DRAINAGE PLAN
RITCHIE INDUSTRIAL PARK
WICHITA, SEDGWICK COUNTY, KANSAS

February 28, 2002

INTRODUCTION

This report provides information and supporting documentation for the "Drainage Plan" located in Section 29, T-26-S, R-2-E in Wichita, Sedgwick County, Kansas. The "Drainage Plan" being submitted herein in intended to serve as a guide for the design of streets, stormwater sewers, and site grading to the proposed development. Modifications to structures, pipes, etc. may be made as necessary during the final design in order to obtain the most economical design and construction possible.

INITIAL DATA

The plat contains three separate existing drainage basins. These basins are delineated in the pre-developed drainage section of the report. The general topography of each basin drains from west to east and east to northwest, with the high point approximately three hundred feet west of the east line. The plat's average existing grade is about one percent. The total area of the plat is 24.5 acres with approximately 3.4 acres of offsite draining into the proposed pond.

The existing soil types per S.C.S. "Soil Survey of Sedgwick County" is Farnum loam, Rosehill and Irwin silty clay loam. Eighty-five percent of soils are classified in hydrologic group D with the remaining classified as B.

The tract of land is located in a Federal Emergency Management Agency (FEMA) Zone C as mapped on the Federal Insurance Rate Map (FIRM) community-panel number 200321 0150, effective date June 3, 1986 and FIRM community-panel number 200328 0015, effective date May 15, 1986.

The time of concentration (Tc) for the site was determined using the S.C.S method TR-55 and the standard fifteen-minute minimum. The Tc for the three separate existing drainage areas were calculated using the lengths, average slopes and other input variables found in the pre-developed and Tc sections of the report.

COMPUTATIONS

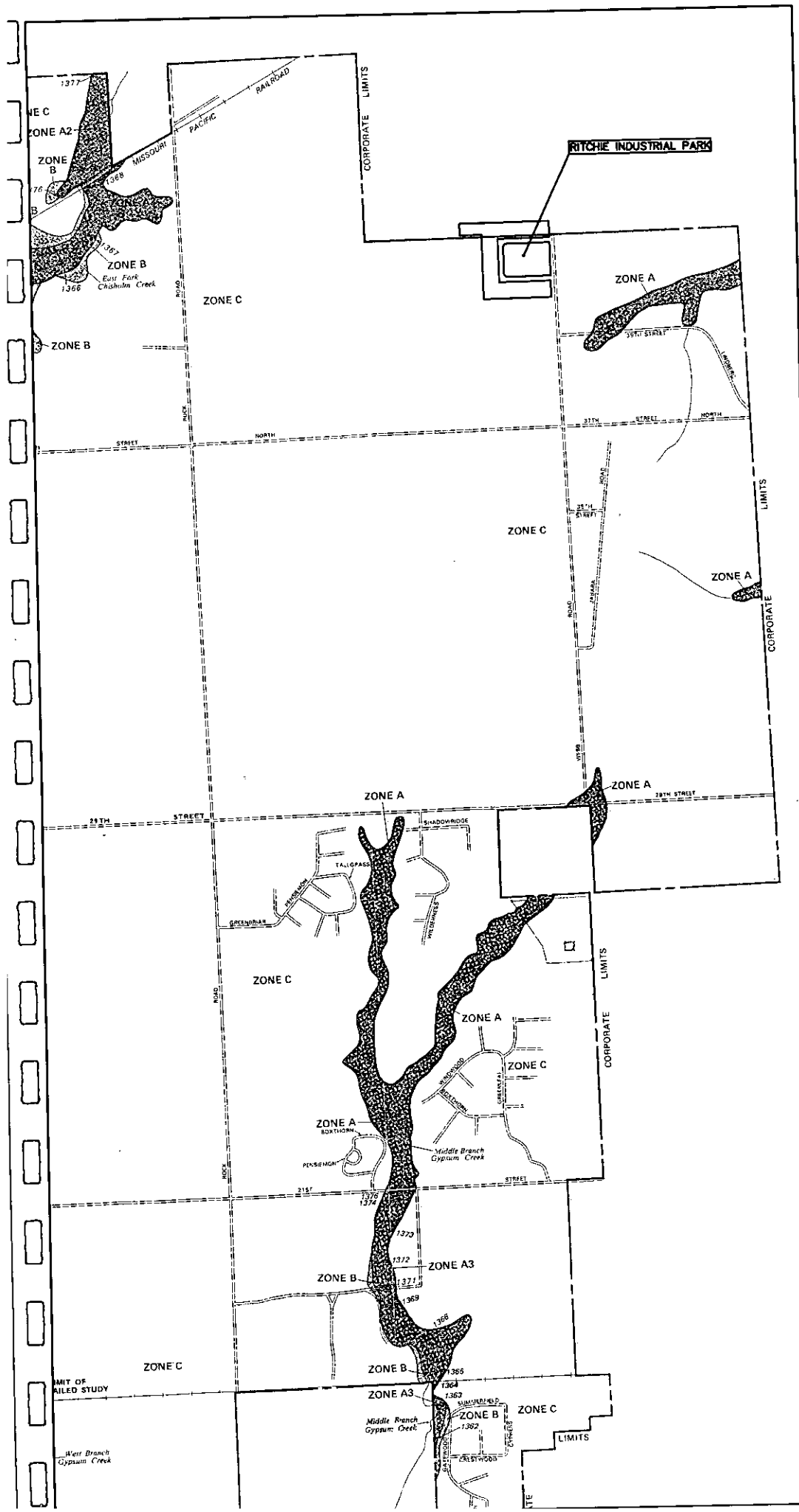
The rational method was used to calculate each individual basin's peak flow rate and the input variables and results are found on the face of the drainage plan sheet. The west drainage basin was routed using PondPack to generate pre/post-developed unit hydrographs. The pond's size and outfall structures were designed to discharge a rate that does not exceed pre-developed conditions. The table's below summarizes the drainage area, stage, and discharge of the proposed pond. See the post-development pond routing section for specific details.

Table 1. Ritchie Industrial Park – D.A. = 22.16 ac.

Storm Event	*Q (cfs)*	*Stage (ft)*
5-Yr	19	217.3
10-Yr	49	218.2
100-Yr	100.1	218.8

The proposed subdivision will drain by the combination of storm sewer and overland flow. The runoff will concentrate in the road right-of-way and at the area inlet locations. The storm sewer systems were designed to carry the five-year storm event in the pipe as the hydraulic grade lines indicate in the system reports. Once the system surcharges the drainage will flow overland in the form of a v-ditch/flume constructed to convey runoff equal or greater than the capacity of the proposed v-ditch.

The set of inlets at the upstream end of 41st Street north are bypass inlets. Street hydraulic calculations were performed using HY-22 to determine the maximum possible interception of the inlets and was added to the inlet node for system one StormCad calculations. The bypass runoff was added to the downstream sump inlets. The input variables for this procedure are found in the system one's StormCad section.



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

CITY OF
WICHITA,
KANSAS
SEDGWICK COUNTY

PANEL 15 OF 40
(SEE MAP INDEX FOR PANELS NOT PRINTED)

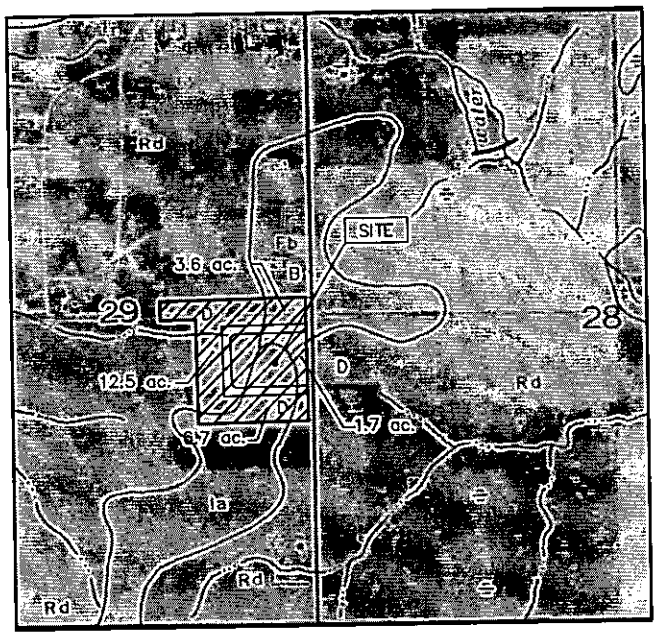
COMMUNITY-PANEL NUMBER
200328 0015 B

EFFECTIVE DATE:
MAY 15, 1986

Federal Emergency Management Agency

SEDGWICK COUNTY SOIL SURVEY
FOR
RITCHIE INDUSTRIAL PARK

Scale – 1: 20000



Fb : Farnum loam – Hydrologic Group B (15% of Drainage Basin)
Ia : Irwin silty clay loam – Hydrologic Group D (27% of Drainage Basin)
Rd : Rosehill – Hydrologic Group D (58% of Drainage Basin)

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Ritchie Industrial Park – Tc Equations and Calculations for existing conditions

SCS TR-55 Sheet Flow

$$Tc = \frac{\left[.007\left(n \times L_f\right)^{0.8}\right]}{\left[\left(P^{0.5}\right)\left(S_f{}^{0.4}\right)\right]}$$

Where: Tc = Time of concentration, hrs
n = Mannings n
L_f = Flow length, ft
P = 2yr, 24hr Rain depth, inches
S_f = Slope, ft/ft

SCS TR-55 Shallow Concentrated Flow

Unpaved surface:

$$V = 16.1345 \times \left(S_f{}^{0.5}\right)$$

Paved surface:

$$V = 20.3282 \times \left(S_f{}^{0.5}\right)$$

$$Tc = \frac{\left(\frac{L_f}{V}\right)}{\left(3600\,\text{sec}/hr\right)}$$

Where: V = Velocity, ft/sec
S_f = Slope, ft/ft
Tc = Time of concentration, hrs
L_f = Flow length, ft

SCS Channel Flow

$$R = \left(\frac{Aq}{Wp}\right)$$

$$V = \frac{\left[\left(1.49 \times R^{2/3}\right)\left(\sqrt{S_f}\right)\right]}{n}$$

$$Tc = \frac{\left(\frac{L_f}{V}\right)}{\left(3600\,\text{sec}/hr\right)}$$

Where: R = Hydraulic radius
Aq = Flow area, sq.ft.
Wp = Wetted perimeter, ft
V = Velocity, ft/sec
S_f = Slope, ft/ft
n = Mannings n
Tc = Time of concentration, hrs
L_f = Flow length, ft

Type.... Master Network Summary
Name.... Watershed

MASTER DESIGN STORM SUMMARY

Default Network Design Storm File, ID SEDGWICK.RNQ Sedgwick

Return Event	Total Depth in	Rainfall Type	RNF File	RNF ID
Pre..2	3.6000	Synthetic Curve	SCSTYPES	TypeII 24hr
Pre..5	4.5600	Synthetic Curve	SCSTYPES	TypeII 24hr
Pre.10	5.2800	Synthetic Curve	SCSTYPES	TypeII 24hr
Pre100	7.6800	Synthetic Curve	SCSTYPES	TypeII 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Storage Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond ac-ft
BASIN #3	AREA	2	2.299		12.1500	26.21		
BASIN #3	AREA	5	3.394		12.1500	38.98		
BASIN #3	AREA	10	4.257		12.1500	48.89		
BASIN #3	AREA	100	7.286		12.1500	82.82		
OFF-SITE	AREA	2	.466		12.1500	5.40		
OFF-SITE	AREA	5	.688		12.1500	8.01		
OFF-SITE	AREA	10	.863		12.1000	10.07		
OFF-SITE	AREA	100	1.476		12.1000	17.17		
*OUTLET	JCT	2	2.765		12.1500	31.61		
*OUTLET	JCT	5	4.081		12.1500	46.99		
*OUTLET	JCT	10	5.119		12.1500	58.93		
*OUTLET	JCT	100	8.763		12.1500	99.80		

Type.... Master Network Summary
Name.... Watershed
File.... F:\HYDRO\PROJECTS\RITCHIEN\POST.PPW

MASTER DESIGN STORM SUMMARY

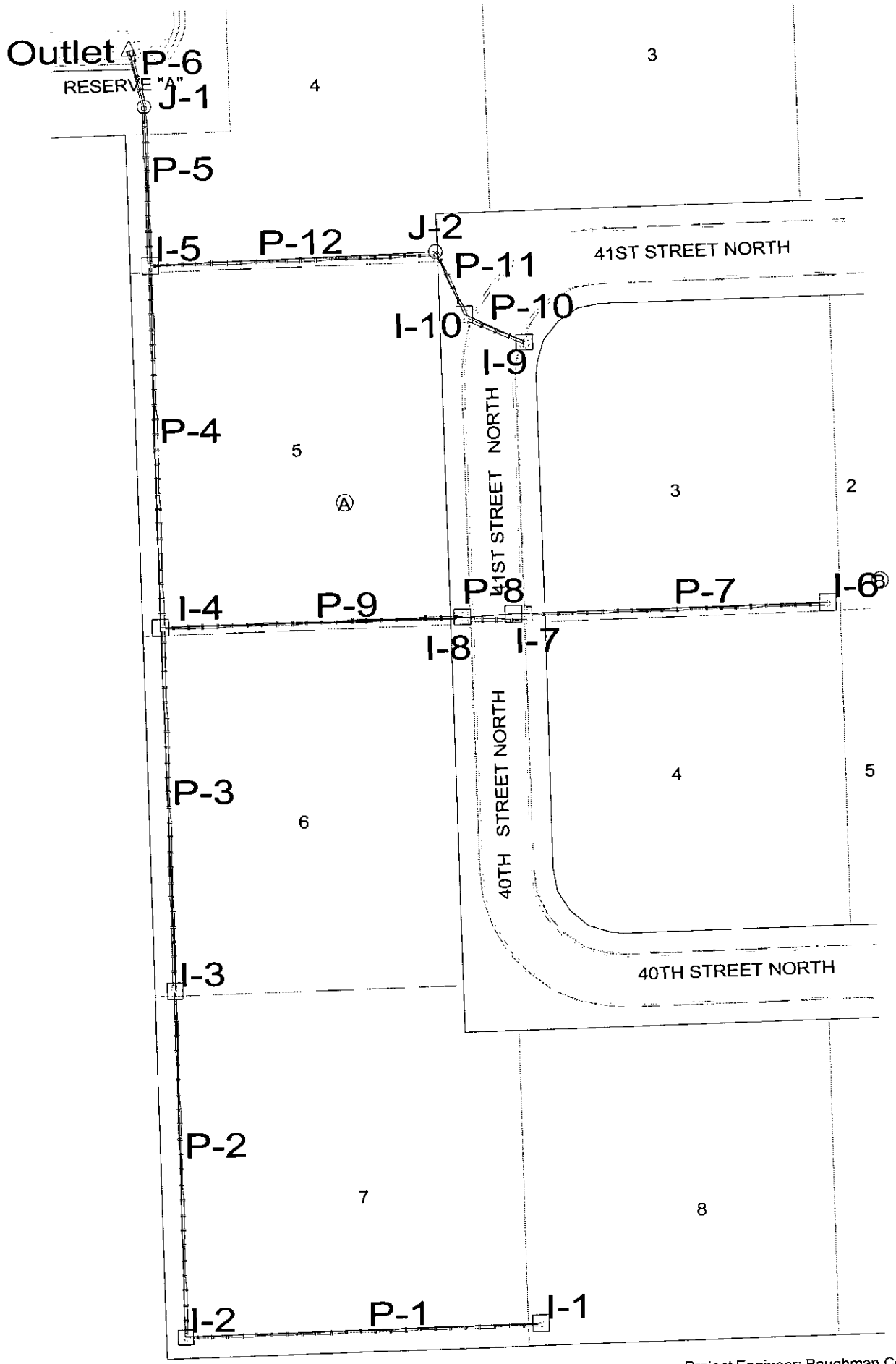
Default Network Design Storm File, ID SEDGWICK.RNQ Sedgwick

Return Event	Total Depth in	Rainfall Type	RNF File	RNF ID
Dev..2	3.6000	Synthetic Curve	SCSTYPES	TypeII 24hr
Dev..5	4.5600	Synthetic Curve	SCSTYPES	TypeII 24hr
Dev.10	5.2800	Synthetic Curve	SCSTYPES	TypeII 24hr
Dev100	7.6800	Synthetic Curve	SCSTYPES	TypeII 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Storage Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond ac-ft
BASIN #3	AREA	2	4.121		12.1000	46.32		
BASIN #3	AREA	5	5.559		12.1000	61.82		
BASIN #3	AREA	10	6.651		12.1000	73.40		
BASIN #3	AREA	100	10.332		12.1000	111.64		
OFF-SITE	AREA	2	.466		12.1500	5.40		
OFF-SITE	AREA	5	.688		12.1500	8.01		
OFF-SITE	AREA	10	.863		12.1000	10.07		
OFF-SITE	AREA	100	1.476		12.1000	17.17		
*OUTLET	JCT	2	4.585		12.5000	18.81		
*OUTLET	JCT	5	6.245		12.4000	32.85		
*OUTLET	JCT	10	7.512		12.3500	48.83		
*OUTLET	JCT	100	11.806		12.2500	100.07		
POND IN	POND	2	4.587		12.1500	51.71		
POND IN	POND	5	6.247		12.1000	69.82		
POND IN	POND	10	7.513		12.1000	83.47		
POND IN	POND	100	11.808		12.1000	128.80		
POND OUT	POND	2	4.585		12.5000	18.81	217.32	1.745
POND OUT	POND	5	6.245		12.4000	32.85	217.91	2.248
POND OUT	POND	10	7.512		12.3500	48.83	218.17	2.480



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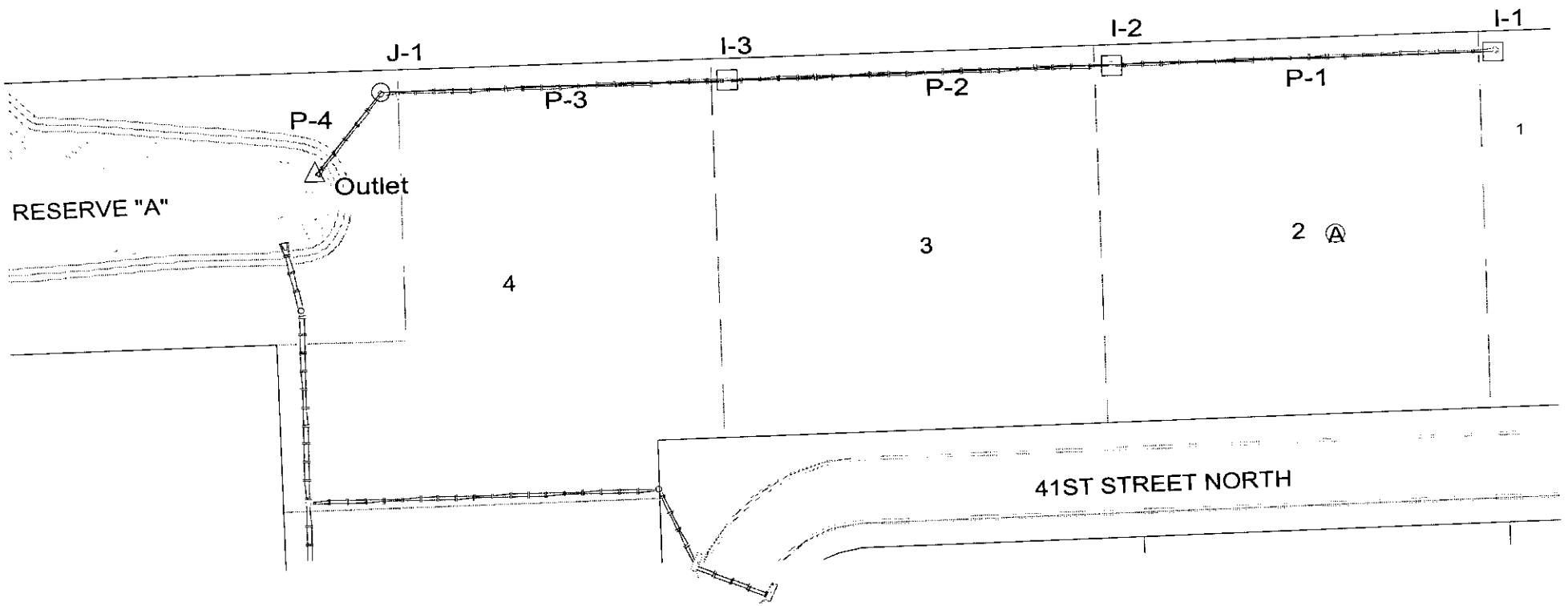
SYSTEM #1

	Node Report									
	Node	Area (acres)	Runoff Coefficient	Tc (min)	Rainfall Intensity (in/hr)	Added Flow (cfs)	Discharge (cfs)	Ground Elevation (ft)	HGL In (ft)	HGL Out (ft)
5-yr	I-9	1.15	0.85	15	4.56	5.22	5.22	224.00	220.66	220.59
	I-10	1.15	0.85	15	4.52	5.22	10.44	224.00	220.47	220.39
	J-2	N/A	N/A	N/A	4.49	N/A	10.44	224.50	220.28	220.14
	I-6	2.34	0.85	15	4.56	9	9	230.00	229.08	228.66
	I-7	1.1	0.85	15	4.49	3.53	12.53	226.00	224.14	223.75
	I-8	1.1	0.85	15	4.48	3.53	16.06	226.00	223.21	223.00
	I-1	1.22	0.85	15	4.56	4.7	4.7	233.00	230.08	229.88
	I-2	0.81	0.85	15	4.43	3.1	7.8	229.00	227.49	227.08
	I-3	0.81	0.85	15	4.36	3.1	10.9	224.00	222.50	222.31
	I-4	1.39	0.85	15	4.24	5.4	32.36	222.00	221.88	221.34
	I-5	1.39	0.85	15	4.17	5.4	48.2	220.00	219.69	219.11
	J-1	N/A	N/A	N/A	4.14	N/A	48.2	220.00	218.50	218.14
	Outlet	N/A	N/A	N/A	4.13	N/A	N/A	220.00	217.91	217.91
100-yr	I-9	1.15	0.91	15	7.37	10.1	10.1	224.00	223.63	223.38
	I-10	1.15	0.91	15	7.34	10.1	20.2	224.00	222.93	222.61
	J-2	N/A	N/A	N/A	7.32	N/A	20.2	224.50	222.20	221.69
	I-6	2.34	0.91	15	7.37	15.6	15.6	230.00	230.00	230.00
	I-7	1.1	0.91	15	7.31	4.95	20.55	226.00	226.00	226.00
	I-8	1.1	0.91	15	7.3	4.95	25.5	226.00	225.35	224.83
	I-1	1.22	0.91	15	7.37	8.2	8.2	233.00	233.00	233.00
	I-2	0.81	0.91	15	7.25	5.5	13.7	229.00	229.00	228.34
	I-3	0.81	0.91	15	7.14	5.5	19.2	224.00	224.00	223.93
	I-4	1.39	0.91	15	7.01	9.3	54	222.00	222.00	222.00
	I-5	1.39	0.91	15	6.95	9.3	83.5	220.00	220.00	220.00
	J-1	N/A	N/A	N/A	6.92	N/A	83.5	220.00	220.00	219.46
	Outlet	N/A	N/A	N/A	6.91	N/A	N/A	220.00	218.77	218.77

SYSTEM #1

Pipe Report

	Pipe Section	Upstream Node	Downstream Node	Discharge (cfs)	Constructed (ft/ft)	Length (ft)	Section Size	Mannings n	Upstream Invet (ft)	Downstream Invert (ft)	Upstream Ground (ft)	Downstream Ground (ft)	Upstream HGL (ft)	Downstream HGL (ft)
5-yr	P-10	I-9	I-10	5.22	0.010417	48	18 inch	0.013	218.00	217.50	224.00	224.00	220.59	220.47
	P-11	I-10	J-2	10.44	0.005882	51	24 inch	0.013	217.00	216.70	224.00	224.50	220.39	220.28
	P-12	J-2	I-5	10.44	0.00283	212	24 inch	0.013	216.60	216.00	224.50	220.00	220.14	219.69
	P-7	I-6	I-7	9	0.009657	233	15 inch	0.013	224.00	221.75	230.00	226.00	228.66	224.14
	P-8	I-7	I-8	12.53	0.013158	38	18 inch	0.013	220.50	220.00	226.00	226.00	223.75	223.21
	P-9	I-8	I-4	16.06	0.00852	223	24 inch	0.013	219.90	218.00	226.00	222.00	223.00	221.88
	P-1	I-1	I-2	4.7	0.010456	263	15 inch	0.013	229.00	226.25	233.00	229.00	229.88	227.49
	P-2	I-2	I-3	7.8	0.017647	255	18 inch	0.013	226.00	221.50	229.00	224.00	227.08	222.30
	P-3	I-3	I-4	10.9	0.011194	268	24 inch	0.013	221.00	218.00	224.00	222.00	222.31	221.88
	P-4	I-4	I-5	32.36	0.009057	265	30 inch	0.013	217.50	215.10	222.00	220.00	221.34	219.69
	P-5	I-5	J-1	48.2	0.008547	117	36 inch	0.013	215.00	214.00	220.00	220.00	219.11	218.50
	P-6	J-1	Outlet	48.2	0.056818	44	36 inch	0.013	213.50	211.00	220.00	220.00	218.14	217.91
100-yr	P-10	I-9	I-10	10.1	0.010417	48	18 inch	0.013	218.00	217.50	224.00	224.00	223.38	222.93
	P-11	I-10	J-2	20.2	0.005882	51	24 inch	0.013	217.00	216.70	224.00	224.50	222.61	222.20
	P-12	J-2	I-5	20.2	0.00283	212	24 inch	0.013	216.60	216.00	224.50	220.00	221.69	220.00
	P-7	I-6	I-7	15.6	0.009657	233	15 inch	0.013	224.00	221.75	230.00	226.00	239.59	226.00
	P-8	I-7	I-8	20.55	0.013158	38	18 inch	0.013	220.50	220.00	226.00	226.00	226.80	225.35
	P-9	I-8	I-4	25.5	0.00852	223	24 inch	0.013	219.90	218.00	226.00	222.00	224.83	222.00
	P-1	I-1	I-2	8.2	0.010456	263	15 inch	0.013	229.00	226.25	233.00	229.00	233.24	229.00
	P-2	I-2	I-3	13.7	0.017647	255	18 inch	0.013	226.00	221.50	229.00	224.00	228.34	224.00
	P-3	I-3	I-4	19.2	0.011194	268	24 inch	0.013	221.00	218.00	224.00	222.00	223.93	222.00
	P-4	I-4	I-5	54	0.009057	265	30 inch	0.013	217.50	215.10	222.00	220.00	224.59	220.00
	P-5	I-5	J-1	83.5	0.008547	117	36 inch	0.013	215.00	214.00	220.00	220.00	221.83	220.00
	P-6	J-1	Outlet	83.5	0.056818	44	36 inch	0.013	213.50	211.00	220.00	220.00	219.46	218.77



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Project Engineer: Baughman Company, P.A.
StormCAD v1.0

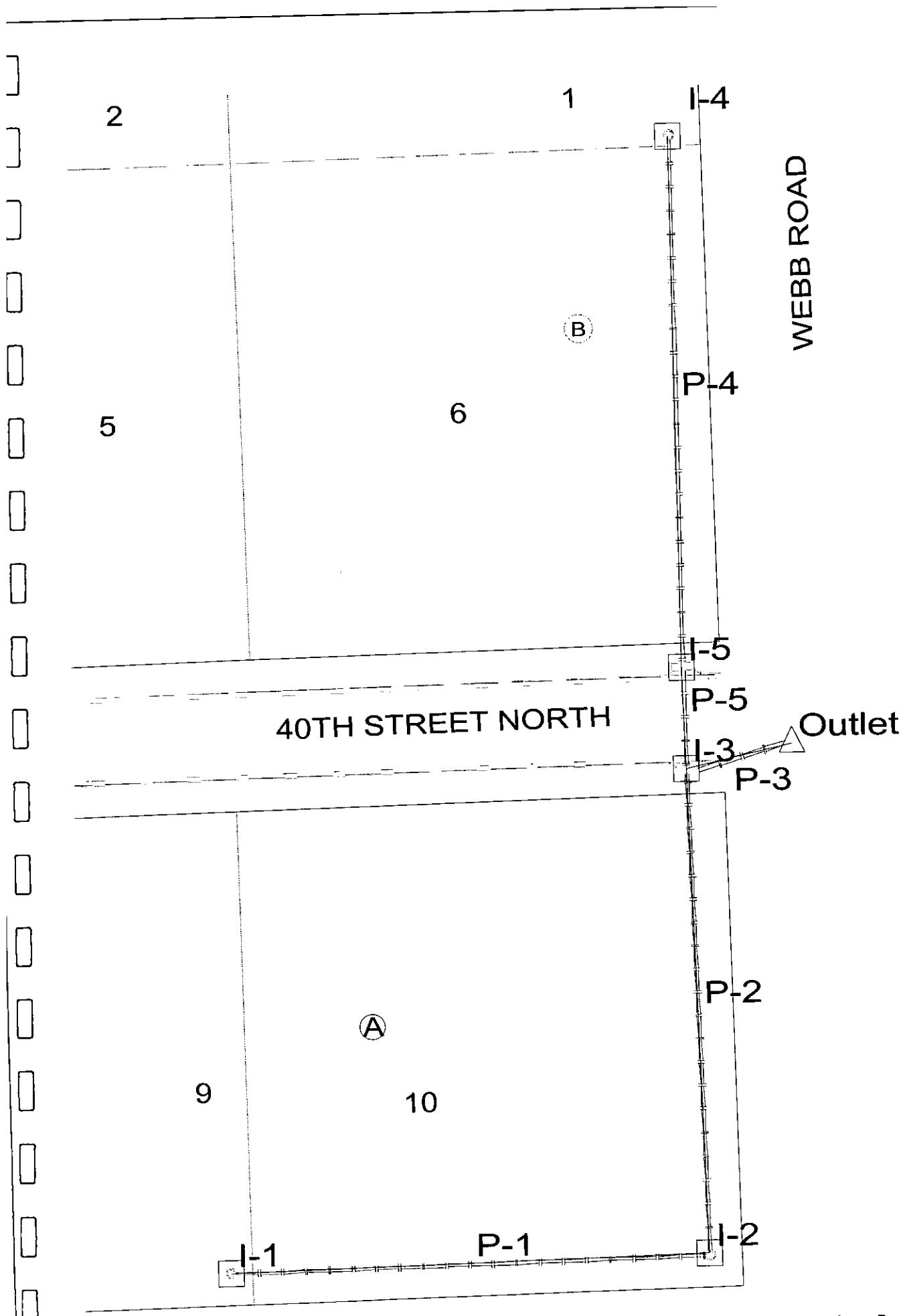
SYSTEM #2

	Node Report									
	Node	Area (acres)	Runoff Coefficient	Tc (min)	Rainfall Intensity (in/hr)	Added Flow (cfs)	Discharge (cfs)	Ground Elevation (ft)	HGL In (ft)	HGL Out (ft)
5-yr	I-1	1.2	0.85	15	4.56	4.7	4.7	231.00	227.40	227.29
	I-2	1.21	0.85	15	4.43	4.7	9.4	230.00	226.08	225.86
	I-3	1.21	0.85	15	4.34	4.7	14.1	227.00	224.02	223.52
	J-1	N/A	N/A	N/A	4.29	N/A	14.1	223.00	219.76	219.06
	Outlet	N/A	N/A	N/A	4.28	N/A	N/A	222.00	217.91	217.91
100-yr	I-1	1.2	0.91	15	7.37	8	8	231.00	231.00	231.00
	I-2	1.21	0.91	15	7.26	8.1	16.1	230.00	230.00	230.00
	I-3	1.21	0.91	15	7.18	8.1	24.2	227.00	227.00	227.00
	J-1	N/A	N/A	N/A	7.13	N/A	24.2	223.00	223.00	222.17
	Outlet	N/A	N/A	N/A	7.12	N/A	N/A	222.00	218.77	218.77

SYSTEM #2

Pipe Report

	Pipe Section	Upstream Node	Downstream Node	Discharge (cfs)	Constructed (ft/ft)	Length (ft)	Section Size	Mannings n	Upstream Invet (ft)	Downstream Invert (ft)	Upstream Ground (ft)	Downstream Ground (ft)	Upstream HGL (ft)	Downstream HGL (ft)
5-yr	P-1	I-1	I-2	4.7	0.008734	229	15 inch	0.013	226.00	224.00	231.00	230.00	227.29	226.08
	P-2	I-2	I-3	9.4	0.011957	230	18 inch	0.013	223.75	221.00	230.00	227.00	225.86	224.02
	P-3	I-3	J-1	14.1	0.01866	209	18 inch	0.013	220.90	217.00	227.00	223.00	223.52	219.76
	P-4	J-1	Outlet	14.1	0.046875	64	18 inch	0.013	215.00	212.00	223.00	222.00	219.06	217.91
100-yr	P-1	I-1	I-2	8	0.008734	229	15 inch	0.013	226.00	224.00	231.00	230.00	233.51	230.00
	P-2	I-2	I-3	16.1	0.011957	230	18 inch	0.013	223.75	221.00	230.00	227.00	232.40	227.00
	P-3	I-3	J-1	24.2	0.01866	209	18 inch	0.013	220.90	217.00	227.00	223.00	234.09	223.00
	P-4	J-1	Outlet	24.2	0.046875	64	18 inch	0.013	215.00	212.00	223.00	222.00	222.17	218.77



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Project Engineer: Baughman Company, P.A.
StormCAD v1.0

SYSTEM #3

	Node Report									
	Node	Area (acres)	Runoff Coefficient	Tc (min)	Rainfall Intensity (in/hr)	Added Flow (cfs)	Discharge (cfs)	Ground Elevation (ft)	HGL In (ft)	HGL Out (ft)
5-yr	I-4	2.37	0.85	15	4.56	9.4	9.4	229.00	227.96	227.74
	I-5	0.28	0.85	15	4.47	1.1	10.5	229.00	225.63	225.49
	I-1	0.28	0.85	15	4.56	4.7	4.7	230.00	228.83	228.72
	I-2	1.22	0.85	15	4.43	4.7	9.4	228.00	227.53	227.31
	I-3	1.22	0.85	15	4.35	1.1	21	229.00	225.49	225.04
	Outlet	N/A	N/A	N/A	4.33	N/A	N/A	227.00	224.33	224.33
100-yr	I-4	2.37	0.91	15	7.37	15.8	15.8	229.00	229.00	229.00
	I-5	0.28	0.91	15	7.28	1.9	17.7	229.00	227.51	227.26
	I-1	0.28	0.91	15	7.37	8.2	8.2	230.00	230.00	230.00
	I-2	1.22	0.91	15	7.26	8.2	16.4	228.00	228.00	228.00
	I-3	1.22	0.91	15	7.19	1.9	36	229.00	226.97	225.95
	Outlet	N/A	N/A	N/A	7.17	N/A	N/A	227.00	224.62	224.62

SYSTEM #3

Pipe Report

	Pipe Section	Upstream Node	Downstream Node	Discharge (cfs)	Constructed (ft/ft)	Length (ft)	Section Size	Mannings n	Upstream Invet (ft)	Downstream Invert (ft)	Upstream Ground (ft)	Downstream Ground (ft)	Upstream HGL (ft)	Downstream HGL (ft)
5-yr	P-4	I-4	I-5	9.4	0.006073	247	18 inch	0.013	226.00	224.50	229.00	229.00	227.74	225.68
	P-5	I-5	I-3	10.5	0.010638	47	24 inch	0.013	224.00	223.50	229.00	229.00	225.49	225.49
	P-1	I-1	I-2	4.7	0.004444	225	15 inch	0.013	226.00	225.00	230.00	228.00	228.72	227.53
	P-2	I-2	I-3	9.4	0.005507	227	18 inch	0.013	224.75	223.50	228.00	229.00	227.31	225.49
	P-3	I-3	Outlet	21	0.013922	51	24 inch	0.013	223.40	222.69	229.00	227.00	225.04	224.33
100-yr	P-4	I-4	I-5	15.8	0.006073	247	18 inch	0.013	226.00	224.50	229.00	229.00	233.10	227.51
	P-5	I-5	I-3	17.7	0.010638	47	24 inch	0.013	224.00	223.50	229.00	229.00	227.26	226.97
	P-1	I-1	I-2	8.2	0.004444	225	15 inch	0.013	226.00	225.00	230.00	228.00	231.63	228.00
	P-2	I-2	I-3	16.4	0.005507	227	18 inch	0.013	224.75	223.50	228.00	229.00	232.51	226.97
	P-3	I-3	Outlet	36	0.013922	51	24 inch	0.013	223.40	222.69	229.00	227.00	225.95	224.62

Ritchie Industrial Park
Worksheet for Triangular Channel

Project Description	
Project File	f:\hydro\projects\ritchien\ditch.fm2
Worksheet	V-Ditch
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.010000	ft/ft
Depth	1.50	ft
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V

Results		
Discharge	36.06	cfs
Flow Area	9.00	ft^2
Wetted Perimeter	12.37	ft
Top Width	12.00	ft
Critical Depth	1.38	ft
Critical Slope	0.015443	ft/ft
Velocity	4.01	ft/s
Velocity Head	0.25	ft
Specific Energy	1.75	ft
Froude Number	0.82	
Flow is subcritical.		