BRYN MAWR STORM DRAIN
DESIGN ANALYSIS REPORT
COA Project No. 784903

FINAL

Prepared for the City of Albuquerque
Department of Municipal Development
Engineering Division
One Civic Plaza
Albuquerque, NM 87103

Prepared by Smith Engineering Company
2201 San Pedro Drive NE, Building 4, Suite 200
Albuquerque, NM 87110

January 17, 2013

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1/17/2013
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Bryn Mawr Storm Drain

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Smith Project #112134

Table of Contents

Appendices

Exhibits

Introduction

The purpose of this Design Analysis Report is to outline the project requirements and conceptual design for the Bryn Mawr Storm Drain Project. The conceptual design included in this report consists of a proposed horizontal and vertical alignment for the storm drain system and appurtenances, associated hydraulic analyses, and the proposed vertical re-alignment of the existing dip section at Bryn Mawr.

1. Written Narrative of Project Requirements

The primary goals of this project are to convey storm flows from Aztec Road through a closed conduit to the Comanche South Park Detention Pond and to construct an all-weather crossing at Bryn Mawr Drive. The scope of this project also includes a water quality component to reduce the amount of floatables and debris in the system. The storm drain system will be designed for the 100-year, 24-hour peak flows.

2. Design Criteria

The City of Albuquerque Development Process Manual (DPM), Volume II contains the design criteria used for this project. For the design presented in this report, Chapter 22 of Volume II (Drainage, Flood Control, and Erosion Control) was used for the storm drain design criteria and Chapter 23 of Volume II (Transportation Design) was used for the roadway design criteria. Table 23.3.1 is referenced for the vertical curve design on Bryn Mawr Drive.

3. Design Analysis Summary

While numerous design options were considered, this report presents only the recommended horizontal and vertical alignment of the proposed storm drain system. The following sections summarize the major design and analyses of the components of the proposed system.

Hydrology

Per the COA's request the hydrologic information required to perform the design analysis presented in this report was obtained from the December 2003 Comanche Park – Phase 1 Drainage Report. As the hydrologic conditions of the area have not changed significantly since the publication of this report no new hydrologic modeling is necessary for this project.

From the Comanche Park – Phase 1 report, the peak discharge rate expected to reach the existing dip section in Aztec Road for the 100-year return period storm event with 24-hour duration is 209 cubic feet per second (cfs). The drainage area map from the Comanche Park report is included in Appendix I of this report. The 209 cfs peak discharge was used as the design flow for the proposed Bryn Mawr storm drain.

While the Comanche Park analysis uses the 24-hour storm event in accordance with the DPM requirements for detention pond design, the DPM requires use of the 6-hour storm for closed conduit design. However, the peak discharge is the same for both the 24-hour and 6-hour storms due to both storm events having the same rainfall distribution (up to six hours) with peak intensity at 1.4 hours.

Hydraulic Analysis

Introduction

The proposed storm drain system will convey runoff that collects at an existing dip section at Aztec just east of Bryn Mawr. The total flow reaching this point is estimated to be 209 cfs during the 100-year, 24-hour storm event. Flow to this point will be from the areas east, south and west of the low point at Aztec Road.

Proposed System Overview

The proposed storm drain system will begin at the existing dip section in Aztec Road with a large inlet structure to collect stormwater runoff. The inlet at Aztec will include a water quality structure to capture floatables and debris. From the inlet structure, flows will be conveyed via closed conduit through the existing drainage easement and under Bryn Mawr Drive. The system will terminate into the existing concrete open channel at the Comanche South Park Detention Pond. This effort looked at several possible alternatives for the storm drain system between the Aztec Inlet Structure and the crossing at Bryn Mawr. Some alternatives considered include dual 43” x 68” (height x width) horizontal elliptical pipe (HEP), a single 53” x 83” HEP, dual 48” x 48” pre-cast concrete box culverts (CBC), a single 48” x 96” CBC, and a single cast-in-place 48” x 96” CBC. Based on information available during the proposal phase, the available drainage easement from Aztec to Bryn Mawr was 50’ wide. A subsequent property survey of the area during this design phase shows that 15’ on either side of the original 50’ wide easement had been vacated as a drainage easement and reclassified as a utility easement only. Only the center 20’ of the original easement has been retained as a City drainage easement. There are 14 property owners adjacent to the easement (including the COA Parks Department at the north end). Of the 13 private property owners, four have re-platted their properties to include the 15’ utility easement. It is reasonable to assume that the other owners may also reclaim that property at some point in time. This would allow them to construct in the easement (walls, flatwork, etc.). While the City has the right to remove any structures on an easement for maintenance of their underlying systems, they have typically tried not to disturb private property and the improvements made on the private property. Previous storm drain options were considered assuming there was a 50’ wide drainage easement available for the storm drain installation and any subsequent maintenance. With the reduction in available drainage easement, the selection of alternatives is driven by not only the hydraulics of the system but also the available space for future maintenance of the system within the 20’ wide easement.

In reviewing the alternatives, the footprint of the system was considered as well as the constructability of the system. The dual 43” x 68” HEP has a footprint of 16 feet (68” width plus 16” for wall thicknesses x 2 pipes plus 3’ between the pipes for installation and access at a later date by a backhoe bucket). This would result in only 1.5 feet on either side of the pipe alignment within the 20’ wide easement. If walls were constructed along the drainage easement, there would be little, if any, room for maintenance of the system in the future. The minimal drainage easement width resulted in consideration of using either pre-cast CBC or cast-in-place CBC to reduce the footprint of the storm drain system. Constructability was looked at in determining whether to use cast-in-place CBC or a pre-cast CBC. The 4’ x 8’ CBC weighs approximately 30,000 pounds per 8’ joint. This about the same weight as a 108” diameter round RCP. The equipment used to place this size of CBC would be either a crane or a large track hoe. We looked at how the CBC would be delivered as well as the ability of the equipment to move about the site. There are power lines on the west side of the easement and there are trees along the alignment on both sides leaving little room to swing the bucket of a track hoe or the boom of a crane. Based on these criteria, it was felt that the cast-in-place CBC would provide the most flexibility for both design and for installation.

Preliminary calculations were performed for various sizes of CBC. After review of flow properties, cover requirements, and flexibility for the design, it was determined that a 48" tall x 96" wide CBC would work best. The CBC will be designed to handle HS-25 loads (fully loaded tractor-trailer) and this loading should be adequate to handle any maintenance vehicle loads in the future. The cast-in-place CBC lends itself to clean and easy transitions from the junction box at Aztec and the transition structure (to get to the twin 2' tall CBCs under Bryn Mawr) east of Bryn Mawr. This type of construction allows for adequate cover over the CBC for the parks department to install an irrigation system over the CBC in the park area in the future.

The proposed CBC is designed to flow with a free water surface (non-pressure) due to the entrance conditions at the proposed Aztec inlet. Non-pressure flow in the system helps to lower the required headwater elevation in the junction box which will minimize ponding in the roadway. Because of the free water surface in the CBC, the Hydraulic Grade Line (HGL) analysis was performed using HEC-RAS and the system was modeled as an open channel. The results show that the system will not pressure up at any point. HEC-RAS was used because the program can easily model transitions and curves in alignment. The results of the HGL analysis are shown on the conceptual plan-and-profile sheet of the system and Appendix III contains the detailed HEC-RAS input and output.

Inlet at Aztec Road

Hydraulic Analysis

Existing Conditions at Aztec Road and the Unlined Channel

Stormwater flows enter the existing earthen channel at Aztec Road via overland flow at the dip section in the road. A complex flow situation is present at the dip section as runoff collects from the east and west and turns north to enter the channel. To simplify the flow situation for design purposes the existing entrance condition into the unlined channel was modeled as a broad-crested weir. Modeling the dip section as a broad-crested weir accounts for frictional resistance across the breadth of the dip section and contraction losses at the overfall. Inclusion of these losses results in a conservative estimate of the anticipated water depth in the road for the design storm event.

To model the weir it was assumed that the entire length of the concrete paved dip section contributes to the weir length (about 60 ft). A weir crest elevation of 5093.50 was used, which is the estimated low point elevation of the dip section determined from the site survey (located on the edge of pavement on the north side of the road). A weir coefficient of 2.64 was selected using Table 5-3 ("Values of *C* in the Formula $Q = CLH^{3/2}$ for Broad-Crested Weirs") from Brater and King's *Handbook of Hydraulics* (6th edition, 1976). A copy of the table is provided in Appendix V. A breadth of 15 feet is the maximum weir breadth provided in the table and was therefore used for the computation. The parameters described above resulted in a Water Surface Elevation (WSE) of approximately 5094.70 WSE in the road for the design storm. We used this elevation and the 60' weir length as the controls for the sizing of the inlet to the proposed junction box at Aztec Road.

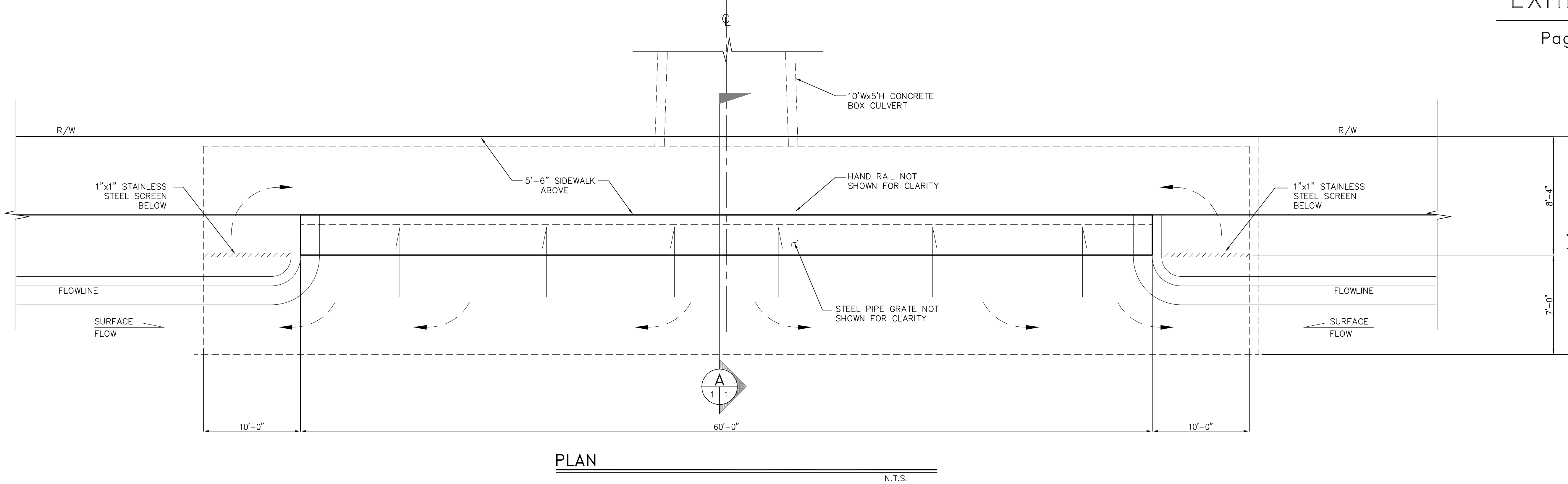
Junction Box Entrance Conditions

As stated above, for existing conditions, the 60' weir length and the 5094.70 WSE were used as the control conditions for the new junction box. The weir model assumes that the length of the weir is a level plane when in reality it is a flat vertical curve. Therefore, instead of a constant depth of 1.2 ft for the 60 ft length of the weir, the water will be slightly deeper at the low point of the dip section and slightly shallower at the east and west edges of the inlet. However, the 60' opening will allow for the 209 cfs to enter the junction box and the existing water elevation in the road will remain the same as current conditions. The proposed steel pipe grate across the junction box entrance will have large openings, which will allow trash to enter the junction box rather than collecting in the roadway and clogging the grate (see Exhibit 1). Therefore, the length of the weir rather than clogging assumptions will control the depth of water entering the inlet in this case. The exact size of the openings will be determined during design.

Proposed Construction of Aztec Junction Box

A large junction box (custom inlet) will be constructed at the dip section in Aztec Road to convey water from the road to the proposed 48" x 96" CBC storm drain. The plan of the junction box is shown on Exhibit 1. This junction box is designed to collect trash and floatables during the low flow events in the drainage basin. Calculations were performed to determine the peak flow rate for a net runoff depth of 0.44 inches. This was selected as this is the runoff depth identified as the amount of runoff that will collect and convey the pollutants in a drainage basin. The 0.44-inch parameter is included in the proposed DPM revisions. Using AHYMO 97, we found that the 1-year, 6-hour storm would produce a net runoff of 0.60 inches resulting in a peak runoff rate of 50 cfs. Therefore, we used the 1-year storm as the control event for analyzing the trash collection system. The output of the AHYMO 97 model is included in Appendix II of this report. The structure at Aztec is designed to intercept and collect the gross pollutants (floatables) contained in this flow. This is accomplished by use of a deflecting baffle that will direct the low flows (and trash that typically accompanies low flows) to a collection chamber.

The profile for the free fall of the runoff into the junction box was plotted using methods described in _Open Channel Flow_ by Henderson, 1966. The calculations from the Henderson text are provided in Appendix II, and supporting reference material is provided in Appendix V. The procedure described in Henderson's _Open Channel Flow_ is derived from empirical data, and provides relative coordinates for the upper and lower streamlines of a free overfall jet based on a given flow's critical depth. For purposes of this report and selection of the required baffle elevation, only the upper streamline flow profile was determined. Using the method outlined in _Open Channel Flow_ the brink depth of the 50 cfs runoff was computed to be 0.20 feet (elevation 5093.70'). In the same manner, additional flow profile coordinates were computed. The lowermost flow profile coordinate provided in the Henderson text for the upper streamline is at the crest elevation of the free overfall (elevation 5093.50'). For this report, however, the flow profile *below* the crest elevation is of greatest interest. Therefore, to determine the flow profile below the weir crest elevation of 5093.50, a best-fit curve was created from the flow profile coordinates computed within the range included in Henderson's text. Using the best-fit curve equation the data was extrapolated out to determine the necessary height and horizontal distance from the weir crest for the proposed baffle to deflect flows into the trash collection chamber. The *top* of the baffle is at elevation 5092.00' while the top of the flow profile will contact the deflecting baffle at elevation 5089.36' (4.14' feet below the drop-off elevation and 2.64' below the top of the baffle). The baffle will effectively catch floatables on the water surface in this event. The deflecting baffle will then direct runoff and floatables back under the road into a collection chamber. The flow in the collection chamber will be directed east and west to the ends of the chamber. Stainless steel screens with 1" openings will keep the trash from moving into the main flow chamber that outfalls to a 5' X 10' CBC entry that will transition into the 8' x 4' CBC storm system. Manhole covers will be placed at the east and west ends of the collection chamber to allow vactor truck access to remove the trash form the chamber. As the water surface in the collection chamber rises, the trash will also rise. This would occur under higher runoff rates into the structure. The increased runoff into the structure would result in a jet of water falling directly into the main chamber and by-passing the deflecting baffle. This flow over the deflecting baffle will create a roller in the collection chamber thereby keeping the trash in the collection chamber.



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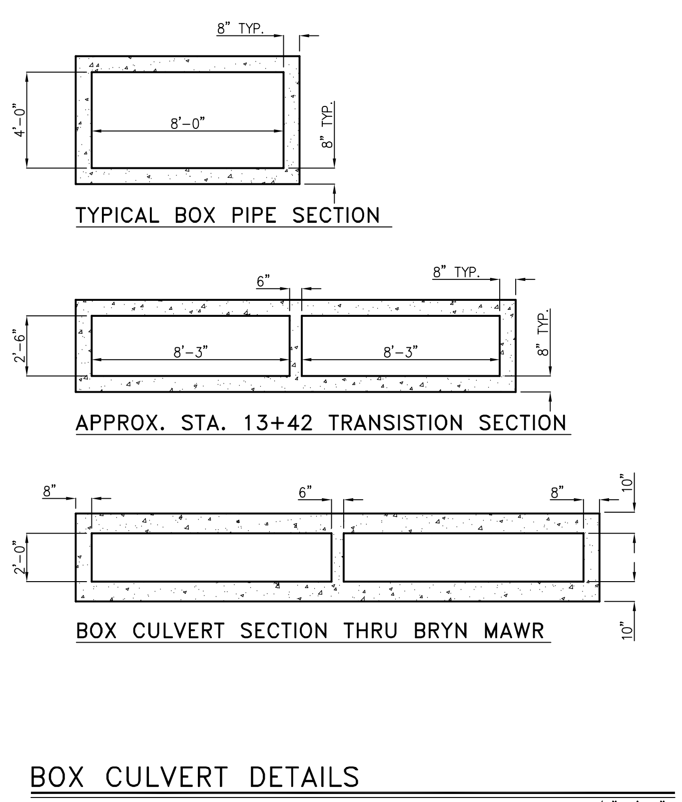
N.T.S.



BOX CULVERT DETAILS
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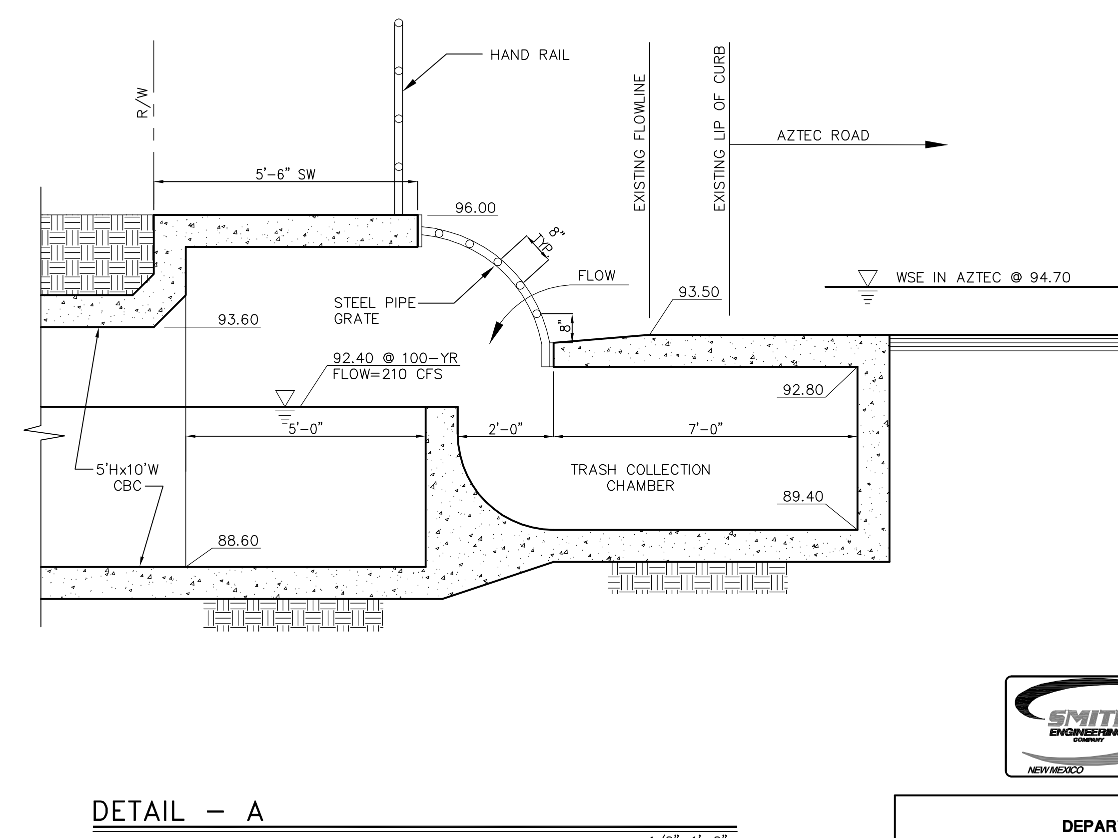

DETAIL – A
1/2"=1'-0"

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NO.	FIELD NOTES BY	DATE
11599	SURVEYING CONTROL	07/12

BENCH MARKS
C.O.A. CONTROL STATION "P 225"
(PUBLISHED ELEV. = 5102.670') NAVD 88.
COORDINATES ARE MODIFIED (SURFACE)
NM STATE PLANE COORDINATES
CENTRAL ZONE, NAD 83.

NOTE:
THIS DRAWING AT 11"x17" = 1/2 OF SHOWN SCALE

CITY OF ALBUQUERQUE
DEPARTMENT OF MUNICIPAL DEVELOPMENT
ENGINEERING DIVISION

TITLE: **BRYN MAWR STORM DRAIN DESIGN ANALYSIS REPORT**
AZTEC INLET

City Project No.	Zone Map No.
784903	G-16-Z

A 30’ long transition structure will be constructed on the north end of the junction box to direct flows into the 4’ x 8’ CBC. The opening into the transition structure at the junction box will be 5’ tall x 10’ wide to keep the headloss to a minimum in the junction box. The calculated WSE at the entrance to the 5’ x 10’ transition will be 5092.42’.

Proposed Storm Drain System

The proposed storm drain system from the junction box at Aztec Road to the transition structure east of Bryn Mawr is a 4’ tall x 8’ wide cast-in-place CBC at a slope of 0.005 ft/ft. The layout of this system is shown on Exhibit 2. A HEC-RAS analysis was performed for this system and the resulting typical non-pressure flow properties in the CBC are as follows:

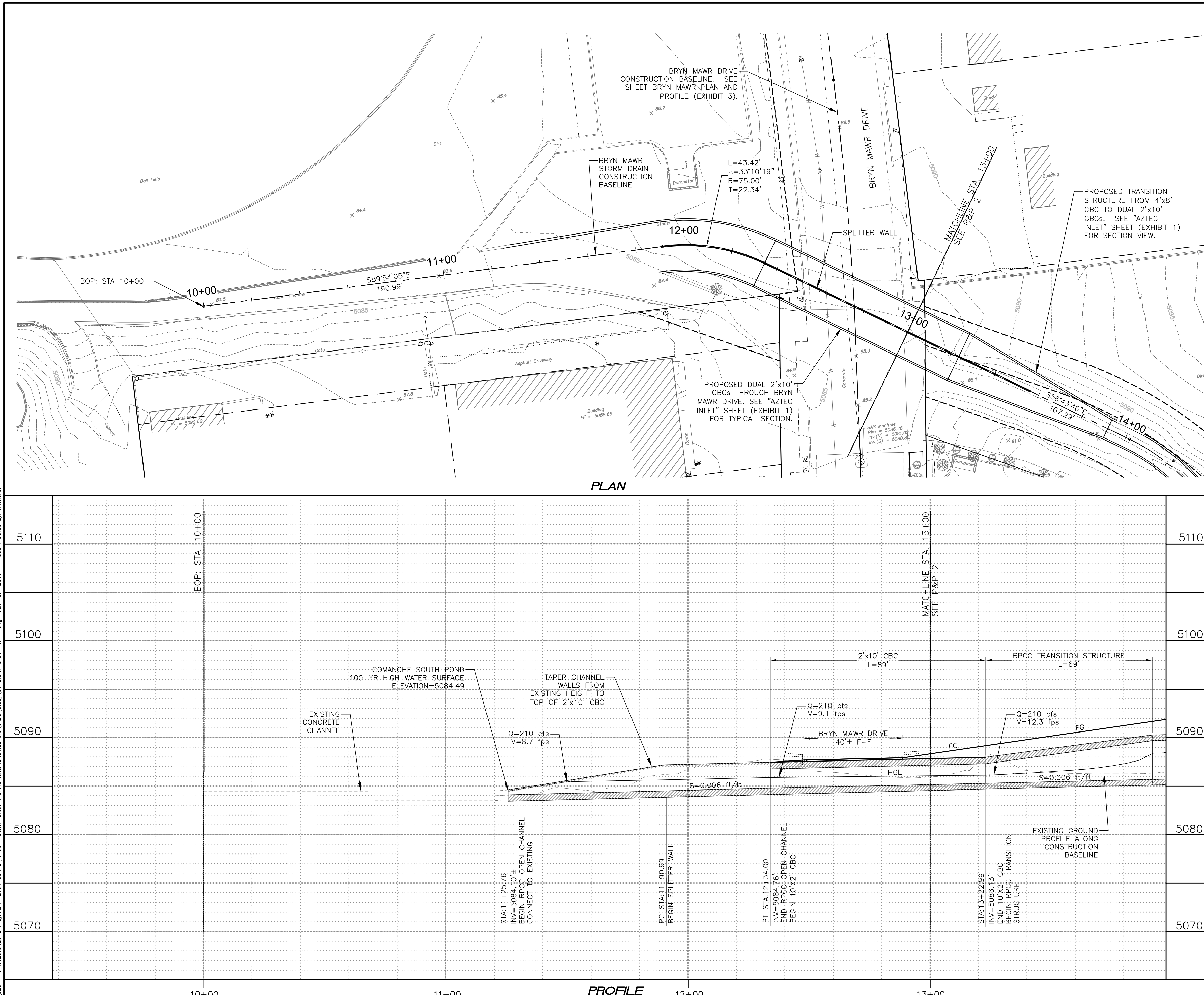
100-year flow rate = 209 cfs
Manning’s “n” = 0.015
Slope = 0.005 ft/ft
Normal depth, y_n = 2.72 ft
Velocity = 9.60 fps
Froude number = 1.03
Flow regime = Supercritical

The proposed storm drain alignment will be constructed north from the Aztec junction box along the centerline of the existing drainage easement. Two manhole ring and covers will be cast directly in the top of the CBC along this portion of the storm drain. Along the north-bearing portion of the easement, the existing top of channel on the west side is generally lower than the top of channel on the east side. Runoff from the properties on the west side of the channel has historically discharged into the channel. Modifications made to the existing drainage easement must maintain positive drainage from these properties into the easement to maintain the historical drainage patterns of the adjacent properties. The proposed CBC will be designed to handle HS-25 loading with no cover, however, we propose that some cover be placed over the box for aesthetic purposes. The minimal cover will allow the grade in the channel to be kept at the lowest possible elevation which will, in turn, allow flows from adjacent properties to be drained into the CBC via inlets as required along the alignment. The type and location of these inlets will be determined during the design phase.

As discussed in the proposal phase of this project it is the intent of the COA to expand Lafayette Park by incorporating the existing drainage and utility easements into the park. From the existing retaining wall at Lafayette Park, the existing ground slopes downward to the drainage easement at an average slope of about 0.08 ft/ft. With future development in mind, the storm drain alignment is pulled to the northeast (uphill) as it approaches Lafayette Park. A wide-sweeping curve is used to pull the alignment uphill while also beginning to direct it west toward Bryn Mawr Drive. This alignment is proposed so that there will be adequate cover over the CBC through Lafayette Park for installation of sod and irrigation lines. In doing so, the proposed CBC alignment will move off of the center of the existing 20’ drainage easement and into the 15’ utility easement on the north/east side of the drainage easement. While the alignment will be shifted out of the 20’ drainage easement, the storm drain system will not be located on any private property. The proposed alignment assumes that the COA Parks Department will permit the storm drain to extend beyond the limits of the drainage easement at both Lafayette and Comanche Parks.

EXHIBIT 2

Page 7



NOTE: IF THIS SHEET IS OTHER THAN 11"X17", UTILIZE BAR SCALE IN LIEU OF NUMERIC SCALE.

SCALE: 1" = 40'

SCALE: 1" = 10'

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CITY OF ALBUQUERQUE
DEPARTMENT OF MUNICIPAL DEVELOPMENT
ENGINEERING DIVISION

TITLE: **BRYN MAWR STORM DRAIN DESIGN ANALYSIS REPORT**

STORM DRAIN PLAN AND PROFILE 1

STA. 10+00 TO 13+00

City Project No.	Zone Map No.
784903	G-16-Z

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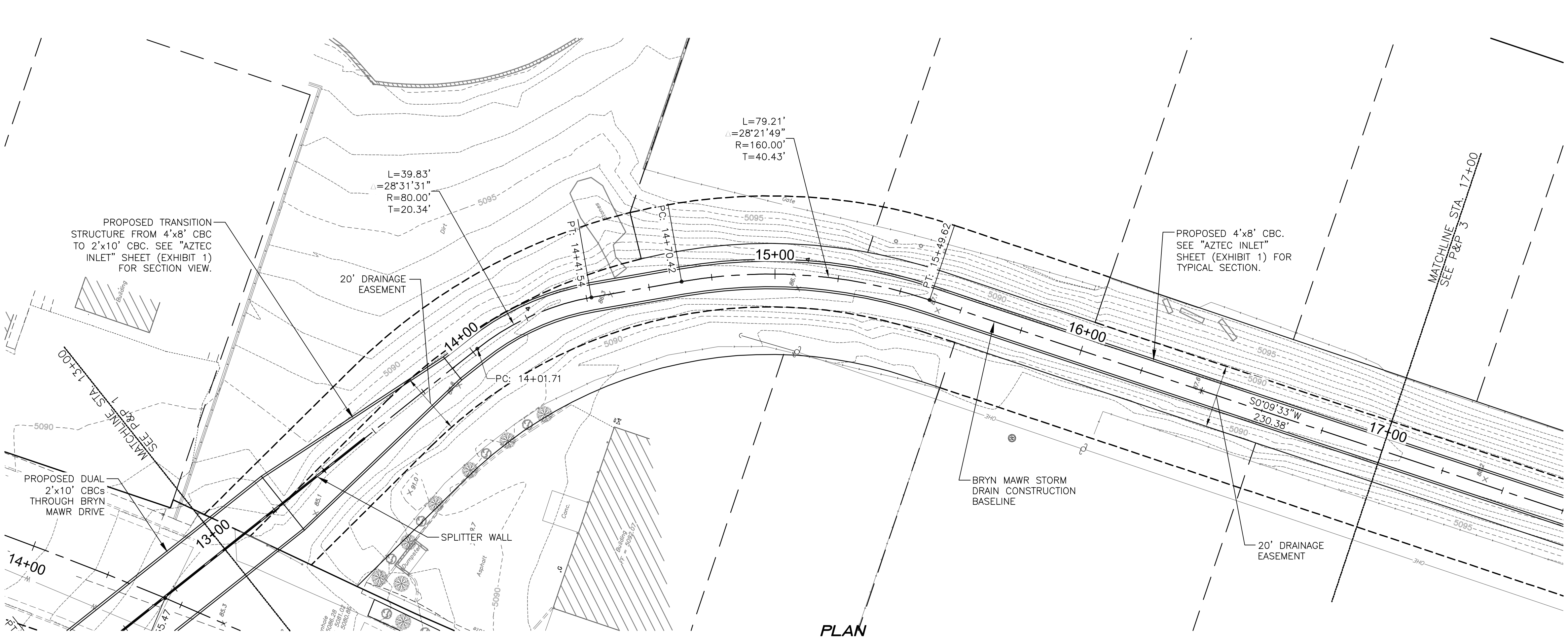
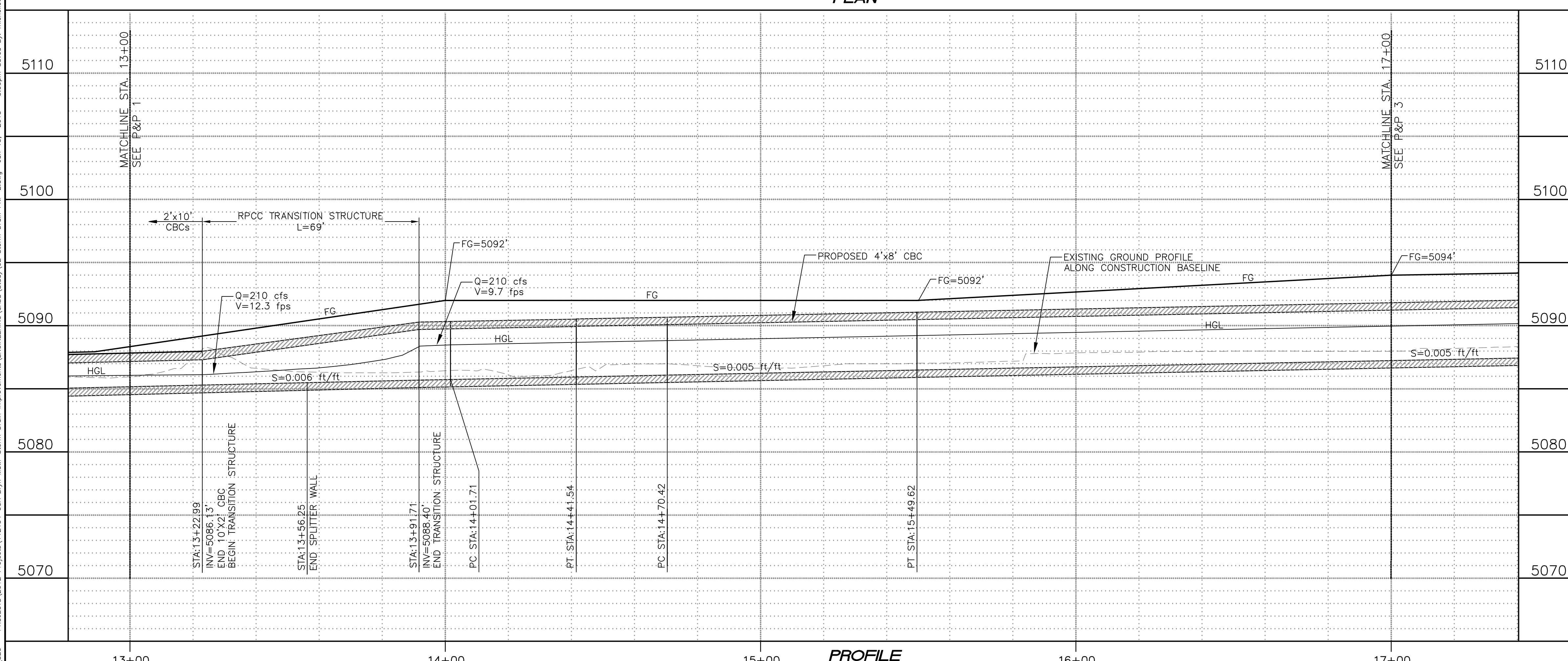
EXHIBIT 2

Page 8





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ENGINEERING DIVISION

TITLE: BRYN MAWR STORM DRAIN DESIGN ANALYSIS REPORT

STORM DRAIN PLAN AND PROFILE 2

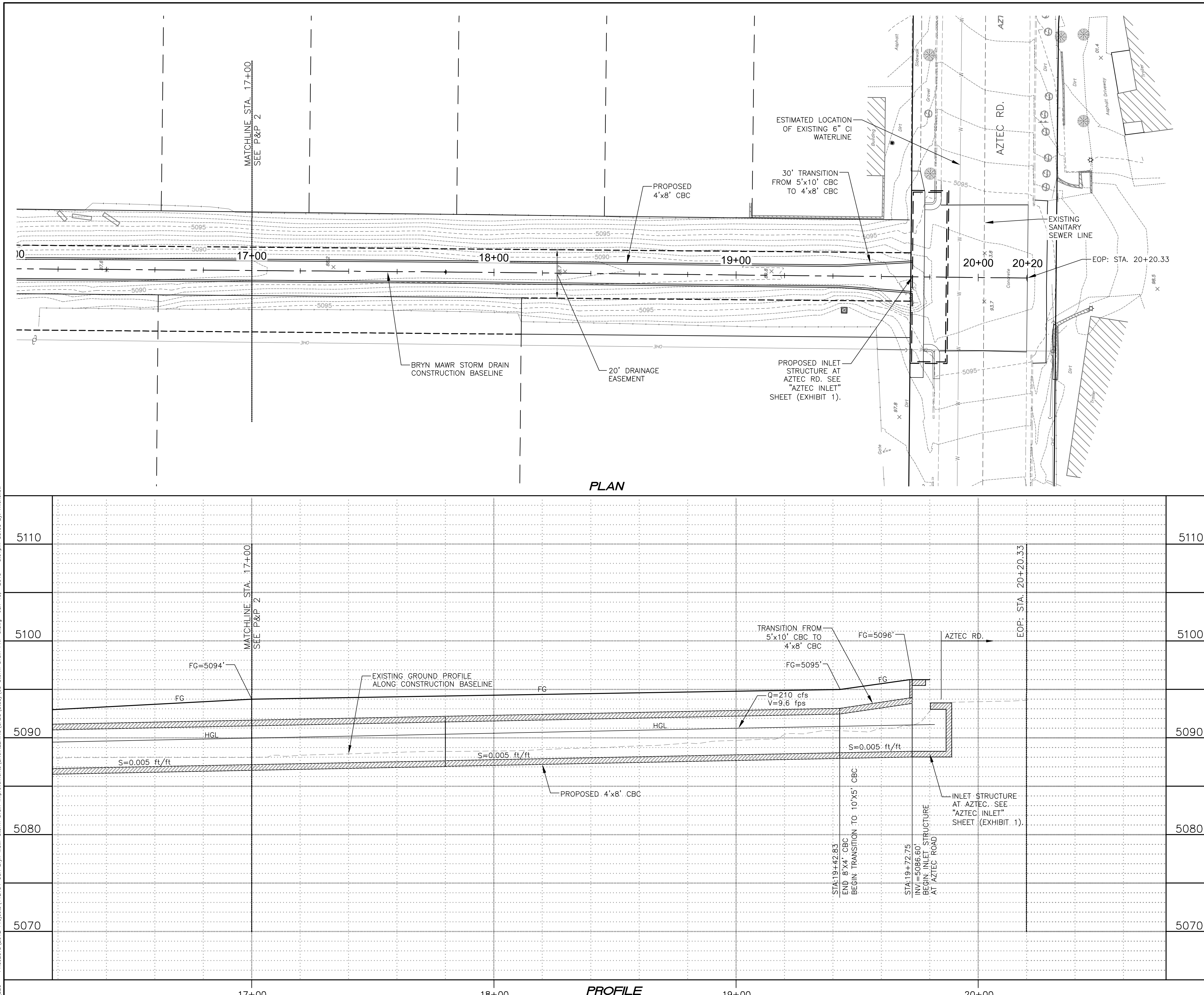
STA. 13+00 TO 17+00

City Project No. 784903

Zone Map No. G-16-Z

EXHIBIT 2

Page 9



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DEPARTMENT OF MUNICIPAL DEVELOPMENT
ENGINEERING DIVISION

TITLE: BRYN MAWR STORM DRAIN DESIGN ANALYSIS REPORT

STORM DRAIN PLAN AND PROFILE 3

STA. 17+00 TO 20+20

City Project No. 784903

Zone Map No. G-16-Z

Transition Structure

A 69’ transition structure is proposed from Sta. 13+92 to Sta. 13+23 in Lafayette Park. This transition will connect the 4’ x 8’ CBC to the dual 2’ tall x 10’ wide CBCs that will be constructed under Bryn Mawr. The transition length was determined using the City of Albuquerque Development Process Manual (DPM) requirements for divergence angles and transition lengths in open channels. A splitter wall will be constructed in the transition at approximately 35’ down from the 4’ x 8’ CBC. This will split the 209 cfs design flow into 105 cfs for each of the 2’ x 10’ CBCs under Bryn Mawr to reduce the WSE in each of those CBCs.

Twin 2’ x 10’ CBCs Under Bryn Mawr

Once the transition structure has terminated, twin 2’ x 10’ CBCs (89’ long) will cross under Bryn Mawr Drive. The proposed CBC crossing at Bryn Mawr is located north of the existing drainage crossing (low point) in the road. The horizontal alignment of the proposed CBC crossing is controlled by the upstream alignment of the system through Lafayette Park. The height of the CBCs is controlled by the elevation of Bryn Mawr Drive at the horizontal alignment crossing. The vertical re-alignment of Bryn Mawr is limited by the fact that properties on all quadrants where the current drainage easement crosses Bryn Mawr are fully developed. The COA Parks Department property, Comanche Park, located on the NW quadrant could be raised to a level allowing for deeper CBCs under Bryn Mawr. However, the properties at the other three quadrants are limited in vertical adjustments due to existing building finish floor elevations. The building located on the southwest quadrant is the controlling finish floor elevation and is 5088.85. The vertical re-alignment of Bryn Mawr will accommodate drainage from the building to the road thereby limiting the height to which the road can be raised. See the section on the Bryn Mawr re-alignment for more discussion.

Low Flow Channel

The low flow channel will begin at the CBC’s termination (Sta. 12+34) and will connect to the existing low flow channel at the Comanche South Park Detention Basin. A slope of 0.006 ft/ft can be achieved. The walls on the upstream end of the low flow channel will be built up to match the height of the box culvert to help contain the water and prevent overtopping. The walls will gradually decrease in height to match the existing wall heights.

Vertical Realignment of Bryn Mawr Drive

The existing dip section in Bryn Mawr Drive will be altered as part of this design effort to bring the vertical geometry of the roadway into compliance with current COA roadway standards and to accommodate the proposed alignment of the twin 2’ x 10’ CBCs under Bryn Mawr.

The “K” values for the existing dip section were estimated by creating a roadway profile that best fit the existing ground profile created from the site survey topographic data. The existing roadway profile contains a sag vertical curve with an estimated “K” value of 5. The existing crest vertical curves on the north and south ends of the sag vertical curve have “K” values of approximately 7 and 14, respectively. Bryn Mawr Drive is classified as a local industrial /commercial street and as such the DPM requires a “K” value of 30 for crest curve stopping sight distance and a “K” value of 40 for sag curve stopping sight distance. Bryn Mawr Drive will be modified in accordance with the specified “K” values.

In addition to meeting the DPM transportation design requirements, the proposed roadway profile must also meet criteria related to the drainage design aspects of this project. Alteration of the roadway profile is controlled by three key parameters: maintenance of historical drainage allowances from the surrounding properties into the city right-of-way, height of the proposed CBCs, and COA design standards. Raising the low point of the dip section will improve the sight distance and provide the necessary clearance for the proposed CBCs through Bryn Mawr. However, the vertical re-alignment is limited by the finished floor elevations of the properties on the northeast, southeast, and southwest quadrants of the storm drain alignment's intersection with Bryn Mawr Drive. Runoff from these properties drains to the roadway, into the existing dip section, and into the existing concrete channel at the Comanche South Park Detention Basin. The controlling finished floor elevation is 5088.85 at the property on the southwest quadrant. In order for runoff from this property to drain to Bryn Mawr, the low point in the roadway should be no higher than 5088.00. This should allow for a slope of about one percent across the property's parking lot and into the road. The proposed low point elevation represents a vertical increase of about 2.75' from the existing low point elevation of 5085.27. The adjusted low point elevation also allows enough clearance for a 2' tall CBC under Bryn Mawr Drive.

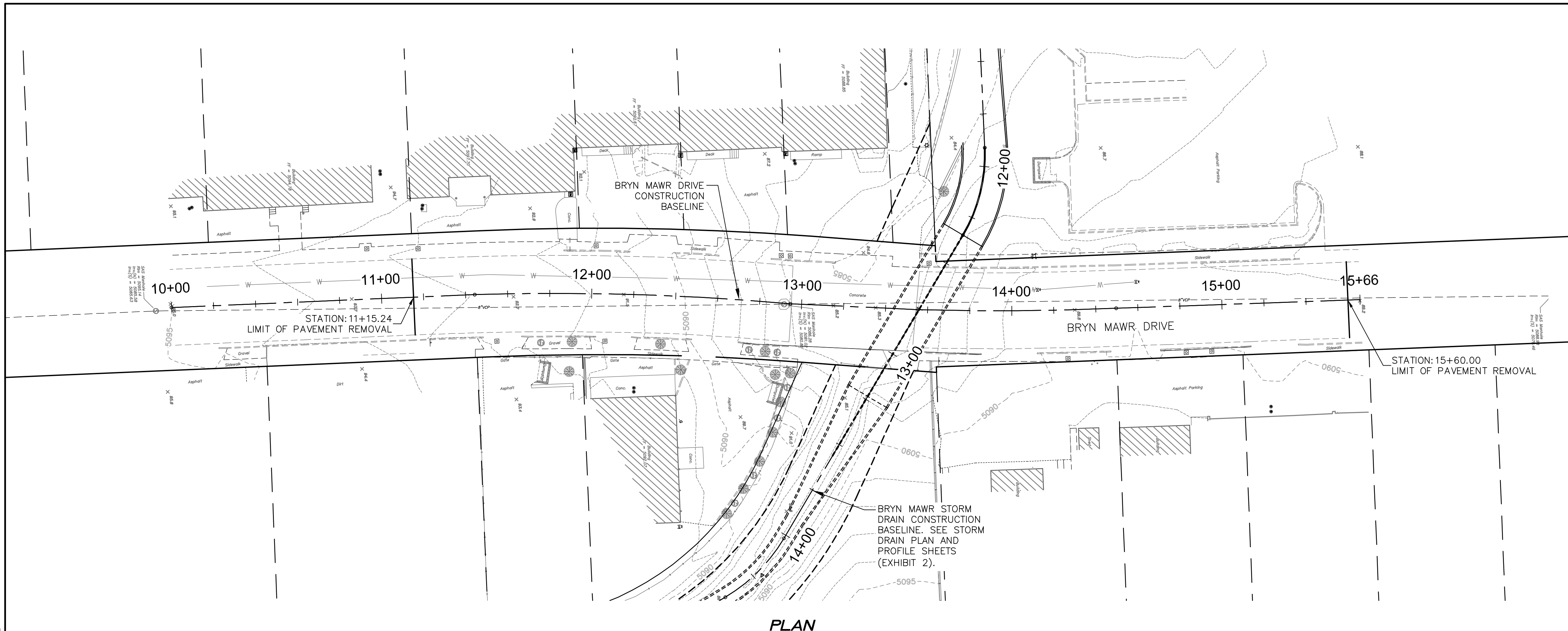
At the proposed low point elevation, a 220' long vertical curve will be required to meet the "K" value criterion of 40 for a sag curve. A crest vertical curve will be required on each end of the sag vertical curve to tie into existing grades per COA standards. The "K" values of all three vertical curves are approximately 45, and all three curves meet the minimum vertical curve length of 90 feet. The proposed improvements will require a total of approximately 450 linear feet of pavement removal and replacement within the city right-of-way. The proposed roadway profile is shown on Exhibit 3. As shown on Exhibit 3, the new low point will be approximately 50 feet north of the existing low point. Moving the low point to the north will help to reduce impact of the new vertical alignment of the roadway on adjacent properties. The proposed roadway modifications will affect the three properties on the northeast, southeast, and southwest quadrants of the storm drain alignment's intersection with Bryn Mawr Drive. If the horizontal location of the existing low point in the road is maintained, the proposed roadway profile will shift south about 50 feet. Doing so will cause at least two more properties to the south to be affected. Shortening the vertical curve lengths to avoid impacting additional properties will cause the vertical curves to be out of compliance with COA design criteria (the sag curve will not meet the "K" value criterion, and the crest curves will not meet the minimum length criterion). Paving and flatwork on the affected properties will have to be re-graded and reconstructed due to the change in the vertical profile of Bryn Mawr. Temporary construction easements will be necessary to re-grade the parking lots of the affected areas.

4. Real Estate Acquisition Needs

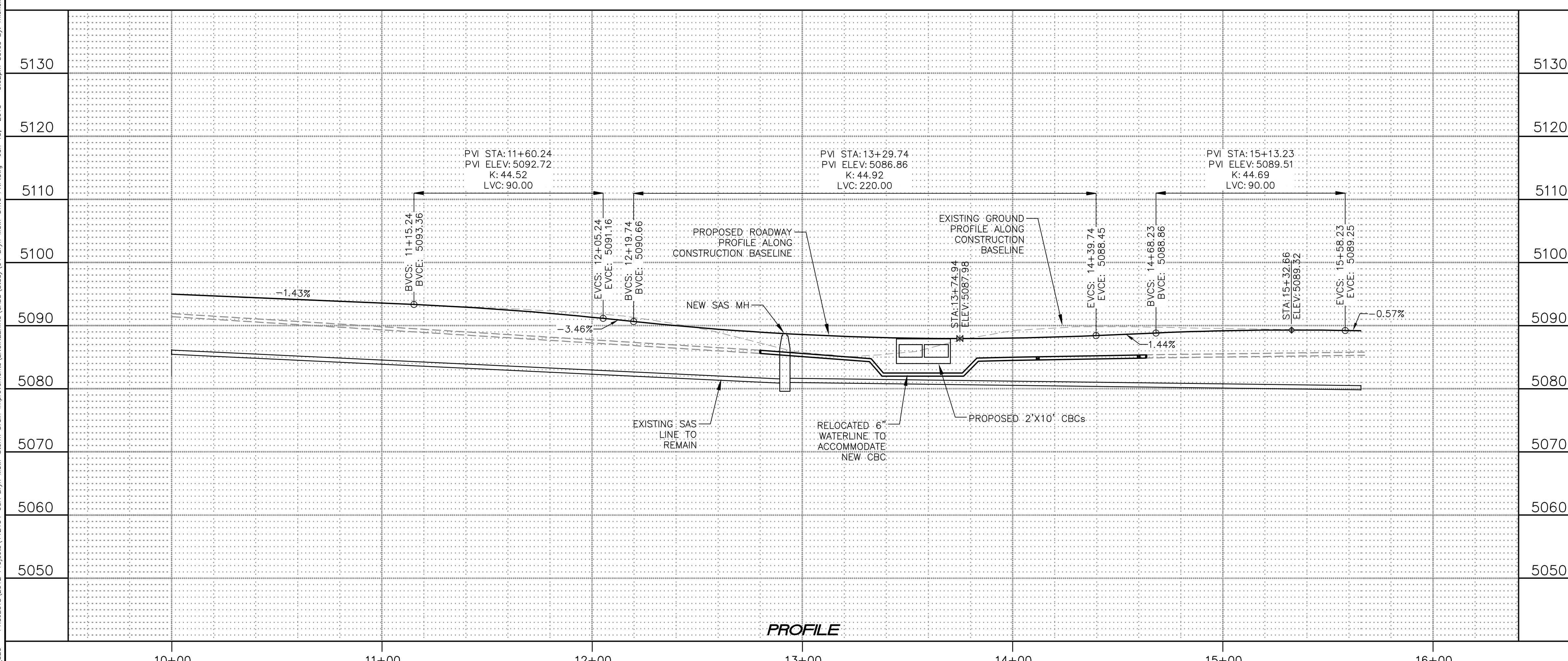
Temporary Construction Easements (TCEs) will be required to construct the project. These TCEs locations and areas are shown in Exhibit 4. The total area is approximately 14,612 square feet (SF). Based on a SF cost of $9.00, the estimated cost for TCEs is $131,508. The TCEs should be obtained prior to the start of any construction.

EXHIBIT 3

Page 12



PLAN



PROFILE

NOTE: IF THIS SHEET IS OTHER THAN 11"X17", UTILIZE BAR SCALE IN LIEU OF NUMERIC SCALE.

SCALE: 1" = 60'

SCALE: 1" = 20'

BENCH MARKS

C.O.A. CONTROL STATION "P 225"
(PUBLISHED ELEV. = 5102.670') NAVD 88.
COORDINATES ARE MODIFIED (SURFACE)
NM STATE PLANE COORDINATES
CENTRAL ZONE, NAD 83.

SURVEY INFORMATION

FIELD NOTES		
NO.	BY	DATE
11599	SURVEYING CONTROL	07/12

SEC JOB # 112134

SMITH ENGINEERING COMPANY
SOLUTIONS FOR TODAY... VISION FOR TOMORROW
2201 San Pedro Dr. NE
Building 4, Suite 200
Albuquerque, NM 87110
Phone: (505) 884-0700
Fax: (505) 884-2376
NEW MEXICO TEXAS

CITY OF ALBUQUERQUE
DEPARTMENT OF MUNICIPAL DEVELOPMENT
ENGINEERING DIVISION

TITLE: BRYN MAWR STORM DRAIN DESIGN ANALYSIS REPORT
BRYN MAWR DRIVE PLAN AND PROFILE SHEET
STA. 10+00 TO 15+66

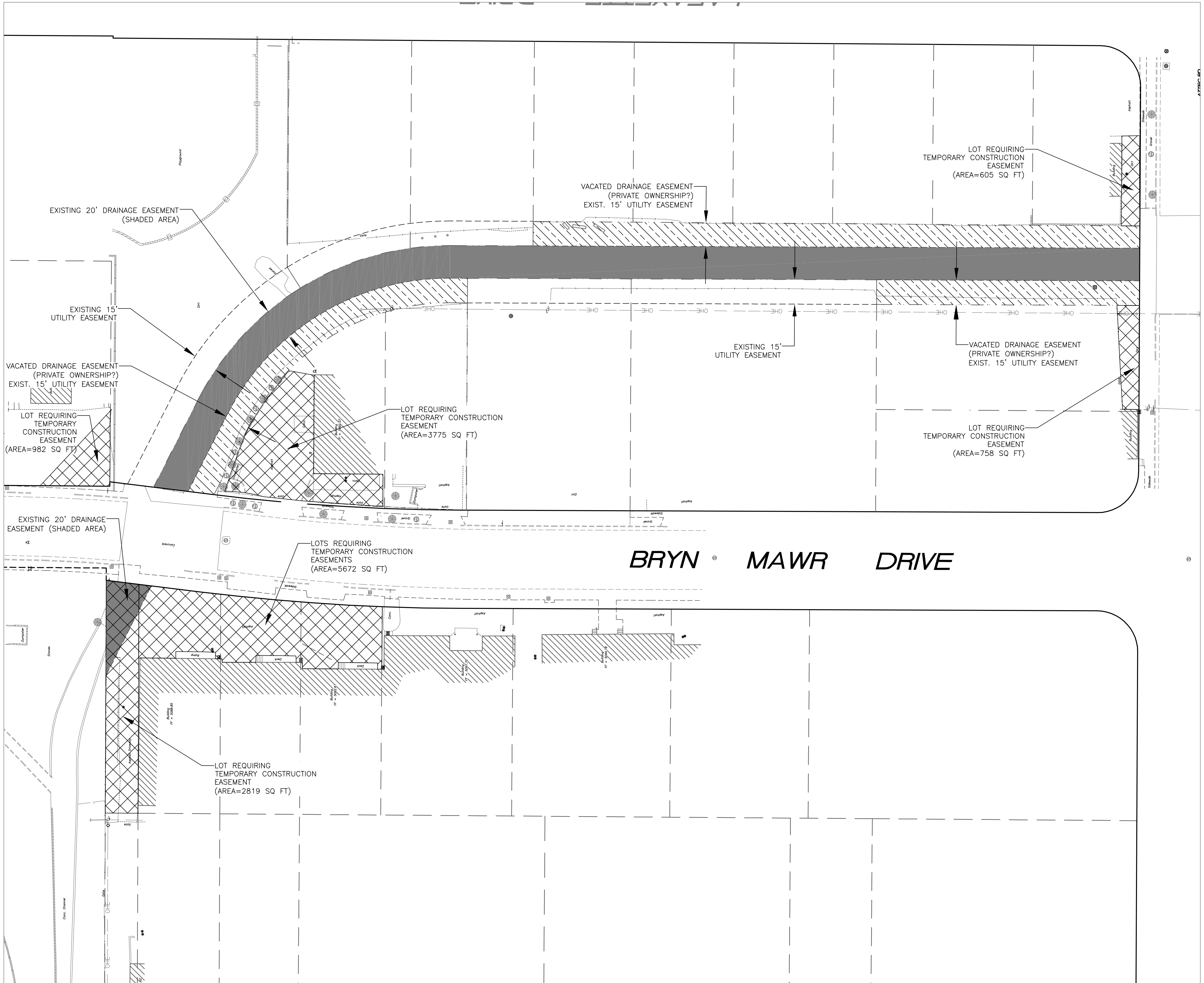
City Project No. 784903

Zone Map No. G-16-Z

Q:\SEC---PROJECTS\2012 Projects\112134 COA Bryn Mawr Storm Drain Improvements\ENGINEERING\CADD\Study\04 Bryn Mawr Drive PNP.dwg Jan 15, 2013 - 5:02pm Saved By: michellew

EXHIBIT 4

Page 13



NOTE: IF THIS SHEET IS OTHER THAN 11"X17", UTILIZE BAR SCALE IN LIEU OF NUMERIC SCALE.

30' 15' 0 30' 60'

SCALE: 1" = 60'

SEC JOB # 112134

SMITH ENGINEERING COMPANY — SOLUTIONS FOR TODAY... VISION FOR TOMORROW — 2201 San Pedro Dr. NE, Building 4, Suite 200, Albuquerque, NM 87110, Phone: (505) 884-0700, Fax: (505) 884-2376 — NEW MEXICO — TEXAS

SURVEY INFORMATION

FIELD NOTES			BENCH MARKS
NO.	BY	DATE	
11599	SURVEYING CONTROL	07/12	C.O.A. CONTROL STATION "P 225" (PUBLISHED ELEV. = 5102.670') NAVD 88. COORDINATES ARE MODIFIED (SURFACE) NM STATE PLANE COORDINATES CENTRAL ZONE, NAD 83.

CITY OF ALBUQUERQUE
DEPARTMENT OF MUNICIPAL DEVELOPMENT
ENGINEERING DIVISION

TITLE: **BRYN MAWR STORM DRAIN DESIGN ANALYSIS REPORT**

TEMPORARY CONSTRUCTION EASEMENTS

City Project No.	Zone Map No.
784903	G-16-Z

5. Potential Utility Conflicts

Gas

There is an existing 2" high pressure coated steel gas line in the eastern half of Bryn Mawr Drive running in the north-south direction. Assuming a 2 to 3 foot depth of bury, this gas line will need to be lowered to accommodate the proposed concrete box culvert in Bryn Mawr Drive. Some service lines may also be affected. It is believed that the gas line in Bryn Mawr is outside of the city right-of-way and the Gas Company of New Mexico will charge the City for this relocation. It is recommended that this relocation occur prior to the start of the construction.

Power

An existing overhead electric line runs parallel to the existing drainage easement on the western side. Relocation of the utility poles is not anticipated as they are located outside of the estimated construction area. There should be no concerns regarding construction in the proximity of the overhead lines.

Communications

There are two direct bury copper cables (3/4" and ½") located on the east side of Bryn Mawr in the right-of-way (ROW) that may have to be relocated. However, because it is in the ROW, this will be relocated under the franchise agreement with the communications company.

Sewer

There is an 8" sanitary sewer line in Bryn Mawr Drive that can remain at its current vertical location.

Water

An existing 6" cast iron waterline in Bryn Mawr Drive will need to be lowered to accommodate the proposed concrete box culvert. An existing fire hydrant on the west side of Bryn Mawr north of the proposed box culvert will require a new valve and line to connect to the lowered 6" waterline. Two new water meters and water service lines will be required. Because these are located in the COA ROW, the cost for these relocations will be the responsibility of the Albuquerque Bernalillo County Water Utility Authority (ABCWUA).

6. Outline of Specifications Content

The City of Albuquerque Standard Specifications for Public Works Construction, Update 8 will be used for this project. We do not anticipate that any special specifications will be required for this project.

7. Special Materials and Equipment Specifications and/or Labor and Materials to be Furnished by the City

No special materials, equipment, or labor will be required for this project.

8. Preliminary List of Plan Sheets

01 – Cover Sheet
02 – General Notes
03 – Existing Site Survey/Survey Control Information
04-05 – Removal Sheets
06-09 – Plan and Profile Sheets for Storm Drain
10 – Plan and Profile Sheet for Bryn Mawr Drive
11 – Grading and Drainage Sheet for Private Properties
12-13 – Details
14-15 – Suggested Traffic Control Plan

9. Conceptual Construction Cost Estimate

A Conceptual level "Opinion of Estimated Construction Cost" was prepared based on the proposed project design. The unit prices for the estimate were, generally, taken from the City of Albuquerque "City Engineer's Estimated Unit Prices for Contract Items 2009". This is the latest cost estimating book from the City and increases were made to unit costs to account for the date of the document. Some of the unit costs were based on the current bidding climate in Albuquerque. The estimate includes the following items:

- Anticipated removals and reconstruction on private property
- Removal and reconstruction of Bryn Mawr
- Waterline removal and relocation for ABCWUA line in Bryn Mawr
- Drainage system
- Utility relocation allowance
- Project sign screening allowance
- Materials testing allowance

The total opinion of estimated construction cost for the project is $1,201,546. This includes a 15% contingency and 7% NMGRT rate. This estimate does not include any costs for Temporary Construction Easement costs. The estimate is included in Appendix IV.

APPENDIX I

Drainage Basin Map and AHYMO Basin Parameter Worksheets from Comanche Park – Phase I Drainage Report

ANALYSIS POINT SUMMARY TABLE

ANALYSIS POINT	CONTRIBUTING BASINS	Q(2) (24-HR) (cfs)	V(2) (24-HR) (ac-ft)	Q(5) (24-HR) (cfs)	V(5) (24-HR) (ac-ft)	Q(10) (24-HR) (cfs)	V(10) (24-HR) (ac-ft)	Q(100) (24-HR) (cfs)	V(100) (24-HR) (ac-ft)
1	PS-1	79	3.18	109	4.47	133	5.47	209	8.87
2	PS-1 & PS-2	84	3.58	118	5.05	145	6.19	231	10.05
3	PS-3	7	0.28	9	0.39	11	0.47	17	0.75
4	PS-1, PS-2, PS-3, & PS-4 (TOTAL FLOW INTO SOUTH POND)	93	3.91	135	5.60	175	7.00	345	12.46
5	PN-1 & PN-2	35	1.47	49	2.08	59	2.56	95	4.20
6	PN-1, PN-2, PN-3, & PN-4	44	1.88	62	2.67	76	3.29	122	5.41
7	PN-1, PN-2, PN-3, PN-4, PN-5, PN-6, PN-7, & PN-8	60	2.56	84	3.64	102	4.49	165	7.37
8	PN-9	18	0.67	29	1.03	37	1.33	65	2.41
9	PN-9 & PN-10	8	0.68	12	1.07	16	1.39	26	2.54
10	PN-11	15	0.60	22	0.87	28	1.08	45	1.83
11	PN-9, PN-10, PN-11, & PN-12	30	1.79	45	2.67	57	3.38	97	5.87
12	PN-1,THRU PN-13 & PS-1 THRU PS-4 (TOTAL FLOW INTO NORTH POND)	106	8.29	137	12.04	153	15.01	182	25.35

LEGEND

3 ANALYSIS POINT

PN-6 DRAINAGE BASIN ID

FLOW ARROW

DRAINAGE BASIN BOUNDARY

EXISTING CULVERT OR STORM DRAIN

DOUGLAS L. ANDREWS
NEW MEXICO
11771
REGISTERED PROFESSIONAL ENGINEER

Douglas L Andrews
12-18-03

100' 0 200' 400'
SCALE: 1" = 200'

Smith Engineering Company
A Full Service Engineering Company
6400 Uptown Boulevard, N.E. Suite 600E Albuquerque, New Mexico 87110

COMANCHE PARK - PHASE 1

CITY OF ALBUQUERQUE
PUBLIC WORKS DEPARTMENT
HYDROLOGY DEVELOPMENT GROUP

OFFSITE DRAINAGE AREA MAP

PROJECT NUMBER:	DRAWN BY:	DESIGNED BY:	DATE:	MAP NO:
101103C	AB	DLA	9-03	1

COMANCHE PARK

OFF-SITE ANALYSIS

AHYMO BASIN PARAMETER WORKSHEET
PEAK BASIN FLOWS AND VOLUMES

DEVELOPED CONDITIONS *

									LAND TREATMENT (%)				2 YEAR		5 YEAR		10 YEAR		100 YEAR	
BASIN	AREA (sq.mi.)	LENGTH (ft.)	ELEV. DIFF. (ft.)	SLOPE (%)	K	VEL (fps)	T(c) (hr.)	T(p) (hr.)	A	B	C	D	PEAK FLOW (24hr.) (cfs)	RUNOFF VOLUME (24hr.) (ac.ft.)	PEAK FLOW (24hr.) (cfs)	RUNOFF VOLUME (24hr.) (ac.ft.)	PEAK FLOW (24hr.) (cfs)	RUNOFF VOLUME (24hr.) (ac.ft.)	PEAK FLOW (24hr.) (cfs)	RUNOFF VOLUME (24hr.) (ac.ft.)
PS-1	0.0777	250	3.0	1.20	1.0	1.10	0.06	0.04												
		150	2.0	1.33	1.0	1.15	0.04	0.02												
		160	6.0	3.75	2.0	3.87	0.01	0.01												
		200	4.0	2.00	2.0	2.83	0.02	0.01												
		100	5.0	5.00	2.0	4.47	0.01	0.00												
		850	25.0	2.94	3.0	5.14	0.05	0.03												
	TOTAL =						0.18	0.12	0	10	10	80	79	3.177	109	4.467	133	5.472	209	8.866
PS-2	0.0112	130	2.0	1.54	1.0	1.24	0.03	0.02												
		700	7.5	1.07	3.0	3.11	0.06	0.04												
	TOTAL =						0.09	0.06	0	15	15	70	10	0.406	15	0.580	18	0.717	29	1.186
PS-3	0.0061	400	3.0	0.75	1.0	0.87	0.13	0.09												
		380	8.0	2.11	2.0	2.90	0.04	0.02												
	TOTAL =						0.16	0.11	0	5	5	90	7	0.278	9	0.385	11	0.469	17	0.746
PS-4 *	0.0153	700	6.0	0.86	3.0	2.78	0.07	0.05												
	TOTAL =						0.07	0.05	0	60	40	0	2	0.051	7	0.171	12	0.279	25	0.713
PN-1	0.0323	200	2.0	1.00	1.0	1.00	0.06	0.04												
		800	21.0	2.63	3.0	4.86	0.05	0.03												
		630	1.5	0.24	3.0	1.46	0.12	0.08												
	TOTAL =						0.22	0.15	0	13	13	74	29	1.231	40	1.747	49	2.151	79	3.526
PN-2	0.0062	975	20.0	2.05	3.0	4.30	0.06	0.04												
	TOTAL =						0.06	0.04	0	13	13	74	6	0.236	8	0.335	10	0.413	16	0.677
PN-3	0.0074	130	4.0	3.08	1.0	1.75	0.02	0.01												
		100	0.5	0.50	1.0	0.71	0.04	0.03												
		170	5.0	2.94	1.0	1.71	0.03	0.02												
		650	9.0	1.38	3.0	3.53	0.05	0.03												
	TOTAL =						0.14	0.09	0	13	13	74	7	0.282	10	0.400	12	0.493	19	0.808
PN-4	0.0041	275	8.0	2.91	1.0	1.71	0.04	0.03												
		300	10.0	3.33	3.0	5.48	0.02	0.01												
	TOTAL =						0.06	0.04	0	20	20	60	3	0.130	5	0.189	6	0.236	10	0.401
PN-5	0.0067	300	14.0	4.67	1.0	2.16	0.04	0.03												
		550	3.0	0.55	3.0	2.22	0.07	0.05												
	TOTAL =						0.11	0.07	0	15	15	70	6	0.243	9	0.347	11	0.429	17	0.710
PN-6	0.0080	650	7.0	1.08	3.0	3.11	0.06	0.04												
	TOTAL =						0.06	0.04	0	15	15	70	7	0.290	10	0.415	13	0.512	21	0.847

COMANCHE PARK

OFF-SITE ANALYSIS

AHYMO BASIN PARAMETER WORKSHEET
PEAK BASIN FLOWS AND VOLUMES

DEVELOPED CONDITIONS *

BASIN	AREA (sq.mi.)	LENGTH (ft.)	ELEV. DIFF. (ft.)	SLOPE (%)	K	VEL (fps)	T(c) (hr.)	T(p) (hr.)	LAND TREATMENT (%)				2 YEAR		5 YEAR		10 YEAR		100 YEAR	
									A	B	C	D	PEAK FLOW (24hr.) (cfs)	RUNOFF VOLUME (24hr.) (ac.ft.)	PEAK FLOW (24hr.) (cfs)	RUNOFF VOLUME (24hr.) (ac.ft.)	PEAK FLOW (24hr.) (cfs)	RUNOFF VOLUME (24hr.) (ac.ft.)	PEAK FLOW (24hr.) (cfs)	RUNOFF VOLUME (24hr.) (ac.ft.)
PN-7	0.0009	330	4.0	1.21	3.0	3.30	0.03	0.02												
	TOTAL =						0.03	0.02	0	5	5	90	1	0.041	1	0.057	2	0.069	3	0.110
PN-8	0.0024	750	23.0	3.07	3.0	5.25	0.04	0.03												
	TOTAL =						0.04	0.03	0	5	5	90	3	0.109	4	0.152	4	0.184	7	0.294
PN-9	0.0297	150	1.0	0.67	0.7	0.57	0.07	0.05												
		470	4.5	0.96	3.0	2.94	0.04	0.03												
		300	2.5	0.83	3.0	2.74	0.03	0.02												
		230	5.0	2.17	3.0	4.42	0.01	0.01												
		100	10.0	10.00	3.0	9.49	0.00	0.00												
		380	4.0	1.05	3.0	3.08	0.03	0.02												
	TOTAL =						0.20	0.13	0	30	30	40	18	0.666	29	1.034	37	1.333	65	2.413
PN-10	0.0024	330	5.0	1.52	0.7	0.86	0.11	0.07												
	TOTAL =						0.11	0.07	0	67	26	7	0.5	0.014	1	0.034	2	0.052	4	0.122
PN-11	0.0184	150	1.5	1.00	0.7	0.70	0.06	0.04												
		825	12.0	1.45	3.0	3.62	0.06	0.04												
		315	2.0	0.63	3.0	2.39	0.04	0.02												
		170	1.0	0.59	3.0	2.30	0.02	0.01												
	TOTAL =						0.18	0.12	0	19	19	62	15	0.599	22	0.870	28	1.084	45	1.828
PN-12	0.0142	200	3.0	1.50	1.0	1.22	0.05	0.03												
		400	1.0	0.25	2.0	1.00	0.11	0.07												
		400	8.0	2.00	2.0	2.83	0.04	0.03												
	TOTAL =						0.20	0.13	0	15	15	70	13	0.515	19	0.736	23	0.909	36	1.504
PN-13 *	0.0015	100	19.0	19.00	1.0	4.36	0.01	0.00												
		400	1.0	0.25	2.0	1.00	0.11	0.07												
	TOTAL =						0.12	0.08	50	0	50	0	1	0.021	5	0.113	8	0.210	21	0.589

* LAND TREATMENTS FOR COMANCHE PARK SOUTH SHOWN IN THIS WORKSHEET INDICATE EXISTING CONDITIONS

PS-4 **	0.0153	1,100	5.4	0.49	4.0	2.80	0.11	0.07												
	TOTAL =						0.11	0.07	0	0	94	6	7	0.161	13	0.318	17	0.452	31	0.960

** LAND TREATMENTS FOR COMANCHE PARK SOUTH SHOWN DIRECTLY ABOVE INDICATE DEVELOPED CONDITIONS

APPENDIX II

Aztec Road Inlet Structure Supporting Calculations

```
START
*
*S   COMMANCHE PARK CONSISTS OF TWO AREAS. ONE IS SOUTH OF COMANCHE RD.
*S   EAST OF THE NORTH DIVERSION CHANNEL CONSISTING OF THE THUNDERBIRD
*S   LITTLE LEAGUE BASEBALL FIELDS. THE SECOND AREA IS NORTH OF COMANCHE
*S   BLVD.  BOTH AREAS ACT AS DETENTION POND FACILITIES.
*S   THE TWO AREAS ARE CONNECTED BY AN EXISTING 36" CULVERT UNDER
*S   COMANCHE BLVD. THE RUNOFF FLOWS IN THE NORTH POND ARE PUMPED UP TO THE
*S   NORTH DIVERSION CHANNEL. THE CONTRIBUTING DRAINAGE BASIN IS
*S   APPROXIMATELY 95% DEVELOPED.  THIS ANAYLSIS ASSUMES 100% DEVELOPMENT.
*S   PROPOSED LAND TREATMENTS WERE UTILIZED FOR THE SOUTH PARK AREA WHILE
*S   EXISTING LAND TREATEMENTS WERE UTILIZED FOR THE NORTH PARK.  ALL OTHER
*S   LAND TREATEMENTS WERE DETERMINED BY USING THE LATEST ARERIAL PHOTO
*S   OF THE AREA AND TABLE A-5 OF SECTION 22 OF THE CITY OF ALBUQUERQUE
*S   DEVELOPMENT PROCESS MANUAL (DPM).
*S
*S   DATE:  REVISED BASIN PS-1 November 1, 2012
*S
*S   FILENAME - input         :  Pro1.TXT
*S   FILENAME - output        :  Pro1.OUT
*S   FILENAME - summary table :  Pro1.SUM
*S
*S   PROJECT TITLE:  DRAINAGE ANALYSIS REPORT FOR BRYN MAWR STORM DRAIN
*S
*S SEC PROJECT NUMBER: 112134
*S CONSULTANT: SMITH ENGINEERING COMPANY
*S CLIENT: CITY OF ALBUQUERQUE, DMD - HYDROLOGY
*S
*S ---------------------------------------------------------------------
*S        COMANCHE PARK (North and South) DRAINAGE ANALYSIS:
*S        1-YR, 24 HOUR STORM EVENT
*S ---------------------------------------------------------------------
*
RAINFALL             TYPE=2  RAIN QUARTER=0.0
                     RAIN ONE=0.540 IN   RAIN SIX=0.791 IN
                     RAIN DAY=0.986 IN   DT=0.05 HR
*S
*
*S** BASIN PS-1 ******************************************************
*
*TOTAL FLOWS AT AP-1
*
COMPUTE NM HYD       ID=3   HYD=PS-1&AP-1  DA=0.0777 SQ MI
                     PER A=0 PER B=10 PER C=10 PER D=80
                     TP=0.13 HR MASS RAIN=-1
*
PRINT HYD            ID=3   CODE=1
FINISH
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Summary output for Basin PS-1

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AHYMO PROGRAM SUMMARY TABLE (AHYMO_97) -                    - VERSION:  1997.02c      RUN DATE (MON/DAY/YR) =11/01/2012
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                              FROM  TO                  PEAK         RUNOFF                   TIME TO   CFS       PAGE =   1
                  HYDROGRAPH   ID   ID        AREA    DISCHARGE      VOLUME        RUNOFF      PEAK     PER
COMMAND        IDENTIFICATION  NO.  NO.     (SQ MI)     (CFS)        (AC-FT)     (INCHES)   (HOURS)    ACRE      NOTATION

START                                                                                                        TIME=       .00
*S   COMMANCHE PARK CONSISTS OF TWO AREAS. ONE IS SOUTH OF COMMANCHE RD.
*S   EAST OF THE NORTH DIVERSION CHANNEL CONSISTING OF THE THUNDERBIRD
*S   LITTLE LEAGUE BASEBALL FIELDS. THE SECOND AREA IS NORTH OF COMANCHE
*S   BLVD.  BOTH AREAS ACT AS DETENTION POND FACILITIES.
*S   THE TWO AREAS ARE CONNECTED BY AN EXISTING 36" CULVERT UNDER
*S   COMANCHE BLVD. THE RUNOFF FLOWS IN THE NORTH POND ARE PUMPED UP TO THE
*S   NORTH DIVERSION CHANNEL. THE CONTRIBUTING DRAINAGE BASIN IS
*S   APPROXIMATELY 95% DEVELOPED.  THIS ANAYLSIS ASSUMES 100% DEVELOPMENT.
*S   PROPOSED LAND TREATMENTS WERE UTILIZED FOR THE SOUTH PARK AREA WHILE
*S   EXISTING LAND TREATEMENTS WERE UTILIZED FOR THE NORTH PARK.  ALL OTHER
*S   LAND TREATEMENTS WERE DETERMINED BY USING THE LATEST ARERIAL PHOTO
*S   OF THE AREA AND TABLE A-5 OF SECTION 22 OF THE CITY OF ALBUQUERQUE
*S   DEVELOPMENT PROCESS MANUAL (DPM).
*S
*S   DATE:  REVISED BASIN PS-1 November 1, 2012
*S
*S   FILENAME - input         :  Pro1.TXT
*S   FILENAME - output        :  Pro1.OUT
*S   FILENAME - summary table :  Pro1.SUM
*S
*S   PROJECT TITLE:  DRAINAGE ANALYSIS REPORT FOR BRYN MAWR STORM DRAIN
*S
*S SEC PROJECT NUMBER: 112134
*S CONSULTANT: SMITH ENGINEERING COMPANY
*S CLIENT: CITY OF ALBUQUERQUE, DMD - HYDROLOGY
*S
*S ------------------------------------------------------------------
*S        COMMANCHE PARK (North and South) DRAINAGE ANALYSIS:
*S        1-YR, 24 HOUR STORM EVENT
*S ------------------------------------------------------------------
RAINFALL  TYPE= 2                                                                                            RAIN24=    .986
*S
*S** BASIN PS-1 ******************************************************
COMPUTE NM HYD     PS-1&AP-1   -     3       .07770       48.61       2.485       .59956    1.500     .978 PER IMP=  80.00
FINISH
```

```
   AHYMO PROGRAM (AHYMO_97) -                            - Version:  1997.02c
         RUN DATE (MON/DAY/YR) = 11/01/2012
         START TIME (HR:MIN:SEC) = 11:27:44     USER NO.= AHYMO-S-9702c01SEC01A-AH
         INPUT FILE = C:\Users\georgen\Desktop\Pro1.txt

START
*
*S   COMANCHE PARK CONSISTS OF TWO AREAS. ONE IS SOUTH OF COMANCHE RD.
*S   EAST OF THE NORTH DIVERSION CHANNEL CONSISTING OF THE THUNDERBIRD
*S   LITTLE LEAGUE BASEBALL FIELDS. THE SECOND AREA IS NORTH OF COMANCHE
*S   BLVD.  BOTH AREAS ACT AS DETENTION POND FACILITIES.
*S   THE TWO AREAS ARE CONNECTED BY AN EXISTING 36" CULVERT UNDER
*S   COMANCHE BLVD. THE RUNOFF FLOWS IN THE NORTH POND ARE PUMPED UP TO THE
*S   NORTH DIVERSION CHANNEL. THE CONTRIBUTING DRAINAGE BASIN IS
*S   APPROXIMATELY 95% DEVELOPED.  THIS ANAYLSIS ASSUMES 100% DEVELOPMENT.
*S   PROPOSED LAND TREATMENTS WERE UTILIZED FOR THE SOUTH PARK AREA WHILE
*S   EXISTING LAND TREATEMENTS WERE UTILIZED FOR THE NORTH PARK.  ALL OTHER
*S   LAND TREATEMENTS WERE DETERMINED BY USING THE LATEST ARERIAL PHOTO
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*S   FILENAME - input         :  Pro1.TXT
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*S   FILENAME - summary table :  Pro1.SUM
*S
*S   PROJECT TITLE:  DRAINAGE ANALYSIS REPORT FOR BRYN MAWR STORM DRAIN
*S
*S SEC PROJECT NUMBER: 112134
*S CONSULTANT: SMITH ENGINEERING COMPANY
*S CLIENT: CITY OF ALBUQUERQUE, DMD - HYDROLOGY
*S
*S -----------------------------------------------------------------
*S        COMANCHE PARK (North and South) DRAINAGE ANALYSIS:
*S        1-YR, 24 HOUR STORM EVENT
*S -----------------------------------------------------------------
*
RAINFALL             TYPE=2  RAIN QUARTER=0.0
                     RAIN ONE=0.540 IN   RAIN SIX=0.791 IN
                     RAIN DAY=0.986 IN   DT=0.05 HR

               COMPUTED 24-HOUR RAINFALL DISTRIBUTION BASED ON NOAA ATLAS 2 - PEAK AT 1.40 HR.
               DT =    .050000 HOURS       END TIME =    24.000000 HOURS
                  .0000   .0046   .0093   .0142   .0192   .0243   .0297
                  .0352   .0408   .0467   .0529   .0592   .0659   .0728
                  .0801   .0877   .0957   .1042   .1133   .1229   .1333
                  .1356   .1381   .1454   .1626   .1922   .2380   .3039
                  .3941   .4652   .4974   .5242   .5477   .5687   .5877
                  .6051   .6210   .6357   .6492   .6617   .6733   .6758
                  .6783   .6806   .6829   .6851   .6872   .6893   .6914
                  .6934   .6953   .6972   .6991   .7009   .7028   .7045
                  .7063   .7080   .7097   .7114   .7131   .7147   .7163
                  .7179   .7195   .7211   .7226   .7241   .7257   .7272
                  .7286   .7301   .7316   .7330   .7344   .7359   .7373
                  .7387   .7400   .7414   .7428   .7441   .7455   .7468
                  .7481   .7494   .7507   .7520   .7533   .7546   .7559
                  .7571   .7584   .7596   .7609   .7621   .7633   .7646
                  .7658   .7670   .7682   .7694   .7706   .7718   .7729
                  .7741   .7753   .7764   .7776   .7787   .7799   .7810
```

.7821	.7833	.7844	.7855	.7866	.7877	.7888
.7899	.7910	.7918	.7926	.7935	.7943	.7951
.7959	.7967	.7975	.7983	.7991	.7999	.8007
.8015	.8023	.8030	.8038	.8046	.8054	.8062
.8069	.8077	.8085	.8092	.8100	.8107	.8115
.8123	.8130	.8138	.8145	.8152	.8160	.8167
.8175	.8182	.8189	.8197	.8204	.8211	.8219
.8226	.8233	.8240	.8247	.8254	.8262	.8269
.8276	.8283	.8290	.8297	.8304	.8311	.8318
.8325	.8332	.8338	.8345	.8352	.8359	.8366
.8373	.8379	.8386	.8393	.8400	.8406	.8413
.8420	.8426	.8433	.8440	.8446	.8453	.8459
.8466	.8472	.8479	.8485	.8492	.8498	.8505
.8511	.8518	.8524	.8530	.8537	.8543	.8549
.8556	.8562	.8568	.8575	.8581	.8587	.8593
.8599	.8606	.8612	.8618	.8624	.8630	.8636
.8642	.8649	.8655	.8661	.8667	.8673	.8679
.8685	.8691	.8697	.8703	.8709	.8714	.8720
.8726	.8732	.8738	.8744	.8750	.8755	.8761
.8767	.8773	.8779	.8784	.8790	.8796	.8802
.8807	.8813	.8819	.8824	.8830	.8836	.8841
.8847	.8852	.8858	.8864	.8869	.8875	.8880
.8886	.8891	.8897	.8902	.8908	.8913	.8919
.8924	.8930	.8935	.8940	.8946	.8951	.8957
.8962	.8967	.8973	.8978	.8983	.8989	.8994
.8999	.9005	.9010	.9015	.9020	.9026	.9031
.9036	.9041	.9046	.9052	.9057	.9062	.9067
.9072	.9077	.9082	.9088	.9093	.9098	.9103
.9108	.9113	.9118	.9123	.9128	.9133	.9138
.9143	.9148	.9153	.9158	.9163	.9168	.9173
.9178	.9183	.9188	.9193	.9197	.9202	.9207
.9212	.9217	.9222	.9227	.9231	.9236	.9241
.9246	.9251	.9255	.9260	.9265	.9270	.9275
.9279	.9284	.9289	.9293	.9298	.9303	.9308
.9312	.9317	.9322	.9326	.9331	.9336	.9340
.9345	.9349	.9354	.9359	.9363	.9368	.9372
.9377	.9382	.9386	.9391	.9395	.9400	.9404
.9409	.9413	.9418	.9422	.9427	.9431	.9436
.9440	.9445	.9449	.9453	.9458	.9462	.9467
.9471	.9476	.9480	.9484	.9489	.9493	.9497
.9502	.9506	.9511	.9515	.9519	.9524	.9528
.9532	.9536	.9541	.9545	.9549	.9554	.9558
.9562	.9566	.9571	.9575	.9579	.9583	.9588
.9592	.9596	.9600	.9604	.9609	.9613	.9617
.9621	.9625	.9629	.9634	.9638	.9642	.9646
.9650	.9654	.9658	.9662	.9666	.9671	.9675
.9679	.9683	.9687	.9691	.9695	.9699	.9703
.9707	.9711	.9715	.9719	.9723	.9727	.9731
.9735	.9739	.9743	.9747	.9751	.9755	.9759
.9763	.9767	.9771	.9775	.9779	.9783	.9787
.9791	.9794	.9798	.9802	.9806	.9810	.9814
.9818	.9822	.9825	.9829	.9833	.9837	.9841
.9845	.9849	.9852	.9856	.9860		

```
*S
*
*S** BASIN PS-1 ******************************************************
*
*TOTAL FLOWS AT AP-1
*
COMPUTE NM HYD       ID=3   HYD=PS-1&AP-1  DA=0.0777 SQ MI
```

```
                  PER A=0 PER B=10 PER C=10 PER D=80
                             TP=0.13 HR MASS RAIN=-1

     K =   .073786HR    TP =   .130000HR    K/TP RATIO =   .567588     SHAPE CONSTANT, N =  6.748185
     UNIT PEAK =   243.48    CFS   UNIT VOLUME =    .9994       B =   509.20      P60 = .54000
     AREA =      .062160 SQ MI    IA =    .10000 INCHES    INF =    .04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000


     K =   .133698HR    TP =   .130000HR    K/TP RATIO =  1.028444     SHAPE CONSTANT, N =  3.432319
     UNIT PEAK =   37.697    CFS   UNIT VOLUME =    1.000       B =   315.36      P60 = .54000
     AREA =      .015540 SQ MI    IA =    .42500 INCHES    INF =   1.04000 INCHES PER HOUR
     RUNOFF COMPUTED BY INITIAL ABSTRACTION/INFILTRATION NUMBER METHOD - DT =   .050000

*
PRINT HYD            ID=3   CODE=1

                                         HYDROGRAPH FROM AREA PS-1&AP-1


    RUNOFF VOLUME =      .59956 INCHES     =       2.4846 ACRE-FEET
    PEAK DISCHARGE RATE =      48.61 CFS  AT   1.500 HOURS   BASIN AREA =   .0777 SQ. MI.



FINISH

    NORMAL PROGRAM FINISH          END TIME (HR:MIN:SEC) = 11:27:44
```

NOAA Atlas 14, Volume 1, Version 5
Location name: Albuquerque, New Mexico, US*
Coordinates: 35.1219, -106.6113
Elevation: 5102ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals

Duration	Average recurrence interval(years)							
	1	2	5	10	25	50	100	200
5-min	0.172 (0.146-0.203)	0.223 (0.188-0.263)	0.299 (0.252-0.353)	0.359 (0.301-0.422)	0.440 (0.368-0.518)	0.503 (0.420-0.593)	0.571 (0.472-0.671)	0.642 (0.528-0.755)
10-min	0.261 (0.222-0.309)	0.339 (0.287-0.399)	0.455 (0.384-0.538)	0.546 (0.459-0.643)	0.669 (0.560-0.788)	0.766 (0.639-0.902)	0.869 (0.719-1.02)	0.978 (0.804-1.15)
15-min	0.324 (0.275-0.383)	0.420 (0.355-0.495)	0.564 (0.476-0.666)	0.676 (0.569-0.797)	0.829 (0.695-0.977)	0.950 (0.793-1.12)	1.08 (0.891-1.27)	1.21 (0.997-1.42)
30-min	0.436 (0.371-0.515)	0.565 (0.478-0.667)	0.759 (0.642-0.897)	0.911 (0.766-1.07)	1.12 (0.935-1.32)	1.28 (1.07-1.51)	1.45 (1.20-1.71)	1.63 (1.34-1.92)
60-min	0.540 (0.459-0.638)	0.700 0.86 (0.592-0.825)	0.940 (0.794-1.11)	1.13 1.32 (0.948-1.33)	1.38 (1.16-1.63)	1.58 (1.32-1.86)	1.80 1.98 (1.49-2.11)	2.02 (1.66-2.37)
2-hr	0.636 (0.531-0.774)	0.815 (0.682-0.994)	1.08 (0.900-1.31)	1.29 (1.07-1.56)	1.59 (1.31-1.91)	1.83 (1.50-2.20)	2.08 (1.69-2.50)	2.34 (1.90-2.81)
3-hr	0.678 (0.572-0.820)	0.863 (0.725-1.04)	1.13 (0.952-1.37)	1.35 (1.13-1.62)	1.65 (1.37-1.97)	1.89 (1.56-2.26)	2.14 (1.76-2.56)	2.42 (1.97-2.89)
6-hr	0.791 (0.671-0.949)	0.999 1.00 (0.848-1.20)	1.29 (1.10-1.54)	1.52 1.54 (1.29-1.81)	1.83 (1.54-2.19)	2.08 (1.74-2.47)	2.34 2.31 (1.95-2.79)	2.61 (2.16-3.10)
12-hr	0.867 (0.744-1.01)	1.09 (0.938-1.28)	1.39 (1.19-1.62)	1.62 (1.39-1.89)	1.94 (1.65-2.25)	2.18 (1.85-2.53)	2.44 (2.05-2.83)	2.70 (2.26-3.13)
24-hr	0.986 (0.857-1.14)	1.24 1.16 (1.07-1.43)	1.55 (1.34-1.78)	1.80 1.79 (1.56-2.07)	2.14 (1.84-2.46)	2.39 (2.06-2.75)	2.66 2.68 (2.28-3.06)	2.94 (2.50-3.37)
2-day	1.03 (0.893-1.17)	1.29 (1.12-1.47)	1.61 (1.40-1.84)	1.86 (1.62-2.12)	2.21 (1.91-2.51)	2.47 (2.13-2.81)	2.74 (2.35-3.12)	3.02 (2.58-3.44)
3-day	1.12 (0.994-1.25)	1.40 (1.24-1.56)	1.73 (1.53-1.94)	1.99 (1.76-2.23)	2.34 (2.07-2.62)	2.61 (2.30-2.92)	2.89 (2.53-3.23)	3.16 (2.76-3.54)
4-day	1.21 (1.10-1.34)	1.51 (1.36-1.66)	1.85 (1.66-2.04)	2.12 (1.91-2.33)	2.48 (2.23-2.73)	2.75 (2.47-3.03)	3.03 (2.71-3.34)	3.31 (2.95-3.64)
7-day	1.38 (1.25-1.51)	1.71 (1.55-1.87)	2.08 (1.88-2.27)	2.36 (2.14-2.58)	2.74 (2.48-2.99)	3.02 (2.73-3.30)	3.30 (2.97-3.61)	3.57 (3.21-3.90)
10-day	1.52 (1.39-1.66)	1.88 (1.72-2.06)	2.31 (2.10-2.52)	2.63 (2.40-2.87)	3.07 (2.80-3.34)	3.39 (3.08-3.69)	3.72 (3.37-4.05)	4.04 (3.65-4.40)
20-day	1.88 (1.71-2.07)	2.33 (2.12-2.57)	2.83 (2.57-3.11)	3.21 (2.91-3.52)	3.68 (3.34-4.05)	4.03 (3.65-4.42)	4.36 (3.94-4.78)	4.67 (4.21-5.12)
30-day	2.26 (2.05-2.46)	2.79 (2.54-3.05)	3.36 (3.05-3.66)	3.78 (3.43-4.11)	4.29 (3.89-4.67)	4.66 (4.22-5.06)	5.01 (4.53-5.44)	5.34 (4.82-5.80)
45-day	2.77 (2.52-3.02)	3.42 (3.13-3.73)	4.07 (3.72-4.44)	4.53 (4.14-4.94)	5.10 (4.65-5.55)	5.48 (5.00-5.98)	5.82 (5.31-6.35)	6.12 (5.58-6.67)
60-day	3.18	3.92	4.67	5.21	5.85	6.29	6.69	7.03

Existing Conditions Headwater Elevation at Aztec Road

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	209.00	ft³/s
Crest Elevation	5093.50	ft
Weir Coefficient	2.64	US
Crest Length	60.00	ft

Results

Headwater Elevation	5094.70	ft
Headwater Height Above Crest	1.20	ft
Flow Area	72.18	ft²
Velocity	2.90	ft/s
Wetted Perimeter	62.41	ft
Top Width	60.00	ft

Headwater Elevation for 50cfs Storm Event, Weir Length = 60'

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	50.00	ft³/s
Crest Elevation	5093.50	ft
Weir Coefficient	2.64	US
Crest Length	60.00	ft

Results

Headwater Elevation	5093.96	ft
Headwater Height Above Crest	0.46	ft
Flow Area	27.82	ft²
Velocity	1.80	ft/s
Wetted Perimeter	60.93	ft
Top Width	60.00	ft

Bryn Mawr Storm Drain Design Analysis Report

Free Overfall Calculations for Inlet at Aztec Road

Input Data and Assumptions:	
Storm Event Flow	50 cfs
Weir Length	60 ft
Velocity	1.80 fps
Critical Depth	0.28 ft
Weir Crest Elevation	5093.50 ft

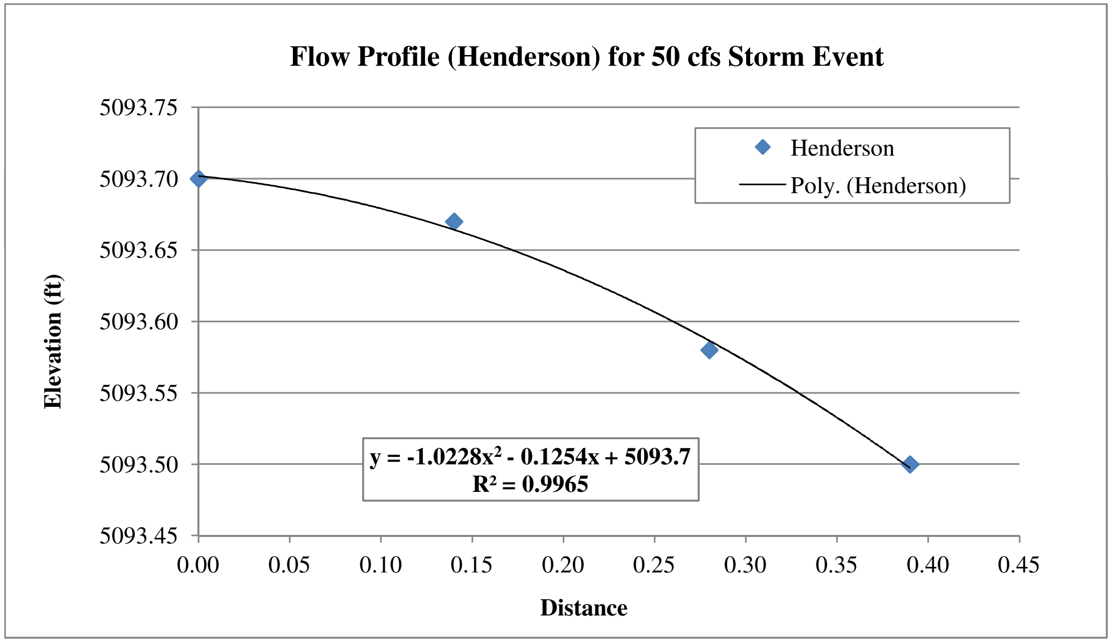
Calculate trajectory coordinates (distance and elevation) using flow profile method described in Henderson's Open Channel Flow.
(Distance = 0 at weir crest). Plot data points and create regression curve.

Flow Profile Coordinates

Distance (ft)	Elevation (ft)
0.00	5093.7
0.14	5093.67
0.28	5093.58
0.39	5093.50

Quadratic Regression Equation:

$$y = -1.0228x^2 - 0.1254x + 5093.7$$



Bryn Mawr Storm Drain Design Analysis Report

Free Overfall Calculations for Inlet at Aztec Road

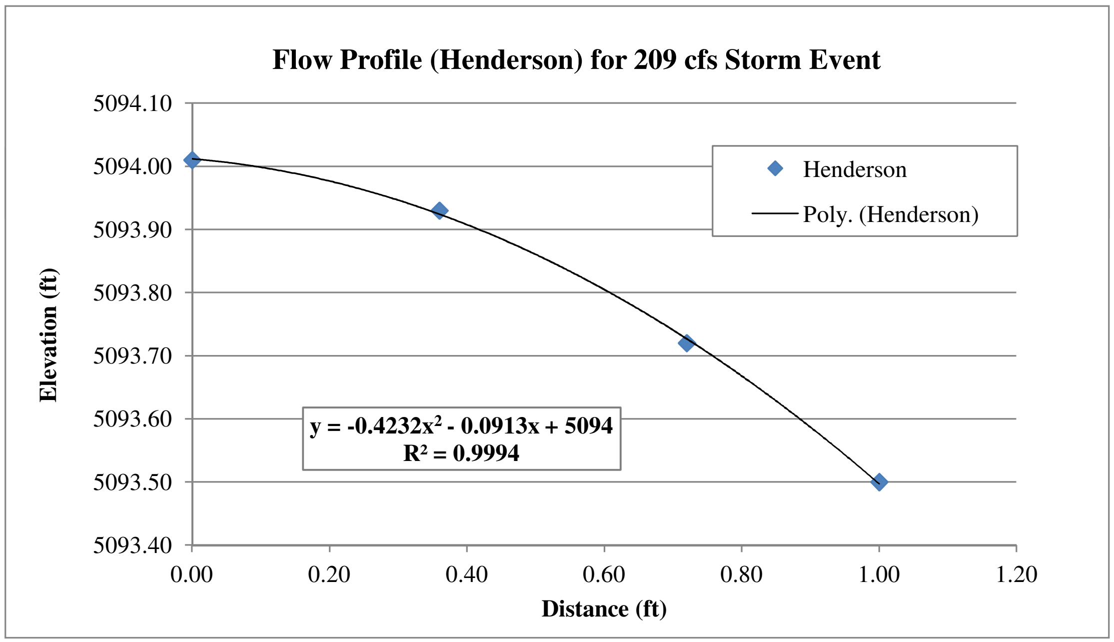
Input Data and Assumptions:	
Storm Event Flow	209 cfs
Weir Length	60 ft
Velocity	2.90 fps
Critical Depth	0.72 ft
Weir Crest Elevation	5093.50 ft

Calculate trajectory coordinates (distance and elevation) using flow profile method described in Henderson's Open Channel Flow.
(Distance = 0 at weir crest). Plot data points and create regression equation.

Flow Profile Coordinates

Distance	Elevation
0.00	5094.01
0.36	5093.93
0.72	5093.72
1.00	5093.50

Quadratic Regression Equation:
$$y = -0.4232x^2 - 0.0913x + 5094$$



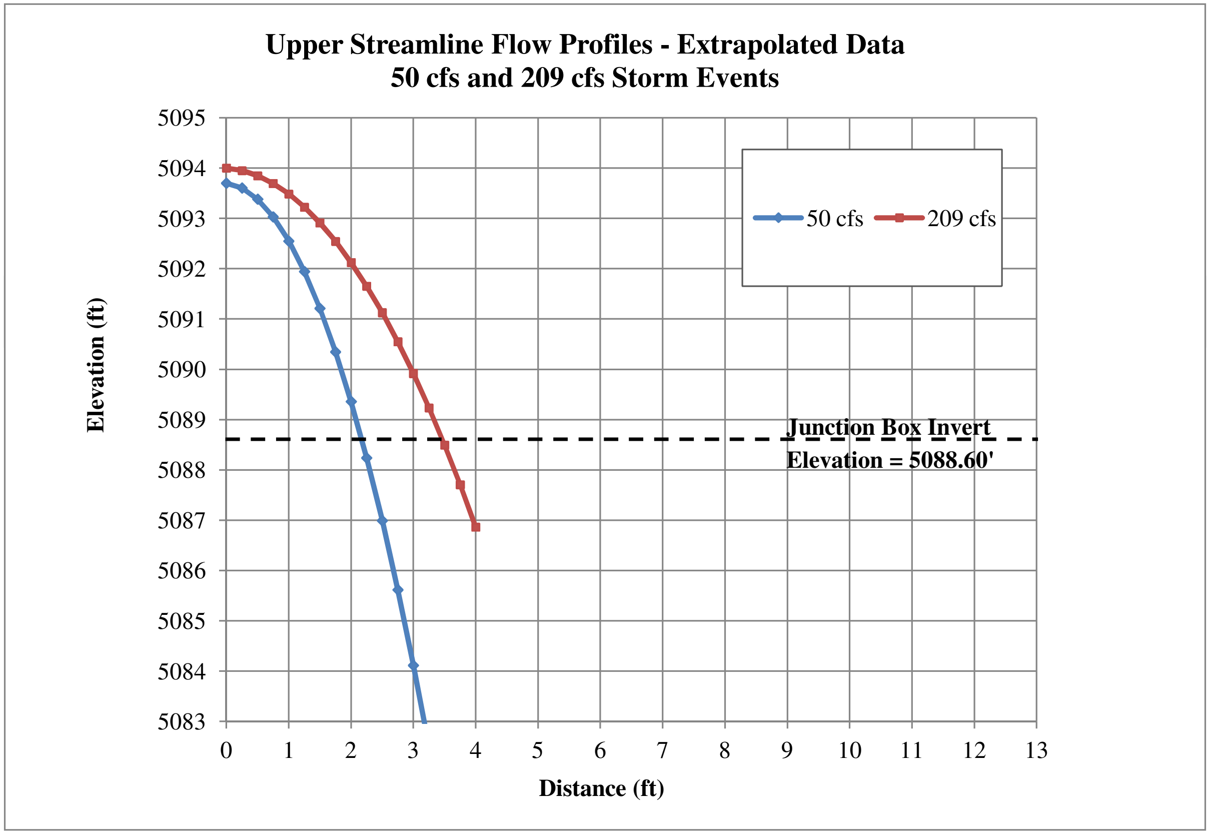
Bryn Mawr Storm Drain Design Analysis Report

Free Overfall Calculations for Inlet at Aztec Road

Input Data and Assumptions:		
Storm Event Flow	50 cfs	209 cfs
Weir Length	60 ft	60 ft
Velocity	1.80 fps	2.90 fps
Critical Depth	0.28 ft	0.72 ft
Weir Crest Elevation	5093.50 ft	5093.50 ft

Flow Profile Coordinates (for Upper Streamline) Determined from Quadratic Regression Equations

Distance (ft)	Elevation for Q=50 cfs (ft)	Elevation for Q=209 cfs (ft)
0.00	5093.70	5094.00
0.25	5093.60	5093.95
0.50	5093.38	5093.85
0.75	5093.03	5093.69
1.00	5092.55	5093.49
1.25	5091.95	5093.22
1.50	5091.21	5092.91
1.75	5090.35	5092.54
2.00	5089.36	5092.12
2.25	5088.24	5091.65
2.50	5086.99	5091.13
2.75	5085.62	5090.55
3.00	5084.12	5089.92
3.25	5082.49	5089.23
3.50	5080.73	5088.50
3.75	5078.85	5087.71
4.00	5076.83	5086.86



Culvert Calculator Report
5' x 10' CBC for Inlet Structure at Aztec Road

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	5,093.50	ft	Headwater Depth/Height	0.76	
Computed Headwater Elevation	5,092.40	ft	Discharge	209.00	cfs
Inlet Control HW Elev.	5,092.36	ft	Tailwater Elevation	5,091.17	ft
Outlet Control HW Elev.	5,092.40	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	5,088.60	ft	Downstream Invert	5,088.45	ft
Length	30.00	ft	Constructed Slope	0.005000	ft/ft

Hydraulic Profile					
Profile	S1		Depth, Downstream	2.72	ft
Slope Type	Steep		Normal Depth	2.23	ft
Flow Regime	Subcritical		Critical Depth	2.39	ft
Velocity Downstream	7.68	ft/s	Critical Slope	0.004128	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.015	
Section Material	Concrete		Span	10.00	ft
Section Size	10 x 5 ft		Rise	5.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5,092.40	ft	Upstream Velocity Head	1.10	ft
Ke	0.20		Entrance Loss	0.22	ft

Inlet Control Properties					
Inlet Control HW Elev.	5,092.36	ft	Flow Control	N/A	
Inlet Type	90° headwall w 45° bevels		Area Full	50.0	ft²
K	0.49500		HDS 5 Chart	10	
M	0.66700		HDS 5 Scale	2	
C	0.03140		Equation Form	2	
Y	0.82000				

APPENDIX III

HEC-RAS Model Input and Output Data

```
                         HEC-RAS Version 4.1.0 Jan 2010
                          U.S. Army Corps of Engineers
                         Hydrologic Engineering Center
                               609 Second Street
                               Davis, California

           X     X  XXXXXX    XXXX        XXXX       XX      XXXX
           X     X  X        X    X       X   X     X  X    X
           X     X  X        X            X   X    X    X   X
           XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
           X     X  X        X            X X      X    X        X
           X     X  X        X    X       X  X     X    X        X
           X     X  XXXXXX    XXXX        X   X    X    X   XXXXX
```

PROJECT DATA
Project Title: Bryn Mawr DAR
Project File : BrynMawrDAR.prj
Run Date and Time: 11/3/2012 11:34:35 AM

Project in English units

PLAN DATA

Plan Title: Bryn Mawr DAR
Plan File : q:\SEC---PROJECTS\2012 Projects\112134 COA Bryn Mawr Storm Drain Improvements\ENGINEERING\Modeling\Study\Bryn Mawr DAR\BrynMawrDAR.p01

Geometry Title: Bryn Mawr SD
Geometry File : q:\SEC---PROJECTS\2012 Projects\112134 COA Bryn Mawr Storm Drain Improvements\ENGINEERING\Modeling\Study\Bryn Mawr DAR\BrynMawrDAR.g01

Flow Title : Bryn Mawr DAR
Flow File : q:\SEC---PROJECTS\2012 Projects\112134 COA Bryn Mawr Storm Drain Improvements\ENGINEERING\Modeling\Study\Bryn Mawr DAR\BrynMawrDAR.f01

Plan Summary Information:

Number of:					
	Cross Sections	= 29	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
    Water surface calculation tolerance = 0.01
    Critical depth calculation tolerance = 0.01
    Maximum number of iterations   = 20
    Maximum difference tolerance   = 0.3
    Flow tolerance factor   = 0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method: Average Conveyance
    Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: Bryn Mawr DAR
Flow File : q:\SEC---PROJECTS\2012 Projects\112134 COA Bryn Mawr Storm Drain Improvements\ENGINEERING\Modeling\Study\Bryn Mawr DAR\BrynMawrDAR.f01

Flow Data (cfs)

River	Reach	RS	PF 1
Bryn Mawr SD	Aztec-Pond	1972	209

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Bryn Mawr SD	Aztec-Pond	PF 1	Normal S = 0.005	Known WS = 5084.49

GEOMETRY DATA

Geometry Title: Bryn Mawr SD
Geometry File : q:\SEC---PROJECTS\2012 Projects\112134 COA Bryn Mawr Storm Drain Improvements\ENGINEERING\Modeling\Study\Bryn Mawr DAR\BrynMawrDAR.g01

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1972

INPUT
Description: Inlet at Aztec
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
8	5092.6	8	5088.6	16	5088.6	16	5092.6

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
8	.015	8	.015	16	.015

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
8	16	72	72	72	.1	.03

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1900

INPUT
Description: Bryn Mawr SD Station 19+00
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
8	5092.25	8	5088.25	16	5088.25	16	5092.25

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
8	.015	8	.015	16	.015

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
8	16	100	100	100	.1	.03

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1800

INPUT
Description: Bryn Mawr SD Station 18+00
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
8	5091.75	8	5087.75	16	5087.75	16	5091.75

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
8	.015	8	.015	16	.015

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
8	16	100	100	100	.1	.03

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1700

INPUT
Description: Bryn Mawr SD Station 17+00
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
8	5091.25	8	5087.25	16	5087.25	16	5091.25

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
8	.015	8	.015	16	.015

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
8	16	100	100	100	.1	.03

```
CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond          RS: 1600

INPUT
Description: Bryn Mawr SD Station 16+00
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       8 5090.75       8 5086.75      16 5086.75      16 5090.75

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       8    .015       8    .015      16    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             8      16               50      50      50              .1      .03

CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond          RS: 1550

INPUT
Description: Bryn Mawr SD Station 15+50 - PT of R=160' Curve
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       8  5090.5       8  5086.5      16  5086.5      16  5090.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       8    .015       8    .015      16    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             8      16               78      80      82              .1      .03

CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond          RS: 1470

INPUT
Description: Bryn Mawr SD Station 14+70 - PC of R=160' Curve
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       8  5090.1       8  5086.1      16  5086.1      16  5090.1

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       8    .015       8    .015      16    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             8      16               28      28      28              .1      .03

CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond          RS: 1442

INPUT
Description: Bryn Mawr SD Station 14+42 - PT of R=80' Curve
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       8 5089.96       8 5085.96      16 5085.96      16 5089.96

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       8    .015       8    .015      16    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             8      16               38      40      42              .1      .03
```

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1402

INPUT
Description: Bryn Mawr SD Station 14+02 - PC of R=80' Curve
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
8	5089.76	8	5085.76	16	5085.76	16	5089.76

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
8	.015	8	.015	16	.015

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
8	16	10	10	10	.1	.03

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1392

INPUT
Description: Bryn Mawr SD Station 13+92 - End of Transition Structure
Bryn
Mawr SD Station 13+92 - End of Transition Structure
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
8	5089.7	8	5085.7	16	5085.7	16	5089.7

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
8	.015	8	.015	16	.015

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
8	16	5.5	5.5	5.5	.1	.03

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1386.5

INPUT
Description: Bryn Mawr SD Station 13+86.5 - Transition Structure
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
7.5	5089.5	7.5	5085.67	16.5	5085.67	16.5	5089.5

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
7.5	.015	7.5	.015	16.5	.015

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
7.5	16.5	5.5	5.5	5.5	.1	.03

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1381

INPUT
Description: Bryn Mawr SD Station 13+81 - Transition Structure
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
7	5089.31	7	5085.64	17	5085.64	17	5089.31

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
7	.015	7	.015	17	.015

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
7	17	5.5	5.5	5.5	.1	.03

```
CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond         RS: 1375.5

INPUT
Description: Bryn Mawr SD Station 13+75.5 - Transition Structure
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     6.5 5089.11     6.5 5085.61    17.5 5085.61    17.5 5089.11

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     6.5    .015     6.5    .015    17.5    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           6.5    17.5              5.5     5.5     5.5              .1      .03

CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond         RS: 1370

INPUT
Description: Bryn Mawr SD Station 13+70 - Transition Structure
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       6 5088.91       6 5085.57      18 5085.57      18 5088.91

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       6    .015       6    .015      18    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             6      18              5.5     5.5     5.5              .1      .03

CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond         RS: 1364.5

INPUT
Description: Bryn Mawr SD Station 13+64.5 - Transition Structure
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     5.5 5088.72     5.5 5085.54    18.5 5085.54    18.5 5088.72

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     5.5    .015     5.5    .015    18.5    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           5.5    18.5              5.5     5.5     5.5              .1      .03

CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond         RS: 1359

INPUT
Description: Bryn Mawr SD Station 13+59 - Transition Structure
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       5 5088.52       5 5085.51      19 5085.51      19 5088.52

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       5    .015       5    .015      19    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             5      19             2.75    2.75    2.75              .1      .03
```

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1356.25

INPUT
Description: Bryn Mawr SD Station 13+56.25 - Transition Structure
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
4.75	5088.42	4.75	5085.48	11.75	5085.48	12.25	5085.48	19.25	5085.48
19.25	5088.42								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
4.75	.015	4.75	.015	19.25	.015

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
4.75	19.25	2.75	2.75	2.75	.1	.03

Blocked Obstructions num= 1

Sta L	Sta R	Elev
11.75	12.25	5088.42

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1353.5

INPUT
Description: Bryn Mawr SD Station 13+53.5 - Transition Structure
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
4.5	5088.32	4.5	5085.46	11.75	5085.46	12.25	5085.46	19.5	5085.46
19.5	5088.32								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
4.5	.015	4.5	.015	19.5	.015

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
4.5	19.5	5.5	5.5	5.5	.1	.03

Blocked Obstructions num= 1

Sta L	Sta R	Elev
11.75	12.25	5088.32

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1348

INPUT
Description: Bryn Mawr SD Station 13+48 - Transition Structure
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
4	5088.13	4	5085.43	11.75	5085.43	12.25	5085.43	20	5085.43
20	5088.13								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
4	.015	4	.015	20	.015

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
4	20	5.5	5.5	5.5	.1	.03

Blocked Obstructions num= 1

Sta L	Sta R	Elev
11.75	12.25	5088.12

```
CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond         RS: 1342.5

INPUT
Description: Bryn Mawr SD Station 13+42.5 - Transition Structure
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     3.5 5087.93     3.5  5085.4   11.75  5085.4   12.25  5085.4    20.5  5085.4
    20.5 5087.93

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     3.5    .015     3.5    .015    20.5    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           3.5    20.5              5.5     5.5     5.5              .1      .03
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
   11.75   12.25 5087.93

CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond         RS: 1337

INPUT
Description: Bryn Mawr SD Station 13+37 - Transition Structure
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       3 5087.73       3 5085.37   11.75 5085.37   12.25 5085.37      21 5085.37
      21 5087.73

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       3    .015       3    .015      21    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             3      21              5.5     5.5     5.5              .1      .03
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
   11.75   12.25 5087.73

CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond         RS: 1331.5

INPUT
Description: Bryn Mawr SD Station 13+31.5 - Transition Structure
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     2.5 5087.53     2.5 5085.34   11.75 5085.34   12.25 5085.34    21.5 5085.34
    21.5 5087.53

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     2.5    .015     2.5    .015    21.5    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           2.5    21.5              5.5     5.5     5.5              .1      .03
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
   11.75   12.25 5087.53
```

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1326

INPUT
Description: Bryn Mawr SD Station 13+26 - Transition Structure
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
2	5087.34	2	5085.3	11.75	5085.3	12.25	5085.3	22	5085.3
22	5087.34								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
2	.015	2	.015	22	.015

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
2	22	3	3	3	.1	.03

Blocked Obstructions num= 1

Sta L	Sta R	Elev
11.75	12.25	5087.34

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1323

INPUT
Description: Bryn Mawr SD Station 13+23 - Begin Transition Structure
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1.75	5087.28	1.75	5085.28	11.75	5085.28	12.25	5085.28	22.25	5085.28
22.25	5087.28								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1.75	.015	1.75	.015	22.25	.015

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
1.75	22.25	10	10	10	.1	.03

Blocked Obstructions num= 1

Sta L	Sta R	Elev
11.75	12.25	5087.28

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1313

INPUT
Description: Bryn Mawr SD Station 13+13 - End 10'x2' CBC
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1.75	5087.22	1.75	5085.22	11.75	5085.22	12.25	5085.22	22.25	5085.22
22.25	5087.22								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1.75	.015	1.75	.015	22.25	.015

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
1.75	22.25	78	78	78	.1	.03

Blocked Obstructions num= 1

Sta L	Sta R	Elev
11.75	12.25	5087.22

```
CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond         RS: 1234

INPUT
Description: Bryn Mawr SD Station 13+13 - Begin 10'x2' CBC
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1.75 5086.76    1.75 5084.76   11.75 5084.76   12.25 5084.76   22.25 5084.76
   22.25 5086.76

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1.75    .015    1.75    .015   22.25    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          1.75   22.25               41      43      45              .1      .03
Blocked Obstructions     num=       1
   Sta L   Sta R    Elev
   11.75   12.25 5086.76

CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond         RS: 1191

INPUT
Description: Bryn Mawr SD Station 11+91 - PC of  R=75' Curve
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1.75  5086.5    1.75  5084.5   11.75  5084.5   12.25  5084.5   22.25  5084.5
   22.25  5086.5

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1.75    .015    1.75    .015   22.25    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          1.75   22.25               41      41      41              .1      .03

CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond         RS: 1150

INPUT
Description: Bryn Mawr SD Station 11+50
Station Elevation Data    num=       6
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    1.75 5086.26    1.75 5084.26   11.75 5084.26   12.25 5084.26   22.25 5084.26
   22.25 5086.26

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    1.75    .015    1.75    .015   22.25    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          1.75   22.25               25      25      25              .1      .03

CROSS SECTION


RIVER: Bryn Mawr SD
REACH: Aztec-Pond         RS: 1125

INPUT
Description: Tie-In to Existing Channel at Comanche South Pond Park
Station Elevation Data    num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 5086.11       0 5084.11      24 5084.11      24 5086.11

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .015       0    .015      24    .015

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0      24               50      50      50              .1      .03
```

SUMMARY OF MANNING'S N VALUES

River:Bryn Mawr SD

Reach	River Sta.	n1	n2	n3
Aztec-Pond	1972	.015	.015	.015
Aztec-Pond	1900	.015	.015	.015
Aztec-Pond	1800	.015	.015	.015
Aztec-Pond	1700	.015	.015	.015
Aztec-Pond	1600	.015	.015	.015
Aztec-Pond	1550	.015	.015	.015
Aztec-Pond	1470	.015	.015	.015
Aztec-Pond	1442	.015	.015	.015
Aztec-Pond	1402	.015	.015	.015
Aztec-Pond	1392	.015	.015	.015
Aztec-Pond	1386.5	.015	.015	.015
Aztec-Pond	1381	.015	.015	.015
Aztec-Pond	1375.5	.015	.015	.015
Aztec-Pond	1370	.015	.015	.015
Aztec-Pond	1364.5	.015	.015	.015
Aztec-Pond	1359	.015	.015	.015
Aztec-Pond	1356.25	.015	.015	.015
Aztec-Pond	1353.5	.015	.015	.015
Aztec-Pond	1348	.015	.015	.015
Aztec-Pond	1342.5	.015	.015	.015
Aztec-Pond	1337	.015	.015	.015
Aztec-Pond	1331.5	.015	.015	.015
Aztec-Pond	1326	.015	.015	.015
Aztec-Pond	1323	.015	.015	.015
Aztec-Pond	1313	.015	.015	.015
Aztec-Pond	1234	.015	.015	.015
Aztec-Pond	1191	.015	.015	.015
Aztec-Pond	1150	.015	.015	.015
Aztec-Pond	1125	.015	.015	.015

SUMMARY OF REACH LENGTHS

River: Bryn Mawr SD

Reach	River Sta.	Left	Channel	Right
Aztec-Pond	1972	72	72	72
Aztec-Pond	1900	100	100	100
Aztec-Pond	1800	100	100	100
Aztec-Pond	1700	100	100	100
Aztec-Pond	1600	50	50	50
Aztec-Pond	1550	78	80	82
Aztec-Pond	1470	28	28	28
Aztec-Pond	1442	38	40	42
Aztec-Pond	1402	10	10	10
Aztec-Pond	1392	5.5	5.5	5.5
Aztec-Pond	1386.5	5.5	5.5	5.5
Aztec-Pond	1381	5.5	5.5	5.5
Aztec-Pond	1375.5	5.5	5.5	5.5
Aztec-Pond	1370	5.5	5.5	5.5
Aztec-Pond	1364.5	5.5	5.5	5.5
Aztec-Pond	1359	2.75	2.75	2.75
Aztec-Pond	1356.25	2.75	2.75	2.75
Aztec-Pond	1353.5	5.5	5.5	5.5
Aztec-Pond	1348	5.5	5.5	5.5
Aztec-Pond	1342.5	5.5	5.5	5.5
Aztec-Pond	1337	5.5	5.5	5.5
Aztec-Pond	1331.5	5.5	5.5	5.5
Aztec-Pond	1326	3	3	3
Aztec-Pond	1323	10	10	10
Aztec-Pond	1313	78	78	78
Aztec-Pond	1234	41	43	45
Aztec-Pond	1191	41	41	41
Aztec-Pond	1150	25	25	25
Aztec-Pond	1125	50	50	50

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Bryn Mawr SD

Reach	River Sta.	Contr.	Expan.
Aztec-Pond	1972	.1	.03
Aztec-Pond	1900	.1	.03
Aztec-Pond	1800	.1	.03
Aztec-Pond	1700	.1	.03
Aztec-Pond	1600	.1	.03
Aztec-Pond	1550	.1	.03
Aztec-Pond	1470	.1	.03
Aztec-Pond	1442	.1	.03
Aztec-Pond	1402	.1	.03
Aztec-Pond	1392	.1	.03
Aztec-Pond	1386.5	.1	.03
Aztec-Pond	1381	.1	.03
Aztec-Pond	1375.5	.1	.03
Aztec-Pond	1370	.1	.03
Aztec-Pond	1364.5	.1	.03
Aztec-Pond	1359	.1	.03
Aztec-Pond	1356.25	.1	.03
Aztec-Pond	1353.5	.1	.03
Aztec-Pond	1348	.1	.03
Aztec-Pond	1342.5	.1	.03
Aztec-Pond	1337	.1	.03
Aztec-Pond	1331.5	.1	.03
Aztec-Pond	1326	.1	.03
Aztec-Pond	1323	.1	.03
Aztec-Pond	1313	.1	.03
Aztec-Pond	1234	.1	.03
Aztec-Pond	1191	.1	.03
Aztec-Pond	1150	.1	.03
Aztec-Pond	1125	.1	.03

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                    HEC-RAS Version 4.1.0 Jan 2010
                     U.S. Army Corps of Engineers
                    Hydrologic Engineering Center
                          609 Second Street
                          Davis, California

 X     X  XXXXXX   XXXX        XXXX       XX     XXXX
 X     X  X       X    X       X   X     X  X   X
 X     X  X       X            X   X    X    X  X
 XXXXXXX  XXXX    X      XXX   XXXX     XXXXXX   XXXX
 X     X  X       X            X  X     X    X       X
 X     X  X       X    X       X   X    X    X       X
 X     X  XXXXXX   XXXX        X    X   X    X  XXXXX
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PROJECT DATA
Project Title: Bryn Mawr DAR
Project File : BrynMawrDAR.prj
Run Date and Time: 11/3/2012 11:34:35 AM

Project in English units

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond   RS: 1972

CROSS SECTION OUTPUT Profile #PF 1

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	5092.75	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.44	Wt. n-Val.		0.015	
W.S. Elev (ft)	5091.31	Reach Len. (ft)	72.00	72.00	72.00
Crit W.S. (ft)	5091.36	Flow Area (sq ft)		21.67	
E.G. Slope (ft/ft)	0.005001	Area (sq ft)		21.67	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	8.00	Top Width (ft)		8.00	
Vel Total (ft/s)	9.64	Avg. Vel. (ft/s)		9.64	
Max Chl Dpth (ft)	2.71	Hydr. Depth (ft)		2.71	
Conv. Total (cfs)	2955.3	Conv. (cfs)		2955.3	
Length Wtd. (ft)	72.00	Wetted Per. (ft)		13.42	
Min Ch El (ft)	5088.60	Shear (lb/sq ft)		0.50	
Alpha	1.00	Stream Power (lb/ft s)	16.00	0.00	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)		0.42	
C & E Loss (ft)		Cum SA (acres)		0.22	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond   RS: 1900

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5092.40	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.43	Wt. n-Val.		0.015	
W.S. Elev (ft)	5090.97	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	5091.01	Flow Area (sq ft)		21.75	
E.G. Slope (ft/ft)	0.004949	Area (sq ft)		21.75	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	8.00	Top Width (ft)		8.00	
Vel Total (ft/s)	9.61	Avg. Vel. (ft/s)		9.61	
Max Chl Dpth (ft)	2.72	Hydr. Depth (ft)		2.72	
Conv. Total (cfs)	2971.0	Conv. (cfs)		2971.0	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		13.44	
Min Ch El (ft)	5088.25	Shear (lb/sq ft)		0.50	
Alpha	1.00	Stream Power (lb/ft s)	16.00	0.00	0.00
Frctn Loss (ft)	0.36	Cum Volume (acre-ft)		0.38	
C & E Loss (ft)	0.00	Cum SA (acres)		0.21	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1800

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5091.90	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.43	Wt. n-Val.		0.015	
W.S. Elev (ft)	5090.47	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	5090.51	Flow Area (sq ft)		21.77	
E.G. Slope (ft/ft)	0.004936	Area (sq ft)		21.77	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	8.00	Top Width (ft)		8.00	
Vel Total (ft/s)	9.60	Avg. Vel. (ft/s)		9.60	
Max Chl Dpth (ft)	2.72	Hydr. Depth (ft)		2.72	
Conv. Total (cfs)	2974.7	Conv. (cfs)		2974.7	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		13.44	
Min Ch El (ft)	5087.75	Shear (lb/sq ft)		0.50	
Alpha	1.00	Stream Power (lb/ft s)	16.00	0.00	0.00
Frctn Loss (ft)	0.49	Cum Volume (acre-ft)		0.33	
C & E Loss (ft)	0.00	Cum SA (acres)		0.19	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1700

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5091.40	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.42	Wt. n-Val.		0.015	
W.S. Elev (ft)	5089.98	Reach Len. (ft)	100.00	100.00	100.00
Crit W.S. (ft)	5090.01	Flow Area (sq ft)		21.82	
E.G. Slope (ft/ft)	0.004907	Area (sq ft)		21.82	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	8.00	Top Width (ft)		8.00	
Vel Total (ft/s)	9.58	Avg. Vel. (ft/s)		9.58	
Max Chl Dpth (ft)	2.73	Hydr. Depth (ft)		2.73	
Conv. Total (cfs)	2983.7	Conv. (cfs)		2983.7	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		13.46	
Min Ch El (ft)	5087.25	Shear (lb/sq ft)		0.50	
Alpha	1.00	Stream Power (lb/ft s)	16.00	0.00	0.00
Frctn Loss (ft)	0.49	Cum Volume (acre-ft)		0.28	
C & E Loss (ft)	0.00	Cum SA (acres)		0.17	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1600

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5090.90	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.43	Wt. n-Val.		0.015	
W.S. Elev (ft)	5089.47	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)	5089.51	Flow Area (sq ft)		21.74	
E.G. Slope (ft/ft)	0.004956	Area (sq ft)		21.74	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	8.00	Top Width (ft)		8.00	
Vel Total (ft/s)	9.61	Avg. Vel. (ft/s)		9.61	
Max Chl Dpth (ft)	2.72	Hydr. Depth (ft)		2.72	
Conv. Total (cfs)	2968.7	Conv. (cfs)		2968.7	
Length Wtd. (ft)	50.00	Wetted Per. (ft)		13.44	
Min Ch El (ft)	5086.75	Shear (lb/sq ft)		0.50	
Alpha	1.00	Stream Power (lb/ft s)	16.00	0.00	0.00
Frctn Loss (ft)	0.49	Cum Volume (acre-ft)		0.23	
C & E Loss (ft)	0.00	Cum SA (acres)		0.15	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond   RS: 1550

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5090.65	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.43	Wt. n-Val.		0.015	
W.S. Elev (ft)	5089.22	Reach Len. (ft)	78.00	80.00	82.00
Crit W.S. (ft)	5089.26	Flow Area (sq ft)		21.77	
E.G. Slope (ft/ft)	0.004939	Area (sq ft)		21.77	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	8.00	Top Width (ft)		8.00	
Vel Total (ft/s)	9.60	Avg. Vel. (ft/s)		9.60	
Max Chl Dpth (ft)	2.72	Hydr. Depth (ft)		2.72	
Conv. Total (cfs)	2974.0	Conv. (cfs)		2974.0	
Length Wtd. (ft)	80.00	Wetted Per. (ft)		13.44	
Min Ch El (ft)	5086.50	Shear (lb/sq ft)		0.50	
Alpha	1.00	Stream Power (lb/ft s)	16.00	0.00	0.00
Frctn Loss (ft)	0.25	Cum Volume (acre-ft)		0.21	
C & E Loss (ft)	0.00	Cum SA (acres)		0.14	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond   RS: 1470

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5090.25	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.43	Wt. n-Val.		0.015	
W.S. Elev (ft)	5088.83	Reach Len. (ft)	28.00	28.00	28.00
Crit W.S. (ft)	5088.86	Flow Area (sq ft)		21.80	
E.G. Slope (ft/ft)	0.004919	Area (sq ft)		21.80	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	8.00	Top Width (ft)		8.00	
Vel Total (ft/s)	9.59	Avg. Vel. (ft/s)		9.59	
Max Chl Dpth (ft)	2.73	Hydr. Depth (ft)		2.73	
Conv. Total (cfs)	2979.9	Conv. (cfs)		2979.9	
Length Wtd. (ft)	28.00	Wetted Per. (ft)		13.45	
Min Ch El (ft)	5086.10	Shear (lb/sq ft)		0.50	
Alpha	1.00	Stream Power (lb/ft s)	16.00	0.00	0.00
Frctn Loss (ft)	0.39	Cum Volume (acre-ft)		0.17	
C & E Loss (ft)	0.00	Cum SA (acres)		0.13	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond   RS: 1442

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5090.11	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.43	Wt. n-Val.		0.015	
W.S. Elev (ft)	5088.69	Reach Len. (ft)	38.00	40.00	42.00
Crit W.S. (ft)	5088.72	Flow Area (sq ft)		21.82	
E.G. Slope (ft/ft)	0.004909	Area (sq ft)		21.82	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	8.00	Top Width (ft)		8.00	
Vel Total (ft/s)	9.58	Avg. Vel. (ft/s)		9.58	
Max Chl Dpth (ft)	2.73	Hydr. Depth (ft)		2.73	
Conv. Total (cfs)	2982.9	Conv. (cfs)		2982.9	
Length Wtd. (ft)	40.00	Wetted Per. (ft)		13.45	
Min Ch El (ft)	5085.96	Shear (lb/sq ft)		0.50	
Alpha	1.00	Stream Power (lb/ft s)	16.00	0.00	0.00
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)		0.15	
C & E Loss (ft)	0.00	Cum SA (acres)		0.12	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1402

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5089.91	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.42	Wt. n-Val.		0.015	
W.S. Elev (ft)	5088.49	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)	5088.52	Flow Area (sq ft)		21.84	
E.G. Slope (ft/ft)	0.004892	Area (sq ft)		21.84	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	8.00	Top Width (ft)		8.00	
Vel Total (ft/s)	9.57	Avg. Vel. (ft/s)		9.57	
Max Chl Dpth (ft)	2.73	Hydr. Depth (ft)		2.73	
Conv. Total (cfs)	2988.1	Conv. (cfs)		2988.1	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		13.46	
Min Ch El (ft)	5085.76	Shear (lb/sq ft)		0.50	
Alpha	1.00	Stream Power (lb/ft s)	16.00	0.00	0.00
Frctn Loss (ft)	0.20	Cum Volume (acre-ft)		0.13	
C & E Loss (ft)	0.00	Cum SA (acres)		0.12	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1392

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5089.85	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.45	Wt. n-Val.		0.015	
W.S. Elev (ft)	5088.40	Reach Len. (ft)	5.50	5.50	5.50
Crit W.S. (ft)	5088.46	Flow Area (sq ft)		21.61	
E.G. Slope (ft/ft)	0.005042	Area (sq ft)		21.61	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	8.00	Top Width (ft)		8.00	
Vel Total (ft/s)	9.67	Avg. Vel. (ft/s)		9.67	
Max Chl Dpth (ft)	2.70	Hydr. Depth (ft)		2.70	
Conv. Total (cfs)	2943.4	Conv. (cfs)		2943.4	
Length Wtd. (ft)	5.50	Wetted Per. (ft)		13.40	
Min Ch El (ft)	5085.70	Shear (lb/sq ft)		0.51	
Alpha	1.00	Stream Power (lb/ft s)	16.00	0.00	0.00
Frctn Loss (ft)	0.05	Cum Volume (acre-ft)		0.13	
C & E Loss (ft)	0.00	Cum SA (acres)		0.11	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1386.5

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5089.75	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.07	Wt. n-Val.		0.015	
W.S. Elev (ft)	5087.68	Reach Len. (ft)	5.50	5.50	5.50
Crit W.S. (ft)	5088.22	Flow Area (sq ft)		18.08	
E.G. Slope (ft/ft)	0.008783	Area (sq ft)		18.08	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	9.00	Top Width (ft)		9.00	
Vel Total (ft/s)	11.56	Avg. Vel. (ft/s)		11.56	
Max Chl Dpth (ft)	2.01	Hydr. Depth (ft)		2.01	
Conv. Total (cfs)	2230.1	Conv. (cfs)		2230.1	
Length Wtd. (ft)	5.50	Wetted Per. (ft)		13.02	
Min Ch El (ft)	5085.67	Shear (lb/sq ft)		0.76	
Alpha	1.00	Stream Power (lb/ft s)	16.50	0.00	0.00
Frctn Loss (ft)	0.04	Cum Volume (acre-ft)		0.12	
C & E Loss (ft)	0.06	Cum SA (acres)		0.11	

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1381

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5089.68	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.33	Wt. n-Val.		0.015	
W.S. Elev (ft)	5087.35	Reach Len. (ft)	5.50	5.50	5.50
Crit W.S. (ft)	5088.02	Flow Area (sq ft)		17.07	
E.G. Slope (ft/ft)	0.011077	Area (sq ft)		17.07	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	10.00	Top Width (ft)		10.00	
Vel Total (ft/s)	12.24	Avg. Vel. (ft/s)		12.24	
Max Chl Dpth (ft)	1.71	Hydr. Depth (ft)		1.71	
Conv. Total (cfs)	1985.8	Conv. (cfs)		1985.8	
Length Wtd. (ft)	5.50	Wetted Per. (ft)		13.41	
Min Ch El (ft)	5085.64	Shear (lb/sq ft)		0.88	
Alpha	1.00	Stream Power (lb/ft s)	17.00	0.00	0.00
Frctn Loss (ft)	0.05	Cum Volume (acre-ft)		0.12	
C & E Loss (ft)	0.03	Cum SA (acres)		0.11	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1375.5

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5089.59	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.47	Wt. n-Val.		0.015	
W.S. Elev (ft)	5087.12	Reach Len. (ft)	5.50	5.50	5.50
Crit W.S. (ft)	5087.85	Flow Area (sq ft)		16.58	
E.G. Slope (ft/ft)	0.012953	Area (sq ft)		16.58	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	11.00	Top Width (ft)		11.00	
Vel Total (ft/s)	12.61	Avg. Vel. (ft/s)		12.61	
Max Chl Dpth (ft)	1.51	Hydr. Depth (ft)		1.51	
Conv. Total (cfs)	1836.4	Conv. (cfs)		1836.4	
Length Wtd. (ft)	5.50	Wetted Per. (ft)		14.01	
Min Ch El (ft)	5085.61	Shear (lb/sq ft)		0.96	
Alpha	1.00	Stream Power (lb/ft s)	17.50	0.00	0.00
Frctn Loss (ft)	0.07	Cum Volume (acre-ft)		0.12	
C & E Loss (ft)	0.01	Cum SA (acres)		0.11	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1370

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5089.50	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.57	Wt. n-Val.		0.015	
W.S. Elev (ft)	5086.92	Reach Len. (ft)	5.50	5.50	5.50
Crit W.S. (ft)	5087.67	Flow Area (sq ft)		16.23	
E.G. Slope (ft/ft)	0.014814	Area (sq ft)		16.23	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	12.00	Top Width (ft)		12.00	
Vel Total (ft/s)	12.88	Avg. Vel. (ft/s)		12.88	
Max Chl Dpth (ft)	1.35	Hydr. Depth (ft)		1.35	
Conv. Total (cfs)	1717.2	Conv. (cfs)		1717.2	
Length Wtd. (ft)	5.50	Wetted Per. (ft)		14.71	
Min Ch El (ft)	5085.57	Shear (lb/sq ft)		1.02	
Alpha	1.00	Stream Power (lb/ft s)	18.00	0.00	0.00
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)		0.12	
C & E Loss (ft)	0.01	Cum SA (acres)		0.11	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1364.5

CROSS SECTION OUTPUT Profile #PF 1

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	5089.41	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.64	Wt. n-Val.		0.015	
W.S. Elev (ft)	5086.77	Reach Len. (ft)	5.50	5.50	5.50
Crit W.S. (ft)	5087.54	Flow Area (sq ft)		16.03	
E.G. Slope (ft/ft)	0.016522	Area (sq ft)		16.03	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	13.00	Top Width (ft)		13.00	
Vel Total (ft/s)	13.04	Avg. Vel. (ft/s)		13.04	
Max Chl Dpth (ft)	1.23	Hydr. Depth (ft)		1.23	
Conv. Total (cfs)	1626.0	Conv. (cfs)		1626.0	
Length Wtd. (ft)	5.50	Wetted Per. (ft)		15.47	
Min Ch El (ft)	5085.54	Shear (lb/sq ft)		1.07	
Alpha	1.00	Stream Power (lb/ft s)	18.50	0.00	0.00
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)		0.12	
C & E Loss (ft)	0.01	Cum SA (acres)		0.11	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1359

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5089.32	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.67	Wt. n-Val.		0.015	
W.S. Elev (ft)	5086.65	Reach Len. (ft)	2.75	2.75	2.75
Crit W.S. (ft)	5087.41	Flow Area (sq ft)		15.93	
E.G. Slope (ft/ft)	0.018058	Area (sq ft)		15.93	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	14.00	Top Width (ft)		14.00	
Vel Total (ft/s)	13.12	Avg. Vel. (ft/s)		13.12	
Max Chl Dpth (ft)	1.14	Hydr. Depth (ft)		1.14	
Conv. Total (cfs)	1555.3	Conv. (cfs)		1555.3	
Length Wtd. (ft)	2.75	Wetted Per. (ft)		16.28	
Min Ch El (ft)	5085.51	Shear (lb/sq ft)		1.10	
Alpha	1.00	Stream Power (lb/ft s)	19.00	0.00	0.00
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)		0.11	
C & E Loss (ft)	0.00	Cum SA (acres)		0.11	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1356.25

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5089.26	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.64	Wt. n-Val.		0.015	
W.S. Elev (ft)	5086.63	Reach Len. (ft)	2.75	2.75	2.75
Crit W.S. (ft)	5087.38	Flow Area (sq ft)		16.04	
E.G. Slope (ft/ft)	0.021036	Area (sq ft)		16.04	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	14.00	Top Width (ft)		14.00	
Vel Total (ft/s)	13.03	Avg. Vel. (ft/s)		13.03	
Max Chl Dpth (ft)	1.15	Hydr. Depth (ft)		1.15	
Conv. Total (cfs)	1441.0	Conv. (cfs)		1441.0	
Length Wtd. (ft)	2.75	Wetted Per. (ft)		18.58	
Min Ch El (ft)	5085.48	Shear (lb/sq ft)		1.13	
Alpha	1.00	Stream Power (lb/ft s)	19.25	0.00	0.00
Frctn Loss (ft)	0.05	Cum Volume (acre-ft)		0.11	
C & E Loss (ft)	0.00	Cum SA (acres)		0.11	

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1353.5

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5089.20	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.64	Wt. n-Val.		0.015	
W.S. Elev (ft)	5086.57	Reach Len. (ft)	5.50	5.50	5.50
Crit W.S. (ft)	5087.32	Flow Area (sq ft)		16.04	
E.G. Slope (ft/ft)	0.021556	Area (sq ft)		16.04	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	14.50	Top Width (ft)		14.50	
Vel Total (ft/s)	13.03	Avg. Vel. (ft/s)		13.03	
Max Chl Dpth (ft)	1.11	Hydr. Depth (ft)		1.11	
Conv. Total (cfs)	1423.5	Conv. (cfs)		1423.5	
Length Wtd. (ft)	5.50	Wetted Per. (ft)		18.93	
Min Ch El (ft)	5085.46	Shear (lb/sq ft)		1.14	
Alpha	1.00	Stream Power (lb/ft s)	19.50	0.00	0.00
Frctn Loss (ft)	0.06	Cum Volume (acre-ft)		0.11	
C & E Loss (ft)	0.00	Cum SA (acres)		0.10	

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1348

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5089.08	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.61	Wt. n-Val.		0.015	
W.S. Elev (ft)	5086.47	Reach Len. (ft)	5.50	5.50	5.50
Crit W.S. (ft)	5087.20	Flow Area (sq ft)		16.12	
E.G. Slope (ft/ft)	0.022318	Area (sq ft)		16.12	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	15.50	Top Width (ft)		15.50	
Vel Total (ft/s)	12.96	Avg. Vel. (ft/s)		12.96	
Max Chl Dpth (ft)	1.04	Hydr. Depth (ft)		1.04	
Conv. Total (cfs)	1399.0	Conv. (cfs)		1399.0	
Length Wtd. (ft)	5.50	Wetted Per. (ft)		19.66	
Min Ch El (ft)	5085.43	Shear (lb/sq ft)		1.14	
Alpha	1.00	Stream Power (lb/ft s)	20.00	0.00	0.00
Frctn Loss (ft)	0.12	Cum Volume (acre-ft)		0.11	
C & E Loss (ft)	0.00	Cum SA (acres)		0.10	

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1342.5

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5088.95	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.56	Wt. n-Val.		0.015	
W.S. Elev (ft)	5086.39	Reach Len. (ft)	5.50	5.50	5.50
Crit W.S. (ft)	5087.10	Flow Area (sq ft)		16.27	
E.G. Slope (ft/ft)	0.022817	Area (sq ft)		16.27	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	16.50	Top Width (ft)		16.50	
Vel Total (ft/s)	12.85	Avg. Vel. (ft/s)		12.85	
Max Chl Dpth (ft)	0.99	Hydr. Depth (ft)		0.99	
Conv. Total (cfs)	1383.6	Conv. (cfs)		1383.6	
Length Wtd. (ft)	5.50	Wetted Per. (ft)		20.44	
Min Ch El (ft)	5085.40	Shear (lb/sq ft)		1.13	
Alpha	1.00	Stream Power (lb/ft s)	20.50	0.00	0.00
Frctn Loss (ft)	0.12	Cum Volume (acre-ft)		0.11	
C & E Loss (ft)	0.00	Cum SA (acres)		0.10	

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1337

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5088.82	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.51	Wt. n-Val.		0.015	
W.S. Elev (ft)	5086.31	Reach Len. (ft)	5.50	5.50	5.50
Crit W.S. (ft)	5087.00	Flow Area (sq ft)		16.45	
E.G. Slope (ft/ft)	0.023162	Area (sq ft)		16.45	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	17.50	Top Width (ft)		17.50	
Vel Total (ft/s)	12.71	Avg. Vel. (ft/s)		12.71	
Max Chl Dpth (ft)	0.94	Hydr. Depth (ft)		0.94	
Conv. Total (cfs)	1373.3	Conv. (cfs)		1373.3	
Length Wtd. (ft)	5.50	Wetted Per. (ft)		21.26	
Min Ch El (ft)	5085.37	Shear (lb/sq ft)		1.12	
Alpha	1.00	Stream Power (lb/ft s)	21.00	0.00	0.00
Frctn Loss (ft)	0.13	Cum Volume (acre-ft)		0.11	
C & E Loss (ft)	0.00	Cum SA (acres)		0.10	

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1331.5

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5088.69	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.44	Wt. n-Val.		0.015	
W.S. Elev (ft)	5086.24	Reach Len. (ft)	5.50	5.50	5.50
Crit W.S. (ft)	5086.92	Flow Area (sq ft)		16.66	
E.G. Slope (ft/ft)	0.023391	Area (sq ft)		16.66	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	18.50	Top Width (ft)		18.50	
Vel Total (ft/s)	12.55	Avg. Vel. (ft/s)		12.55	
Max Chl Dpth (ft)	0.90	Hydr. Depth (ft)		0.90	
Conv. Total (cfs)	1366.6	Conv. (cfs)		1366.6	
Length Wtd. (ft)	5.50	Wetted Per. (ft)		22.10	
Min Ch El (ft)	5085.34	Shear (lb/sq ft)		1.10	
Alpha	1.00	Stream Power (lb/ft s)	21.50	0.00	0.00
Frctn Loss (ft)	0.13	Cum Volume (acre-ft)		0.10	
C & E Loss (ft)	0.00	Cum SA (acres)		0.10	

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1326

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5088.55	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.39	Wt. n-Val.		0.015	
W.S. Elev (ft)	5086.16	Reach Len. (ft)	3.00	3.00	3.00
Crit W.S. (ft)	5086.82	Flow Area (sq ft)		16.85	
E.G. Slope (ft/ft)	0.023665	Area (sq ft)		16.85	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	19.50	Top Width (ft)		19.50	
Vel Total (ft/s)	12.40	Avg. Vel. (ft/s)		12.40	
Max Chl Dpth (ft)	0.86	Hydr. Depth (ft)		0.86	
Conv. Total (cfs)	1358.6	Conv. (cfs)		1358.6	
Length Wtd. (ft)	3.00	Wetted Per. (ft)		22.96	
Min Ch El (ft)	5085.30	Shear (lb/sq ft)		1.08	
Alpha	1.00	Stream Power (lb/ft s)	22.00	0.00	0.00
Frctn Loss (ft)	0.13	Cum Volume (acre-ft)		0.10	
C & E Loss (ft)	0.00	Cum SA (acres)		0.09	

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1323

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5088.49	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.36	Wt. n-Val.		0.015	
W.S. Elev (ft)	5086.13	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)	5086.78	Flow Area (sq ft)		16.94	
E.G. Slope (ft/ft)	0.023832	Area (sq ft)		16.94	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	20.00	Top Width (ft)		20.00	
Vel Total (ft/s)	12.34	Avg. Vel. (ft/s)		12.34	
Max Chl Dpth (ft)	0.85	Hydr. Depth (ft)		0.85	
Conv. Total (cfs)	1353.8	Conv. (cfs)		1353.8	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		23.39	
Min Ch El (ft)	5085.28	Shear (lb/sq ft)		1.08	
Alpha	1.00	Stream Power (lb/ft s)	22.25	0.00	0.00
Frctn Loss (ft)	0.07	Cum Volume (acre-ft)		0.10	
C & E Loss (ft)	0.00	Cum SA (acres)		0.09	

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1313

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5088.26	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.15	Wt. n-Val.		0.015	
W.S. Elev (ft)	5086.11	Reach Len. (ft)	78.00	78.00	78.00
Crit W.S. (ft)	5086.72	Flow Area (sq ft)		17.74	
E.G. Slope (ft/ft)	0.020619	Area (sq ft)		17.74	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	20.00	Top Width (ft)		20.00	
Vel Total (ft/s)	11.78	Avg. Vel. (ft/s)		11.78	
Max Chl Dpth (ft)	0.89	Hydr. Depth (ft)		0.89	
Conv. Total (cfs)	1455.5	Conv. (cfs)		1455.5	
Length Wtd. (ft)	78.00	Wetted Per. (ft)		23.55	
Min Ch El (ft)	5085.22	Shear (lb/sq ft)		0.97	
Alpha	1.00	Stream Power (lb/ft s)	22.25	0.00	0.00
Frctn Loss (ft)	0.22	Cum Volume (acre-ft)		0.10	
C & E Loss (ft)	0.01	Cum SA (acres)		0.09	

Warning: Divided flow computed for this cross-section.

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1234

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5087.20	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.29	Wt. n-Val.		0.015	
W.S. Elev (ft)	5085.90	Reach Len. (ft)	41.00	43.00	45.00
Crit W.S. (ft)	5086.26	Flow Area (sq ft)		22.89	
E.G. Slope (ft/ft)	0.009340	Area (sq ft)		22.89	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	20.00	Top Width (ft)		20.00	
Vel Total (ft/s)	9.13	Avg. Vel. (ft/s)		9.13	
Max Chl Dpth (ft)	1.14	Hydr. Depth (ft)		1.14	
Conv. Total (cfs)	2162.6	Conv. (cfs)		2162.6	
Length Wtd. (ft)	43.00	Wetted Per. (ft)		24.58	
Min Ch El (ft)	5084.76	Shear (lb/sq ft)		0.54	
Alpha	1.00	Stream Power (lb/ft s)	22.25	0.00	0.00
Frctn Loss (ft)	1.04	Cum Volume (acre-ft)		0.06	
C & E Loss (ft)	0.03	Cum SA (acres)		0.05	

Warning: Divided flow computed for this cross-section.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1191

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5086.85	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.18	Wt. n-Val.		0.015	
W.S. Elev (ft)	5085.67	Reach Len. (ft)	41.00	41.00	41.00
Crit W.S. (ft)	5085.98	Flow Area (sq ft)		23.99	
E.G. Slope (ft/ft)	0.007241	Area (sq ft)		23.99	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	20.50	Top Width (ft)		20.50	
Vel Total (ft/s)	8.71	Avg. Vel. (ft/s)		8.71	
Max Chl Dpth (ft)	1.17	Hydr. Depth (ft)		1.17	
Conv. Total (cfs)	2456.1	Conv. (cfs)		2456.1	
Length Wtd. (ft)	41.00	Wetted Per. (ft)		22.84	
Min Ch El (ft)	5084.50	Shear (lb/sq ft)		0.47	
Alpha	1.00	Stream Power (lb/ft s)	22.25	0.00	0.00
Frctn Loss (ft)	0.35	Cum Volume (acre-ft)		0.04	
C & E Loss (ft)	0.00	Cum SA (acres)		0.03	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1150

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5086.57	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.10	Wt. n-Val.		0.015	
W.S. Elev (ft)	5085.47	Reach Len. (ft)	25.00	25.00	25.00
Crit W.S. (ft)	5085.73	Flow Area (sq ft)		24.86	
E.G. Slope (ft/ft)	0.006461	Area (sq ft)		24.86	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	20.50	Top Width (ft)		20.50	
Vel Total (ft/s)	8.41	Avg. Vel. (ft/s)		8.41	
Max Chl Dpth (ft)	1.21	Hydr. Depth (ft)		1.21	
Conv. Total (cfs)	2600.0	Conv. (cfs)		2600.0	
Length Wtd. (ft)	25.00	Wetted Per. (ft)		22.93	
Min Ch El (ft)	5084.26	Shear (lb/sq ft)		0.44	
Alpha	1.00	Stream Power (lb/ft s)	22.25	0.00	0.00
Frctn Loss (ft)	0.28	Cum Volume (acre-ft)		0.01	
C & E Loss (ft)	0.00	Cum SA (acres)		0.01	

CROSS SECTION

RIVER: Bryn Mawr SD
REACH: Aztec-Pond RS: 1125

CROSS SECTION OUTPUT Profile #PF 1

E.G. Elev (ft)	5086.35	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.28	Wt. n-Val.		0.015	
W.S. Elev (ft)	5085.07	Reach Len. (ft)			
Crit W.S. (ft)	5085.43	Flow Area (sq ft)		23.00	
E.G. Slope (ft/ft)	0.009861	Area (sq ft)		23.00	
Q Total (cfs)	209.00	Flow (cfs)		209.00	
Top Width (ft)	24.00	Top Width (ft)		24.00	
Vel Total (ft/s)	9.09	Avg. Vel. (ft/s)		9.09	
Max Chl Dpth (ft)	0.96	Hydr. Depth (ft)		0.96	
Conv. Total (cfs)	2104.7	Conv. (cfs)		2104.7	
Length Wtd. (ft)		Wetted Per. (ft)		25.92	
Min Ch El (ft)	5084.11	Shear (lb/sq ft)		0.55	
Alpha	1.00	Stream Power (lb/ft s)	24.00	0.00	0.00
Frctn Loss (ft)	0.20	Cum Volume (acre-ft)			
C & E Loss (ft)	0.02	Cum SA (acres)			

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

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X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
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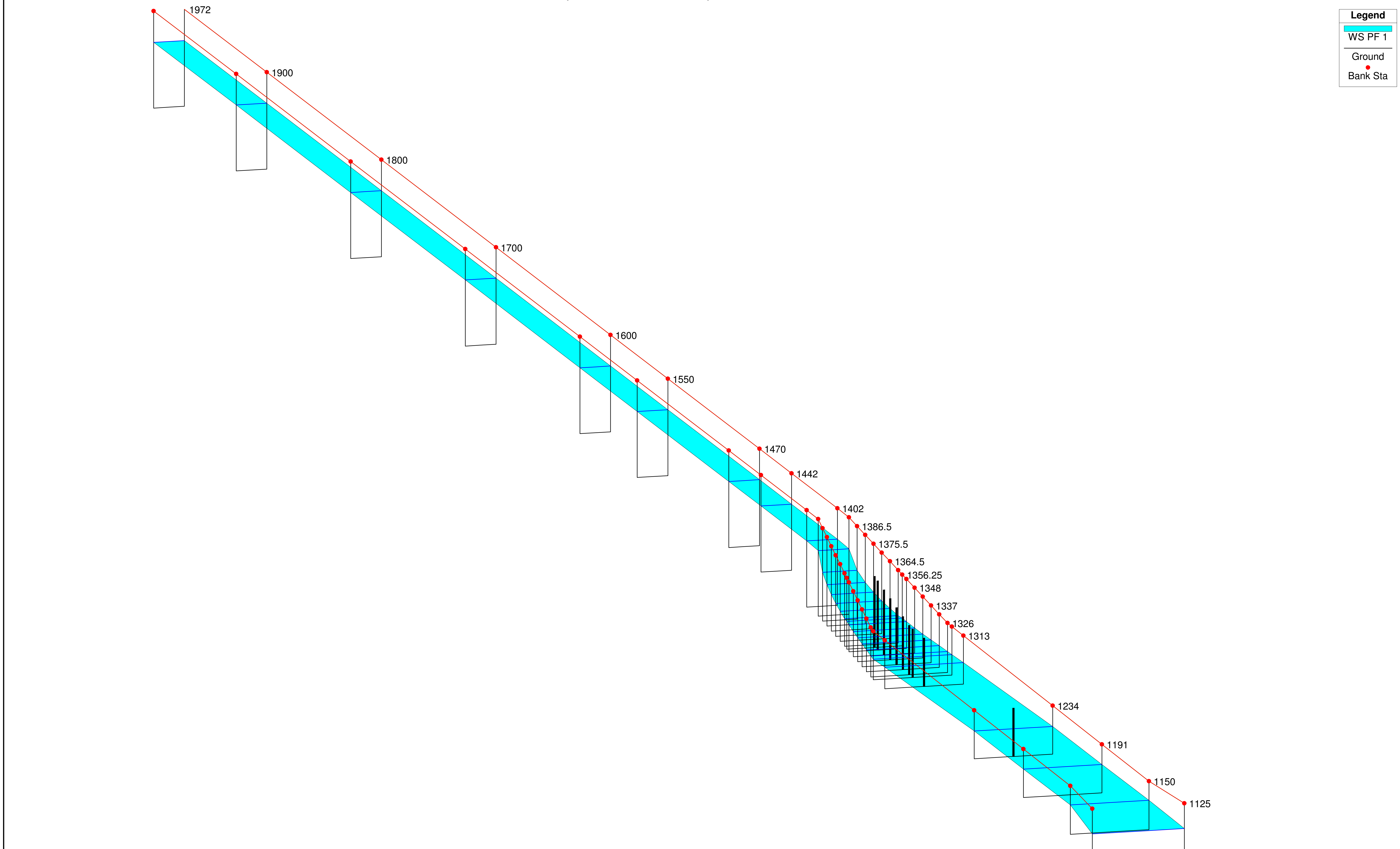
PROJECT DATA
Project Title: Bryn Mawr DAR
Project File : BrynMawrDAR.prj
Run Date and Time: 11/3/2012 11:34:35 AM

Project in English units

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Aztec-Pond	1972	PF 1	209.00	5088.60	5091.31	5091.36	5092.75	0.005001	9.64	21.67	8.00	1.03
Aztec-Pond	1900	PF 1	209.00	5088.25	5090.97	5091.01	5092.40	0.004949	9.61	21.75	8.00	1.03
Aztec-Pond	1800	PF 1	209.00	5087.75	5090.47	5090.51	5091.90	0.004936	9.60	21.77	8.00	1.03
Aztec-Pond	1700	PF 1	209.00	5087.25	5089.98	5090.01	5091.40	0.004907	9.58	21.82	8.00	1.02
Aztec-Pond	1600	PF 1	209.00	5086.75	5089.47	5089.51	5090.90	0.004956	9.61	21.74	8.00	1.03
Aztec-Pond	1550	PF 1	209.00	5086.50	5089.22	5089.26	5090.65	0.004939	9.60	21.77	8.00	1.03
Aztec-Pond	1470	PF 1	209.00	5086.10	5088.83	5088.86	5090.25	0.004919	9.59	21.80	8.00	1.02
Aztec-Pond	1442	PF 1	209.00	5085.96	5088.69	5088.72	5090.11	0.004909	9.58	21.82	8.00	1.02
Aztec-Pond	1402	PF 1	209.00	5085.76	5088.49	5088.52	5089.91	0.004892	9.57	21.84	8.00	1.02
Aztec-Pond	1392	PF 1	209.00	5085.70	5088.40	5088.46	5089.85	0.005042	9.67	21.61	8.00	1.04
Aztec-Pond	1386.5	PF 1	209.00	5085.67	5087.68	5088.22	5089.75	0.008783	11.56	18.08	9.00	1.44
Aztec-Pond	1381	PF 1	209.00	5085.64	5087.35	5088.02	5089.68	0.011077	12.24	17.07	10.00	1.65
Aztec-Pond	1375.5	PF 1	209.00	5085.61	5087.12	5087.85	5089.59	0.012953	12.61	16.58	11.00	1.81
Aztec-Pond	1370	PF 1	209.00	5085.57	5086.92	5087.67	5089.50	0.014814	12.88	16.23	12.00	1.95
Aztec-Pond	1364.5	PF 1	209.00	5085.54	5086.77	5087.54	5089.41	0.016522	13.04	16.03	13.00	2.07
Aztec-Pond	1359	PF 1	209.00	5085.51	5086.65	5087.41	5089.32	0.018058	13.12	15.93	14.00	2.17
Aztec-Pond	1356.25	PF 1	209.00	5085.48	5086.63	5087.38	5089.26	0.021036	13.03	16.04	14.00	2.14
Aztec-Pond	1353.5	PF 1	209.00	5085.46	5086.57	5087.32	5089.20	0.021556	13.03	16.04	14.50	2.18
Aztec-Pond	1348	PF 1	209.00	5085.43	5086.47	5087.20	5089.08	0.022318	12.96	16.12	15.50	2.24
Aztec-Pond	1342.5	PF 1	209.00	5085.40	5086.39	5087.10	5088.95	0.022817	12.85	16.27	16.50	2.28
Aztec-Pond	1337	PF 1	209.00	5085.37	5086.31	5087.00	5088.82	0.023162	12.71	16.45	17.50	2.31
Aztec-Pond	1331.5	PF 1	209.00	5085.34	5086.24	5086.92	5088.69	0.023391	12.55	16.66	18.50	2.33
Aztec-Pond	1326	PF 1	209.00	5085.30	5086.16	5086.82	5088.55	0.023665	12.40	16.85	19.50	2.35
Aztec-Pond	1323	PF 1	209.00	5085.28	5086.13	5086.78	5088.49	0.023832	12.34	16.94	20.00	2.36
Aztec-Pond	1313	PF 1	209.00	5085.22	5086.11	5086.72	5088.26	0.020619	11.78	17.74	20.00	2.20
Aztec-Pond	1234	PF 1	209.00	5084.76	5085.90	5086.26	5087.20	0.009340	9.13	22.89	20.00	1.50
Aztec-Pond	1191	PF 1	209.00	5084.50	5085.67	5085.98	5086.85	0.007241	8.71	23.99	20.50	1.42
Aztec-Pond	1150	PF 1	209.00	5084.26	5085.47	5085.73	5086.57	0.006461	8.41	24.86	20.50	1.35
Aztec-Pond	1125	PF 1	209.00	5084.11	5085.07	5085.43	5086.35	0.009861	9.09	23.00	24.00	1.64

Bryn Mawr DAR Plan: Bryn Mawr DAR 1/14/2013



1 in Horiz. = 0.03 1 in Vert. = 0.05

APPENDIX IV

Conceptual Cost Estimate

	DESIGN ANALYSIS REPORT COST ESTIMATE: BRYN MAWR STORM DRAIN IMPROVEMENTS						
	BID ITEM NO.	**SPEC. ITEM NO.**	**DESCRIPTION**	**EST. QTY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
General Items	1	4.010X	Construction Staking including staking of project, quantity verification, and as-built information, compl.	1	LS	$ 20,000.00	$ 20,000.00
	2	6.010	Construction Project Sign, materials, installation and maintenance per Contract Special Provisions, cip.	3	EA	$ 650.00	$ 1,950.00
	3	19.010	Construction Traffic Control & Barricading, including any and all access signs and including all final striping, compl.	1	LS	$ 15,000.00	$ 15,000.00
	4	30.010	Flood Protection, compl.	1	LS	$ 10,000.00	$ 10,000.00
	5	30.020	NPDES Compliance, complete	1	LS	$ 7,500.00	$ 7,500.00
Paving - Private Properties	6	301.020	Subgrade Prep. 12" at 95% compaction, cip.	1,415	SY	$ 2.00	$ 2,830.00
	7	336.AAA	Asphalt Concrete, 2 inch thick, superpave, cip.	2,830	SY	$ 15.00	$ 42,450.00
	8	336.010	Prime Coat, emulsified asphalt, cip.	1,415	SY	$ 1.00	$ 1,415.00
	9	336.120	Tack Coat, cationic emulsified asphalt, cip.	1,415	SY	$ 1.00	$ 1,415.00
	10	337.020	Concrete Pavement, 6" thick, Portland Cement Concrete with fly ash, cip. SD 2411	57	SY	$ 66.66	$ 3,799.62
	11	343.020	AC Pavement, any thickness, sawcut, R&D	1,415	SY	$ 8.00	$ 11,320.00
	12	343.050	Existing Pavement, PC Concrete, any thickness, sawcut, remove & dispose, compl.	57	SY	$ 17.00	$ 969.00
	13	340.110	Header Curb, Portland Cement Concrete, incl. subgrade, cip., SD 2415	120	LF	$ 25.00	$ 3,000.00
	14	343.08X	Existing Header Curb, PC Concrete, remove & dispose, compl.	120	LF	$ 7.00	$ 840.00
Paving - Bryn Mawr Drive	15	301.020	Subgrade Prep. 12" at 95% compaction, cip.	1,538	SY	$ 2.00	$ 3,076.00
	16	302.020	Aggregate Base Course, crushed, 6" at 95% compaction, cip. SD 2408	1,538	SY	$ 8.00	$ 12,304.00
	17	336.AAA	Asphalt Concrete, 2-1/2" thick, superpave, cip	4,614	SY	$ 15.00	$ 69,210.00
	18	336.010	Prime Coat, emulsified asphalt, cip.	1,538	SY	$ 1.00	$ 1,538.00

	DESIGN ANALYSIS REPORT COST ESTIMATE: BRYN MAWR STORM DRAIN IMPROVEMENTS						
	BID ITEM NO.	**SPEC. ITEM NO.**	**DESCRIPTION**	**EST. QTY**	**UNIT**	**UNIT PRICE**	**AMOUNT**
	19	336.120	Tack Coat, cationic emulsified asphalt, cip.	1,538	SY	$ 1.00	$ 1,538.00
	20	340.010	Sidewalk, 4" thick, Portland Cement Concrete, incl. subgrade compaction, cip. SD 2430	373	SY	$ 45.00	$ 16,785.00
	21	340.020	Drivepad, 6" thick, Portland Cement Concrete, incl. subgrade compaction, cip. SD 2425	200	SY	$ 60.00	$ 12,000.00
	22	340.035	Valley Gutter, Portland Cement Concrete, remove, dispose, & replace, cip.	20	SY	$ 61.24	$ 1,224.80
	23	340.050	Curb & Gutter, Standard, Portland Cement Concrete, incl. subgrade preparation, cip. SD 2415	755	LF	$ 25.00	$ 18,875.00
	24	343.020	AC Pavement, any thickness, sawcut, R&D	1,538	SY	$ 8.00	$ 12,304.00
	25	343.050	Existing Pavement, PC Concrete, any thickness, sawcut, remove & dispose, compl.	303	SY	$ 17.00	$ 5,151.00
	26	343.080	Existing Curb & Gutter or Valley Gutter, PC Concrete remove & dispose, compl.	635	LF	$ 7.00	$ 4,445.00
	27	343.090	Sidewalk & Drivepad, sawcut, remove & dispose, compl.	428	SY	$ 10.00	$ 4,280.00
	28	450.XXX	Traffic Signs and Posts, cip.	1	LS	$ 5,000.00	$ 5,000.00
Utilities	29	801.002	6" Waterline Pipe excl. fittings, incl. trench & compacted backfill, up to 6' depth, cip	180	LF	$ 25.00	$ 4,500.00
	30	801.055	Existing Waterline, 6", with fittings, Remove & Dispose, excl. trenching, compl.	180	LF	$ 4.00	$ 720.00
	31	801.065	Ductile Iron MJ Fittings, Class 250, 6" Waterline, incl. jointing material, cip.	60	LB	$ 3.30	$ 198.00
	32	801.078	Tee, 6" waterline, incl. jointing material, cip.	1	EA	$ 575.00	$ 575.00
	33	801.081	6" Gate Valve (Fire Hydrant Isolation Valve) 6", cip.	3	EA	$ 750.00	$ 2,250.00
	34	801.105	Type A valve box, cip	3	EA	$ 450.00	$ 1,350.00
	35	801.104	Valve Box, Remove & Dispose, compl.	2	EA	$ 135.00	$ 270.00
	36	801.114	Fire Hydrant, 4-1/2' bury, MJ, incl. blocking & aggregate, cip. SD 2340	1	EA	$ 2,227.02	$ 2,227.02
	37	801.115	Mechanical Joint Restraining Gland, DI, 6"	20	EA	$ 80.00	$ 1,600.00

DESIGN ANALYSIS REPORT COST ESTIMATE: BRYN MAWR STORM DRAIN IMPROVEMENTS

	BID ITEM NO.	SPEC. ITEM NO.	DESCRIPTION	EST. QTY	UNIT	UNIT PRICE	AMOUNT
	38	801.119	Fire Hydrant, Existing, Remove & Salvage, compl.	1	EA	$ 400.00	$ 400.00
	39	801.155	Mechanical Joint Restaining Harness, DI, 6", cip.	9	EA	$ 80.00	$ 720.00
	40	802.300	3/4" Service Line Replacement & Transfer, incl. tapping saddle & tubing, cip. SD 2362	4	EA	$ 750.00	$ 3,000.00
	41	802.570	Water Meter Box, Remove & Replace, incl. cover & lid, compl.	10	EA	$ 900.00	$ 9,000.00
	42	920.570	4' MH, R&D, compl.	1	EA	$ 800.00	$ 800.00
	43	920.070	Manhole, 4' dia. Type "E", 6'-10' deep, cip. SD 2101	1	EA	$ 3,000.00	$ 3,000.00
Drainage	44	201.010	Clear and grub, complete	1	AC	$ 1,500.00	$ 1,500.00
	45	1011.010	Seeding, complete	1	AC	$ 2,000.00	$ 2,000.00
	46	410.03X	Existing access gate, remove and dispose	1	EA	$ 500.00	$ 500.00
	47	201.01X	Remove and relocate boulders	15	EA	$ 250.00	$ 3,750.00
	48	410.060	Pipe gate, 16' wide, cip	3	EA	$ 2,000.00	$ 6,000.00
	49	910.XXX	Erosion protection along low flow channel	160	CY	$ 115.00	$ 18,400.00
	50	501.020	Existing Drainage Structure or Channel Lining, Reinforced concrete, Remove & Dispose, compl.	30	CY	$ 50.00	$ 1,500.00
	51	301.020	12" subgrade under CBC at 95%, cip	1,150	SY	$ 1.50	$ 1,725.00
	52	205.01X	2' fill under CBC at 95%, cip	880	CY	$ 6.00	$ 5,280.00
	53	205.01X	Existing on-site material, cut, process, and recompact at 95%, cip	3,000	CY	$ 6.00	$ 18,000.00
	54	205.010	Import fill, place and compact, 95%, cip.	2,000	CY	$ 10.00	$ 20,000.00
	55	501.11A	4' tall RPCC retaining wall and footing, cip	96	CY	$ 250.00	$ 24,000.00

DESIGN ANALYSIS REPORT COST ESTIMATE: BRYN MAWR STORM DRAIN IMPROVEMENTS

	BID ITEM NO.	SPEC. ITEM NO.	DESCRIPTION	EST. QTY	UNIT	UNIT PRICE	AMOUNT
	56	501.11B	RPCC 8" Deep Open Channel in Park, incl. integral cut-off wall	41	CY	$ 250.00	$ 10,250.00
	57	510.11C	RPCC 2' Deep Open Channel in Park, incl. integral cut-off wall	35	CY	$ 250.00	$ 8,750.00
	58	510.11D	RPCC Dual 2' x 10' Box Culvert, 4,000 psi, incl. reinforcing, form work, cip	134	CY	$ 500.00	$ 67,000.00
	59	510.11E	RPCC Transition Structure from 2' x 10' dual culverts to 4' x 8' CBC, 4,000 psi, incl. reinforcing, form work, cip	77	CY	$ 500.00	$ 38,500.00
	60	510.11F	4' x 8' RPCC box culvert 4,000 psi incl. reinforcing, form work, cip	424	CY	$ 500.00	$ 212,000.00
	61	510.11G	RPCC Transition Structure from 4' x 8' CBC to Aztec Junction Box, 4,000 psi, incl. reinforcing, form work, cip	26	CY	$ 500.00	$ 13,000.00
	62	510.11H	Junction Box at Aztec , RPCC, 4,000 psi, incl reinforcing, formwork, cip	85	CY	$ 500.00	$ 42,500.00
	63	510.11J	Stainless steel water quality screen for Aztec Water Junction box, cip	140	SF	$ 40.00	$ 5,600.00
	64	510.11K	Steel pipe grate for inlet at street level, cip	1	LS	$ 15,000.00	$ 15,000.00
	65	343.050	RPCC apron at Aztec, Remove and dispose, complete	30	SY	$ 10.00	$ 300.00
	66	337.040	8" RPCC paving at Aztec, complete	352	SF	$ 10.00	$ 3,520.00
	67	301.020	12" subgrade under RPCC paving at 95%, cip	352	SF	$ 1.50	$ 528.00
	68	340.050	Curb and gutter, std, PCC incl. subgrade preparations, cip	16	LF	$ 25.00	$ 400.00
	69	343.080	Ex. C&G, R&D, compl.	16	LF	$ 8.00	$ 128.00
	70	920.430X	Manhole ring and cover, cip	4	EA	$ 500.00	$ 2,000.00
	71	920.550	Manhole steps for Aztec WQ box, cip	5	EA	$ 20.00	$ 100.00
	72	920.xxx	2' dia. Beehive grate, cip	3	EA	$ 1,500.00	$ 4,500.00
	73	340.210	24" Sidewalk Drain, cip., SD 2236	1	EA	$ 2,000.00	$ 2,000.00
Miscellaneous Site Work Items for Private Property	74	A	Remove and dispose of exsiting trash enclosure, compl.	1	EA	$ 750.00	$ 750.00
	75	B	New dumpster enclosure, complete	1	EA	$ 3,500.00	$ 3,500.00
	76	C	Landscaping, cip	1	LS	$ 7,500.00	$ 7,500.00

DESIGN ANALYSIS REPORT COST ESTIMATE: BRYN MAWR STORM DRAIN IMPROVEMENTS

BID ITEM NO.	SPEC. ITEM NO.	DESCRIPTION	EST. QTY	UNIT	UNIT PRICE	AMOUNT
77	410.030	Remove, store and reinstall existing 8' chainlink fence, complete	620	SF	$ 4.00	$ 2,480.00
78	410.03A	Install new fence posts, complete	10	EA	$ 75.00	$ 750.00
79	410.035	Existing chain link fence and gate, remove & reinstall, compl.	160	SF	$ 24.00	$ 3,840.00
80	D	Remove and dispose of PCC landings outside business on west	300	SF	$ 2.50	$ 750.00

SUB-TOTAL OF BASE BID ITEMS 1 - 80	$ 869,130.44

6.050	Construction Mobilization, compl. (5% of Base Bid)	1	LS	$ 43,456.52	$ 43,456.52
6.060	Demobilization, complete (2% of Base Bid)	1	LS	$ 17,382.61	$ 17,382.61

COA UTILITY RELOCATION ALLOWANCE	$ 25,000.00
CONSTR. PROJECT SIGN SCREEN ALLOWANCE 3 @ $500	$ 1,500.00
MATERIALS TESTING ALLOWANCE	$ 20,000.00
SUB-TOTAL OF BASE BID ITEMS 1 - 80 PLUS	$ 976,469.57
CONTINGENCY @ 15%	$ 146,470.44
SUB-TOTAL OF BASE BID ITEMS 1 - 80 PLUS ALLOWANCES PLUS CONTIGENCIES	$ 1,122,940.01
NEW MEXICO GROSS RECEIPTS TAX @ 7%	$ 78,605.80
TOTAL OF BASE BID ITEMS 1 - 80 PLUS ALLOWANCES PLUS NMGRT	$ 1,201,545.81

APPENDIX V

Reference Material

CENTRIFUGAL PRESSURE (6–26)

-12a. This result can only be an
) must, by the Bernoulli equation,
t the velocity profile will be some-
velocity will then be less than v_1,
Eq. (6–26) will not be correct.
by assuming that the streamlines
, and that the velocity distribution
that in the free, or irrotational,

f any streamline. Since the stream-
asure of distance along AO from
ine at A, then $C = v_1 R_1$. The dis-

$$v_1 R_1 \int_{R_1}^{R} r^{-1}\, dr$$

$$v_1 R_1 \log \frac{R}{R_1}$$

$$\boxed{g \frac{R}{R_1}} \qquad (6\text{–}27)$$

$_1$ can be obtained by trial from this
he pressure at O, from the condition

$$= \tfrac{1}{2}\rho v_1^2$$

$$\boxed{= 1 - \left(\frac{R_1}{R}\right)^2} \qquad (6\text{–}28)$$

A and O; this assumption appears

sults that are quite accurate within a
ous limitation, arising from the fact
um value of $1/e$, which occurs when
ns (Prob. 6.4). Applying this result

to Eq. (6–27) we see that the ratio R/y_1 has a minimum value of e when $R/R_1 = e$, even though R/y_1 is by the nature of the problem an independent variable, which may in practice assume any value at all. The effect of this curious result is that the theory cannot be applied when $R/y_1 < e$, and a curve displaying the results of the theory must, as in Fig. 6-12c, terminate at the point where $R/y_1 = e$, although lower values of R/y_1 are quite possible. The corresponding terminal value of $p_0/\frac{1}{2}\rho v_1^2$ will, from Eq. (6–28), be equal to $1 - 1/e^2$.

A complete solution of the problem requires the use of the mathematical theory of irrotational flow. This has been done by Henderson and Tierney [14] for the case where there is an open sluice through the spillway, as shown by broken lines in Fig. 6-12a, and for the more usual case discussed above, where the toe is a curved solid surface. Theoretical and experimental results for the latter case are shown in Fig. 6-12c, which displays the behavior of p_0, the pressure at O, for angles θ (Fig. 6-12a) of 45° and 90°. It is seen that the free vortex method gives results approximating closely to those of the complete theory when $R/y_1 > 6$, as does the elementary result of Eq. (6–26). However, the latter fails to predict any thickening of the jet and therefore seriously underestimates the total thrust and bending moment on the sidewalls. For complete details the reader is referred to the original papers.

All the above discussion implies the assumption that the flow is irrotational. This assumption is a reasonable one, since losses must be small over the short length of spillway involved, and the highly turbulent approaching flow must have a transverse velocity distribution very close to the uniform distribution which is characteristic of irrotational flow of a perfect fluid. Also, there is little risk of separation when a solid boundary is continually curving *into* the flow, as in this case. Pressure distributions should therefore be close to those in the irrotational flow of a perfect fluid, and this conclusion is confirmed by the good agreement between theory and experiment shown in Fig. 6-12.

Further, the effect of gravity has been ignored, so that the pressures derived are purely those due to centrifugal action. We take gravity into account simply by adding hydrostatic pressure, calculated as in Sec. 2.1, to the pressures obtained above. This additional pressure may be substantial in the case of the bucket-type energy dissipator, in which a structure like that of Fig. 6-12b is deeply drowned under a turbulent but stationary eddy, as shown in Fig. 6-36.

6.4 The Free Overfall

In this situation, shown in Fig. 6-13, flow takes place over a drop which is sharp enough for the lowermost streamline to part company with the channel bed. It has been previously mentioned as a special case ($W = 0$) of the sharp-crested weir, but it is of enough importance to warrant individual treatment.

Clearly, an important feature of the flow is the strong departure from hydrostatic pressure distribution which must exist near the brink, induced by strong vertical components of acceleration in the neighborhood. The form of this pressure distribution at the brink B will evidently be somewhat as shown in Fig. 6-13, with a mean pressure considerably less than hydrostatic. It should also be clear that at some section A, quite a short distance back from the brink, the vertical accelerations will be small and the pressure will be hydrostatic. Experiment confirms the conclusion suggested by intuition—that from A to B there is pronounced acceleration and reduction in depth, as in Fig. 6-13.

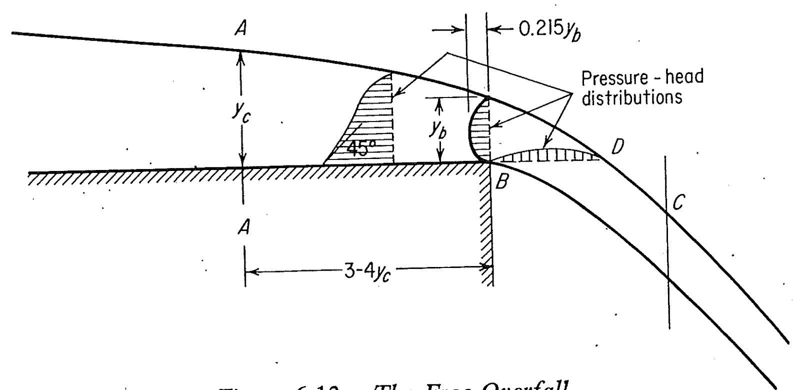


Figure 6-13. *The Free Overfall*

If the upstream channel is steep, the flow at A will be supercritical and determined by upstream conditions. If on the other hand the channel slope is mild, horizontal, or adverse, the flow at A will be critical. This is readily seen to be true by recalling the argument of Sec. 4.4, according to which flow is critical at the transition from a mild (or horizontal, or adverse) slope to a steep slope. Imagine now that in this case (shown in Fig. 4-7) the steep slope is gradually made even steeper, until the lower streamline separates and the overfall condition is reached. The critical section cannot disappear; it simply retreats upstream into the region of hydrostatic pressure—i.e., to A in Fig. 6-13.

The local effects of the brink are therefore confined to the region AB; experiment shows this section to be quite short, of the order of 3–4 times the depth. Upstream of A the profile will be one of the normal types determined by channel slope and roughness, and discussed in Chap. 4; if our interest is confined to longitudinal profiles the local effect of the brink may be neglected because AB is so short compared with the channel lengths normally considered in profile computations.

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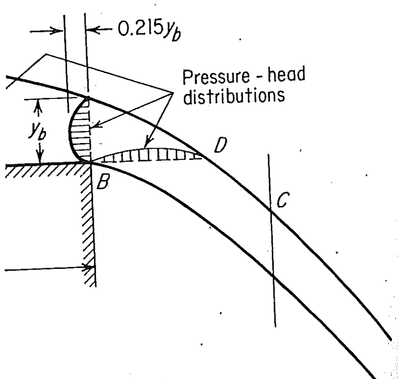

e Free Overfall

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However, our interest may center on the overfall itself, because of its use either as a form of spillway or as a means of flow measurement—the latter arising from the unique relationship between brink depth and the discharge. Apart from these matters of practical interest, the problem, like that of the sharp-crested weir, continues to attract the exasperated interest of theoreticians who find it difficult to believe that a complete theoretical solution can really be as elusive as it has so far proved to be.

In the following discussion it is convenient to subdivide the flow into two regions of interest—first, the brink itself, and the falling jet, which we may call the "head" of the overfall; and second, the base of the overfall where the jet strikes some lower bed level and proceeds downstream after the dissipation of some energy.

The Head of the Overfall

The simplest case is that of a rectangular channel with sidewalls continuing downstream on either side of the free jet, so that the atmosphere has access only to the upper and lower streamlines, not to the sides. This is a two-dimensional case and it is only in this form of the problem that serious attempts have been made at a complete theoretical solution.

Consider section C (Fig. 6-13), a vertical section through the jet far enough downstream for the pressure throughout the jet to be atmospheric, and the horizontal velocity to be constant. If we simplify the problem further by assuming a horizontal channel bed with no resistance, and apply the momentum equation to sections A and C, it is easily shown (Prob. 6.5) that

$$\frac{y_2}{y_1} = \frac{2\mathrm{Fr}_1^{\,2}}{1 + 2\mathrm{Fr}_1^{\,2}} \tag{6–29}$$

where the subscripts 1 and 2 characterize sections A and C respectively; if the flow is critical at section A the above equation becomes

$$\frac{y_2}{y_c} = \frac{2}{3} \tag{6–30}$$

which sets a lower limit on the brink depth y_b; since there is some residual pressure at the brink, y_b must be greater than y_2. It follows that

$$\frac{2}{3} < \frac{y_b}{y_c} < 1 \tag{6–31}$$

Actually there is no part of the jet, however far downstream, where the pressure is completely atmospheric; if there were the streamlines would all become parabolas, and these curves cannot exhibit the property of asymptotic convergence which the streamlines actually possess. However, the point is a somewhat academic one, for it can be shown (Probs. 6.6 and 6.7) that the internal pressure in the jet tends to zero much faster than does the width of the jet, as the jet moves further downstream. In the limit, when the jet has fallen infinitely far below the brink, Eq. (6–30) will be true and the horizontal velocity will be equal to $3v_c/2$. From this last fact it can be seen that the internal pressure of the jet plays a decisive role in developing the ultimate form of the jet, for the horizontal velocity on the lower streamline is originally equal to $\sqrt{2g(3y_c/2)} = \sqrt{3}v_c$ (at B) and that on the upper streamline to v_c (at A). The horizontal forces required to bring each of these to the ultimate value of $3v_c/2$ are supplied by the pressure gradients at either end of pressure profiles such as that shown on the horizontal section BD.

The form of the pressure distribution at B has already been referred to; the pressure profiles just upstream must be of the form indicated in Fig. 6-13, with inflexions as shown. These are necessary in order to return the pressure distribution to hydrostatic at the bed, where the vertical acceleration must be zero. One consequence of this property of the profiles is that the pressure on the bed must remain finite very close to the brink; the longitudinal pressure gradient there must therefore be infinite, and the same is true of the lateral pressure gradient, as indicated by the pressure profile at B. It follows that the radius of the curvature of the lower streamline must momentarily be zero just downstream of B. This is a well-recognized property of all free jets.

The foregoing discussion, although of some general interest, does not lead to specific conclusions. For these we depend on experiment and on approximate analysis. The experiments of Rouse [15] showed that the brink section has a depth of 0.715 y_c. Rouse also pointed out that combination of the weir Eq. (6–1) with the critical flow equation

$$q = v_c y_c = y_c\sqrt{g y_c}$$

setting $H = y_c$ and $v_0 = v_c$, led to the result $y_b = 0.715\ y_c$, although there might be some doubt about the physical significance of the result.

More recently Replogle [16] has carried out further experiments with substantially the same results, and has also measured the brink pressure profile, with the result shown in Fig 6-13. The brink depth and pressure profile are approximately consistent with each other (Prob. 6.5), although the pressure is somewhat smaller than it should be for complete consistency. Bed resistance over the length AB can account for only about half of this discrepancy (Prob. 6.8), but the matter is of little significance because the discrepancy represents a very much smaller percentage error in the brink depth than in the brink pressure. Replogle [16] discusses the relationship between corresponding errors in the various parameters and shows, among other things, that the effect of velocity variation at the brink, expressed by a momentum coefficient β, is quite negligible.

Although no complete theoretical solution has yet been obtained, a number of solutions based on trial or approximate methods have been advanced, most of them offering remarkably close confirmation of Rouse's result

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$y_b = 0.715\ y_c$. Southwell and Vaisey [4] used relaxation methods to plot the complete flow pattern, finding in the process a value of y_b of approximately $0.705\ y_c$. Jaeger [17] and Roy [18] used ingenious approximations to obtain near-complete solutions in the neighborhood of the brink; each found that $y_b = 0.72\ y_c$. Fraser [19] used an iterative method due to Woods [20] to trace the upper and lower streamlines, concluding that $y_b = 0.71\ y_c$. Hay and Markland [44] used the electrical analogy to determine an experimental solution in an electrolytic plotting tank. The profile they deduced was very close to Southwell and Vaisey's except near the brink, where they found $y_b = 0.676\ y_c$.

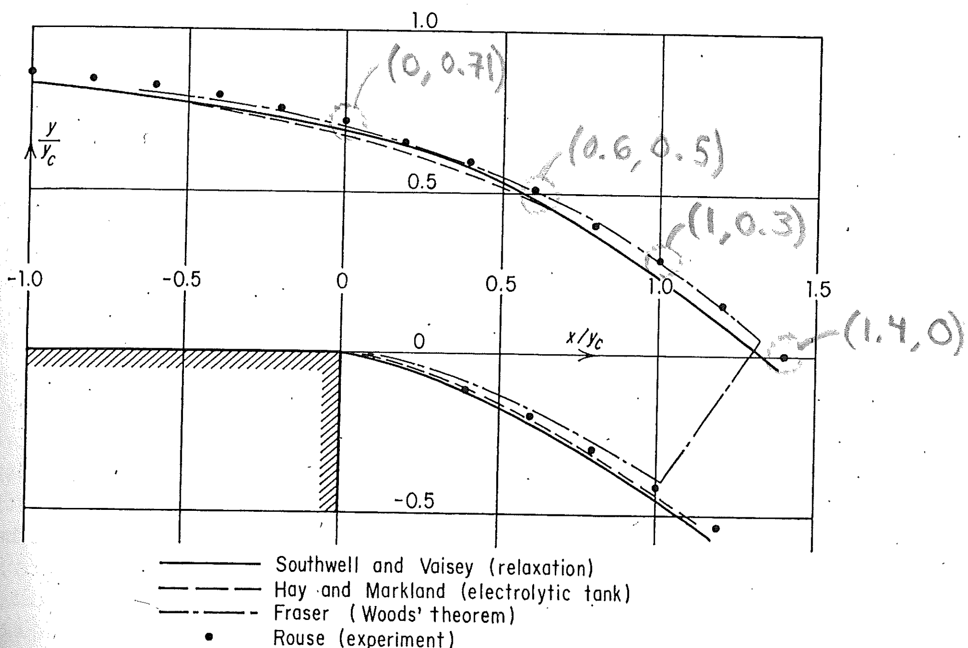

Figure 6-14. *Flow Profiles at the Free Overfall*

The conclusion suggested by all this work, summarized in Fig. 6-14, is that a brink depth $y_b = 0.715\ y_c$ can safely be used for flow measurement, with a likely error of only 1 or 2 percent.

The preceding discussion has concentrated particularly on the two-dimensional case with a horizontal bed and no resistance. The theoretical methods described assume a perfect fluid; if the bed is smooth and the upstream flow fully turbulent, this assumption should create little error in the analysis, for the bed resistance between sections *A* and *B*, Fig. 6-13, will have little effect on the brink depth (Prob. 6.8). No analysis has yet been attempted of the case where the slope and resistance are large, but comprehensive experimental results have been obtained by Delleur and others [21]. They are illustrated in Fig. 6-15.

Experimental results have also been obtained by Diskin [22] for trapezoidal channels and by a number of investigators for circular pipes. In these cases the whole periphery of the flow at the brink is exposed to atmosphere, so one would expect the average static pressure at this section to be appreciably less than in the two-dimensional case, and y_b to be correspondingly closer to a value calculated from the momentum equation by neglecting the hydrostatic thrust at the brink.

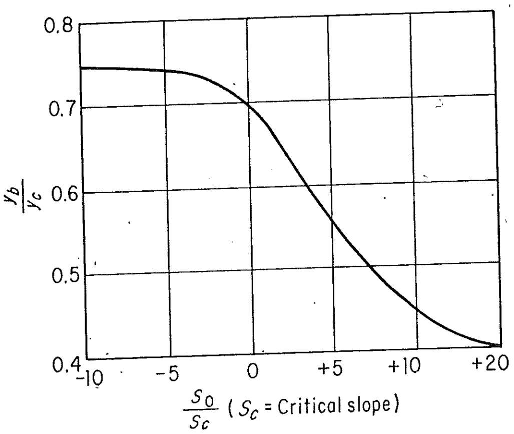

Figure 6-15. *Brink Depth at the Free Overfall, after J. W. Delleur et al.* [21]

For trapezoidal channels of side slopes mH : 1V, Diskin [22] found that the result of this momentum argument could be conveniently expressed in terms of the dimensionless number $y' = my/b$, used in Chap. 2 for the determination of critical depth in trapezoidal channels. If, as before, we indicate brink conditions and critical conditions by the subscripts b and c respectively, the momentum argument yields (Prob. 6.9)

$$y'_b = \tfrac{1}{2}[\sqrt{1 + 4T_c} - 1] \qquad \textbf{(6–32)}$$

where

$$T = \frac{6y'(1 + y')^3}{9 + 20y' + 10y'^2}$$

From these equations, brink conditions may be calculated from critical conditions. Diskin's experiments showed very good agreement with Eq. (6–32) for $m = 2$, but for $m = 1.5$ the measured value of y_b was about 4–5 percent greater than the calculated value. In these experiments the ratio y/b went up to 0.8 approximately.

Table 5-3. Values of C in the Formula $Q = CLH^{3/2}$ for Broad-crested Weirs

Measured head in feet, H	Breadth of crest of weir in feet										
	0.50	0.75	1.00	1.50	2.00	2.50	3.00	4.00	5.00	10.00	15.00
0.2	2.80	2.75	2.69	2.62	2.54	2.48	2.44	2.38	2.34	2.49	2.68
0.4	2.92	2.80	2.72	2.64	2.61	2.60	2.58	2.54	2.50	2.56	2.70
0.6	3.08	2.89	2.75	2.64	2.61	2.60	2.68	2.69	2.70	2.70	2.70
0.8	3.30	3.04	2.85	2.68	2.60	2.60	2.67	2.68	2.68	2.69	2.64
1.0	3.32	3.14	2.98	2.75	2.66	2.64	2.65	2.67	2.68	2.68	2.63
1.2	3.32	3.20	3.08	2.86	2.70	2.65	2.64	2.67	2.66	2.69	2.64
1.4	3.32	3.26	3.20	2.92	2.77	2.68	2.64	2.65	2.65	2.67	2.64
1.6	3.32	3.29	3.28	3.07	2.89	2.75	2.68	2.66	2.65	2.64	2.63
1.8	3.32	3.32	3.31	3.07	2.88	2.74	2.68	2.66	2.65	2.64	2.63
2.0	3.32	3.31	3.30	3.03	2.85	2.76	2.72	2.68	2.65	2.64	2.63
2.5	3.32	3.32	3.31	3.28	3.07	2.89	2.81	2.72	2.67	2.64	2.63
3.0	3.32	3.32	3.32	3.32	3.20	3.05	2.92	2.73	2.66	2.64	2.63
3.5	3.32	3.32	3.32	3.32	3.32	3.19	2.97	2.76	2.68	2.64	2.63
4.0	3.32	3.32	3.32	3.32	3.32	3.32	3.07	2.79	2.70	2.64	2.63
4.5	3.32	3.32	3.32	3.32	3.32	3.32	3.32	2.88	2.74	2.64	2.63
5.0	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.07	2.79	2.64	2.63
5.5	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32	2.88	2.64	2.63

Table 5-4. Values of C in the Formula $Q = CLH^{3/2}$ for Models of Broad-crested Weirs with Rounded Upstream Corner

Name of experimenter	Radius of curve in feet	Breadth of weir in feet, B	Height of weir in feet, P	Head in feet, H									
				0.4	0.6	0.8	1.0	1.5	2.0	2.5	3.0	4.0	5.0
Bazin..........	0.33	2.62	2.46	2.93	2.97	2.98	3.01	3.04					
Bazin..........	0.33	6.56	2.46	2.70	2.82	2.87	2.89	2.92					
U. S. Deep Waterways...	0.33	2.62	4.57	....	2.77	2.80	2.83	2.92	3.00	3.08	3.17	3.34	3.50
U. S. Deep Waterways...	0.33	6.56	4.56	....	....	2.83	2.83	2.83	2.82	2.82	2.82	2.82	2.81