = Y_1 + \frac{\left(\frac{Q}{A_1}\right)^2}{2g}$$

$A_1 = (Y_1)(b)$

$b = 96'$

$\Delta Z = 3.55'$

$$Y_0 + \frac{V_0^2}{2g} + \Delta Z = 1.30' + \frac{(13.63)^2}{2g} + 3.55' = 7.7347' \checkmark$$

$$Y_1 + \frac{\left(\frac{1509}{96 Y_1}\right)^2}{2g} = 7.7347'$$

$Y_1 = 0.74065$ by trial & error method

Use: $\boxed{Y_1 = 0.74' \checkmark \quad V_1 = 21.24 \text{ fps}}$ ✓

Y_1	EG
0.73	7.9
0.74	7.746
0.741	7.728
0.7405	7.737
0.7406	7.7355
0.7407	7.7377
* 0.74065	7.7346 ✓

Assume $Y_2 = Y_1$ & $V_2 = V_1$ → no energy loss along spillway from toe to toe (conservative assumption)

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Job No. E002102 Project OCCL - Spillways Sheet 2 of 5

Subject Hydraulic Jump

By AUB Date 11-10-94 Checked By JVG Date 12/6/94

Froude number

$$\mathbb{F}_2 = \frac{V_2}{\sqrt{gy_2}} = \frac{21.24}{\sqrt{0.74g}} = 4.35 \checkmark$$

$$L/y_2 = 32.5 \checkmark \quad \text{(Figure VI-11 page VI-24 HEC-14)}$$

$$L = 32.5(0.74) = 24.05' \checkmark$$

$$\mathbb{F}_2 = 4.35 \checkmark$$

$$J = \frac{y_3}{y_2} = 5.5 \checkmark \quad \text{(Figure VI-4 page VI-17 HEC-14)}$$

$$y_3 = 5.5(0.74) = 4.07' \checkmark \longrightarrow \text{would result in ponding}$$

el = 1213.82 > 1213.0

Therefore, try $\Delta Z = 4.07'$

Grate EL = 1209.23'

From energy equation: $y_0 + \frac{V_0^2}{2g} + \Delta Z = 1.30' + \frac{(13.63)^2}{2g} + 4.07' = 8.2547'$

$$y_1 + \frac{\left(\frac{1509}{96 y_1}\right)^2}{2g} = 8.2547'$$

$$\boxed{\begin{array}{l} y_1 = 0.713' \checkmark \\ V_1 = 22.05 \text{ fps} \checkmark \end{array}}$$

y_1	EG
0.71	8.3208
0.72	8.1209
0.715	8.2198
* 0.713	8.2599 ✓
0.7135	8.249

Assume $y_2 = y_1$ & $V_2 = V_1$

$$\mathbb{F}_2 = \frac{V_2}{\sqrt{gy_2}} = \frac{22.05}{\sqrt{0.713g}} = 4.60 \checkmark$$

$$\frac{L}{y_2} = 35 \checkmark$$

$$L = 35(0.713) = 24.96' \checkmark$$

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Job No. E002102 Project OCCC - Spillway Sheet 3 of 5

Subject Hydraulic Jump

By AVD Date 11/10/94 Checked By JVG Date 12/6/94

$F_2 = 4.60$ ✓

$J = Y_3/Y_2 = 6.0$ ✓

$Y_3 = 6.0(0.713) = 4.28'$ → would result in ponding EL = 1213.51 > 1213.0

Therefore, try $\Delta Z = 4.3'$

Grate EL = 1209'

From energy equation: $Y_0 + \frac{V_0^2}{2g} + \Delta Z = 1.30' + \frac{(13.63)^2}{2g} + 4.3' = 8.4847$

$Y_1 + \frac{\left(\frac{1509}{96 Y_1}\right)^2}{2g} = 8.4847$

Y_1	EG
0.70	8.5299
0.71	8.3208
0.705	8.4242
0.703	8.4662
* 0.702	8.4873 ✓
0.7015	8.4979

$Y_1 = 0.702'$
$V_1 = 22.39$ fps

Assume $Y_2 = Y_1$ & $V_2 = V_1$

$F_2 = \frac{V_2}{\sqrt{gY_2}} = \frac{22.39}{\sqrt{0.702g}} = 4.71$ ✓

$L/Y_2 = 36$

$L = 36(0.702) = 25.27'$ ✓

$F_2 = 4.71$ ✓

$J = \frac{Y_3}{Y_2} = 6.1$ ✓

$Y_3 = 6.1(0.702) = 4.28'$ ✓ → would result in ponding elev of 1213.28 ✓ > 1213.0

Therefore, try $\Delta Z = 4.5'$ ✓

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Job No. E002107 Project OCCC - Spillway Sheet 4 of 5

Subject Hydraulic Jump

By ALB Date 11/10/94 Checked By VVG Date 12/6/94

$\Delta z = 4.5'$

Grate EL = 1208.8'

From Energy Equation: $y_0 + \frac{V_0^2}{2g} + \Delta z = 1.30' + \frac{(13.63)^2}{2g} + 4.5' = 8.6847'$ ✓

$$y_1 + \frac{\left(\frac{1509}{96 y_1}\right)^2}{2g} = 8.6847' \checkmark$$

y_1	EG
0.70	8.5299
0.69	8.7485
0.695	8.6379
* 0.693	8.6818 ✓
0.694	8.6599

$$\boxed{\begin{array}{l} y_1 = 0.693' \checkmark \\ V_1 = 22.68 \text{ fps} \checkmark \end{array}}$$

Assume $y_2 = y_1$ & $V_2 = V_1$

$$Fr_2 = \frac{V_2}{\sqrt{g y_2}} = \frac{22.68}{\sqrt{0.693 g}} = 4.80 \checkmark$$

$$y/y_2 = 37.5 \checkmark$$

$$y_2 = 37.5(0.693) = 25.99' \checkmark$$

$$J = y_3/y_2 = 6.25$$

$$y_3 = 6.25(0.693) = 4.33' \checkmark$$

→ would result in ponding elev. of 1213.13 ✓ > 1213.0

Therefore, Try $\Delta z = 4.75'$

Grate EL = 1208.55' ✓

From Energy Equation: $y_0 + \frac{V_0^2}{2g} + \Delta z = 1.30' + \frac{(13.63)^2}{2g} + 4.75' = 8.9347$ ✓

$$y_1 + \frac{\left(\frac{1509}{96 y_1}\right)^2}{2g} = 8.9347$$

y_1	EG
0.68	8.9772
0.685	8.8615
0.683	8.9075
* 0.682	8.9306 ✓
0.681	8.9539

$$\boxed{\begin{array}{l} y_1 = 0.682' \checkmark \\ V_1 = 23.05 \text{ fps} \checkmark \end{array}}$$

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Job No. E002102 Project OCC - Spillways Sheet 5 of 5

Subject Hydraulic Jump

By ALB Date 11/10/94 Checked By JVG Date 12/6/94

Assume $y_2 = y_1$ & $V_2 = V_1$

$$F_2 = \frac{V_2}{\sqrt{g y_2}} = \frac{23.05}{\sqrt{0.682 g}} = 4.92 \checkmark$$

$$L/y_2 = 38$$

$$L = 38(0.682) = \underline{25.92'} \checkmark$$ = Extent of conc. spillway from toe of sump to the west

$$F_2 = 4.92$$

$$J = y_3/y_2 = 6.5 \checkmark$$

$$y_3 = 6.5(0.682) = 4.43'$$ → would result in ponding elev. of 1212.98 < 1213.0 OK

$$V_3 = \frac{1509}{(96)(4.43)} = 3.55 \text{ fps} \checkmark$$

Results:

$y_0 = 1.30'$
$V_0 = 13.63$ fps

$y_1 = 0.682'$
$V_1 = 23.05$ fps

$L_J = \underline{\underline{25.92'}}$ → Length of jump ≈ 26'

$y_3 = 4.43'$; $V_3 = 3.55$ fps

Grate El = $\underline{\underline{1208.55'}}$

$\Delta z = 4.75'$

1212.98
1208.55
004.43

PROJECT NAME:	OLD CROSS CUT CANAL	Grate Net Area:	4.25	No. OF GRATES:	40
JOB NUMBER:	E002102	Height of Catch Basin:	4	Ke:	0.50
		Top Slab Thickness:	1.75	Ko:	1.00
GRATE TYPE:	C.O.P. Standard Detail P1565 Type 1 Grate	Length:	5.75	Kf:	0.0611
CATCH BASIN LOCATION:	EARLL DRIVE	Manning's n:	0.014		
MAXIMUM ALLOWABLE PONDING EL.:	1213.00	Grate Total Area:	6.67		
HG IN LATERAL AT INLET:	1210.96	Total Perimeter:	10.67		
GRATE ELEVATION:	1208.80	Hydraulic Radius:	0.6251		

Q	Hp	Ho	An	Ag	Kl	Kl−Kt	Ktg	Vn	Hvn	Vg	Hvg	Ktn	Ktn	Qo
Assumed Discharge	Pressure Head	Orifice Head	Net Grate Open Area	Total Grate Open Area	Calculated Total Loss Coefficient	Total Loss Coefficient Without Trashrack Loss	Calculated Trashrack Adjusted Coefficient	Net Grate Area Velocity	Net Grate Area Velocity Head	Total Grate Area Velocity	Total Grate Area Velocity Head	Calculated Trashrack Coefficient	"Small Dam's" Trashrack Coefficient	Discharge Orifice Equation
1000	2.04	4.20	170	266.8	9.3516	1.5611	7.7906	5.8824	0.5373	3.7481	0.2181	3.1630	0.7573	1873.23
1100	2.04	4.20	170	266.8	7.7286	1.5611	6.1676	6.4706	0.6501	4.1229	0.2640	2.5040	0.7573	1873.23
1200	2.04	4.20	170	266.8	6.4942	1.5611	4.9331	7.0588	0.7737	4.4978	0.3141	2.0029	0.7573	1873.23
1300	2.04	4.20	170	266.8	5.5335	1.5611	3.9725	7.6471	0.9080	4.8726	0.3687	1.6128	0.7573	1873.23
1400	2.04	4.20	170	266.8	4.7712	1.5611	3.2102	8.2353	1.0531	5.2474	0.4276	1.3033	0.7573	1873.23
1500	2.04	4.20	170	266.8	4.1563	1.5611	2.5952	8.8235	1.2089	5.6222	0.4908	1.0537	0.7573	1873.23
1600	2.04	4.20	170	266.8	3.6530	1.5611	2.0919	9.4118	1.3755	5.9970	0.5584	0.8493	0.7573	1873.23
1650	2.04	4.20	170	266.8	3.4349	1.5611	1.8739	9.7059	1.4628	6.1844	0.5939	0.7608	0.7573	1873.23
1652	2.04	4.20	170	266.8	3.4266	1.5611	1.8656	9.7176	1.4663	6.1919	0.5953	0.7574	0.7573	1873.23
1652.05	2.04	4.20	170	266.8	3.4264	1.5611	1.8654	9.7179	1.4664	6.1921	0.5954	0.7573	0.7573	1873.23

NOTE: Qo Should Be > Q (Column 'A' < Column 'O'); Column 'M' Should = Column 'N'
NOTE: If Qo < Qp, then use Qo.

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Job No. E002102 Project Old Cross Cut Canal Sheet 1 of 2

Subject Scour Length - Spillway protection length

By ALB Date 11/15/94 Checked By JVG Date 12/6/94

Earll Drive

Procedure: As outlined in HEC-14 Chapter V, convert area to equivalent depth (y_e). Concrete shall extend the length of the hydraulic jump with grass-crete extending the remainder of the scour length.

$Q = 1509$ cfs

$y = 0.682$

$b = 96'$

$A = 65.472$

$$y_e = \left(\frac{A}{2}\right)^{0.5} = 5.72' \checkmark$$

$$D.I. = \frac{Q}{\sqrt{g}\, y_e^{5/2}} = 3.3984 \checkmark$$

$$\frac{L_s}{y_e} = \alpha_e (D.I.)^{\beta} \left(\frac{t}{t_o}\right)^{\theta}$$

$\alpha_e = 11.75$

$\beta = 0.71$

$\theta = 0.125$

$t = 30$ min (estimated)

$t_o = 316$ min

$$\frac{L_s}{y_e} = 20.7 \checkmark$$

$L_s = 118.5'$ from toe of slope ✓

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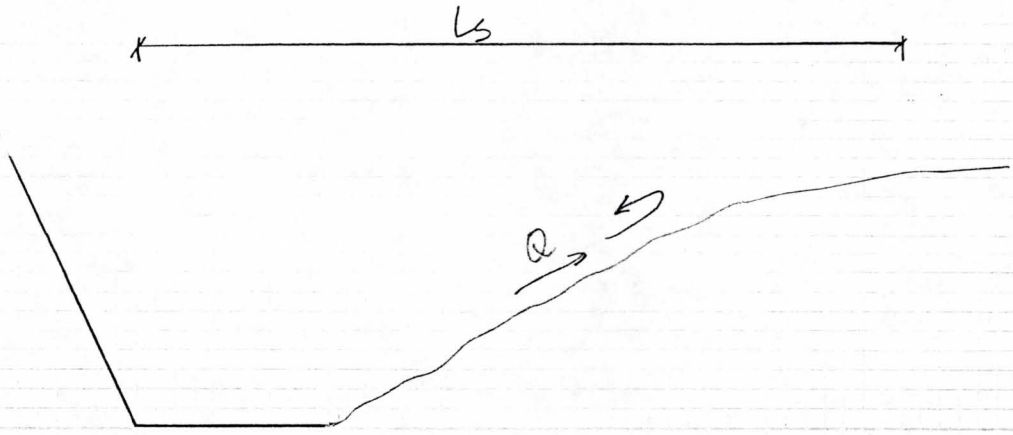
Job No. E002102 Project Old Cross Cut Canal Sheet 2 of 2

Subject Scour length - Spillway Protection length

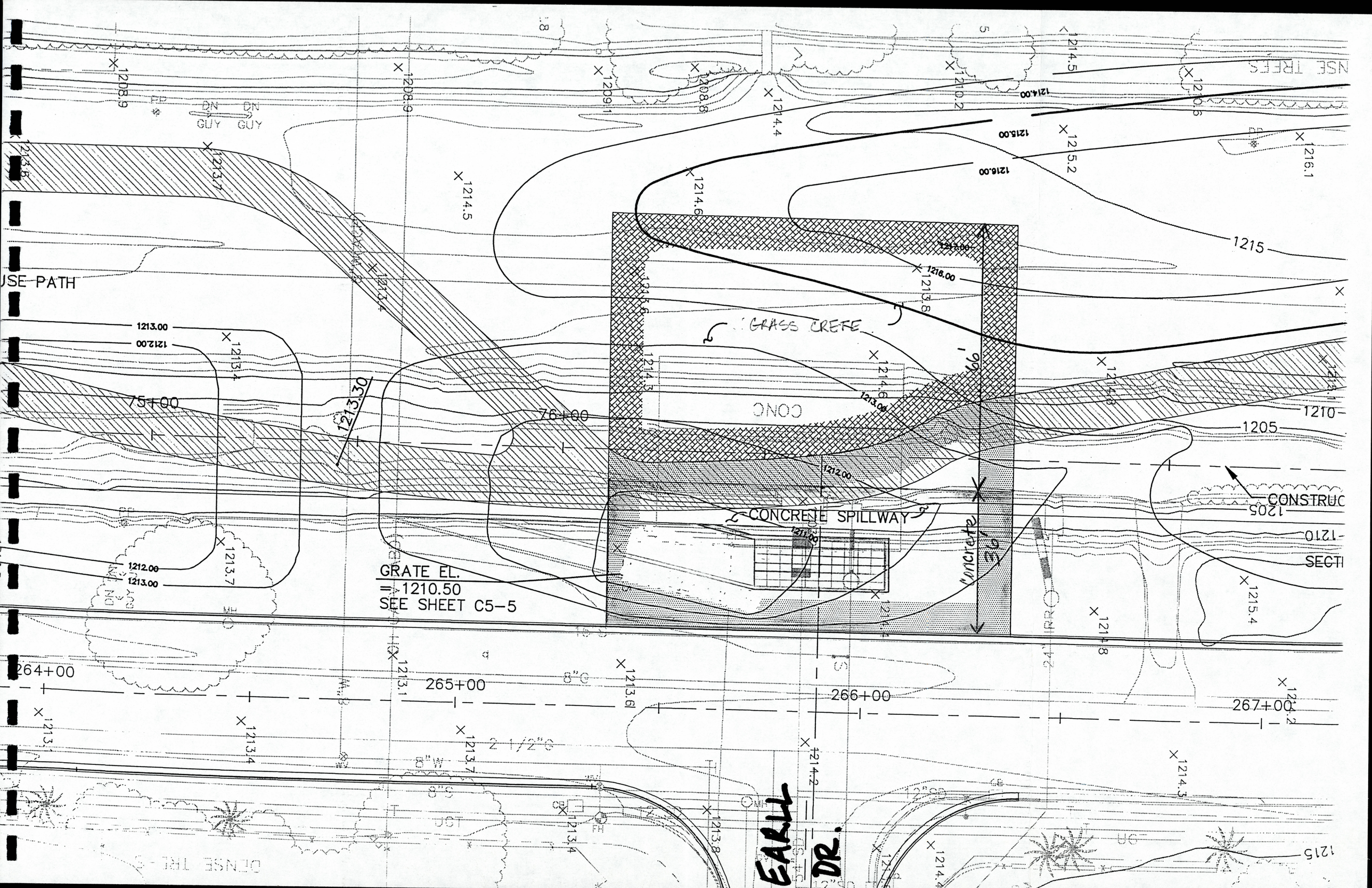
By ALB Date 11/15/94 Checked By JVG Date 12/6/94



Ls calculation does not necessarily apply to this situation for the following reasons:

- there is no CHIMP or broad channel area to create a situation similar to the outlet of a structure as the equations apply
- as flow travels up slope, velocity will decrease potentially to the point where the flow will back up on itself
- hydraulic jump conjugate depth is lower than berm elevation, therefore, it is unlikely that scour will occur beyond the top of berm as flow will likely be confined to the sump

∴ Therefore, grasscrete protection will be provided from the edge of concrete to the top of berm.


USE PATH
GRASS CREEK
CONC
CONCRETE SPILLWAY
GRATE EL.
=1210.50
SEE SHEET C5-5
75+00
76+00
264+00
265+00
266+00
267+00
1213.30
1213.00
1212.00
1215
1210
1205
CONSTRUC
SECTI
EARL
DR.

Richardson Drive

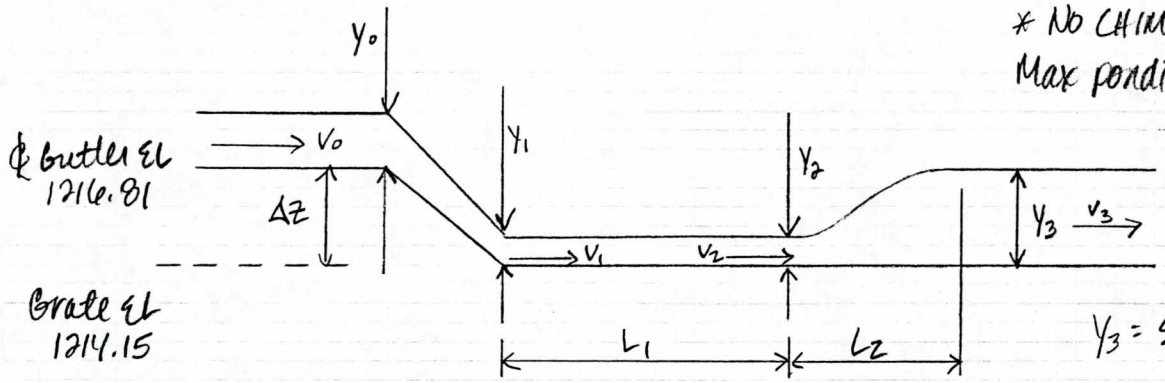
Greiner

Job No. E002102 Project OCCC - Spillways Sheet 1 of 2

Subject Hydraulic Jump - Richardson

By ALB Date 12/2/94 Checked By JVG Date 12/6/94

Richardson Drive:



* No CHIMP

Max ponding El = 1217.31 (TC

y_3 = sequent depth

Previously Calculated:

Local storm $Q = 66$ cfs

$y_0 = 0.61'$

$V_0 = 5.02'$

Total spread $b = 65'$

16.81
14.50
2.31

From Energy Eqn.

$$y_0 + \frac{V_0^2}{2g} + \Delta Z = y_1 + \frac{(Q/A_1)^2}{2g}$$

$$\Delta Z = 1216.81 - 1214.5 = 2.31'$$

$$A_1 = y_1 b = 65 y_1 = 65 * y_1$$

$$y_0 + \frac{V_0^2}{2g} + \Delta Z = 0.61 + \frac{(5.02)^2}{2g} + 2.31 = 3.3113'$$

$$3.3113 = y_1 + \frac{(Q/A_1)^2}{2g}$$

$$3.3113 = y_1 + \frac{0.01601}{y_1^2}$$

y_1	EG
.07	3.3373
.08	2.5816
.075	2.9212
.072	3.1603
.071	3.2470
.0705	3.2917
.0704	3.3007
→ .0703	3.3098

Use $y_1 = 0.07'$

$V_1 = 14.51$ fps ← $\left(\frac{66 \text{ CFS}}{0.07 \times 65}\right)$ (Q/A)

Assume $y_2 = y_1$ & $V_2 = V_1$ & $L_1 = 0$

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Job No. E002102 Project OCCC - Spillways Sheet 2 of 2

Subject Hydraulic Jump - Richardson

By AWB Date 12/2/94 Checked By JVG Date 12/6/94

Froude number

$$F_r = \frac{V_2}{\sqrt{gy_2}} = \frac{14.51}{\sqrt{0.07g}} = 9.665 \checkmark$$

$$J = \frac{y_3}{y_2} = 13.0 \checkmark$$ (Figure VI-4, pg VI-17 HEC-14)

$$y_3 = 13.0y_2 = (13.0)(0.07) = 0.91 \checkmark$$ → would result in ponding El 1215.41 < 1217.31 (TC) OK

$$L/y_2 = 81.7 \checkmark$$ (Figure VI-11, pg VI-24 HEC-14)

$$L = 81.7y_2 = 81.7(0.07) = \underline{\underline{5.72'}} \checkmark$$

Concrete protection to extend at least 16' from east toe of spillway to the west.

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Job No. E002102 Project Old Cross Cut Canal Sheet 1 of 1

Subject Scour Length

By ALB Date 12/2/94 Checked By JVG Date 12/6/94

Richardson Drive (Ref. HEC-14, Chapter V)

$Q = 66$ cfs

$y_1 = 0.07'$ (spillway toe)

$V_1 = 14.51$ fps (spillway toe)

$b = 65'$

$A = by_1 = 4.55$

$$y_e = \left(\frac{4.55}{2}\right)^{0.5} = 1.5083$$

$$D.1. = \frac{Q}{\sqrt{g}\, y_e^{5/2}} = \frac{66}{\sqrt{g}(1.5083)^{5/2}} = 4.1629$$

$$\frac{L_s}{y_e} = \alpha_e (D.1.)^{\beta} \left(\frac{t}{t_o}\right)^{\theta} \qquad (V-2)$$

$\alpha_e = 11.75$

$\beta = 0.71$

$\theta = 0.125$

$t = 30$ min

$t_o = 316$ min

$$\frac{L_s}{y_e} = 11.75(4.1629)^{0.71}\left(\frac{30}{316}\right)^{0.125} = 24.10$$

$L_s = 24.10 y_e = 24.10(1.5083) = 36.35'$ from toe of slope

∴ Grasscrete to edge of bike path will be sufficient because:

1) $L_j = 6.0'$ = length of conc. from toe of spillway
2) Grasscrete length $= L_s - L_j = 36.35' - 6.0' = 30.35'$
3) Distance from edge of conc. to bike path along spillway ℄ $= 24' < 30.35'$ however, considering bike path width of 12'

$24' + 12' = 36' > 30.35'$ ∴ OK

DENSE TREES
1215
1217.00
1218.00
1219.00
81+00
83+00
84+00
1205
SECTION LINE
6' min.
GRATE EL.
=1214.15
271+00
272+00
273+00
48th
ST.
Richardson
Dr.