

REFERENCE 10

"Technical Drainage Study for Summerlin Village 13 East Phase-I Improvements"
Approved on July 28, 1999

**TECHNICAL DRAINAGE STUDY
FOR
SUMMERLIN VILLAGE 13 EAST
PHASE 1 IMPROVEMENTS**

62013.211

May 1999

Prepared for:

**The Howard Hughes Corporation
Summerlin Division
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Department of Public Works

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M.J. Manning, Director • E-Mail: mjm@co.clark.nv.us

July 28, 1999

AUG 02 1999

G.C. Wallace, Inc.
1555 South Rainbow Boulevard
Las Vegas, Nevada 89146

Re: TECHNICAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 13 EAST PHASE 1 IMPROVEMENTS

Study dated: May 7, 1999

Addendum #1 Dated: June 30, 1999

Location: South of Charleston Boulevard, west of Hualapai Way

Section 01, T. 21 S., R59 E.

WT-0216-99, ET/VC 1936-97, TM 0054-99

HTE# 99-13810

The above-referenced Technical Drainage Study has been reviewed and is accepted as complying with the minimum improvement standards. As set forth in the subject study, the following measures are accepted:

1. The site shall be graded with respect to drainage as shown on "Drainage and Grading Plan - Summerlin Village 13 East Phase 1 Improvements", signed and sealed by Jeff Stayton, P.E. on June 30, 1999.
2. The following drainage facilities shall be constructed:
 - a. Revised grading to the existing earthen detention basin as shown on sheet 9 of the grading plans referenced in item 1 above;
 - b. A 2-foot thick rip rap lined rundown with d(50) of 12-inches, approximately 70-feet wide, and located along the western edge of item 2(a) above;
 - c. A 2' X 10' restrictor plate over the existing 10' X 10' inlet grate draining into existing 5' X 4' RCB outfall pipe for item 2(a) above;
 - d. An earthen berm along the western limits of Town Center Drive with 3:1 side slopes and of varying height as shown on sheet 38 of the plans referenced in item 1;

BOARD OF COUNTY COMMISSIONERS

BRUCE L. WOODBURY, Chairman • ERIN KENNY, Vice-Chair

Technical Drainage Study

Design Point 8 collects 12 cfs in a sump condition at a depth below top of curb with two 5.5-foot Modified Type "C" drop inlets. The west half of the road includes 1 cfs of bypass from Design Point 5 and 5.5 cfs from the road section itself for a total of 6.5 cfs. The 100-year flow of 5.5 cfs on the east half of the road is generated in the road section itself (2 cfs from north 3.5 cfs from south). A 100-year flow of 47 cfs is collected by a 30-inch RCP lateral for Parcel N. This flow combines with the flow collected by the drop inlets in the sump condition for a combined 100-year flow of 59 cfs in the storm drain in Sandstone Bluffs Drive. This 59 cfs is conveyed to the existing 5-foot by 4-foot RCB from the Village 13 Detention Basin/Park.

A 24-inch RCP is proposed to be extended from an existing 24-inch RCP stub from the Faith Lutheran High School site. This stub will be provided to, as a minimum, collect nuisance flow. Additionally, the extension allows for flexibility in the future development of Parcel C and C1. The technical drainage studies for these parcels will further address the 24-inch RCP, as at that time it will be determined if the pipe is proposed to collect flow other than nuisance flow. The *Faith Lutheran Junior/Senior High School Drainage Study* (Reference 7) calculated a capacity of 70 cfs for the existing 24-inch RCP, see Appendix C.

Town Center Drive will be constructed with future phases of improvements. The only improvements for Town Center Drive proposed with this project are constructing turn pockets to the existing east half of Town Center Drive at Griffith Peak Drive and Park Center Drive. The design flows for Town Center Drive were addressed in the Summerlin Village 13 East Conceptual Drainage Study.

VIII. VILLAGE 13 DETENTION BASIN/PARK

The Village 13 Detention Basin/Park was conceptually approved in the Summerlin Village 13 Faith Lutheran Half Street Improvements drainage study (Reference 6) and further refined in the *Faith Lutheran Junior/Senior High School Drainage Study* (Reference 7) and the *Summerlin Village 13 East Conceptual Drainage Study* (Reference 5). Modifications to the size of the existing detention basin and the size of the inlet grate to the existing 5-foot by 4-foot RCB outlet structure were recommended in the *Summerlin Village 13 East Conceptual Drainage Study*. Those modifications are

further refined with this technical study and are included in the grading plan for the modified detention basin.

The output summary for the detention basin is included in the HEC-1 model in Appendix A. The peak 10-year and 100-year inflow to the detention basin and storm drain facilities is 268 cfs and 555 cfs, respectively. The outflow is 219 cfs and 224 cfs respectively. The peak storage occurs at 3.92 hours with a volume of 11 acre feet. The peak stage occurs at elevation 45.7, which is approximately 0.4 feet below existing spillway elevation of 46.1. The detention basin is completely empty after 10.67 hours (640 minutes) in the 100-year event. For the design 6-hour storm, this equates to a drain time of approximately 4.67 hours. To match into existing grades around the new detention basin layout, the embankment elevation varies along the perimeter but in all cases it is higher than the previous design embankment elevation of 49.0. In previous studies, the spillway elevation was proposed at elevation 45.5. At elevation 45.5, approximately 90 cfs was designed to be conveyed over the spillway in the 100-year event to be conveyed to the Faith Lutheran High School site by an existing 48-inch RCP. The existing spillway was approximately constructed at elevation 46.1. Attached Sheet 9 shows as-built elevations for the existing detention basin. With the proposed expansion of the detention basin, runoff will not be conveyed over the spillway in the 100-year event. The detention basin hydraulics have been revised to ensure that the peak flows to the existing Faith Lutheran High School site are equal to or lower than design flows, as determined in the Faith Lutheran Junior/Senior High School Drainage Study (Reference 7).

The detention basin was designed as an offline facility. Minor storm flow events will be conveyed in the storm drain system underneath the detention basin. The majority of flow to the detention basin will be conveyed to the basin from a 72-inch RCP from Town Center Drive. This facility will be constructed with a future phase of construction. The only surface flow directly into the detention basin is the runoff generated in the detention basin/park area itself (13 cfs). The 72-inch RCP from Town Center Drive will junction into an offline 48-inch RCP with a 45-inch orifice plate within the detention basin. The junction of these pipes will not be a normal manhole structure. The junction structure will be designed so that the facilities are offline to dissipate the energy in the flow and regulate the 48-inch RCP to convey flow under orifice control conditions. Flow above the capacity of the 48-inch RCP with 45-inch orifice plate will bubble out into the detention basin through a grate opening in the junction structure. Conceptually, this

structure was approved in the *Summerlin Village 13 East Conceptual Study*, final design of this structure will be submitted with the future improvement plans for that facility.

The 100-year flow of 38 cfs from Parcel A22 will be conveyed to the 72-inch RCP for a combined flow of 528 cfs. Additionally, 27 cfs will be conveyed through the detention basin by a future 24-inch RCP through the Paseo Park and into the 48-inch RCP for a combined inflow to the detention basin of 555 cfs ($490 \text{ cfs} + 38 \text{ cfs} + 27 \text{ cfs} = 555 \text{ cfs}$) in the 100-year event.

Flow above the capacity of the 48-inch RCP with 45-inch orifice plate will be detained in the detention basin and released through a 2-foot by 2-foot grate opening on the existing 5-foot by 4-foot RCB. An existing 10-foot by 10-foot grate collects the flow as an orifice into the existing 5-foot by 4-foot RCB. In the Village 13 East Conceptual Study it was determined that the existing 10-foot by 10-foot grate needs to be replaced with a 2-foot by 2-foot grate to ensure the outflow to the 5-foot by 4-foot RCB is less than 246 cfs, which is the flow used for design of the existing Faith Lutheran High School. The 2-foot by 2-foot size included a 35 percent reduction in clear area for grate steel. This correlates to a clear opening of 2.6 square feet. The actual steel area equates to a 22 percent reduction in clear area of the 2-foot by 2-foot opening. The proposed opening size will be achieved by bolting a steel plate to the existing grates and leaving the required opening uncovered. Outflow through the 2-foot by 2-foot grate opening was calculated using both the weir and orifice equations. The lowest result of the calculations was used as the outflow for the grate.

It should be noted that it was previously requested to design the grate opening with a 50 percent clogging factor. Since this is an offline detention basin (i.e. water will back up into the detention basin), the grate regulates flow into the 5-foot by 4-foot RCB, and capacity of existing downstream facilities is limited, the County previously agreed that the 50 percent clogging factor should not be applied to the grate.

A spreadsheet was created in the *Faith Lutheran Site One Half Street Improvements Drainage Study* and a modified version is included as Table 4 that calculates the flow to the 48-inch RCP with 45-inch orifice plate, the flow to the modified grate opening, and the flow over the spillway based on varying water surface elevations within the detention basin.

SUMMERLIN VILLAGE 13 EAST

PARK/DETENTION BASIN HYDRAULICS

TABLE 4

DETENTION BASIN OUTFLOW: (USING 2' BY 2' GRATED INLET AND 48" RCP TO CONTROL THE AMOUNT OF OUTFLOW)

ELEVATION (ft)	Volume (cu ft)	Volume (ac-ft)	INLET WIDTH (ft)	INLET LENGTH (ft)	OUTFLOW FROM 48" RCP BYPASS WITH 45" ORIFICE OPENING (cfs)	HEAD FOR 48" RCP BYPASS (ft)	FLOW FOR 2'x2' GRATE (WEIR EQUATION) (cfs)	FLOW FOR 2'x2' GRATE (ORIFICE EQUATION) (cfs)	OUTFLOW FROM 2'x2' GRATE (cfs)	OUTFLOW FROM SPILLWAY (cfs)	TOTAL OUTFLOW (cfs)
39.5	0	0.00	2	2	123	7.5	0.0	0.0	0.0		123
40	2004	0.05	2	2	128	8	8.5	11.9	8.5		137
40.5	9874	0.22	2	2	134	8.5	24.0	16.8	16.8		151
41	28078	0.64	2	2	140	9	44.1	20.5	20.5		161
41.5	61473	1.41	2	2	145	9.5	87.9	23.7	23.7		169
42	104295	2.39	2	2	150	10	94.9	26.5	26.5		178
43	184787	4.47	2	2	159	11	157.1	31.4	31.4		191
44	289414	6.64	2	2	168	12	229.1	35.6	35.6		204
45	388275	8.91	2	2	178	13	309.6	39.3	39.3		216
45.5	439877	10.10	2	2	180	13.5	352.7	41.1	41.1		221
46	491479	11.28	2	2	184	14	387.7	42.8	42.8	0.0	227
47	559080	13.75	2	2	185	15	493.0	45.9	45.9	290.7	522
48	654060	15.02	2	2	185	16	594.8	48.9	48.9	997.0	1231
49	708734	16.27	2	2	185	17	702.7	51.7	51.7	2074.2	2311

NOTE: - CAPACITY FOR THE 48" RCP BYPASS WITH 45" ORIFICE OPENING WAS COMPUTED BASED ON THE INLET CONTROL H_{we}.
 - THE INVERT OF THE 48" RCP WAS ASSUMED TO BE AT APPROX. 7.5 FEET BELOW THE BOTTOM OF THE DETENTION BASIN.
 - WEIR EQUATION FOR THE 2'x2' GRATED INLET:

$$Q = CLH^{3/2} \quad \text{WHERE } C = 3.0, L = 8, H = \text{DEPTH AT EACH ELEVATION}$$

- ORIFICE EQUATION FOR THE 2'x2' GRATED INLET WITH 0 CLOGGING FACTOR:

$$Q = C \cdot A \cdot \sqrt{2 \cdot g \cdot H} \quad \text{WHERE } C = 0.67, A = 0.785 \cdot 2^2, g = 32.2, H = \text{DEPTH AT EACH ELEVATION}$$

- OUTFLOW FROM 2'x2' GRATE.

- OUTFLOW FROM SPILLWAY WAS COMPUTED BASE ON WEIR EQUATION FOR THE EXISTING 100' SPILLWAY.

$$Q = CLH^{3/2} \quad \text{WHERE } C = 3.0, L = 100 \cdot 2^2, H = \text{DEPTH OF FLOW}$$

- TOTAL OUTFLOW IS THE SUM OF FLOWS FROM 48" RCP BYPASS, 2'x2' GRATED INLET AND SPILLWAY.

**TABLE 2
STREET FLOW CHARACTERISTICS**

Street*	Width (ft)	Slope (%)	Q ₁₀₀ (cfs)	Depth (ft)	Velocity (fps)	V _{xd}
Sandstone Bluffs Dr. South of Sump (East)	46	0.4	3.5	0.42	1.63	0.7
Park Center Dr.	60	1.5	9	0.46	3.38	1.6
Indigo Road South of Point 6 (West)	66	1.97	4.5	0.37	3.18	1.2
Indigo Road South of Point 6 (East)	66	1.97	2.5	0.31	2.78	0.9
Indigo Road North of Point 6 (West)	66	0.5	7.5	0.45	2.93	1.3
Indigo Road North of Point 6 (West)	66	0.5	7.5	0.45	2.93	1.3
Home Stretch Drive	66	2.0	7	0.34	3.02	1.0

*See Figure 6

Drop inlets were sized using the nomographs contained in the Manual for inlets. For Modified Type "C" inlets on grade, a safety clogging factor was added by assuming that the extended grate portion of the inlet will make up the additional clogging capacity to achieve an overall capacity factor in excess of 50 percent. This approach to inlet sizing has been used in numerous approved drainage studies submitted by G. C. Wallace, Inc. For inlets in a sump condition a 50 percent clogging factor was applied to the full length of the curb and grate opening per the Manual. Calculations for sizing the drop inlets are included in Appendix B and summarized in Table 3.

The proposed storm drain system is shown on Figure 6. The proposed storm drain system was designed and modeled using the combined peak flows from the revised HEC-1 analysis. Hydraulic calculations were performed using Standard Form 6 and are included in Appendix B. The hydraulic grade line and energy grade line are included with the pipe profile in the attached drawings. The starting HGL elevation of 29.24 at the 5-foot by 4-foot RCB was taken from the *Village 13 Faith Lutheran One Half Street Improvements Drainage Study*. This starting HGL should be conservative since it was based on a 100-year flow of 246 cfs in the 5-foot by 4-foot RCB. The current design 100-year flow in the 5-foot by 4-foot RCB is 224 cfs.

That is the overflow from the
detention basin. Need to add
flow from basins to the
North + A 26 + 132 for
A 17.2 or 20.1 cfs

WEST HALF OF INDIGO DRIVE SOUTH OF POINT
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\streets.fm2
Worksheet	66-foot BC to BC
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope		0.019700 ft/ft		
Elevation range: 0.00 ft to 0.88 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	0.88	0.00	52.00	0.016
19.00	0.50			
19.50	0.50			
19.50	0.00			
21.00	0.13			
21.00	0.17			
52.00	0.79			
Discharge	4.50	cfs		

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	0.37	ft
Flow Area	1.41	ft ²
Wetted Perimeter	11.72	ft
Top Width	11.31	ft
Height	0.37	ft
Critical Depth	0.42	ft
Critical Slope	0.007362	ft/ft
Velocity	3.18	ft/s
Velocity Head	0.16	ft
Specific Energy	0.52	ft
Froude Number	1.59	
Flow is supercritical.		

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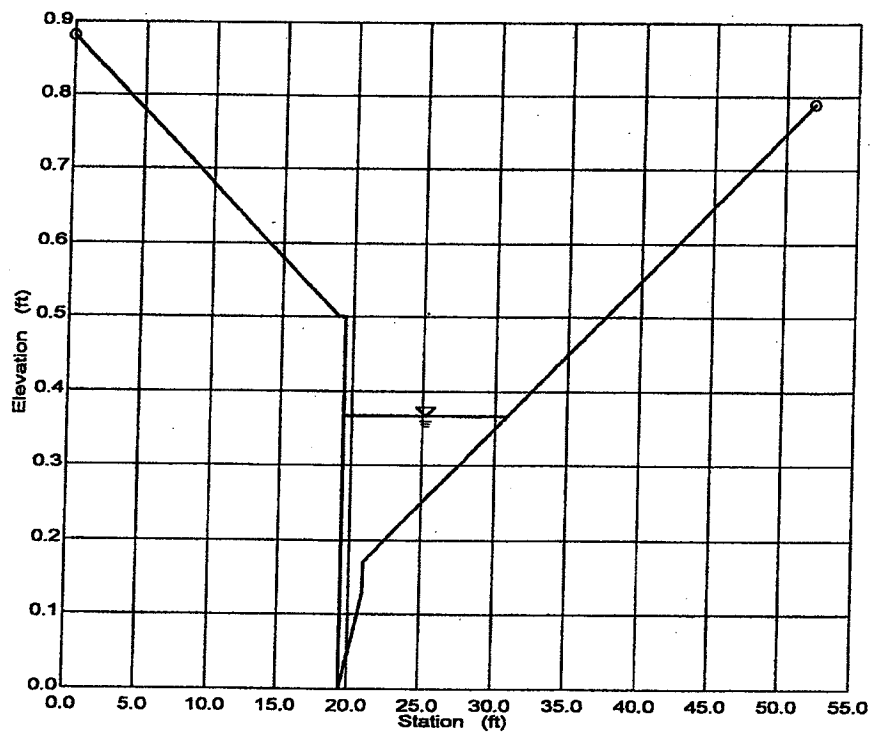
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Haestad Methods, Inc. 37 Brookside Road Waterbury, CT 06708 (203) 755-1666

FlowMaster v5.10
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Cross Section
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\streets.fm2
Worksheet	66-foot BC to BC
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data	
Wtd. Mannings Coefficient	0.016
Channel Slope	0.019700 ft/ft
Water Surface Elevation	0.37 ft
Discharge	4.50 cfs



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EAST HALF OF INDIGO DRIVE SOUTH OF PT 6
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\streets.fm2
Worksheet	66-foot BC to BC
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data				
Channel Slope		0.019700 ft/ft		
Elevation range: 0.00 ft to 0.88 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	0.88	0.00	52.00	0.016
19.00	0.50			
19.50	0.50			
19.50	0.00			
21.00	0.13			
21.00	0.17			
52.00	0.79			
Discharge	2.50	cfs		

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	0.31	ft
Flow Area	0.90	ft ²
Wetted Perimeter	9.10	ft
Top Width	8.73	ft
Height	0.31	ft
Critical Depth	0.35	ft
Critical Slope	0.007958	ft/ft
Velocity	2.78	ft/s
Velocity Head	0.12	ft
Specific Energy	0.44	ft
Froude Number	1.53	
Flow is supercritical.		

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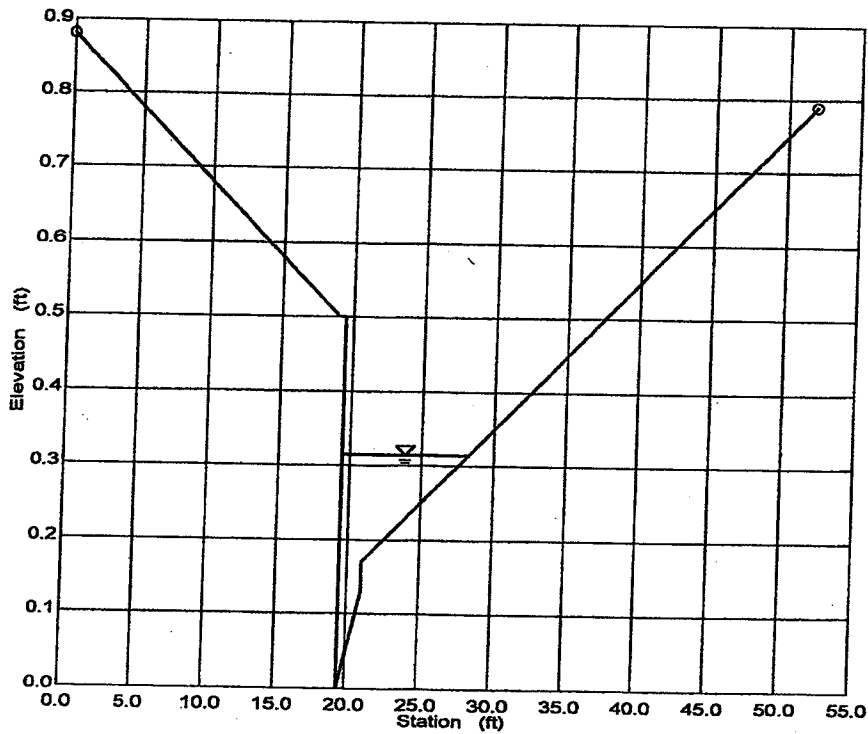
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Cross Section
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\streets.fm2
Worksheet	66-foot BC to BC
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data	
Wtd. Mannings Coefficient	0.016
Channel Slope	0.019700 ft/ft
Water Surface Elevation	0.31 ft
Discharge	2.50 cfs



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Indigo Drive - Pt. 6
Worksheet for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\streets.fm2
Worksheet	66-foot BC to BC
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data					
Channel Slope		0.011500 ft/ft			
Elevation range: 0.00 ft to 0.88 ft.					
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness	
0.00	0.88	0.00	104.00	0.016	
19.00	0.50				
19.50	0.50				
19.50	0.00				
21.00	0.13				
21.00	0.17				
52.00	0.79				
83.00	0.17				
83.00	0.13				
84.50	0.00				
84.50	0.50				
85.00	0.50				
104.00	0.88				
Discharge	15.00	cfs			

Results		
Wtd. Mannings Coefficient	0.016	
Water Surface Elevation	0.45	ft
Flow Area	5.12	ft ²
Wetted Perimeter	32.16	ft
Top Width	31.16	ft
Height	0.45	ft
Critical Depth	0.49	ft
Critical Slope	0.006876	ft/ft
Velocity	2.93	ft/s
Velocity Head	0.13	ft
Specific Energy	0.58	ft
Froude Number	1.27	
Flow is supercritical.		
Flow is divided.		

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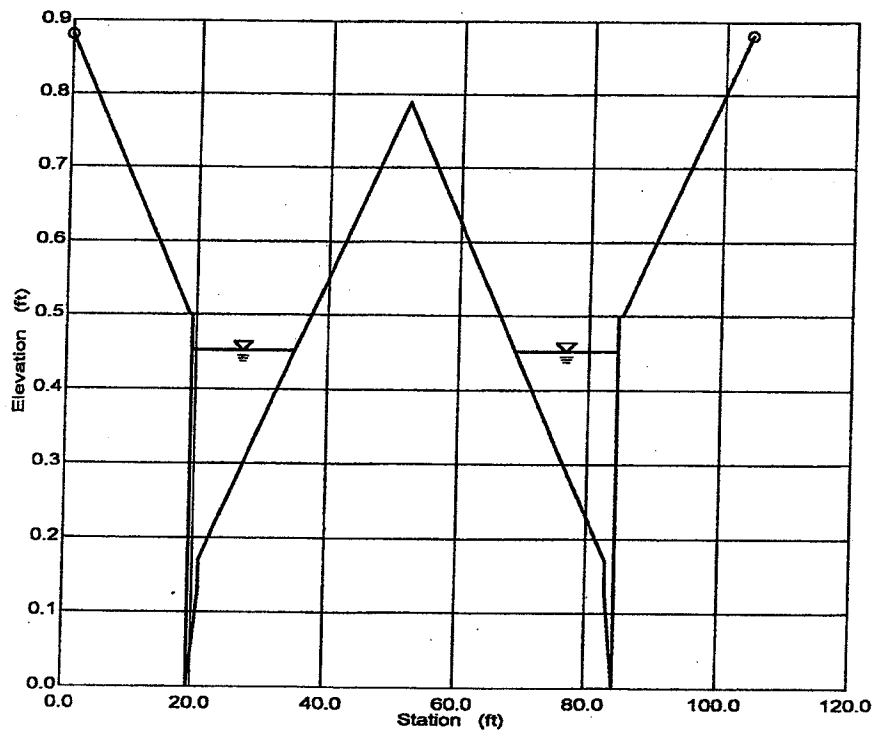
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Cross Section
Cross Section for Irregular Channel

Project Description	
Project File	c:\haestad\fmw\streets.fm2
Worksheet	66-foot BC to BC
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data	
Wtd. Mannings Coefficient	0.016
Channel Slope	0.011500 ft/ft
Water Surface Elevation	0.45 ft
Discharge	15.00 cfs



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