Final Drainage Plan and Storm Water Sewer Calculations For

WOODLAND AT THE PARK ADDITION

June 7, 1988

SWS #373

Project No.
468-76-245-81874-000-000-001

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FINAL DRAINAGE REPORT FOR WOODLAND AT THE PARK ADDITION
JUNE 12, 1988

EXISTING CONDITIONS

Woodland At The Park Addition is located on the East side of Yellowstone just South of Pawnee Avenue. The site is a replat of Lot 1, Block 4, The Park Addition to Wichita, Kansas.

The drainage areas for Woodland At The Park Addition are as defined in Fig. 1. The site generally drains to the east toward the Cowskin Creek. Existing soils on the site fall in to the type "B" hydrological group as defined by the SCS Manual "Soil Survey of Sedgwick County, Kansas". The site is currently well drained and is covered with grass and supports a large tree cover.

IMPROVED CONDITIONS

Woodland At the Park Addition will be improved as a residental area with lot sizes of about 1/4 acre. Storm water sewer will be provided on the site at two sump locations as defined on Fig. 1. For the type "B" soil and 1/4 acre lots, the runoff coefficients will be C2 = 0.44 and C100 = 0.61.

METHOD OF ANALYSIS

Runoff amounts for the 2 year and the 100 year storms will be calculated using the Rational Formula and a time of concentration of 15 minutes as required by City of Wichita design standards. Runoff will be removed from the site via two 100 year sumps as indicated on Fig. 1. Gravity flow amounts for outlet pipes will be calculated using the method as defined by "Design Data 4", from the Concrete Pipe Association. Final hydraulic grade line calculations will be run on the Civilsoft program "STORM".

RESULTS

Runoff amounts for each sump location, along with the required inlet size and outlet pipe diameter can be found on Fig. 1 The use of R.C.P. on this project is essential due to underground utilties and limitations of grade for the storm sewer pipe. Final discharge to the creek is via a 5 foot wide ditch, as indicated on the typical section located on the final plans.

For detailed design calculations, see the following worksheets.

Drainage for Kloodland @ the Park

From SCS "Soil Survey for Sedgwick County"
Soil Type = Mo = Milan Loam (Map 49)
Soil Type "B"
From C of W/ Attachment "D"; Drainage Criteria and using Avg. lot size of 65'x120' = 0.2 Ac (Assume 1/4 Acre); Type B soil;

$C_2 = 0.44$
$C_{100} = 0.61$

For Yellostone Court $Q = CiA$

$D_A = 2.4$ Ac

$i_2 = 3.83$ $C_2 = 0.44$ $Q_2 = (2.4)(3.83)(0.44) = 4.0$ cfs ✓
$i_{100} = 7.37$ $C_{100} = 0.61$ $Q_{100} = (2.4)(7.37)(0.61) = 10.8$ cfs

For Maxwell / Fairway / Savanna

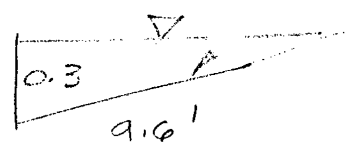
$D_A = 6.7$ Ac

$i_2 = 3.83$ $C_2 = 0.44$ $Q_2 = (6.7)(3.83)(0.44) = 11.3$ cfs
$i_{100} = 7.37$ $C_{100} = 0.61$ $Q_{100} = (6.7)(7.37)(0.61) = 30.1$ cfs ✓

Check Initial Storm Depth for Yellowstone Ct.

$Q_2 = 4.0$ cfs ; assume 2.0 cfs / side Maximum (North)

$s = 0.005$
$n = 0.016$ @ 0.3' (Roll Cb)



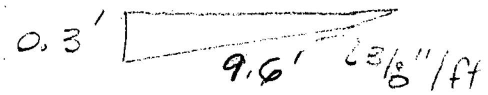
$A = (0.3)(9.6)(1/2) = 1.44$ ft²
$WP = 9.6 + 0.3 = 9.9$
$R = 1.44/9.9 = 0.145$
$V = \frac{1.49}{0.016}(0.145)^{0.67}(0.005)^{1/2} = 1.8$ ft/sec

$Q_{Avail} = VA = 1.44(1.8) = 2.6$ cfs
Curb should hold the initial storm O.K.

For Maxwell/Fairway/Savannah

$$\text{slope} = \frac{128-120}{720} = 1.1\%$$

Use 1% street slope, roll curb



$A = 1.44\ ft^2$
$wp = 9.91$

$V = 1.49/0.016\,(0.145)^{0.67}(0.01)^{1/2} = 2.55$ ft/sec
$Q = VA = 2.55(1.44) = 3.7$ cfs

Initial storm here = 11.3 cfs
About 70% from the South = 0.7(11.3) = 7.9 cfs
Per curb = 7.9/2 = 3.95 → 4.0 cfs.

A bit shy for initial storm, check w/ Neenah Foundary Flo Calculator; Flo in triangular gutter sections

Slope	N	trans slope (3/8"/ft)	D	Q (chart)	Calc
0.005	0.016	0.0313	0.3'	3.3 cfs	3.2 cfs
0.01	0.016	0.0313	0.3'	4.7 cfs	4.5 cfs

(Note; Neenah Equ = $Q = \frac{0.56}{N} Z D^{8/3} S^{1/2}$)
D = Depth (ft)
Z = trans slope

Since gutter section using Mannings Equ is close, and using Neenah Equation both work well, No other Inlets are necessary for Initial storm, except those needed @ sump locations.

4/27/06
CB

Inlets @ Yellowstone Ct.
For Initial Storm $Q_2 = 4.0$ cfs
Use 1A Inlets in sump Condition.
Depth of sump = 0.3' + 2" = 0.47' Deep
1A Inlet @ 0.47' Depth; C_{ap} = 3.2 cfs → Use 2
(See Fig 1 for Inlet Capacity)

For 100 yr. storm; Q_{100} = 10.8 cfs
Depth = 0.3' (Cb. Ht) + 2" depression + 0.3' (R/W Elev)
Depth = 0.77'
1A Inlet @ D = 0.77; Q = 6.9 cfs
Again; Use 2 inlets or 1 long inlet.

Use 4'-6" x 11'-6" Type 1A Inlet

Inlets @ Maxwell Street.
For Initial storm; Q_2 = 11.3 cfs
D_i = 0.47' (See Above) Q = 3.2 cfs
Need 11.3/3.2 = 3.5 → 4 inlets
For 100 yr storm; Q_{100} = 30.1 cfs
D_i = 0.77'; Q_{1A} = 6.9 cfs
Need 30.1/6.9 = 4.3 → Use 4 inlets
(Note; R/W Elevation Based on 0.3' minimum needed above T.C.; should have more like 0.4 to 0.5' depth available @ R/W.)

Use 2 - 4'-6" x 11'-6" Type 1A Inlets one each side

Pipe Sizing: since both sumps are 100 yr sump areas, pipes must be sized for 100 yr storm.

4/27/88
CB

4/4

@ Yellowstone Ct. Q_{100} = 10.8 cfs
From "Design Data 4" Conc. Pipe Association
@ Q = 12.1 ; Use 18" @ 1.06%

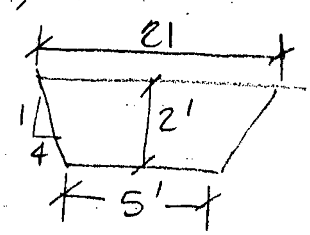
@ Maxwell ; Q_{100} = 30.1 cfs

Cross pipe = use 1/2 flo = 15 cfs
21" @ 0.898 %
or
18" @ 2.04 %

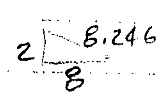
Outlet Pipe @ 30.1 cfs
24" @ 1.77 %
30" @ 0.539 %

@ Manhole Junction ; Q_T = 30.1 + 10.8 = 40.9 cfs
30" @ 0.995 %

Ditch section past outlet pipe
Q = 40.9 cfs
slope = 0.005 % (Assumed)
n = 0.03 (grass)
Depth = 2'
Side Slope = 4/1



Area = $\left(\frac{21+5}{2}\right)2$ = 26 ft^2
WP = (2)(8.246) + 5 = 21.49
R = 26/21.49 = 1.21
$V = \frac{1.49}{0.03}(1.21)^{0.67}(0.005)^{1/2}$ = 3.99 → 4.0 ft/sec



Q = VA = (4)(26) = 104 cfs O.K.

for final design - see attached final drainage plan.

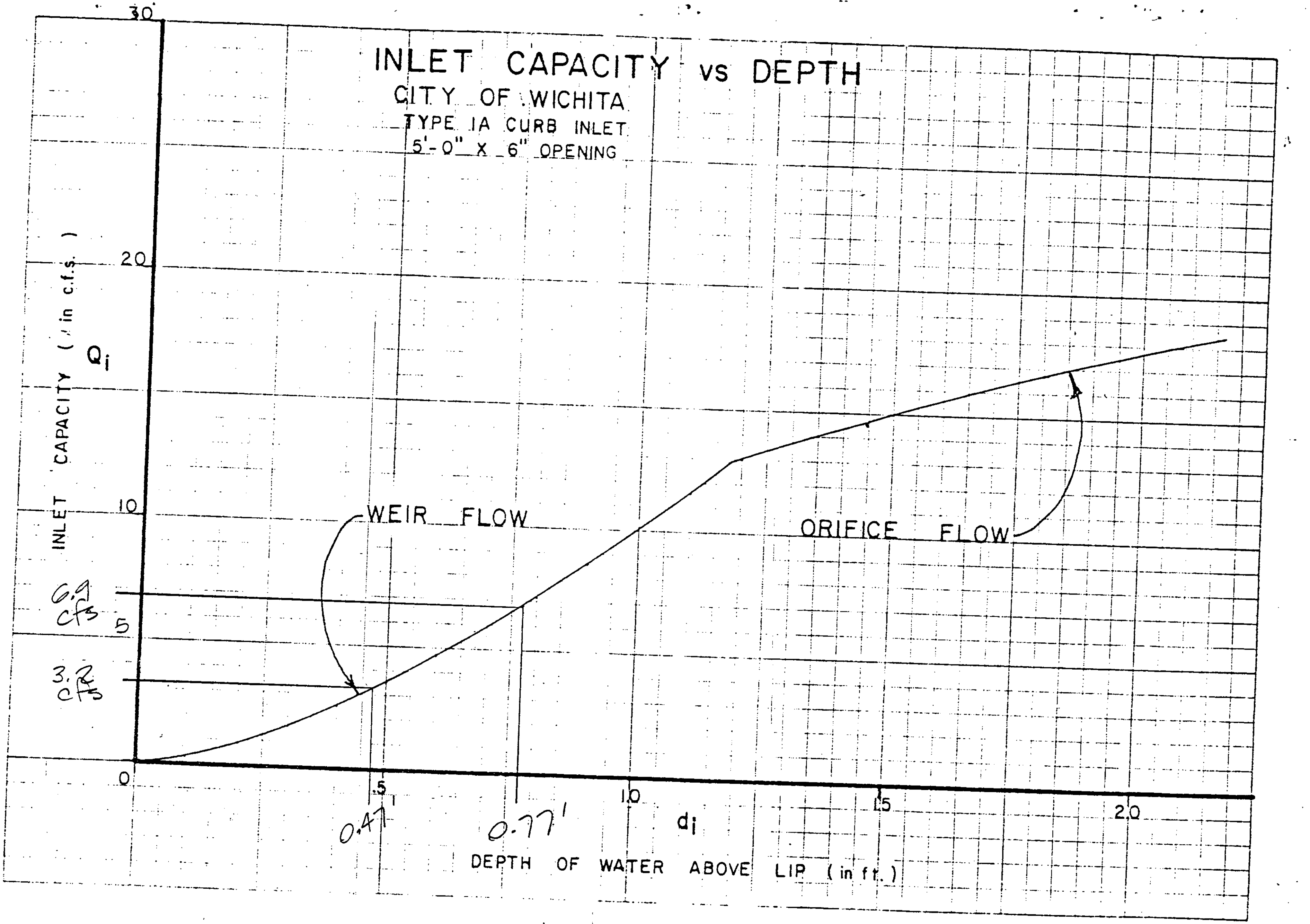

INLET CAPACITY vs DEPTH
CITY OF WICHITA
TYPE IA CURB INLET
5'-0" X 6" OPENING
30
20
10
5
0
INLET CAPACITY (in c.f.s.)
Qi
6.9 cfs
3.2 cfs
WEIR FLOW
ORIFICE FLOW
.5
1.0
1.5
2.0
0.47'
0.77'
di
DEPTH OF WATER ABOVE LIP (in ft.)

FIGURE 1

WOODLAND AT THE PARK

CB — By — 6/11/66 — Date — Page — Of

FINAL SWS RUN

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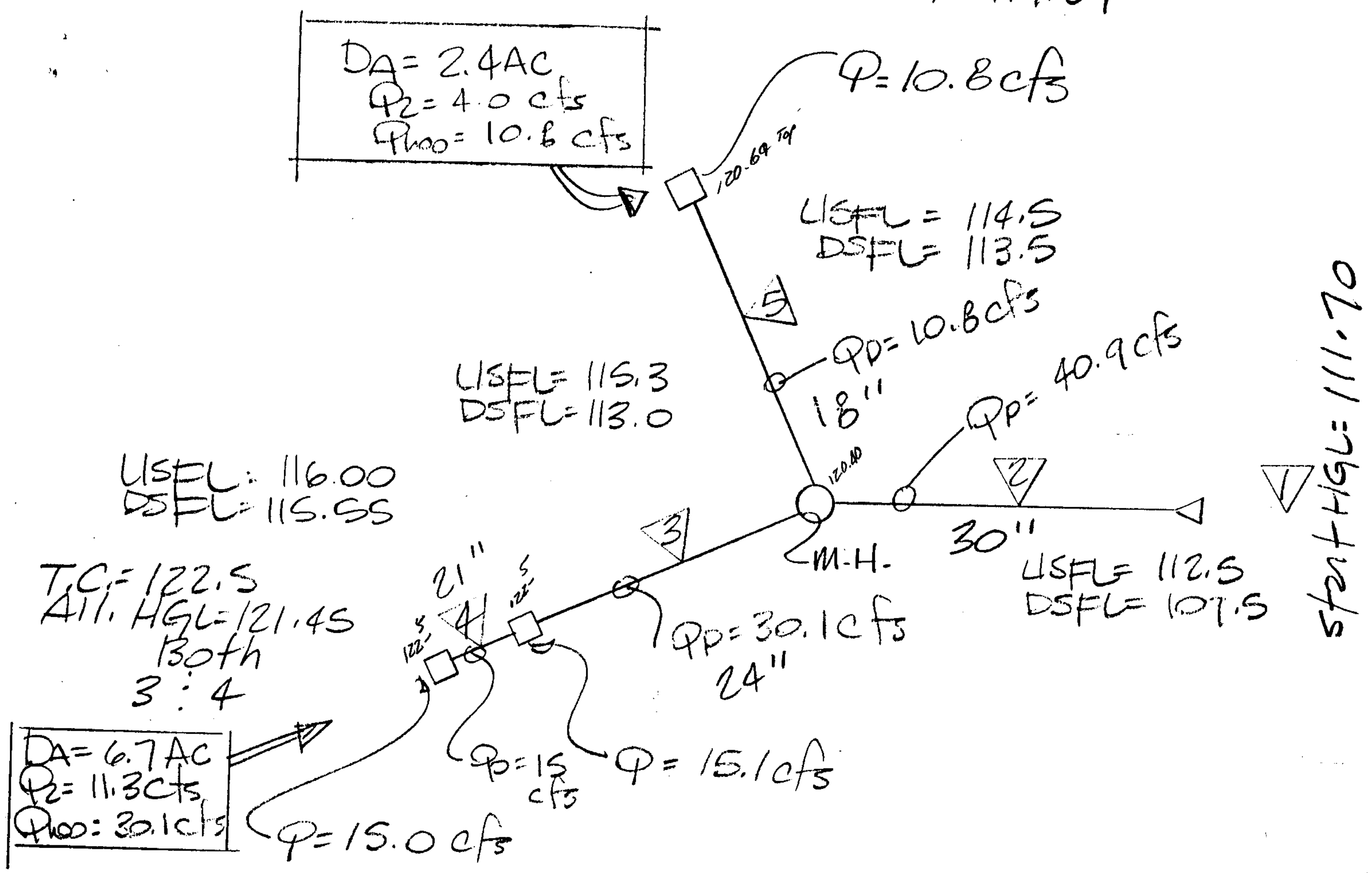
100 YR. STORM

Tc = 120.64
All. HGL = 119.59



Start HGL for System = Critical Depth @ Flo Rate For 30" R.C.P.

From "Manual for Selection of Highway Culverts"
Dc for a 30" R.C.P. @ 40.9 cfs = 2.2'
Start HGL = 109.5 + 2.2 = 111.7 (Chart #16)

FIGURE 1

Project : WOODLAND AT THE PARK, SWS 373

Date: 6/11/1988 Time: 1:44:56

INPUT DATA LISTING

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						111.70															
2	2	40.9	40.9	210.00	109.50	112.50	.00	30.	0.	3	.00	.00	.00	1	3	5	0	48.	66.	0.	5.00	.013
2	3	30.1	30.1	152.10	113.00	115.30	.00	24.	0.	3	.00	.00	.00	0	4	0	0	0.	0.	0.	5.00	.013
2	4	15.0	15.0	35.40	115.55	116.00	.00	21.	0.	1	.00	.00	.00	0	0	0	0	0.	0.	0.	5.00	.013
2	5	10.8	10.8	151.10	113.50	114.50	.00	18.	0.	1	.00	.00	.00	3	0	0	0	0.	0.	0.	5.00	.013

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Date: 6/11/1988 Time: 1:44:56

STORM DRAIN ANALYSIS RESULTS

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
1	Hydraulic grade line control = 111.70																
2	40.9	30	0	1.74	2.15	Part	.00994	11.2	9.1	109.50	112.50	111.25	114.65	1.75	2.15	.00	.00
	X =		.00	X(N) =	201.82												
3	30.1	24	0	2.00	1.86	Full	.01770	9.6	9.6	113.00	115.30	115.90	118.59	2.90	3.29	.00	.00
4	15.0	21	0	1.23	1.43	Full	.00896	6.2	6.2	115.55	116.00	120.84	121.15	5.29	5.15	121.76	.00
3	Hydraulic grade line control = 115.27																
5	10.8	18	0	1.50	1.26	Full	.01057	6.1	6.1	113.50	114.50	115.27	116.87	1.77	2.37	117.45	.00

1

LIST OF ABBREVIATIONS

V 1, FL 1, D 1 and HG 1 refer to downstream end
0 V 2, FL 2, D 2 and HG 2 refer to upstream end
0 X - Distance in feet from downstream end to point where HG intersects soffit in seal condition
0 X(N) - Distance in feet from downstream end to point where water surface reaches normal depth by either drawdown or backwater
0 X(J) - Distance in feet from downstream end to point where hydraulic jump occurs in line
0 F(J) - The computed force at the hydraulic jump
0 D(BJ) - Depth of water before the hydraulic jump (upstream side)
0 D(AJ) - Depth of water after the hydraulic jump (downstream side)
0 SEAL indicates flow changes from part to full or from full to part
0 HJ indicates that flow changes from supercritical to subcritical through a hydraulic jump
0 HJU indicates that hydraulic jump occurs at the junction at the upstream end of the line
0 HJD indicates that hydraulic jump occurs at the junction at the downstream end of the line
1