J·R ENGINEERING
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DRAINAGE LETTER AMENDMENT TO PRELIMINARY/FINAL DRAINAGE REPORT FOR AUSTIN BLUFFS PARKWAY (MINOR ARTERIAL) FROM WOODMEN ROAD NORTH TO MEADOW RIDGE DRIVE

April 2000

Prepared For:

LP47, LLC dba LA PLATA INVESTMENTS
2315 Briargate Parkway, Suite 100
Colorado Springs, CO 80920
(719) 260-7477

Prepared By:

JR ENGINEERING
4310 ArrowsWest Drive
Colorado Springs, CO 80907
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Job No. 8715.70

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DRAINAGE REPORT STATEMENT

ENGINEER'S STATEMENT:
The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

COLORADO REGISTERED KYLE CAMPBELL 29794 PROFESSIONAL ENGINEER

Kyle R. Campbell, Colorado P.E. #29794 — Date
For and On Behalf of JR Engineering, LLC

DEVELOPER'S STATEMENT:
I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: LP47, LLC dba La Plata Investments

By: Thomas Taylor

Title: Director of Development Services

Address: 2315 Briargate Parkway, Suite 100

Colorado Springs, CO 80920

CITY OF COLORADO SPRINGS ONLY:
Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980, as amended.

City Engineer — Date July 15, 2010

Conditions:

4310 ArrowsWest Drive, Colorado Springs, CO 80907
719-593-2593 • Fax: 719-528-6613 • www.jrengineering.com

April 17, 2000

City of Colorado Springs
Subdivision Engineering Review Team
101 W. Costilla, Suite 113
Colorado Springs, CO 80903

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ATTN: Tim Mitros

RE: Drainage Letter Amendment to Preliminary/Final Drainage Report for Austin Bluffs Parkway (Minor Arterial) from Woodmen Road North to Meadow Ridge Drive, as approved in July 1997

Dear Tim:

The purpose of this Drainage Letter is to document changes to proposed storm inlets located south of the intersection of Meadow Ridge Drive and Austin Bluffs Parkway.

The changes are precipitated by more runoff being directed into Meadow Ridge Drive than was planned for in the subject report to be amended. The additional runoff is described in "Antelope Trails Drainage Report" dated May 1998, prepared by Becker-Johnson Inc. The Antelope Trails Drainage Report was approved in September of 1998.

The Antelope Trails Drainage Report indicates that 22 cfs of additional flow will be contributed to the intersection of Austin Bluffs Parkway and Meadow Ridge Drive during the 100-year design event. The report proposed that a new 10' long D-10-R inlet and storm drain be constructed along the north curb line of Meadow Ridge to intercept the additional flow and convey it into the adjacent channel.

Upon investigation it was discovered that construction of the additional inlet at this location would be difficult due to the presence of existing utilities and paving improvements. There is an existing inlet located along the north side of Meadow Ridge to intercept nuisance flows. It is proposed to increase the length of the proposed inlets to be located along the west curb line of Austin Bluffs Parkway immediately south of Meadow Ridge Drive to intercept the additional flow.

Previous analysis have indicated the area located north and east of the intersection of Meadow Ridge Drive and Austin Bluffs Parkway will contribute substantial flows to the intersection in the 100-year design event. This is mostly the result of the area being developed under less restrictive drainage criteria. The Preliminary/Final Drainage Report for Austin Bluffs Parkway estimated a peak 100-year flow rate at the upstream end of the Austin Bluffs Parkway inlets at 240 cfs. Assuming a direct addition of peaks (conservative) the addition of the 22 cfs from the Antelope Trails site will result in a 100-year peak rate of 262 cfs at this location. This is a huge

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flow rate to have in the street. The purpose of the inlets located south of the Meadow Ridge intersection is to reduce the flow in the street to a more acceptable level.

The Austin Bluffs Parkway inlets as previously planned consisted of a 25' long D-10-R and a 20' long D-10-R. The inlets were to be connected by 35 linear feet of 48" diameter RCP. The inlets were proposed to intercept a combined flow of 165cfs in the 100-year design event and allow 75 cfs to flow by. The current proposal is to add 15' of inlet and to combine the separate inlets into one to improve constructability. This will result in a 60' long inlet with an estimated interception capacity of 187 cfs in the 100-year design event. Assuming the additional 22 cfs will result in a 22 cfs increase to the overall 100-year peak flow the lengthened inlet will maintain the same flow by as was proposed in the approve Preliminary/Final Drainage Report for Austin Bluffs Parkway.

The proposed 60' long inlet will be connected to an existing, adjacent 6' x 11' box culvert by an existing 48" diameter RCP. The capacity of the 48" pipe is pushed with the introduction of the additional flow but appears to be adequate (although marginally). The additional flow introduced to the box culvert through the 48" RCP was assumed to already be in the box culvert at this point in previous analysis so it will not negatively affect the overall flow rate in the box culvert.

Calculations to determine inlet capacity are attached. 100-year peak flow depths are estimated at 1.1' above normal flow line elevation at the upstream end of the inlet and 0.7' deep at the downstream end of the inlet. Given that at these depths the inlet opening will be completely submerged and that the 187 cfs flow to be intercepted will be carried within 15' of the curb face, the city standard inlet capacity calculation did not seem appropriate. Instead the orifice equation was used to size the inlet. Capacity based on available head at both ends was determined and an average of these two capacities was used to estimate required length.

The calculations done with this analysis indicate that the proposed revision to the inlet will allow it to intercept the additional flow contributed to Austin Bluffs Parkway by the Antelope Trails Site.

Please do not hesitate to call me if you have questions regarding this information.

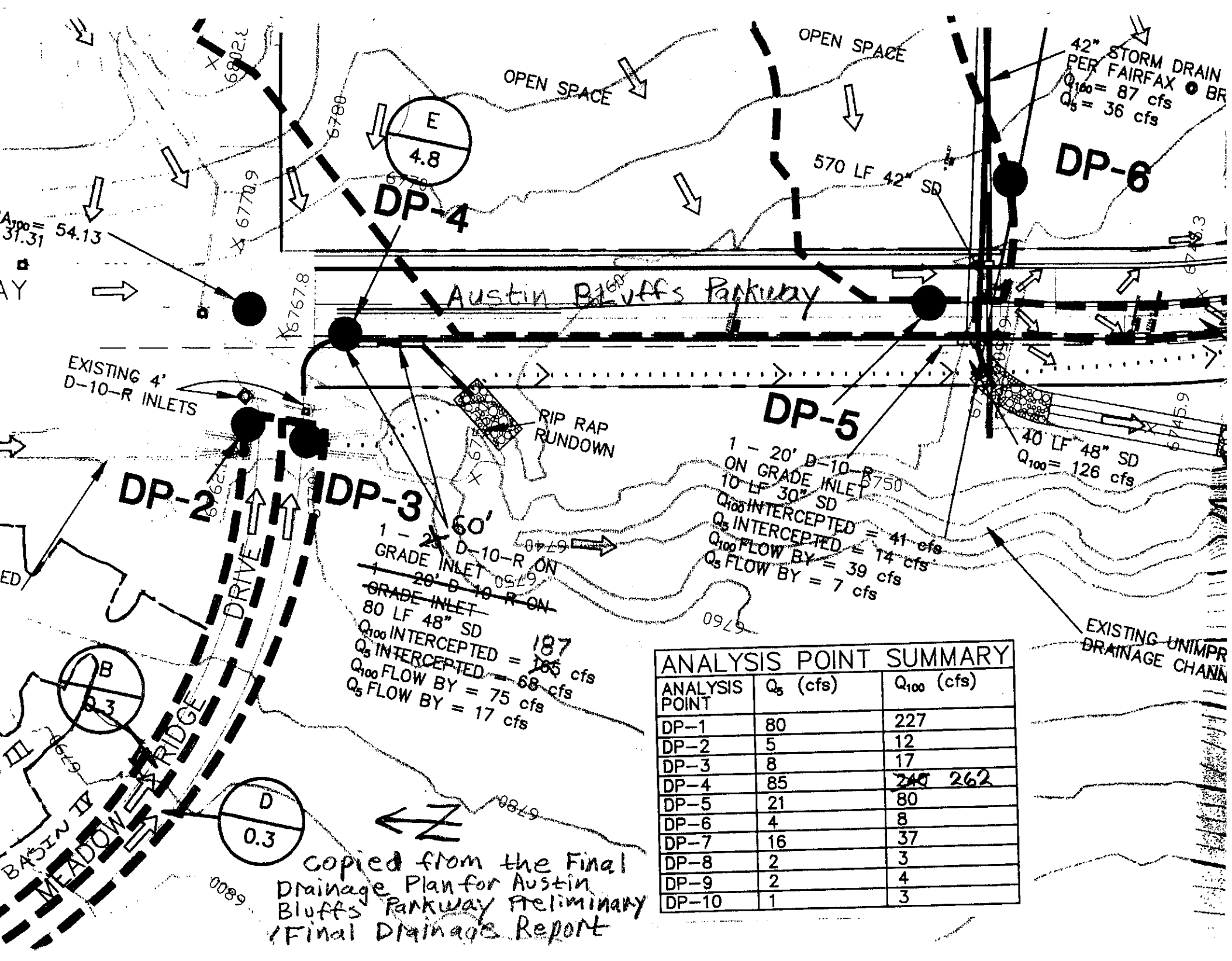
Respectfully submitted,

JR Engineering

Vancel S. Fossinger, P.E.
Project Manager

/vsf-le/871570/FDR Drainage Letter Amendment

APPENDIX



ANALYSIS POINT SUMMARY		
ANALYSIS POINT	Q_5 (cfs)	Q_{100} (cfs)
DP-1	80	227
DP-2	5	12
DP-3	8	17
DP-4	85	~~240~~ 262
DP-5	21	80
DP-6	4	8
DP-7	16	37
DP-8	2	3
DP-9	2	4
DP-10	1	3

copied from the Final Drainage Plan for Austin Bluffs Parkway Preliminary / Final Drainage Report

Client: _____ Job No: 8717.12

Project: Austin Bluffs Pkwy STORM outfall By: _____ Chk. By: _____ Date: 4-15-2000

Subject: Revision of Inlets S. of Meadow Ridge Sheet No: ___ of ___

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Calculate Hgl from Box culvert assuming 187cfs is collected by inlet

Connector Pipe is 36' of 48" RCP @ 2.01 % K=1436

Stating hgl = 6757.3

Friction Slope = $(187 \div 1436)^2 = 0.017$ ft/ft

Friction Loss = 0.017(36) = 0.61'

Hgl entering inlet = 6757.3 + 0.61 = 6757.91

TOP of Pipe @ inlet = 6753.44 + 4 = 6757.44 < hgl

V = 187 ÷ 12.566 = 14.88 fps $hv = 14.88^2/64.4 = 3.44'$

Assume that entrance K = 0.30 due to rounding at entrance as required by construction plans

Loss @ entrance inc. velocity head = 3.44(1.30) = 4.47'

HGL in Inlet = 6757.91 + 4.47 = 6762.38

Estimated depth of flow at downstream end of inlet = Normal fl eleu (6762.40) + depth of flow (0.69) = 6763.09

Δ @ downstream end = 6763.09 - 6762.38 = 0.71'

HGL in inlet will be very near to normal fl eleu in the gutter at the down stream end.

If we were starting from scratch a larger pipe would be specified for the connection. However given that the connector is in place it appears that it will be adequate (though marginally) at the peak. The configuration of the inlet should result in considerable energy (via velocity of inlet flow) being delivered to aid the entrance to the connector pipe. This was not considered in the above calculations.

Client: _____ Job No: 8717.12

Project: Austin Bluffs PKWY Storm Outfall By: _____ Chk. By: _____ Date: 4-15-2000

Subject: Revision of Inlets S. of Meadow Ridge Sheet No: ___ of ___

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Introduction of more flow to inlet results in higher hgl making it very difficult to make 2 inlets separated by a pipe work. Look at sizing 1 continuous inlet to intercept 187 cfs

Depth are out of the normal range that the inlet calculation method proposed in the City Criteria manual was intended for.

Estimated flow depths will be over 1 ft above normal gutter ft at the upstream end + curb high at the downstream end of the inlet. A flowmaster/mannings analysis of the street sections indicates that 187 cfs will be flowing within 15' of the face of the inlet. Thus it is assumed that the inlet will act more as a long orifice than a normal inlet constructed on grade.

Calculate capacity per foot at upstream end + downstream end then average them for average capacity/ft.

Upstream end: h = 1.08' (depth above normal ft)
A = 0.67 (opening height) x 1 = 0.67
C = 0.65

Note: 4" of opening is below normal ft so 'h' is = to normal depth above normal ft

$Q_i = 0.65(.67)\sqrt{64.4(1.08)} = 3.63$ cfs/ft

Downstream end: h = 0.70 (depth above normal ft)
A = 0.67
C = 0.65

$Q_i = 0.65(.67)\sqrt{64.4(.7)} = 2.92$ cfs/ft

Avg $Q_i = (3.63 + 2.92) \div 2 = 3.27$ cfs/ft

Estimate length required

$187 \div 3.27 = 57.2$ LF → Use 60 LF

Table
Rating Table for Irregular Channel

Project Description	
Project File	x:\870000.all\871571\hydro\abpkw.fm2
Worksheet	A.B. PKWY @ D.P. 4
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Constant Data	
Channel Slope	0.028000 ft/ft

Input Data			
	Minimum	Maximum	Increment
Discharge	70.00	260.00	10.00 cfs

Rating Table

Discharge (cfs)	Wtd. Mannings Coefficient	Water Surface Elevation (ft)	Velocity (ft/s)
70.00	0.014	0.68	7.69
80.00	0.014	0.72	7.93
90.00	0.014	0.75	8.15
100.00	0.014	0.77	8.35
110.00	0.015	0.80	8.54
120.00	0.015	0.82	8.71
130.00	0.015	0.85	8.88
140.00	0.015	0.87	9.03
150.00	0.015	0.89	9.18
160.00	0.015	0.91	9.32
170.00	0.015	0.93	9.46
180.00	0.015	0.95	9.59
190.00	0.015	0.97	9.71
200.00	0.015	0.98	9.83
210.00	0.015	1.00	9.95
220.00	0.015	1.02	10.06
230.00	0.015	1.03	10.17
240.00	0.015	1.05	10.27
250.00	0.015	1.06	10.37
260.00	0.015	1.08	10.47

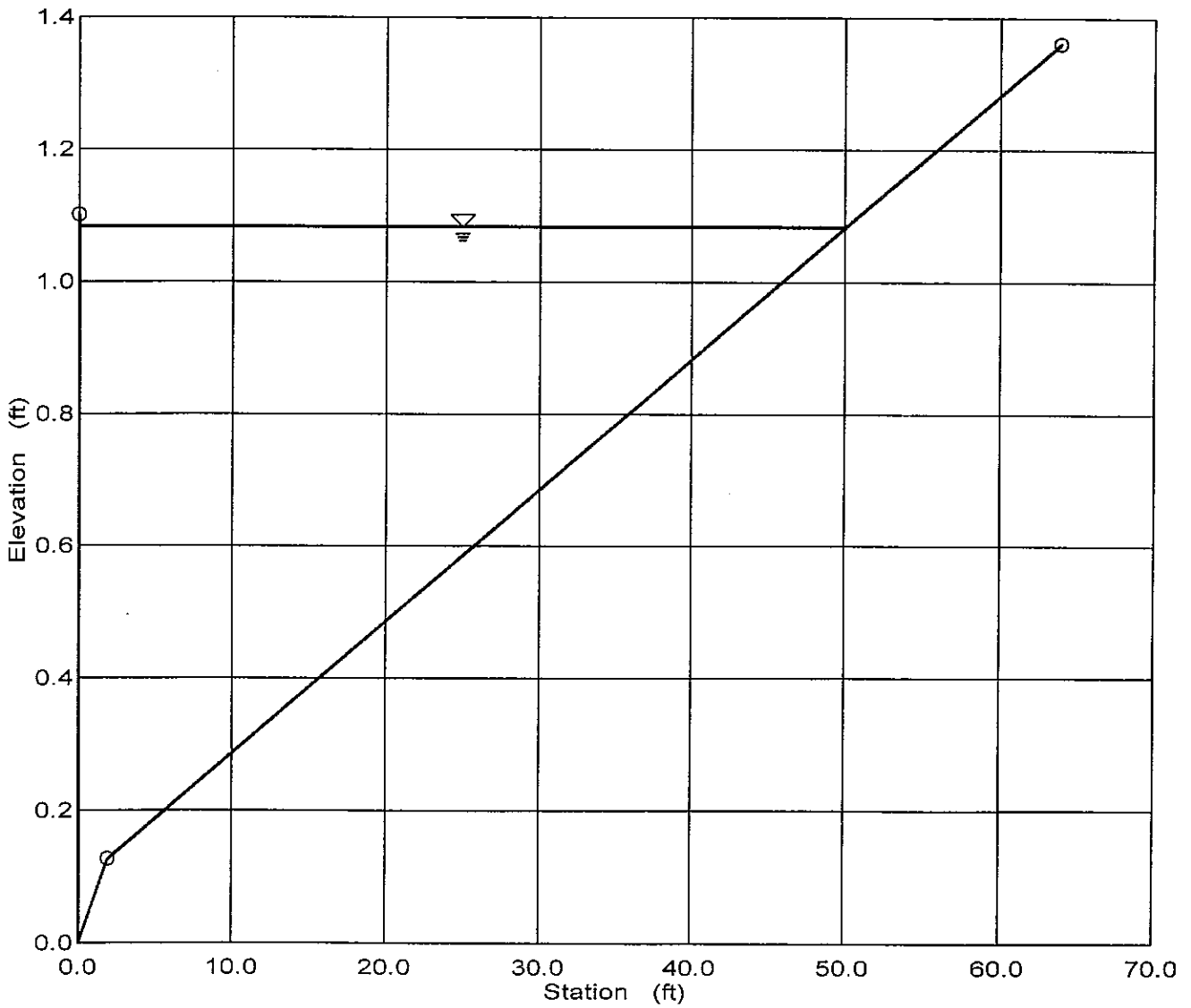
> @ 75 cfs use d = .70'

- @ 262 cfs use d = 1.08'

A.B. PKWY @ DP 4
Cross Section for Irregular Channel

Project Description	
Project File	x:\870000.all\871571\hydro\abpkw.fm2
Worksheet	A.B. PKWY @ D.P. 4
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.015	
Channel Slope	0.028000	ft/ft
Water Surface Elevation	1.08	ft
Discharge	262.00	cfs



Worksheet
Worksheet for Irregular Channel

Project Description	
Project File	x:\870000.all\871571\hydro\abpkw.fm2
Worksheet	A.B. PKWY @ D.P. 4
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.028000	ft/ft
Elevation range: 0.00 ft to 1.36 ft.		
Discharge	262.00	cfs

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	1.10	0.00	2.00	0.013
0.00	0.00	2.00	64.00	0.015
2.00	0.13			
64.00	1.36			

Results		
Wtd. Mannings Coefficient	0.015	
Water Surface Elevation	1.08	ft
Flow Area	24.98	ft²
Wetted Perimeter	51.09	ft
Top Width	49.99	ft
Height	1.08	ft
Critical Depth	1.53	ft
Critical Slope	0.003585	ft/ft
Velocity	10.49	ft/s
Velocity Head	1.71	ft
Specific Energy	2.79	ft
Froude Number	2.62	
Flow is supercritical.		

Worksheet
Worksheet for Irregular Channel

Project Description	
Project File	x:\870000.all\871571\hydro\abpkw.fm2
Worksheet	CHECK FLOW WITHIN 15' OF CURB
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Channel Slope	0.028000	ft/ft
Water Surface Elevation	1.10	ft

Elevation range: 0.00 ft to 1.10 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	1.10	0.00	2.00	0.013
0.00	0.00	2.00	15.00	0.015
2.00	0.13			
15.00	0.39			
15.00	1.05			

Results		
Wtd. Mannings Coefficient	0.015	
Discharge	186.63	cfs
Flow Area	13.03	ft²
Wetted Perimeter	16.82	ft
Top Width	15.00	ft
Height	1.10	ft
Critical Depth	1.92	ft
Critical Slope	0.003406	ft/ft
Velocity	14.33	ft/s
Velocity Head	3.19	ft
Specific Energy	4.29	ft
Froude Number	2.71	

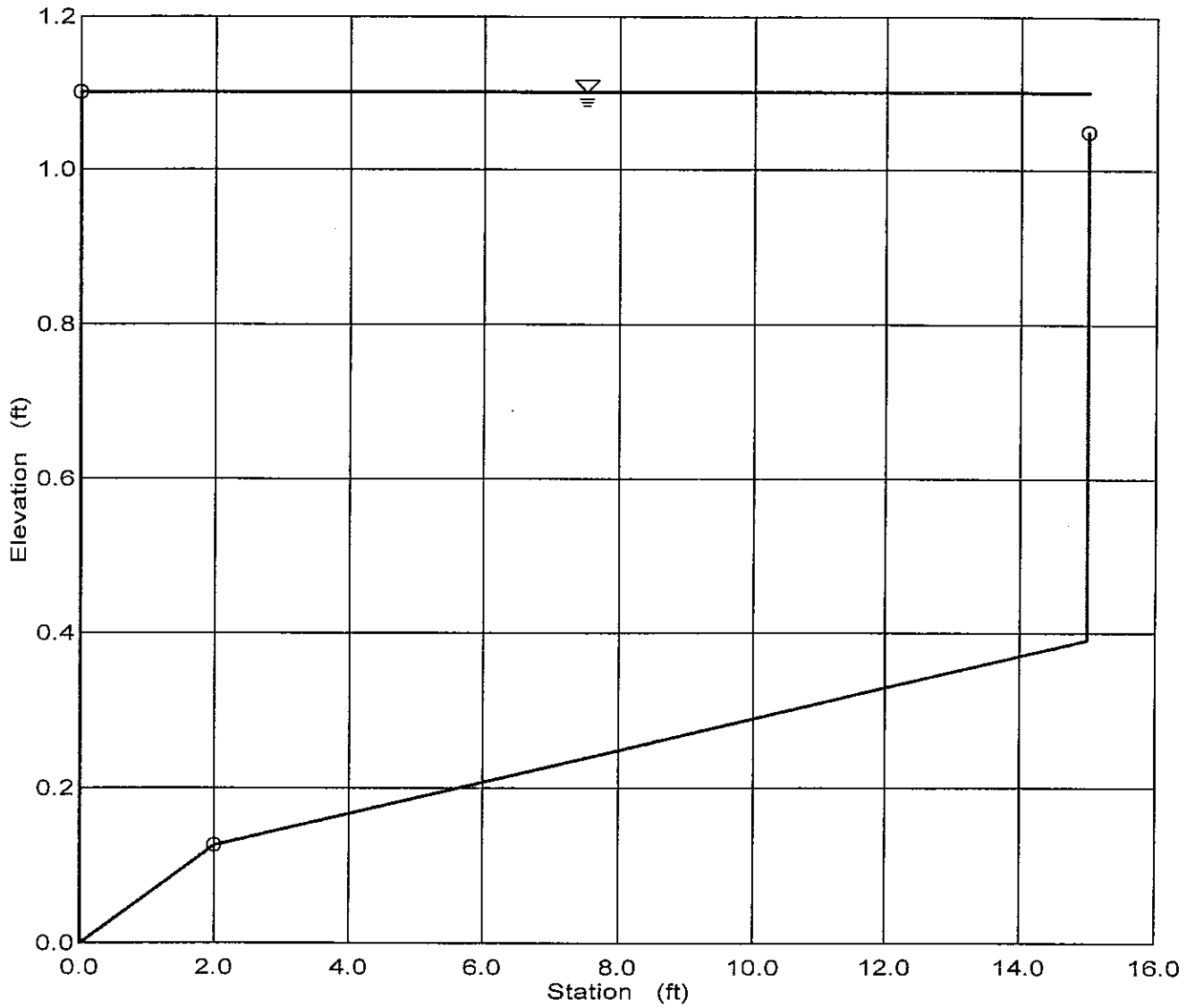
Flow is supercritical.

Water elevation exceeds lowest end station by 0.05 ft.

FLOW WITHIN 15' OF CURB
Cross Section for Irregular Channel

Project Description	
Project File	x:\870000.all\871571\hydro\abpkw.fm2
Worksheet	CHECK FLOW WITHIN 15' OF CURB
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Discharge

Section Data		
Wtd. Mannings Coefficient	0.015	
Channel Slope	0.028000	ft/ft
Water Surface Elevation	1.10	ft
Discharge	186.63	cfs



Worksheet
Worksheet for Rectangular Channel

Project Description	
Project File	x:\870000.all\871571\hydro\abpkw.fm2
Worksheet	INLET CHANNEL
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Slope

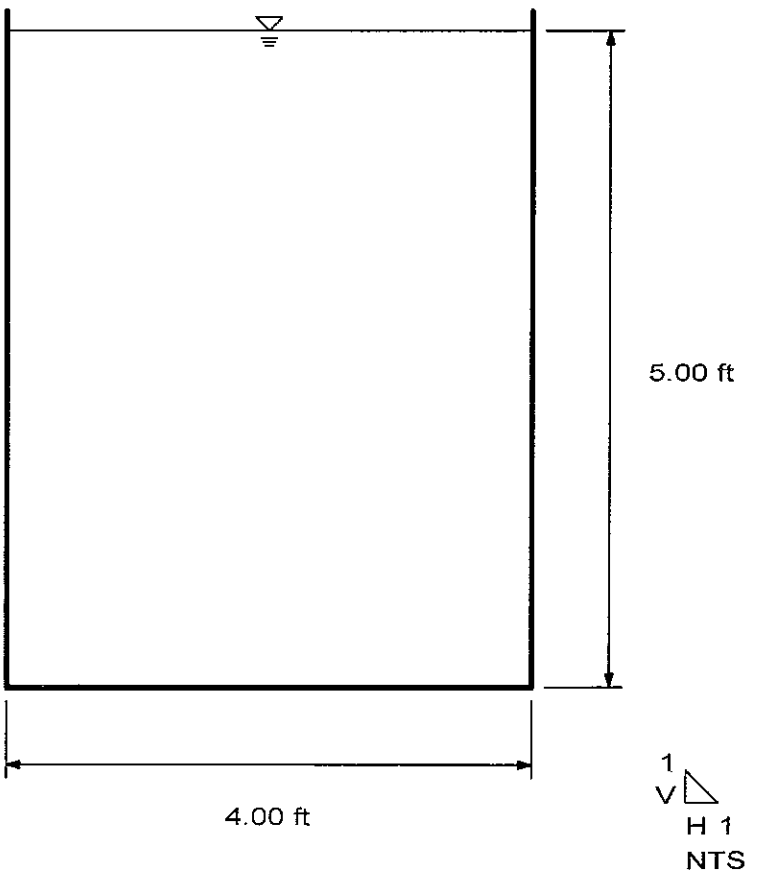
Input Data		
Mannings Coefficient	0.013	
Depth	5.00	ft
Bottom Width	4.00	ft
Discharge	187.00	cfs

Results		
Channel Slope	0.004159	ft/ft
Flow Area	20.00	ft^2
Wetted Perimeter	14.00	ft
Top Width	4.00	ft
Critical Depth	4.08	ft
Critical Slope	0.006787	ft/ft
Velocity	9.35	ft/s
Velocity Head	1.36	ft
Specific Energy	6.36	ft
Froude Number	0.74	
Flow is subcritical.		

Inlet with 5' flow depth & 187cfs
Cross Section for Rectangular Channel

Project Description	
Project File	x:\870000.all\871571\hydro\abpkw.fm2
Worksheet	INLET CHANNEL
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Slope

Section Data		
Mannings Coefficient	0.013	
Channel Slope	0.004159	ft/ft
Depth	5.00	ft
Bottom Width	4.00	ft
Discharge	187.00	cfs



Worksheet
Worksheet for Rectangular Channel

Project Description	
Project File	x:\870000.all\871571\hydro\abpkw.fm2
Worksheet	INLET CHANNEL
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.020000	ft/ft
Bottom Width	4.00	ft
Discharge	187.00	cfs

Results		
Depth	2.65	ft
Flow Area	10.60	ft^2
Wetted Perimeter	9.30	ft
Top Width	4.00	ft
Critical Depth	4.08	ft
Critical Slope	0.006787	ft/ft
Velocity	17.64	ft/s
Velocity Head	4.84	ft
Specific Energy	7.49	ft
Froude Number	1.91	
Flow is supercritical.		