FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

OAK STREET BASIN AND STORM DRAIN DESIGN

FINAL DESIGN DATA REPORT
VOLUME I

CONTRACT FCD – 2009C021

October, 2012

Prepared For:

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix AZ, 85009

In Cooperation With:

City of Mesa
20 East Main Street, 5th Floor
Mesa, Arizona 85211

REGISTERED PROFESSIONAL ENGINEER (CIVIL)
CERTIFICATE NO.
15594
MARK T.
GAVAN
Date Signed 12-12-12
ARIZONA, U.S.A.
Expires 12-31-14

Prepared By:

Gavan & Barker, Inc.
3030 North Central Avenue, Suite 1530
Phoenix, Arizona 85012
Phone: (602) 200-0031
Fax: (602) 200-0032

Job No. 0912

SECTION A - HYDROLOGY

HYDROLOGY **9**

Memorandum **10**

Introduction 10
HEC-1 Hydrologic Analysis 10
Diversion Estimation 11
Results & Comparison 13
Oak Street Basin Design 13
Rational Equation Hydrologic Analysis 14

HYDROLOGY SUB-SECTIONS

Sub-Section A1: **Rainfall, Land Use and Soil Calculations** **15**
Sub-Section A2: **HEC-1 Diversion and Storage Calculations** **24**
Sub-Section A3: **DDMSW Summary Tables** **30**
Sub-Section A4: **HEC-1 Model** **40**
Sub-Section A5: **Rational Equation - Peak Discharge Calculation** **197**

HYDROLOGY EXHIBITS

Exhibit A2.1: D385A Diversion Schematic **25**
Exhibit A2.2: Overall Oak Street Basin Exhibit **26**
Exhibit A4.1: Watershed Map and HEC-1 Schematic **41**
Exhibit A4.2: Peak Flow Summary **42**
Exhibit A5.1: Inlet Design Drainage Area Map **198**

HYDROLOGY CALCULATIONS

HEC-1 Output **46**
100-Year Peak Discharge Calculations **199**

HYDROLOGY TABLES

Table A1.1: Sub-Basin Soil Distribution 21
Table A1.2: Sub-Basin Land Use Distribution 23
Table A2.1: Oak Street Basin Stage-Storage-Discharge Summary Table 27
Table A3.1: DDMSW Rainfall Summary Table 31
Table A3.2: DDMSW Soils Summary Table 32
Table A3.3: DDMSW Land-Use Summary Table 33
Table A3.4: DDMSW Major Basin Summary Table 34
Table A3.5: DDMSW Sub-Basin Summary Table 35
Table A3.6: DDMSW Diversions Summary Table 37
Table A3.7: DDMSW Routes Summary Table (Pipe Routes) 38
Table A3.8: DDMSW Routes Summary Table (Channel Routes) 39
Table A4.1: Gavan & Barker – Kimley Horn Flow Comparison 43
Table A4.2: Oak Street Basin Hydraulic Results Summary 44

HYDROLOGY FIGURES

Figure A1.1: NOAA 2 Rainfall Contours (2 Year – 6 Hour) 16
Figure A1.2: NOAA 2 Rainfall Contours (2 Year – 24 Hour) 17
Figure A1.3: NOAA 2 Rainfall Contours (100 Year – 6 Hour) 18
Figure A1.4: NOAA 2 Rainfall Contours (100 Year – 24 Hour) 19
Figure A1.5: NRCS Soils Map 20
Figure A1.6: Land Use Map 22
Figure A2.1: Oak Street Basin Inlet Control Nomograph 28
Figure A2.2: Oak Street Basin Primary Outlet Performance Curves 29
Figure A4.1: Oak Street Basin Inflow/Outflow Hydrographs 45

SECTION B - HYDRAULICS

HYDRAULICS 218

Memorandum 219

Introduction 219
Storm Drain Hydraulic Grade Line Calculations 219
HEC-RAS Storm Drain Modeling 219
Storm Drain Tailwater Elevation/Inlet Headwater Elevation 220
Inlet Design Calculations 221
Sediment Analysis Calculations 221
Basin Outlet and Hawes Road Channel HEC-RAS Model 222
Granite Mountain Channel HEC-RAS Model 223
Oak Street Basin Secondary (Spillway) Outfall 223
Oak Street Basin Rip-Rap and Scour Design Calculations 224

HYDRAULIC SUB-SECTIONS

Sub-Section B1: **Storm Drain Hydraulics 225**
Sub-Section B2: **Catch Basin Design 284**
Sub-Section B3: **Sediment Analysis 329**
Sub-Section B4: **Basin Outlet and Hawes Road Channel Analysis 351**
Sub-Section B5: **Granite Mountain Channel Analysis 369**
Sub-Section B6: **Oak Street Basin Secondary (Spillway) Outfall Analysis 376**
Sub-Section B7: **Oak Street Basin Inflow Analysis 379**

HYDRAULIC EXHIBITS

Exhibit B1.1: Oak Street & Hawes Road SD – HEC RAS Location Map 226
Exhibit B3.1: Oak Street SD 181+90 Inlet Wash HEC-RAS Model 343
Exhibit B3.2: Oak Street SD 173+70 Inlet Wash HEC-RAS Model 347
Exhibit B4.1: Hawes Road Channel – HEC RAS Location Map 352
Exhibit B5.1: Granite Mountain Channel – HEC RAS Location Map 370
Exhibit B7.1: Oak Street Basin Inflow – HEC RAS Location Map 380

HYDRAULIC CALCULATIONS

Drop Inlet Design: Inlet Capacity Calculations 286
Catch Basin and Connector Pipe Design Calculations 295
Hawes Road Storm Drain Sediment Analysis Calculations 331
Oak Street Storm Drain Sediment Analysis Calculations 333
Oak Street Basin Inflow Spillway Wash Sediment Analysis Calculations 338
Wash Load and Sediment Delivery Ratio Analysis Calculations 339
Total Sediment Yield at the Oak Street Basin 341
Oak Street Basin Secondary (Spillway) Outfall Critical Velocity Calculations 378

HYDRAULIC TABLES

Table B1.1: Hawes Road SD (STA 132+98 – 134+45) HEC RAS Summary 228
Table B1.2: Hawes Road SD (STA 134+45 – 136+57) HEC RAS Summary 230
Table B1.3: Hawes Road SD (STA 136+57 – 144+28) HEC RAS Summary 232
Table B1.4: Hawes Road SD (STA 134+45 Inlet) HEC RAS Summary 234
Table B1.5: Hawes Road SD (STA 136+57 Inlet) HEC RAS Summary 236
Table B1.6: Oak Street SD (STA 163+82 – 165+50) HEC RAS Summary 238
Table B1.7: Oak Street SD (STA 165+50 – 173+70) HEC RAS Summary 240
Table B1.8: Oak Street SD (STA 173+70 – 182+35) HEC RAS Summary 242
Table B1.9: Oak Street SD (STA 165+50 Inlet) HEC RAS Summary 244
Table B1.10: Oak Street SD (STA 173+70 Inlet) HEC RAS Summary 246
Table B2.1: Drop Inlet Design – Inlet Capacity Summary 285
Table B2.2: On Grade Curb Opening Catch Basin Design Summary 292
Table B2.3: Sump Curb Opening Catch Basin Design Summary 293
Table B2.4: Sump Grated Catch Basin Design Summary 294
Table B4.1: Hawes Road Channel – HEC RAS Cross Section Summary 353
Table B4.2: Hawes Road Channel – HEC RAS Culvert Summary 354
Table B4.3: Hawes Road Channel Freeboard Requirements 368
Table B5.1: Granite Mountain Channel – HEC RAS Cross Section Summary 371
Table B7.1: Oak Street Basin Inflow – HEC RAS Cross Section Summary 381

HYDRAULIC FIGURES

Figure B1.1: Hawes Road SD (STA 132+98 – 134+45) HEC RAS Profile..... 227
Figure B1.2: Hawes Road SD (STA 134+45 – 136+57) HEC RAS Profile..... 229
Figure B1.3: Hawes Road SD (STA 136+57 – 144+28) HEC RAS Profile..... 231
Figure B1.4: Hawes Road SD (STA 134+45 Inlet) HEC RAS Profile 233
Figure B1.5: Hawes Road SD (STA 136+57 Inlet) HEC RAS Profile 235
Figure B1.6: Oak Street SD (STA 163+82 – 165+50) HEC RAS Profile 237
Figure B1.7: Oak Street SD (STA 165+50 – 173+70) HEC RAS Profile 239
Figure B1.8: Oak Street SD (STA 173+70 – 182+35) HEC RAS Profile 241
Figure B1.9: Oak Street SD (STA 165+50 Inlet) HEC RAS Profile..... 243
Figure B1.10: Oak Street SD (STA 173+70 Inlet) HEC RAS Profile..... 245
Figure B1.11: Hawes Road SD – HEC RAS Cross Sections 247
Figure B1.12: Oak Street SD – HEC RAS Cross Sections..... 260
Figure B3.1: Grain Size Distribution Curves 330
Figure B4.1: Hawes Road Channel – HEC RAS Profile 355
Figure B4.2: Hawes Road Channel – HEC RAS Cross Sections 356
Figure B5.1: Granite Mountain Channel – HEC RAS Profile 372
Figure B5.2: Granite Mountain Channel – HEC RAS Cross Sections 373
Figure B6.1: Oak Street Basin Secondary (Spillway) Outfall Weir Calculation.... 377
Figure B7.1: Oak Street Basin Inflow – HEC RAS Profile 382
Figure B7.2: Oak Street Basin Inflow – HEC RAS Cross Sections..... 383

SECTION C – DIGITAL DATA

DIGITAL DATA 386
DIGITAL DATA CD 387

Project Overview

The Oak Street Basin and Storm Drain project is a proposed flood control system located at Oak Street and Hawes Road in Mesa, Arizona. The project consist of the Oak Street Basin that is located on a 10-acre site on the northwest corner of Oak Street and Hawes Road, as well as new storm drains that collect flows along Oak Street and Hawes Road and discharge them to the basin. The Oak Street Storm Drain collects flows using specially designed drop inlets at major wash crossings as well as curb opening inlets along the street. The storm drain extends from roughly 88th Street to the Oak Street Basin. The Hawes Road Storm Drain also intercepts flows at major wash crossings using specially designed drop inlets and extends from the Granite Mountain channel to the Oak Street Basin.

The Oak Street Basin and Storm Drain project is part of the Spook Hill Area Drainage Master Plan (ADMP). As identified in the ADMP, this project is the final part of an overall flood control system for the area. The downstream portion of the master planned system, which includes the Hawes Road channel and the McDowell Road Storm Drain, has already been constructed. Therefore, the Oak Street Basin has to be designed so that the discharge from the basin does not exceed the design inflows to the McDowell Road Storm Drain.

The primary purpose of the project is to capture and attenuate the 100-year peak discharge along Oak Street and Hawes Road before discharging it to the downstream infrastructure. The location of the project provided unique design considerations for both the basin and the storm drains. The primary design challenges for the Oak Street Basin were:

1) Soil Substrate – the majority of the basin is located in cemented soils and granite, which can be seen as an advantage (allows for steeper slopes) or a disadvantage (hard excavation)
2) Aesthetical Considerations – an undisturbed, natural landscaped buffer had to be provided around the basin
3) Existing Infrastructure – downstream infrastructure (sanitary sewer and Hawes Road channel) limited the bottom elevation of the basin

In contrast, a different set of challenges was present in the design of the two storm drains. The primary design challenges for the Oak Street and Hawes Road Storm Drains were:

1) Collection of Flows – at natural wash locations, the drop inlets had to be designed to accommodate high debris loads which have the potential to clog the inlet
2) Storm Drain Velocities – due to the nature of the areas steep terrain, the storm drains will have to be designed as to not exceed the allowable maximum pipe velocities
3) Sediment Considerations – high sediment concentrations in the wash flows are anticipated, the storm drains and connector pipes will have to be designed to convey both the 100-year peak discharge and the sediment loads.

Additional discussion on the design objectives and the modeling process can be found in the enclosed hydrologic and hydraulic memorandums.

HYDROLOGY

MEMORANDUM

Gavan & Barker Inc.

To: **Afshin Ahouraiyan**

From: **Omer Karovic & Mark Gavan**

Date: **October, 2012**

Project: **Oak Street Basin and Storm Drain Design**

Subject: **Hydrologic Calculations**

Introduction

This memo provides an explanation of the hydrologic assumptions and calculations that were made in order to design the Oak Street Basin and Storm Drain.

The Oak Street Basin and Storm Drain project is part of the proposed Spook Hill ADMP. Downstream features of the ADMP, including the McDowell Road Storm Drain and the Hermosa Vista/Hawes Road Storm Drain, have already been constructed. So it is important for the design of the Oak Street Basin and Storm Drain project to not exceed the capacities of the existing downstream infrastructure.

HEC-1 Hydrologic Analysis

The hydrologic analysis for this project was performed using HEC-1 and the District's DDMSW software. The base HEC-1 model that was used is the 100-year, 24-hour Spook Hill ADMP model with modifications made by Kimley-Horn for the McDowell Road Basin and Storm Drain project.

The sub-basins that contribute to the proposed Oak Street Basin were further subdivided in order to better define the peak flows that are intercepted at multiple locations along the storm drains proposed in Oak Street and Hawes Road. The District's contour mapping and aerial photography as well as field investigations were used to delineate the new sub-basins. The contour mapping and aerial photography were also used to input the sub-basin parameters such as area, flow length and longitudinal slope.

The new sub-basins that were delineated for the Oak Street Basin and Storm Drain project can be found in Exhibit A4.1. This exhibit also shows the location of new diverts, routes and hydrograph combines. A peak flow summary is included in Exhibit A4.2 which presents the peak discharges at critical locations along the Oak Street Basin and Storm Drain project. Along with the HEC-1 output file, sub-section A4 also includes the Oak Street Basin inflow/outflow hydrographs in Figure A4.1 and the basin hydraulic results in Table A4.2.

To be consistent with the Spook Hill ADMP hydrologic model, the NOAA 2 Rainfall Contours found in Figures A1.1-A1.4 were used to establish the point rainfall depths for the project area.

A summary of the rainfall data produced by DDMSW can be found in Table A3.1. This rainfall data was entered into DDMSW in order to calculate the Time of Concentration for use with the Clark Unit Hydrograph.

The NRCS Soils Map in Figure A1.5 and the Land Use Map in Figure A1.6 were used to establish the soils data and land use data within DDMSW. The DDMSW soils and land use summary tables can be found under Table A3.2-A3.3.

The Green-Ampt parameters for rainfall loses as well as the Clark Unit Hydrograph *TC* and *R* values were calculated using DDMSW with the above mentioned input data. A sub-basin summary of the parameters can be found in Table A3.5.

Two types of channel routes were used in the HEC-1 model. For washes, normal depth channel routing was used. The parameters for these normal depth channel routes were taken from contour mapping, aerial photography and field measurements. A summary of all the channel routes can be found in Table A3.8. For the storm drain channel routes, Muskingum-Cunge pipe routes were employed. A summary of all the Muskingum-Cunge pipe routes can be found in Table A3.7.

The stage-discharge relationship for the detention basin was calculated for both inlet and outlet control. For inlet control, Figure 5.20 from the Maricopa County Hydraulics Manual was used to determine the capacity of the primary 48-inch basin outlet at different water surface elevations in the basin. For outlet control, the Basin Outlet and Hawes Road Channel HEC-RAS model, which can be found in sub-section B4, was used to determine the capacity of the aforementioned basin outlet storm drain. It was found that the capacity of the outlet storm drain will be governed by outlet control. The stage-storage-discharge relationship for the Oak Street Basin can be found in Table A2.1.

Diversion Estimation

In order to better predict the flows between and within individual sub-basins, multiple diversions were developed and added to the HEC-1 model. There are a total of 9 diversions that were added to the model. The location of the 9 diversions can be found on the Watershed/HEC-1 Schematic map in Exhibit A4.1.

DIV1 & DIV2: These two diversions were established with the help of contour mapping and aerial photography as well as with a site visit that included District staff. The concentration point of sub-basin 370A is an apex of an alluvium fan. From the site visit, it was estimated that 25 percent of the runoff from the apex will split off to the west into sub-basin 385A with the remainder continuing southerly into sub-basin 370B. The second diversion, DIV2, was also established with a site visit with District staff and it was estimated that 50 percent of the flow from DIV1 will drain into sub-basin 385A with the remainder draining to sub-basin 395A.

DIV3: This diversion was established with the help of contour mapping, aerial photography and a site visit. It was concluded that there is a 50-50 split of the flow at the concentration point of sub-basin 385B; with 50 percent of the flow being diverted into sub-basin 385C, while the remaining 50 percent drains to sub-basin 385A.

DIV4: This diversion actually consists of three diversions which were all combined into one for the sake of simplicity. In order to better understand the reasoning behind this diversion, the reader is referred to Exhibit A2.1. As can be seen in the exhibit, there are three locations where water will divert out of sub-basin 385A and flow into sub-basin 385D.

The first diversion occurs just downstream of Range Rider Trail where runoff is conveyed through sub-basin 385A in a braided system of small washes. One of these washes leaves sub-basin 385A; flowing westerly into sub-basin 385D. In order to estimate this diversion, the capacity of the diverted wash was compared to the total combined capacity of all the washes. The capacity of the washes was determined with the help of contour mapping, aerial photography and detailed field measurements. The capacity of each wash, including the wash that flows out of sub-basin 385A, was found using normal depth calculations. The percentage of diverted flow was assumed to be equal to the capacity of the diverted wash divided by the combined capacity of all of the washes. Refer to the exhibit for the calculations associated with this diversion.

The second diversion occurs at a cul-de-sac. At this location, the major wash of sub-basin 385A will spill into the depressed landscaped center of the cul-de-sac. From here, there are two 24-inch outlet pipes that will divert water from sub-basin 385A into sub-basin 385D. Once the capacity of the pipes is exceeded, the flow will spill over the street and back into sub-basin 385A. Refer to Exhibit A2.1 for location and calculations of this diversion.

The third diversion occurs just downstream of the cul-de-sac. At this location, there is a residential property where the wash has been channelized around the east and south sides of the lot. However, once the capacity of the wash is exceeded, the remaining flow will spill back into sub-basin 385A. Refer to the exhibit for the location and calculations of this diversion.

All three of these diversions were combined into one diversion for modeling purposes. Diversions #2 and #3 are low flow channels, so their capacities were assumed to take the initial flows from the hydrograph. Flows above the capacity of these low flow channels were assumed to split in accordance with the diversion percentage established for diversion #1.

DIV5 & DIV8: Diversion DIV5 and DIV8 are located at proposed storm drain inlets to account for low-flow by-pass into 404 jurisdictional washes. However, for the 90% design, the inlet by-pass flows were eliminated and the diversions were set to divert the entire flow into the Oak Street Basin.

DIV6: This diversion was established using the as-built plans for the Granite Mountain sub-division. According to the as-built plans there are two equal sized culverts at this location. Therefore a 50-50 split was assumed to occur. Half of the flow from concentration point CP385C gets diverted to sub-basin 385G while the remaining half flows to sub-basin 385D.

Results & Comparison

As previously mentioned, it is important that the design of the Oak Street Basin and Storm Drain project not exceed the capacities of the downstream infrastructure. Key concentration points between the Oak Street Basin and Storm Drain hydrologic model and the Kimley-Horn model are shown in Table A4.1.

BASIN: This concentration point is the inflow into the Oak Street Basin (refer to Exhibit A4.1) The table shows the Kimley-Horn model as having a total flow into the Oak Street Basin as 1055 cfs, whereas the Gavan & Barker model has a total flow into the basin of 830 cfs.

SBASIN: This concentration point is the outflow from the Oak Street Basin (refer to Exhibit A4.1). The Kimley-Horn model assumed the Oak Street Basin to be an off-line basin, with an initial combined flow of 150 cfs bypassing the basin and flowing directly into the Hawes Road channel. Since the initial 150 cfs was assumed to bypass the basin, the outflow peak discharge from the Kimley-Horn basin was only 55 cfs. The Gavan & Barker 90% design model assumed the Oak Street Basin to be an in-line basin, which means that all the flow from the Oak Street and Hawes Road storm drains first enters the basin and then discharges through the basin outlet to the Hawes Road channel. The outflow peak discharge from the Gavan & Barker model is 183 cfs.

CC415B: This concentration point is the inflow into the Hawes Road Channel (refer to Exhibit A4.1). Because the Kimley-Horn model has the basin modeled as an off-line basin, the bypass flows and the basin outflow combine at the Hawes Road channel for a combined channel inflow of 205 cfs. The Gavan & Barker model has the basin as an in-line basin, where the only inflow into the Hawes Road channel is the basin outflow of 183 cfs.

CP390B: This concentration point is the inflow into the Thunder Mountain Basin (refer to Exhibit A4.1). The total inflow into the Thunder Mountain Basin according to the Kimley-Horn model is 613 cfs, whereas the total inflow into the basin according to the Gavan & Barker model is 494 cfs.

S390: This concentration point is the outflow from the Thunder Mountain Basin (refer to Exhibit A4.1). The total outflow from the Thunder Mountain Basin according to the Kimley-Horn model is 519 cfs, compared to 431 cfs from the Gavan & Barker model.

From the results it can be seen that the Oak Street Basin and Storm Drain project is not exceeding the capacities of the downstream infrastructure. In all cases, the flows downstream of the project are actually lower than the Kimley-Horn design flows. This is in part the result of converting the Oak Street Basin from an off-line basin to an in-line basin.

Oak Street Basin Design

The Oak Street Basin was designed with four primary objectives in mind:

1) The basin has to attenuate the 100-year peak discharge from the Oak Street and Hawes Road storm drains to the capacity of the downstream infrastructure (i.e. the capacity of the Hawes Road channel and the McDowell Road storm drain).

2) The basin had to meet aesthetic requirements that had previously been shown to the neighborhood, including an undisturbed, landscaped buffer around the basin property.
3) The basin had to provide a minimum of one foot of freeboard from the 100-year peak water surface elevation to the elevation of the emergency spillway.
4) Finally, the basin invert (outlet invert) elevation was limited by the receiving Hawes Road channel and the 8-inch sewer that crosses Oak Street at a diagonal, just east of Hawes Road.

A "trial and success" procedure was followed in the design of the Oak Street Basin. The design process started with a roughly graded basin that was aesthetically acceptable. The design calculations were performed by coding in the basin parameters into the aforementioned HEC-1 model. For subsequent trials, the parameters of the basin, such as the volume, spillway elevation and outlet invert were adjusted in order to meet the design objectives. Refer to Exhibit A2.2 and Table A2.1 for the final Oak Street Basin layout and parameters that satisfy all of the design objectives.

Rational Equation Hydrologic Analysis

The rational equation was used to calculate the 100-year peak discharge for 9 small local watersheds. The calculated peak discharges were used to size storm drain inlets along Hawes Road and Oak Street.

Exhibit A5.1 shows the drainage areas for the 9 local watersheds that were modeled using the rational equation and the runoff calculations can be found immediately after Exhibit A5.1 in sub-section A5.

As can be seen in Exhibit A5.1, the peak discharge for concentration point CP @ STA 134+40 consists of the calculated runoff from the rational equation as well as the split flow from the HEC-1 sub-basin corresponding to concentration point CP385G. Upon field inspection, it was estimated that the wash that enters the basin at the northeast corner has a capacity of approximately 54 cfs while the total flow in the wash was calculated to be 94 cfs (HEC-1 concentration point: CP385G). The excess 40 cfs was assumed to split into the local watershed corresponding to CP @ STA 134+40 and combine with the rational method calculated runoff (14.0 cfs) to provide a 100-year peak discharge of 54 cfs. Refer to the *CP @ STA 134+40 – 100-Year Peak Discharge Calculation* in sub-section A5 for detailed calculations.

The 100-year peak discharges at the remaining concentration points consist only of the runoff calculated by the rational method. A summary of the peak discharges can be found in Exhibit A5.1 and the corresponding calculations can be found in sub-section A5.

Sub-Section A1: **Rainfall, Land Use and Soil Calculations**

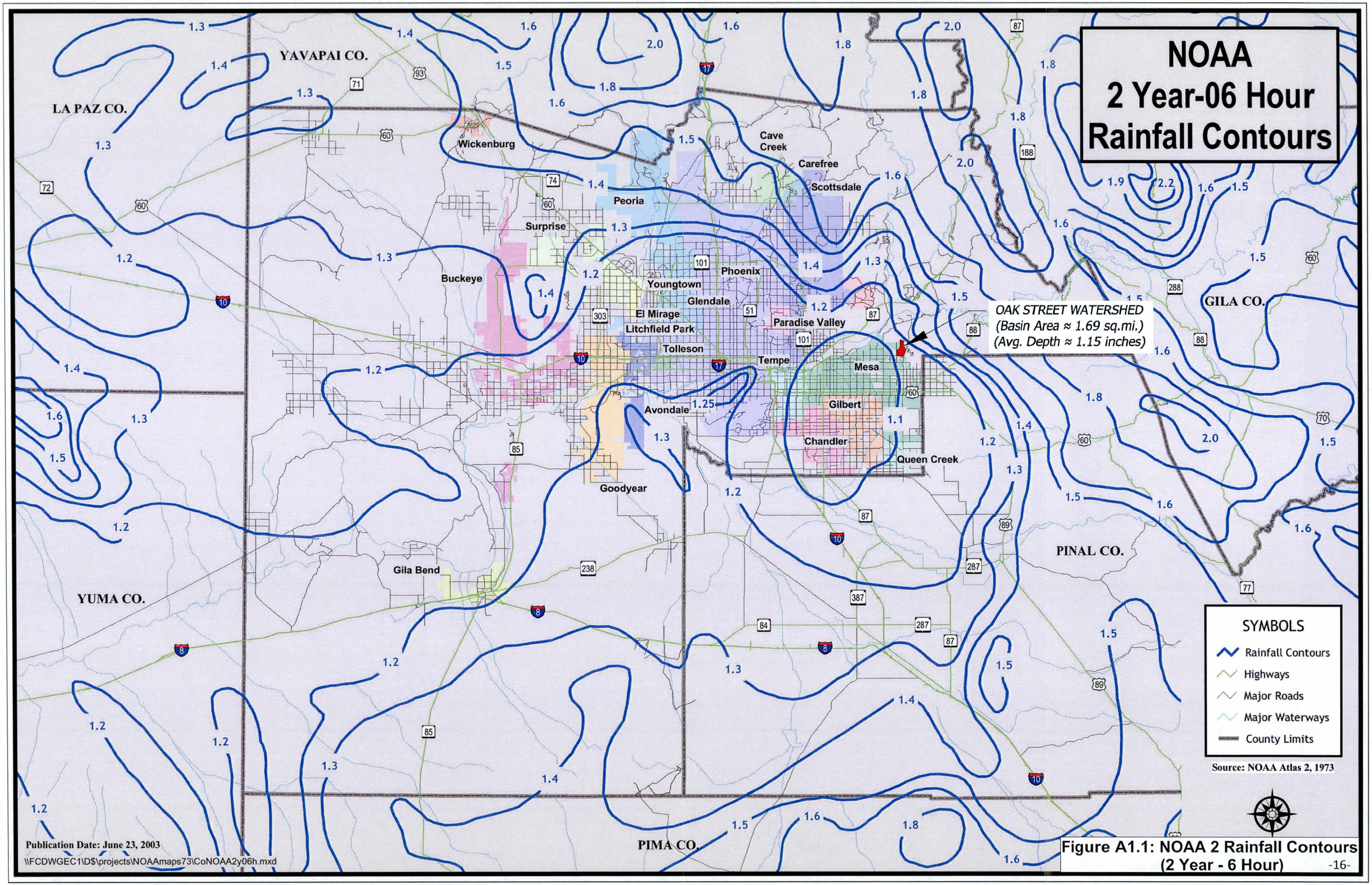


Figure A1.1: NOAA 2 Rainfall Contours (2 Year - 6 Hour)

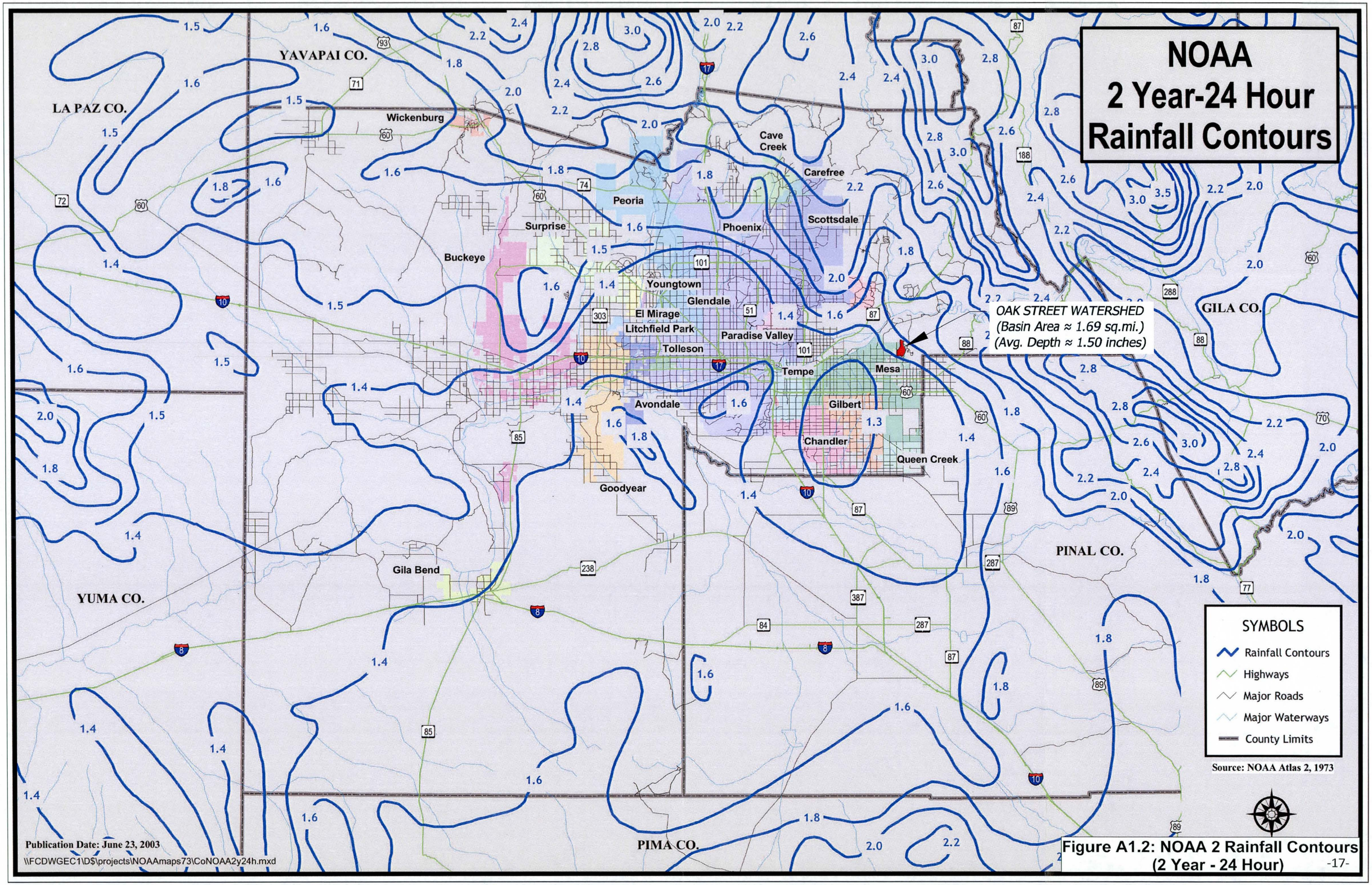


Figure A1.2: NOAA 2 Rainfall Contours (2 Year - 24 Hour)

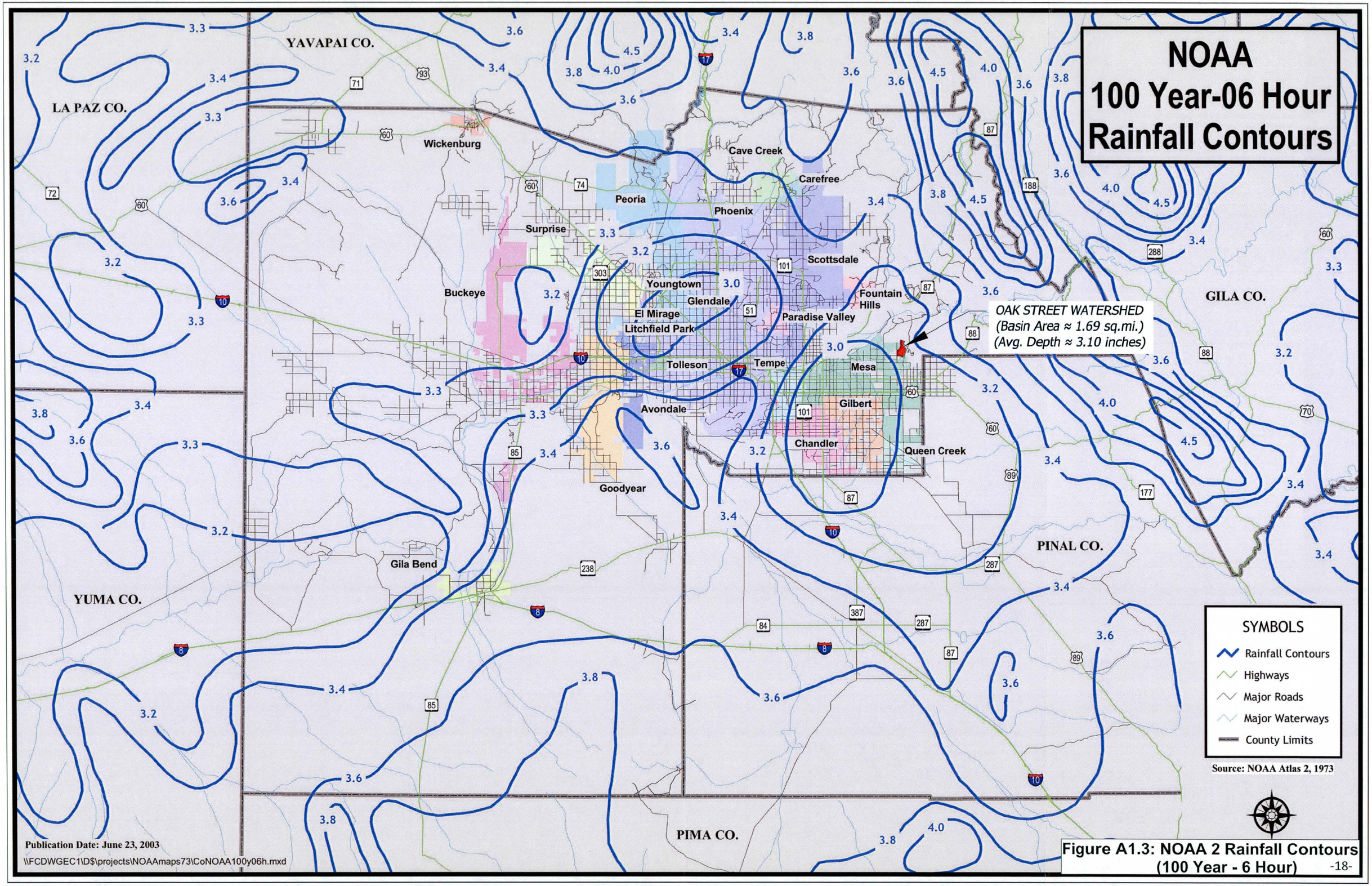


Figure A1.3: NOAA 2 Rainfall Contours (100 Year - 6 Hour)

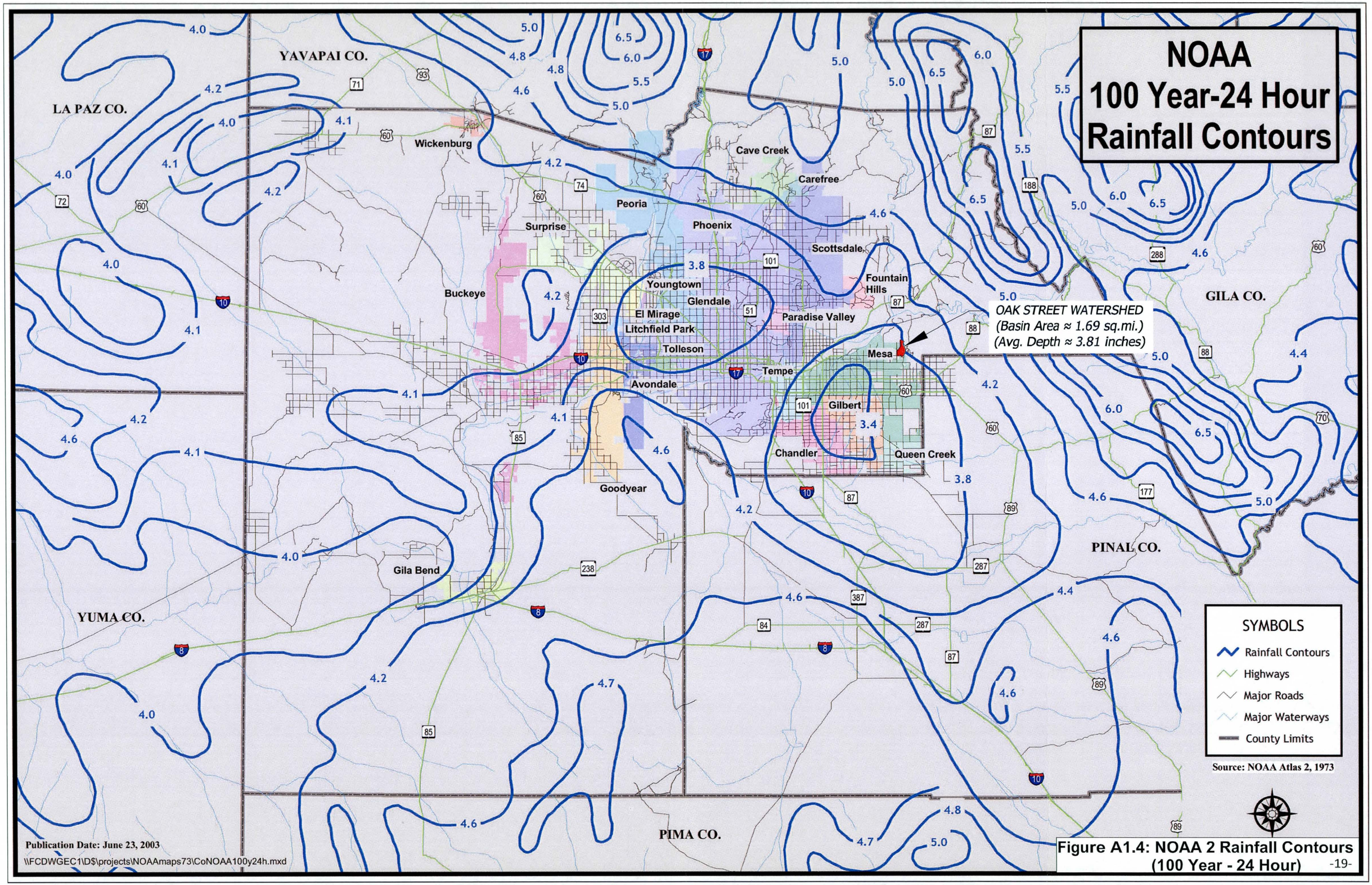
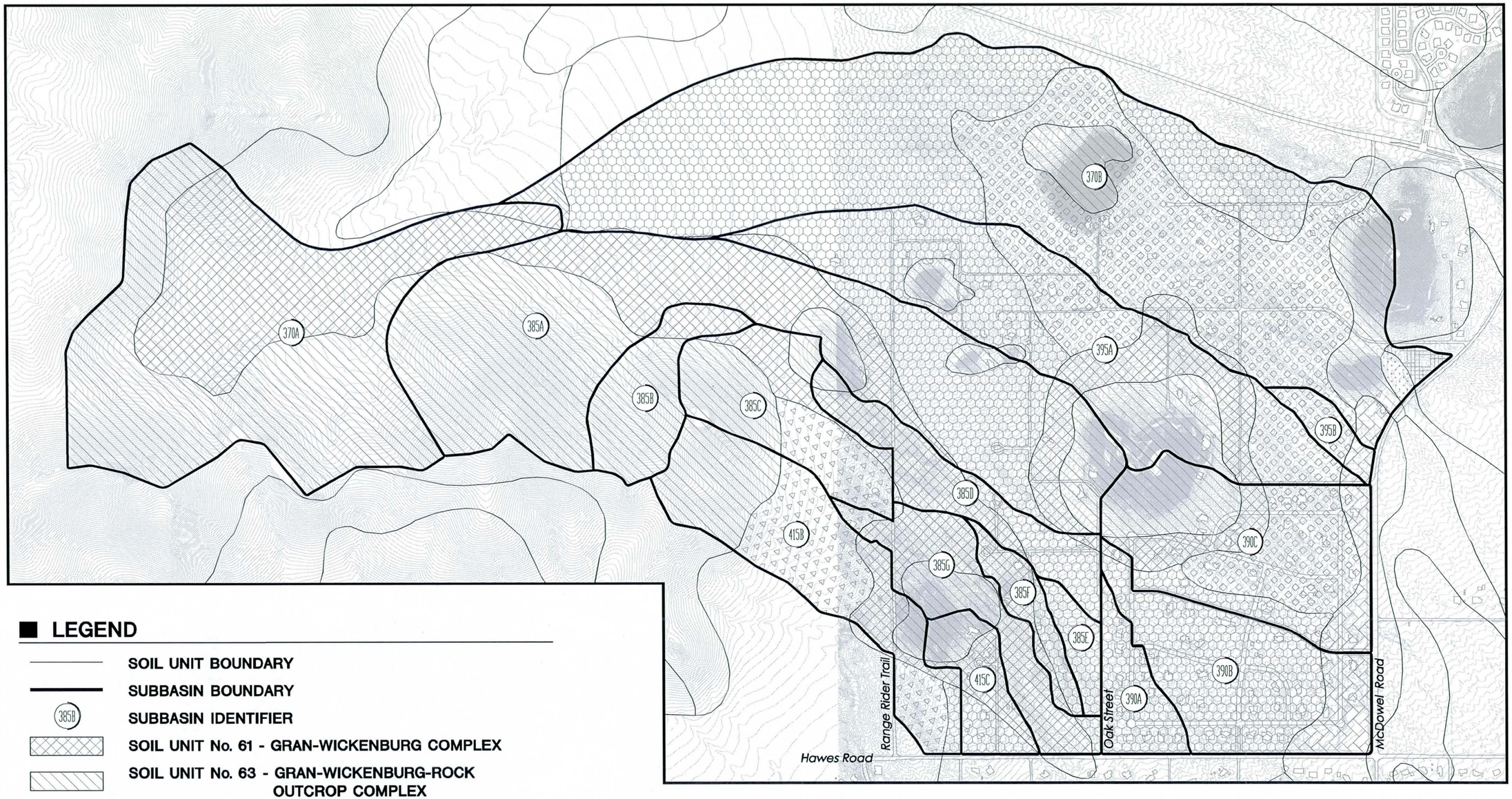


Figure A1.4: NOAA 2 Rainfall Contours (100 Year - 24 Hour)



LEGEND

- SOIL UNIT BOUNDARY
- SUBBASIN BOUNDARY
- 385B SUBBASIN IDENTIFIER
- SOIL UNIT No. 61 - GRAN-WICKENBURG COMPLEX
- SOIL UNIT No. 63 - GRAN-WICKENBURG-ROCK OUTCROP COMPLEX
- SOIL UNIT No. 68 - GUNSIGHT-CIPRIANO COMPLEX
- SOIL UNIT No. 90 - MOMOLI GRAVELLY SANDY LOAM
- SOIL UNIT No. 98 - PINAMT-TREMANT COMPLEX
- SOIL UNIT No. 101 - RILLITO LOAM
- SOIL UNIT No. 110 - SUNCITY CIPRIANO COMPLEX
- SOIL UNIT No. 115 - TREMANT-ANTHO COMPLEX
- SOIL UNIT No. 118 - TREMANT-RILLITO COMPLEX

N

GRAPHIC SCALE

500 0 250 500 1000

SCALE: 1"=500 FT.

Gavan & Barker Inc.

Gavan & Barker, Inc.
3030 N. Central Ave.
Suite 1530
Phoenix, Arizona 85012
Phone: 602-200-0031
Fax: 602-200-0032

Civil Engineering
Landscape Architecture

Project :

Oak Street Basin and Storm Drain Design

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD - 2009C021

Submittal :

G&B No.	0912
Issue Date:	04/11
Drawn By:	OK
Checked By:	MTG

Sheet Title :

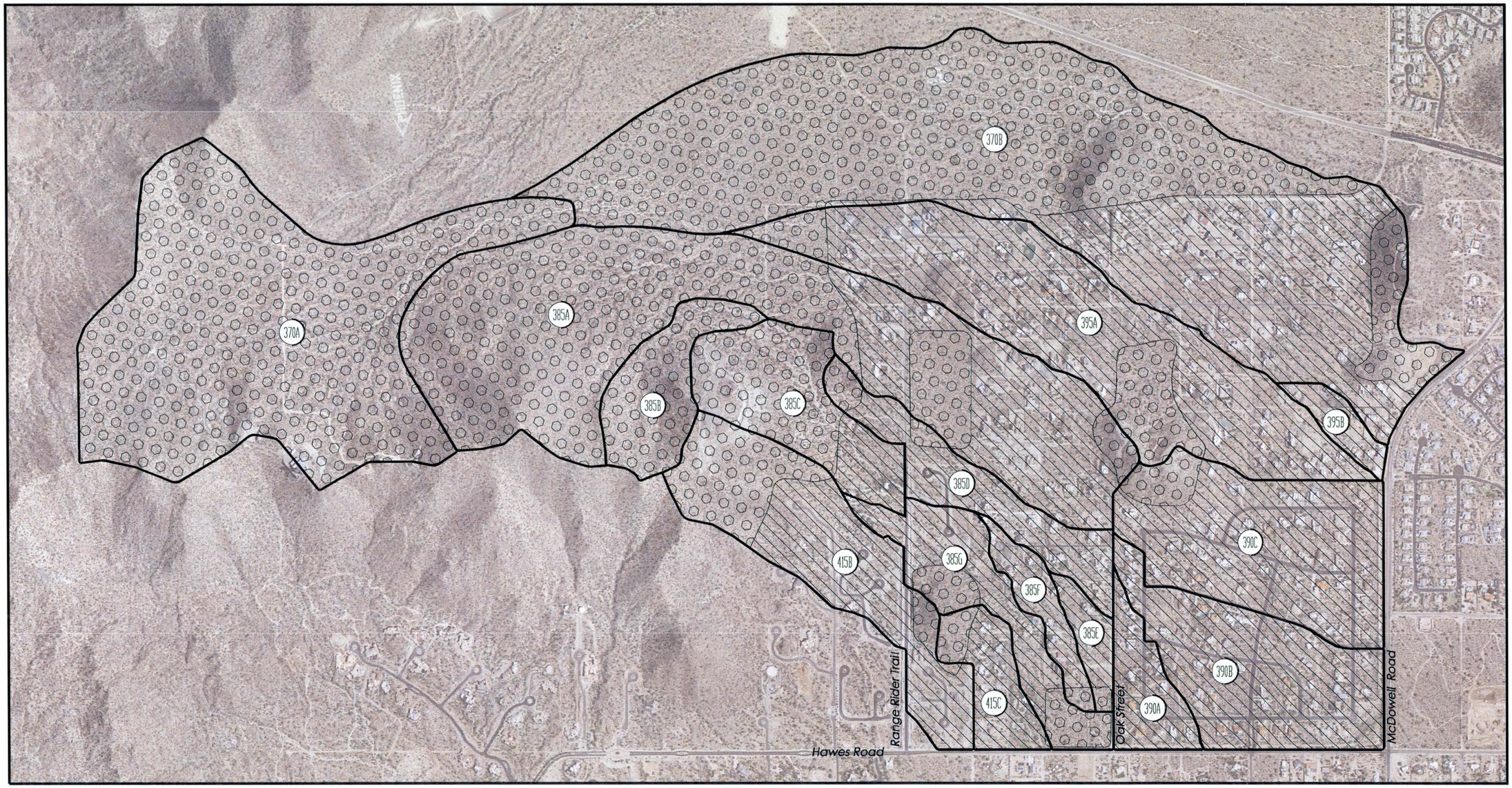
FIGURE A1.5: NRCS SOILS MAP

Page Number:

Subbasin	Total Area (sq.ft.)	Total Area (sq.mi.)	Soil #61 (sq.ft.)	Soil #61 (sq.mi.)	Soil #63 (sq.ft.)	Soil #63 (sq.mi.)	Soil #68 (sq.ft.)	Soil #68 (sq.mi.)	Soil #90 (sq.ft.)	Soil #90 (sq.mi.)	Soil #98 (sq.ft.)	Soil #98 (sq.mi.)
370A	8327339	0.299	3478006	0.125	4718352	0.169	0	0.000	0	0.000	0	0.000
370B	13867052	0.497	205583	0.007	1481435	0.053	0	0.000	6947124	0.249	113113	0.004
385A	8733812	0.313	2582285	0.093	4313971	0.155	0	0.000	1837556	0.066	0	0.000
385B	1225320	0.044	242905	0.009	982415	0.035	0	0.000	0	0.000	0	0.000
385C	1863743	0.067	383177	0.014	828921	0.030	651645	0.023	0	0.000	0	0.000
385D	1454879	0.052	847330	0.030	64221	0.002	12442	0.000	530886	0.019	0	0.000
385E	379389	0.014	0	0.000	0	0.000	0	0.000	379389	0.014	0	0.000
385F	562406	0.020	358401	0.013	0	0.000	0	0.000	204005	0.007	0	0.000
385G	1586023	0.057	1065713	0.038	380903	0.014	84062	0.003	55345	0.002	0	0.000
395A	5350712	0.192	1008204	0.036	1143073	0.041	0	0.000	1815377	0.065	0	0.000
415B	3020481	0.108	394198	0.014	1092966	0.039	1438399	0.052	94918	0.003	0	0.000
415C	809220	0.029	334421	0.012	221768	0.008	0	0.000	253031	0.009	0	0.000
TOTAL	47180376	1.692	10900223	0.391	15228025	0.546	2186548	0.078	12117631	0.435	0	0.000

Subbasin	Total Area (sq.ft.)	Total Area (sq.mi.)	Soil #101 (sq.ft.)	Soil #101 (sq.mi.)	Soil #110 (sq.ft.)	Soil #110 (sq.mi.)	Soil #115 (sq.ft.)	Soil #115 (sq.mi.)	Soil #118 (sq.ft.)	Soil #118 (sq.mi.)
370A	8327339	0.299	0	0.000	0	0.000	0	0.000	130981	0.005
370B	13867052	0.497	4788480	0.172	119633	0.004	86734	0.003	124950	0.004
385A	8733812	0.313	0	0.000	0	0.000	0	0.000	0	0.000
385B	1225320	0.044	0	0.000	0	0.000	0	0.000	0	0.000
385C	1863743	0.067	0	0.000	0	0.000	0	0.000	0	0.000
385D	1454879	0.052	0	0.000	0	0.000	0	0.000	0	0.000
385E	379389	0.014	0	0.000	0	0.000	0	0.000	0	0.000
385F	562406	0.020	0	0.000	0	0.000	0	0.000	0	0.000
385G	1586023	0.057	0	0.000	0	0.000	0	0.000	0	0.000
395A	5350712	0.192	1358999	0.049	25059	0.001	0	0.000	0	0.000
415B	3020481	0.108	0	0.000	0	0.000	0	0.000	0	0.000
415C	809220	0.029	0	0.000	0	0.000	0	0.000	0	0.000
TOTAL	47180376	1.692	6147479	0.221	144692	0.005	86734	0.003	255931	0.009

Table A1.1: Sub-Basin Soil Distribution



LEGEND

- LAND USE BOUNDARY
- SUBBASIN BOUNDARY
- 385B SUBBASIN IDENTIFIER
- LAND USE CODE - DESERT
- LAND USE CODE - L.D.R. (LOW DENSITY RESIDENTIAL)

GRAPHIC SCALE

500 0 250 500 1000

SCALE: 1"=500 FT.

Gavan & Barker Inc.

Gavan & Barker, Inc.
3030 N. Central Ave.
Suite 1530
Phoenix, Arizona 85012
Phone: 602-200-0031
Fax: 602-200-0032

Civil Engineering
Landscape Architecture

Project :

Oak Street Basin and Storm Drain Design

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD - 2009C021

Submittal :	
G&B No.	0912
Issue Date:	04/11
Drawn By:	OK
Checked By:	MTG

Sheet Title :

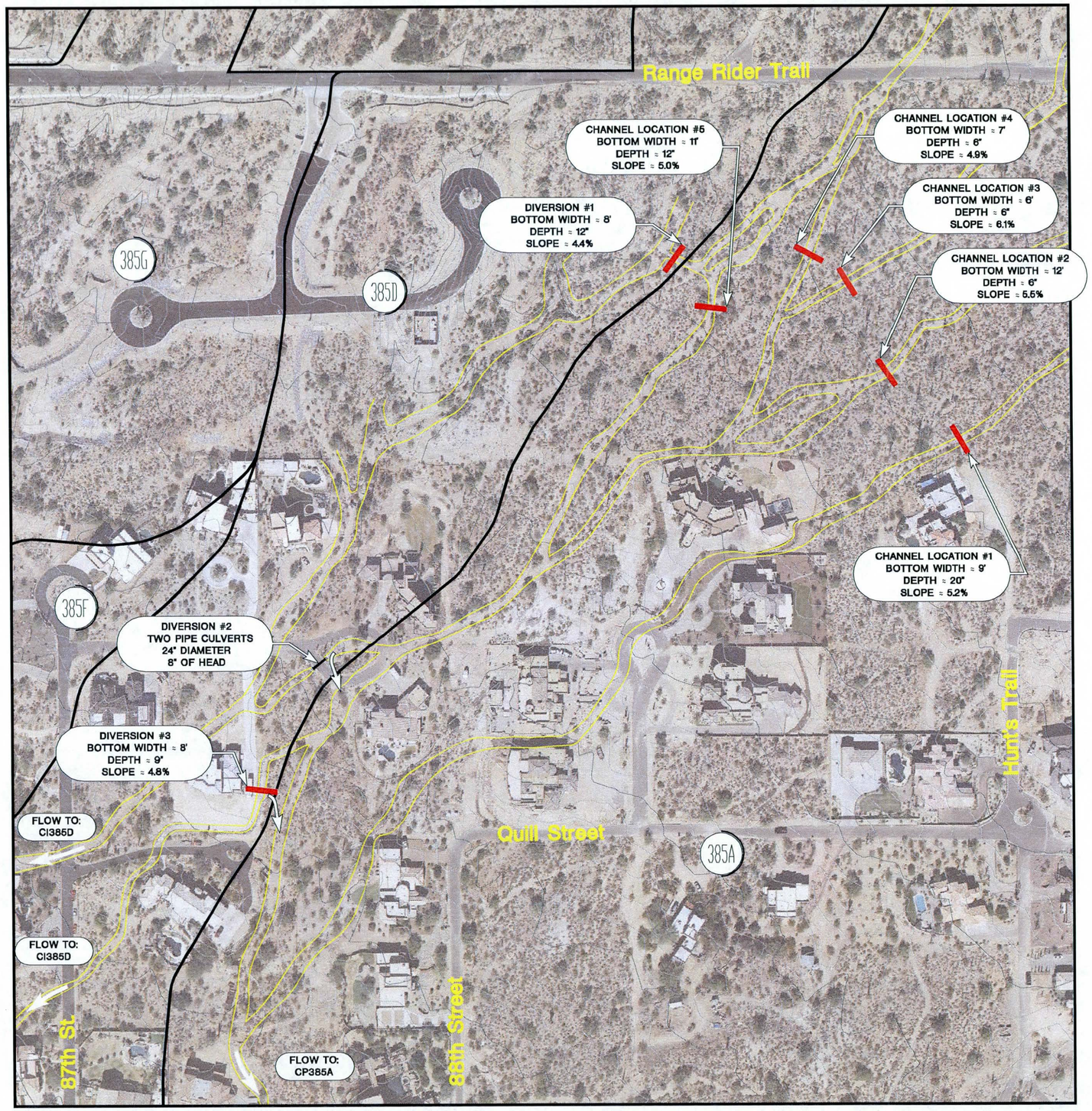
FIGURE A1.6: LAND USE MAP

Page Number:

Subbasin	Total Area (sq.ft.)	Total Area (sq.mi.)	L.D.R. (sq.ft.)	L.D.R. (sq.mi.)	DESERT (sq.ft.)	DESERT (sq.mi.)
370A	8,327,339	0.299	0	0.000	8,327,339	0.299
370B	13,867,052	0.497	4,684,705	0.168	9,182,347	0.329
385A	8,733,812	0.313	2,529,529	0.091	6,204,283	0.223
385B	1,225,320	0.044	0	0.000	1,225,320	0.044
385C	1,863,743	0.067	242,625	0.009	1,621,118	0.058
385D	1,454,879	0.052	1,164,457	0.042	290,422	0.010
385E	379,289	0.014	332,543	0.012	46,746	0.002
385F	562,406	0.020	505,553	0.018	56,853	0.002
385G	1,586,023	0.057	1,074,165	0.039	511,858	0.018
395A	5,350,712	0.192	4,437,151	0.159	913,561	0.033
415B	3,020,481	0.108	1,863,347	0.067	1,157,134	0.042
415C	809,220	0.029	656,382	0.024	152,838	0.005
TOTAL	47,180,276	1.692	17,490,457	0.627	29,689,819	1.065

Table A1.2: Sub-Basin Land Use Distribution

Sub-Section A2: **HEC-1 Diversion and Storage Calculations**



LEGEND

- Sub-basin Boundaries
- 385D — Sub-basin Identifications
- Existing Channels
- Channel Capacity Locations
- FLOW TO: CP385A — Flow to Concentration Points

GRAPHIC SCALE

200 0 100 200 400

SCALE: 1"=200 FT.

DIVERSION #1

Location	Bottom W. (ft)	Depth (ft)	Slope (%)	Capacity (cfs)
Channel Location #1	9.0	1.7	5.2	129.1
Channel Location #2	12.0	0.5	5.5	27.7
Channel Location #3	6.0	0.5	6.1	13.9
Channel Location #4	7.0	0.5	4.9	14.7
Channel Location #5	11.0	1.0	5.0	71.9
Diversion #1	8.0	1.0	4.4	50.9
			Total Capacity	308.2

$$\text{Percentage of Flow Diverted at Diversion \#1} = \frac{\text{Capacity of Diversion \#1}}{\text{Total Capacity}}$$

$$\text{Percentage of Flow Diverted at Diversion \#1} = \frac{50.9 \text{ cfs}}{308.2 \text{ cfs}} \times 100$$

Percentage of Flow Diverted at Diversion #1 ≈ **17 %**

DIVERSION #2

Location	Quantity (#)	Diameter (in)	Head (in)	Capacity (cfs)
Pipe Culvert	2	24	8	30

Total Flow Diverted at Diversion #2 = **30 cfs**

DIVERSION #3

Location	Bottom W. (ft)	Depth (ft)	Slope (%)	Capacity (cfs)
Diversion #3	8.0	0.8	4.8	41.1

Total Flow Diverted at Diversion #3 = **41 cfs**

Gavan & Barker Inc.
Gavan & Barker, Inc.
3030 N. Central Ave.
Suite 1530
Phoenix, Arizona 85012
Phone: 602-200-0031
Fax: 602-200-0032
Civil Engineering
Landscape Architecture

Project:

Oak Street Basin and Storm Drain Design

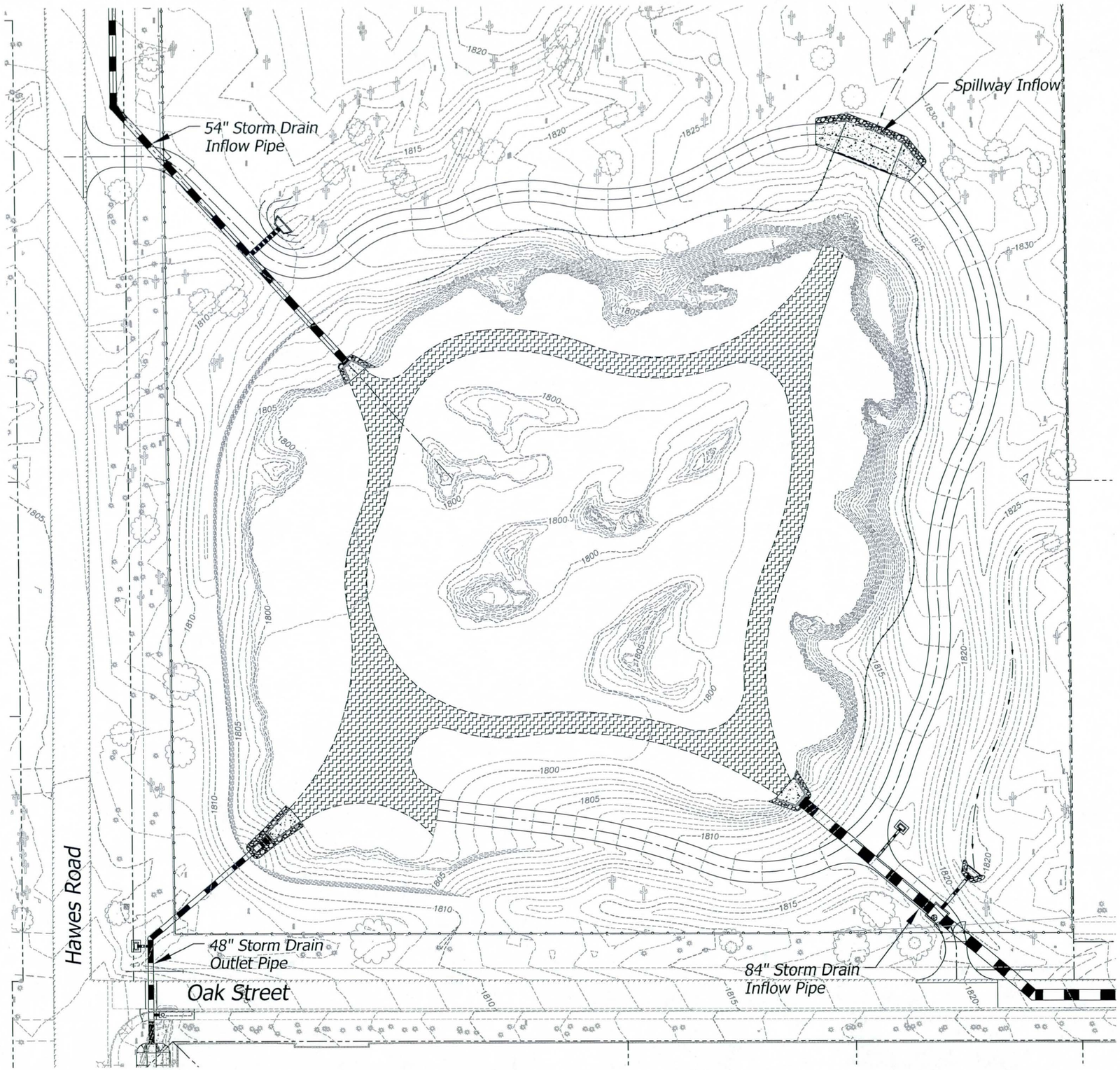
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD - 2009C021

Submittal:
G&B No. 0912
Issue Date: 04/11
Drawn By: OK
Checked By: MTG

Sheet Title:

Exhibit A2.1: D385A Diversion Schematic

Page Number:



GRAPHIC SCALE

35 0 35 70

SCALE: 1"=70 FT.

Gavan & Barker Inc.

Gavan & Barker, Inc.
3030 N. Central Ave.
Suite 1530
Phoenix, Arizona 85012
Phone: 602-200-0031
Fax: 602-200-0032

Civil Engineering
Landscape Architecture

Project :

Oak Street Basin and Storm Drain Design

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD - 2009C021

Submittal :	
G&B No.	0912
Issue Date:	09/12
Drawn By:	OK
Checked By:	MTG

Sheet Title :

Exhibit A2.2: Overall Oak Street Basin Exhibit

Page Number:

Basin Headwater Elevation	Basin Volume	Primary Basin Outlet Discharge		Governing Primary Outlet Discharge
		(Inlet Control)*	(Outlet Control)**	
(ft)	(ac-ft)	(cfs)	(cfs)	(cfs)
1798.0	0.00	0	0.0	0.0
1800.0	1.75	24	22.7	22.7
1802.0	7.14	79	71.3	71.3
1804.0	13.13	128	111.3	111.3
1806.0	19.58	165	141.4	141.4
1808.0	26.49	193	167.4	167.4
1809.0	30.08	207	179.2	179.2
1810.0	33.77	220	190.4	190.4
1811.0	37.55	232	201.0	201.0
1812.0	41.42	243	211.1	211.1

The primary basin outlet is a 48-inch storm drain (Inv Elev = 1798.0 ft) discharging to the Hawes Road channel.
The secondary basin outlet is a 325-foot spillway at elevation 1810.3 ft.
* Inlet Control discharge was determined using Figure A2.1: Oak Street Basin Inlet Control Nomograph
** Outlet Control discharge was determined using the Hawes Road Channel and Primary Basin Outlet HEC-RAS model (refer to *Sub-Section B4*)

Table A2.1: Oak Street Basin Stage-Storage-Discharge Summary Table

FIGURE 5.20
INLET CONTROL HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS
(USDOT, FHWA, HDS-5, 1985)

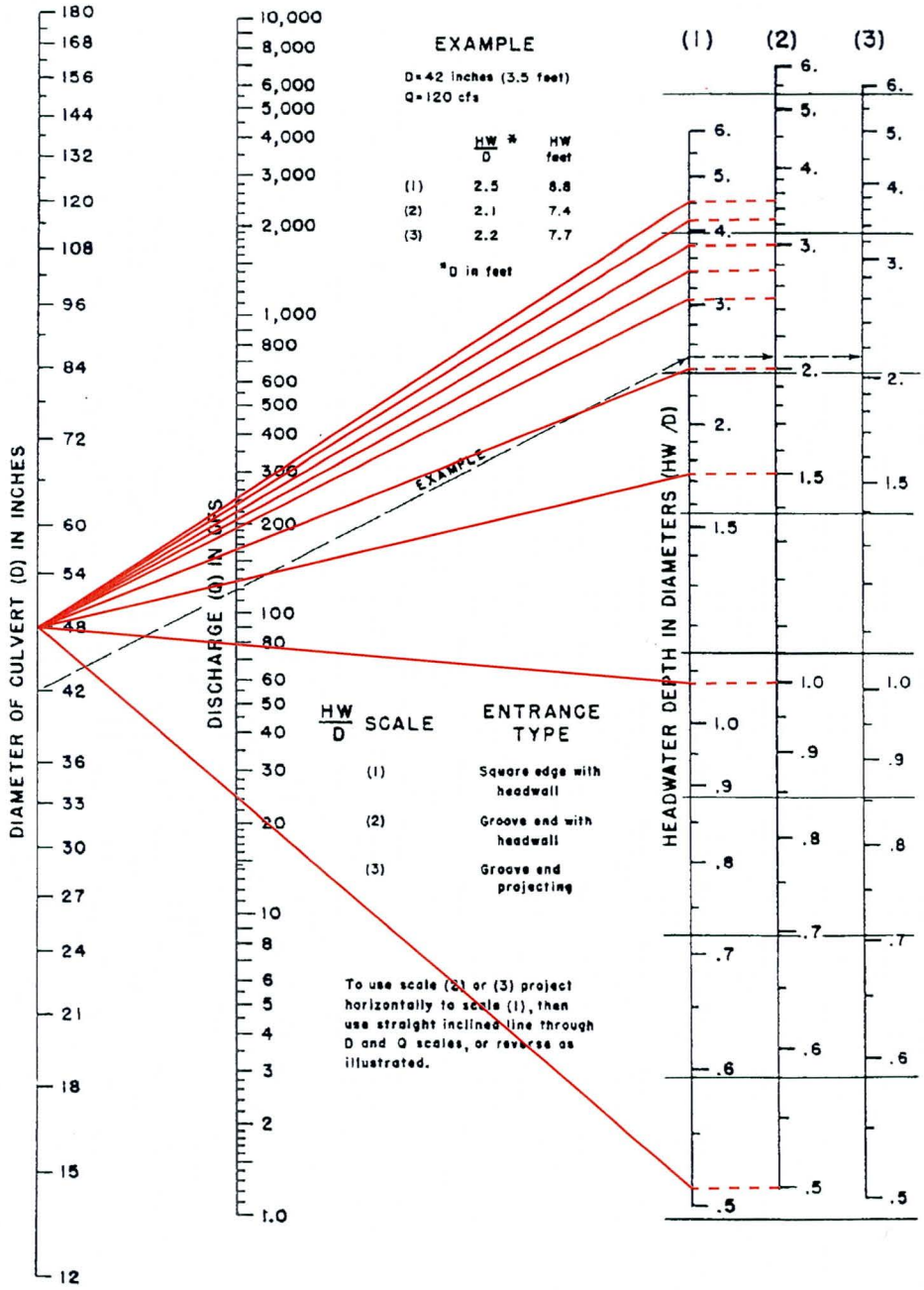


Figure A2.1: Oak Street Basin Inlet Control Nomograph

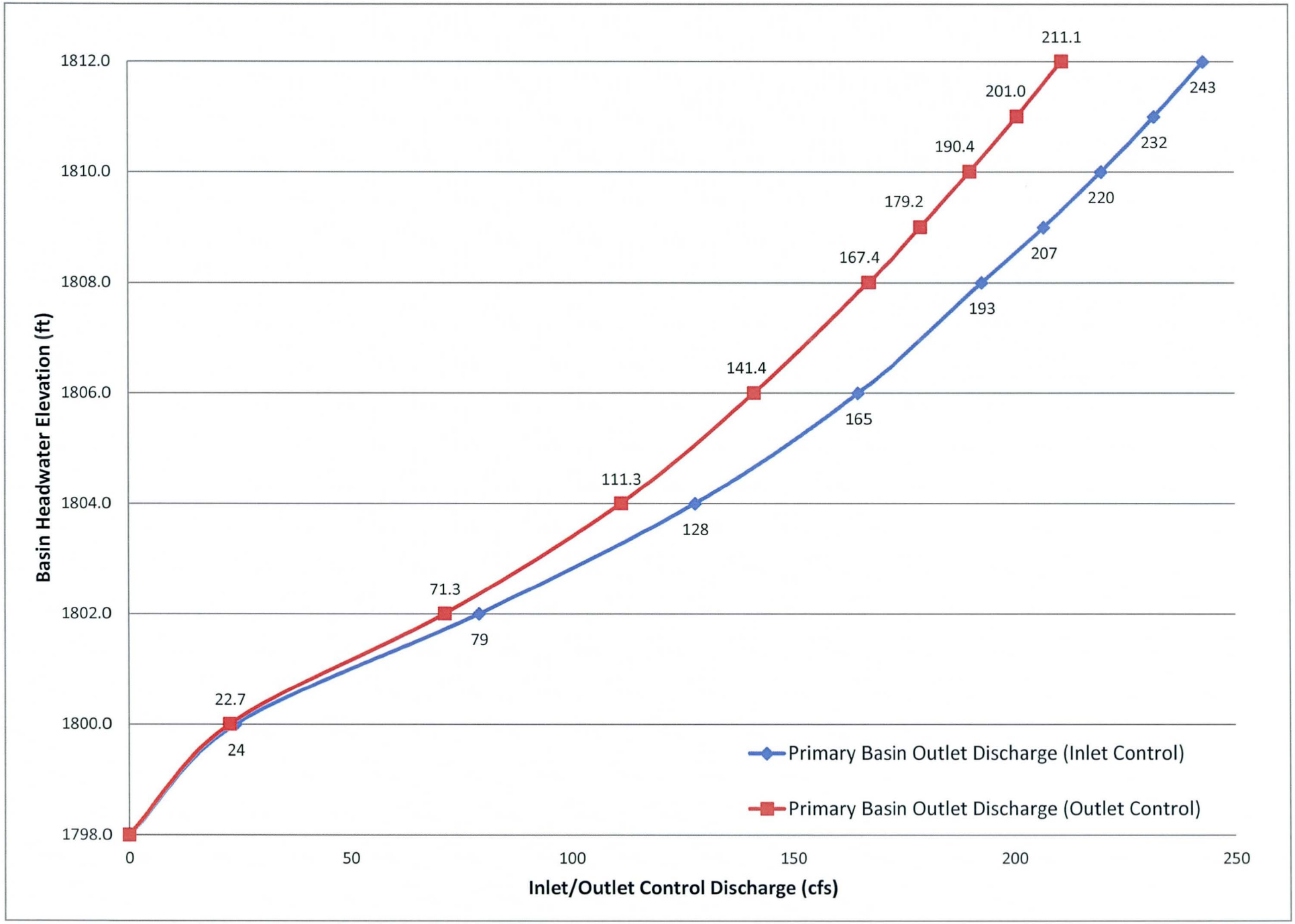


Figure 2.2: Oak Street Basin Primary Outlet Performance Curves

Sub-Section A3: **DDMSW Summary Tables**

ID	Method	Duration	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
DEFAULT	NOAA2	5 MIN	0.280	0.390	0.460	0.560	0.640	0.720
	NOAA2	10 MIN	0.420	0.590	0.700	0.860	0.980	1.100
	NOAA2	15 MIN	0.510	0.740	0.890	1.100	1.260	1.420
	NOAA2	30 MIN	0.670	0.990	1.200	1.480	1.700	1.920
	NOAA2	1 HOUR	0.820	1.220	1.480	1.840	2.120	2.400
	NOAA2	2 HOUR	0.930	1.360	1.650	2.040	2.340	2.640
	NOAA2	3 HOUR	1.010	1.460	1.760	2.170	2.480	2.800
	NOAA2	6 HOUR	1.150	1.640	1.960	2.410	2.760	3.100
	NOAA2	12 HOUR	1.330	1.850	2.210	2.700	3.080	3.450
	NOAA2	24 HOUR	1.500	2.070	2.460	2.990	3.400	3.810

Table A3.1: DDMSW Rainfall Summary Table

Area ID	Book Number	Map Unit	Soil ID	Area (sq mi)	Area (%)	XKSAT	Rock Percent (%)	Effective Rock (%)
Major Basin ID: B1								
370A	645	61	64561	0.125	41.80	0.15	-	100
	645	63	64563	0.169	56.50	0.14	25.00	100
	645	118	645118	0.005	1.70	0.42	-	100
370B	645	61	64561	0.007	1.40	0.15	-	100
	645	63	64563	0.053	10.70	0.14	25.00	100
	645	90	64590	0.249	50.20	0.39	-	100
	645	98	64598	0.004	0.80	0.37	-	100
	645	101	645101	0.172	34.70	0.28	-	100
	645	110	645110	0.004	0.80	0.13	-	100
	645	115	645115	0.003	0.60	0.39	-	100
	645	118	645118	0.004	0.80	0.42	-	100
385A	645	61	64561	0.093	29.60	0.15	-	100
	645	63	64563	0.155	49.40	0.14	25.00	100
	645	90	64590	0.066	21.00	0.39	-	100
385B	645	61	64561	0.009	20.50	0.15	-	100
	645	63	64563	0.035	79.50	0.14	25.00	100
385C	645	61	64561	0.014	20.90	0.15	-	100
	645	63	64563	0.030	44.80	0.14	25.00	100
	645	68	64568	0.023	34.30	0.63	-	100
385D	645	61	64561	0.030	58.80	0.15	-	100
	645	63	64563	0.002	3.90	0.14	25.00	100
	645	90	64590	0.019	37.30	0.39	-	100
385E	645	90	64590	0.014	100.00	0.39	-	100
385F	645	61	64561	0.013	65.00	0.15	-	100
	645	90	64590	0.007	35.00	0.39	-	100
385G	645	61	64561	0.038	66.70	0.15	-	100
	645	63	64563	0.014	24.60	0.14	25.00	100
	645	68	64568	0.003	5.30	0.63	-	100
	645	90	64590	0.002	3.50	0.39	-	100
395A	645	61	64561	0.036	18.80	0.15	-	100
	645	63	64563	0.041	21.40	0.14	25.00	100
	645	90	64590	0.065	33.90	0.39	-	100
	645	101	645101	0.049	25.50	0.28	-	100
	645	110	645110	0.001	0.50	0.13	-	100
415B	645	61	64561	0.014	13.00	0.15	-	100
	645	63	64563	0.039	36.10	0.14	25.00	100
	645	68	64568	0.052	48.10	0.63	-	100
	645	90	64590	0.003	2.80	0.39	-	100
415C	645	61	64561	0.012	41.40	0.15	-	100
	645	63	64563	0.008	27.60	0.14	25.00	100
	645	90	64590	0.009	31.00	0.39	-	100

Table A3.2: DDMSW Soils Summary Table

* Non default value

Sub Basin	Land Use Code	Area (sq mi)	Area (%)	Initial Loss (IA)	Percent Impervious (RTIMP)	Vegetable Cover (%)	DTHETA	Kb
Major Basin ID: B1								
370A	DESERT	0.299	100.0	0.35	0	25.0	DRY	0.093 *
		0.299	**100.0**					
370B	DESERT	0.329	66.2	0.35	0	25.0	DRY	0.046
	L.D.R.	0.168	33.8	0.30	15	50.0	NORMAL	0.046
		0.497	**100.0**					
385A	DESERT	0.223	71.0	0.35	0	25.0	DRY	0.092 *
	L.D.R.	0.091	29.0	0.30	15	50.0	NORMAL	0.048
		0.314	**100.0**					
385B	DESERT	0.044	100.0	0.35	0	25.0	DRY	0.114 *
		0.044	**100.0**					
385C	DESERT	0.058	86.6	0.35	0	25.0	DRY	0.109 *
	L.D.R.	0.009	13.4	0.30	15	50.0	NORMAL	0.058
		0.067	**100.0**					
385D	DESERT	0.010	19.2	0.35	0	25.0	DRY	0.059
	L.D.R.	0.042	80.8	0.30	15	50.0	NORMAL	0.059
		0.052	**100.0**					
385E	DESERT	0.002	14.3	0.35	0	25.0	DRY	0.067
	L.D.R.	0.012	85.7	0.30	15	50.0	NORMAL	0.067
		0.014	**100.0**					
385F	DESERT	0.002	10.0	0.35	0	25.0	DRY	0.065
	L.D.R.	0.018	90.0	0.30	15	50.0	NORMAL	0.065
		0.020	**100.0**					
385G	DESERT	0.018	31.6	0.35	0	25.0	DRY	0.059
	L.D.R.	0.039	68.4	0.30	15	50.0	NORMAL	0.059
		0.057	**100.0**					
395A	DESERT	0.033	17.2	0.35	0	25.0	DRY	0.051
	L.D.R.	0.159	82.8	0.30	15	50.0	NORMAL	0.051
		0.192	**100.0**					
415B	DESERT	0.042	38.5	0.35	0	25.0	DRY	0.104 *
	L.D.R.	0.067	61.5	0.30	15	50.0	NORMAL	0.055
		0.109	**100.0**					
415C	DESERT	0.005	17.2	0.35	0	25.0	DRY	0.118 *
	L.D.R.	0.024	82.8	0.30	15	50.0	NORMAL	0.063
		0.029	**100.0**					

Table A3.3: DDMSW Land-Use Summary Table

Major Basin	Area (sq mi)	Storm	Duration	Tab Interval	Ordinates	Output	Description
B1	1.6920	Single	24 Hour	2	2,000	5	The Oak Street Basin and Storm Drain Watershed

Table A3.4: DDMSW Major Basin Summary Table

Gavan & Barker Inc.
Drainage Design Management System
SUB BASINS
Project Reference: OAK STREET HYDROLOGY

4/19/2010

Area ID	Sub Basin Parameters: Area (sq mi)	Length (mi)	Slope (ft/mi)	Adj Slope	Time-Area	Kb	Rainfall Losses: IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)		Return Period Parameters: 2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
Major Basin ID: B1																		
370A	0.299	0.97	495.9	302.0	NATURAL	0.093	0.35	0.40	6.00	0.18	14	**Tc (Hrs)**	0.660*	0.593*	0.551*	0.501*	0.471*	0.446*
												Vel (f/s)	2.16	2.40	2.58	2.84	3.02	3.19
												R (Hrs)	0.453	0.402	0.371	0.334	0.312	0.293
370B	0.497	1.91	183.3	183.3	NATURAL	0.046	0.33	0.32	4.45	0.39	8	**Tc (Hrs)**	0.853*	0.741*	0.676*	0.616*	0.574*	0.540*
												Vel (f/s)	3.28	3.78	4.14	4.55	4.88	5.19
												R (Hrs)	0.776	0.663	0.599	0.540	0.499	0.467
385A	0.313	0.70	837.4	313.0	NATURAL	0.080	0.34	0.34	5.60	0.23	17	**Tc (Hrs)**	0.502*	0.453*	0.423*	0.387	0.364	0.345
												Vel (f/s)	2.05	2.27	2.43	2.65	2.82	2.98
												R (Hrs)	0.251	0.224	0.208	0.188	0.176	0.166
385B	0.044	0.49	841.9	313.0	NATURAL	0.114	0.35	0.39	6.20	0.16	20	**Tc (Hrs)**	0.486*	0.442*	0.413	0.379	0.357	0.339
												Vel (f/s)	1.48	1.63	1.74	1.90	2.01	2.12
												R (Hrs)	0.556	0.502	0.465	0.422	0.396	0.374
385C	0.067	0.49	435.0	294.3	NATURAL	0.102	0.34	0.34	4.90	0.29	13	**Tc (Hrs)**	0.514*	0.457*	0.424*	0.387	0.362	0.343
												Vel (f/s)	1.40	1.57	1.69	1.86	1.99	2.10
												R (Hrs)	0.467	0.410	0.376	0.340	0.316	0.298
385D	0.052	0.70	276.7	254.0	URBAN	0.059	0.31	0.27	5.20	0.29	13	**Tc (Hrs)**	0.470*	0.423*	0.394	0.358	0.337	0.319
												Vel (f/s)	2.18	2.43	2.61	2.87	3.05	3.22
												R (Hrs)	0.649	0.577	0.533	0.480	0.448	0.423
385E	0.014	0.27	223.0	220.7	URBAN	0.067	0.31	0.26	4.00	0.55	13	**Tc (Hrs)**	0.352	0.311	0.286	0.262	0.247	0.232
												Vel (f/s)	1.13	1.27	1.38	1.51	1.60	1.71
												R (Hrs)	0.464	0.405	0.368	0.335	0.313	0.293
385F	0.020	0.43	225.4	222.6	URBAN	0.065	0.31	0.26	5.20	0.30	14	**Tc (Hrs)**	0.400	0.361	0.336	0.306	0.288	0.274
												Vel (f/s)	1.58	1.75	1.88	2.06	2.19	2.30
												R (Hrs)	0.634	0.565	0.522	0.471	0.440	0.416
385G	0.057	0.71	246.8	237.9	URBAN	0.059	0.32	0.29	5.70	0.23	16	**Tc (Hrs)**	0.465*	0.422*	0.394	0.359	0.339	0.321
												Vel (f/s)	2.24	2.47	2.64	2.90	3.07	3.24
												R (Hrs)	0.615	0.553	0.512	0.462	0.433	0.408

Table A3.5: DDMSW Sub-Basin Summary Table

* Non default value or value out of range

Area ID	Sub Basin Parameters: Area (sq mi)	Length (mi)	Slope (ft/mi)	Adj Slope	Time-Area	Kb	Rainfall Losses: IA (in)	DTHETA	PSIF (in)	XKSAT (in/hr)	RTIMP (%)		Return Period Parameters: 2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
Major Basin ID: B1																		
395A	0.192	1.32	203.9	203.7	URBAN	0.051	0.31	0.27	4.90	0.34	18	**Tc (Hrs)**	0.624 *	0.564 *	0.527*	0.484*	0.456*	0.433*
												Vel (f/s)	3.10	3.43	3.67	4.00	4.25	4.47
												R (Hrs)	0.701	0.627	0.581	0.528	0.495	0.468
415B	0.108	0.76	496.7	302.1	URBAN	0.074	0.32	0.29	4.50	0.40	18	**Tc (Hrs)**	0.521 *	0.468 *	0.435*	0.402	0.377	0.358
												Vel (f/s)	2.14	2.38	2.56	2.77	2.96	3.11
												R (Hrs)	0.513	0.455	0.420	0.384	0.358	0.338
415C	0.029	0.30	210.2	209.6	URBAN	0.072	0.31	0.27	5.30	0.28	19	**Tc (Hrs)**	0.344	0.313	0.293	0.268	0.254	0.241
												Vel (f/s)	1.28	1.41	1.50	1.64	1.73	1.83
												R (Hrs)	0.325	0.293	0.272	0.247	0.232	0.219

Diversion ID/ DT Card ID	Maximum Volume (ac-ft)	Maximum Diversion (cfs)		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
D370A			**Inflow (cfs)**		100	1,000							
DIV1			**Diversion (cfs)**		25	250							
D385B			**Inflow (cfs)**		100	1,000							
DIV3			**Diversion (cfs)**		50	500							
DDIV1			**Inflow (cfs)**		100	1,000							
DIV2			**Diversion (cfs)**		50	500							
DD385A			**Inflow (cfs)**		25	1,000							
DIV5			**Diversion (cfs)**			975							
D385C			**Inflow (cfs)**		100	1,000							
DIV6			**Diversion (cfs)**		50	500							
D385G			**Inflow (cfs)**		25	1,000							
DIV8			**Diversion (cfs)**		25	25							
D385A			**Inflow (cfs)**		71	1,000							
DIV4			**Diversion (cfs)**		71	230							
D385E			**Inflow (cfs)**		100	1,000							
DIV10			**Diversion (cfs)**			900							
D415C			**Inflow (cfs)**		25	1,000							
DIV9			**Diversion (cfs)**			975							

Table A3.6: DDMSW Diversions Summary Table

Route ID	Shape	Length (ft)	Slope (ft/ft)	Manning's N	Diameter (in)	Height (ft)	Width (ft)	Side Slope (h/v)
MUSKINGUM-CUNGE								
Major Basin B1								
R385D	PIPE	830.00	0.0170	0.012	84	-	-	-
RD385E	PIPE	480.00	0.0080	0.012	42	-	-	-
RD415B	PIPE	780.00	0.0300	0.012	48	-	-	-
RD415C	PIPE	640.00	0.0160	0.012	24	-	-	-
RDIV5	PIPE	880.00	0.0220	0.012	72	-	-	-

Table A3.7: DDMSW Routes Summary Table (Pipe Routes)

Route ID	LOB N	Chan N	ROB N	Length (ft)	Slope (ft/ft)	Max Elev (ft)		1.	2.	3.	4.	5.	6.	7.	8.
NORMAL DEPTH															
Major Basin B1															
R390A1	0.020	0.020	0.020	780.00	0.0100	-	X:	-	2.00	3.00	4.00	17.00	19.00	23.00	30.00
							Y:	3.50	2.00	1.00	-	-	1.00	2.00	3.50
R390B2	0.020	0.020	0.020	1,100.00	0.0260	-	X:	-	2.00	3.00	4.00	17.00	19.00	23.00	30.00
							Y:	3.50	2.00	1.00	-	-	1.00	2.00	3.50
R390C3	0.045	0.035	0.045	2,770.00	0.0303	-	X:	-	10.00	30.00	45.00	65.00	80.00	100.00	110.00
							Y:	2.50	2.50	1.50	-	-	1.50	2.50	2.50
RD370A	0.045	0.035	0.045	10,080.00	0.0347	-	X:	-	1.00	41.00	47.00	67.00	73.00	113.00	114.00
							Y:	3.00	2.00	2.00	-	-	2.00	2.00	3.00
RD385B	0.045	0.040	0.045	4,400.00	0.0482	-	X:	-	1.00	40.00	46.00	66.00	72.00	112.00	113.00
							Y:	3.00	2.00	2.00	-	-	2.00	2.00	3.00
RD385C	0.045	0.035	0.045	2,500.00	0.0392	-	X:	-	5.00	30.00	50.00	70.00	90.00	105.00	110.00
							Y:	3.00	2.00	2.00	-	-	2.00	2.00	3.00
RDDIV1	0.045	0.040	0.045	6,990.00	0.0375	-	X:	-	1.00	40.00	46.00	71.00	77.00	117.00	118.00
							Y:	3.00	2.50	2.00	-	-	2.00	2.50	3.00
RDIV1	0.045	0.040	0.045	1,420.00	0.0563	-	X:	-	20.00	30.00	40.00	70.00	80.00	100.00	110.00
							Y:	8.00	6.00	5.00	-	-	5.00	6.00	8.00
RDIV2	0.045	0.040	0.045	4,770.00	0.0465	-	X:	-	1.00	40.00	46.00	66.00	72.00	112.00	113.00
							Y:	3.00	2.00	2.00	-	-	2.00	2.00	3.00
RDIV3	0.045	0.035	0.045	2,010.00	0.0667	-	X:	-	1.00	31.00	37.00	77.00	83.00	113.00	114.00
							Y:	3.00	2.00	1.50	-	-	1.50	2.00	3.00
RDIV4	0.045	0.035	0.045	4,450.00	0.0216	-	X:	-	5.00	30.00	50.00	70.00	90.00	105.00	110.00
							Y:	3.00	2.00	2.00	-	-	2.00	2.00	3.00
RDIV6	0.045	0.035	0.045	3,210.00	0.0386	-	X:	-	10.00	25.00	40.00	65.00	80.00	95.00	100.00
							Y:	5.00	4.00	2.00	-	-	2.00	4.00	5.00
RDIV8	0.045	0.040	0.045	5,940.00	0.0249	-	X:	-	1.00	40.00	46.00	66.00	72.00	112.00	113.00
							Y:	3.00	2.00	1.50	-	-	1.50	2.00	3.00

Table A3.8: DDMSW Routes Summary Table (Channel Routes)

Sub-Section A4: **HEC-1 Model**

LEGEND

- SUBBASIN BOUNDARY
- SUBBASIN IDENTIFIER
- DIVERSION
- CHANNEL ROUTE
- HYDROGRAPH COMBINE
- RESERVOIR ROUTE

GRAPHIC SCALE

500 0 250 500 1000

SCALE: 1"=500 FT.

Gavan & Barker Inc.

Gavan & Barker, Inc.
3030 N. Central Ave.
Suite 1530
Phoenix, Arizona 85012
Phone: 602-200-0031
Fax: 602-200-0032

Civil Engineering
Landscape Architecture

Project :

Oak Street Basin and Storm Drain Design

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD - 2009C021

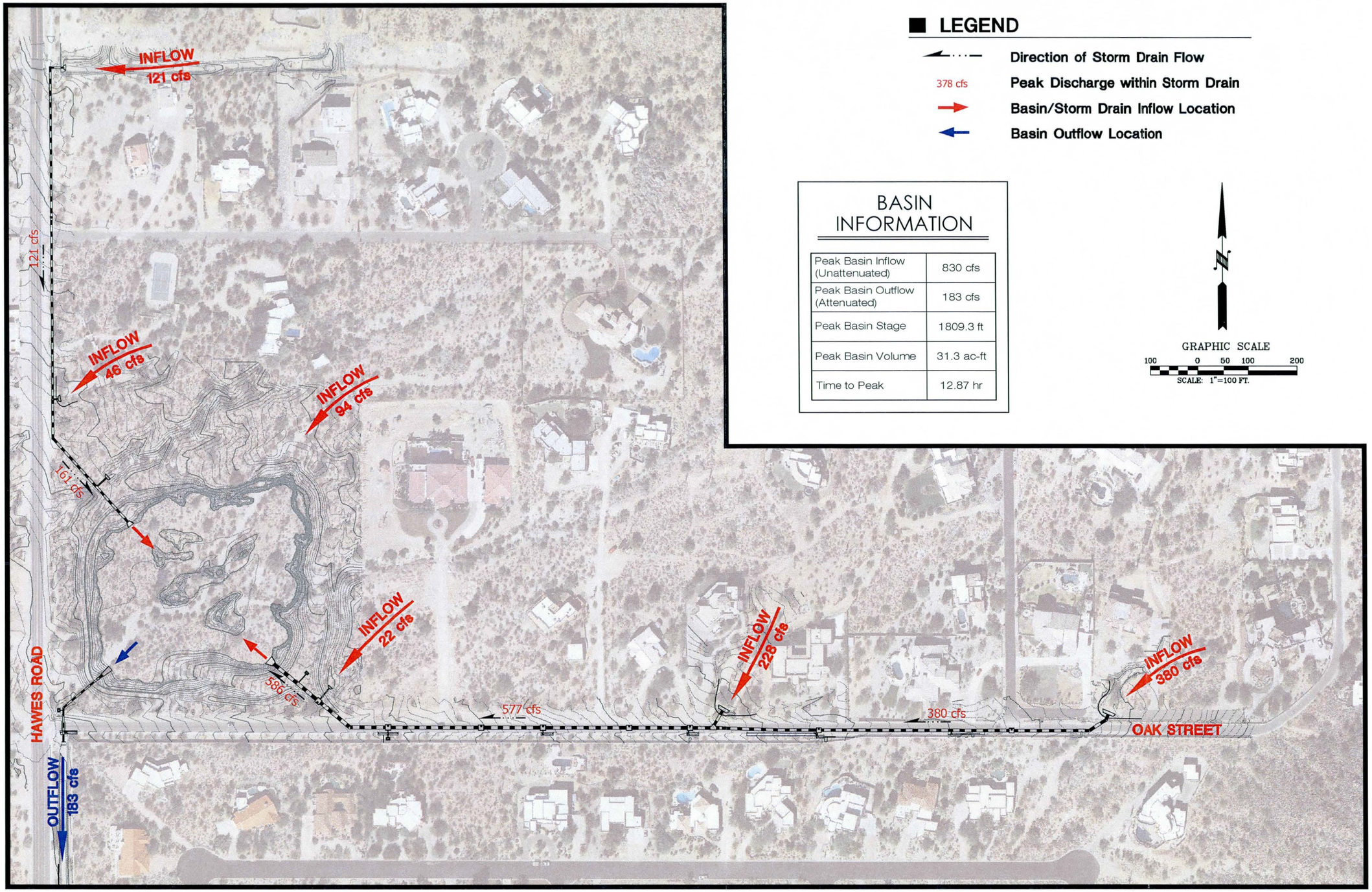
Submittal :

G&B No.	0912
Issue Date:	07/12
Drawn By:	OK
Checked By:	MTG

Sheet Title :

Exhibit A4.1: Watershed Map and HEC-1 Schematic

Page Number:



LEGEND

- Direction of Storm Drain Flow
- 378 cfs — Peak Discharge within Storm Drain
- Basin/Storm Drain Inflow Location
- Basin Outflow Location

BASIN INFORMATION

Peak Basin Inflow (Unattenuated)	830 cfs
Peak Basin Outflow (Attenuated)	183 cfs
Peak Basin Stage	1809.3 ft
Peak Basin Volume	31.3 ac-ft
Time to Peak	12.87 hr

GRAPHIC SCALE

100 0 50 100 200

SCALE: 1"=100 FT.

Gavan & Barker Inc.

Gavan & Barker, Inc.
3030 N. Central Ave.
Suite 1530
Phoenix, Arizona 85012
Phone: 602-200-0031
Fax: 602-200-0032

Civil Engineering
Landscape Architecture

Project :

Oak Street Basin and Storm Drain Design

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD - 2009C021

Submittal :

G&B No.	0912
Issue Date:	09/12
Drawn By:	OK
Checked By:	MTG

Sheet Title :

Exhibit A4.2: Flow Summary Map

Page Number:

Concentration Point	Gavan & Barker	Kimley-Horn
	(cfs)	(cfs)
CP370B	623	817
S370	350	374
395A	178	191
CP390C/CC390C	356	379
TOC-H	100	104
TO390B	253	275
BASIN	830	1055
SBASIN	183	55
CC415B	183	205
CP390A	185	210
CP390B	494	613
S390B	431	519

Table A4.1: Gavan & Barker – Kimley Horn Flow Comparison

HEC-1 Calculated 100-yr Basin Outlet Peak Discharge	Interpolated Basin Water Surface Elevation	Interpolated Basin Storage Volume
(cfs)	(ft)	(ac-ft)
0.0	1798.0	0.00
22.7	1800.0	1.75
71.3	1802.0	7.14
111.3	1804.0	13.13
141.4	1806.0	19.58
167.4	1808.0	26.49
179.2	1809.0	30.08
183	1809.3	31.33
190.4	1810.0	33.77
201.0	1811.0	37.55
211.1	1812.0	41.42

Shaded values are from Table A2.1: Oak Street Basin Stage-Storage-Discharge Summary
The 100-year peak basin outlet discharge is 183 cfs (Calculated with HEC-1)
The 100-year basin water surface elevation is 1809.3 ft
The 100-year basin storage volume is 31.33 ac-ft

Table A4.2: Oak Street Basin Hydraulic Results Summary

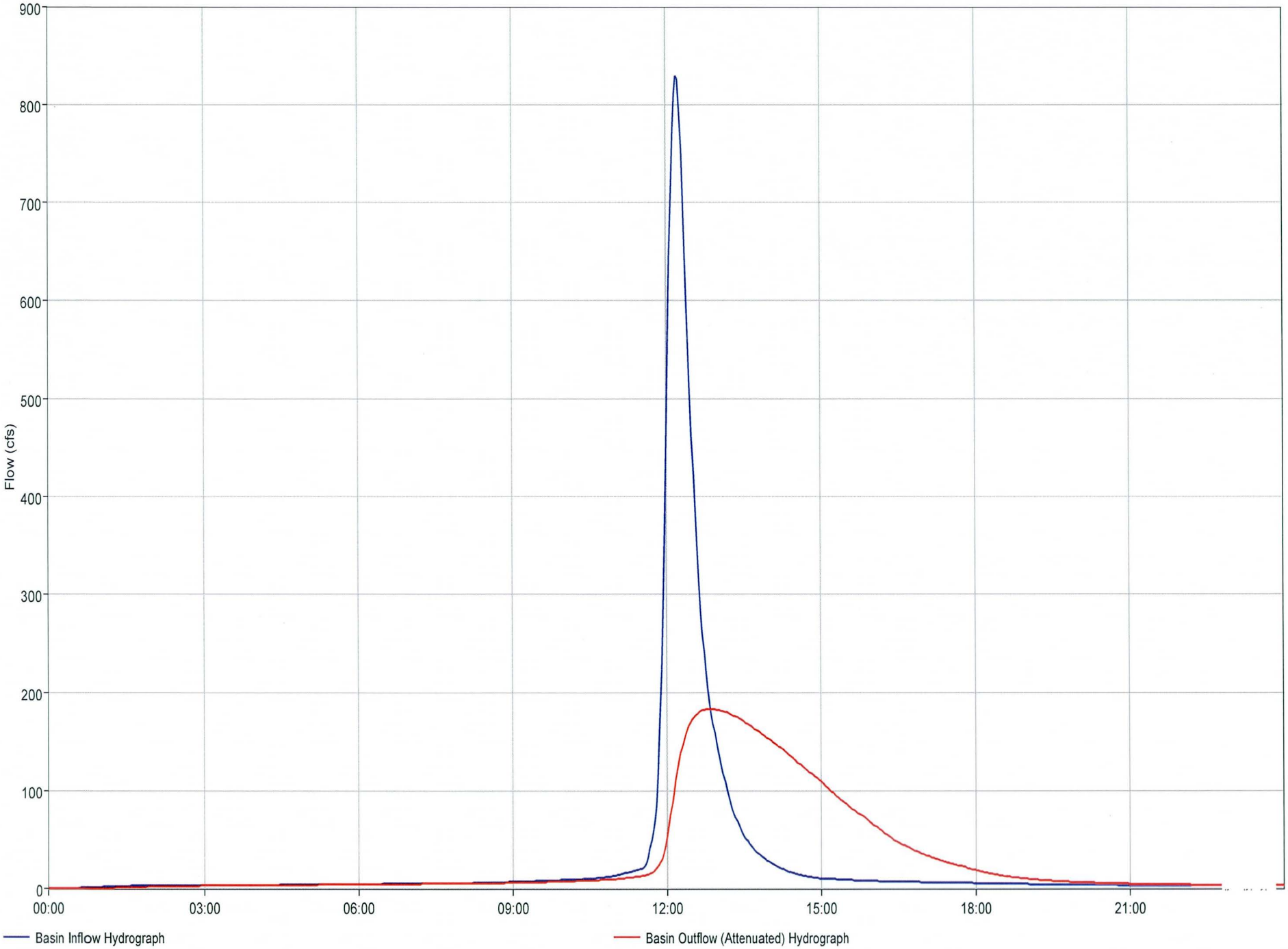


Figure 4.1: Oak Street Basin Inflow/Outflow Hydrographs

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              JUN   1998              *
*           VERSION 4.1                *
*                                      *
*  RUN DATE   24JUL12  TIME  13:31:21  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
```

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

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID   ******************************************************************************
  2           ID   *************** OAK STREET BASIN AND STORM DRAIN HYDROLOGY ******************
  3           ID   ******************************************************************************
  4           ID   ***                                                                        ***
  5           ID   ***  Project:    OAK STREET BASIN AND STORM DRAIN                          ***
  6           ID   ***  Client:     FLOOD CONTROL DISTRICT OF MARICOPA COUNTY                 ***
  7           ID   ***  Input File: Oak_Street_Basin_and_Storm_Drain.dat                      ***
  8           ID   ***                                                                        ***
  9           ID   ***  Contract FCD:     2009C021                                            ***
 10           ID   ***  Gavan & Barker:   0912                                                ***
 11           ID   ***  Modelers:         Mark Gavan & Omer Karovic                           ***
 12           ID   ***  Storm:            100-year, 24-hour                                   ***
 13           ID   ***                                                                        ***
 14           ID   ***  NOTE:                                                                 ***
 15           ID   ***  The Spook Hill ADMP model as well as the McDowell Road Basin and      ***
 16           ID   ***  Storm Drain Hydrology model were used as a base for this model.       ***
 17           ID   ***                                                                        ***
 18           ID   ******************************************************************************
 19           ID   *************** OAK STREET BASIN AND STORM DRAIN HYDROLOGY ******************
 20           ID   ******************************************************************************
```

```
 21          ID   ******************************************************************************
 22          ID   ************************** START OF BASE MODEL ******************************
 23          ID   ******************************************************************************
 24          ID   McDowell Road Basin and Storm Drain Design
 25          ID   This model assumes that the Oak Street detention basin is installed,
 26          ID   and all flows pass through the Thunder Mountain detention basin.
 27          ID
 28          ID   The Spook Hill ADMP model was used as a base for this model
 29          ID   Return Period = 100 Years, Rainfall Duration = 24 Hours
 30          ID
 31          ID   METHODOLOGY
 32          ID   THE US CORPS OF ENGINEERS FLOW HYDROGRAPH PACKAGE HEC-1 DATED JUNE 1998 V4.1
 33          ID   SCS TYPE II RAINFALL DISTRIBUTION
 34          ID   CLARK UNIT HYDROGRAPH
 35          ID   GREEN AND AMPT INFILTRATION EQUATION USED FOR CALCULATING LOSSES
 36          ID   NORMAL DEPTH STORAGE CHANNEL ROUTING
             *
             *DIAGRAM
 37          IT       2 01JAN00            720
 38          IO       5
 39          IN      15
 40          JD    3.81    0.01
 41          PC    .000    .002    .005    .008    .011    .014    .017    .020    .023    .026
 42          PC    .029    .032    .035    .038    .041    .044    .048    .052    .056    .060
 43          PC    .064    .068    .072    .076    .080    .085    .090    .095    .100    .105
 44          PC    .110    .115    .120    .126    .133    .140    .147    .155    .163    .172
 45          PC    .181    .191    .203    .218    .236    .257    .283    .387    .663    .707
 46          PC    .735    .758    .776    .791    .804    .815    .825    .834    .842    .849
 47          PC    .856    .863    .869    .875    .881    .887    .893    .898    .903    .908
 48          PC    .913    .918    .922    .926    .930    .934    .938    .942    .946    .950
 49          PC    .953    .956    .959    .962    .965    .968    .971    .974    .977    .980
 50          PC    .983    .986    .989    .992    .995    .998   1.000
 51          JD   3.787    1.00
 52          JD   3.677    5.80
 53          JD   3.574   10.66
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 54          JD   3.539   13.70
 55          JD   3.467   20.00
 56          JD   3.315   50.00
             *
             * DDM   ***** Updated *****

 57          KK      10
 58          KM   SUB-BASIN 10
 59          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 60          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .996
 61          KM     L = 2.00  Kb = .044  Adj. Slope =  165.0
 62          BA    .690
 63          LG    .350    .310   7.600    .090  16.000
 64          UC    .421    .305
 65          UA       0       3       5       8      12      20      43      75      90      96
 66          UA     100
             *
             * DDM   ***** Preserved *****
```

```
 67          KK     R10
 68          KM   ROUTING OF FLOW FROM SUB-BASIN 10 TO R12
 69          RS       4    FLOW      -1
 70          RC    .045     .03    .045    8700    .021
 71          RX       0       1       2      17      27      42      43      44
 72          RY       5       5       5       0       0       5       5       5
             * DDM   ***** Preserved *****

 73          KK     R12
 74          KM   ROUTING OF FLOW FROM R12 TO SUB-BASIN 20
 75          RS       7    FLOW      -1
 76          RC    .045     .03    .045    4500     .01
 77          RX       0       1      45    52.5    72.5      80     124     125
 78          RY       4     2.5     2.5       0       0     2.5     2.5       4
             * DDM   ***** Updated *****

 79          KK      20
 80          KM   SUB-BASIN 20
 81          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 82          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .993
 83          KM     L = 2.50  Kb = .040  Adj. Slope =   88.0
 84          BA   1.167
 85          LG    .310    .290   5.800    .220  11.000
 86          UC    .629    .422
 87          UA       0       5      16      30      65      77      84      90      94      97
 88          UA     100
             * DDM   ***** Preserved *****

 89          KK     D20
 90          KM        100-YEAR 2-HOUR ONSITE RETENTION BASIN
 91          KM        MAXIMUM VOLUME DIVERSION = 47.8 acre-feet
 92          DT    BS20    47.8
 93          DI       0   10000
 94          DQ       0   10000
             * DDM   ***** Preserved *****
1                                   HEC-1 INPUT                                          PAGE  3

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 95          KK    RT20
 96          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
 97          DR    BS20
             * DDM   ***** Preserved *****

 98          KK     S20
 99          KM   RETRIEVE FLOW INTO FICTITIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
100          KM   BLEEDOFF FLOW = 17 CFS
101          RS       1    STOR       0
102          SV       0     .01    47.8     70
103          SQ       0     0.5    17.0     50
             * DDM   ***** Preserved *****

104          KK     C20
105          KM   HYDROGRAPH COMBINATION
106          HC       3
             * DDM   ***** Preserved *****
```

```
 107          KK     R20
 108          KM        ROUTE FLOW THROUGH BULLDOG FLOODWAY FROM APACHE JUNCTION FRS
 109          RS       1    FLOW      -1
 110          RC    .016    .016    .016     990    .004
 111          RX       0       5       7    14.5    34.5      42      44      50
 112          RY       4       2       2       0       0       2       2       4
              * DDM   ***** Updated *****

 113          KK      40
 114          KM   SUB-BASIN 40
 115          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 116          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .987
 117          KM     L = 3.08  Kb = .036  Adj. Slope =  189.0
 118          BA   2.227
 119          LG    .320    .300   4.900    .310  11.000
 120          UC    .492    .262
 121          UA       0       3       5       8      12      20      43      75      90      96
 122          UA     100
              * DDM   ***** Preserved *****

 123          KK     D40
 124          KM        100-YEAR 2-HOUR ONSITE RETENTION BASIN
 125          KM        MAXIMUM VOLUME DIVERSION = 39.1 acre-feet
 126          DT    BS40    39.1
 127          DI       0   10000
 128          DQ       0   10000
              * DDM   ***** Preserved *****

 129          KK    RT40
 130          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
 131          DR    BS40
              * DDM   ***** Preserved *****
1                                   HEC-1 INPUT                                    PAGE  4

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 132          KK     S40
 133          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
 134          KM   BLEEDOFF FLOW = 14 CFS
 135          RS       1    STOR       0
 136          SV       0     .01    39.1     60
 137          SQ       0     0.5    14.0     40
              * DDM   ***** Preserved *****

 138          KK     C40
 139          KM   HYDROGRAPH COMBINATION
 140          HC       3
              * DDM   ***** Updated *****

 141          KK      60
 142          KM   SUB-BASIN 60
 143          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 144          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .989
 145          KM     L = 4.19  Kb = .038  Adj. Slope =  209.6
 146          BA   1.751
 147          LG    .320    .340   5.800    .190  10.000
 148          UC    .592    .472
```

```
149          UA       0       3       5       8      12      20      43      75      90      96
150          UA     100
             *
             * DDM   ***** Preserved *****

151          KK     D60
152          KM        100-YEAR 2-HOUR ONSITE RETENTION BASIN
153          KM        MAXIMUM VOLUME DIVERSION = 4.60 acre-feet
154          DT    BS60     4.6
155          DI       0   10000
156          DQ       0   10000
             * DDM   ***** Preserved *****

157          KK    RT60
158          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
159          DR    BS60
             * DDM   ***** Preserved *****

160          KK    SB60
161          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
162          KM   BLEEDOFF FLOW = 2 CFS
163          RS       1    STOR       0
164          SV       0     .01     4.6     10
165          SQ       0     0.5     2.0     10
             * DDM   ***** Preserved *****

166          KK     C60
167          KM   HYDROGRAPH COMBINATION
168          HC       3
             *
             * DDM   ***** Preserved *****
1                                   HEC-1 INPUT                                          PAGE  5

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


169          KK     S60
170          KM   APACHE JUNCTION FRS AS-BUILT PLANS 12/19/88
171          KM   OUTLET PIPE=30"RCP; L=136.6'; INLET INV.=1783.5; OUTLET INV.=1783
172          KM   EMERGENCY SPILLWAY ELEV.=1799.77'; PRINCIPAL SPILLWAY ELEV.=1793.5'
173          KM   STORAGE VOLUME BELOW PRINCIPAL SPILLWAY FOR SEDIMENT = 100 ACRE-FEET
             *  ESE = 1799.77 ft; PSE = 1793.5 ft; Sediment Vol. = 130 Ac-Ft.
174          RS       1    STOR       0
175          SV       0    46.8     106     130   161.2   170.7   230.7   322.2     543   812.9
176          SV    1122  1470.1    1865
177          SQ       0    0.01    0.02    26.3    74.4    91.2    96.2   102.4   113.9    1650
178          SQ    7700   15200   26200
179          SE   791.4     793   794.1   794.5     795   795.1     796   797.1   799.4   801.7
180          SE     804   806.3   808.6
             * DDM   ***** Preserved *****

181          KK     R60
182          KM        ROUTE FLOW THROUGH BULLDOG FLOODWAY FROM APACHE JUNCTION FRS
183          RS       2    FLOW      -1
184          RC    .016    .016    .016    2850    .012
185          RX       0       1       2     2.1     5.6     5.7       6       7
186          RY     4.5     3.5     3.5       0       0     3.5     3.5     4.5
             * DDM   ***** Preserved *****
```

```
 187          KK    RR60
 188          KM   ROUTE FLOW FROM BULLDOG FLOODWAY TO SUB-BASIN 80
 189          RS       3    FLOW      -1
 190          RC    .016    .016    .016    3500    .005
 191          RX       0       1       2     2.1     7.1     7.2       8       9
 192          RY     4.5     3.5     3.5       0       0     3.5     3.5     4.5
              * DDM   ***** Updated *****

 193          KK      80
 194          KM   SUB-BASIN 80
 195          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 196          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .991
 197          KM     L = 2.69  Kb = .039  Adj. Slope =  229.8
 198          BA   1.493
 199          LG    .320    .300   5.600    .220   7.000
 200          UC    .429    .254
 201          UA       0       5      16      30      65      77      84      90      94      97
 202          UA     100
              * DDM   ***** Preserved *****

 203          KK     D80
 204          KM        100-YEAR 2-HOUR ONSITE RETENTION BASIN
 205          KM        MAXIMUM VOLUME DIVERSION = 18.9 acre-feet
 206          DT    BS80    18.9
 207          DI       0   10000
 208          DQ       0   10000
              * DDM   ***** Preserved *****
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 209          KK    RT80
 210          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
 211          DR    BS80
              * DDM   ***** Preserved *****

 212          KK     S80
 213          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
 214          KM   BLEEDOFF FLOW =  7 CFS
 215          RS       1    STOR       0
 216          SV       0     .01    18.9     30
 217          SQ       0     1.0     7.0     20
              * DDM   ***** Preserved *****

 218          KK     C80
 219          KM   HYDROGRAPH COMBINATION
 220          HC       2
              * DDM   ***** Preserved *****

 221          KK    CC80
 222          KM   HYDROGRAPH COMBINATION FOR FLOW FROM APACHE JUNCTION FRS & SUB-BASIN 80
 223          HC       2   1.493
              * DDM   ***** Preserved *****

 224          KK     R80
 225          KM   ROUTE FLOW FROM SUB-BASIN 80 TO SUB-BASIN 100
```

```
226          RS       2    FLOW      -1
227          RC    .025    .016    .025    1200    .003
228          RX       0       2       6     6.1    41.1    41.2    56.2    58.2
229          RY     5.5     4.5     4.5       0       0     4.5     4.5     5.5
             * DDM   ***** Updated *****

230          KK     100
231          KM   SUB-BASIN 100
232          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
233          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .997
234          KM     L = 1.94  Kb = .045  Adj. Slope =  108.0
235          BA    .488
236          LG    .300    .250   5.100    .280   9.000
237          UC    .517    .455
238          UA       0       5      16      30      65      77      84      90      94      97
239          UA     100
             * DDM   ***** Preserved *****

240          KK    D100
241          KM        100-YEAR 2-HOUR ONSITE RETENTION BASIN
242          KM        MAXIMUM VOLUME DIVERSION = 10.0 acre-feet
243          DT   BS100    10.0
244          DI       0   10000
245          DQ       0   10000
             * DDM   ***** Preserved *****
1                                          HEC-1 INPUT                                          PAGE  7

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


246          KK   RT100
247          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
248          DR   BS100
             * DDM   ***** Preserved *****

249          KK    S100
250          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
251          KM   BLEEDOFF FLOW =  4 CFS
252          RS       1    STOR       0
253          SV       0     .01    10.0     20
254          SQ       0     1.0     4.0     10
             * DDM   ***** Preserved *****

255          KK    C100
256          KM   HYDROGRAPH COMBINATION FOR FLOW FROM SUB-BASIN 80 & 100
257          HC       3
             * DDM   ***** Preserved *****

258          KK    R100
259          KM   ROUTE FLOW FROM SUB-BASIN 100 TO SUB-BASIN 120
260          RS       1    FLOW      -1
261          RC    .016    .016    .016     940    .004
262          RX       0       1       2     2.1    52.1    52.2      53      54
263          RY     4.5     4.5     4.5       0       0     4.5     4.5     4.5
             * DDM   ***** Updated *****

264          KK     120
265          KM   SUB-BASIN 120
```

```
266          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
267          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .987
268          KM     L = 3.07  Kb = .037  Adj. Slope =  239.0
269          BA   2.197
270          LG    .330    .280   6.800    .130  12.000
271          UC    .429    .227
272          UA       0       3       5       8      12      20      43      75      90      96
273          UA     100
             * DDM   ***** Preserved *****

274          KK    D120
275          KM        100-YEAR 2-HOUR ONSITE RETENTION BASIN
276          KM        MAXIMUM VOLUME DIVERSION = 5.7 acre-feet
277          DT   BS120     5.7
278          DI       0   10000
279          DQ       0   10000
             * DDM   ***** Preserved *****

280          KK   RT120
281          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
282          DR   BS120
             * DDM   ***** Preserved *****
1                                          HEC-1 INPUT                                          PAGE  8

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


283          KK    S120
284          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
285          KM   BLEEDOFF FLOW =  2 CFS
286          RS       1    STOR       0
287          SV       0     .01     5.7     15
288          SQ       0     1.0     2.0     10
             * DDM   ***** Preserved *****

289          KK    C120
290          KM   HYDROGRAPH COMBINATION FOR FLOW FROM SUB-BASIN 100 & 120
291          HC       3
             * DDM   ***** Preserved *****

292          KK    R120
293          KM   ROUTE FLOW FROM SUB-BASIN 120 TO SIGNAL BUTTE FRS
294          RS       2    FLOW      -1
295          RC    .025    .016    .025    2100    .005
296          RX       0       6      10    10.1    60.1    60.2    74.2    80.2
297          RY       8       5       5       0       0       5       5       8
             * DDM   ***** Updated *****

298          KK     140
299          KM   SUB-BASIN 140
300          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
301          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .996
302          KM     L = 1.61  Kb = .044  Adj. Slope =  149.0
303          BA    .598
304          LG    .310    .280   4.200    .440   5.000
305          UC    .421    .278
306          UA       0       5      16      30      65      77      84      90      94      97
307          UA     100
```

```
                *
                * DDM   ***** Preserved *****

308             KK    D140
309             KM        100-YEAR 2-HOUR ONSITE RETENTION BASIN
310             KM        MAXIMUM VOLUME DIVERSION = 5.9 acre-feet
311             DT   BS140     5.9
312             DI       0   10000
313             DQ       0   10000
                * DDM   ***** Preserved *****

314             KK   RT140
315             KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
316             DR   BS140
                * DDM   ***** Preserved *****

317             KK    S140
318             KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
319             KM   BLEEDOFF FLOW =  2 CFS
320             RS       1    STOR       0
321             SV       0     .01     5.9     15
322             SQ       0     1.0     2.0     10
                *
                * DDM   ***** Preserved *****
1                                   HEC-1 INPUT                                          PAGE  9

LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


323             KK    C140
324             KM   HYDROGRAPH COMBINATION
325             HC       3
                *
                * DDM   ***** Updated *****

326             KK     150
327             KM   SUB-BASIN 150
328             KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
329             KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
330             KM     L = 1.50  Kb = .047  Adj. Slope =  314.6
331             BA    .407
332             LG    .350    .360   5.100    .260   7.000
333             UC    .296    .221
334             UA       0       3       5       8      12      20      43      75      90      96
335             UA     100
                * DDM   ***** Preserved *****

336             KK    R150
337             KM   ROUTING OF FLOW FROM SUB-BASIN 150 TO R152
338             RS       2    FLOW      -1
339             RC    .045     .04    .045    3100    .032
340             RX       0       1       2      23      33      54      55      56
341             RY       7       7       7       0       0       7       7       7
                * DDM   ***** Preserved *****

342             KK    R152
343             KM   ROUTING OF FLOW FROM R152 TO SUB-BASIN 160
344             RS       3    FLOW      -1
```

```
 345          RC    .045     .03    .045    5900    .019
 346          RX       0       1       2       8      33      39      40      41
 347          RY       2       2       2       0       0       2       2       2
              * DDM   ***** Updated *****

 348          KK     160
 349          KM   SUB-BASIN 160
 350          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 351          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
 352          KM     L = 2.10  Kb = .047  Adj. Slope =  129.0
 353          BA    .365
 354          LG    .340    .330   4.150    .440   1.000
 355          UC    .587    .659
 356          UA       0       3       5       8      12      20      43      75      90      96
 357          UA     100
              *
              * DDM   ***** Preserved *****

 358          KK    D160
 359          KM        100-YEAR 2-HOUR ONSITE RETENTION BASIN
 360          KM        MAXIMUM VOLUME DIVERSION = 1.2 acre-feet
 361          DT   BS160     1.2
 362          DI       0   10000
 363          DQ       0   10000
              * DDM   ***** Preserved *****
1                                          HEC-1 INPUT                                          PAGE 10

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 364          KK   RT160
 365          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
 366          DR   BS160
              * DDM   ***** Preserved *****

 367          KK    S160
 368          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
 369          KM   BLEEDOFF FLOW =  1 CFS
 370          RS       1    STOR       0
 371          SV       0     .01     1.2     10
 372          SQ       0     0.5     1.0     10
              * DDM   ***** Preserved *****

 373          KK    C160
 374          KM   HYDROGRAPH COMBINATION
 375          HC       3
              *
              * DDM   ***** Updated *****

 376          KK     180
 377          KM   SUB-BASIN 180
 378          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 379          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .994
 380          KM     L = 2.42  Kb = .041  Adj. Slope =  140.0
 381          BA   1.014
 382          LG    .350    .350   4.150    .430    .000
 383          UC    .571    .400
 384          UA       0       3       5       8      12      20      43      75      90      96
```

```
385          UA     100
             * DDM   ***** Preserved *****

386          KK    C180
387          KM   HYDROGRAPH COMBINATION FOR SIGNAL BUTTE FRS
388          HC       3
             * DDM   ***** Updated *****

389          KK     210
390          KM   SUB-BASIN 210
391          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
392          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .995
393          KM     L = 1.84  Kb = .043  Adj. Slope =  315.0
394          BA    .792
395          LG    .350    .360   6.800    .130   4.000
396          UC    .313    .189
397          UA       0       3       5       8      12      20      43      75      90      96
398          UA     100
             * DDM   ***** Preserved *****

399          KK    R210
400          KM   ROUTING OF FLOW FROM SUB-BASIN 210 TO SUB-BASIN 220
401          RS       2    FLOW      -1
402          RC    .045     .03    .045    5100    .022
403          RX       0       1       2      14      34      46      47      48
404          RY       4       4       4       0       0       4       4       4
             * DDM   ***** Updated *****
1                                          HEC-1 INPUT                                          PAGE 11

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


405          KK     240
406          KM   SUB-BASIN 240
407          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
408          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .992
409          KM     L = 3.50  Kb = .039  Adj. Slope =  298.6
410          BA   1.408
411          LG    .350    .370   5.300    .230   2.000
412          UC    .467    .356
413          UA       0       3       5       8      12      20      43      75      90      96
414          UA     100
             * DDM   ***** Preserved *****

415          KK    C240
416          KM   HYDROGRAPH COMBINATION FOR SUB-BASIN 240 & 220
417          HC       2
             * DDM   ***** Preserved *****

418          KK    S240
419          KM    WEIR GEOMETRY OBTAINED FROM AS-BUILT PLANS @ PASS MTN. DIVERSION.
420          KM   WEIR STORAGE DATA OBTAINED FROM 2' CONTOUR MAPPING.
421          RS       1    STOR       0
422          SA    1.38    14.2    36.5
423          SE     1.7       5      11
424          SS       5      42       3     1.5
             * DDM   ***** Preserved *****
```

```
425          KK    R240
426          KM   ROUTE FLOW FROM SUB-BASIN 240 TO SUB-BASIN 220
427          KM   PASS MOUNTAIN DIVERSION
428          RS       1    FLOW      -1
429          RC    .035    .025    .035    1800    .005
430          RX       0      15      30      39      69      81      96     111
431          RY     3.6     3.3       3       0       0       3       3       4
             * DDM   ***** Updated *****

432          KK     220
433          KM   SUB-BASIN 220
434          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
435          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .997
436          KM     L = 1.92  Kb = .046  Adj. Slope =  315.0
437          BA    .473
438          LG    .350    .350   7.000    .120   5.000
439          UC    .333    .282
440          UA       0       3       5       8      12      20      43      75      90      96
441          UA     100
             * DDM   ***** Preserved *****

442          KK    C220
443          KM   HYDROGRAPH COMBINATION FOR SUB-BASIN 240 & 220
444          HC       2
             * DDM   ***** Preserved *****
1                                    HEC-1 INPUT                                          PAGE 12

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


445          KK   SW220
446          KM    WEIR GEOMETRY OBTAINED FROM AS-BUILT PLANS @ PASS MTN. DIVERSION.
447          KM   WEIR STORAGE DATA OBTAINED FROM 2' CONTOUR MAPPING.
448          RS       1    STOR       0
449          SA     .78     4.1    13.7
450          SE       1       3      10
451          SS       3      65       3     1.5
             * DDM   ***** Preserved *****

452          KK    R220
453          KM   ROUTE FLOW FROM SUB-BASIN 220 TO SUB-BASIN 200
454          KM   PASS MOUNTAIN DIVERSION
455          RS       1    FLOW      -1
456          RC    .035    .025    .035    1250    .005
457          RX       0      50     100     109     139     148     178     184
458          RY       5       4       3       0       0       3       3       5
             * DDM   ***** Updated *****

459          KK     190
460          KM   SUB-BASIN 190
461          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
462          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .994
463          KM     L = 1.91  Kb = .042  Adj. Slope =  315.0
464          BA    .918
465          LG    .350    .390   5.800    .190   8.000
466          UC    .321    .185
467          UA       0       3       5       8      12      20      43      75      90      96
468          UA     100
```

```
                * DDM   ***** Preserved *****

469             KK    R190
470             KM   ROUTING OF FLOW FROM SUB-BASIN 190 TO SUB-BASIN 200
471             RS       2    FLOW      -1
472             RC    .045     .03    .045    4740     .03
473             RX       0       1       2      17      37      52      53      54
474             RY       5       5       5       0       0       5       5       5
                * DDM   ***** Preserved *****

475             KK    R192
476             KM   ROUTING OF FLOW FROM SUB-BASIN 190 TO SUB-BASIN 200
477             RS       3    FLOW      -1
478             RC    .045    .035    .045    2200    .018
479             RX       0       1      50      59      79      88     137     138
480             RY     4.5       3       3       0       0       3       3     4.5
                * DDM   ***** Updated *****

481             KK     200
482             KM   SUB-BASIN 200
483             KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
484             KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .997
485             KM     L = 1.58  Kb = .045  Adj. Slope =  305.6
486             BA    .530
487             LG    .350    .390   5.700    .200  10.000
488             UC    .300    .201
1                                          HEC-1 INPUT                                                    PAGE 13

LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

489             UA       0       3       5       8      12      20      43      75      90      96
490             UA     100
                * DDM   ***** Preserved *****

491             KK    C200
492             KM   HYDROGRAPH COMBINATION FOR SUB-BASIN 220 & 200
493             HC       3
                * DDM   ***** Preserved *****

494             KK   SW200
495             KM    WEIR GEOMETRY OBTAINED FROM AS-BUILT PLANS @ PASS MTN. DIVERSION.
496             KM   WEIR STORAGE DATA OBTAINED FROM 2' CONTOUR MAPPING.
497             RS       1    STOR       0
498             SA    2.56     3.1     9.4
499             SE       0       3      10
500             SS       3     112       3     1.5
                * DDM   ***** Preserved *****

501             KK    R200
502             KM   ROUTE FLOW FROM SUB-BASIN 200 TO SIGNAL BUTTE FRS through storage
503             RS       1    FLOW      -1
504             RC    .035    .025    .035     650    .005
505             RX       0       1       2      17     117     132     133     134
506             RY       5       5       5       0       0       5       5       5
                * DDM   ***** Preserved *****

507             KK   SS200
508             KM    WEIR GEOMETRY OBTAINED FROM AS-BUILT PLANS @ PASS MTN. DIVERSION.
```

```
 509          KM   WEIR STORAGE DATA OBTAINED FROM 2' CONTOUR MAPPING.
 510          RS       1    STOR       0
 511          SA       8     9.2     9.2
 512          SE       0       7      10
 513          SS       7     251       3     1.5
              * DDM   ***** Preserved *****

 514          KK   RR200
 515          KM   ROUTE FLOW FROM SUB-BASIN 200 TO SIGNAL BUTTE FRS
 516          RS       4    FLOW      -1
 517          RC    .035    .025    .035    3150    .005
 518          RX       0       1       2      17     117     132     133     134
 519          RY       5       5       5       0       0       5       5       5
              * DDM   ***** Preserved *****

 520          KK   CC180
 521          KM   HYDROGRAPH COMBINATION FOR SIGNAL BUTTE FRS
 522          HC       2
              * DDM   ***** Preserved *****

 523          KK    S180
 524          KM   SIGNAL BUTTE FRS DATED 1/28/85
 525          KM   OUTLET PIPE=36"RCP; L= 147';  INLET INV.=1690; OUTLET INV.=1687
 526          KM   EMERGENCY SPILLWAY ELEV.=1712.4; PRINCIPAL SPILLWAY ELEV.=1701
 527          KM   STORAGE VOLUME BELOW PRINCIPAL SPILLWAY FOR SEDIMENT = 250 ACRE-FEET
              *  ESE = 1712.4 ft; PSE = 1701.0 ft; Sediment Vol. = 247 Ac-Ft.
 528          RS       1    STOR       0
1                                        HEC-1 INPUT                                          PAGE 14

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 529          SV       0   172.1   273.3   482.2   871.3  1101.5  1163.5  1294.1  1390.2  1432.1
 530          SV  1446.1  1578.8  1733.6  1980.3  2712.2    3121    3530
 531          SQ       0    10.2    10.7   121.8   138.4   145.9   147.7   151.4     154     155
 532          SQ     156     390     820    1950    6600    9500   12400
 533          SE     696     700   701.4     704     708     710   710.5   711.5   712.2   712.5
 534          SE   712.6   713.5   714.5     716     720     722     724
              * DDM   ***** Preserved *****

 535          KK    R180
 536          KM   Routing length updated using Signal Butte Floodway plans dated March 1983
 537          KM   Routing length increased 100' from 1500' to 1600'    12/12/00
 538          KM   CHANNEL GEOMETRY FOR SIGNAL BUTTE FRS OBTAINED FROM AS-BUILT PLANS.
 539          KM   ROUTE FLOW FROM SIGNAL BUTTE FRS TO SUB-BASIN 260
 540          RS       1    FLOW      -1
 541          RC    .035    .025    .035    1600    .003
 542          RX       0       1       2    22.6    38.6    59.2      60      61
 543          RY     9.3     9.3     9.3       0       0     9.3     9.3     9.3
              * DDM   ***** Updated *****

 544          KK     260
 545          KM   SUB-BASIN 260
 546          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 547          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
 548          KM     L =  .81  Kb = .046  Adj. Slope =   68.0
 549          BA    .263
 550          LG    .280    .210   6.600    .160  11.000
 551          UC    .350    .209
```

```
552          UA       0       5      16      30      65      77      84      90      94      97
553          UA     100
             * DDM   ***** Preserved *****

554          KK    C260
555          KM   HYDROGRAPH COMBINATION FOR OUTFLOW OF SIGNAL BUTTE FRS & SUB-BASIN 260
556          HC       2    .263
             * DDM   ***** Preserved *****

557          KK    R260
558          KM   Routing length updated using Signal Butte Floodway plans dated March 1983
559          KM   Routing length unchanged     12/12/00
560          KM   CHANNEL GEOMETRY FOR SIGNAL BUTTE FRS OBTAINED FROM AS-BUILT PLANS.
561          KM   ROUTE FLOW FROM SUB-BASIN 260 TO SUB-BASIN 280
562          RS       3    FLOW      -1
563          RC    .035    .025    .035    2300    .003
564          RX       0       1       2    23.4    43.4    64.8      65      66
565          RY     9.7     9.7     9.7       0       0     9.7     9.7     9.7
             * DDM   ***** Updated *****

566          KK     280
567          KM   SUB-BASIN 280
568          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
569          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
570          KM     L =  .77  Kb = .048  Adj. Slope =   84.0
571          BA    .319
572          LG    .300    .250   5.300    .290  15.000
573          UC    .329    .168
1                                    HEC-1 INPUT                                          PAGE 15

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

574          UA       0       5      16      30      65      77      84      90      94      97
575          UA     100
             * DDM   ***** Preserved *****

576          KK    C280
577          KM   HYDROGRAPH COMBINATION FOR SUB-BASIN 260 & SUB-BASIN 280
578          HC       2
             * DDM   ***** Preserved *****

579          KK    R280
580          KM   Routing length updated using Signal Butte Floodway plans dated March 1983
581          KM   Routing length decreased 400' from 2500' to 2100'    12/12/00
582          KM   CHANNEL GEOMETRY FOR SIGNAL BUTTE FRS OBTAINED FROM AS-BUILT PLANS.
583          KM   ROUTE FLOW FROM SUB-BASIN 280 TO SUB-BASIN 300
584          RS       3    FLOW      -1
585          RC    .035    .025    .035    2100    .003
586          RX       0       1       2    23.4    43.4    64.8      65      66
587          RY     9.7     9.7     9.7       0       0     9.7     9.7     9.7
             * DDM   ***** Updated *****

588          KK     300
589          KM   SUB-BASIN 300
590          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
591          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
592          KM     L =  .78  Kb = .049  Adj. Slope =  103.0
593          BA    .289
```

```
 594          LG    .300    .250   4.200    .520  16.000
 595          UC    .321    .174
 596          UA       0       5      16      30      65      77      84      90      94      97
 597          UA     100
              * DDM   ***** Preserved *****

 598          KK    C300
 599          KM   HYDROGRAPH COMBINATION OF SUB-BASIN 280 & 300
 600          HC       2
              *
              * DDM   ***** Preserved *****

 601          KK    R300
 602          KM   Routing length updated using Signal Butte Floodway plans dated March 1983
 603          KM   Routing length increased 300' from 2200' to 2500'    12/12/00
 604          KM   CHANNEL GEOMETRY FOR SIGNAL BUTTE FRS OBTAINED FROM AS-BUILT PLANS.
 605          KM   ROUTE FLOW FROM SUB-BASIN 300 TO START OF FLOODWAY CONCRETE CHANNEL
 606          RS       2    FLOW      -1
 607          RC    .035    .025    .035    2500    .003
 608          RX       0       1       2    23.4    55.4    76.8      77      78
 609          RY     9.7     9.7     9.7       0       0     9.7     9.7     9.7
              *
              * DDM   ***** Updated *****
1                                          HEC-1 INPUT                                          PAGE 16

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 610          KK    305A
 611          KM   SUB-BASIN 305A
 612          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 613          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
 614          KM     L =  .98  Kb = .048  Adj. Slope =   82.0
 615          BA    .316
 616          LG    .340    .320   4.600    .350  12.000
 617          UC    .400    .254
 618          UA       0       5      16      30      65      77      84      90      94      97
 619          UA     100
              *
              * DDM   ***** Preserved *****

 620          KK    C305
 621          KM   HYDROGRAPH COMBINATION OF SUB-BASIN 300 AND 305A
 622          HC       2
              * DDM   ***** Preserved *****

 623          KK    R305
 624          KM   Routing length updated using Signal Butte Floodway plans dated March 1983
 625          KM   CHANNEL GEOMETRY FOR SPOOK HILL FRS OBTAINED FROM AS-BUILTS PLANS.
 626          KM   CONTINUE TO ROUTE FLOW WITHIN CONCRETE CHANNEL TO SPOOK HILL FRS
 627          RS       2    FLOW      -1
 628          RC    .016    .016    .016    4000   .0146
 629          RX       0       1       2     2.1    16.1    16.2      17      18
 630          RY     7.5     7.5     7.5       0       0     7.5     7.5     7.5
              *
              * DDM   ***** Updated *****

 631          KK   320B1
```

```
632          KM   SUB-BASIN 320B1
633          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
634          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .997
635          KM     L = 1.13  Kb = .046  Adj. Slope =  106.0
636          BA    .454
637          LG    .300    .260   4.800    .310  17.000
638          UC    .375    .215
639          UA       0       5      16      30      65      77      84      90      94      97
640          UA     100
             *
             * DDM   ***** Preserved *****

641          KK  D320B1
642          KM        DIVERT FLOW INTO ONLINE  DETENTION BASIN
643          KM   DETENTION/RETENTION BASINS LOCATED WITHIN THREE SUBDIVISIONS
644          KM   SIERRA HEIGHTS       FALCON RIDGE    & MARBLE CREEK
645          KM        MAXIMUM VOLUME DIVERSION =  9.3 acre-feet
646          DT  B320B1    9.30
647          DI       0   10000
648          DQ       0   10000
             * DDM   ***** Preserved *****
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

649          KK  T320B1
650          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
651          DR  B320B1
             * DDM   ***** Preserved *****

652          KK  S320B1
653          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
654          KM   9.30 ACRE-FEETx43560/36x3600=4.cfs
655          RS       1    STOR       0
656          SV       0     .01     9.3    15.0
657          SQ       0     0.5     4.0    50.0
             * DDM   ***** Preserved *****

658          KK  C320B1
659          KM   HYDROGRAPH COMBINATION FOR SPOOK HILL FRS
660          HC       3
             *
             * DDM   ***** Updated *****

661          KK     350
662          KM   SUB-BASIN 350
663          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
664          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .994
665          KM     L = 2.22  Kb = .041  Adj. Slope =  315.0
666          BA    .997
667          LG    .350    .350   4.550    .340   4.000
668          UC    .363    .227
669          UA       0       3       5       8      12      20      43      75      90      96
670          UA     100
             * DDM   ***** Preserved *****

671          KK    D350
```

```
 672          KM   DIVERT FLOW FROM SUB-BASIN 350. FOR MODELING PURPOSES THE SPLIT FLOW WILL
 673          KM   BE ROUTED BETWEEN SUB-BASINS 355 & 310. THE MAIN FLOW WILL ROUTED TO 310
 674          DT   SF350
 675          DI       0    5000
 676          DQ       0    2500
              * DDM   ***** Preserved *****

 677          KK    R350
 678          KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING
 679          KM   ROUTING OF MAIN FLOW FROM DIVERSION OF SUB-BASIN 350 TO SUB-BASIN 310
 680          RS       7    FLOW      -1
 681          RC    .045    .035    .045    5150    .025
 682          RX       0       1      40      46      56      62     102     103
 683          RY       3       2       2       0       0       2       2       3
              * DDM   ***** Updated *****

 684          KK     310
 685          KM   SUB-BASIN 310
 686          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 687          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .997
 688          KM     L = 2.70  Kb = .045  Adj. Slope =  283.5
 689          BA    .538
1                                          HEC-1 INPUT                                          PAGE 18

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 690          LG    .350    .350   3.910    .480    .000
 691          UC    .483    .520
 692          UA       0       3       5       8      12      20      43      75      90      96
 693          UA     100
              * DDM   ***** Preserved *****

 694          KK    C310
 695          KM   HYDROGRAPH COMBINATION OF SUB-BASINS 350 & 310
 696          HC       2    1.04
              * DDM   ***** Preserved *****

 697          KK    R310
 698          KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
 699          KM   ROUTING OF FLOW FROM SUB-BASIN 310 TO 320B
 700          RS      10    FLOW      -1
 701          RC    .045    .035    .045    8550    .022
 702          RX       0       1      40      46      56      62     102     103
 703          RY       3       2       2       0       0       2       2       3
              *
              * DDM   ***** Updated *****

 704          KK    305B
 705          KM   SUB-BASIN 305B
 706          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 707          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
 708          KM     L = 1.70  Kb = .047  Adj. Slope =  124.0
 709          BA    .386
 710          LG    .350    .350   4.500    .350    .000
 711          UC    .492    .443
 712          UA       0       3       5       8      12      20      43      75      90      96
 713          UA     100
              *
```

```
                 * DDM   ***** Preserved *****

714              KK   R305B
715              KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
716              KM   ROUTING OF FLOW FROM SUB-BASINS 305B TO SUB-BASIN 320B2.
717              RS       3    FLOW      -1
718              RC    .045    .035    .045    1700    .016
719              RX       0       1      40      46      56      62     102     103
720              RY       3       2       2       0       0       2       2       3
                 *
                 * DDM   ***** Updated *****

721              KK   320B2
722              KM   SUB-BASIN 320B2
723              KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
724              KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
725              KM     L = 1.08  Kb = .050  Adj. Slope =  120.0
726              BA    .220
727              LG    .300    .270   4.500    .380   9.000
728              UC    .375    .314
729              UA       0       5      16      30      65      77      84      90      94      97
730              UA     100
                 *
                 * DDM   ***** Preserved *****
1                                          HEC-1 INPUT                                          PAGE 19

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


731              KK  D320B2
732              KM        DIVERT FLOW INTO ONLINE  DETENTION BASIN
733              KM   DETENTION/RETENTION BASINS LOCATED WITHIN THREE SUBDIVISIONS
734              KM   SIERRA HEIGHTS       FALCON RIDGE    & MARBLE CREEK
735              KM        MAXIMUM VOLUME DIVERSION =  3.32acre-feet
736              DT  B320B2    3.32
737              DI       0   10000
738              DQ       0   10000
                 * DDM   ***** Preserved *****

739              KK  T320B2
740              KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
741              DR  B320B2
                 * DDM   ***** Preserved *****

742              KK  S320B2
743              KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
744              KM   3.32 ACRE-FEETx43560/36x3600=1.2cfs
745              RS       1    STOR       0
746              SV       0     .01     3.3     5.0
747              SQ       0     0.5     1.2    15.0
                 *
                 * DDM   ***** Preserved *****

748              KK  C320B2
749              KM    Combine R305B, R310 and 320B2
750              HC       4
                 *
                 * DDM   ***** Preserved *****
```

```
751          KK  R320B2
752          KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
753          KM   ROUTING OF FLOW FROM SUB-BASINS 320B2 TO SUB-BASIN 340B.
754          RS       2    FLOW      -1
755          RC    .045    .035    .045    1000    .016
756          RX       0       1      40      46      56      62     102     103
757          RY       5       2       2       0       0       2       2       5
             *
             * DDM   ***** Updated *****

758          KK    340B
759          KM   SUB-BASIN 340B
760          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
761          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
762          KM     L =  .85  Kb = .049  Adj. Slope =  238.5
763          BA    .290
764          LG    .280    .250   4.000    .560  23.000
765          UC    .242    .136
766          UA       0       5      16      30      65      77      84      90      94      97
767          UA     100
             *
             * DDM   ***** Preserved *****
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


768          KK   D340B
769          KM        DIVERT FLOW INTO ONLINE  DETENTION BASIN
770          KM   DETENTION/RETENTION BASINS LOCATED WITHIN THREE SUBDIVISIONS
771          KM   GRANDVIEW ESTATES    BOULDER MOUNTAIN & 33% OF MESA HIGHLANDS
772          KM        MAXIMUM VOLUME DIVERSION = 15.6 acre-feet
773          DT  BS340B    15.6
774          DI       0   10000
775          DQ       0   10000
             * DDM   ***** Preserved *****

776          KK  RT340B
777          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
778          DR  BS340B
             * DDM   ***** Preserved *****

779          KK   S340B
780          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
781          KM    15.6 ACRE-FEETx43560/36x3600= 5.2cfs
782          RS       1    STOR       0
783          SV       0     .01    15.6      20
784          SQ       0     1.0     5.2      50
             * DDM   ***** Preserved *****

785          KK   C340B
786          KM   HYDROGRAPH COMBINATION
787          HC       3
             *
             * DDM   ***** Preserved *****

788          KK  DD340B
```

```
789          KM   DIVERT FLOW INTO OFFLINE DETENTION BASIN LOCATED WITHIN SUB-BASINS 340B.
790          DT   BS340
791          DI       0     200    1000    2000    5000
792          DQ       0       0     800    1800    4800
             * DDM   ***** Preserved *****

793          KK   RT340
794          KM   RETRIEVE FLOW FROM DIVERSION
795          DR   BS340
             * DDM   ***** Preserved *****

796          KK  SS340B
797          KM   RETRIEVE FLOW INTO OFFLINE BASIN AND BLEED OFF WITHIN 36 HOURS.
798          KM      55 ACRE-FEETx43560/36x3600 = 19cfs
799          RS       1    STOR       0
800          SV       0     .01      55      60
801          SQ       0     3.0      50     100
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

802          KK  CD340B
803          KM   HYDROGRAPH COMBINATION
804          HC       2
             * DDM   ***** Preserved *****

805          KK   RT350
806          KM   RETRIEVE SPLIT FLOW FROM DIVERSION OF SUB-BASIN 350
807          DR   SF350
             * DDM   ***** Preserved *****

808          KK   RR350
809          KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
810          KM   ROUTING OF FLOW FROM SPLIT OF SUB-BASIN 350 TO 355
811          RS       7    FLOW      -1
812          RC    .045    .035    .045    6050    .025
813          RX       0       1      40      46      56      62     102     103
814          RY       3       2       2       0       0       2       2       3
             *
             * DDM   ***** Updated *****

815          KK     355
816          KM   SUB-BASIN 355
817          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
818          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .996
819          KM     L = 3.00  Kb = .044  Adj. Slope =  284.0
820          BA    .676
821          LG    .340    .340   4.450    .370   4.000
822          UC    .488    .502
823          UA       0       3       5       8      12      20      43      75      90      96
824          UA     100
             * DDM   ***** Preserved *****

825          KK    C355
826          KM   HYDROGRAPH COMBINATION OF SUB-BASIN 355 AND THE SPLIT FLOW FROM SUB-BASIN 350
827          HC       2  1.1745
```

```
                 *
                 * DDM   ***** Preserved *****

828              KK    D355
829              KM        DIVERT FLOW INTO OFFLINE BASIN
830              KM        MAXIMUM VOLUME DIVERSION = 18 acre-feet
831              DT   BS355
832              DI       0     100     450    1000    2000    5000
833              DQ       0       0       0     550    1550    4550
                 *
                 * DDM   ***** Preserved *****

834              KK   RT355
835              KM   RETRIEVE FLOW FROM DIVERSION INTO OFFLINE BASIN
836              DR   BS355
                 *
                 * DDM   ***** Preserved *****
1                                          HEC-1 INPUT                                                PAGE 22

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


837              KK    S355
838              KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
839              KM   18.0 ACRE-FEETx43560/36x3600= 6.0CFS
840              RS       1    STOR       0
841              SV       0     .01    18.0    25.0
842              SQ       0     2.0      40      50
                 *
                 * DDM   ***** Preserved *****

843              KK   CC355
844              KM   HYDROGRAPH COMBINATION
845              HC       2
                 *
                 * DDM   ***** Preserved *****

846              KK    R355
847              KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
848              KM   ROUTING OF FLOW FROM SUB-BASIN 355 TO SUB-BASIN 340B
849              RS       1    FLOW      -1
850              RC    .045    .035    .045    4000    .025
851              RX       0       1      40      46      56      62     102     103
852              RY       3       2       2       0       0       2       2       3
                 *
                 * DDM   ***** Preserved *****

853              KK  CC340B
854              KM   HYDROGRAPH COMBINATION
855              HC       2
                 * DDM   ***** Preserved *****

856              KK   R340B
857              KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
858              KM   ROUTING OF FLOW FROM SUB-BASIN 340B TO SUB-BASIN 340A2.
859              RS       2    FLOW      -1
860              RC    .045    .035    .045    1500    .027
861              RX       0       1      40      46      56      62     102     103
```

```
862          RY       3       2       2       0       0       2       2       3
             *
             * DDM   ***** Updated *****

863          KK   340A2
864          KM   SUB-BASIN 340A2
865          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
866          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
867          KM     L =  .48  Kb = .047  Adj. Slope =  297.9
868          BA    .037
869          LG    .230    .310   5.300    .250  55.000
870          UC    .158    .174
871          UA       0       5      16      30      65      77      84      90      94      97
872          UA     100
             *
             * DDM   ***** Preserved *****
1                                        HEC-1 INPUT                                          PAGE 23

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


873          KK  D340A2
874          KM        DIVERT FLOW INTO ONLINE  DETENTION BASIN
875          KM        MAXIMUM VOLUME DIVERSION = 2.2 acre-feet
876          DT  B340A2     2.2
877          DI       0   10000
878          DQ       0   10000
             * DDM   ***** Preserved *****

879          KK  T340A2
880          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
881          DR  B340A2
             * DDM   ***** Preserved *****

882          KK  S340A2
883          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
884          KM    2.20 ACRE-FEETx43560/36x3600= 1.0cfs
885          RS       1    STOR       0
886          SV       0     .01     2.2     5.0
887          SQ       0     0.5     1.0    10.0
             * DDM   ***** Preserved *****

888          KK  C340A2
889          KM   HYDROGRAPH COMBINATION
890          HC       3
             *
             * DDM   ***** Preserved *****

891          KK  R340A2
892          KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
893          KM   ROUTING OF FLOW FROM SUB-BASIN 340A2 TO SUB-BASIN 320B.
894          RS       5    FLOW      -1
895          RC    .045    .035    .045    4500    .020
896          RX       0       1      40      46      56      62     102     103
897          RY       3       2       2       0       0       2       2       3
             *
             * DDM   ***** Preserved *****
```

```
898          KK  CC320B
899          KM   HYDROGRAPH COMBINATION
900          HC       2
             *
             * DDM   ***** Preserved *****

901          KK   R320B
902          KM   Routing Flow from 320B1 to 320A
903          KM   Routing length updated using Signal Butte Floodway plans dated March 1983
904          KM   CHANNEL GEOMETRY FOR SPOOK HILL FRS OBTAINED FROM AS-BUILTS PLANS.
905          KM   CONTINUE TO ROUTE FLOW WITHIN CONCRETE CHANNEL TO SPOOK HILL FRS
906          RS       1    FLOW      -1
907          RC    .016    .016    .016    1500   .0146
908          RX       0       1       2     2.1    16.1    16.2      17      18
909          RY     7.5     7.5     7.5       0       0     7.5     7.5     7.5
             *
             * DDM   ***** Updated *****
1                                    HEC-1 INPUT                                          PAGE 24

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


910          KK    320A
911          KM   SUB-BASIN 320A
912          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
913          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
914          KM     L = 1.07  Kb = .049  Adj. Slope =   93.0
915          BA    .270
916          LG    .280    .250   4.300    .490  25.000
917          UC    .404    .301
918          UA       0       5      16      30      65      77      84      90      94      97
919          UA     100
             *
             * DDM   ***** Preserved *****

920          KK   D320A
921          KM        DIVERT FLOW INTO ONLINE  DETENTION BASIN
922          KM   DETENTION/RETENTION BASINS LOCATED WITHIN THREE SUBDIVISIONS
923          KM   GRANDVIEW ESTATES    BOULDER MOUNTAIN & 33% OF MESA HIGHLANDS
924          KM        MAXIMUM VOLUME DIVERSION = 11.8 acre-feet
925          DT  BS320A    11.8
926          DI       0   10000
927          DQ       0   10000
             * DDM   ***** Preserved *****

928          KK  RT320A
929          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
930          DR  BS320A
             * DDM   ***** Preserved *****

931          KK   S320A
932          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
933          KM    11.8 ACRE-FEETx43560/36x3600= 4.0cfs
934          RS       1    STOR       0
935          SV       0     .01    11.8      20
936          SQ       0     1.0     4.0    40.0
             * DDM   ***** Preserved *****
```

```
937          KK    C320
938          KM   HYDROGRAPH COMBINATION
939          HC       3
             *
             * DDM   ***** Updated *****

940          KK   340A1
941          KM   SUB-BASIN 340A1
942          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
943          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .993
944          KM     L = 1.80  Kb = .045  Adj. Slope =  117.0
945          BA   1.089
946          LG    .250    .250   4.150    .560  24.000
947          UC    .500    .261
948          UA       0       5      16      30      65      77      84      90      94      97
949          UA     100
             *
             * DDM   ***** Preserved *****
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

950          KK  D340A1
951          KM        DIVERT FLOW INTO ONLINE  DETENTION BASIN
952          KM   DETENTION/RETENTION BASINS LOCATED WITHIN THREE SUBDIVISIONS
953          KM   GRANDVIEW ESTATES    BOULDER MOUNTAIN & 33% OF MESA HIGHLANDS
954          KM        MAXIMUM VOLUME DIVERSION = 91.9 acre-feet
955          DT  B340A1    91.9
956          DI       0   10000
957          DQ       0   10000
             * DDM   ***** Preserved *****

958          KK  T340A1
959          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
960          DR  B340A1
             * DDM   ***** Preserved *****

961          KK  S340A1
962          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
963          KM    91.9 ACRE-FEETx43560/36x3600=30.9cfs
964          RS       1    STOR       0
965          SV       0     .01    91.9     120
966          SQ       0     3.0    20.9     300
             *
             * DDM   ***** Preserved *****

967          KK  C340A1
968          KM   HYDROGRAPH COMBINATION FOR SPOOK HILL FRS
969          HC       2
             *
             * DDM   ***** Preserved *****

970          KK    C340
971          KM   HYDROGRAPH COMBINATION FOR SPOOK HILL FRS
972          HC       2
             *
             * DDM   ***** Updated *****
```

```
 973          KK     360
 974          KM   SUB-BASIN 360
 975          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
 976          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .995
 977          KM     L = 2.10  Kb = .044  Adj. Slope =  124.0
 978          BA    .880
 979          LG    .260    .250   4.100    .570  23.000
 980          UC    .538    .362
 981          UA       0       5      16      30      65      77      84      90      94      97
 982          UA     100
              * DDM   ***** Preserved *****

 983          KK    D360
 984          KM        DIVERT FLOW INTO ONLINE  DETENTION BASIN
 985          KM   DETENTION/RETENTION BASINS LOCATED WITHIN 33% OF MESA HIGHLANDS
 986          KM        MAXIMUM VOLUME DIVERSION = 49.5 acre-feet
 987          DT   BS360    49.5
 988          DI       0   10000
1                                        HEC-1 INPUT                                          PAGE 26

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 989          DQ       0   10000
              * DDM   ***** Preserved *****

 990          KK   RT360
 991          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
 992          DR   BS360
              * DDM   ***** Preserved *****

 993          KK    S360
 994          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
 995          KM    49.5 ACRE-FEETx43560/36x3600=16.6 cfs
 996          RS       1    STOR       0
 997          SV       0     .01    49.5      70
 998          SQ       0     3.0    16.6     150
              * DDM   ***** Preserved *****

 999          KK    C360
1000          KM   HYDROGRAPH COMBINATION FOR SPOOK HILL FRS
1001          HC       3
              *
              * DDM   ***** Updated *****

1002          KK    380A
1003          KM   SUB-BASIN 380A
1004          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1005          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
1006          KM     L =  .66  Kb = .076  Adj. Slope =   91.0
1007          BA    .261
1008          LG    .170    .250   4.100    .710  21.000
1009          UC    .425    .221
1010          UA       0       3       5       8      12      20      43      75      90      96
1011          UA     100
              *
              * DDM   ***** Preserved *****
```

```
1012          KK   C380A
1013          KM   HYDROGRAPH COMBINATION FOR SPOOK HILL FRS
1014          HC       2
              *
              * DDM   ***** Updated *****

1015          KK    400A
1016          KM   SUB-BASIN 400A
1017          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1018          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
1019          KM     L =  .28  Kb = .094  Adj. Slope =   71.0
1020          BA    .048
1021          LG    .250    .290   4.000    .640    .000
1022          UC    .317    .211
1023          UA       0       3       5       8      12      20      43      75      90      96
1024          UA     100
              *
              * DDM   ***** Preserved *****
1                                          HEC-1 INPUT                                          PAGE 27

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1025          KK   C400A
1026          KM   HYDROGRAPH COMBINATION FOR SPOOK HILL FRS
1027          HC       2
              *
              * ***************************************************************************
              * ***************************************************************************
              *                    BEGIN OF MODIFICATION BY GAVAN BARKER INC.
              *                    OAK STREET BASIN AND STORM DRAIN HYDROLOGY
              *                                  APRIL 2010
              * ***************************************************************************
              * ***************************************************************************
              *
              * KK   370
              * KM SUB-BASIN 370
              * KM 24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
              * KM THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .996
              * KM   L = 1.90  Kb = .044  Adj. Slope =  203.5
              * BA  .672
              * LG  .340    .320   4.650    .330   8.000
              * UC  .404    .284
              * UA     0       3       5       8      12      20      43      75      90
              * UA   100
              *

1028          KK    370A   BASIN
1029          KM        SUB-BASIN 370A
1030          KM        TC & R CALCULATED WITH DDMSW VERSION 4.1.9
1031          KM        L = 0.97    Kb = 0.093      Adj. Slope = 302.0
1032          BA   0.299
1033          LG    0.35    0.40    6.00    0.18      14
1034          UC   0.447   0.294
1035          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
1036          UA     100

1037          KK   D370A  DIVERT
```

```
1038          KM        UPON FIELD INVESTIGATION: 25% OF THE FLOW FROM SUB-BASIN 370A WAS DEEMED
1039          KM        TO DIVERT INTO SUB-BASIN 385A WHILE THE REMAINING FLOW GOES INTO
1040          KM        SUB-BASIN 370B.
1041          KM        REMAINING HYDROGRAPH (D370A) ROUTED THROUGH SUB-BASIN 370B (RD370A).
1042          KM        DIVERTED HYDROGRAPH (DIV1) ROUTED TO DIVERSION DDIV1 (RDIV1).
1043          DT    DIV1     0.0     0.0
1044          DI     0.0   100.0  1000.0
1045          DQ     0.0    25.0   250.0
              *

1046          KK  RD370A   ROUTE
1047          KM        ROUTED FLOW FROM D370 TO CP370B.
1048          KM        CHANNEL GEOMETRY OBTAINED FROM 2' AND 10' CONTOURS.
1049          RS       5    FLOW
1050          RC   0.045   0.035   0.045   10080  0.0347    0.00
1051          RX    0.00    1.00   41.00   47.00   67.00   73.00  113.00  114.00
1052          RY    3.00    2.00    2.00    0.00    0.00    2.00    2.00    3.00
              *
1                                          HEC-1 INPUT                                          PAGE 28

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1053          KK    370B   BASIN
1054          KM        SUB-BASIN 370B
1055          KM        TC & R CALCULATED WITH DDMSW VERSION 4.1.9
1056          KM        L = 1.91    Kb = 0.046      Adj. Slope = 183.3
1057          BA   0.497
1058          LG    0.33    0.32    4.45    0.39       8
1059          UC   0.541   0.468
1060          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
1061          UA     100
              *

1062          KK  CP370B COMBINE
1063          KM        COMBINE ROUTED HYDROGRAPH FROM DIVERSION D370A WITH
1064          KM        RUNOFF HYDROGRAPH FROM SUB-BASIN 370B.
1065          HC       2
              *
              * ***************************************************************************
              * ***************************************************************************
              *                     END OF MODIFICATION BY GAVAN BARKER INC.
              *                    OAK STREET BASIN AND STORM DRAIN HYDROLOGY
              *                                  APRIL 2010
              * ***************************************************************************
              * ***************************************************************************
              *

1066          KK    S370
1067          KM   Online Detention Basin at Madrid Subdivision
1068          KM   Basin Bottom Elevation = 1822.9 ft
1069          KM   Route through 24" pipe for 404 low flow and
1070          KM   Route through 72" pipe to west along McDowell
1071          KM   2-8'x3' RCBC as emergency spillway
1072          RS       1    STOR       0
1073          SV       0    1.37    3.61    5.97    8.46   11.07   13.81   16.69   19.72
1074          SE     0.9     2.0     3.0     4.0     5.0     6.0     7.0     8.0     9.0
1075          SQ     0.0      98     157     221     270     313     350     380     800
```

```
                *

1076            KK    D370
1077            KM   Split the out flow to pipe along McDowell Road and to Madrid subdivision
1078            DT   B370W
1079            DI     0.0      98     157     221     270     313     350     380     800
1080            DQ       0      89     141     199     243     282     315     340     380
                *

1081            KK   R370S
1082            KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
1083            KM   ROUTING FLOW to SUB-BASINS 380B1
1084            RS      12    FLOW      -1
1085            RC    .045    .035    .045    8800    .023
1086            RX       0       1      40      46      56      62     102     103
1087            RY       3       2       2       0       0       2       2       3
                *
```



```
LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1088            KK   380B1
1089            KM   SUB-BASIN 380B1
1090            KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1091            KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
1092            KM     L = 1.61  Kb = .047  Adj. Slope =  124.0
1093            BA    .369
1094            LG    .300    .250   4.200    .520  16.000
1095            UC    .471    .414
1096            UA       0       5      16      30      65      77      84      90      94      97
1097            UA     100
                *

1098            KK  D380B1
1099            KM        DIVERT FLOW INTO ONLINE  DETENTION BASIN
1100            KM   DETENTION/RETENTION BASINS LOCATED WITHIN MESA HIGHLANDS
1101            KM        MAXIMUM VOLUME DIVERSION = 10.5 acre-feet
1102            DT  B380B1    10.5
1103            DI       0   10000
1104            DQ       0   10000
                *

1105            KK  T380B1
1106            KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
1107            DR  B380B1
                *

1108            KK  S380B1
1109            KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
1110            KM    10.5 ACRE-FEETx43560/36x3600=3.5cfs
1111            RS       1    STOR       0
1112            SV       0     .01    10.5    20.0
1113            SQ       0     1.0     3.5    50.0
                *

1114            KK  C380B1
1115            KM   HYDROGRAPH COMBINATION
```

```
1116          HC       3
              *

1117          KK  R380B1
1118          KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
1119          KM   ROUTING OF FLOW FROM SUB-BASINS 380B1 TO SUB-BASIN 400B1.
1120          RS       7    FLOW      -1
1121          RC    .045    .035    .045    2600    .023
1122          RX       0       1      40      46      56      62     102     103
1123          RY       3       2       2       0       0       2       2       3
              *
              * DDM   ***** Updated *****
1                                          HEC-1 INPUT                                                    PAGE 30

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1124          KK   400B1
1125          KM   SUB-BASIN 400B1
1126          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1127          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
1128          KM     L =  .93  Kb = .057  Adj. Slope =   91.0
1129          BA    .385
1130          LG    .280    .250   4.100    .590  12.000
1131          UC    .433    .238
1132          UA       0       5      16      30      65      77      84      90      94      97
1133          UA     100
              *
              * DDM   ***** Preserved *****

1134          KK  D400B1
1135          KM        DIVERT FLOW INTO ONLINE  DETENTION BASIN
1136          KM   DETENTION/RETENTION BASIN LOCATED WITHIN SAGUARO VISTA SUBDIVISION
1137          KM        MAXIMUM VOLUME DIVERSION = 5.6 ACRE-FEET
1138          DT  B400B1     5.6
1139          DI       0   10000
1140          DQ       0   10000
              * DDM   ***** Preserved *****

1141          KK  T400B1
1142          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
1143          DR  B400B1
              * DDM   ***** Preserved *****

1144          KK  S400B1
1145          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
1146          KM     5.6 ACRE-FEETx43560/36x3600 = 2 cfs
1147          RS       1    STOR       0
1148          SV       0     .01     5.6    10.0
1149          SQ       0       1       2    20.0
              * DDM   ***** Preserved *****

1150          KK  C400B1
1151          KM   HYDROGRAPH COMBINATION FOR SPOOK HILL FRS
1152          HC       2
              * DDM   ***** Preserved *****

1153          KK  CC400B
```

```
1154          KM   HYDROGRAPH COMBINATION FOR SPOOK HILL FRS
1155          HC       3
              *
              * DDM   ***** Updated *****

1156          KK   420A2
1157          KM   SUB-BASIN 420A2
1158          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1159          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
1160          KM     L =  .26  Kb = .064  Adj. Slope =   96.0
1161          BA    .022
1162          LG    .350    .350   4.150    .430    .000
1163          UC    .208    .194
1                                   HEC-1 INPUT                                          PAGE 31

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1164          UA       0       5      16      30      65      77      84      90      94      97
1165          UA     100
              *
              * DDM   ***** Preserved *****

1166          KK  C400A2
1167          KM   HYDROGRAPH COMBINATION FOR SPOOK HILL FRS
1168          HC       2
              *

1169          KK   T370W
1170          KM   RETRIEVE FLOW FROM DIVERSION of ONLINE BASIN
1171          DR   B370W
              *

1172          KK   R370W
1173          KM   ROUTING OF FLOW FROM SUB-BASINS 370W TO Hawes along McDowell.
1174          RS       5    FLOW      -1
1175          RC    .045    .035    .045    3200    .023
1176          RX       0       1      40      46      56      62     102     103
1177          RY       3       2       2       0       0       2       2       3
              *
              * ***********************************************************************
              * ***********************************************************************
              *                    BEGIN OF MODIFICATION BY GAVAN BARKER INC.
              *                    OAK STREET BASIN AND STORM DRAIN HYDROLOGY
              *                                  APRIL 2010
              * ***********************************************************************
              * ***********************************************************************
              *
              * KK  395A
              * KM SUB-BASIN 395A
              * KM 24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
              * KM THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
              * KM   L = 1.48  Kb = .051  Adj. Slope =  216.6
              * BA  .187
              * LG  .310    .270   4.800    .300   9.000
              * UC  .358    .421
              * UA     0       5      16      30      65      77      84      90      94
              * UA   100
              * DDM   ***** Preserved *****
```

```
                 *

1178             KK   D370ARETRIEVE
1179             KM        RETRIEVE FLOW FROM D370A DIVERSION
1180             DR    DIV1
                 *

1181             KK   RDIV1   ROUTE
1182             KM        ROUTE RETRIEVED DIVERSION DIV1 TO DIVERSION DDIV1.
1183             RS       5    FLOW
1184             RC   0.045   0.040   0.045    1420  0.0563    0.00
1185             RX    0.00   20.00   30.00   40.00   70.00   80.00  100.00  110.00
1186             RY    8.00    6.00    5.00    0.00    0.00    5.00    6.00    8.00
                 *
```



```
LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1187             KK   DDIV1  DIVERT
1188             KM        UPON FIELD INVESTIGATION: 50% OF THE FLOW FROM THE ROUTED DIVERT RDIV1
1189             KM        WAS DEEMED TO DIVERT INTO SUB-BASIN 385A WHILE THE REMAINING FLOW GOES
1190             KM        INTO SUB-BASIN 395A.
1191             KM        REMAINING HYDROGRAPH (DDIV1) ROUTED THROUGH SUB-BASIN 395A (RDDIV1).
1192             KM        DIVERTED HYDROGRAPH (DIV2) ROUTED TO CP385A (RDIV2).
1193             DT    DIV2     0.0     0.0
1194             DI     0.0   100.0  1000.0
1195             DQ     0.0    50.0   500.0
                 *

1196             KK  RDDIV1   ROUTE
1197             KM        ROUTED FLOW FROM DDIV1 TO CP395A
1198             KM        CHANNEL GEOMETRY OBTAINED FROM 2' AND 10' CONTOURS.
1199             RS       5    FLOW
1200             RC   0.045   0.040   0.045    6990  0.0375    0.00
1201             RX    0.00    1.00   40.00   46.00   71.00   77.00  117.00  118.00
1202             RY    3.00    2.50    2.00    0.00    0.00    2.00    2.50    3.00
                 *

1203             KK    395A   BASIN
1204             KM        SUB-BASIN 395A
1205             KM        TC & R CALCULATED WITH DDMSW VERSION 4.1.9
1206             KM        L = 1.32    Kb = 0.051      Adj. Slope = 203.7
1207             BA   0.192
1208             LG    0.31    0.27    4.90    0.34      18
1209             UC   0.434   0.469
1210             UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
1211             UA     100
                 *

1212             KK  CP395A COMBINE
1213             KM        COMBINE ROUTED HYDROGRAPH FROM DIVERSION DDIV1 WITH
1214             KM        RUNOFF HYDROGRAPH FROM SUB-BASIN 395A.
1215             HC       2
                 *
                 * ***************************************************************************
                 * ***************************************************************************
                 *                     END OF MODIFICATION BY GAVAN BARKER INC.
```

```
                 *                    OAK STREET BASIN AND STORM DRAIN HYDROLOGY
                 *                                APRIL 2010
                 * ***************************************************************************
                 * ***************************************************************************
                 *

1216             KK  R390C1
1217             KM   Route runoff from subbasin 395A through Thunder Mountain subdivision
1218             KM   to concentration point 390C
1219             KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
1220             RS       3    FLOW      -1
1221             RC   0.045   0.035   0.045    1600   0.032
1222             RX       0       5      10      22      40      45      60      90
1223             RY       4       3       2       0       0       2       3       4
                 * DDM   ***** Updated *****
1                                          HEC-1 INPUT                                          PAGE 33

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1224             KK    395B
1225             KM   SUB-BASIN 395B
1226             KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1227             KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
1228             KM     L =  .18  Kb = .075  Adj. Slope =  167.0
1229             BA    .004
1230             LG    .300    .250   5.100    .270   5.000
1231             UC    .150    .266
1232             UA       0       5      16      30      65      77      84      90      94      97
1233             UA     100
                 * DDM   ***** Preserved *****

1234             KK  R390C2
1235             KM   Route runoff hydrograph from 395B to concentration point 390C in existing
1236             KM   channel along McDowell Road
1237             KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
1238             RS       3    FLOW      -1
1239             RC   0.045   0.035   0.045    1380   0.027
1240             RX       0       1       3       6      28      31      34      37
1241             RY       2       2       1       0       0       1       2       3
                 * DDM   ***** Updated *****

1242             KK    390C
1243             KM   SUB-BASIN 390C
1244             KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1245             KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
1246             KM     L =  .53  Kb = .054  Adj. Slope =  162.0
1247             BA    .121
1248             LG    .300    .250   5.300    .290  20.000
1249             UC    .221    .139
1250             UA       0       5      16      30      65      77      84      90      94      97
1251             UA     100
                 * DDM   ***** Preserved *****

1252             KK  CP390C
1253             KM   Combine routed hydrographs from 395A, 395B, with runoff hydrograph from
1254             KM   subbasin 390C
1255             HC       3
```

```
                    * DDM   ***** Preserved *****
                    *
                    * ************************************************************************
                    * ************************************************************************
                    *                    BEGIN OF MODIFICATION BY GAVAN BARKER INC.
                    *                    OAK STREET BASIN AND STORM DRAIN HYDROLOGY
                    *                                APRIL 2010
                    * ************************************************************************
                    * ************************************************************************
                    *
1                                                HEC-1 INPUT                                                    PAGE 34

          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          1256      KK    385A   BASIN
          1257      KM        SUB-BASIN 385A
          1258      KM        TC & R CALCULATED WITH DDMSW VERSION 4.1.9
          1259      KM        L = 0.70    Kb = 0.080      Adj. Slope = 313.0
          1260      BA   0.313
          1261      LG    0.34    0.34    5.60    0.23      17
          1262      UC   0.346   0.166
          1263      UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          1264      UA     100
                    *

          1265      KK   DDIV1RETRIEVE
          1266      KM        RETRIEVE FLOW FROM DDIV1 DIVERSION
          1267      DR    DIV2
                    *

          1268      KK   RDIV2   ROUTE
          1269      KM        ROUTED FLOW FROM DIV2 TO CP385A
          1270      KM        CHANNEL GEOMETRY OBTAINED FROM 2' AND 10' CONTOURS.
          1271      RS       5    FLOW
          1272      RC   0.045   0.040   0.045    4770  0.0465    0.00
          1273      RX    0.00    1.00   40.00   46.00   66.00   72.00  112.00  113.00
          1274      RY    3.00    2.00    2.00    0.00    0.00    2.00    2.00    3.00
                    *

          1275      KK    385B   BASIN
          1276      KM        SUB-BASIN 385B
          1277      KM        TC & R CALCULATED WITH DDMSW VERSION 4.1.9
          1278      KM        L = 0.49    Kb = 0.114      Adj. Slope = 313.0
          1279      BA   0.044
          1280      LG    0.35    0.39    6.20    0.16      20
          1281      UC   0.340   0.375
          1282      UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
          1283      UA     100
                    *

          1284      KK   D385B  DIVERT
          1285      KM        UPON FIELD INVESTIGATION: 50% OF THE FLOW FROM SUB-BASIN 385B WAS DEEMED
          1286      KM        TO DIVERT INTO SUB-BASIN 385C WHILE THE REMAINING 50% OF FLOW GOES INTO
          1287      KM        SUB-BASIN 385A.
          1288      KM        REMAINING HYDROGRAPH (D385B) ROUTED THROUGH SUB-BASIN 385A (RD385B).
          1289      KM        DIVERTED HYDROGRAPH (DIV3) ROUTED TO CP385C (RDIV3).
          1290      DT    DIV3     0.0     0.0
```

```
1291          DI     0.0   100.0  1000.0
1292          DQ     0.0    50.0   500.0
              *

1293          KK  RD385B   ROUTE
1294          KM        ROUTED FLOW FROM D385B TO CP385A
1295          KM        CHANNEL GEOMETRY OBTAINED FROM 2' AND 10' CONTOURS.
1296          RS       5    FLOW
1297          RC   0.045   0.040   0.045    4400  0.0482    0.00
1298          RX    0.00    1.00   40.00   46.00   66.00   72.00  112.00  113.00
1299          RY    3.00    2.00    2.00    0.00    0.00    2.00    2.00    3.00
              *
1                                          HEC-1 INPUT                                                    PAGE 35

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1300          KK  CP385A COMBINE
1301          KM        COMBINE ROUTED HYDROGRAPH FROM DIVERSION DIV2 AND D385B WITH
1302          KM        RUNOFF HYDROGRAPH FROM SUB-BASIN 385A.
1303          HC       3   0.66
              *

1304          KK   D385A  DIVERT
1305          KM        REMAINING HYDROGRAPH (D385A) STAYS WITHIN BASIN 385A
1306          KM        DIVERTED HYDROGRAPH (DIV4) SPLITS OUT OF BASIN 385A INTO BASIN 385D
1307          KM        REFER TO THE DESIGN DATA REPORT FOR THE CALCULATION OF THIS DIVERT.
1308          DT    DIV4     0.0     0.0
1309          DI     0.0    71.0  1000.0
1310          DQ     0.0    71.0   230.0
              *
              * KKDD385A  DIVERT
              * KM     REMAINING HYDROGRAPH (DD385A) IS THE FLOW THAT GETS TO THUNDER MOUNTAIN
              * KM     DIVERTED HYDROGRAPH (DIV5) IS COLLECTED IN THE OAK STREET STORM DRAIN
              * KM     INITIAL DIVERSION PLANNED TO BYPASS 25cfs THROUGH THE EXISTING WALL
              * KM     OPENING INTO THUNDER MOUNTAIN. NOT CONSIDERED (NO BYPASS) AS PART OF
              * KM     THE 60% OAK STREET BASIN AND STORM DRAIN DESIGN.
              * DT  DIV5     0.0     0.0
              * DI   0.0      25    1000
              * DQ   0.0       0     975
              *

1311          KK  DD385A  DIVERT
1312          KM        REMAINING HYDROGRAPH (DD385A) IS THE FLOW THAT GOES TO THUNDER MOUNTAIN
1313          KM        DIVERTED HYDROGRAPH (DIV5) IS COLLECTED IN THE OAK STREET STORM DRAIN
1314          KM        ORIGINAL PLAN WAS TO ALLOW THE INITIAL 25cfs TO BYPASS THE OAK STREET ST
1315          KM        DRAIN AND FLOW ACROSS OAK STREET INTO THE THUNDER MOUNTAIN SUB-DIVISION.
1316          KM        THIS APPROACH WAS CHANGED AT THE 60% DESIGN STAGE WHEREIN THE ENTIRE FLO
1317          KM        CAPTURED WITH THE OAK STREET STROM DRAIN WITH NO FLOW ALLOWED TO SPILL I
1318          KM        THUNDER MOUNTAIN
1319          DT    DIV5     0.0     0.0
1320          DI     0.0      25    1000
1321          DQ     0.0      25    1000
              *

1322          KK  R390C3   ROUTE
1323          KM        ROUTED FLOW FROM DD385A TO CC390C
1324          KM        CHANNEL GEOMETRY OBTAINED FROM 2' CONTOURS.
```

```
1325          RS       5    FLOW
1326          RC   0.045   0.035   0.045    2770  0.0303    0.00
1327          RX    0.00   10.00   30.00   45.00   65.00   80.00  100.00  110.00
1328          RY    2.50    2.50    1.50    0.00    0.00    1.50    2.50    2.50
              *

1329          KK  CC390C COMBINE
1330          KM        COMBINE ROUTED HYDROGRAPH FROM DIVERSION DD385A WITH
1331          KM        CONCENTRATION POINT CP390C
1332          HC       2
              *
              * ***********************************************************************
              * ***********************************************************************
              *                     END OF MODIFICATION BY GAVAN BARKER INC.
              *                    OAK STREET BASIN AND STORM DRAIN HYDROLOGY
              *                                  APRIL 2010
              * ***********************************************************************
              * ***********************************************************************
              *
1                                   HEC-1 INPUT                                          PAGE 36

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1333          KK   TOC-H
1334          KM   Divert into proposed storm drain for Culver-Hawes detention
1335          KM   basin.  Diversion determined by rating curve.
1336          DT  TO390B
1337          DI       0       8      29      86     244     457    1000
1338          DQ       0       0       0      31     159     342     885
              *
              *

1339          KK    C370
1340          KM   COMBINE FLOWS IN STORM DRAIN ALONG McDOWELL FROM LaMADRID BASIN AND THUNDER
1341          KM   MOUNTAIN BASIN
1342          HC       2    1.30
              *

1343          KK   R390S
1344          KM   Route Flow South to Subbasin 400B3.
1345          RS       2    FLOW      -1
1346          RC    .045    .045    .045    1000    .020
1347          RX       0       1      40      46      56      62     102     103
1348          RY       3       2       2       0       0       2       2       3
              *

1349          KK   400B3
1350          KM   SUB-BASIN 400B3
1351          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1352          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
1353          KM     L =  .26  Kb = .064  Adj. Slope =  135.0
1354          BA    .024
1355          LG    .300    .250   4.500    .430    .000
1356          UC    .183    .161
1357          UA       0       5      16      30      65      77      84      90      94      97
1358          UA     100
              *
```

```
1359          KK  D400B3
1360          KM        DIVERT FLOW INTO ONLINE  DETENTION BASIN
1361          KM   DETENTION/RETENTION BASIN LOCATED WITHIN SAGUARO VISTA SUBDIVISION
1362          KM        MAXIMUM VOLUME DIVERSION = 1.6 ACRE-FEET
1363          DT  B400B3     1.6
1364          DI       0   10000
1365          DQ       0   10000
              *

1366          KK  T400B3
1367          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
1368          DR  B400B3
              *
1                                          HEC-1 INPUT                                                    PAGE 37

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1369          KK  S400B3
1370          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
1371          KM     1.6 ACRE-FEETx43560/36x3600 = 1 cfs
1372          RS       1    STOR       0
1373          SV       0     .01     1.6     5.0
1374          SQ       0       1       1    10.0
              *

1375          KK  C400B3
1376          KM   HYDROGRAPH COMBINATION
1377          HC       2
              *

1378          KK   C390S
1379          KM   HYDROGRAPH COMBINATION of flow fron north of the Basin
1380          HC       2
              *

1381          KK   380B3
1382          KM   SUB-BASIN 380B3
1383          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1384          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
1385          KM     L =  .69  Kb = .054  Adj. Slope =  138.0
1386          BA    .123
1387          LG    .300    .250   4.350    .480  16.000
1388          UC    .279    .220
1389          UA       0       5      16      30      65      77      84      90      94      97
1390          UA     100
              *

1391          KK  D380B3
1392          KM        DIVERT FLOW INTO ONLINE  DETENTION BASIN
1393          KM        MAXIMUM VOLUME DIVERSION = 4.0 acre-feet
1394          DT  B380B3     4.0
1395          DI       0   10000
1396          DQ       0   10000
              *

1397          KK  T380B3
```

```
1398          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
1399          DR  B380B3
              *

1400          KK  S380B3
1401          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
1402          KM     4.0 ACRE-FEETx43560/36x3600= 2.cfs
1403          RS       1    STOR       0
1404          SV       0     .01     4.0     6.0
1405          SQ       0     0.5     2.0    20.0
              *
1                                   HEC-1 INPUT                                          PAGE 38

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1406          KK  C380B3
1407          KM   HYDROGRAPH COMBINATION
1408          HC       2
              *

1409          KK  D380B3
1410          KM   Subbasin 380B3 is Divided into 3 Smaller Areas
1411          KM   38% to 380B3a, 35% to 380B3b, and 27% to 380B3c
1412          DT  380B3c
1413          DI       0    1000
1414          DQ       0     270
              *

1415          KK  380B3b
1416          KM   Subbasin 380B3 is Divided into 3 Smaller Areas
1417          KM   38% to 380B3a, 35% to 380B3b, and 27% to 380B3c
1418          DT  380B3a
1419          DI       0    1000
1420          DQ       0     520
              *

1421          KK  C380BB
1422          KM   Total Basin Inflows from North and East Areas
1423          HC       2
              *

1424          KK   D380B
1425          KM   DIVERT FLOW INTO OFFLINE DETENTION BASIN LOCATED WITHIN SUB-BASINS
1426          KM   380B3b - Culver/Hawes basin
1427          DT  B38B3b
1428          DI       0      70    5000
1429          DQ       0       0    4930
              *

1430          KK  RT380B
1431          KM   RETRIEVE FLOW FROM DIVERSION
1432          DR  B38B3b
              *

1433          KK   S380B
1434          KM   RETRIEVE FLOW INTO OFFLINE BASIN AND BLEED OFF WITHIN 36 HOURS.
1435          RS       1    STOR       0
```

```
1436          SV       0     2.5     5.1    11.0    18.7    28.0    32.0
1437          SE       0     1.0     2.0     4.0     6.0     8.0     9.0
1438          SQ       0     6.2     8.8    15.3    20.0      25     250
              *

1439          KK  CC380B
1440          KM   HYDROGRAPH COMBINATION at outlet of Basin "S380B"
1441          HC       2
              *
1                                          HEC-1 INPUT                                                    PAGE 39

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1442          KK  R38B3b
1443          KM   ROUTING OF FLOW FROM BASIN TO SUB-BASIN 380B3c
1444          RS       3    FLOW      -1
1445          RC    .045    .035    .045    1300    .020
1446          RX       0       1      40      46      56      62     102     103
1447          RY       3       2       2       0       0       2       2       3
              *

1448          KK  T38B3a
1449          KM   RETRIEVE FLOW FROM DIVERSION of 380B3a
1450          DR  380B3a
              *

1451          KK  R38B3a
1452          KM   ROUTING OF FLOW FROM SUB-BASINS 380B3a TO SUB-BASIN 380B3c.
1453          RS       3    FLOW      -1
1454          RC    .045    .035    .045    1800    .020
1455          RX       0       1      40      46      56      62     102     103
1456          RY       3       2       2       0       0       2       2       3
              *

1457          KK  T38B3c
1458          KM   RETRIEVE FLOW FROM DIVERSION of 380B3c
1459          DR  380B3c
              *

1460          KK  C38B3c
1461          KM   HYDROGRAPH COMBINATION of 380B3c, 380B3a and flow from the Basin
1462          HC       3
              *

1463          KK  R380B3
1464          KM   ROUTING OF FLOW FROM SUB-BASINS 380B3c TO SUB-BASIN 380B2.
1465          RS       4    FLOW      -1
1466          RC    .045    .035    .045    2500    .020
1467          RX       0       1      40      46      56      62     102     103
1468          RY       3       2       2       0       0       2       2       3
              *

1469          KK   380B2
1470          KM   SUB-BASIN 380B2
1471          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1472          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
1473          KM     L =  .55  Kb = .055  Adj. Slope =  136.0
```

```
1474          BA    .096
1475          LG    .300    .250   3.950    .580  15.000
1476          UC    .250    .187
1477          UA       0       5      16      30      65      77      84      90      94      97
1478          UA     100
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1479          KK  C380B2
1480          KM   HYDROGRAPH COMBINATION
1481          HC       2
              *

1482          KK  R380B2
1483          KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
1484          KM   ROUTING OF FLOW FROM SUB-BASINS 380B2 TO SUB-BASIN 400B2.
1485          RS       9    FLOW      -1
1486          RC    .045    .035    .045    4000    .018
1487          RX       0       1      40      46      56      62     102     103
1488          RY       3       2       2       0       0       2       2       3
              *

1489          KK   400B2
1490          KM   SUB-BASIN 400B2
1491          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1492          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
1493          KM     L =  .93  Kb = .051  Adj. Slope =  118.0
1494          BA    .194
1495          LG    .300    .250   4.150    .530    .000
1496          UC    .363    .288
1497          UA       0       5      16      30      65      77      84      90      94      97
1498          UA     100
              *

1499          KK  C400B2
1500          KM   HYDROGRAPH COMBINATION
1501          HC       2
              *

1502          KK  R400B2
1503          KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
1504          KM   ROUTING OF FLOW FROM SUB-BASINS 400B2 TO SUB-BASIN 420A1.
1505          RS       3    FLOW      -1
1506          RC    .045    .035    .045    1800    .018
1507          RX       0       1      40      46      56      62     102     103
1508          RY       3       2       2       0       0       2       2       3
              *

1509          KK   420A1
1510          KM   SUB-BASIN 420A1
1511          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1512          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .997
1513          KM     L = 1.20  Kb = .044  Adj. Slope =  108.0
1514          BA    .566
1515          LG    .300    .270   4.250    .480  17.000
```

```
1516          UC    .387    .207
1517          UA       0       5      16      30      65      77      84      90      94      97
1518          UA     100
              *
1                                                HEC-1 INPUT                                                PAGE 41

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1519          KK  D420A1
1520          KM        DIVERT FLOW INTO ONLINE  DETENTION BASIN
1521          KM   DETENTION/RETENTION BASINS LOCATED WITHIN GRAY FOX SUBDIVISION
1522          KM        MAXIMUM VOLUME DIVERSION = 11.2 acre-feet
1523          DT  B420A1    11.2
1524          DI       0   10000
1525          DQ       0   10000
              *

1526          KK  T420A1
1527          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
1528          DR  B420A1
              *

1529          KK  S420A1
1530          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
1531          KM    11.2 ACRE-FEETx43560/36x3600= 4cfs
1532          RS       1    STOR       0
1533          SV       0     .01    11.2      20
1534          SQ       0     1.0     4.0      40
              *

1535          KK   C420A
1536          KM   HYDROGRAPH COMBINATION FOR SPOOK HILL FRS
1537          HC       4
              * DDM   ***** Preserved *****

1538          KK   R390B
1539          KM   Retrive Flows diverted from CP390C to existing Thunder Mountain detention
1540          KM   basin
1541          DR  TO390B

1542          KK  R390B1
1543          KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
1544          RS       3    FLOW      -1
1545          RC   0.020   0.020   0.020     430   0.019
1546          RX       0       3       6       9      26      30      34      38
1547          RY       3       2       1       0       0       1       2       3
              * DDM   ***** Updated *****
              *
              * ***************************************************************************
              * ***************************************************************************
              *                    BEGIN OF MODIFICATION BY GAVAN BARKER INC.
              *                    OAK STREET BASIN AND STORM DRAIN HYDROLOGY
              *                                  APRIL 2010
              * ***************************************************************************
              * ***************************************************************************
              *
              * KK  385C
```

```
* KM SUB-BASIN 385C
* KM 24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
* KM THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .997
* KM   L = 2.16  Kb = .039  Adj. Slope =  303.2
* BA  .501
* LG  .280    .380   5.600    .200  13.000
* UC  .333    .300
* UA     0       5      16      30      65      77      84      90      94
* UA   100
* DDM   ***** Updated *****
* KK  385B
* KM SUB-BASIN 385B
* KM 24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
* KM THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
* KM   L =  .82  Kb = .057  Adj. Slope =  280.2
* BA  .077
* LG  .340    .330   5.200    .250   6.000
* UC  .242    .281
* UA     0       5      16      30      65      77      84      90      94
* UA   100
* DDM   ***** Updated *****
* KK  385A
* KM SUB-BASIN 385A
* KM 24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
* KM THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
* KM   L =  .37  Kb = .065  Adj. Slope =  207.0
* BA  .018
* LG  .300    .250   4.150    .530  15.000
* UC  .196    .270
* UA     0       5      16      30      65      77      84      90      94
* UA   100
* DDM   ***** Updated *****
* KK  415B
* KM SUB-BASIN 415B
* KM 24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
* KM THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
* KM   L = 1.20  Kb = .049  Adj. Slope =  303.2
* BA  .276
* LG  .300    .250   5.000    .330  24.000
* UC  .262    .202
* UA     0       5      16      30      65      77      84      90      94
* UA   100
* KKCP415B
* KM Combine hydrographs from 385C and 385B with runoff hydrographs from 385A
* KM and 415B
* HC     4
*
* KK D415B
* KM DIVERT FLOW INTO OFFLINE DETENTION BASIN
* KM MAXIMUM STORAGE VOLUME FOR DIVERSION = 32 AC-FT @ 5' DEPTH.
* DTBS415B
* DI     0     150    5000
* 8DQ     0       0    4850
*
* DDM   ***** Preserved *****
* KKRT415B
* KM RETRIEVE FLOW FROM DIVERSION INTO OFFLINE BASIN
* DRBS415B
```

```
*
* DDM   ***** Preserved *****
* KK S415B
* KM RETRIEVE FLOW INTO OFFLINE BASIN AND BLEED OFF WITHIN 36 HOURS.
* KM    32 ACRE-FEETx43560/36x3600 = 11cfs
* RS     1    STOR       0
* SV     0     .01      32      40
* SQ     0       5      50      60
* DDM   ***** Preserved *****
*
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1548          KK    385C   BASIN
1549          KM        SUB-BASIN 385C
1550          KM        TC & R CALCULATED WITH DDMSW VERSION 4.1.9
1551          KM        L = 0.49    Kb = 0.102      Adj. Slope = 294.3
1552          BA   0.067
1553          LG    0.34    0.34    4.90    0.29      13
1554          UC   0.344   0.299
1555          UA       0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
1556          UA     100
              *

1557          KK   D385BRETRIEVE
1558          KM        RETRIEVE DIVERSION DIV3
1559          DR    DIV3
              *

1560          KK   RDIV3   ROUTE
1561          KM        ROUTED FLOW FROM DIV3 TO CP385C
1562          KM        CHANNEL GEOMETRY OBTAINED FROM 2' AND 10' CONTOURS.
1563          RS       5    FLOW
1564          RC   0.045   0.035   0.045    2010  0.0667    0.00
1565          RX    0.00    1.00   31.00   37.00   77.00   83.00  113.00  114.00
1566          RY    3.00    2.00    1.50    0.00    0.00    1.50    2.00    3.00
              *

1567          KK  CP385C COMBINE
1568          KM        COMBINE ROUTED HYDROGRAPH FROM DIVERSION DIV3 WITH
1569          KM        RUNOFF HYDROGRAPH FROM SUB-BASIN 385C.
1570          HC       2   0.11
              *

1571          KK   D385C  DIVERT
1572          KM        UPON FIELD INVESTIGATION AND INSPECTION OF G&D PLANS FOR THE GRANITE
1573          KM        MOUNTAIN SUBDIVISION: IT WAS DETERMINED THAT THE EXISTING CULVERTS
1574          KM        UNDER RANGE RIDER TRAIL WILL DISTRIBUTE THE FLOW AT CP385C EVENLY ACROSS
1575          KM        SUB-BASINS 385D AND 385G. THEREFORE THE DIVERSION IS 50%-50%.
1576          KM        REMAINING HYDROGRAPH (D385C) ROUTED THROUGH SUB-BASIN 385D (RD385C).
1577          KM        DIVERTED HYDROGRAPH (DIV6) ROUTED TO CP385G (RDIV6).
1578          DT    DIV6     0.0     0.0
1579          DI     0.0   100.0  1000.0
1580          DQ     0.0    50.0   500.0
              *
```

```
1581          KK  RD385C   ROUTE
1582          KM        ROUTED FLOW FROM D385C TO CP385D
1583          KM        CHANNEL GEOMETRY OBTAINED FROM 2' CONTOURS.
1584          RS       5    FLOW
1585          RC   0.045   0.035   0.045    2500  0.0392    0.00
1586          RX    0.00    5.00   30.00   50.00   70.00   90.00  105.00  110.00
1587          RY    3.00    2.00    2.00    0.00    0.00    2.00    2.00    3.00
              *
1                                          HEC-1 INPUT                                                PAGE 43

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1588          KK    385D   BASIN
1589          KM        SUB-BASIN 385D
1590          KM        TC & R CALCULATED WITH DDMSW VERSION 4.1.9
1591          KM        L = 0.70    Kb = 0.059      Adj. Slope = 254.0
1592          BA   0.052
1593          LG    0.31    0.27    5.20    0.29      13
1594          UC   0.320   0.424
1595          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
1596          UA     100
              *

1597          KK   D385ARETRIEVE
1598          KM        RETRIEVE DIVERSION DIV4
1599          DR    DIV4
              *

1600          KK   RDIV4   ROUTE
1601          KM        ROUTED FLOW FROM DIV4 TO CP385D
1602          KM        CHANNEL GEOMETRY OBTAINED FROM 2' CONTOURS.
1603          RS       5    FLOW
1604          RC   0.045   0.035   0.045    4450  0.0216    0.00
1605          RX    0.00    5.00   30.00   50.00   70.00   90.00  105.00  110.00
1606          RY    3.00    2.00    2.00    0.00    0.00    2.00    2.00    3.00
              *

1607          KK  CI385D COMBINE
1608          KM        COMBINE ROUTED HYDROGRAPH FROM DIVERSION DIV4 AND D385C WITH
1609          KM        RUNOFF HYDROGRAPH FROM SUB-BASIN 385D. THIS IS THE FLOW AT THE INLET,
1610          KM        USE THIS FLOW TO SIZE THE INLET AT THIS LOCATION.
1611          HC       3   0.78
              *

1612          KK  DD385ARETRIEVE
1613          KM        RETRIEVE DIVERSION DIV5
1614          DR    DIV5
              *

1615          KK   RDIV5   ROUTE
1616          KM        ROUTED FLOW FROM DIV5 TO CP385D
1617          KM        ROUTED IN PROPOSED OAK STREET STORM DRAIN
1618          RD     880  0.0220   0.012            CIRC   6.000
              *

1619          KK  CP385D COMBINE
1620          KM        COMBINE ROUTED HYDROGRAPH FROM DIVERSION DIV5 (FLOW INSIDE THE STORM
```

```
1621          KM        DRAIN) WITH CI385D (THE SURFACE FLOW TO BE PICKED UP BY THE STORM
1622          KM        DRAIN INLET). THIS IS THE TOTAL FLOW AT THIS LOCATION.
1623          HC       2   0.78
              *
1                                          HEC-1 INPUT                                                PAGE 44

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1624          KK   R385D   ROUTE
1625          KM        ROUTED FLOW FROM CP385D TO CP385E
1626          KM        ROUTED IN PROPOSED OAK STREET STORM DRAIN
1627          RD     830  0.0170   0.012            CIRC   7.000
              *

1628          KK    385E   BASIN
1629          KM        SUB-BASIN 385E
1630          KM        TC & R CALCULATED WITH DDMSW VERSION 4.1.9
1631          KM        L = 0.27    Kb = 0.067      Adj. Slope = 220.7
1632          BA   0.014
1633          LG    0.31    0.26    4.00    0.55      13
1634          UC   0.233   0.294
1635          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
1636          UA     100
              *

1637          KK  CP385E COMBINE
1638          KM        COMBINE ROUTED HYDROGRAPH FROM CP385D WITH
1639          KM        RUNOFF HYDROGRAPH FROM SUB-BASIN 385E.
1640          HC       2   0.79
              *
              * KK D385E  DIVERT
              * KM      REMAINING HYDROGRAPH (D385E) IS THE BASIN BYPASS FLOW
              * KM      DIVERTED HYDROGRAPH (DIV10) GOES INTO THE OAK STREET BASIN
              * KM      INITIAL PLANS CALLED FOR A OFFLINE BASIN, WHERE THE FIRST 100cfs
              * KM      FROM THE OAK STREET STORM DRAIN BYPASS THE BASIN AND CONTINUE TO THE
              * KM      HAWES ROAD CHANNEL.
              * DT DIV10     0.0     0.0
              * DI   0.0     100    1000
              * DQ   0.0       0     900
              *

1641          KK   D385E  DIVERT
1642          KM        REMAINING HYDROGRAPH (D385E) IS THE BASIN BYPASS FLOW
1643          KM        DIVERTED HYDROGRAPH (DIV10) GOES INTO THE OAK STREET BASIN
1644          KM        THE ORIGINAL PLAN WAS TO ALLOW THE INITIAL 100cfs TO BYPASS THE BASIN
1645          KM        IN A SMALLER STORM DRAIN AND FLOW DIRECTLY INTO THE HAWES ROAD CHANNEL.
1646          KM        THIS APPROACH WASCHANGED AT THE 60% DESIGN STAGE WHEREIN THE ENTIRE OAK
1647          KM        STREET STORM DRAIN FLOW IS DIVERTED TO THE OAK STREET BASIN.
1648          DT   DIV10     0.0     0.0
1649          DI     0.0     100    1000
1650          DQ     0.0     100    1000
              *

1651          KK  RD385E   ROUTE
1652          KM        ROUTED FLOW FROM D385E TO CC415B
1653          KM        ROUTED IN PROPOSED OAK STREET STORM DRAIN BYPASS
1654          RD     480  0.0080   0.012            CIRC   3.500
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1655          KK    415B   BASIN
1656          KM        SUB-BASIN 415B
1657          KM        TC & R CALCULATED WITH DDMSW VERSION 4.1.9
1658          KM        L = 0.76    Kb = 0.074      Adj. Slope = 302.1
1659          BA   0.108
1660          LG    0.32    0.29    4.50    0.40      18
1661          UC   0.359   0.338
1662          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
1663          UA     100
              *

1664          KK  RD415B   ROUTE
1665          KM        ROUTED FLOW FROM D415B TO CP415C
1666          KM        ROUTED IN PROPOSED HAWES ROAD STORM DRAIN
1667          RD     780  0.0300   0.012            CIRC   4.000
              *

1668          KK    415C   BASIN
1669          KM        SUB-BASIN 415C
1670          KM        TC & R CALCULATED WITH DDMSW VERSION 4.1.9
1671          KM        L = 0.30    Kb = 0.072      Adj. Slope = 209.6
1672          BA   0.029
1673          LG    0.31    0.27    5.30    0.28      19
1674          UC   0.242   0.220
1675          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
1676          UA     100
              *

1677          KK  CP415C COMBINE
1678          KM        COMBINE ROUTED HYDROGRAPH FROM DIVERSION D415B WITH
1679          KM        RUNOFF HYDROGRAPH FROM SUB-BASIN 415C
1680          HC       2
              *
              * KK D415C  DIVERT
              * KM      REMAINING HYDROGRAPH (D415C) IS THE BASIN BYPASS FLOW
              * KM      DIVERTED HYDROGRAPH (DIV9) GOES INTO THE OAK STREET BASIN
              * KM      INITIAL PLANS CALLED FOR A OFFLINE BASIN, WHERE THE FIRST 25cfs
              * KM      FROM THE HAWES ROAD STORM DRAIN BYPASS THE BASIN AND CONTINUE TO THE
              * KM      HAWES ROAD CHANNEL.
              * DT  DIV9     0.0     0.0
              * DI   0.0      25    1000
              * DQ   0.0       0     975
              *

1681          KK   D415C  DIVERT
1682          KM        REMAINING HYDROGRAPH (D415C) IS THE BASIN BYPASS FLOW
1683          KM        DIVERTED HYDROGRAPH (DIV9) GOES INTO THE OAK STREET BASIN
1684          KM        THE ORIGINAL PLAN WAS TO ALLOW THE INITIAL 25cfs TO BYPASS THE BASIN
1685          KM        IN A SMALLER STORM DRAIN AND FLOW DIRECTLY INTO THE HAWES ROAD CHANNEL.
1686          KM        THIS APPROACH WAS CHANGED AT THE 60% DESIGN STAGE WHEREIN THE ENTIRE
1687          KM        HAWES ROAD STORM DRAIN FLOW IS DIVERTED TO THE OAK STREET BASIN.
1688          DT    DIV9     0.0     0.0
1689          DI     0.0    0.01    1000
```

```
1690          DQ     0.0     0.0  999.99
              *
1                                        HEC-1 INPUT                                                PAGE 46

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1691          KK  RD415C   ROUTE
1692          KM        ROUTED FLOW FROM D415C TO CC415B
1693          KM        ROUTED IN PROPOSED HAWES ROAD STORM DRAIN BYPASS
1694          RD     640  0.0160   0.012            CIRC   2.000
              *

1695          KK    385G   BASIN
1696          KM        SUB-BASIN 385G
1697          KM        TC & R CALCULATED WITH DDMSW VERSION 4.1.9
1698          KM        L = 0.71    Kb = 0.059      Adj. Slope = 237.9
1699          BA   0.057
1700          LG    0.32    0.29    5.70    0.23      16
1701          UC   0.322   0.409
1702          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
1703          UA     100
              *

1704          KK   D385CRETRIEVE
1705          KM        RETRIEVE DIVERSION DIV6
1706          DR    DIV6
              *

1707          KK   RDIV6   ROUTE
1708          KM        ROUTED FLOW FROM DIV6 TO CP385G
1709          KM        CHANNEL GEOMETRY OBTAINED FROM 2' CONTOURS.
1710          RS       5    FLOW
1711          RC   0.045   0.035   0.045    3210  0.0386    0.00
1712          RX    0.00   10.00   25.00   40.00   65.00   80.00   95.00  100.00
1713          RY    5.00    4.00    2.00    0.00    0.00    2.00    4.00    5.00
              *

1714          KK  CP385G COMBINE
1715          KM        COMBINE ROUTED HYDROGRAPH FROM DIVERSION DIV6 WITH
1716          KM        RUNOFF HYDROGRAPH FROM SUB-BASIN 385G
1717          HC       2   0.17
              *
              * KK D385G  DIVERT
              * KM     REMAINING HYDROGRAPH (D385G) GOES INTO OAK STREET BASIN
              * KM     DIVERTED HYDROGRAPH (DIV8) SPILLS OVER HAWES ROAD INTO SUB-BASIN 415A.
              * KM     INITIAL DIVERSION PLANNED TO BYPASS 25cfs THROUGH OVER HAWES ROAD AND
              * KM     INTO SUB-BASIN 415A. NOT CONSIDERED (NO BYPASS) AS PART OF
              * KM     THE 60% OAK STREET BASIN AND STORM DRAIN DESIGN.
              * DT  DIV8     0.0     0.0
              * DI   0.0    25.0  1000.0
              * DQ   0.0    25.0    25.0
              *

1718          KK   D385G  DIVERT
1719          KM        REMAINING HYDROGRAPH (D385G) GOES INTO OAK STREET BASIN
1720          KM        DIVERTED HYDROGRAPH (DIV8) SPILLS OVER HAWES ROAD INTO SUB-BASIN 415A.
1721          KM        ORIGINAL PLAN WAS TO ALLOW INITIAL 25cfs TO BYPASS THE BASIN AND FLOW
```

```
1722          KM        OVER HAWES ROAD. THIS APPROACH WAS CHANGED AT THE 60% DESIGN STAGE
1723          KM        WHEREIN THE ENTIRE FLOW IS CAPTURED WITH THE HAWES ROAD STROM DRAIN
1724          KM        WITH NO FLOW ALLOWED TO SPILL OVER THE ROAD.
1                                        HEC-1 INPUT                                          PAGE 47

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1725          DT    DIV8     0.0     0.0
1726          DI     0.0     100    1000
1727          DQ     0.0       0       0
              *

1728          KK   D415CRETRIEVE
1729          KM        RETRIEVE DIVERSION DIV9
1730          DR    DIV9
              *

1731          KK  CC385G COMBINE
1732          KM        COMBINE REMAINING HYDROGRAPH FROM D385G DIVERSION WITH
1733          KM        RETRIEVED DIVERSION DIV9
1734          HC       2
              *

1735          KK    385F   BASIN
1736          KM        SUB-BASIN 385F
1737          KM        TC & R CALCULATED WITH DDMSW VERSION 4.1.9
1738          KM        L = 0.43    Kb = 0.065      Adj. Slope = 222.6
1739          BA   0.020
1740          LG    0.31    0.26    5.20    0.30      14
1741          UC   0.274   0.417
1742          UA       0     5.0    16.0    30.0    65.0    77.0    84.0    90.0    94.0    97.0
1743          UA     100
              *

1744          KK   D385ERETRIEVE
1745          KM        RETRIEVE DIVERSION DIV10
1746          DR   DIV10
              *

1747          KK   BASIN COMBINE
1748          KM        THIS IS THE FLOW THAT GETS TO THE OAK STREET DETENTION BASIN.
1749          KM        COMBINE HYDROGRAPH FROM DIVERSION DIV10, COMBINE CC385G AND
1750          KM        RUNOFF HYDROGRAPH FROM SUB-BASIN 385F
1751          KO       3       0
1752          HC       3    1.00
1753          ZW   A=OAK   B=BAS C=FLOW  F=CALC
              *

1754          KK  SBASIN STORAGE
1755          KM        OAK STREET DETENTION BASIN, WHERE THE PRIMARY BASIN OUTLET IS A
1756          KM        48-INCH STORM DRAIN (INV ELEV = 1798) THAT IS UNDER OUTLET CONTROL
1757          KM        AND THAT DISCHRGES TO THE EXISTING HAWES ROAD CHANNEL.
1758          KO       3       0
1759          RS       1    STOR
1760          SV    0.00    1.75    7.14   13.13   19.58   26.49   30.08   33.77  37.55   41.42
1761          SQ     0.0    22.7    71.3   111.3   141.4   167.4   179.2   190.4  201.0   211.1
1762          SE  1798.0  1800.0  1802.0  1804.0  1806.0  1808.0  1809.0  1810.0 1811.0  1812.0
1763          ZW   A=OAK   B=OLP  C=FLOW  F=CALC
```

```
1764          ZW   B=OLP  C=STOR
1765          ZW   B=OLP C=STAGE
              *
              * KKSBASIN STORAGE
              * KM      OAK STREET DETENTION BASIN, WITH 325-FOOT LONG RCC SPILLWAY.
              * KO     3       0
              * RS     1    STOR
              * SV  0.00    0.01   0.02
              * SQ   0.0   830.0 9999.0
              * SE1810.0  1811.0 1812.0
              * ZW A=OAK   B=SPW C=FLOW  F=CALC
              * ZW B=SPW  C=STOR
              * ZW B=SPW C=STAGE
              *
1                                   HEC-1 INPUT                                    PAGE 48

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1766          KK  CC415B
1767          KM   HYDROGRAPH COMBINATION OF 415 DIVERSION.
1768          KM   GB MODIFIED: COMBINE THE TWO OAK STREET BASIN BYPASS FLOWS WITH THE
1769          KM   GB MODIFIED: OAK STREET BASIN STORAGE ROUTE. HENCE CHANGE HC FROM 2 TO 3.
1770          HC       3   1.00
              *DDM   ***** Preserved *****
              *

1771          KK  R390A1
1772          KM   Route runoff hydrograph from subbasin 385B to CP390A
1773          KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
1774          KM   GB MODIFIED: ROUTE GEOMETRY WAS FROM 385B TO CP390A, CHANGE TO ROUTE
1775          KM   GB MODIFIED: GEOMETRY OF EXISTING THUNDER MOUNTAIN CHANNEL.
1776          RS       3    FLOW      -1
1777          RC   0.020   0.020   0.020     780   0.010
1778          RX       0       2       3       4      17      19      23      30
1779          RY    3.50    2.00       1       0       0       1       2    3.50
              * DDM   ***** Updated *****
              *
              * ***************************************************************************
              * ***************************************************************************
              *                     END OF MODIFICATION BY GAVAN BARKER INC.
              *                    OAK STREET BASIN AND STORM DRAIN HYDROLOGY
              *                                 APRIL 2010
              * ***************************************************************************
              * ***************************************************************************
              *

1780          KK    390A
1781          KM   SUB-BASIN 390A
1782          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1783          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
1784          KM     L =  .36  Kb = .064  Adj. Slope =  164.0
1785          BA    .024
1786          LG    .300    .250   4.000    .560  15.000
1787          UC    .204    .235
1788          UA       0       5      16      30      65      77      84      90      94      97
1789          UA     100
              * DDM   ***** Preserved *****
```

```
                    *
                    * ************************************************************************
                    * ************************************************************************
                    *                    BEGIN OF MODIFICATION BY GAVAN BARKER INC.
                    *                    OAK STREET BASIN AND STORM DRAIN HYDROLOGY
                    *                                  APRIL 2010
                    * ************************************************************************
                    * ************************************************************************
                    *
1                                          HEC-1 INPUT                                          PAGE 49

LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1790                KK  CP390A
1791                KM   Combine routed hydrographs from the Oak Street detention basin with
1792                KM   runoff hydrograph from subbasin 390A
1793                KM   GB MODIFIED: ADJUSTED THE AREA OF THE COMBINE, DUE TO AREA-LOSS IN DIVERSIONS
1794                HC       2   1.03
                    * DDM   ***** Preserved *****
                    *

1795                KK  R390B2
1796                KM   Route combined hydrograph from CP390A to existing Thunder Mountain detention
1797                KM   basin
1798                KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING
1799                KM   GB MODIFIED: ADJUSTED LENGTH AND SLOPE OF CHANNEL TO COMBINE AT CC390B,
1800                KM                COMBINE WITH RUNOFF HYDROGRAPH OCCURS IN THE CHANNEL
1801                KM                PRIOR TO THE THUNDER MOUNTAIN DETENTION BASIN.
1802                RS       3    FLOW      -1
1803                RC   0.020   0.020   0.020    1100   0.026
1804                RX       0       2       3       4      17      19      23      30
1805                RY     3.5       2       1       0       0       1       2     3.5
                    * DDM   ***** Updated *****
                    *
                    * ************************************************************************
                    * ************************************************************************
                    *                     END OF MODIFICATION BY GAVAN BARKER INC.
                    *                    OAK STREET BASIN AND STORM DRAIN HYDROLOGY
                    *                                  APRIL 2010
                    * ************************************************************************
                    * ************************************************************************
                    *

1806                KK    390B
1807                KM   SUB-BASIN 390B
1808                KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1809                KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
1810                KM     L =  .68  Kb = .055  Adj. Slope =  153.0
1811                BA    .101
1812                LG    .300    .250   4.450    .450  15.000
1813                UC    .267    .232
1814                UA       0       5      16      30      65      77      84      90      94      97
1815                UA     100
                    * DDM   ***** Preserved *****
                    *
                    * ************************************************************************
                    * ************************************************************************
```

```
                    *                    BEGIN OF MODIFICATION BY GAVAN BARKER INC.
                    *                    OAK STREET BASIN AND STORM DRAIN HYDROLOGY
                    *                                APRIL 2010
                    * ************************************************************************
                    * ************************************************************************
                    *
1                                              HEC-1 INPUT                                          PAGE 50

LINE                ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1816                KK  CC390B COMBINE
1817                KM        NEW COMBINE: TO ADD THE CHANNEL ROUTE R390B2 WITH THE RUNOFF HYDROGRAPH
1818                KM        FROM SUB-BASIN 390B PRIOR TO THE THUNDER MOUNTAIN DETENTION BASIN.
1819                HC       2
                    *

1820                KK  CP390B
1821                KM   Combine routed hydrographs from CP390C and CP390A with runoff hydrograph from
1822                KM   subbasin 390B
1823                KM   GB MODIFIED: MODIFIED THE HC FROM 3 TO 2, ACCOUNTING FOR COMBINE CC390B
1824                HC       2   1.45
                    * DDM   ***** Preserved *****
                    *
                    * ************************************************************************
                    * ************************************************************************
                    *                     END OF MODIFICATION BY GAVAN BARKER INC.
                    *                    OAK STREET BASIN AND STORM DRAIN HYDROLOGY
                    *                                APRIL 2010
                    * ************************************************************************
                    * ************************************************************************
                    *

1825                KK   S390B
1826                KM   Thunder Mountain Detention Basin, with 78-inch outlet pipe, discharge from
1827                KM   the basin can be through the pipe and out of 32-6 ft x 0.65 ft holes in
1828                KM   the wall at the southwest corner of the basin the lowest hole is at
1829                KM   elevation 1759.27 feet
1830                RS       1    STOR       0
1831                SV       0    0.01    0.45    1.77    4.38    8.09   12.61   18.16   24.98
1832                SQ       0     325     400     460     676    1450    1958    2321    2615
1833                SE    1753    1754    1756    1758    1760    1762    1764    1766    1768
                    * DDM   ***** Updated *****

1834                KK  420B05
1835                KM   SUB-BASIN 420B05
1836                KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1837                KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
1838                KM     L =  .41  Kb = .061  Adj. Slope =  159.0
1839                BA    .040
1840                LG    .300    .250   4.650    .390  15.000
1841                UC    .213    .204
1842                UA       0       5      16      30      65      77      84      90      94      97
1843                UA     100
                    * DDM   ***** Preserved *****

1844                KK  CPSD05
1845                KM   Combine routed flow in storm drain from Thunder Mountain Detention basin
```

```
1846          KM   with runoff from subbasin 420B05
1847          HC       2
              * DDM   ***** Updated *****
1                                          HEC-1 INPUT                                                    PAGE 51

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1848          KK  420B10
1849          KM   SUB-BASIN 420B10
1850          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1851          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
1852          KM     L =  .49  Kb = .063  Adj. Slope =  159.0
1853          BA    .025
1854          LG    .300    .250   3.850    .620  15.000
1855          UC    .242    .354
1856          UA       0       5      16      30      65      77      84      90      94      97
1857          UA     100
              * DDM   ***** Preserved *****

1858          KK  CPSD10
1859          KM   Combine routed flow in storm drain from CPSD05 with runoff from subbasin
1860          KM   420B10
1861          HC       2
              * DDM   ***** Updated *****

1862          KK  420B15
1863          KM   SUB-BASIN 420B15
1864          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1865          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
1866          KM     L =  .36  Kb = .068  Adj. Slope =  133.0
1867          BA    .011
1868          LG    .300    .250   3.850    .620  15.000
1869          UC    .229    .416
1870          UA       0       5      16      30      65      77      84      90      94      97
1871          UA     100
              * DDM   ***** Preserved *****

1872          KK  CPSD15
1873          KM   Combine routed flow in storm drain from CPSD10 with runoff from subbasin
1874          KM   420B15
1875          HC       2
              * DDM   ***** Updated *****

1876          KK  420B20
1877          KM   SUB-BASIN 420B20
1878          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1879          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
1880          KM     L =  .48  Kb = .067  Adj. Slope =  144.0
1881          BA    .014
1882          LG    .300    .250   4.200    .520  15.000
1883          UC    .254    .512
1884          UA       0       5      16      30      65      77      84      90      94      97
1885          UA     100
              * DDM   ***** Preserved *****

1886          KK  CPSD20
1887          KM   Combine routed flow in storm drain from CPSD15 with runoff from subbasin
```

```
1888          KM   420B20
1889          HC       2
              * DDM   ***** Updated *****
1                                        HEC-1 INPUT                                                    PAGE 52

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1890          KK  420B25
1891          KM   SUB-BASIN 420B25
1892          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1893          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
1894          KM     L = 1.90  Kb = .056  Adj. Slope =  203.5
1895          BA    .084
1896          LG    .300    .250   3.880    .610  15.000
1897          UC    .496   1.165
1898          UA       0       3       5       8      12      20      43      75      90      96
1899          UA     100

1900          KK  SFIRES
1901          KM   Detention basin at Mesa Fire Station #16 at NW corner of McDowell Rd. and
1902          KM   80th Street.  Detention volumes taken from as-built plans dated 5/22/00,
1903          KM   prepared by AGRA Infrastructure, Inc.
1904          RS       1    STOR       0
1905          SV       0    0.03    0.14    0.37    0.53    0.73
1906          SQ       0       7      17      25      27      31
1907          SE      92      93      94      95      96      97
              * DDM   ***** Preserved *****

1908          KK  CPSD25
1909          KM   Combine routed flow in storm drain from CPSD20 with runoff from subbasin
1910          KM   420B25
1911          HC       2
              * DDM   ***** Updated *****

1912          KK  420B30
1913          KM   SUB-BASIN 420B30
1914          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1915          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
1916          KM     L =  .87  Kb = .059  Adj. Slope =  144.0
1917          BA    .055
1918          LG    .300    .250   4.400    .460  15.000
1919          UC    .342    .525
1920          UA       0       5      16      30      65      77      84      90      94      97
1921          UA     100
              * DDM   ***** Preserved *****

1922          KK  CPSD30
1923          KM   Combine routed flow in storm drain from CPSD25 with runoff from subbasin
1924          KM   420B30
1925          HC       2
              * DDM   ***** Updated *****

1926          KK  420B35
1927          KM   SUB-BASIN 420B35
1928          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1929          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
1930          KM     L =  .40  Kb = .062  Adj. Slope =  112.0
```

```
1931          BA    .035
1932          LG    .300    .260   3.530    .770  15.000
1933          UC    .246    .253
1934          UA       0       5      16      30      65      77      84      90      94      97
1                                          HEC-1 INPUT                                          PAGE 53

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

1935          UA     100

1936          KK  SCHRCH
1937          KM   Detention basin at Falcon Hill Ward Church of Jesus Christ of Latter-
1938          KM   Day Saints at NW corner of McDowell Rd. and 78th Street.  Detention
1939          KM   volumes taken from as-built plans dated 7-22-03, prepared by Rosendahl
1940          KM   & Associates, Inc.
1941          RS       1    STOR       0
1942          SV       0    0.09    0.23    0.49    0.66    0.71    0.84
1943          SQ       0     1.4     2.2     5.5     6.0     6.4     157
1944          SE    1663    1664    1665    1666  1666.5    1667    1668
              * DDM   ***** Preserved *****

1945          KK  CPSD35
1946          KM   Combine routed flow in storm drain from CPSD30 with runoff from subbasin
1947          KM   420B35
1948          HC       2
              * DDM   ***** Updated *****

1949          KK  420B40
1950          KM   SUB-BASIN 420B40
1951          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1952          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
1953          KM     L =  .17  Kb = .073  Adj. Slope =  118.0
1954          BA    .005
1955          LG    .300    .260   3.700    .680  15.000
1956          UC    .171    .258
1957          UA       0       5      16      30      65      77      84      90      94      97
1958          UA     100
              * DDM   ***** Preserved *****

1959          KK  CPSD40
1960          KM   Combine routed flow in storm drain from CPSD35 with runoff from subbasin
1961          KM   420B40
1962          HC       2
              * DDM   ***** Updated *****

1963          KK  420B45
1964          KM   SUB-BASIN 420B45
1965          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1966          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
1967          KM     L =  .25  Kb = .071  Adj. Slope =  120.0
1968          BA    .007
1969          LG    .300    .260   3.630    .710  15.000
1970          UC    .204    .354
1971          UA       0       5      16      30      65      77      84      90      94      97
1972          UA     100
              * DDM   ***** Preserved *****

1973          KK  CPSD45
```

```
1974          KM   Combine routed flow in storm drain from CPSD40 with runoff from subbasin
1975          KM   420B45
1976          HC       2
              * DDM   ***** Preserved *****
1                                          HEC-1 INPUT                                          PAGE 54

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


1977          KK  TOLSCH
1978          KO       3
1979          KM   Divert out of storm drain through splitter structure.  Divert flow amount
1980          KM   such that the flow at CP415A is less than or equal to 1540 cfs, the existing
1981          KM   peak discharge of LasSendas channel.
1982          DT    MCDB
1983          DI       0     331     419     558     658     693     728     901    1043
1984          DQ       0       0      61     176     262     292     323     473     594
              * DDM   ***** Updated *****

1985          KK     440
1986          KM   SUB-BASIN 440
1987          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
1988          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
1989          KM     L =  .40  Kb = .039  Adj. Slope =  315.0
1990          BA    .080
1991          LG    .190    .380   6.400    .140  13.000
1992          UC    .129    .077
1993          UA       0       3       5       8      12      20      43      75      90      96
1994          UA     100
              * DDM   ***** Preserved *****

1995          KK     R70
1996          KM   ROUTE FLOW FROM SUB-BASIN 440 TO C108
1997          RS       2    FLOW      -1
1998          RC     .05    .035     .05    2250     .08
1999          RX    1000    1025    1050    1070    1075    1095    1120    1145
2000          RY      30    22.9    15.7      10      10    15.7    22.9      30
              * DDM   ***** Updated *****

2001          KK     441
2002          KM   SUB-BASIN 441
2003          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2004          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
2005          KM     L =  .28  Kb = .069  Adj. Slope =  315.0
2006          BA    .010
2007          LG    .300    .250   5.600    .220   5.000
2008          UC    .150    .225
2009          UA       0       5      16      30      65      77      84      90      94      97
2010          UA     100
              * DDM   ***** Preserved *****

2011          KK    C108
2012          KM   COMBINE HYDROGRAPHS FROM SUB-BASINS 440 & 441
2013          HC       2
              * DDM   ***** Preserved *****

2014          KK      D4
2015          KM        SPLIT FLOW WITH TWO 42 INCH PIPES TO WEST AND SOUTH
```

```
2016          DT   SPLIT
2017          DI       0      14      40      82     120     154     180
2018          DQ       0       7      20      41      60      77      90
              * DDM   ***** Preserved *****
1                                          HEC-1 INPUT                                                    PAGE 55

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


2019          KK    R108
2020          KM        ROUTE FLOW FROM SUB-BASIN C108 TO C67
2021          RS       2    FLOW      -1
2022          RC     .05    .035     .05    3200      .1
2023          RX    1000    1025    1050    1070    1075    1095    1120    1145
2024          RY      30    22.9    15.7      10      10    15.7    22.9      30
              * DDM   ***** Updated *****

2025          KK     442
2026          KM   SUB-BASIN 442
2027          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2028          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
2029          KM     L =  .83  Kb = .055  Adj. Slope =  274.2
2030          BA    .100
2031          LG    .300    .270   3.290    .770   5.000
2032          UC    .258    .264
2033          UA       0       5      16      30      65      77      84      90      94      97
2034          UA     100
              * DDM   ***** Preserved *****

2035          KK     C67
2036          KM   COMBINE FLOW FROM SUB-BASIN 442 & DIV4
2037          HC       2
              * DDM   ***** Preserved *****

2038          KK      D6
2039          KM        OFFLINE BASIN WITH 25 FOOT WEIR SET AT 2.5 FEET ABOVE BOTTOM OF CHANNEL
2040          KM        FLOW CONTINUES BEYOND BASIN THROUGH 2-30" PIPES
2041          DT  BASIN4     3.3
2042          DI       0      10      32      44    79.9   132.5     198   272.9   356.8
2043          DQ       0       0       0       0    23.9    67.5     124   190.9   266.8
              * DDM   ***** Preserved *****

2044          KK    RTD6
2045          KM   RETRIEVE FLOW FROM DIVERSION INTO OFFLINE BASIN
2046          DR  BASIN4
              * DDM   ***** Preserved *****

2047          KK     SD6
2048          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
2049          KM     3.3 ACRE-FEETx43560/36x3600=1.1cfs
2050          RS       1    STOR       0
2051          SV       0     .01     3.3
2052          SQ       0     0.2     1.1
              * DDM   ***** Preserved *****

2053          KK     CD6
2054          KM   HYDROGRAPH COMBINATION FOR OFFLINE BASIN BLEEDOFF
2055          HC       2
```

```
                * DDM   ***** Updated *****

LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


2056            KK     443
2057            KM   SUB-BASIN 443
2058            KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2059            KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
2060            KM     L =  .71  Kb = .050  Adj. Slope =  315.0
2061            BA    .080
2062            LG    .250    .190   8.000    .080  10.000
2063            UC    .196    .194
2064            UA       0       5      16      30      65      77      84      90      94      97
2065            UA     100
                * DDM   ***** Preserved *****

2066            KK     D66
2067            KM        DIVERT FLOW INTO 3 NATURAL WASHES WITH ONE 24" PIPE IN EACH WASH.
2068            KM        EACH PIPE CAPACITY BASED ON 4 FEET OF HEAD
2069            DT   WSH66
2070            DI       0      78     100     200
2071            DQ       0      78      78      78
                * DDM   ***** Preserved *****

2072            KK    R113
2073            KM        ROUTE FLOW FROM C113 TO C114
2074            RS       1    FLOW      -1
2075            RC    .019    .019    .019    1300    .029
2076            RX    1000    1004    1008    1012    1018    1022    1026    1030
2077            RY      17   15.33   12.67      10      10   12.67   15.33      17
                * DDM   ***** Preserved *****

2078            KK    C114
2079            KM        COMBINE HYDROGRAPHS FROM SUB-BASIN 67 AND C113
2080            HC       2
                * DDM   ***** Updated *****

2081            KK     444
2082            KM   SUB-BASIN 444
2083            KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2084            KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
2085            KM     L =  .33  Kb = .034  Adj. Slope =  315.0
2086            BA    .040
2087            LG    .130    .350   4.450    .320   1.000
2088            UC    .112    .084
2089            UA       0       3       5       8      12      20      43      75      90      96
2090            UA     100
                * DDM   ***** Preserved *****

2091            KK     R58
2092            KM   ROUTE FLOW FROM SUB-BASIN 444 TO C107
2093            RS       2    FLOW      -1
2094            RC     .05    .035     .05    2370   .0516
2095            RX    1000    1010    1020    1050    1055    1085    1095    1105
2096            RY      19      18      17      10      10      17      18      19
                * DDM   ***** Updated *****
```

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

2097          KK     445
2098          KM   SUB-BASIN 445
2099          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2100          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
2101          KM     L =  .82  Kb = .036  Adj. Slope =  315.0
2102          BA    .190
2103          LG    .170    .320   3.470    .590   3.000
2104          UC    .192    .130
2105          UA       0       5      16      30      65      77      84      90      94      97
2106          UA     100
              * DDM   ***** Preserved *****

2107          KK    C107
2108          KM   COMBINE HYDROGRAPHS FROM SUB-BASINS 444 & 445
2109          HC       2
              * DDM   ***** Preserved *****

2110          KK    R107
2111          KM        ROUTE FLOW FROM C107 TO C109
2112          RS       2    FLOW      -1
2113          RC     .05    .035     .05     700   .0516
2114          RX    1000    1010    1020    1050    1055    1085    1095    1105
2115          RY      19      18      17      10      10      17      18      19
              * DDM   ***** Preserved *****

2116          KK    RTB2
2117          KM        RETRIEVE DIVERTED FLOW FROM BASIN 1
2118          DR   SPLIT
              * DDM   ***** Preserved *****

2119          KK  RSPLIT
2120          KM        ROUTE FLOW FROM SPLIT TO C109
2121          RS       1    FLOW      -1
2122          RC     .05    .035     .05     800     .05
2123          RX    1000    1025    1050    1070    1075    1095    1120    1145
2124          RY      30    22.9    15.7      10      10    15.7    22.9      30
              * DDM   ***** Updated *****

2125          KK     446
2126          KM   SUB-BASIN 446
2127          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2128          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
2129          KM     L =  .46  Kb = .061  Adj. Slope =  303.9
2130          BA    .040
2131          LG    .270    .250   4.500    .400  19.000
2132          UC    .183    .189
2133          UA       0       5      16      30      65      77      84      90      94      97
2134          UA     100
              * DDM   ***** Preserved *****
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
2135          KK    C109
2136          KM        COMBINE HYDROGRAPHS FROM COMBINES C107 AND C108
2137          HC       3
              * DDM   ***** Preserved *****

2138          KK      D5
2139          KM        DIVERT FLOW INTO WASHES TOWARDS WEST
2140          KM        DIVERSION THROUGH 36" PIPE WITH 3 FEET OF HEAD
2141          DT  WSH404
2142          DI       0    40.7    71.2   121.6     190     276   379.4   500.6
2143          DQ       0      35      35      35      35      35      35      35
              * DDM   ***** Preserved *****

2144          KK    R109
2145          KM        ROUTE FLOW FROM C109 TO C110
2146          RS       1    FLOW      -1
2147          RC    .019    .019    .019    3080     .05
2148          RX    1000    1005    1010    1015    1025    1030    1035    1040
2149          RY   13.75    12.5   11.25      10      10   11.25    12.5   13.75
              * DDM   ***** Updated *****

2150          KK     447
2151          KM   SUB-BASIN 447
2152          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2153          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
2154          KM     L =  .49  Kb = .056  Adj. Slope =  221.0
2155          BA    .090
2156          LG    .250    .270   3.350    .870  30.000
2157          UC    .208    .145
2158          UA       0       5      16      30      65      77      84      90      94      97
2159          UA     100
              * DDM   ***** Preserved *****

2160          KK   RT404
2161          KM        RETRIEVE DIVERTED FLOW FOR WASH 109
2162          DR  WSH404
              * DDM   ***** Preserved *****

2163          KK    R404
2164          KM        ROUTE FLOW FROM C110 TO C110
2165          RS       6    FLOW      -1
2166          RC    .019    .019    .019    3540     .03
2167          RX    1000    1012    1016    1020    1025    1029    1033    1045
2168          RY      15      12      11      10      10      11      12      15
              * DDM   ***** Preserved *****

2169          KK    C110
2170          KM   COMBINE HYDROGRAPHS FROM SUB-BASIN 447 AND R404
2171          HC       3
              * DDM   ***** Preserved *****
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

2172          KK    R110
2173          KM        ROUTE FLOW FROM C110 TO C115
```

```
2174          RS       1    FLOW      -1
2175          RC    .019    .019    .019     580   .0291
2176          RX    1000    1012    1016    1020    1035    1039    1043    1055
2177          RY      15      12      11      10      10      11      12      15
              * DDM   ***** Preserved *****

2178          KK    C115
2179          KM        COMBINE HYDROGRAPHS FROM C114 AND C110
2180          HC       2
              * DDM   ***** Preserved *****

2181          KK    R115
2182          KM        ROUTE FLOW FROM C115 TO Sub 453
2183          RS       1    FLOW      -1
2184          RC    .019    .019    .019    2125    .029
2185          RX    1000    1012    1016    1020    1035    1039    1043    1055
2186          RY      15      12      11      10      10      11      12      15
              * DDM   ***** Updated *****

2187          KK     448
2188          KM   SUB-BASIN 448
2189          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2190          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
2191          KM     L =  .36  Kb = .042  Adj. Slope =  315.0
2192          BA    .045
2193          LG    .170    .310   4.200    .390  11.000
2194          UC    .133    .102
2195          UA       0       5      16      30      65      77      84      90      94      97
2196          UA     100
              * DDM   ***** Updated *****

2197          KK     449
2198          KM   SUB-BASIN 449
2199          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2200          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
2201          KM     L =  .40  Kb = .054  Adj. Slope =  315.0
2202          BA    .050
2203          LG    .260    .280   3.500    .640   6.000
2204          UC    .167    .134
2205          UA       0       5      16      30      65      77      84      90      94      97
2206          UA     100
              * DDM   ***** Preserved *****

2207          KK   C6364
2208          KM   COMBINE HYDROGRAPHS FROM SUB-BASINS 448 & 449
2209          HC       2
              * DDM   ***** Preserved *****
1                                   HEC-1 INPUT                                          PAGE 60

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


2210          KK   R6364
2211          KM   ROUTE FLOW FROM C116 AND SUB-BASINS 448 AND 449
2212          RS       5    FLOW      -1
2213          RC     .05    .035     .05    4375   .0333
2214          RX    1000    1027    1053    1080    1090    1117    1143    1170
2215          RY      15   13.33   11.67      10      10   11.67   13.33      15
```

```
                 * DDM   ***** Updated *****

2216             KK     450
2217             KM   SUB-BASIN 450
2218             KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2219             KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
2220             KM     L =  .85  Kb = .057  Adj. Slope =  210.5
2221             BA    .070
2222             LG    .340    .350   3.630    .570   4.000
2223             UC    .296    .383
2224             UA       0       3       5       8      12      20      43      75      90      96
2225             UA     100
                 * DDM   ***** Updated *****

2226             KK     451
2227             KM   SUB-BASIN 451
2228             KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2229             KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
2230             KM     L =  .57  Kb = .063  Adj. Slope =  175.0
2231             BA    .025
2232             LG    .340    .340   3.290    .750   3.000
2233             UC    .271    .453
2234             UA       0       3       5       8      12      20      43      75      90      96
2235             UA     100
                 * DDM   ***** Preserved *****

2236             KK    C451
2237             KM   COMBINE HYDROGRAPHS FROM SUB-BASINS 450 & 451
2238             HC       2
                 * DDM   ***** Preserved *****

2239             KK    RT66
2240             KM        RETRIEVE DIVERTED FLOW FROM SUB-BASIN 66
2241             DR   WSH66
                 * DDM   ***** Updated *****

2242             KK     452
2243             KM   SUB-BASIN 452
2244             KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2245             KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
2246             KM     L =  .43  Kb = .055  Adj. Slope =  315.0
2247             BA    .040
2248             LG    .260    .280   3.700    .550   9.000
2249             UC    .171    .166
2250             UA       0       5      16      30      65      77      84      90      94      97
2251             UA     100
                 * DDM   ***** Preserved *****
1                                          HEC-1 INPUT                                          PAGE 61

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


2252             KK   C6465
2253             KM   COMBINE HYDROGRAPHS FROM SUB-BASINS 443 AND 452
2254             HC       2
                 * DDM   ***** Preserved *****

2255             KK   R6566
```

```
2256          KM        ROUTE FLOW FROM DIVERSIONS 65 AND 66 TO C116
2257          RS       3    FLOW      -1
2258          RC     .05    .035     .05    2435   .0282
2259          RX    1000    1045    1090    1150    1160    1220    1265    1310
2260          RY      25      23      20      10      10      20      23      25
              * DDM   ***** Preserved *****

2261          KK    C116
2262          KM   COMBINE HYDROGRAPHS FROM SUB-BASINS 450 & 451 AND R6364 & R6465
2263          HC       3
              * DDM   ***** Preserved *****

2264          KK  BASIN5
2265          KM        RESERVOIR WITHIN PARCEL 31      2-48 INCH PIPES AT OUTFALL
2266          KM        BASIN 5 FEET DEEP
2267          RS       1    ELEV       0
2268          SV       0     4.5     9.9
2269          SQ       0      69     190
2270          SE       0     2.5       5
              * DDM   ***** Preserved *****

2271          KK    R116
2272          KM   ROUTE FLOW FROM C116 TO C117
2273          RS       2    FLOW      -1
2274          RC     .05    .035     .05    1300   .0333
2275          RX    1000    1100    1200    1300    1320    1420    1520    1620
2276          RY      13      12      11      10      10      11      12      13
              * DDM   ***** Updated *****

2277          KK     453
2278          KM   SUB-BASIN 453
2279          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2280          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
2281          KM     L =  .58  Kb = .058  Adj. Slope =  138.0
2282          BA    .060
2283          LG    .290    .300   3.290    .820  18.000
2284          UC    .275    .284
2285          UA       0       5      16      30      65      77      84      90      94      97
2286          UA     100
              * DDM   ***** Preserved *****

2287          KK    C117
2288          KM   COMBINE HYDROGRAPHS FROM SUB-BASIN 453 AND R116
2289          HC       2
              * DDM   ***** Preserved *****
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

2290          KK    C118
2291          KM   COMBINE HYDROGRAPHS FROM R115 AND C117
2292          HC       2
              * DDM   ***** Preserved *****

2293          KK    R118
2294          KM        ROUTE FLOW FROM C118 TO DIV7
2295          RS       1    FLOW      -1
```

```
2296          RC    .019    .019    .019    1500    .024
2297          RX    1000    1012    1016    1020    1035    1039    1043    1055
2298          RY      15      12      11      10      10      11      12      15
              * DDM   ***** Preserved *****

2299          KK      D7
2300          KM        OFFLINE BASIN AT NORTH MOUNTAIN RIDGE   FLOWS ENTER BASIN OVER
2301          KM        30' WEIR SET AT 5.3' ABOVE THE CHANNEL BOTTOM, Vol = 3.6 A-F
2302          DT  BASIN6     3.6
2303          DI       0     363     487     563     645     900
2304          DQ       0       2      10      15      25     260
              * DDM   ***** Preserved *****

2305          KK    RTD7
2306          KM   RETRIEVE FLOW FROM DIVERSION INTO OFFLINE BASIN
2307          DR  BASIN6
              * DDM   ***** Preserved *****

2308          KK     SD7
2309          KM   RETRIEVE FLOW INTO FICTITIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
2310          KM     3.6 ACRE-FEETx43560/36x3600=1.2cfs
2311          RS       1    STOR       0
2312          SV       0     .01     3.6     4.0
2313          SQ       0     0.2     1.2     1.5
              * DDM   ***** Preserved *****

2314          KK     CD7
2315          KM   HYDROGRAPH COMBINATION FOR OFFLINE BASIN BLEEDOFF
2316          HC       2
              * DDM   ***** Updated *****

2317          KK     454
2318          KM   SUB-BASIN 454
2319          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2320          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
2321          KM     L = 1.23  Kb = .051  Adj. Slope =  163.0
2322          BA    .180
2323          LG    .300    .310   3.780    .560  14.000
2324          UC    .379    .395
2325          UA       0       5      16      30      65      77      84      90      94      97
2326          UA     100
              * DDM   ***** Preserved *****
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


2327          KK    C454
2328          KM        COMBINE HYDROGRAPHS FROM SUB-BASIN 454 AND CDIV7
2329          HC       2
              * DDM   ***** Preserved *****
              *

2330          KK    R454
2331          KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
2332          KM   ROUTE FLOW FROM C454 TO 415C
2333          RS       3    FLOW      -1
```

```
2334          RC    .045    .035    .045    2200    .009
2335          RX       0      .5       1      33      42      67    67.5      68
2336          RY       5       4       4       0       0       6       6       6
              * DDM   ***** Updated *****

2337          KK    415A
2338          KM   SUB-BASIN 415A
2339          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2340          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
2341          KM     L = 1.21  Kb = .049  Adj. Slope =  140.0
2342          BA    .280
2343          LG    .300    .260   3.630    .710  15.000
2344          UC    .400    .322
2345          UA       0       5      16      30      65      77      84      90      94      97
2346          UA     100
              * DDM   ***** Preserved *****
              *
              * ************************************************************************
              * ************************************************************************
              *                    BEGIN OF MODIFICATION BY GAVAN BARKER INC.
              *                    OAK STREET BASIN AND STORM DRAIN HYDROLOGY
              *                                  APRIL 2010
              * ************************************************************************
              * ************************************************************************
              *

2347          KK   D385GRETRIEVE
2348          KM        RETRIEVE DIVERTED HYDROGRAPH (DIV8) THAT SPILLS OVER HAWES ROAD
2349          KM        INTO SUB-BASIN 415A.
2350          DR    DIV8
              *

2351          KK   RDIV8   ROUTE
2352          KM        ROUTED FLOW FROM DIV8 TO CP415A
2353          KM        CHANNEL GEOMETRY OBTAINED FROM 2' CONTOURS.
2354          RS       5    FLOW
2355          RC   0.045   0.040   0.045    5940  0.0249    0.00
2356          RX    0.00    1.00   40.00   46.00   66.00   72.00  112.00  113.00
2357          RY    3.00    2.00    1.50    0.00    0.00    1.50    2.00    3.00
              *
1                                   HEC-1 INPUT                                          PAGE 64

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


2358          KK  CP415A
2359          KM   Combine contributing hydrographs to the Las Sendas channel.  This
2360          KM   includes routed hydrographs from 415B and R454, flow diverted directly into
2361          KM   the channel from CPSD45, and the runoff hydrograph from subbasin 415A
2362          KM   GB MODIFIED: ADD RETRIEVE DIV8 AND ROUTE RDIV8 AND CHANGE HC FROM 3 TO 4.
2363          HC       4
              * DDM   ***** Preserved *****
              * ************************************************************************
              * ************************************************************************
              *                     END OF MODIFICATION BY GAVAN BARKER INC.
              *                    OAK STREET BASIN AND STORM DRAIN HYDROLOGY
              *                                  APRIL 2010
              * ************************************************************************
```

```
                 * ***********************************************************************
                 *

2364             KK   RMCDB
2365             KO       3
2366             KM   Retrieve flow that remained in the storm drain and goes to the McDowell Road
2367             KM   detention basin
2368             DR    MCDB
                 * DDM   ***** Preserved *****

2369             KK   SMCDB
2370             KM   McDowell Road Basin - outlet is a 48-inch storm drain with restricter to the
2371             KM   channel
2372             RS       1    STOR       0
2373             SV       0    0.23    0.57    1.01    1.56    2.23    3.02    3.93    4.99    6.20
2374             SV    7.58    9.15
2375             SQ       0      16      35      54      71      86      97     107     116     127
2376             SQ     144     171
2377             SE    1630    1631    1632    1633    1634    1635    1636    1637    1638    1639
2378             SE    1640    1641
                 *
                 * DDM   ***** Preserved *****

2379             KK  CPLSCH
2380             KM   Combine discharge from McDowell Road basin with the flows in the Las Sendas
2381             KM   channel
2382             HC       2
                 *
                 * DDM   ***** Preserved *****

2383             KK   R415A
2384             KM   CHANNEL GEOMETRY OBTAINED FROM 2' CONTOUR MAPPING.
2385             KM   ROUTING OF FLOW FROM C415A TO 455C
2386             RS       2    FLOW      -1
2387             RC    .045     .03    .045    4100    .024
2388             RX       0      .5       1       8      16      23    23.5      24
2389             RY       8       8       8       0       0       8       8       8
                 * DDM   ***** Updated *****
1                                          HEC-1 INPUT                                          PAGE 65

LINE             ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


2390             KK     455
2391             KM   SUB-BASIN 455
2392             KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2393             KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .993
2394             KM     L = 1.70  Kb = .041  Adj. Slope =  146.0
2395             BA   1.111
2396             LG    .270    .280   3.700    .640  24.000
2397             UC    .421    .204
2398             UA       0       5      16      30      65      77      84      90      94      97
2399             UA     100
                 * DDM   ***** Preserved *****

2400             KK    D455
2401             KM        DIVERT FLOW INTO ONLINE  DETENTION BASIN
2402             KM   DETENTION/RETENTION BASINS LOCATED WITHIN LAS SENDAS ADDENDUM III
```

```
2403          KM   FOR BASIN #: 30      34      43      47&58
2404          KM        MAXIMUM VOLUME DIVERSION = 74.1 acre-feet
2405          DT   BS455    74.1
2406          DI       0   10000
2407          DQ       0   10000
              * DDM   ***** Preserved *****

2408          KK   RT455
2409          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
2410          DR   BS455
              * DDM   ***** Preserved *****

2411          KK    S455
2412          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
2413          KM    74.1 ACRE-FEETx43560/36x3600=25cfs
2414          RS       1    STOR       0
2415          SV       0     .01    74.1   100.0
2416          SQ       0     3.0      25   250.0
              * DDM   ***** Preserved *****

2417          KK    C455
2418          KM   HYDROGRAPH COMBINATION FOR SUB-BASIN 455 AND DIVERTED BASIN STORAGE OF 455
2419          HC       2
              *

2420          KK   CC455
2421          KM  HYDROGRAPH COMBINATION OF 420A, R415A AND C455
2422          HC       3
              * DDM   ***** Preserved *****

2423          KK    S440
2424          KM   SPOOK HILL FRS PLANS DATED 6/15/77
2425          KM   OUTLET PIPE=7'x7.5'RCBC; L=70 INLET INV.=1566; OUTLET INV.=1566
2426          KM   EMERGENCY SPILLWAY ELEV.=1582; PRINCIPLE SPILLWAY ELEV.=1577.5
2427          KM   STORAGE VOLUME BELOW PRINCIPLE SPILLWAY FOR SEDIMENT = 271 ACRE-FEET
2428          RS       1    STOR       0
2429          SV     0.0      81   211.0  265.72  692.96  896.16  1120.0 1630.34  2230.9 3311.68
2430          SQ     0.0     1.0     3.0     8.0  515.00  780.00  825.00  3184.7  7426.0 16007.3
2431          SE   577.0  578.00  579.00  579.36  581.86  582.86  583.86  585.86  587.86  590.86
              * DDM   ***** Preserved *****
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


2432          KK    R455
2433          KM   ROUTE FLOW FROM SPOOK HILL FRS TO SUB-BASIN 480
2434          RS      15    FLOW      -1
2435          RC    .035    .025    .035    7000   .0002
2436          RX       0       1       2      28      58      84      85      86
2437          RY    13.5    13.5    13.5       0       0    13.5    13.5    13.5
              * DDM   ***** Updated *****

2438          KK     480
2439          KM   SUB-BASIN 480
2440          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2441          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .996
2442          KM     L = 1.21  Kb = .042  Adj. Slope =  165.0
```

```
2443          BA    .731
2444          LG    .270    .270   3.580    .730  27.000
2445          UC    .325    .148
2446          UA       0       5      16      30      65      77      84      90      94      97
2447          UA     100
              * DDM   ***** Preserved *****

2448          KK    D480
2449          KM        DIVERT FLOW INTO ONLINE  DETENTION BASIN
2450          KM   DETENTION/RETENTION BASINS LOCATED WITHIN LAS SENDAS ADDENDUM III
2451          KM   FOR BASIN #: 18 & 26
2452          KM        MAXIMUM VOLUME DIVERSION = 16.5 acre-feet
2453          DT   BS480    16.5
2454          DI       0   10000
2455          DQ       0   10000
              * DDM   ***** Preserved *****

2456          KK   RT480
2457          KM   RETRIEVE FLOW FROM DIVERSION INTO ONLINE BASIN
2458          DR   BS480
              * DDM   ***** Preserved *****

2459          KK    S480
2460          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
2461          KM    16.5 ACRE-FEETx43560/36x3600=5.5cfs
2462          RS       1    STOR       0
2463          SV       0     .01    16.5    30.0
2464          SQ       0     3.0     5.6    50.0
              * DDM   ***** Preserved *****

2465          KK    C480
2466          KM   HYDROGRAPH COMBINATION FOR SPOOK HILL FRS
2467          HC       2
              * DDM   ***** Preserved *****

2468          KK   CC480
2469          KM   HYDROGRAPH COMBINATION AT SUBBASIN 480
2470          HC       2   0.731
              * DDM   ***** Preserved *****
1                                   HEC-1 INPUT                                          PAGE 67

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


2471          KK    R480
2472          KM   ROUTE FLOW FROM SUB-BASIN 480 TO SUBBASIN 462
2473          RS       7    FLOW      -1
2474          RC    .035    .025    .035    2800   .0002
2475          RX       0       1       2      28      58      84      85      86
2476          RY    13.5    13.5    13.5       0       0    13.5    13.5    13.5
              * DDM   ***** Updated *****

2477          KK     456
2478          KM   SUB-BASIN 456
2479          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2480          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
2481          KM     L =  .94  Kb = .045  Adj. Slope =  315.0
2482          BA    .260
```

```
2483          LG    .300    .380   5.600    .200  12.000
2484          UC    .217    .139
2485          UA       0       5      16      30      65      77      84      90      94      97
2486          UA     100
              * DDM   ***** Preserved *****

2487          KK      D1
2488          KM        DIVERT FLOW INTO OFFLINE DETENTION BASIN
2489          KM        WEIR FOR BASIN SET AT 4 FEET ABOVE CHANNEL BOTTOM
2490          DT  BASIN1     4.0
2491          DI       0    11.1   127.9   234.4   577.7   789.9  1025.5  1280.9  1555.7
2492          DQ       0       0       0    47.7     248   381.8   533.6   701.5     884
              * DDM   ***** Preserved *****

2493          KK     CD2
2494          KM        SPLIT OUT FLOW FOR WASHES THAT FLOW TO THE SOUTH FROM
2495          KM        WASHES THAT DRAIN TO THE WES, SOUTHERN WASHES FED BY 30" & 24" PIPE
2496          DT    WA30
2497          DI       0    11.1   127.9   189.6   329.7     408   491.9   579.4   671.7
2498          DQ       0    11.1    38.4    48.2      63    69.5      76      81      86
              * DDM   ***** Preserved *****

2499          KK    R456
2500          KM        ROUTE FLOW FROM SUB-BASIN 51 TO C101
2501          RS       2    FLOW      -1
2502          RC     .05    .035     .05    3800    .044
2503          RX    1000    1010    1020    1036    1041    1057    1067    1077
2504          RY   14.88   14.44      14      10      10      14   14.44   14.88
              * DDM   ***** Updated *****

2505          KK     457
2506          KM   SUB-BASIN 457
2507          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2508          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
2509          KM     L = 1.01  Kb = .045  Adj. Slope =  308.8
2510          BA    .190
2511          LG    .270    .330   3.950    .460   6.000
2512          UC    .237    .195
2513          UA       0       5      16      30      65      77      84      90      94      97
2514          UA     100
              * DDM   ***** Preserved *****
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


2515          KK    C101
2516          KM        COMBINE HYDROGRAPHS FROM SUB-BASINS 50 AND 51
2517          HC       2
              * DDM   ***** Preserved *****

2518          KK      D3
2519          KM        RESERVOIR AT THE EDGE OF THE PROPERTY   FLOW FROM CHANNEL
2520          KM        DIVERTED  INTO OFFLINE BASIN A 25' WEIR SET AT ELEVATION 1808 FT
2521          DT  BASIN2     5.0
2522          DI       0      36      70     110     180   313.5     402   500.9
2523          DQ       0       0       0       0       0    67.5     124   190.9
              * DDM   ***** Preserved *****
```

```
2524          KK    RTD3
2525          KM   RETRIEVE FLOW FROM DIVERSION INTO OFFLINE BASIN
2526          DR  BASIN2
              * DDM   ***** Preserved *****

2527          KK     SD3
2528          KM   RETRIEVE FLOW INTO FICTICIOUS BASIN AND BLEED OFF WITHIN 36 HOURS.
2529          KM     5.0 ACRE-FEETx43560/36x3600=1.7cfs
2530          RS       1    STOR       0
2531          SV       0     .01       5
2532          SQ       0     0.7     1.7
              * DDM   ***** Preserved *****

2533          KK     CD3
2534          KM   HYDROGRAPH COMBINATION FOR OFFLINE BASIN BLEEDOFF
2535          HC       2
              * DDM   ***** Preserved *****

2536          KK    R101
2537          KM        ROUTE FLOW FROM SUBBASIN C101 TO C103
2538          RS       1    FLOW      -1
2539          RC     .05    .035     .05    1450     .05
2540          RX    1000    1010    1020    1036    1041    1057    1067    1077
2541          RY      15    14.5      14      10      10      14    14.5      15
              * DDM   ***** Updated *****

2542          KK     458
2543          KM   SUB-BASIN 458
2544          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2545          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
2546          KM     L =  .76  Kb = .048  Adj. Slope =  299.0
2547          BA    .190
2548          LG    .290    .330   5.800    .190   6.000
2549          UC    .204    .131
2550          UA       0       5      16      30      65      77      84      90      94      97
2551          UA     100
              * DDM   ***** Preserved *****
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

2552          KK    C103
2553          KM        COMBINE HYDROGRAPHS FROM SUB-BASIN 55 AND C101
2554          HC       2
              * DDM   ***** Preserved *****

2555          KK    R103
2556          KM        ROUTE FLOW FROM SUBBASIN C103 TO C106
2557          RS       1    FLOW      -1
2558          RC     .05    .035     .05     900     .03
2559          RX    1000    1010    1020    1030    1050    1060    1070    1080
2560          RY   13.16   12.83    12.5      10      10    12.5   12.83   13.16
              * DDM   ***** Preserved *****

2561          KK    RT30
2562          KM        RETRIEVE DIVERTED FLOW FOR WASH BELOW 30 INCH PIPE
```

```
2563          DR    WA30
              * DDM   ***** Preserved *****

2564          KK     R30
2565          KM        ROUTE FLOW FROM WASH DIVERSION TO COMBINE C52
2566          RS       1    FLOW      -1
2567          RC     .05    .035     .05    1630     .05
2568          RX    1000    1010    1020    1036    1041    1057    1067    1077
2569          RY      15    14.5      14      10      10      14    14.5      15
              * DDM   ***** Preserved *****

2570          KK    RTB1
2571          KM        RETRIEVE DIVERTED FLOW FROM BASIN 1
2572          DR  BASIN1
              * DDM   ***** Preserved *****

2573          KK      B1
2574          KM        ROUTE FLOW THROUGH OFFLINE DETENTION BASIN
2575          KM        FLOW OUTLETS THROUGH A 30 INCH OUTLET PIPE
2576          RS       1    ELEV       0
2577          SV              .7     1.4     2.3     2.7     4.0
2578          SQ       0       5      16      28    32.5      37
2579          SE       0       1       2       3     3.5       4
              * DDM   ***** Preserved *****

2580          KK     RB1
2581          KM        ROUTE FLOW FROM BASIN DIVERSION TO COMBINE C52
2582          RS       3    FLOW      -1
2583          RC     .05    .035     .05    1720     .05
2584          RX    1000    1010    1020    1036    1041    1057    1067    1077
2585          RY      15    14.5      14      10      10      14    14.5      15
              * DDM   ***** Preserved *****

2586          KK    CDIV
2587          KM        COMBINE FLOWS FROM WA30 AND BASIN 1
2588          HC       2     .12
              * DDM   ***** Updated *****
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


2589          KK     459
2590          KM   SUB-BASIN 459
2591          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2592          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF 1.000
2593          KM     L =  .35  Kb = .052  Adj. Slope =  251.6
2594          BA    .030
2595          LG    .220    .300   3.330    .710   8.000
2596          UC    .162    .157
2597          UA       0       5      16      30      65      77      84      90      94      97
2598          UA     100
              * DDM   ***** Preserved *****

2599          KK     C52
2600          KM        COMBINE FLOWS FROM SUB-BASIN 52 WA30 AND BASIN 1
2601          HC       2
              * DDM   ***** Preserved *****
```

```
2602          KK     R52
2603          KM        ROUTE FLOW FROM SUBBASIN 52 TO C102
2604          RS       3    FLOW      -1
2605          RC     .05    .035     .05    2000     .05
2606          RX    1000    1010    1020    1036    1041    1057    1067    1077
2607          RY      15    14.5      14      10      10      14    14.5      15
              * DDM   ***** Updated *****

2608          KK     460
2609          KM   SUB-BASIN 460
2610          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2611          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
2612          KM     L =  .62  Kb = .058  Adj. Slope =  194.0
2613          BA    .140
2614          LG    .250    .260   3.740    .690  27.000
2615          UC    .242    .160
2616          UA       0       5      16      30      65      77      84      90      94      97
2617          UA     100
              * DDM   ***** Preserved *****

2618          KK    C102
2619          KM        COMBINE HYDROGRAPHS FROM SUB-BASINS 52 AND 53
2620          HC       2
              * DDM   ***** Preserved *****

2621          KK  BASIN3
2622          KM        RESERVOIR AT CLUBHOUSE LOCATION 1-30 INCH PIPE AT OUTFALL
2623          KM        BOTTOM OF BASIN AT 6 FEET ABOVE 1795 ELEVATION
2624          RS       1    ELEV       0
2625          SA       0       0       0       0     .34    1.59    1.81    1.96    2.13     2.3
2626          SQ       0      22      45    47.4      48      51      57      62      67      73
2627          SE    1795  1797.5    1800  1800.4  1800.5    1801    1802    1803    1804  1805.5
              * DDM   ***** Preserved *****
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

2628          KK      R3
2629          KM        ROUTE FLOW FROM C102 to C106
2630          RS       5    FLOW      -1
2631          RC     .05     .03     .05    2750   .0375
2632          RX    1000    1010    1020    1052    1086    1118    1128    1138
2633          RY    19.2    18.4      18      10      10      18    18.4    19.2
              * DDM   ***** Updated *****

2634          KK     461
2635          KM   SUB-BASIN 461
2636          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2637          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .999
2638          KM     L =  .83  Kb = .052  Adj. Slope =  181.0
2639          BA    .120
2640          LG    .270    .250   4.250    .450  21.000
2641          UC    .271    .250
2642          UA       0       5      16      30      65      77      84      90      94      97
2643          UA     100
              * DDM   ***** Preserved *****
```

```
2644          KK    C104
2645          KM        COMBINE HYDROGRAPHS FROM SUB-BASIN 54 AND R102
2646          HC       2
              * DDM   ***** Preserved *****

2647          KK    C106
2648          KM        COMBINE HYDROGRAPHS FROM SUB-BASIN C103 AND C104
2649          HC       2
              * DDM   ***** Preserved *****

2650          KK    R106
2651          KM        ROUTE FLOW FROM C106 TO C49
2652          RS       2    FLOW      -1
2653          RC     .05    .035     .05    3950    .033
2654          RX    1000    1010    1020    1030    1050    1060    1070    1080
2655          RY   13.16   12.83    12.5      10      10    12.5   12.83   13.16
              * DDM   ***** Updated *****

2656          KK     462
2657          KM   SUB-BASIN 462
2658          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2659          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .998
2660          KM     L =  .97  Kb = .045  Adj. Slope =  297.7
2661          BA    .301
2662          LG    .300    .330   5.300    .240  12.000
2663          UC    .225    .137
2664          UA       0       5      16      30      65      77      84      90      94      97
2665          UA     100
              * DDM   ***** Preserved *****
1                                          HEC-1 INPUT                                          PAGE 72

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


2666          KK     C56
2667          KM        COMBINE HYDROGRAPHS FROM SUB-BASIN 56 AND C106
2668          HC       2
              * DDM   ***** Preserved *****

2669          KK    C462
2670          KM        COMBINE HYDROGRAPHS AT SUBBASIN 462
2671          HC       2    2.09
              * DDM   ***** Preserved *****

2672          KK    R462
2673          KM   ROUTE FLOW FROM SUB-BASIN 462 TO SUB-BASIN 500 (First Channel Reach)
2674          RS       1    FLOW      -1
2675          RC    .025    .025    .025    1800    .005
2676          RX       0       1      20      32      62      74      93      94
2677          RY      13      12      12       0       0      12      12      13
              *
              * DDM   ***** Preserved *****

2678          KK   RR462
2679          KM   ROUTE FLOW FROM SUB-BASIN 462 TO SUB-BASIN 500 (Second Natural Wash Reach)
2680          RS       3    FLOW      -1
2681          RC    .055     .05    .055    4700     .05
```

```
2682          RX       0       1       2      28      58      84      85      86
2683          RY    13.5    13.5    13.5       0       0    13.5    13.5    13.5
              * DDM   ***** Updated *****

2684          KK     500
2685          KM   SUB-BASIN 500
2686          KM   24-HOUR SCS TYPE II RAINFALL WAS USED TO FIND TC & R FOR THIS BASIN
2687          KM   THIS BASIN USED RAINFALL REDUCTION FACTOR OF  .994
2688          KM     L = 2.77  Kb = .042  Adj. Slope =  286.8
2689          BA    .930
2690          LG    .350    .400   6.000    .170   9.000
2691          UC    .421    .333
2692          UA       0       3       5       8      12      20      43      75      90      96
2693          UA     100
              * DDM   ***** Preserved *****

2694          KK    C500
2695          KM   HYDROGRAPH COMBINATION FOR THE ENTIRE WATERSHED AT THE SALT RIVER
2696          HC       2    3.02
2697          ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   57          10
                V
                V
   67         R10
                V
                V
   73         R12
                .
                .
   79           .          20
                .           .
                .           .
   92           .           .------->    BS20
   89           .         D20
                .           .
                .           .
   97           .           .           .<-------    BS20
   95           .           .        RT20
                .           .           V
                .           .           V
   98           .           .         S20
                .           .           .
                .           .           .
  104         C20.......................
                V
                V
  107         R20
                .
                .
  113           .          40
                .           .
```

```
              .           .
126           .           .------->    BS40
123           .         D40
              .           .
              .           .
131           .           .           .<-------    BS40
129           .           .        RT40
              .           .           V
              .           .           V
132           .           .         S40
              .           .           .
              .           .           .
138         C40.......................
              .
              .
141           .          60
              .           .
              .           .
154           .           .------->    BS60
151           .         D60
              .           .
              .           .
159           .           .           .<-------    BS60
157           .           .        RT60
              .           .           V
              .           .           V
160           .           .        SB60
              .           .           .
              .           .           .
166         C60.......................
              V
              V
169         S60
              V
              V
181         R60
              V
              V
187        RR60
              .
              .
193           .          80
              .           .
              .           .
206           .           .------->    BS80
203           .         D80
              .           .
              .           .
211           .           .           .<-------    BS80
209           .           .        RT80
              .           .           V
              .           .           V
212           .           .         S80
              .           .           .
              .           .           .
218           .         C80............
              .           .
              .           .
```

```
221        CC80............
              V
              V
224         R80
              .
              .
230           .         100
              .           .
              .           .
243           .           .-------->   BS100
240           .        D100
              .           .
              .           .
248           .           .           .<-------   BS100
246           .           .       RT100
              .           .           V
              .           .           V
249           .           .        S100
              .           .           .
              .           .           .
255        C100........................
              V
              V
258        R100
              .
              .
264           .         120
              .           .
              .           .
277           .           .-------->   BS120
274           .        D120
              .           .
              .           .
282           .           .           .<-------   BS120
280           .           .       RT120
              .           .           V
              .           .           V
283           .           .        S120
              .           .           .
              .           .           .
289        C120........................
              V
              V
292        R120
              .
              .
298           .         140
              .           .
              .           .
311           .           .-------->   BS140
308           .        D140
              .           .
              .           .
316           .           .           .<-------   BS140
314           .           .       RT140
              .           .           V
              .           .           V
317           .           .        S140
```

```
                .          .          .
                .          .          .
323         C140.......................
                .
                .
326             .        150
                .          V
                .          V
336             .       R150
                .          V
                .          V
342             .       R152
                .          .
                .          .
348             .          .        160
                .          .          .
                .          .          .
361             .          .          .-------->   BS160
358             .          .       D160
                .          .          .
                .          .          .
366             .          .          .          .<-------   BS160
364             .          .          .      RT160
                .          .          .          V
                .          .          .          V
367             .          .          .       S160
                .          .          .          .
                .          .          .          .
373             .       C160.......................
                .          .
                .          .
376             .          .        180
                .          .          .
                .          .          .
386         C180.......................
                .
                .
389             .        210
                .          V
                .          V
399             .       R210
                .          .
                .          .
405             .          .        240
                .          .          .
                .          .          .
415             .       C240............
                .          V
                .          V
418             .       S240
                .          V
                .          V
425             .       R240
                .          .
                .          .
432             .          .        220
                .          .          .
                .          .          .
```

```
442          .        C220............
             .           V
             .           V
445          .       SW220
             .           V
             .           V
452          .        R220
             .           .
             .           .
459          .           .         190
             .           .           V
             .           .           V
469          .           .        R190
             .           .           V
             .           .           V
475          .           .        R192
             .           .           .
             .           .           .
481          .           .           .         200
             .           .           .           .
             .           .           .           .
491          .        C200........................
             .           V
             .           V
494          .       SW200
             .           V
             .           V
501          .        R200
             .           V
             .           V
507          .       SS200
             .           V
             .           V
514          .       RR200
             .           .
             .           .
520       CC180............
             V
             V
523       S180
             V
             V
535       R180
             .
             .
544          .         260
             .           .
             .           .
554       C260............
             V
             V
557       R260
             .
             .
566          .         280
             .           .
             .           .
576       C280............
```

```
             V
             V
579        R280
             .
             .
588          .         300
             .           .
             .           .
598        C300............
             V
             V
601        R300
             .
             .
610          .        305A
             .           .
             .           .
620        C305............
             V
             V
623        R305
             .
             .
631          .       320B1
             .           .
             .           .
646          .           .-------> B320B1
641          .      D320B1
             .           .
             .           .
651          .           .          .<-------  B320B1
649          .           .      T320B1
             .           .          V
             .           .          V
652          .           .      S320B1
             .           .           .
             .           .           .
658      C320B1........................
             .
             .
661          .         350
             .           .
             .           .
674          .           .------->   SF350
671          .        D350
             .           V
             .           V
677          .        R350
             .           .
             .           .
684          .           .         310
             .           .           .
             .           .           .
694          .        C310............
             .           V
             .           V
697          .        R310
             .           .
```

```
                .          .
704             .          .       305B
                .          .          V
                .          .          V
714             .          .      R305B
                .          .          .
                .          .          .
721             .          .          .      320B2
                .          .          .          .
                .          .          .          .
736             .          .          .          .-------> B320B2
731             .          .          .     D320B2
                .          .          .          .
                .          .          .          .
741             .          .          .          .          .<------- B320B2
739             .          .          .          .     T320B2
                .          .          .          .          V
                .          .          .          .          V
742             .          .          .          .     S320B2
                .          .          .          .          .
                .          .          .          .          .
748             .     C320B2.................................
                .          V
                .          V
751             .     R320B2
                .          .
                .          .
758             .          .       340B
                .          .          .
                .          .          .
773             .          .          .-------> BS340B
768             .          .      D340B
                .          .          .
                .          .          .
778             .          .          .          .<------- BS340B
776             .          .          .     RT340B
                .          .          .          V
                .          .          .          V
779             .          .          .      S340B
                .          .          .          .
                .          .          .          .
785             .      C340B......................
                .          .
                .          .
790             .          .------->  BS340
788             .     DD340B
                .          .
                .          .
795             .          .          .<-------  BS340
793             .          .      RT340
                .          .          V
                .          .          V
796             .          .     SS340B
                .          .          .
                .          .          .
802             .     CD340B............
                .          .
                .          .
```

```
807          .          .          .<-------   SF350
805          .          .      RT350
             .          .          V
             .          .          V
808          .          .      RR350
             .          .          .
             .          .          .
815          .          .          .         355
             .          .          .           .
             .          .          .           .
825          .          .       C355............
             .          .          .
             .          .          .
831          .          .          .------->   BS355
828          .          .       D355
             .          .          .
             .          .          .
836          .          .          .           .<-------   BS355
834          .          .          .       RT355
             .          .          .           V
             .          .          .           V
837          .          .          .       S355
             .          .          .           .
             .          .          .           .
843          .          .      CC355............
             .          .          V
             .          .          V
846          .          .       R355
             .          .          .
             .          .          .
853          .     CC340B............
             .          V
             .          V
856          .      R340B
             .          .
             .          .
863          .          .      340A2
             .          .          .
             .          .          .
876          .          .          .------->  B340A2
873          .          .     D340A2
             .          .          .
             .          .          .
881          .          .          .           .<-------  B340A2
879          .          .          .     T340A2
             .          .          .           V
             .          .          .           V
882          .          .          .     S340A2
             .          .          .           .
             .          .          .           .
888          .     C340A2........................
             .          V
             .          V
891          .     R340A2
             .          .
             .          .
898     CC320B............
             V
```

```
                V
901        R320B
                .
                .
910             .        320A
                .           .
                .           .
925             .           .-------> BS320A
920             .       D320A
                .           .
                .           .
930             .           .          .<-------  BS320A
928             .           .     RT320A
                .           .          V
                .           .          V
931             .           .      S320A
                .           .          .
                .           .          .
937         C320........................
                .
                .
940             .       340A1
                .           .
                .           .
955             .           .-------> B340A1
950             .      D340A1
                .           .
                .           .
960             .           .          .<-------  B340A1
958             .           .     T340A1
                .           .          V
                .           .          V
961             .           .     S340A1
                .           .          .
                .           .          .
967             .      C340A1............
                .           .
                .           .
970         C340............
                .
                .
973             .         360
                .           .
                .           .
987             .           .------->   BS360
983             .        D360
                .           .
                .           .
992             .           .          .<-------   BS360
990             .           .      RT360
                .           .          V
                .           .          V
993             .           .       S360
                .           .          .
                .           .          .
999         C360........................
                .
                .
```

```
1002          .        380A
              .           .
              .           .
1012      C380A............
              .
              .
1015          .        400A
              .           .
              .           .
1025      C400A............
              .
              .
1028          .        370A
              .           .
              .           .
1043          .           .-------->    DIV1
1037          .       D370A
              .           V
              .           V
1046          .      RD370A
              .           .
              .           .
1053          .           .        370B
              .           .           .
              .           .           .
1062          .      CP370B............
              .           V
              .           V
1066          .        S370
              .           .
              .           .
1078          .           .-------->   B370W
1076          .        D370
              .           V
              .           V
1081          .       R370S
              .           .
              .           .
1088          .           .       380B1
              .           .           .
              .           .           .
1102          .           .           .-------->  B380B1
1098          .           .      D380B1
              .           .           .
              .           .           .
1107          .           .           .           .<-------  B380B1
1105          .           .           .      T380B1
              .           .           .           V
              .           .           .           V
1108          .           .           .      S380B1
              .           .           .           .
              .           .           .           .
1114          .      C380B1........................
              .           V
              .           V
1117          .      R380B1
              .           .
              .           .
```

```
1124          .          .       400B1
              .          .          .
              .          .          .
1138          .          .          .-------> B400B1
1134          .          .      D400B1
              .          .          .
              .          .          .
1143          .          .          .          .<-------  B400B1
1141          .          .          .     T400B1
              .          .          .          V
              .          .          .          V
1144          .          .          .     S400B1
              .          .          .          .
              .          .          .          .
1150          .          .      C400B1............
              .          .          .
              .          .          .
1153     CC400B.......................
              .
              .
1156          .       420A2
              .          .
              .          .
1166     C400A2............
              .
              .
1171          .          .<-------   B370W
1169          .       T370W
              .          V
              .          V
1172          .       R370W
              .          .
              .          .
1180          .          .          .<-------    DIV1
1178          .          .       D370A
              .          .          V
              .          .          V
1181          .          .       RDIV1
              .          .          .
              .          .          .
1193          .          .          .------->    DIV2
1187          .          .       DDIV1
              .          .          V
              .          .          V
1196          .          .      RDDIV1
              .          .          .
              .          .          .
1203          .          .          .        395A
              .          .          .          .
              .          .          .          .
1212          .          .      CP395A............
              .          .          V
              .          .          V
1216          .          .      R390C1
              .          .          .
              .          .          .
1224          .          .          .        395B
              .          .          .          V
```

```
                .          .          .          V
1234            .          .          .     R390C2
                .          .          .          .
                .          .          .          .
1242            .          .          .          .       390C
                .          .          .          .          .
                .          .          .          .          .
1252            .          .     CP390C.......................
                .          .          .
                .          .          .
1256            .          .          .       385A
                .          .          .          .
                .          .          .          .
1267            .          .          .          .          .<-------    DIV2
1265            .          .          .          .      DDIV1
                .          .          .          .          V
                .          .          .          .          V
1268            .          .          .          .      RDIV2
                .          .          .          .          .
                .          .          .          .          .
1275            .          .          .          .          .       385B
                .          .          .          .          .          .
                .          .          .          .          .          .
1290            .          .          .          .          .          .------->    DIV3
1284            .          .          .          .          .      D385B
                .          .          .          .          .          V
                .          .          .          .          .          V
1293            .          .          .          .          .     RD385B
                .          .          .          .          .          .
                .          .          .          .          .          .
1300            .          .          .     CP385A.......................
                .          .          .          .
                .          .          .          .
1308            .          .          .          .------->    DIV4
1304            .          .          .      D385A
                .          .          .          .
                .          .          .          .
1319            .          .          .          .------->    DIV5
1311            .          .          .     DD385A
                .          .          .          V
                .          .          .          V
1322            .          .          .     R390C3
                .          .          .          .
                .          .          .          .
1329            .          .     CC390C............
                .          .          .
                .          .          .
1336            .          .          .------->  TO390B
1333            .          .      TOC-H
                .          .          .
                .          .          .
1339            .       C370............
                .          V
                .          V
1343            .      R390S
                .          .
                .          .
1349            .          .      400B3
```

```
                .          .          .
                .          .          .
1363            .          .          .-------> B400B3
1359            .          .     D400B3
                .          .          .
                .          .          .
1368            .          .          .          .<------- B400B3
1366            .          .          .     T400B3
                .          .          .          V
                .          .          .          V
1369            .          .          .     S400B3
                .          .          .          .
                .          .          .          .
1375            .          .     C400B3............
                .          .          .
                .          .          .
1378            .      C390S............
                .          .
                .          .
1381            .          .      380B3
                .          .          .
                .          .          .
1394            .          .          .-------> B380B3
1391            .          .     D380B3
                .          .          .
                .          .          .
1399            .          .          .          .<------- B380B3
1397            .          .          .     T380B3
                .          .          .          V
                .          .          .          V
1400            .          .          .     S380B3
                .          .          .          .
                .          .          .          .
1406            .          .     C380B3............
                .          .          .
                .          .          .
1412            .          .          .-------> 380B3c
1409            .          .     D380B3
                .          .          .
                .          .          .
1418            .          .          .-------> 380B3a
1415            .          .     380B3b
                .          .          .
                .          .          .
1421            .      C380BB............
                .          .
                .          .
1427            .          .-------> B38B3b
1424            .      D380B
                .          .
                .          .
1432            .          .          .<------- B38B3b
1430            .          .     RT380B
                .          .          V
                .          .          V
1433            .          .      S380B
                .          .          .
                .          .          .
```

```
1439          .      CC380B............
              .           V
              .           V
1442          .      R38B3b
              .           .
              .           .
1450          .           .           .<-------  380B3a
1448          .           .      T38B3a
              .           .           V
              .           .           V
1451          .           .      R38B3a
              .           .           .
              .           .           .
1459          .           .           .           .<-------  380B3c
1457          .           .           .      T38B3c
              .           .           .           .
              .           .           .           .
1460          .      C38B3c........................
              .           V
              .           V
1463          .      R380B3
              .           .
              .           .
1469          .           .       380B2
              .           .           .
              .           .           .
1479          .      C380B2............
              .           V
              .           V
1482          .      R380B2
              .           .
              .           .
1489          .           .       400B2
              .           .           .
              .           .           .
1499          .      C400B2............
              .           V
              .           V
1502          .      R400B2
              .           .
              .           .
1509          .           .       420A1
              .           .           .
              .           .           .
1523          .           .           .-------> B420A1
1519          .           .      D420A1
              .           .           .
              .           .           .
1528          .           .           .           .<-------  B420A1
1526          .           .           .      T420A1
              .           .           .           V
              .           .           .           V
1529          .           .           .      S420A1
              .           .           .           .
              .           .           .           .
1535       C420A...................................
              .
              .
```

```
1541          .          .<-------  TO390B
1538          .      R390B
              .          V
              .          V
1542          .     R390B1
              .          .
              .          .
1548          .          .       385C
              .          .          .
              .          .          .
1559          .          .          .          .<-------    DIV3
1557          .          .          .      D385B
              .          .          .          V
              .          .          .          V
1560          .          .          .      RDIV3
              .          .          .          .
              .          .          .          .
1567          .          .     CP385C............
              .          .          .
              .          .          .
1578          .          .          .------->    DIV6
1571          .          .      D385C
              .          .          V
              .          .          V
1581          .          .     RD385C
              .          .          .
              .          .          .
1588          .          .          .       385D
              .          .          .          .
              .          .          .          .
1599          .          .          .          .          .<-------    DIV4
1597          .          .          .          .      D385A
              .          .          .          .          V
              .          .          .          .          V
1600          .          .          .          .      RDIV4
              .          .          .          .          .
              .          .          .          .          .
1607          .          .     CI385D........................
              .          .          .
              .          .          .
1614          .          .          .          .<-------    DIV5
1612          .          .          .     DD385A
              .          .          .          V
              .          .          .          V
1615          .          .          .      RDIV5
              .          .          .          .
              .          .          .          .
1619          .          .     CP385D............
              .          .          V
              .          .          V
1624          .          .      R385D
              .          .          .
              .          .          .
1628          .          .          .       385E
              .          .          .          .
              .          .          .          .
1637          .          .     CP385E............
              .          .          .
```

```
                .          .          .
1648            .          .          .-------->   DIV10
1641            .          .      D385E
                .          .          V
                .          .          V
1651            .          .     RD385E
                .          .          .
                .          .          .
1655            .          .          .       415B
                .          .          .          V
                .          .          .          V
1664            .          .          .     RD415B
                .          .          .          .
                .          .          .          .
1668            .          .          .          .       415C
                .          .          .          .          .
                .          .          .          .          .
1677            .          .          .     CP415C............
                .          .          .          .
                .          .          .          .
1688            .          .          .          .-------->    DIV9
1681            .          .          .      D415C
                .          .          .          V
                .          .          .          V
1691            .          .          .     RD415C
                .          .          .          .
                .          .          .          .
1695            .          .          .          .       385G
                .          .          .          .          .
                .          .          .          .          .
1706            .          .          .          .          .          .<-------    DIV6
1704            .          .          .          .          .      D385C
                .          .          .          .          .          V
                .          .          .          .          .          V
1707            .          .          .          .          .      RDIV6
                .          .          .          .          .          .
                .          .          .          .          .          .
1714            .          .          .          .     CP385G............
                .          .          .          .          .
                .          .          .          .          .
1725            .          .          .          .          .-------->    DIV8
1718            .          .          .          .      D385G
                .          .          .          .          .
                .          .          .          .          .
1730            .          .          .          .          .          .<-------    DIV9
1728            .          .          .          .          .      D415C
                .          .          .          .          .          .
                .          .          .          .          .          .
1731            .          .          .          .     CC385G............
                .          .          .          .          .
                .          .          .          .          .
1735            .          .          .          .          .       385F
                .          .          .          .          .          .
                .          .          .          .          .          .
1746            .          .          .          .          .          .          .<-------   DIV10
1744            .          .          .          .          .          .      D385E
                .          .          .          .          .          .          .
                .          .          .          .          .          .          .
```

```
1747          .          .          .          .      BASIN.......................
              .          .          .          .          V
              .          .          .          .          V
1754          .          .          .          .     SBASIN
              .          .          .          .          .
              .          .          .          .          .
1766          .          .     CC415B.......................
              .          .          V
              .          .          V
1771          .          .     R390A1
              .          .          .
              .          .          .
1780          .          .          .       390A
              .          .          .          .
              .          .          .          .
1790          .          .     CP390A............
              .          .          V
              .          .          V
1795          .          .     R390B2
              .          .          .
              .          .          .
1806          .          .          .       390B
              .          .          .          .
              .          .          .          .
1816          .          .     CC390B............
              .          .          .
              .          .          .
1820          .     CP390B............
              .          V
              .          V
1825          .      S390B
              .          .
              .          .
1834          .          .     420B05
              .          .          .
              .          .          .
1844          .     CPSD05............
              .          .
              .          .
1848          .          .     420B10
              .          .          .
              .          .          .
1858          .     CPSD10............
              .          .
              .          .
1862          .          .     420B15
              .          .          .
              .          .          .
1872          .     CPSD15............
              .          .
              .          .
1876          .          .     420B20
              .          .          .
              .          .          .
1886          .     CPSD20............
              .          .
              .          .
1890          .          .     420B25
```

```
                .          .          V
                .          .          V
1900            .          .      SFIRES
                .          .          .
                .          .          .
1908            .      CPSD25...........
                .          .
                .          .
1912            .          .      420B30
                .          .          .
                .          .          .
1922            .      CPSD30...........
                .          .
                .          .
1926            .          .      420B35
                .          .          V
                .          .          V
1936            .          .      SCHRCH
                .          .          .
                .          .          .
1945            .      CPSD35...........
                .          .
                .          .
1949            .          .      420B40
                .          .          .
                .          .          .
1959            .      CPSD40...........
                .          .
                .          .
1963            .          .      420B45
                .          .          .
                .          .          .
1973            .      CPSD45...........
                .          .
                .          .
1982            .          .------->    MCDB
1977            .      TOLSCH
                .          .
                .          .
1985            .          .        440
                .          .          V
                .          .          V
1995            .          .        R70
                .          .          .
                .          .          .
2001            .          .          .         441
                .          .          .           .
                .          .          .           .
2011            .          .       C108...........
                .          .          .
                .          .          .
2016            .          .          .------->   SPLIT
2014            .          .         D4
                .          .          V
                .          .          V
2019            .          .       R108
                .          .          .
                .          .          .
```

```
2025          .          .          .        442
              .          .          .          .
              .          .          .          .
2035          .          .        C67............
              .          .          .
              .          .          .
2041          .          .          .-------> BASIN4
2038          .          .         D6
              .          .          .
              .          .          .
2046          .          .          .          .<-------  BASIN4
2044          .          .          .       RTD6
              .          .          .          V
              .          .          .          V
2047          .          .          .        SD6
              .          .          .          .
              .          .          .          .
2053          .          .        CD6............
              .          .          .
              .          .          .
2056          .          .          .        443
              .          .          .          .
              .          .          .          .
2069          .          .          .          .------->   WSH66
2066          .          .          .        D66
              .          .          .          V
              .          .          .          V
2072          .          .          .       R113
              .          .          .          .
              .          .          .          .
2078          .          .       C114............
              .          .          .
              .          .          .
2081          .          .          .        444
              .          .          .          V
              .          .          .          V
2091          .          .          .        R58
              .          .          .          .
              .          .          .          .
2097          .          .          .          .        445
              .          .          .          .          .
              .          .          .          .          .
2107          .          .          .       C107............
              .          .          .          V
              .          .          .          V
2110          .          .          .       R107
              .          .          .          .
              .          .          .          .
2118          .          .          .          .          .<-------   SPLIT
2116          .          .          .          .       RTB2
              .          .          .          .          V
              .          .          .          .          V
2119          .          .          .          .     RSPLIT
              .          .          .          .          .
              .          .          .          .          .
2125          .          .          .          .          .         446
              .          .          .          .          .           .
              .          .          .          .          .           .
```

```
2135          .           .           .        C109.......................
              .           .           .           .
              .           .           .           .
2141          .           .           .           .-------->  WSH404
2138          .           .           .          D5
              .           .           .           V
              .           .           .           V
2144          .           .           .        R109
              .           .           .           .
              .           .           .           .
2150          .           .           .           .         447
              .           .           .           .           .
              .           .           .           .           .
2162          .           .           .           .           .           .<-------  WSH404
2160          .           .           .           .           .       RT404
              .           .           .           .           .           V
              .           .           .           .           .           V
2163          .           .           .           .           .        R404
              .           .           .           .           .           .
              .           .           .           .           .           .
2169          .           .           .        C110.......................
              .           .           .           V
              .           .           .           V
2172          .           .           .        R110
              .           .           .           .
              .           .           .           .
2178          .           .        C115............
              .           .           V
              .           .           V
2181          .           .        R115
              .           .           .
              .           .           .
2187          .           .           .         448
              .           .           .           .
              .           .           .           .
2197          .           .           .           .         449
              .           .           .           .           .
              .           .           .           .           .
2207          .           .           .       C6364............
              .           .           .           V
              .           .           .           V
2210          .           .           .       R6364
              .           .           .           .
              .           .           .           .
2216          .           .           .           .         450
              .           .           .           .           .
              .           .           .           .           .
2226          .           .           .           .           .         451
              .           .           .           .           .           .
              .           .           .           .           .           .
2236          .           .           .           .        C451............
              .           .           .           .           .
              .           .           .           .           .
2241          .           .           .           .           .           .<-------   WSH66
2239          .           .           .           .           .        RT66
              .           .           .           .           .           .
              .           .           .           .           .           .
2242          .           .           .           .           .           .         452
```

```
                .         .         .         .         .         .         .
                .         .         .         .         .         .         .
2252            .         .         .         .         .      C6465...........
                .         .         .         .         .          V
                .         .         .         .         .          V
2255            .         .         .         .         .      R6566
                .         .         .         .         .          .
                .         .         .         .         .          .
2261            .         .         .       C116.......................
                .         .         .          V
                .         .         .          V
2264            .         .         .     BASIN5
                .         .         .          V
                .         .         .          V
2271            .         .         .       R116
                .         .         .          .
                .         .         .          .
2277            .         .         .          .        453
                .         .         .          .          .
                .         .         .          .          .
2287            .         .         .       C117...........
                .         .         .          .
                .         .         .          .
2290            .         .      C118...........
                .         .         V
                .         .         V
2293            .         .      R118
                .         .         .
                .         .         .
2302            .         .         .-------> BASIN6
2299            .         .        D7
                .         .         .
                .         .         .
2307            .         .         .          .<-------  BASIN6
2305            .         .         .       RTD7
                .         .         .          V
                .         .         .          V
2308            .         .         .        SD7
                .         .         .          .
                .         .         .          .
2314            .         .       CD7...........
                .         .         .
                .         .         .
2317            .         .         .        454
                .         .         .          .
                .         .         .          .
2327            .         .      C454...........
                .         .         V
                .         .         V
2330            .         .      R454
                .         .         .
                .         .         .
2337            .         .         .       415A
                .         .         .          .
                .         .         .          .
2350            .         .         .          .          .<-------    DIV8
2347            .         .         .          .      D385G
                .         .         .          .          V
```

```
                .          .          .          .          V
2351            .          .          .          .      RDIV8
                .          .          .          .          .
                .          .          .          .          .
2358            .     CP415A.................................
                .          .
                .          .
2368            .          .          .<-------    MCDB
2364            .          .      RMCDB
                .          .          V
                .          .          V
2369            .          .      SMCDB
                .          .          .
                .          .          .
2379            .     CPLSCH............
                .          V
                .          V
2383            .      R415A
                .          .
                .          .
2390            .          .        455
                .          .          .
                .          .          .
2405            .          .          .------->   BS455
2400            .          .       D455
                .          .          .
                .          .          .
2410            .          .          .          .<-------   BS455
2408            .          .          .      RT455
                .          .          .          V
                .          .          .          V
2411            .          .          .       S455
                .          .          .          .
                .          .          .          .
2417            .          .       C455............
                .          .          .
                .          .          .
2420       CC455........................
               V
               V
2423        S440
               V
               V
2432        R455
               .
               .
2438            .        480
                .          .
                .          .
2453            .          .------->   BS480
2448            .       D480
                .          .
                .          .
2458            .          .          .<-------   BS480
2456            .          .      RT480
                .          .          V
                .          .          V
2459            .          .       S480
```

```
                .          .          .
                .          .          .
2465            .       C480...........
                .          .
                .          .
2468         CC480...........
                V
                V
2471          R480
                .
                .
2477            .        456
                .          .
                .          .
2490            .          .-------> BASIN1
2487            .         D1
                .          .
                .          .
2496            .          .------->   WA30
2493            .        CD2
                .          V
                .          V
2499            .       R456
                .          .
                .          .
2505            .          .         457
                .          .           .
                .          .           .
2515            .       C101...........
                .          .
                .          .
2521            .          .-------> BASIN2
2518            .         D3
                .          .
                .          .
2526            .          .           .<------- BASIN2
2524            .          .        RTD3
                .          .           V
                .          .           V
2527            .          .         SD3
                .          .           .
                .          .           .
2533            .        CD3...........
                .          V
                .          V
2536            .       R101
                .          .
                .          .
2542            .          .         458
                .          .           .
                .          .           .
2552            .       C103...........
                .          V
                .          V
2555            .       R103
                .          .
                .          .
2563            .          .           .<-------   WA30
```

```
2561          .          .       RT30
              .          .          V
              .          .          V
2564          .          .        R30
              .          .          .
              .          .          .
2572          .          .          .          .<-------  BASIN1
2570          .          .          .        RTB1
              .          .          .          V
              .          .          .          V
2573          .          .          .         B1
              .          .          .          V
              .          .          .          V
2580          .          .          .         RB1
              .          .          .          .
              .          .          .          .
2586          .          .       CDIV............
              .          .          .
              .          .          .
2589          .          .          .         459
              .          .          .          .
              .          .          .          .
2599          .          .        C52............
              .          .          V
              .          .          V
2602          .          .        R52
              .          .          .
              .          .          .
2608          .          .          .         460
              .          .          .          .
              .          .          .          .
2618          .          .       C102............
              .          .          V
              .          .          V
2621          .          .     BASIN3
              .          .          V
              .          .          V
2628          .          .         R3
              .          .          .
              .          .          .
2634          .          .          .         461
              .          .          .          .
              .          .          .          .
2644          .          .       C104............
              .          .          .
              .          .          .
2647          .       C106............
              .          V
              .          V
2650          .       R106
              .          .
              .          .
2656          .          .        462
              .          .          .
              .          .          .
2666          .        C56............
              .          .
              .          .
```

```
 2669        C462............
                V
                V
 2672        R462
                V
                V
 2678       RR462
                .
                .
 2684           .         500
                .           .
                .           .
 2694        C500............
```

```
 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *               JUN   1998              *
 *            VERSION 4.1                *
 *                                       *
 *  RUN DATE   24JUL12  TIME  13:31:21   *
 *                                       *
 *****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*           609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

```
*****************************************************************************
*************** OAK STREET BASIN AND STORM DRAIN HYDROLOGY ******************
*****************************************************************************
***                                                                       ***
***  Project:    OAK STREET BASIN AND STORM DRAIN                         ***
***  Client:     FLOOD CONTROL DISTRICT OF MARICOPA COUNTY                ***
***  Input File: Oak_Street_Basin_and_Storm_Drain.dat                     ***
***                                                                       ***
***  Contract FCD:     2009C021                                           ***
***  Gavan & Barker:   0912                                               ***
***  Modelers:         Mark Gavan & Omer Karovic                          ***
***  Storm:            100-year, 24-hour                                  ***
***                                                                       ***
***  NOTE:                                                                ***
***  The Spook Hill ADMP model as well as the McDowell Road Basin and     ***
***  Storm Drain Hydrology model were used as a base for this model.      ***
***                                                                       ***
*****************************************************************************
*************** OAK STREET BASIN AND STORM DRAIN HYDROLOGY ******************
*****************************************************************************
*****************************************************************************
************************** START OF BASE MODEL ******************************
*****************************************************************************
McDowell Road Basin and Storm Drain Design
This model assumes that the Oak Street detention basin is installed,
and all flows pass through the Thunder Mountain detention basin.

The Spook Hill ADMP model was used as a base for this model
Return Period = 100 Years, Rainfall Duration = 24 Hours
```

```
                    METHODOLOGY
                    THE US CORPS OF ENGINEERS FLOW HYDROGRAPH PACKAGE HEC-1 DATED JUNE 1998 V4.1
                    SCS TYPE II RAINFALL DISTRIBUTION
                    CLARK UNIT HYDROGRAPH
                    GREEN AND AMPT INFILTRATION EQUATION USED FOR CALCULATING LOSSES
                    NORMAL DEPTH STORAGE CHANNEL ROUTING

38 IO          OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

   IT          HYDROGRAPH TIME DATA
                      NMIN          2  MINUTES IN COMPUTATION INTERVAL
                     IDATE     1JAN 0  STARTING DATE
                     ITIME       0000  STARTING TIME
                        NQ        720  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE     1JAN 0  ENDING DATE
                    NDTIME       2358  ENDING TIME
                     ICENT         19  CENTURY MARK

                 COMPUTATION INTERVAL     .03 HOURS
                      TOTAL TIME BASE   23.97 HOURS

        ENGLISH UNITS
             DRAINAGE AREA         SQUARE MILES
             PRECIPITATION DEPTH   INCHES
             LENGTH, ELEVATION     FEET
             FLOW                  CUBIC FEET PER SECOND
             STORAGE VOLUME        ACRE-FEET
             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT

40 JD          INDEX STORM NO. 1
                      STRM       3.81  PRECIPITATION DEPTH
                      TRDA        .01  TRANSPOSITION DRAINAGE AREA

41 PI            PRECIPITATION PATTERN
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                    .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
```

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.01	.01	.03	.04	.04	.04	.04	.04	.04	.04
.01	.01	.01	.01	.01	.01	.01	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	

```
51 JD          INDEX STORM NO. 2
                      STRM         3.79  PRECIPITATION DEPTH
                      TRDA         1.00  TRANSPOSITION DRAINAGE AREA
```

0 PI PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.01	.01	.03	.04	.04	.04	.04	.04	.04	.04
.01	.01	.01	.01	.01	.01	.01	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

```
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00
52 JD         INDEX STORM NO. 3
                 STRM        3.68  PRECIPITATION DEPTH
                 TRDA        5.80  TRANSPOSITION DRAINAGE AREA

 0 PI          PRECIPITATION PATTERN
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .00       .00       .00       .00       .00
                .00       .00       .00       .00       .00       .01       .01       .01       .01       .01
                .01       .01       .03       .04       .04       .04       .04       .04       .04       .04
                .01       .01       .01       .01       .01       .01       .01       .00       .00       .00
```

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	

53 JD INDEX STORM NO. 4

STRM 3.57 PRECIPITATION DEPTH

TRDA 10.66 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.01	.01	.03	.04	.04	.04	.04	.04	.04	.04
.01	.01	.01	.01	.01	.01	.01	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	

54 JD INDEX STORM NO. 5

STRM 3.54 PRECIPITATION DEPTH

TRDA 13.70 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.01	.01	.03	.04	.04	.04	.04	.04	.04	.04
.01	.01	.01	.01	.01	.01	.01	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	

55 JD INDEX STORM NO. 6

STRM 3.47 PRECIPITATION DEPTH

TRDA 20.00 TRANSPOSITION DRAINAGE AREA

0 PI PRECIPITATION PATTERN

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.01	.01	.01	.01	.01

```
.01      .01      .03      .04      .04      .04      .04      .04      .04      .04
.01      .01      .01      .01      .01      .01      .01      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00      .00
.00      .00      .00      .00      .00      .00      .00      .00      .00
```

```
56 JD          INDEX STORM NO. 7
                STRM        3.32  PRECIPITATION DEPTH
                TRDA       50.00  TRANSPOSITION DRAINAGE AREA

 0 PI            PRECIPITATION PATTERN
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
                .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
```

.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.01	.01	.01	.01	.01
.01	.01	.03	.04	.04	.04	.04	.04	.04	.04
.01	.01	.01	.01	.01	.01	.01	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
.00	.00	.00	.00	.00	.00	.00	.00	.00	

WARNING EXCESS AT PONDING LESS THAN ZERO FOR PERIOD. EXCESS SET TO ZERO

```
        WARNING EXCESS AT PONDING LESS THAN ZERO FOR PERIOD. EXCESS SET TO ZERO

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
1747 KK     *     BASIN  *      COMBINE
            *            *
            **************

1751 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           3  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

1752 HC          HYDROGRAPH COMBINATION
                      ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                                  ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION    BASIN
                      TRANSPOSITION AREA       .0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                         (CFS)
+     837.     12.20                  107.         30.         30.          30.
                      (INCHES)       .997       1.127       1.127        1.127
                       (AC-FT)        53.         60.         60.          60.

                       CUMULATIVE AREA =    1.00 SQ MI


      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION    BASIN
                      TRANSPOSITION AREA      1.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                         (CFS)
+     830.     12.20                  106.         30.         30.          30.
                      (INCHES)       .988       1.117       1.117        1.117
                       (AC-FT)        53.         60.         60.          60.

                       CUMULATIVE AREA =    1.00 SQ MI


      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION    BASIN
```

TRANSPOSITION AREA 5.8 SQ MI

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	23.97-HR
+ (CFS)	(HR)					
		(CFS)				
+ 794.	12.20		102.	29.	29.	29.
		(INCHES)	.945	1.071	1.071	1.071
		(AC-FT)	50.	57.	57.	57.

CUMULATIVE AREA = 1.00 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION BASIN
TRANSPOSITION AREA 10.7 SQ MI

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	23.97-HR
+ (CFS)	(HR)					
		(CFS)				
+ 761.	12.20		97.	28.	28.	28.
		(INCHES)	.906	1.028	1.028	1.028
		(AC-FT)	48.	55.	55.	55.

CUMULATIVE AREA = 1.00 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION BASIN
TRANSPOSITION AREA 13.7 SQ MI

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	23.97-HR
+ (CFS)	(HR)					
		(CFS)				
+ 749.	12.20		96.	27.	27.	27.
		(INCHES)	.892	1.013	1.013	1.013
		(AC-FT)	48.	54.	54.	54.

CUMULATIVE AREA = 1.00 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION BASIN
TRANSPOSITION AREA 20.0 SQ MI

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	23.97-HR
+ (CFS)	(HR)					
		(CFS)				
+ 726.	12.20		93.	26.	26.	26.
		(INCHES)	.865	.983	.983	.983
		(AC-FT)	46.	52.	52.	52.

```
                        CUMULATIVE AREA =    1.00 SQ MI

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION    BASIN
                       TRANSPOSITION AREA     50.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     677.     12.20                 87.         25.         25.          25.
                       (INCHES)     .808        .921        .921         .921
                        (AC-FT)      43.         49.         49.          49.

                        CUMULATIVE AREA =    1.00 SQ MI

    -----DSS---ZOPEN:  New File Opened,  File: 100-YR OAK STREET BASIN AND ST.DSS
                       Unit:  71;  DSS Version: 6-JG
 -----DSS---ZWRITE Unit  71; Vers.    1:  /OAK/BAS/FLOW/31DEC1899/2MIN/CALC/
 -----DSS---ZWRITE Unit  71; Vers.    1:  /OAK/BAS/FLOW/01JAN1900/2MIN/CALC/
      ***             ***             ***             ***             ***


                        INTERPOLATED HYDROGRAPH AT    BASIN

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     830.     12.20                106.         30.         30.          30.
                       (INCHES)     .988       1.117       1.117        1.117
                        (AC-FT)      53.         60.         60.          60.

                        CUMULATIVE AREA =    1.00 SQ MI


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 1754 KK    *    SBASIN  *      STORAGE
            *            *
            **************

 1758 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

                HYDROGRAPH ROUTING DATA

 1759 RS          STORAGE ROUTING
```

```
                    NSTPS          1  NUMBER OF SUBREACHES
                     ITYP       STOR  TYPE OF INITIAL CONDITION
                   RSVRIC        .00  INITIAL CONDITION
                        X        .00 WORKING R AND D COEFFICIENT

1760 SV          STORAGE        .0      1.8      7.1     13.1     19.6     26.5     30.1     33.8     37.5     41.4

1761 SQ        DISCHARGE        0.      23.      71.     111.     141.     167.     179.     190.     201.     211.

1762 SE        ELEVATION    1798.00  1800.00  1802.00  1804.00  1806.00  1808.00  1809.00  1810.00  1811.00  1812.00

                                                                  ***

     ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION   SBASIN
                   TRANSPOSITION AREA       .0 SQ MI

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     184.     12.87                104.         30.         30.         30.
                        (INCHES)    .966       1.122       1.122       1.122
                         (AC-FT)     51.         60.         60.         60.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     23.97-HR
+  (AC-FT)      (HR)
       32.     12.87                 14.          4.          4.          4.

  PEAK STAGE    TIME                        MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR       72-HR     23.97-HR
+   (FEET)      (HR)
   1809.42     12.87              1804.19     1799.92     1799.92     1799.92

                      CUMULATIVE AREA =    1.00 SQ MI

     ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION   SBASIN
                   TRANSPOSITION AREA      1.0 SQ MI

  PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     183.     12.87                103.         30.         30.         30.
                        (INCHES)    .957       1.112       1.112       1.112
                         (AC-FT)     51.         59.         59.         59.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR       72-HR     23.97-HR
+  (AC-FT)      (HR)
```

```
      31.     12.83                    14.          4.          4.           4.

  PEAK STAGE    TIME                           MAXIMUM AVERAGE STAGE
                                        6-HR       24-HR       72-HR     23.97-HR
+   (FEET)      (HR)
   1809.33     12.87               1804.13     1799.91     1799.91      1799.91

                         CUMULATIVE AREA =    1.00 SQ MI


      ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION   SBASIN
                        TRANSPOSITION AREA      5.8 SQ MI

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                                  (CFS)
+     178.     12.83                   99.         29.         29.          29.
                        (INCHES)      .917       1.066       1.066        1.066
                         (AC-FT)       49.         57.         57.          57.

 PEAK STORAGE   TIME                           MAXIMUM AVERAGE STORAGE
                                        6-HR       24-HR       72-HR     23.97-HR
+  (AC-FT)      (HR)
       30.     12.83                   13.          4.          4.           4.

  PEAK STAGE    TIME                           MAXIMUM AVERAGE STAGE
                                        6-HR       24-HR       72-HR     23.97-HR
+   (FEET)      (HR)
   1808.88     12.83               1803.86     1799.82     1799.82      1799.82

                         CUMULATIVE AREA =    1.00 SQ MI


      ***            ***            ***            ***            ***

                          HYDROGRAPH AT STATION   SBASIN
                        TRANSPOSITION AREA     10.7 SQ MI

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                                  (CFS)
+     173.     12.83                   95.         28.         28.          28.
                        (INCHES)      .880       1.023       1.023        1.023
                         (AC-FT)       47.         55.         55.          55.

 PEAK STORAGE   TIME                           MAXIMUM AVERAGE STORAGE
                                        6-HR       24-HR       72-HR     23.97-HR
+  (AC-FT)      (HR)
       28.     12.83                   13.          3.          3.           3.

  PEAK STAGE    TIME                           MAXIMUM AVERAGE STAGE
                                        6-HR       24-HR       72-HR     23.97-HR
+   (FEET)      (HR)
   1808.46     12.83               1803.61     1799.74     1799.74      1799.74
```

CUMULATIVE AREA = 1.00 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION SBASIN
TRANSPOSITION AREA 13.7 SQ MI

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	23.97-HR
+ (CFS)	(HR)					
		(CFS)				
+ 171.	12.83		93.	27.	27.	27.
		(INCHES)	.868	1.008	1.008	1.008
		(AC-FT)	46.	54.	54.	54.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	23.97-HR
+ (AC-FT)	(HR)				
28.	12.83	12.	3.	3.	3.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	23.97-HR
+ (FEET)	(HR)				
1808.33	12.83	1803.53	1799.72	1799.72	1799.72

CUMULATIVE AREA = 1.00 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION SBASIN
TRANSPOSITION AREA 20.0 SQ MI

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	23.97-HR
+ (CFS)	(HR)					
		(CFS)				
+ 168.	12.87		91.	26.	26.	26.
		(INCHES)	.842	.979	.979	.979
		(AC-FT)	45.	52.	52.	52.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	23.97-HR
+ (AC-FT)	(HR)				
27.	12.83	12.	3.	3.	3.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	23.97-HR
+ (FEET)	(HR)				
1808.04	12.87	1803.36	1799.66	1799.66	1799.66

CUMULATIVE AREA = 1.00 SQ MI

*** *** *** *** ***

```
                    HYDROGRAPH AT STATION   SBASIN
                  TRANSPOSITION AREA     50.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                            (CFS)
+     160.     12.87                     85.         25.         25.          25.
                         (INCHES)      .788        .917        .917         .917
                          (AC-FT)       42.         49.         49.          49.

 PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                        6-HR       24-HR       72-HR     23.97-HR
+  (AC-FT)      (HR)
       25.     12.87                     11.          3.          3.           3.

  PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                        6-HR       24-HR       72-HR     23.97-HR
+   (FEET)      (HR)
   1807.44     12.87                1803.01     1799.56     1799.56      1799.56

                       CUMULATIVE AREA =    1.00 SQ MI

 -----DSS---ZWRITE Unit  71; Vers.    1:  /OAK/OLP/FLOW/31DEC1899/2MIN/CALC/
 -----DSS---ZWRITE Unit  71; Vers.    1:  /OAK/OLP/FLOW/01JAN1900/2MIN/CALC/
 -----DSS---ZWRITE Unit  71; Vers.    1:  /OAK/OLP/STOR/31DEC1899/2MIN/CALC/
 -----DSS---ZWRITE Unit  71; Vers.    1:  /OAK/OLP/STOR/01JAN1900/2MIN/CALC/
 -----DSS---ZWRITE Unit  71; Vers.    1:  /OAK/OLP/STAGE/31DEC1899/2MIN/CALC/
 -----DSS---ZWRITE Unit  71; Vers.    1:  /OAK/OLP/STAGE/01JAN1900/2MIN/CALC/
       ***             ***             ***             ***             ***


                       INTERPOLATED HYDROGRAPH AT   SBASIN

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                            (CFS)
+     183.     12.87                    103.         30.         30.          30.
                         (INCHES)      .957       1.112       1.112        1.112
                          (AC-FT)       51.         59.         59.          59.

                       CUMULATIVE AREA =    1.00 SQ MI

         WARNING EXCESS AT PONDING LESS THAN ZERO FOR PERIOD. EXCESS SET TO ZERO


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 1977 KK    *    TOLSCH  *
            *            *
            **************
```

```
1978 KO          OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE
                           Divert out of storm drain through splitter structure.  Divert flow amount
                           such that the flow at CP415A is less than or equal to 1540 cfs, the existing
                           peak discharge of LasSendas channel.

     DT          DIVERSION
                       ISTAD        MCDB  DIVERSION HYDROGRAPH IDENTIFICATION

     DI             INFLOW         .00    331.00    419.00    558.00    658.00    693.00    728.00    901.00   1043.00

     DQ      DIVERTED FLOW         .00       .00     61.00    176.00    262.00    292.00    323.00    473.00    594.00

                                                                  ***

      ***             ***             ***             ***             ***

                         DIVERSION HYDROGRAPH     MCDB
                       TRANSPOSITION AREA       .0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     242.     12.17                    17.          4.          4.           4.
                       (INCHES)       .094        .094        .094         .094
                        (AC-FT)         9.          9.          9.           9.

                        CUMULATIVE AREA =    1.73 SQ MI


      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION   TOLSCH
                       TRANSPOSITION AREA       .0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     393.     12.17                   161.         47.         47.          47.
                       (INCHES)       .867       1.003       1.003        1.003
                        (AC-FT)        80.         92.         92.          92.

                        CUMULATIVE AREA =    1.73 SQ MI


      ***             ***             ***             ***             ***

                         DIVERSION HYDROGRAPH     MCDB
                       TRANSPOSITION AREA      1.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
```

```
+     239.     12.17                    17.          4.          4.          4.
                          (INCHES)     .092        .092        .092        .092
                           (AC-FT)       8.          8.          8.          8.

                           CUMULATIVE AREA =    1.73 SQ MI


       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION   TOLSCH
                         TRANSPOSITION AREA      1.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                             (CFS)
+     392.     12.17                   160.         46.         46.         46.
                          (INCHES)     .860        .995        .995        .995
                           (AC-FT)      79.         92.         92.         92.

                           CUMULATIVE AREA =    1.73 SQ MI


       ***             ***             ***             ***             ***

                           DIVERSION HYDROGRAPH     MCDB
                         TRANSPOSITION AREA      5.8 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                             (CFS)
+     213.     12.20                    15.          4.          4.          4.
                          (INCHES)     .078        .078        .078        .078
                           (AC-FT)       7.          7.          7.          7.

                           CUMULATIVE AREA =    1.73 SQ MI


       ***             ***             ***             ***             ***

                           HYDROGRAPH AT STATION   TOLSCH
                         TRANSPOSITION AREA      5.8 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                             (CFS)
+     388.     12.20                   154.         45.         45.         45.
                          (INCHES)     .830        .960        .960        .960
                           (AC-FT)      76.         88.         88.         88.

                           CUMULATIVE AREA =    1.73 SQ MI


       ***             ***             ***             ***             ***

                           DIVERSION HYDROGRAPH     MCDB
```

TRANSPOSITION AREA 10.7 SQ MI

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	23.97-HR
+ (CFS)	(HR)					
		(CFS)				
+ 200.	12.20		12.	3.	3.	3.
		(INCHES)	.067	.067	.067	.067
		(AC-FT)	6.	6.	6.	6.

CUMULATIVE AREA = 1.73 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION TOLSCH
TRANSPOSITION AREA 10.7 SQ MI

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	23.97-HR
+ (CFS)	(HR)					
		(CFS)				
+ 386.	12.20		149.	43.	43.	43.
		(INCHES)	.802	.927	.927	.927
		(AC-FT)	74.	85.	85.	85.

CUMULATIVE AREA = 1.73 SQ MI

*** *** *** *** ***

DIVERSION HYDROGRAPH MCDB
TRANSPOSITION AREA 13.7 SQ MI

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	23.97-HR
+ (CFS)	(HR)					
		(CFS)				
+ 190.	12.20		12.	3.	3.	3.
		(INCHES)	.063	.063	.063	.063
		(AC-FT)	6.	6.	6.	6.

CUMULATIVE AREA = 1.73 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION TOLSCH
TRANSPOSITION AREA 13.7 SQ MI

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	23.97-HR
+ (CFS)	(HR)					
		(CFS)				
+ 384.	12.20		147.	43.	43.	43.
		(INCHES)	.791	.915	.915	.915
		(AC-FT)	73.	84.	84.	84.

```
                    CUMULATIVE AREA =    1.73 SQ MI

      ***            ***            ***            ***            ***

                     DIVERSION HYDROGRAPH     MCDB
                   TRANSPOSITION AREA     20.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     172.     12.23                 10.          3.          3.          3.
                         (INCHES)   .056        .056        .056        .056
                          (AC-FT)     5.          5.          5.          5.

                    CUMULATIVE AREA =    1.73 SQ MI

      ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION   TOLSCH
                   TRANSPOSITION AREA     20.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     381.     12.23                143.         41.         41.         41.
                         (INCHES)   .771        .891        .891        .891
                          (AC-FT)    71.         82.         82.         82.

                    CUMULATIVE AREA =    1.73 SQ MI

      ***            ***            ***            ***            ***

                     DIVERSION HYDROGRAPH     MCDB
                   TRANSPOSITION AREA     50.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     141.     12.13                  8.          2.          2.          2.
                         (INCHES)   .042        .042        .042        .042
                          (AC-FT)     4.          4.          4.          4.

                    CUMULATIVE AREA =    1.73 SQ MI

      ***            ***            ***            ***            ***

                     HYDROGRAPH AT STATION   TOLSCH
                   TRANSPOSITION AREA     50.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR     23.97-HR
```

```
+   (CFS)       (HR)
                          (CFS)
+     375.     12.13                135.         39.         39.          39.
                       (INCHES)     .727        .841        .841         .841
                        (AC-FT)      67.         77.         77.          77.

                       CUMULATIVE AREA =    1.73 SQ MI

      ***            ***            ***            ***            ***


                 INTERPOLATED DIVERSION HYDROGRAPH AT     MCDB

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     230.     12.17                 16.          4.          4.           4.
                       (INCHES)     .087        .087        .087         .087
                        (AC-FT)       8.          8.          8.           8.

                       CUMULATIVE AREA =    1.73 SQ MI

      ***            ***            ***            ***            ***


                       INTERPOLATED HYDROGRAPH AT   TOLSCH

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     391.     12.17                158.         46.         46.          46.
                       (INCHES)     .851        .984        .984         .984
                        (AC-FT)      78.         91.         91.          91.

                       CUMULATIVE AREA =    1.73 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
2364 KK     *     RMCDB  *
            *            *
            **************

2365 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           3  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE
                           Retrieve flow that remained in the storm drain and goes to the McDowell Road
                           detention basin
```

```
2368 DR          RETRIEVE DIVERSION HYDROGRAPH
                       ISTAD        MCDB  DIVERSION HYDROGRAPH IDENTIFICATION

                                                                  ***

      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION    RMCDB
                      TRANSPOSITION AREA       .0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     242.     12.17                     17.          4.          4.          4.
                       (INCHES)       .052        .052        .052        .052
                        (AC-FT)         9.          9.          9.          9.

                       CUMULATIVE AREA =    1.73 SQ MI


      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION    RMCDB
                      TRANSPOSITION AREA      1.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     239.     12.17                     17.          4.          4.          4.
                       (INCHES)       .051        .051        .051        .051
                        (AC-FT)         8.          8.          8.          8.

                       CUMULATIVE AREA =    1.73 SQ MI


      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION    RMCDB
                      TRANSPOSITION AREA      5.8 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     213.     12.20                     15.          4.          4.          4.
                       (INCHES)       .043        .043        .043        .043
                        (AC-FT)         7.          7.          7.          7.

                       CUMULATIVE AREA =    1.73 SQ MI


      ***             ***             ***             ***             ***

                        HYDROGRAPH AT STATION    RMCDB
                      TRANSPOSITION AREA     10.7 SQ MI
```

```
  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     200.     12.20                    12.          3.          3.           3.
                         (INCHES)      .037        .037        .037         .037
                          (AC-FT)        6.          6.          6.           6.

                         CUMULATIVE AREA =    1.73 SQ MI


      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION    RMCDB
                       TRANSPOSITION AREA     13.7 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     190.     12.20                    12.          3.          3.           3.
                         (INCHES)      .035        .035        .035         .035
                          (AC-FT)        6.          6.          6.           6.

                         CUMULATIVE AREA =    1.73 SQ MI


      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION    RMCDB
                       TRANSPOSITION AREA     20.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     172.     12.23                    10.          3.          3.           3.
                         (INCHES)      .031        .031        .031         .031
                          (AC-FT)        5.          5.          5.           5.

                         CUMULATIVE AREA =    1.73 SQ MI


      ***             ***             ***             ***             ***

                         HYDROGRAPH AT STATION    RMCDB
                       TRANSPOSITION AREA     50.0 SQ MI

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                        6-HR       24-HR       72-HR     23.97-HR
+   (CFS)       (HR)
                          (CFS)
+     141.     12.13                     8.          2.          2.           2.
                         (INCHES)      .023        .023        .023         .023
                          (AC-FT)        4.          4.          4.           4.

                         CUMULATIVE AREA =    1.73 SQ MI
```

*** *** *** *** ***

INTERPOLATED HYDROGRAPH AT RMCDB

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	23.97-HR
230.	12.17	(CFS)	16.	4.	4.	4.
		(INCHES)	.087	.087	.087	.087
		(AC-FT)	8.	8.	8.	8.

CUMULATIVE AREA = 1.73 SQ MI

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
HYDROGRAPH AT	10	972.	12.27	119.	33.	33.	.69		
ROUTED TO	R10	903.	12.40	119.	33.	33.	.69		
ROUTED TO	R12	845.	12.60	119.	33.	33.	.69		
HYDROGRAPH AT	20	1103.	12.23	165.	45.	45.	1.17		
DIVERSION TO	BS20	1103.	12.23	92.	24.	24.	1.17		
HYDROGRAPH AT	D20	839.	12.50	79.	21.	21.	1.17		
HYDROGRAPH AT	RT20	1103.	12.23	92.	24.	24.	1.17		
ROUTED TO	S20	16.	12.50	15.	8.	8.	1.17		
3 COMBINED AT	C20	1554.	12.57	208.	60.	60.	1.86		
ROUTED TO	R20	1554.	12.57	207.	60.	60.	1.86		
HYDROGRAPH AT	40	2754.	12.30	286.	79.	79.	2.23		

+	DIVERSION TO	BS40	1789.	12.13	72.	20.	20.	2.23
+	HYDROGRAPH AT	D40	2754.	12.30	227.	59.	59.	2.23
+	HYDROGRAPH AT	RT40	1789.	12.13	72.	20.	20.	2.23
+	ROUTED TO	S40	13.	12.20	12.	7.	7.	2.23
+	3 COMBINED AT	C40	3089.	12.33	437.	123.	123.	4.08
+	HYDROGRAPH AT	60	1655.	12.40	244.	66.	66.	1.75
+	DIVERSION TO	BS60	11.	9.17	7.	2.	2.	1.75
+	HYDROGRAPH AT	D60	1655.	12.40	244.	64.	64.	1.75
+	HYDROGRAPH AT	RT60	11.	9.17	7.	2.	2.	1.75
+	ROUTED TO	SB60	2.	9.33	2.	1.	1.	1.75
+	3 COMBINED AT	C60	4601.	12.33	666.	184.	184.	5.84
+	ROUTED TO	S60	101.	14.77	101.	48.	48.	5.84
+	ROUTED TO	R60	101.	14.77	101.	48.	48.	5.84
+	ROUTED TO	RR60	101.	14.87	101.	47.	47.	5.84
+	HYDROGRAPH AT	80	1952.	12.13	199.	53.	53.	1.49
+	DIVERSION TO	BS80	945.	11.93	35.	10.	10.	1.49
+	HYDROGRAPH AT	D80	1952.	12.13	170.	43.	43.	1.49
+	HYDROGRAPH AT	RT80	945.	11.93	35.	10.	10.	1.49
+	ROUTED TO	S80	7.	12.00	6.	4.	4.	1.49

+	2 COMBINED AT	C80	1959.	12.13	176.	47.	47.	1.49
+	2 COMBINED AT	CC80	1959.	12.13	264.	94.	94.	1.49
+	ROUTED TO	R80	1951.	12.17	264.	94.	94.	1.49
+	HYDROGRAPH AT	100	453.	12.20	66.	18.	18.	.49
+	DIVERSION TO	BS100	422.	12.13	19.	5.	5.	.49
+	HYDROGRAPH AT	D100	453.	12.20	50.	13.	13.	.49
+	HYDROGRAPH AT	RT100	422.	12.13	19.	5.	5.	.49
+	ROUTED TO	S100	4.	12.20	3.	2.	2.	.49
+	3 COMBINED AT	C100	2353.	12.20	314.	108.	108.	1.98
+	ROUTED TO	R100	2304.	12.23	313.	108.	108.	1.98
+	HYDROGRAPH AT	120	3346.	12.27	342.	93.	93.	2.20
+	DIVERSION TO	BS120	13.	7.50	10.	3.	3.	2.20
+	HYDROGRAPH AT	D120	3346.	12.27	342.	90.	90.	2.20
+	HYDROGRAPH AT	RT120	13.	7.50	10.	3.	3.	2.20
+	ROUTED TO	S120	2.	8.00	2.	2.	2.	2.20
+	3 COMBINED AT	C120	5563.	12.23	634.	197.	197.	4.18
+	ROUTED TO	R120	5514.	12.27	633.	196.	196.	4.18
+	HYDROGRAPH AT	140	665.	12.13	67.	18.	18.	.60
+	DIVERSION TO	BS140	369.	11.97	11.	3.	3.	.60
	HYDROGRAPH AT							

+		D140	665.	12.13	58.	15.	15.	.60
+	HYDROGRAPH AT	RT140	369.	11.97	11.	3.	3.	.60
+	ROUTED TO	S140	2.	12.03	2.	1.	1.	.60
+	3 COMBINED AT	C140	6030.	12.27	688.	211.	211.	4.78
+	HYDROGRAPH AT	150	594.	12.17	51.	14.	14.	.41
+	ROUTED TO	R150	567.	12.23	51.	14.	14.	.41
+	ROUTED TO	R152	513.	12.33	51.	14.	14.	.41
+	HYDROGRAPH AT	160	225.	12.40	36.	9.	9.	.37
+	DIVERSION TO	BS160	82.	12.13	2.	1.	1.	.37
+	HYDROGRAPH AT	D160	225.	12.40	34.	9.	9.	.37
+	HYDROGRAPH AT	RT160	82.	12.13	2.	1.	1.	.37
+	ROUTED TO	S160	1.	12.20	1.	0.	0.	.37
+	3 COMBINED AT	C160	732.	12.37	86.	23.	23.	.77
+	HYDROGRAPH AT	180	852.	12.37	98.	25.	25.	1.01
+	3 COMBINED AT	C180	7189.	12.27	850.	252.	252.	6.56
+	HYDROGRAPH AT	210	1323.	12.17	111.	29.	29.	.79
+	ROUTED TO	R210	1247.	12.23	111.	29.	29.	.79
+	HYDROGRAPH AT	240	1513.	12.30	167.	43.	43.	1.41
+	2 COMBINED AT	C240	2686.	12.27	273.	70.	70.	2.20
+	ROUTED TO	S240	799.	12.70	226.	58.	58.	2.20

	ROUTED TO						
+	R240	796.	12.77	225.	58.	58.	2.20
	HYDROGRAPH AT						
+	220	676.	12.20	68.	18.	18.	.47
	2 COMBINED AT						
+	C220	955.	12.60	288.	75.	75.	2.67
	ROUTED TO						
+	SW220	896.	12.80	281.	73.	73.	2.67
	ROUTED TO						
+	R220	894.	12.87	280.	73.	73.	2.67
	HYDROGRAPH AT						
+	190	1472.	12.17	123.	33.	33.	.92
	ROUTED TO						
+	R190	1416.	12.23	123.	33.	33.	.92
	ROUTED TO						
+	R192	1360.	12.30	123.	33.	33.	.92
	HYDROGRAPH AT						
+	200	832.	12.17	72.	20.	20.	.53
	3 COMBINED AT						
+	C200	2265.	12.30	460.	122.	122.	4.12
	ROUTED TO						
+	SW200	2145.	12.37	454.	118.	118.	4.12
	ROUTED TO						
+	R200	2136.	12.37	454.	118.	118.	4.12
	ROUTED TO						
+	SS200	1366.	12.70	333.	87.	87.	4.12
	ROUTED TO						
+	RR200	1344.	12.83	331.	87.	87.	4.12
	2 COMBINED AT						
+	CC180	7189.	12.27	1160.	335.	335.	10.68
	ROUTED TO						
+	S180	124.	23.97	124.	56.	56.	10.68
	ROUTED TO						
+	R180	124.	23.97	124.	55.	55.	10.68
	HYDROGRAPH AT						
+	260	427.	12.10	42.	11.	11.	.26
	2 COMBINED AT						
+	C260	428.	12.10	139.	69.	69.	.26

	ROUTED TO							
+		R260	411.	12.20	139.	68.	68.	.26
	HYDROGRAPH AT							
+		280	527.	12.10	46.	13.	13.	.32
	2 COMBINED AT							
+		C280	893.	12.13	180.	81.	81.	.58
	ROUTED TO							
+		R280	870.	12.20	179.	80.	80.	.58
	HYDROGRAPH AT							
+		300	428.	12.10	37.	11.	11.	.29
	2 COMBINED AT							
+		C300	1235.	12.17	213.	91.	91.	.87
	ROUTED TO							
+		R300	1190.	12.23	212.	90.	90.	.87
	HYDROGRAPH AT							
+		305A	395.	12.13	41.	11.	11.	.32
	2 COMBINED AT							
+		C305	1535.	12.20	249.	100.	100.	1.19
	ROUTED TO							
+		R305	1520.	12.23	249.	100.	100.	1.19
	HYDROGRAPH AT							
+		320B1	660.	12.13	66.	19.	19.	.45
	DIVERSION TO							
+		B320B1	364.	11.93	16.	5.	5.	.45
	HYDROGRAPH AT							
+		D320B1	660.	12.13	54.	14.	14.	.45
	HYDROGRAPH AT							
+		T320B1	364.	11.93	16.	5.	5.	.45
	ROUTED TO							
+		S320B1	4.	12.00	3.	2.	2.	.45
	3 COMBINED AT							
+		C320B1	2043.	12.20	303.	115.	115.	1.64
	HYDROGRAPH AT							
+		350	1316.	12.20	112.	29.	29.	1.00
	DIVERSION TO							
+		SF350	658.	12.20	56.	15.	15.	1.00
	HYDROGRAPH AT							
+		D350	658.	12.20	56.	15.	15.	1.00
	ROUTED TO							

+		R350	593.	12.40	56.	15.	15.	1.00
+	HYDROGRAPH AT	310	381.	12.33	50.	13.	13.	.54
+	2 COMBINED AT	C310	950.	12.37	106.	27.	27.	1.04
+	ROUTED TO	R310	866.	12.67	106.	27.	27.	1.04
+	HYDROGRAPH AT	305B	333.	12.33	40.	10.	10.	.39
+	ROUTED TO	R305B	317.	12.43	40.	10.	10.	.39
+	HYDROGRAPH AT	320B2	251.	12.13	27.	7.	7.	.22
+	DIVERSION TO	B320B2	177.	12.00	6.	2.	2.	.22
+	HYDROGRAPH AT	D320B2	251.	12.13	22.	6.	6.	.22
+	HYDROGRAPH AT	T320B2	177.	12.00	6.	2.	2.	.22
+	ROUTED TO	S320B2	1.	12.03	1.	1.	1.	.22
+	4 COMBINED AT	C320B2	1151.	12.63	167.	43.	43.	1.65
+	ROUTED TO	R320B2	1144.	12.67	167.	43.	43.	1.65
+	HYDROGRAPH AT	340B	497.	12.07	41.	12.	12.	.29
+	DIVERSION TO	BS340B	497.	12.07	29.	8.	8.	.29
+	HYDROGRAPH AT	D340B	286.	12.20	15.	4.	4.	.29
+	HYDROGRAPH AT	RT340B	497.	12.07	29.	8.	8.	.29
+	ROUTED TO	S340B	5.	12.20	5.	3.	3.	.29
+	3 COMBINED AT	C340B	1167.	12.67	185.	50.	50.	1.94
+	DIVERSION TO	BS340	967.	12.67	114.	28.	28.	1.94

+	HYDROGRAPH AT	DD340B	200.	12.10	71.	21.	21.	1.94
+	HYDROGRAPH AT	RT340	967.	12.67	114.	28.	28.	1.94
+	ROUTED TO	SS340B	48.	13.40	41.	17.	17.	1.94
+	2 COMBINED AT	CD340B	248.	13.40	109.	38.	38.	1.94
+	HYDROGRAPH AT	RT350	658.	12.20	56.	15.	15.	1.00
+	ROUTED TO	RR350	570.	12.43	56.	15.	15.	1.00
+	HYDROGRAPH AT	355	546.	12.33	75.	19.	19.	.68
+	2 COMBINED AT	C355	1061.	12.40	130.	34.	34.	1.17
+	DIVERSION TO	BS355	611.	12.40	40.	10.	10.	1.17
+	HYDROGRAPH AT	D355	450.	12.13	90.	24.	24.	1.17
+	HYDROGRAPH AT	RT355	611.	12.40	40.	10.	10.	1.17
+	ROUTED TO	S355	40.	12.77	27.	9.	9.	1.17
+	2 COMBINED AT	CC355	490.	12.77	115.	33.	33.	1.17
+	ROUTED TO	R355	478.	12.77	115.	33.	33.	1.17
+	2 COMBINED AT	CC340B	707.	12.77	220.	69.	69.	3.11
+	ROUTED TO	R340B	704.	12.80	220.	69.	69.	3.11
+	HYDROGRAPH AT	340A2	73.	12.03	8.	3.	3.	.04
+	DIVERSION TO	B340A2	64.	11.97	4.	1.	1.	.04
+	HYDROGRAPH AT	D340A2	73.	12.03	5.	1.	1.	.04

	HYDROGRAPH AT						
+		T340A2	64.	11.97	4.	1.	1.	.04
	ROUTED TO						
+		S340A2	1.	12.03	1.	1.	1.	.04
	3 COMBINED AT						
+		C340A2	710.	12.80	225.	71.	71.	3.15
	ROUTED TO						
+		R340A2	703.	12.93	225.	71.	71.	3.15
	2 COMBINED AT						
+		CC320B	2212.	12.23	516.	183.	183.	4.79
	ROUTED TO						
+		R320B	2205.	12.23	516.	183.	183.	4.79
	HYDROGRAPH AT						
+		320A	316.	12.13	40.	12.	12.	.27
	DIVERSION TO						
+		BS320A	316.	12.13	22.	6.	6.	.27
	HYDROGRAPH AT						
+		D320A	267.	12.27	22.	6.	6.	.27
	HYDROGRAPH AT						
+		RT320A	316.	12.13	22.	6.	6.	.27
	ROUTED TO						
+		S320A	4.	12.27	3.	2.	2.	.27
	3 COMBINED AT						
+		C320	2379.	12.30	538.	190.	190.	5.06
	HYDROGRAPH AT						
+		340A1	1255.	12.17	154.	46.	46.	1.09
	DIVERSION TO						
+		B340A1	1255.	12.17	154.	46.	46.	1.09
	HYDROGRAPH AT						
+		D340A1	0.	.00	0.	0.	0.	1.09
	HYDROGRAPH AT						
+		T340A1	1255.	12.17	154.	46.	46.	1.09
	ROUTED TO						
+		S340A1	18.	15.30	18.	10.	10.	1.09
	2 COMBINED AT						
+		C340A1	18.	15.30	18.	10.	10.	1.09
	2 COMBINED AT						
+		C340	2379.	12.30	552.	199.	199.	6.15
	HYDROGRAPH AT						

+		360	840.	12.20	122.	36.	36.	.88
+	DIVERSION TO	BS360	840.	12.20	93.	25.	25.	.88
+	HYDROGRAPH AT	D360	366.	12.67	40.	11.	11.	.88
+	HYDROGRAPH AT	RT360	840.	12.20	93.	25.	25.	.88
+	ROUTED TO	S360	15.	12.67	15.	8.	8.	.88
+	3 COMBINED AT	C360	2379.	12.30	596.	217.	217.	7.03
+	HYDROGRAPH AT	380A	322.	12.27	33.	10.	10.	.26
+	2 COMBINED AT	C380A	2641.	12.30	618.	224.	224.	7.29
+	HYDROGRAPH AT	400A	56.	12.20	4.	1.	1.	.05
+	2 COMBINED AT	C400A	2678.	12.30	621.	225.	225.	7.34
+	HYDROGRAPH AT	370A	384.	12.27	43.	12.	12.	.30
+	DIVERSION TO	DIV1	96.	12.27	11.	3.	3.	.30
+	HYDROGRAPH AT	D370A	288.	12.27	32.	9.	9.	.30
+	ROUTED TO	RD370A	248.	12.50	32.	9.	9.	.30
+	HYDROGRAPH AT	370B	421.	12.37	58.	16.	16.	.50
+	2 COMBINED AT	CP370B	623.	12.43	91.	25.	25.	.80
+	ROUTED TO	S370	350.	12.80	91.	25.	25.	.80
+	DIVERSION TO	B370W	315.	12.80	82.	22.	22.	.80
+	HYDROGRAPH AT	D370	35.	12.80	9.	2.	2.	.80
+	ROUTED TO	R370S	34.	13.17	9.	2.	2.	.80

+	HYDROGRAPH AT 380B1	329.	12.20	47.	14.	14.	.37
+	DIVERSION TO B380B1	329.	12.20	19.	5.	5.	.37
+	HYDROGRAPH AT D380B1	312.	12.27	31.	8.	8.	.37
+	HYDROGRAPH AT T380B1	329.	12.20	19.	5.	5.	.37
+	ROUTED TO S380B1	3.	12.27	3.	2.	2.	.37
+	3 COMBINED AT C380B1	314.	12.27	43.	13.	13.	1.16
+	ROUTED TO R380B1	286.	12.43	43.	13.	13.	1.16
+	HYDROGRAPH AT 400B1	441.	12.13	45.	13.	13.	.38
+	DIVERSION TO B400B1	240.	11.97	10.	3.	3.	.38
+	HYDROGRAPH AT D400B1	441.	12.13	37.	10.	10.	.38
+	HYDROGRAPH AT T400B1	240.	11.97	10.	3.	3.	.38
+	ROUTED TO S400B1	2.	12.03	2.	1.	1.	.38
+	2 COMBINED AT C400B1	442.	12.13	39.	11.	11.	.38
+	3 COMBINED AT CC400B	2956.	12.30	684.	243.	243.	8.89
+	HYDROGRAPH AT 420A2	31.	12.07	2.	1.	1.	.02
+	2 COMBINED AT C400A2	2966.	12.30	686.	243.	243.	8.91
+	HYDROGRAPH AT T370W	315.	12.80	82.	22.	22.	.80
+	ROUTED TO R370W	312.	13.00	82.	22.	22.	.80
+	HYDROGRAPH AT D370A	96.	12.27	11.	3.	3.	.30

	ROUTED TO						
+		RDIV1	95.	12.30	11.	3.	3.	.30
	DIVERSION TO						
+		DIV2	48.	12.30	5.	2.	2.	.30
	HYDROGRAPH AT						
+		DDIV1	48.	12.30	5.	2.	2.	.30
	ROUTED TO						
+		RDDIV1	34.	12.70	5.	1.	1.	.30
	HYDROGRAPH AT						
+		395A	178.	12.17	27.	8.	8.	.19
	2 COMBINED AT						
+		CP395A	179.	12.17	33.	9.	9.	.49
	ROUTED TO						
+		R390C1	178.	12.23	33.	9.	9.	.49
	HYDROGRAPH AT						
+		395B	6.	12.03	1.	0.	0.	.00
	ROUTED TO						
+		R390C2	5.	12.23	1.	0.	0.	.00
	HYDROGRAPH AT						
+		390C	227.	12.07	18.	5.	5.	.12
	3 COMBINED AT						
+		CP390C	356.	12.10	52.	15.	15.	.62
	HYDROGRAPH AT						
+		385A	522.	12.20	46.	13.	13.	.31
	HYDROGRAPH AT						
+		DDIV1	48.	12.30	5.	2.	2.	.30
	ROUTED TO						
+		RDIV2	42.	12.53	5.	2.	2.	.30
	HYDROGRAPH AT						
+		385B	54.	12.20	7.	2.	2.	.04
	DIVERSION TO						
+		DIV3	27.	12.20	3.	1.	1.	.04
	HYDROGRAPH AT						
+		D385B	27.	12.20	3.	1.	1.	.04
	ROUTED TO						
+		RD385B	23.	12.47	3.	1.	1.	.04
	3 COMBINED AT						
+		CP385A	529.	12.20	55.	16.	16.	.66
	DIVERSION TO						

+		DIV4	149.	12.20	28.	9.	9.	.66
+	HYDROGRAPH AT	D385A	380.	12.20	27.	7.	7.	.66
+	DIVERSION TO	DIV5	380.	12.20	27.	7.	7.	.66
+	HYDROGRAPH AT	DD385A	0.	.00	0.	0.	0.	.66
+	ROUTED TO	R390C3	0.	.00	0.	0.	0.	.66
+	2 COMBINED AT	CC390C	356.	12.10	52.	15.	15.	1.28
+	DIVERSION TO	TO390B	253.	12.10	25.	6.	6.	1.28
+	HYDROGRAPH AT	TOC-H	100.	12.10	26.	8.	8.	1.28
+	2 COMBINED AT	C370	365.	12.93	107.	31.	31.	1.30
+	ROUTED TO	R390S	364.	13.00	107.	31.	31.	1.30
+	HYDROGRAPH AT	400B3	39.	12.03	3.	1.	1.	.02
+	DIVERSION TO	B400B3	39.	12.03	3.	1.	1.	.02
+	HYDROGRAPH AT	D400B3	0.	.00	0.	0.	0.	.02
+	HYDROGRAPH AT	T400B3	39.	12.03	3.	1.	1.	.02
+	ROUTED TO	S400B3	1.	11.67	1.	1.	1.	.02
+	2 COMBINED AT	C400B3	1.	11.67	1.	1.	1.	.02
+	2 COMBINED AT	C390S	365.	13.00	108.	31.	31.	1.32
+	HYDROGRAPH AT	380B3	171.	12.10	16.	5.	5.	.12
+	DIVERSION TO	B380B3	170.	12.07	7.	2.	2.	.12
+	HYDROGRAPH AT	D380B3	162.	12.13	10.	3.	3.	.12

+	HYDROGRAPH AT	T380B3	170.	12.07	7.	2.	2.	.12
+	ROUTED TO	S380B3	2.	12.13	2.	1.	1.	.12
+	2 COMBINED AT	C380B3	164.	12.13	11.	4.	4.	.12
+	DIVERSION TO	380B3c	44.	12.13	3.	1.	1.	.12
+	HYDROGRAPH AT	D380B3	120.	12.13	8.	3.	3.	.12
+	DIVERSION TO	380B3a	62.	12.13	4.	1.	1.	.12
+	HYDROGRAPH AT	380B3b	57.	12.13	4.	1.	1.	.12
+	2 COMBINED AT	C380BB	368.	12.97	112.	32.	32.	1.45
+	DIVERSION TO	B38B3b	298.	12.97	70.	18.	18.	1.45
+	HYDROGRAPH AT	D380B	70.	11.90	42.	15.	15.	1.45
+	HYDROGRAPH AT	RT380B	298.	12.97	70.	18.	18.	1.45
+	ROUTED TO	S380B	97.	13.90	29.	11.	11.	1.45
+	2 COMBINED AT	CC380B	167.	13.90	67.	26.	26.	1.45
+	ROUTED TO	R38B3b	166.	13.93	67.	26.	26.	1.45
+	HYDROGRAPH AT	T38B3a	62.	12.13	4.	1.	1.	.12
+	ROUTED TO	R38B3a	50.	12.23	4.	1.	1.	.12
+	HYDROGRAPH AT	T38B3c	44.	12.13	3.	1.	1.	.12
+	3 COMBINED AT	C38B3c	169.	13.93	74.	28.	28.	1.45
+	ROUTED TO	R380B3	168.	14.03	74.	28.	28.	1.45

	HYDROGRAPH AT							
+		380B2	140.	12.07	12.	3.	3.	.10
	2 COMBINED AT							
+		C380B2	208.	12.07	84.	31.	31.	1.54
	ROUTED TO							
+		R380B2	204.	12.37	84.	31.	31.	1.54
	HYDROGRAPH AT							
+		400B2	205.	12.13	19.	5.	5.	.19
	2 COMBINED AT							
+		C400B2	394.	12.17	102.	36.	36.	1.74
	ROUTED TO							
+		R400B2	377.	12.27	102.	36.	36.	1.74
	HYDROGRAPH AT							
+		420A1	759.	12.13	74.	21.	21.	.57
	DIVERSION TO							
+		B420A1	478.	11.97	20.	6.	6.	.57
	HYDROGRAPH AT							
+		D420A1	759.	12.13	60.	16.	16.	.57
	HYDROGRAPH AT							
+		T420A1	478.	11.97	20.	6.	6.	.57
	ROUTED TO							
+		S420A1	4.	12.03	3.	2.	2.	.57
	4 COMBINED AT							
+		C420A	3727.	12.23	820.	288.	288.	11.21
	HYDROGRAPH AT							
+		R390B	253.	12.10	25.	6.	6.	1.28
	ROUTED TO							
+		R390B1	255.	12.10	25.	6.	6.	1.28
	HYDROGRAPH AT							
+		385C	84.	12.20	9.	3.	3.	.07
	HYDROGRAPH AT							
+		D385B	27.	12.20	3.	1.	1.	.04
	ROUTED TO							
+		RDIV3	26.	12.30	3.	1.	1.	.04
	2 COMBINED AT							
+		CP385C	103.	12.27	12.	4.	4.	.11
	DIVERSION TO							
+		DIV6	52.	12.27	6.	2.	2.	.11
	HYDROGRAPH AT							

+		D385C	52.	12.27	6.	2.	2.	.11
+	ROUTED TO	RD385C	50.	12.37	6.	2.	2.	.11
+	HYDROGRAPH AT	385D	55.	12.13	7.	2.	2.	.05
+	HYDROGRAPH AT	D385A	149.	12.20	28.	9.	9.	.66
+	ROUTED TO	RDIV4	140.	12.37	28.	9.	9.	.66
+	3 COMBINED AT	CI385D	228.	12.33	42.	13.	13.	.78
+	HYDROGRAPH AT	DD385A	380.	12.20	27.	7.	7.	.66
+	ROUTED TO	RDIV5	379.	12.20	27.	7.	7.	.66
+	2 COMBINED AT	CP385D	577.	12.20	68.	19.	19.	.78
+	ROUTED TO	R385D	574.	12.23	68.	19.	19.	.78
+	HYDROGRAPH AT	385E	17.	12.07	2.	0.	0.	.01
+	2 COMBINED AT	CP385E	586.	12.23	70.	20.	20.	.79
+	DIVERSION TO	DIV10	586.	12.23	70.	20.	20.	.79
+	HYDROGRAPH AT	D385E	0.	.00	0.	0.	0.	.79
+	ROUTED TO	RD385E	0.	.00	0.	0.	0.	.79
+	HYDROGRAPH AT	415B	121.	12.13	15.	4.	4.	.11
+	ROUTED TO	RD415B	120.	12.13	15.	4.	4.	.11
+	HYDROGRAPH AT	415C	46.	12.07	4.	1.	1.	.03
+	2 COMBINED AT	CP415C	161.	12.13	19.	6.	6.	.14
+	DIVERSION TO	DIV9	161.	12.13	19.	6.	6.	.14

	HYDROGRAPH AT						
+		D415C	0.	.10	0.	0.	0.	.14
	ROUTED TO						
+		RD415C	0.	.27	0.	0.	0.	.14
	HYDROGRAPH AT						
+		385G	63.	12.13	9.	2.	2.	.06
	HYDROGRAPH AT						
+		D385C	52.	12.27	6.	2.	2.	.11
	ROUTED TO						
+		RDIV6	49.	12.37	6.	2.	2.	.11
	2 COMBINED AT						
+		CP385G	94.	12.30	15.	4.	4.	.17
	DIVERSION TO						
+		DIV8	0.	.00	0.	0.	0.	.17
	HYDROGRAPH AT						
+		D385G	94.	12.30	15.	4.	4.	.17
	HYDROGRAPH AT						
+		D415C	161.	12.13	19.	6.	6.	.14
	2 COMBINED AT						
+		CC385G	236.	12.13	34.	10.	10.	.17
	HYDROGRAPH AT						
+		385F	22.	12.10	3.	1.	1.	.02
	HYDROGRAPH AT						
+		D385E	586.	12.23	70.	20.	20.	.79
	3 COMBINED AT						
+		BASIN	830.	12.20	106.	30.	30.	1.00
	ROUTED TO						
+		SBASIN	183.	12.87	103.	30.	30.	1.00
	3 COMBINED AT						
+		CC415B	183.	12.87	103.	30.	30.	1.00
	ROUTED TO						
+		R390A1	183.	12.87	103.	30.	30.	1.00
	HYDROGRAPH AT						
+		390A	33.	12.07	3.	1.	1.	.02
	2 COMBINED AT						
+		CP390A	185.	12.80	106.	31.	31.	1.03
	ROUTED TO						
+		R390B2	185.	12.80	106.	31.	31.	1.03

+	HYDROGRAPH AT	390B	139.	12.07	13.	4.	4.	.10
+	2 COMBINED AT	CC390B	244.	12.13	118.	34.	34.	1.13
+	2 COMBINED AT	CP390B	494.	12.10	142.	40.	40.	1.45
+	ROUTED TO	S390B	431.	12.23	142.	40.	40.	1.45
+	HYDROGRAPH AT	420B05	62.	12.07	5.	2.	2.	.04
+	2 COMBINED AT	CPSD05	472.	12.17	147.	42.	42.	1.49
+	HYDROGRAPH AT	420B10	26.	12.10	3.	1.	1.	.03
+	2 COMBINED AT	CPSD10	496.	12.13	150.	43.	43.	1.51
+	HYDROGRAPH AT	420B15	10.	12.10	1.	0.	0.	.01
+	2 COMBINED AT	CPSD15	506.	12.13	151.	43.	43.	1.53
+	HYDROGRAPH AT	420B20	12.	12.10	2.	1.	1.	.01
+	2 COMBINED AT	CPSD20	517.	12.13	153.	44.	44.	1.54
+	HYDROGRAPH AT	420B25	37.	12.37	10.	3.	3.	.08
+	ROUTED TO	SFIRES	27.	12.80	10.	3.	3.	.08
+	2 COMBINED AT	CPSD25	529.	12.17	162.	46.	46.	1.62
+	HYDROGRAPH AT	420B30	46.	12.13	7.	2.	2.	.05
+	2 COMBINED AT	CPSD30	573.	12.17	169.	48.	48.	1.68
+	HYDROGRAPH AT	420B35	40.	12.07	4.	1.	1.	.04
+	ROUTED TO	SCHRCH	42.	12.17	4.	1.	1.	.04
	2 COMBINED AT							

+		CPSD35	610.	12.17	173.	49.	49.	1.71
+	HYDROGRAPH AT	420B40	6.	12.07	1.	0.	0.	.00
+	2 COMBINED AT	CPSD40	614.	12.17	173.	50.	50.	1.72
+	HYDROGRAPH AT	420B45	7.	12.07	1.	0.	0.	.01
+	2 COMBINED AT	CPSD45	620.	12.17	174.	50.	50.	1.73
+	DIVERSION TO	MCDB	230.	12.17	16.	4.	4.	1.73
+	HYDROGRAPH AT	TOLSCH	391.	12.17	158.	46.	46.	1.73
+	HYDROGRAPH AT	440	184.	12.03	12.	3.	3.	.08
+	ROUTED TO	R70	181.	12.07	12.	3.	3.	.08
+	HYDROGRAPH AT	441	16.	12.03	1.	0.	0.	.01
+	2 COMBINED AT	C108	197.	12.07	14.	4.	4.	.09
+	DIVERSION TO	SPLIT	99.	12.07	7.	2.	2.	.09
+	HYDROGRAPH AT	D4	99.	12.07	7.	2.	2.	.09
+	ROUTED TO	R108	92.	12.13	7.	2.	2.	.09
+	HYDROGRAPH AT	442	105.	12.10	9.	2.	2.	.10
+	2 COMBINED AT	C67	195.	12.10	16.	4.	4.	.19
+	DIVERSION TO	BASIN4	121.	12.10	6.	2.	2.	.19
+	HYDROGRAPH AT	D6	74.	12.10	10.	3.	3.	.19
+	HYDROGRAPH AT	RTD6	121.	12.10	6.	2.	2.	.19
+	ROUTED TO	SD6	1.	12.47	1.	0.	0.	.19

+	2 COMBINED AT	CD6	74.	12.10	10.	3.	3.	.19
+	HYDROGRAPH AT	443	151.	12.07	15.	4.	4.	.08
+	DIVERSION TO	WSH66	78.	11.87	12.	3.	3.	.08
+	HYDROGRAPH AT	D66	73.	12.07	3.	1.	1.	.08
+	ROUTED TO	R113	71.	12.07	3.	1.	1.	.08
+	2 COMBINED AT	C114	144.	12.07	13.	4.	4.	.27
+	HYDROGRAPH AT	444	83.	12.03	5.	1.	1.	.04
+	ROUTED TO	R58	79.	12.07	5.	1.	1.	.04
+	HYDROGRAPH AT	445	307.	12.03	19.	5.	5.	.19
+	2 COMBINED AT	C107	382.	12.03	23.	6.	6.	.23
+	ROUTED TO	R107	382.	12.07	23.	6.	6.	.23
+	HYDROGRAPH AT	RTB2	99.	12.07	7.	2.	2.	.09
+	ROUTED TO	RSPLIT	98.	12.07	7.	2.	2.	.09
+	HYDROGRAPH AT	446	66.	12.03	6.	2.	2.	.04
+	3 COMBINED AT	C109	545.	12.07	36.	10.	10.	.27
+	DIVERSION TO	WSH404	35.	11.70	8.	2.	2.	.27
+	HYDROGRAPH AT	D5	510.	12.07	29.	7.	7.	.27
+	ROUTED TO	R109	494.	12.10	29.	7.	7.	.27
+	HYDROGRAPH AT	447	141.	12.07	12.	4.	4.	.09

	HYDROGRAPH AT							
+		RT404	35.	11.70	8.	2.	2.	.27
	ROUTED TO							
+		R404	35.	11.83	8.	2.	2.	.27
	3 COMBINED AT							
+		C110	666.	12.07	48.	13.	13.	.36
	ROUTED TO							
+		R110	663.	12.10	48.	13.	13.	.36
	2 COMBINED AT							
+		C115	805.	12.07	62.	17.	17.	.63
	ROUTED TO							
+		R115	799.	12.10	62.	17.	17.	.63
	HYDROGRAPH AT							
+		448	89.	12.03	6.	2.	2.	.05
	HYDROGRAPH AT							
+		449	81.	12.03	5.	1.	1.	.05
	2 COMBINED AT							
+		C6364	170.	12.03	11.	3.	3.	.09
	ROUTED TO							
+		R6364	145.	12.17	11.	3.	3.	.09
	HYDROGRAPH AT							
+		450	63.	12.20	7.	2.	2.	.07
	HYDROGRAPH AT							
+		451	18.	12.17	2.	1.	1.	.03
	2 COMBINED AT							
+		C451	80.	12.20	9.	2.	2.	.09
	HYDROGRAPH AT							
+		RT66	78.	11.87	12.	3.	3.	.08
	HYDROGRAPH AT							
+		452	63.	12.03	5.	1.	1.	.04
	2 COMBINED AT							
+		C6465	141.	12.03	17.	4.	4.	.04
	ROUTED TO							
+		R6566	137.	12.10	17.	4.	4.	.04
	3 COMBINED AT							
+		C116	357.	12.17	36.	10.	10.	.23
	ROUTED TO							
+		BASIN5	159.	12.47	36.	10.	10.	.23
	ROUTED TO							

+	R116	157.	12.53	36.	10.	10.	.23
+ HYDROGRAPH AT	453	63.	12.10	7.	2.	2.	.06
+ 2 COMBINED AT	C117	178.	12.47	43.	12.	12.	.29
+ 2 COMBINED AT	C118	893.	12.10	104.	29.	29.	.92
+ ROUTED TO	R118	887.	12.13	104.	29.	29.	.92
+ DIVERSION TO	BASIN6	248.	12.13	7.	2.	2.	.92
+ HYDROGRAPH AT	D7	639.	12.13	97.	27.	27.	.92
+ HYDROGRAPH AT	RTD7	248.	12.13	7.	2.	2.	.92
+ ROUTED TO	SD7	1.	12.67	1.	1.	1.	.92
+ 2 COMBINED AT	CD7	640.	12.13	97.	28.	28.	.92
+ HYDROGRAPH AT	454	163.	12.13	21.	6.	6.	.18
+ 2 COMBINED AT	C454	801.	12.13	118.	34.	34.	1.10
+ ROUTED TO	R454	793.	12.23	118.	34.	34.	1.10
+ HYDROGRAPH AT	415A	267.	12.17	32.	9.	9.	.28
+ HYDROGRAPH AT	D385G	0.	.00	0.	0.	0.	.17
+ ROUTED TO	RDIV8	0.	.00	0.	0.	0.	.17
+ 4 COMBINED AT	CP415A	1424.	12.20	301.	87.	87.	3.11
+ HYDROGRAPH AT	RMCDB	230.	12.17	16.	4.	4.	1.73
+ ROUTED TO	SMCDB	107.	12.47	16.	4.	4.	1.73
+ 2 COMBINED AT	CPLSCH	1512.	12.20	317.	91.	91.	3.11

+	ROUTED TO R415A	1500.	12.27	317.	91.	91.	3.11
+	HYDROGRAPH AT 455	1419.	12.13	150.	45.	45.	1.11
+	DIVERSION TO BS455	1419.	12.13	139.	37.	37.	1.11
+	HYDROGRAPH AT D455	145.	12.80	24.	8.	8.	1.11
+	HYDROGRAPH AT RT455	1419.	12.13	139.	37.	37.	1.11
+	ROUTED TO S455	23.	12.80	22.	12.	12.	1.11
+	2 COMBINED AT C455	169.	12.80	46.	20.	20.	1.11
+	3 COMBINED AT CC455	5082.	12.23	1113.	381.	381.	15.43
+	ROUTED TO S440	297.	20.77	295.	125.	125.	15.43
+	ROUTED TO R455	297.	21.53	294.	112.	112.	15.43
+	HYDROGRAPH AT 480	1102.	12.10	100.	31.	31.	.73
+	DIVERSION TO BS480	487.	11.90	27.	8.	8.	.73
+	HYDROGRAPH AT D480	1102.	12.10	84.	23.	23.	.73
+	HYDROGRAPH AT RT480	487.	11.90	27.	8.	8.	.73
+	ROUTED TO S480	5.	11.97	5.	4.	4.	.73
+	2 COMBINED AT C480	1107.	12.10	88.	27.	27.	.73
+	2 COMBINED AT CC480	1108.	12.10	366.	167.	167.	.73
+	ROUTED TO R480	908.	12.33	366.	161.	161.	.73
+	HYDROGRAPH AT 456	483.	12.07	37.	10.	10.	.26

+	DIVERSION TO	BASIN1	193.	12.07	8.	2.	2.	.26
+	HYDROGRAPH AT	D1	290.	12.07	29.	8.	8.	.26
+	DIVERSION TO	WA30	59.	12.07	10.	3.	3.	.26
+	HYDROGRAPH AT	CD2	232.	12.07	19.	5.	5.	.26
+	ROUTED TO	R456	218.	12.13	19.	5.	5.	.26
+	HYDROGRAPH AT	457	273.	12.07	21.	6.	6.	.19
+	2 COMBINED AT	C101	480.	12.10	40.	10.	10.	.45
+	DIVERSION TO	BASIN2	177.	12.10	8.	2.	2.	.45
+	HYDROGRAPH AT	D3	303.	12.10	32.	8.	8.	.45
+	HYDROGRAPH AT	RTD3	177.	12.10	8.	2.	2.	.45
+	ROUTED TO	SD3	1.	12.40	1.	1.	1.	.45
+	2 COMBINED AT	CD3	304.	12.10	33.	9.	9.	.45
+	ROUTED TO	R101	302.	12.10	33.	9.	9.	.45
+	HYDROGRAPH AT	458	366.	12.03	26.	7.	7.	.19
+	2 COMBINED AT	C103	655.	12.07	59.	16.	16.	.64
+	ROUTED TO	R103	651.	12.07	59.	16.	16.	.64
+	HYDROGRAPH AT	RT30	59.	12.07	10.	3.	3.	.26
+	ROUTED TO	R30	58.	12.10	10.	3.	3.	.26
+	HYDROGRAPH AT	RTB1	193.	12.07	8.	2.	2.	.26
	ROUTED TO							

+		B1	35.	12.20	8.	2.	2.	.26
	ROUTED TO							
+		RB1	35.	12.27	8.	2.	2.	.26
	2 COMBINED AT							
+		CDIV	87.	12.20	18.	5.	5.	.12
	HYDROGRAPH AT							
+		459	45.	12.03	3.	1.	1.	.03
	2 COMBINED AT							
+		C52	117.	12.10	21.	6.	6.	.15
	ROUTED TO							
+		R52	116.	12.17	21.	6.	6.	.15
	HYDROGRAPH AT							
+		460	221.	12.07	20.	6.	6.	.14
	2 COMBINED AT							
+		C102	323.	12.07	40.	12.	12.	.29
	ROUTED TO							
+		BASIN3	71.	12.63	40.	12.	12.	.29
	ROUTED TO							
+		R3	71.	12.77	40.	12.	12.	.29
	HYDROGRAPH AT							
+		461	165.	12.10	17.	5.	5.	.12
	2 COMBINED AT							
+		C104	220.	12.10	57.	17.	17.	.41
	2 COMBINED AT							
+		C106	866.	12.07	115.	33.	33.	1.05
	ROUTED TO							
+		R106	829.	12.13	115.	33.	33.	1.05
	HYDROGRAPH AT							
+		462	557.	12.07	42.	12.	12.	.30
	2 COMBINED AT							
+		C56	1307.	12.10	156.	44.	44.	1.35
	2 COMBINED AT							
+		C462	1634.	12.30	402.	200.	200.	2.09
	ROUTED TO							
+		R462	1601.	12.33	401.	199.	199.	2.09
	ROUTED TO							
+		RR462	1564.	12.40	400.	196.	196.	2.09
	HYDROGRAPH AT							
+		500	1127.	12.27	128.	35.	35.	.93

```
          2 COMBINED AT
+                          C500      2473.   12.33         510.        227.        227.       3.02
1
                                    SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                        (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                          INTERPOLATED TO
                                                                      COMPUTATION INTERVAL
          ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                   PEAK                                     PEAK

                              (MIN)     (CFS)     (MIN)      (IN)     (MIN)     (CFS)     (MIN)       (IN)

         FOR STORM = 1  STORM AREA (SQ MI) =        .01
            RDIV5  MANE          .51    382.00    732.19       .38      2.00    381.62    732.00        .38

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1333E+02 EXCESS= .0000E+00 OUTFLOW= .1333E+02 BASIN STORAGE= .1023E-03 PERCENT ERROR=    .0

         FOR STORM = 2  STORM AREA (SQ MI) =       1.00
            RDIV5  MANE          .52    378.44    732.01       .37      2.00    378.38    732.00        .37

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1316E+02 EXCESS= .0000E+00 OUTFLOW= .1316E+02 BASIN STORAGE= .1043E-03 PERCENT ERROR=    .0

         FOR STORM = 3  STORM AREA (SQ MI) =       5.80
            RDIV5  MANE          .52    361.33    732.08       .35      2.00    361.12    732.00        .35

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1232E+02 EXCESS= .0000E+00 OUTFLOW= .1232E+02 BASIN STORAGE= .8211E-04 PERCENT ERROR=    .0

         FOR STORM = 4  STORM AREA (SQ MI) =      10.66
            RDIV5  MANE          .53    345.16    732.44       .33      2.00    345.02    732.00        .33

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1156E+02 EXCESS= .0000E+00 OUTFLOW= .1156E+02 BASIN STORAGE= .1289E-03 PERCENT ERROR=    .0

         FOR STORM = 5  STORM AREA (SQ MI) =      13.70
            RDIV5  MANE          .53    339.94    732.10       .32      2.00    339.68    732.00        .32

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1130E+02 EXCESS= .0000E+00 OUTFLOW= .1130E+02 BASIN STORAGE= .6764E-04 PERCENT ERROR=    .0

         FOR STORM = 6  STORM AREA (SQ MI) =      20.00
            RDIV5  MANE          .53    328.87    732.16       .31      2.00    328.49    732.00        .31

 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1079E+02 EXCESS= .0000E+00 OUTFLOW= .1079E+02 BASIN STORAGE= .1255E-03 PERCENT ERROR=    .0

         FOR STORM = 7  STORM AREA (SQ MI) =      50.00
            RDIV5  MANE          .54    305.47    732.25       .28      2.00    304.98    732.00        .28
```

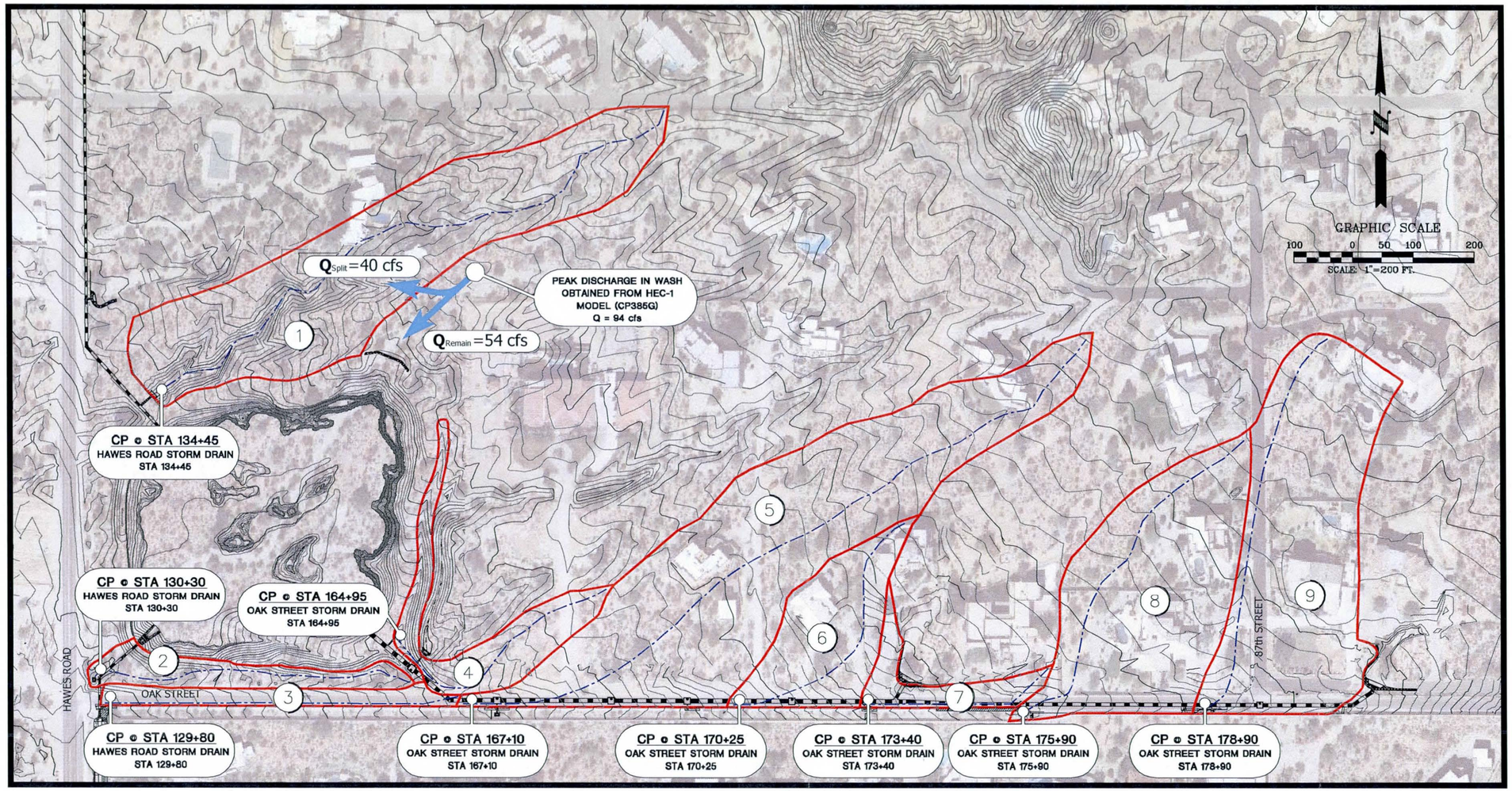
```
CONTINUITY SUMMARY (AC-FT) - INFLOW= .9748E+01 EXCESS= .0000E+00 OUTFLOW= .9748E+01 BASIN STORAGE= .1294E-03 PERCENT ERROR=    .0

         FOR STORM = 1  STORM AREA (SQ MI) =        .01
            R385D  MANE          .48    581.00    732.58       .92      2.00    578.96    734.00         .92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3835E+02 EXCESS= .0000E+00 OUTFLOW= .3835E+02 BASIN STORAGE= .4922E-02 PERCENT ERROR=    .0

         FOR STORM = 2  STORM AREA (SQ MI) =       1.00
            R385D  MANE          .49    576.49    732.79       .91      2.00    574.06    734.00         .91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3802E+02 EXCESS= .0000E+00 OUTFLOW= .3802E+02 BASIN STORAGE= .4898E-02 PERCENT ERROR=    .0

         FOR STORM = 3  STORM AREA (SQ MI) =       5.80
            R385D  MANE          .49    552.21    732.77       .88      2.00    549.94    734.00         .88

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3643E+02 EXCESS= .0000E+00 OUTFLOW= .3643E+02 BASIN STORAGE= .4785E-02 PERCENT ERROR=    .0

         FOR STORM = 4  STORM AREA (SQ MI) =      10.66
            R385D  MANE          .49    529.45    733.08       .84      2.00    528.12    734.00         .84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3495E+02 EXCESS= .0000E+00 OUTFLOW= .3495E+02 BASIN STORAGE= .4676E-02 PERCENT ERROR=    .0

         FOR STORM = 5  STORM AREA (SQ MI) =      13.70
            R385D  MANE          .50    521.71    732.76       .83      2.00    520.20    734.00         .83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+02 EXCESS= .0000E+00 OUTFLOW= .3446E+02 BASIN STORAGE= .4640E-02 PERCENT ERROR=    .0

         FOR STORM = 6  STORM AREA (SQ MI) =      20.00
            R385D  MANE          .50    505.92    732.89       .80      2.00    504.93    734.00         .80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3346E+02 EXCESS= .0000E+00 OUTFLOW= .3345E+02 BASIN STORAGE= .4564E-02 PERCENT ERROR=    .0

         FOR STORM = 7  STORM AREA (SQ MI) =      50.00
            R385D  MANE          .51    472.24    732.92       .75      2.00    471.98    734.00         .75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3137E+02 EXCESS= .0000E+00 OUTFLOW= .3136E+02 BASIN STORAGE= .4404E-02 PERCENT ERROR=    .0

         FOR STORM = 1  STORM AREA (SQ MI) =        .01
           RD385E  MANE          .90       .00    829.80       .00      2.00       .00    830.00         .00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6219E-07 EXCESS= .0000E+00 OUTFLOW= .6219E-07 BASIN STORAGE= .5914E-07 PERCENT ERROR= -95.1
```

```
FOR STORM = 2  STORM AREA (SQ MI) =       1.00
  RD385E  MANE          .80       .00    829.60       .00      2.00       .00    830.00         .00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4457E-07 EXCESS= .0000E+00 OUTFLOW= .4457E-07 BASIN STORAGE= .5914E-07 PERCENT ERROR=-132.7

FOR STORM = 3  STORM AREA (SQ MI) =       5.80
  RD385E  MANE          .80       .00    862.40       .00      2.00       .00    862.00         .00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3812E-07 EXCESS= .0000E+00 OUTFLOW= .3812E-07 BASIN STORAGE= .3397E-07 PERCENT ERROR= -89.1

FOR STORM = 4  STORM AREA (SQ MI) =      10.66
  RD385E  MANE          .70       .00    746.90       .00      2.00       .00    748.00         .00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4471E-07 EXCESS= .0000E+00 OUTFLOW= .4471E-07 BASIN STORAGE= .5914E-07 PERCENT ERROR=-132.3

FOR STORM = 5  STORM AREA (SQ MI) =      13.70
  RD385E  MANE          .60       .00    855.00       .00      2.00       .00    854.00         .00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3824E-07 EXCESS= .0000E+00 OUTFLOW= .3824E-07 BASIN STORAGE= .3397E-07 PERCENT ERROR= -88.8

FOR STORM = 6  STORM AREA (SQ MI) =      20.00
  RD385E  MANE          .60       .00    904.80       .00      2.00       .00    904.00         .00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2143E-07 EXCESS= .0000E+00 OUTFLOW= .2143E-07 BASIN STORAGE= .1951E-07 PERCENT ERROR= -91.0

FOR STORM = 7  STORM AREA (SQ MI) =      50.00
  RD385E  MANE          .60       .00    829.80       .00      2.00       .00    830.00         .00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3773E-07 EXCESS= .0000E+00 OUTFLOW= .3722E-07 BASIN STORAGE= .5914E-07 PERCENT ERROR=-155.4

FOR STORM = 1  STORM AREA (SQ MI) =        .01
  RD415B  MANE          .54    121.01    728.47      1.48      2.00    120.55    728.00        1.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8534E+01 EXCESS= .0000E+00 OUTFLOW= .8533E+01 BASIN STORAGE= .1274E-02 PERCENT ERROR=    .0

FOR STORM = 2  STORM AREA (SQ MI) =       1.00
  RD415B  MANE          .54    119.84    728.69      1.47      2.00    119.49    728.00        1.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8461E+01 EXCESS= .0000E+00 OUTFLOW= .8460E+01 BASIN STORAGE= .1269E-02 PERCENT ERROR=    .0
```

```
FOR STORM = 3  STORM AREA (SQ MI) =       5.80
  RD415B  MANE          .54    114.90    728.55      1.41      2.00    114.43    728.00        1.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8115E+01 EXCESS= .0000E+00 OUTFLOW= .8114E+01 BASIN STORAGE= .1239E-02 PERCENT ERROR=    .0

FOR STORM = 4  STORM AREA (SQ MI) =      10.66
  RD415B  MANE          .55    109.92    728.79      1.35      2.00    109.57    728.00        1.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7789E+01 EXCESS= .0000E+00 OUTFLOW= .7789E+01 BASIN STORAGE= .1208E-02 PERCENT ERROR=    .0

FOR STORM = 5  STORM AREA (SQ MI) =      13.70
  RD415B  MANE          .55    108.29    728.78      1.33      2.00    107.93    728.00        1.33

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7678E+01 EXCESS= .0000E+00 OUTFLOW= .7677E+01 BASIN STORAGE= .1199E-02 PERCENT ERROR=    .0

FOR STORM = 6  STORM AREA (SQ MI) =      20.00
  RD415B  MANE          .55    105.02    728.43      1.29      2.00    104.53    728.00        1.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7449E+01 EXCESS= .0000E+00 OUTFLOW= .7448E+01 BASIN STORAGE= .1182E-02 PERCENT ERROR=    .0

FOR STORM = 7  STORM AREA (SQ MI) =      50.00
  RD415B  MANE          .56     97.84    728.73      1.21      2.00     97.40    728.00        1.21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6962E+01 EXCESS= .0000E+00 OUTFLOW= .6961E+01 BASIN STORAGE= .1138E-02 PERCENT ERROR=    .0

FOR STORM = 1  STORM AREA (SQ MI) =        .01
  RD415C  MANE         1.00       .01    728.00       .00      2.00       .01    728.00         .00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1976E-01 EXCESS= .0000E+00 OUTFLOW= .1965E-01 BASIN STORAGE= .6088E-04 PERCENT ERROR=    .2

FOR STORM = 2  STORM AREA (SQ MI) =       1.00
  RD415C  MANE         1.10       .01    732.60       .00      2.00       .01    732.00         .00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1976E-01 EXCESS= .0000E+00 OUTFLOW= .1965E-01 BASIN STORAGE= .6088E-04 PERCENT ERROR=    .2

FOR STORM = 3  STORM AREA (SQ MI) =       5.80
  RD415C  MANE         1.00       .01    727.00       .00      2.00       .01    726.00         .00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1976E-01 EXCESS= .0000E+00 OUTFLOW= .1965E-01 BASIN STORAGE= .6088E-04 PERCENT ERROR=    .2

FOR STORM = 4  STORM AREA (SQ MI) =      10.66
  RD415C  MANE         1.00       .01    727.00       .00      2.00       .01    726.00         .00
```

```
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1976E-01 EXCESS= .0000E+00 OUTFLOW= .1965E-01 BASIN STORAGE= .6088E-04 PERCENT ERROR=    .2

          FOR STORM = 5  STORM AREA (SQ MI) =      13.70
            RD415C  MANE         1.10       .01    727.10       .00      2.00       .01    728.00         .00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1976E-01 EXCESS= .0000E+00 OUTFLOW= .1965E-01 BASIN STORAGE= .6088E-04 PERCENT ERROR=    .2

          FOR STORM = 6  STORM AREA (SQ MI) =      20.00
            RD415C  MANE         1.00       .01    736.00       .00      2.00       .01    736.00         .00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1976E-01 EXCESS= .0000E+00 OUTFLOW= .1965E-01 BASIN STORAGE= .6088E-04 PERCENT ERROR=    .2

          FOR STORM = 7  STORM AREA (SQ MI) =      50.00
            RD415C  MANE         1.10       .01    730.40       .00      2.00       .01    730.00         .00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1976E-01 EXCESS= .0000E+00 OUTFLOW= .1965E-01 BASIN STORAGE= .6088E-04 PERCENT ERROR=    .2


*** NORMAL END OF HEC-1 ***


   -----DSS---ZCLOSE Unit:  71,   File: 100-YR OAK STREET BASIN AND ST.DSS
             Pointer Utilization:   .25
             Number of Records:      8
             File Size:     35.8  Kbytes
             Percent Inactive:    .0
```

Sub-Section A5: **Rational Equation - Peak Discharge Calculation**



LEGEND

- Drainage Area Boundary
- Longest Flow Path
- (1) **Drainage Area for CP @ STA 134+45** (Hawes Road Storm Drain STA 134+45)
- (2) **Drainage Area for CP @ STA 130+30** (Hawes Road Storm Drain STA 130+30)
- (3) **Drainage Area for CP @ STA 129+80** (Hawes Road Storm Drain STA 129+80)
- (4) **Drainage Area for CP @ STA 164+95** (Oak Street Storm Drain STA 164+95)
- (5) **Drainage Area for CP @ STA 167+10** (Oak Street Storm Drain STA 166+50)
- (6) **Drainage Area for CP @ STA 170+25** (Oak Street Storm Drain STA 171+00)
- (7) **Drainage Area for CP @ STA 173+40** (Oak Street Storm Drain STA 173+20)
- (8) **Drainage Area for CP @ STA 175+90** (Oak Street Storm Drain STA 175+90)
- (9) **Drainage Area for CP @ STA 178+90** (Oak Street Storm Drain STA 178+90)

Peak Discharge Summary

Drainage Area	Area (ac)	Length (mi)	US Elev (ft)	DS Elev (ft)	100-Yr Peak Discharge (cfs)
CP @ STA 134+45	3.45	0.197	1855	1810	14+40 (Split)=54
CP @ STA 130+30	0.53	0.102	1819	1804	2.2
CP @ STA 129+80	0.41	0.112	1822	1803	2.1
CP @ STA 164+95	0.77	0.085	1836	1816	3.5
CP @ STA 167+10	4.28	0.235	1874	1822	15.9
CP @ STA 170+25	1.09	0.089	1855	1837	5.6
CP @ STA 173+40	0.40	0.063	1857	1845	2.3
CP @ STA 175+90	2.59	0.119	1878	1852	12.2
CP @ STA 178+90	3.03	0.127	1885	1860	14.2

Gavan & Barker Inc.
Gavan & Barker, Inc.
3030 N. Central Ave.
Suite 1530
Phoenix, Arizona 85012
Phone: 602-200-0031
Fax: 602-200-0032
Civil Engineering
Landscape Architecture

Project:

Oak Street Basin and Storm Drain Design

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD - 2009C021

Submittal:

G&B No.	0912
Issue Date:	09/12
Drawn By:	OK
Checked By:	MTG

Sheet Title:

Exhibit A5.1: Inlet Design Drainage Area Map

Page Number:

Rational Method 100-Year Peak Discharge Calculation: Drainage Area for CP @ STA 134+45

$Q_{100} = C\, i_{100}\, A$

$A = Total\ Contributing\ Drainage\ Area$

$[A = 3.45\ Acres]$

$Impervious\ Area\ (Street,\ Driveway,\ Sidewalk\ and\ Rooftops) = 0.11\ Acres$

$Area\ of\ Sonoran\ Desert = 3.34\ Acres$

$i = Average\ Rainfall\ Intensity$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = Time\ of\ Concentration$

$L = Length\ of\ Longest\ Flow\ Path = 0.197\ mi$

$[L = 0.197\ mi]$

$K_b = Watershed\ Resistance\ Coefficient$

$K_b = m \log(A) + b$ (Table 3.1-FCDMC Hydrology Drainage Design Manual)

$Type\ C \Rightarrow m = -0.025$ and $b = 0.15$

$K_b = m \log(A) + b$

$K_b = -0.025 \log(3.45) + 0.15$

$[K_b = 0.1366]$

$S = Water\ Course\ Slope$

$US\ Elev = 1855\ ft$

$DS\ Elev = 1810\ ft$

$$S = \frac{US\ Elev - DS\ Elev}{L} = \frac{1855 - 1810}{0.197} = \frac{45}{0.197} = 228.43\ \frac{ft}{mi}$$

$$\left[S = 228\ \frac{ft}{mi}\right]$$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = 11.4(0.197)^{0.5}(0.1366)^{0.52}(228)^{-0.31}\, i_{100}^{-0.38}$

$T_C = 0.334\, i_{100}^{-0.38}$

Try $i_{100} = 5.73\ \frac{in}{hr}$ for a 10 minute duration

(Figure B.2 - FCDMC Hydrology Drainage Design Manual)

$$T_C = 0.334(5.73)^{-0.38}$$
$$T_C = 0.172\ hr\ x\ 60\ \frac{\min}{hr}$$
$$T_C = 10.32\ \min \approx 10\ \min$$
$$\therefore \text{Use}\left[i_{100} = 5.73\ \frac{in}{hr}\right]$$

$C = Runoff\ Coefficient$ (Table 3.2-FCDMC Hydrology Drainage Design Manual)

The runoff coefficient (C) is area weighted. The total drainage area is separated into two different sub-areas, the impervious (street, driveway, sidewalk and rooftops) and Sonoran Desert

$AREA\ \#\ 1$

$$Impervious: \left[A_1 = 0.11\ Acres\right] \in \left[C_1 = 0.95\right]$$

$AREA\ \#\ 2$

$$Sonoran\ Desert: \left[A_2 = 3.34\ Acres\right] \in \left[C_2 = 0.70\right]$$

$C_w = Weighted\ Runoff\ Coefficient$

$$C_w = \left(\frac{A_1}{A}\right)C_1 + \left(\frac{A_2}{A}\right)C_2$$
$$C_w = 0.95\left(\frac{0.11}{3.45}\right) + 0.70\left(\frac{3.34}{3.45}\right)$$
$$C_w = 0.7080$$
$$\left[C_w = 0.71\right]$$

$Q_{100} = 100 - Year\ Peak\ Discharge$

$$Q_{100} = C_w\ i_{100}\ A$$
$$Q_{100} = (0.71)(5.73)(3.45)$$
$$Q_{100} = 14.04\ cfs$$

There is a potential upstream split flow from the HEC-1 concentration point CP385G of 40 cfs. Therefore the total design100-year peak discharge at CP @ STA 134+45 is:

$$Q_{100} = Q_{100} + Q_{Split}$$
$$Q_{100} = 14 + 40$$
$$Q_{100} = 54$$

$$\boxed{\boldsymbol{Q_{100} = 54\ cfs}}$$

See attached Channel Report for the "Existing Wash at Basin NE Corner (CP385G from HEC-1)" for the split flow calculation.

Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. Wednesday, Dec 15 2010

Existing Wash at Basin NE Corner (Flow from HEC-1: CP385G)

Rectangular

Bottom Width (ft)	= 15.00
Total Depth (ft)	= 0.67
Invert Elev (ft)	= 100.00
Slope (%)	= 3.10
N-Value	= 0.035

Calculations

Compute by:	Known Depth
Known Depth (ft)	= 0.67

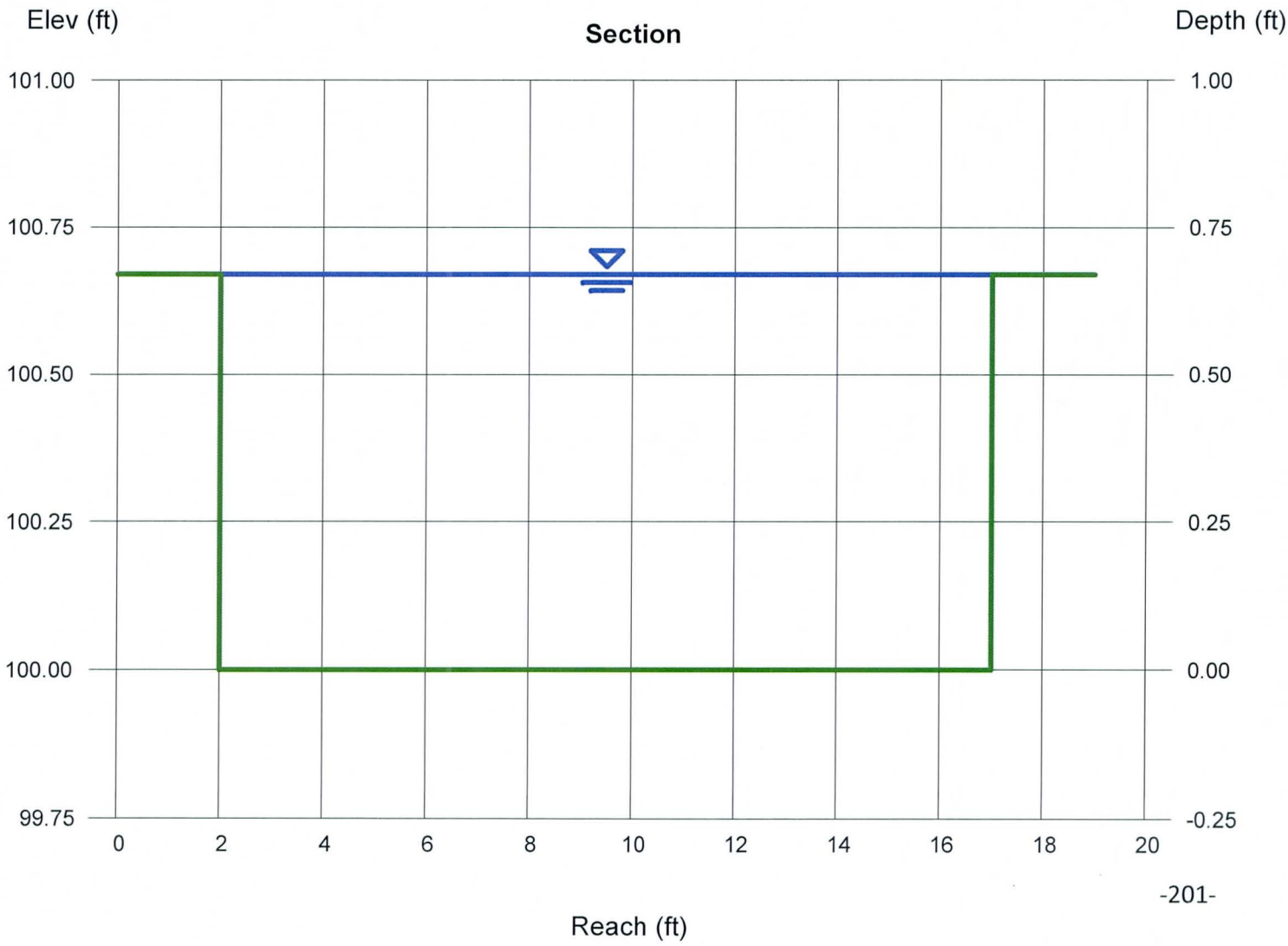
Highlighted

Depth (ft)	= 0.67
Q (cfs)	= 54.33
Area (sqft)	= 10.05
Velocity (ft/s)	= 5.41
Wetted Perim (ft)	= 16.34
Crit Depth, Yc (ft)	= 0.67
Top Width (ft)	= 15.00
EGL (ft)	= 1.12

Existing Wash at Basin NE Corner Flow (From HEC-1: CP385G) = 94 cfs

Existing Wash at Basin NE Corner Capacity (Q_{Remain}) = 54 cfs

Potential Split Flow (Q_{Split}) = 40 cfs



Rational Method 100-Year Peak Discharge Calculation: Drainage Area for CP @ STA 130+30

$Q_{100} = C\, i_{100}\, A$

$A = Total\ Contributing\ Drainage\ Area$

$[A = 0.53\ Acres]$

$Area\ of\ Sonoran\ Desert = 0.53\ Acres$

$i = Average\ Rainfall\ Intensity$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = Time\ of\ Concentration$

$L = Length\ of\ Longest\ Flow\ Path = 0.102\ mi$

$[L = 0.102\ mi]$

$K_b = Watershed\ Resistance\ Coefficient$

$K_b = m \log(A) + b$ (Table 3.1-FCDMC Hydrology Drainage Design Manual)

$Type\ C \Rightarrow m = -0.025$ and $b = 0.15$

$K_b = m \log(A) + b$

$K_b = -0.025 \log(0.53) + 0.15$

$[K_b = 0.1569]$

$S = Water\ Course\ Slope$

$US\ Elev = 1819\ ft$

$DS\ Elev = 1804\ ft$

$$S = \frac{US\ Elev - DS\ Elev}{L} = \frac{1819 - 1804}{0.102} = \frac{15}{0.102} = 147.06\ \frac{ft}{mi}$$

$$\left[S = 147\ \frac{ft}{mi}\right]$$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = 11.4(0.102)^{0.5}(0.1569)^{0.52}(147)^{-0.31}\, i_{100}^{-0.38}$

$T_C = 0.296\, i_{100}^{-0.38}$

Try $i_{100} = 6.00\ \frac{in}{hr}$ for a 9 minute duration

(Figure B.2 - FCDMC Hydrology Drainage Design Manual)

$$T_C = 0.296(6.00)^{-0.38}$$
$$T_C = 0.150\ hr\ x\ 60\ \frac{\min}{hr}$$
$$T_C = 9.00\ \min \approx 7\ \min$$
$$\therefore \text{Use}\left[i_{100} = 6.00\ \frac{in}{hr}\right]$$

$C = Runoff\ Coefficient$ (Table 3.2-FCDMC Hydrology Drainage Design Manual)

$Sonoran\ Desert: [A = 0.53\ Acres] \in [C = 0.70]$

$$Q_{100} = 100 - Year\ Peak\ Discharge$$
$$Q_{100} = C\ i_{100}\ A$$
$$Q_{100} = (0.70)(6.00)(0.53)$$
$$Q_{100} = 2.23\ cfs$$

CP @ STA 130+30

$$\boldsymbol{Q_{100} = 2.2\ cfs}$$

Rational Method 100-Year Peak Discharge Calculation: Drainage Area for CP @ STA 129+80

$Q_{100} = C\, i_{100}\, A$

$A = Total\ Contributing\ Drainage\ Area$

$[A = 0.41\ Acres]$

$Impervious\ Area\left(Street,\ Driveway,\ Sidewalk\ and\ Rooftops\right) = 0.24\ Acres$

$Area\ of\ Sonoran\ Desert = 0.17\ Acres$

$i = Average\ Rainfall\ Intensity$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = Time\ of\ Concentration$

$L = Length\ of\ Longest\ Flow\ Path = 0.112\ mi$

$[L = 0.112\ mi]$

$K_b = Watershed\ Resistance\ Coefficient$

$K_b = m \log(A) + b$ (Table 3.1-FCDMC Hydrology Drainage Design Manual)

$Type\ C \Rightarrow m = -0.025$ and $b = 0.15$

$K_b = m \log(A) + b$

$K_b = -0.025 \log(0.41) + 0.15$

$\left[K_b = 0.1597\right]$

$S = Water\ Course\ Slope$

$US\ Elev = 1822\ ft$

$DS\ Elev = 1803\ ft$

$$S = \frac{US\ Elev - DS\ Elev}{L} = \frac{1822 - 1803}{0.112} = \frac{19}{0.112} = 169.64\ \frac{ft}{mi}$$

$$\left[S = 170\ \frac{ft}{mi}\right]$$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = 11.4(0.112)^{0.5}(0.1597)^{0.52}(170)^{-0.31}\, i_{100}^{-0.38}$

$T_C = 0.299\, i_{100}^{-0.38}$

Try $i_{100} = 5.95\ \frac{in}{hr}$ for a 9 minute duration

(Figure B.2 - FCDMC Hydrology Drainage Design Manual)

$$T_C = 0.299(5.95)^{-0.38}$$

$$T_C = 0.152\ hr\ x\ 60\ \frac{\min}{hr}$$

$$T_C = 9.12\ \min \approx 9\ \min$$

$$\therefore \text{Use}\left[i_{100} = 5.95\ \frac{in}{hr}\right]$$

$C = Runoff\ Coefficient$ (Table 3.2-FCDMC Hydrology Drainage Design Manual)

The runoff coefficient (C) is area weighted. The total drainage area is separated into two different sub-areas, the impervious (street, driveway, sidewalk and rooftops) and Sonoran Desert

$AREA\ \#\ 1$

$$Impervious: \left[A_1 = 0.24\ Acres\right] \in \left[C_1 = 0.95\right]$$

$AREA\ \#\ 2$

$$Sonoran\ Desert: \left[A_2 = 0.17\ Acres\right] \in \left[C_2 = 0.70\right]$$

$C_w = Weighted\ Runoff\ Coefficient$

$$C_w = \left(\frac{A_1}{A}\right)C_1 + \left(\frac{A_2}{A}\right)C_2$$

$$C_w = 0.95\left(\frac{0.24}{0.41}\right) + 0.70\left(\frac{0.17}{0.41}\right)$$

$$C_w = 0.8463$$

$$\left[C_w = 0.85\right]$$

$Q_{100} = 100 - Year\ Peak\ Discharge$

$$Q_{100} = C_w\ i_{100}\ A$$

$$Q_{100} = (0.85)(5.95)(0.41)$$

$$Q_{100} = 2.07\ cfs$$

<u>CP @ STA 129+80</u>

$$\boldsymbol{Q_{100} = 2.1\ cfs}$$

Rational Method 100-Year Peak Discharge Calculation: Drainage Area for CP @ STA 178+90

$Q_{100} = C\, i_{100}\, A$

$A = Total\ Contributing\ Drainage\ Area$

$[A = 3.03\ Acres]$

$Impervious\ Area\left(Street,\ Driveway,\ Sidewalk\ and\ Rooftops\right) = 1.07\ Acres$

$Area\ of\ Sonoran\ Desert = 1.96\ Acres$

$i = Average\ Rainfall\ Intensity$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = Time\ of\ Concentration$

$L = Length\ of\ Longest\ Flow\ Path = 0.127\ mi$

$[L = 0.127\ mi]$

$K_b = Watershed\ Resistance\ Coefficient$

$K_b = m \log(A) + b$ (Table 3.1-FCDMC Hydrology Drainage Design Manual)

$Type\ C \Rightarrow m = -0.025$ and $b = 0.15$

$K_b = m \log(A) + b$

$K_b = -0.025 \log(3.03) + 0.15$

$\left[K_b = 0.1380\right]$

$S = Water\ Course\ Slope$

$US\ Elev = 1885\ ft$

$DS\ Elev = 1860\ ft$

$$S = \frac{US\ Elev - DS\ Elev}{L} = \frac{1885 - 1860}{0.127} = \frac{25}{0.246} = 196.85\ \frac{ft}{mi}$$

$$\left[S = 197\ \frac{ft}{mi}\right]$$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = 11.4(0.127)^{0.5}(0.1380)^{0.52}(197)^{-0.31}\, i_{100}^{-0.38}$

$T_C = 0.282\, i_{100}^{-0.38}$

Try $i_{100} = 5.95\ \frac{in}{hr}$ for a 9 minute duration

(Figure B.2 - FCDMC Hydrology Drainage Design Manual)

$$T_C = 0.282(5.95)^{-0.38}$$

$$T_C = 0.143\ hr\ x\ 60\ \frac{\min}{hr}$$

$$T_C = 8.58\ \min \approx 9\ \min$$

$$\therefore \text{Use}\left[i_{100} = 5.95\ \frac{in}{hr}\right]$$

$C = Runoff\ Coefficient$ (Table 3.2-FCDMC Hydrology Drainage Design Manual)

The runoff coefficient (C) is area weighted. The total drainage area is separated into two different sub-areas, the impervious (street, driveway, sidewalk and rooftops) and Sonoran Desert

$AREA\ \#1$

$$Impervious: \left[A_1 = 1.07\ Acres\right] \in \left[C_1 = 0.95\right]$$

$AREA\ \#2$

$$Sonoran\ Desert: \left[A_2 = 1.96\ Acres\right] \in \left[C_2 = 0.70\right]$$

$C_w = Weighted\ Runoff\ Coefficient$

$$C_w = \left(\frac{A_1}{A}\right)C_1 + \left(\frac{A_2}{A}\right)C_2$$

$$C_w = 0.95\left(\frac{1.07}{3.03}\right) + 0.70\left(\frac{1.96}{3.03}\right)$$

$$C_w = 0.7883$$

$$\left[C_w = 0.79\right]$$

$Q_{100} = 100 - Year\ Peak\ Discharge$

$$Q_{100} = C_w\ i_{100}\ A$$

$$Q_{100} = (0.79)(5.95)(3.03)$$

$$Q_{100} = 14.24\ cfs$$

<u>CP @ STA 178+90</u>

$$\boldsymbol{Q_{100} = 14.2\ cfs}$$

Rational Method 100-Year Peak Discharge Calculation: Drainage Area for CP @ STA 175+90

$Q_{100} = C\, i_{100}\, A$

$A = Total\ Contributing\ Drainage\ Area$

$[A = 2.59\ Acres]$

$Impervious\ Area\left(Street,\ Driveway,\ Sidewalk\ and\ Rooftops\right) = 0.67\ Acres$

$Area\ of\ Sonoran\ Desert = 1.92\ Acres$

$i = Average\ Rainfall\ Intensity$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = Time\ of\ Concentration$

$L = Length\ of\ Longest\ Flow\ Path = 0.119\ mi$

$[L = 0.119\ mi]$

$K_b = Watershed\ Resistance\ Coefficient$

$K_b = m \log(A) + b$ (Table 3.1-FCDMC Hydrology Drainage Design Manual)

$Type\ C \Rightarrow m = -0.025$ and $b = 0.15$

$K_b = m \log(A) + b$

$K_b = -0.025 \log(2.59) + 0.15$

$\left[K_b = 0.1397\right]$

$S = Water\ Course\ Slope$

$US\ Elev = 1878\ ft$

$DS\ Elev = 1852\ ft$

$$S = \frac{US\ Elev - DS\ Elev}{L} = \frac{1878 - 1852}{0.119} = \frac{26}{0.119} = 218.49\ \frac{ft}{mi}$$

$$\left[S = 218\ \frac{ft}{mi}\right]$$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = 11.4(0.119)^{0.5}(0.1397)^{0.52}(218)^{-0.31}\, i_{100}^{-0.38}$

$T_C = 0.266\, i_{100}^{-0.38}$

Try $i_{100} = 6.18\ \frac{in}{hr}$ for a 8 minute duration

(Figure B.2 - FCDMC Hydrology Drainage Design Manual)

$$T_C = 0.266(6.18)^{-0.38}$$

$$T_C = 0.133\ hr\ x\ 60\ \frac{\min}{hr}$$

$$T_C = 7.98\ \min \approx 8\ \min$$

$$\therefore \text{Use}\left[i_{100} = 6.18\ \frac{in}{hr}\right]$$

$C = Runoff\ Coefficient$ (Table 3.2-FCDMC Hydrology Drainage Design Manual)

The runoff coefficient (C) is area weighted. The total drainage area is separated into two different sub-areas, the impervious (street, driveway, sidewalk and rooftops) and Sonoran Desert

$AREA\ \#1$

$$Impervious: \left[A_1 = 0.67\ Acres\right] \in \left[C_1 = 0.95\right]$$

$AREA\ \#2$

$$Sonoran\ Desert: \left[A_2 = 1.92\ Acres\right] \in \left[C_2 = 0.70\right]$$

$C_w = Weighted\ Runoff\ Coefficient$

$$C_w = \left(\frac{A_1}{A}\right)C_1 + \left(\frac{A_2}{A}\right)C_2$$

$$C_w = 0.95\left(\frac{0.67}{2.59}\right) + 0.70\left(\frac{1.92}{2.59}\right)$$

$$C_w = 0.7647$$

$$\left[C_w = 0.76\right]$$

$Q_{100} = 100 - Year\ Peak\ Discharge$

$$Q_{100} = C_w\ i_{100}\ A$$

$$Q_{100} = (0.76)(6.18)(2.59)$$

$$Q_{100} = 12.16\ cfs$$

CP @ STA 175+90

$$\boldsymbol{Q_{100} = 12.2\ cfs}$$

Rational Method 100-Year Peak Discharge Calculation: Drainage Area for CP @ STA 173+40

$Q_{100} = C\, i_{100}\, A$

$A = Total\ Contributing\ Drainage\ Area$

$[A = 0.40\ Acres]$

$Impervious\ Area\left(Street,\ Driveway,\ Sidewalk\ and\ Rooftops\right) = 0.18\ Acres$

$Area\ of\ Sonoran\ Desert = 0.22\ Acres$

$i = Average\ Rainfall\ Intensity$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = Time\ of\ Concentration$

$L = Length\ of\ Longest\ Flow\ Path = 0.063\ mi$

$[L = 0.063\ mi]$

$K_b = Watershed\ Resistance\ Coefficient$

$K_b = m \log(A) + b$ (Table 3.1-FCDMC Hydrology Drainage Design Manual)

$Type\ C \Rightarrow m = -0.025$ and $b = 0.15$

$K_b = m \log(A) + b$

$K_b = -0.025 \log(0.40) + 0.15$

$\left[K_b = 0.1599\right]$

$S = Water\ Course\ Slope$

$US\ Elev = 1857\ ft$

$DS\ Elev = 1845\ ft$

$$S = \frac{US\ Elev - DS\ Elev}{L} = \frac{1857 - 1845}{0.063} = \frac{12}{0.063} = 190.48\ \frac{ft}{mi}$$

$$\left[S = 190\ \frac{ft}{mi}\right]$$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = 11.4(0.063)^{0.5}(0.1599)^{0.52}(190)^{-0.31}\, i_{100}^{-0.38}$

$T_C = 0.217 i_{100}^{-0.38}$

Try $i_{100} = 6.99\ \frac{in}{hr}$ for a 6 minute duration

(Figure B.2 - FCDMC Hydrology Drainage Design Manual)

$$T_C = 0.217(6.99)^{-0.38}$$

$$T_C = 0.104\ hr\ x\ 60\ \frac{\min}{hr}$$

$$T_C = 6.24\ \min \approx 6\ \min$$

$$\therefore \text{Use}\left[i_{100} = 6.99\ \frac{in}{hr}\right]$$

$C = Runoff\ Coefficient$ (Table 3.2-FCDMC Hydrology Drainage Design Manual)

The runoff coefficient (C) is area weighted. The total drainage area is separated into two different sub-areas, the impervious (street, driveway, sidewalk and rooftops) and Sonoran Desert

$AREA\ \#1$

$$Impervious: \left[A_1 = 0.18\ Acres\right] \in \left[C_1 = 0.95\right]$$

$AREA\ \#2$

$$Sonoran\ Desert: \left[A_2 = 0.22\ Acres\right] \in \left[C_2 = 0.70\right]$$

$C_w = Weighted\ Runoff\ Coefficient$

$$C_w = \left(\frac{A_1}{A}\right)C_1 + \left(\frac{A_2}{A}\right)C_2$$

$$C_w = 0.95\left(\frac{0.18}{0.40}\right) + 0.70\left(\frac{0.22}{0.40}\right)$$

$$C_w = 0.8125$$

$$\left[C_w = 0.81\right]$$

$Q_{100} = 100 - Year\ Peak\ Discharge$

$$Q_{100} = C_w\ i_{100}\ A$$

$$Q_{100} = (0.81)(6.99)(0.40)$$

$$Q_{100} = 2.26\ cfs$$

<u>CP @ STA 173+40</u>

$$\boldsymbol{Q_{100} = 2.3\ cfs}$$

Rational Method 100-Year Peak Discharge Calculation: Drainage Area for CP @ STA 170+25

$Q_{100} = C\, i_{100}\, A$

$A = Total\ Contributing\ Drainage\ Area$

$[A = 1.09\ Acres]$

$Impervious\ Area\left(Street,\ Driveway,\ Sidewalk\ and\ Rooftops\right) = 0.39\ Acres$

$Area\ of\ Sonoran\ Desert = 0.70\ Acres$

$i = Average\ Rainfall\ Intensity$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = Time\ of\ Concentration$

$L = Length\ of\ Longest\ Flow\ Path = 0.089\ mi$

$[L = 0.089\ mi]$

$K_b = Watershed\ Resistance\ Coefficient$

$K_b = m \log(A) + b$ (Table 3.1-FCDMC Hydrology Drainage Design Manual)

$Type\ C \Rightarrow m = -0.025$ and $b = 0.15$

$K_b = m \log(A) + b$

$K_b = -0.025 \log(1.09) + 0.15$

$\left[K_b = 0.1491\right]$

$S = Water\ Course\ Slope$

$US\ Elev = 1855\, ft$

$DS\ Elev = 1837\, ft$

$$S = \frac{US\ Elev - DS\ Elev}{L} = \frac{1855 - 1837}{0.089} = \frac{18}{0.089} = 202.25\ \frac{ft}{mi}$$

$$\left[S = 202\ \frac{ft}{mi}\right]$$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = 11.4(0.089)^{0.5}(0.1491)^{0.52}(202)^{-0.31}\, i_{100}^{-0.38}$

$T_C = 0.244\, i_{100}^{-0.38}$

Try $i_{100} = 6.54\ \frac{in}{hr}$ for a 7 minute duration

(Figure B.2 - FCDMC Hydrology Drainage Design Manual)

$$T_C = 0.244(6.54)^{-0.38}$$

$$T_C = 0.120\ hr\ x\ 60\ \frac{\min}{hr}$$

$$T_C = 7.20\ \min \approx 7\ \min$$

$$\therefore \text{Use}\left[i_{100} = 6.54\ \frac{in}{hr}\right]$$

$C = Runoff\ Coefficient$ (Table 3.2-FCDMC Hydrology Drainage Design Manual)

The runoff coefficient (C) is area weighted. The total drainage area is separated into two different sub-areas, the impervious (street, driveway, sidewalk and rooftops) and Sonoran Desert

$AREA\ \#1$

$$Impervious: \left[A_1 = 0.39\ Acres\right] \in \left[C_1 = 0.95\right]$$

$AREA\ \#2$

$$Sonoran\ Desert: \left[A_2 = 0.70\ Acres\right] \in \left[C_2 = 0.70\right]$$

$C_w = Weighted\ Runoff\ Coefficient$

$$C_w = \left(\frac{A_1}{A}\right)C_1 + \left(\frac{A_2}{A}\right)C_2$$

$$C_w = 0.95\left(\frac{0.39}{1.09}\right) + 0.70\left(\frac{0.70}{1.09}\right)$$

$$C_w = 0.7894$$

$$\left[C_w = 0.79\right]$$

$Q_{100} = 100 - Year\ Peak\ Discharge$

$$Q_{100} = C_w\ i_{100}\ A$$

$$Q_{100} = (0.79)(6.54)(1.09)$$

$$Q_{100} = 5.63\ cfs$$

<u>CP @ STA 170+25</u>

$$\boldsymbol{Q_{100} = 5.6\ cfs}$$

Rational Method 100-Year Peak Discharge Calculation: Drainage Area for CP @ STA 167+10

$Q_{100} = C\, i_{100}\, A$

$A = Total\ Contributing\ Drainage\ Area$

$[A = 4.28\ Acres]$

$Impervious\ Area\left(Street,\ Driveway,\ Sidewalk\ and\ Rooftops\right) = 0.33\ Acres$

$Area\ of\ Sonoran\ Desert = 3.95\ Acres$

$i = Average\ Rainfall\ Intensity$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = Time\ of\ Concentration$

$L = Length\ of\ Longest\ Flow\ Path = 0.112\ mi$

$[L = 0.235\ mi]$

$K_b = Watershed\ Resistance\ Coefficient$

$K_b = m \log(A) + b$ (Table 3.1-FCDMC Hydrology Drainage Design Manual)

$Type\ C \Rightarrow m = -0.025$ and $b = 0.15$

$K_b = m \log(A) + b$

$K_b = -0.025 \log(4.28) + 0.15$

$\left[K_b = 0.1342\right]$

$S = Water\ Course\ Slope$

$US\ Elev = 1874\ ft$

$DS\ Elev = 1822\ ft$

$$S = \frac{US\ Elev - DS\ Elev}{L} = \frac{1874 - 1822}{0.235} = \frac{52}{0.235} = 221.28\ \frac{ft}{mi}$$

$$\left[S = 221\ \frac{ft}{mi}\right]$$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = 11.4(0.235)^{0.5}(0.1342)^{0.52}(221)^{-0.31}\, i_{100}^{-0.38}$

$T_C = 0.365\, i_{100}^{-0.38}$

Try $i_{100} = 5.17\ \frac{in}{hr}$ for a 12 minute duration

(Figure B.2 - FCDMC Hydrology Drainage Design Manual)

$$T_C = 0.365(5.17)^{-0.38}$$
$$T_C = 0.195\ hr\ x\ 60\ \frac{\min}{hr}$$
$$T_C = 11.70\ \min \approx 12\ \min$$
$$\therefore \text{Use}\left[i_{100} = 5.17\ \frac{in}{hr}\right]$$

$C = Runoff\ Coefficient$ (Table 3.2-FCDMC Hydrology Drainage Design Manual)

The runoff coefficient (C) is area weighted. The total drainage area is separated into two different sub-areas, the impervious (street, driveway, sidewalk and rooftops) and Sonoran Desert

$AREA\ \#1$

$$Impervious: \left[A_1 = 0.33\ Acres\right] \in \left[C_1 = 0.95\right]$$

$AREA\ \#2$

$$Sonoran\ Desert: \left[A_2 = 3.95\ Acres\right] \in \left[C_2 = 0.70\right]$$

$C_w = Weighted\ Runoff\ Coefficient$

$$C_w = \left(\frac{A_1}{A}\right)C_1 + \left(\frac{A_2}{A}\right)C_2$$
$$C_w = 0.95\left(\frac{0.33}{4.28}\right) + 0.70\left(\frac{3.95}{4.28}\right)$$
$$C_w = 0.7193$$
$$\left[C_w = 0.72\right]$$

$Q_{100} = 100 - Year\ Peak\ Discharge$

$$Q_{100} = C_w\ i_{100}\ A$$
$$Q_{100} = (0.72)(5.17)(4.28)$$
$$Q_{100} = 15.93\ cfs$$

<u>CP @ STA 167+10</u>

$$\boldsymbol{Q_{100} = 15.9\ cfs}$$

Rational Method 100-Year Peak Discharge Calculation: Drainage Area for CP @ STA 164+95

$Q_{100} = C\, i_{100}\, A$

$A = Total\ Contributing\ Drainage\ Area$

$[A = 0.77\ Acres]$

$Area\ of\ Sonoran\ Desert = 0.77\ Acres$

$i = Average\ Rainfall\ Intensity$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = Time\ of\ Concentration$

$L = Length\ of\ Longest\ Flow\ Path = 0.085\ mi$

$[L = 0.085\ mi]$

$K_b = Watershed\ Resistance\ Coefficient$

$K_b = m \log(A) + b$ (Table 3.1-FCDMC Hydrology Drainage Design Manual)

$Type\ C \Rightarrow m = -0.025$ and $b = 0.15$

$K_b = m \log(A) + b$

$K_b = -0.025 \log(0.77) + 0.15$

$[K_b = 0.1528]$

$S = Water\ Course\ Slope$

$US\ Elev = 1836\, ft$

$DS\ Elev = 1816\, ft$

$$S = \frac{US\ Elev - DS\ Elev}{L} = \frac{1836 - 1816}{0.085} = \frac{20}{0.085} = 235.29\ \frac{ft}{mi}$$

$$\left[S = 235\ \frac{ft}{mi}\right]$$

$T_C = 11.4\, L^{0.5}\, K_b^{0.52}\, S^{-0.31}\, i_{100}^{-0.38}$

$T_C = 11.4(0.085)^{0.5}(0.1528)^{0.52}(235)^{-0.31}\, i_{100}^{-0.38}$

$T_C = 0.230\, i_{100}^{-0.38}$

Try $i_{100} = 6.54\ \frac{in}{hr}$ for a 7 minute duration

(Figure B.2 - FCDMC Hydrology Drainage Design Manual)

$$T_C = 0.230(6.54)^{-0.38}$$

$$T_C = 0.113\ hr\ x\ 60\ \frac{\min}{hr}$$

$$T_C = 6.78\ \min \approx 7\ \min$$

$$\therefore \text{Use}\left[i_{100} = 6.54\ \frac{in}{hr}\right]$$

$C = Runoff\ Coefficient$ (Table 3.2-FCDMC Hydrology Drainage Design Manual)

$$Sonoran\ Desert: [A = 0.77\ Acres] \in [C = 0.70]$$

$$Q_{100} = 100 - Year\ Peak\ Discharge$$

$$Q_{100} = C\ i_{100}\ A$$

$$Q_{100} = (0.70)(6.54)(0.77)$$

$$Q_{100} = 3.53\ cfs$$

CP @ STA 164+95

$$\boldsymbol{Q_{100} = 3.5\ cfs}$$

HYDRAULICS

MEMORANDUM

To: Afshin Ahouraiyan

From: Omer Karovic & Mark Gavan

Date: October, 2012

Project: Oak Street Basin and Storm Drain Design

Subject: Hydraulic Calculations

Introduction

This memo provides an explanation of the hydraulic assumptions and calculations that were made in order to design the Oak Street Basin and Storm Drain.

The proposed Oak Street Storm Drain starts east of 87th Street and conveys flows to the proposed Oak Street Basin which is located at the northeast corner of Hawes Road and Oak Street. The project also includes a storm drain in Hawes Road that conveys flow from the watershed north of the Granite Mountain subdivision to the Oak Street Basin. The Oak Street Basin is being designed as an in-line basin, which means that there are no flows bypassing the basin. Instead, the storm drains discharge directly to the basin which has a 48 inch outlet pipe discharging to the partially reconstructed Hawes Road channel.

Storm Drain Hydraulic Grade Line Calculations

Hydraulic grade line calculations were done for the Oak Street and Hawes Road Storm Drains using the U.S. Army Corps of Engineer's HEC-RAS program. The primary constraint on the storm drain size and slope was the allowable maximum velocity. According to the Scope of Work, the storm drain velocities shall be "generally below 20 fps, but not to exceed 25 fps." Both of the existing streets are built on relatively steep gradients; however only the storm drain within Oak Street will require drop structures to control the pipe velocities. The storm drains were designed to limit the pipe velocities to 20 fps and to keep the energy grade line below the ground surface. The hydraulic grade line calculations for the proposed storm drains are presented in sub-section B1.

HEC-RAS Storm Drain Modeling

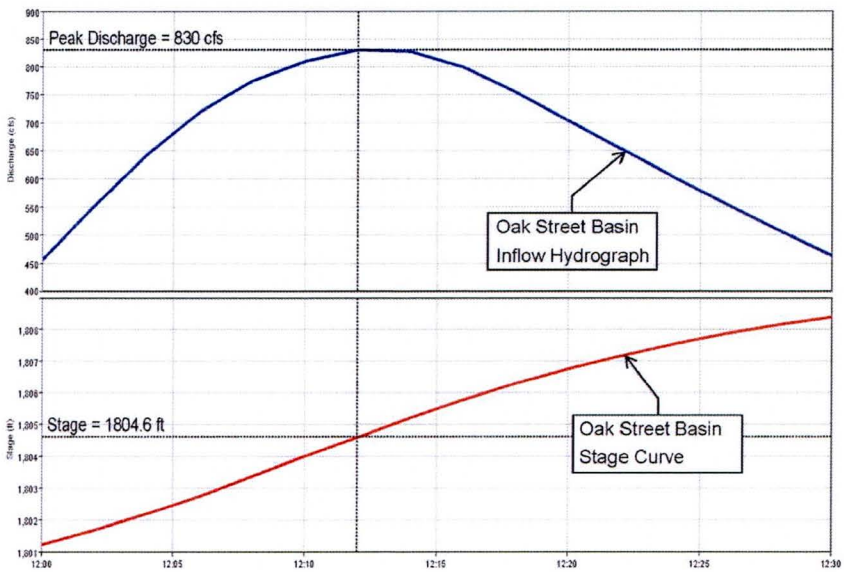
HEC-RAS was found to be the most suitable program in determining the hydraulic grade line through the drop structures as well as at the major junctions. According to the *HEC-RAS v.4.1 Reference Manual,* HEC-RAS has the ability to model both partially full and pressurized pipe flow during steady and unsteady flow conditions. The storm drains were designed using the 100-yr peak discharge obtained from the HEC-1 hydrology model and since only the peak discharge was used in designing the storm drains, the HEC-RAS steady state flow analysis option was selected. For the steady-state analysis, under partially full or pressurized flow conditions, HEC-

RAS solves the energy equation as it would for an open channel; however, in the energy equation the flow area and wetted perimeter are limited to the pipe open area (the area that is between the cross-section bottom and pipe lid). If the program computes awater surface elevation that is greater than the top of the pipe (pressurized flow), then this elevation is representative of the hydraulic grade line. Under these pressurized flow conditions, the pipe size limits the cross-sectional flow area and wetted perimeter, therefore the program uses the hydraulic grade line (above the top of the pipe) instead of the water surface elevation (top of pipe) to balance the energy equation.

In order to accurately define the hydraulic grade line through the storm drain system using HEC-RAS, losses associated with bends and storm drain manholes have to be manually entered. This is accomplished by adding minor loss coefficients in the "Set Changes to WS and EG" at location where bends and manholes occur in the storm drain system. The minor loss coefficients for each location were found using the *Hydraulics Drainage Design Manual* (Figure 4.8 – Bend Loss Coefficient).

Storm Drain Tailwater Elevation/Inlet Headwater Elevation

According to the *Hydraulics Drainage Design Manual*; in the case of a conduit discharging into a storage basin, the tailwater shall be the storage basin water surface elevation coinciding with the design peak inflow or the crown elevation of the discharging conduit, whichever is greater (Section 4.4.2 – Determination of Controlling Water Surface Elevation). As can be seen from the Oak Street Basin inflow hydrograph and stage curve below, the combined (flow entering the basin from the two inflow storm drains and the inflow spillway) design peak inflow into the basin is 830 cfs, which corresponds to a basin stage elevation of 1804.6 feet. However, the crown elevations for the two storm drains discharging into the Oak Street Basin are above 1804.6 feet (at the basin, the Oak Street storm drain crown elevation is 1807.67 feet and the Hawes Road storm drain crown elevation is 1805.17 feet). Therefore, since both the discharging storm drains have crown elevations that are higher than the basin stage at the design peak inflow, the crown elevations for each storm drain were used as the tailwater elevations for the HEC-RAS storm drain hydraulic analysis.



In addition to the storm drain tailwater elevations, the headwater elevation at the drop inlets was also manually specified in the HEC-RAS storm drain model. The headwater elevations at the

drop inlets were hand calculated to take into account the drop inlet length and grate clogging factor. The calculations can be found in sub-section B2.

Furthermore, the headwater elevation for the basin outlet HEC-RAS model was manually set to 1809.3 ft, which corresponds to the HEC-1 calculated 100-yr water surface elevation (stage) in the Oak Street Basin. Refer to Table A4.2 for the Oak Street Basin hydraulic summary results and to sub-section B4 for the Basin Outlet and Hawes Road Channel HEC-RAS modeling results.

Inlet Design Calculations

Drop inlets were employed at the major inflow points. They were sized using the weir equation with half the total open length obstructed to account for potential clogging of the inlet. A summary of the drop inlet sizes can be found in Table B2.1 and the corresponding calculations can be found immediately following the Table in sub-section B2.

The curb opening catch basins and grated catch basins along the Oak Street and Hawes Road storm drains were sized according to the FCD Drainage Design Manual. A summary of the curb opening sizes and their capacities can be found in Table B2.2 and the corresponding calculations can be found after the Table in sub-section B2. A summary of the curb opening catch basins located at the two Thunder Mountain wall openings is presented in Table B2.3. The inlets were sized in order to capture the entire 100-year peak discharge that was calculated in sub-section A5. A summary of the two grated catch basins located on the southeast and southwest corners of the Oak Street Basin is presented in Table B2.3. These two inlets drain relatively small drainage areas, which primarily consist of the runoff from the basin berm. The calculations for the sizing of the curb opening and grated catch basins can be found immediately following Table B2.3 in sub-section B2.

Sediment Analysis Calculations

The washes within the watershed upstream of the Oak Street Basin exhibit significant sediment loads in large flood events. Therefore, a sediment transport analysis was done for the design of the Oak Street Basin as well as the storm drains leading to the basin. All the sediment analysis calculations can be found in sub-section B3.

The bed load sediment capacity of the four major washes that enter the Oak Street Basin was computed using the Zeller-Fullerton equation. In addition to computing the total sediment that enters the basin, an analysis was performed for each storm drain to verify that they have adequate sediment carrying capacity. The storm drain sediment carrying capacities were calculated using the Graf & Acaroglu equation. As can be seen in sub-section B3, all of the storm drain segments have adequate sediment carrying capacity to convey the anticipated upstream sediment load to the basin.

In addition to calculating the bed load, the total wash load was also estimated and added to the bed load to estimate the total sediment yield that can be expected at the basin. The wash load was calculated using the Modified Universal Soil Loss equation. As can be seen in the *Total Wash Load and Sediment Delivery Ratio (SDR) Calculations* in sub-section B3, the equation was

applied to the entire upstream watershed to determine the total volume of wash load entering the basin.

The calculations for the combined total sediment yield at the basin (combination of bed load sediment and wash load sediment) can be found in sub-section B3. The results indicate that the total sediment yield at the basin during a 100-year flood event is 0.53 ac-ft. This is less than the volume provided with the one foot of freeboard, which has a volume of approximately 3.7 ac-ft. Therefore, the basin freeboard provides ample storage volume to accommodate the anticipated sediment yield.

Basin Outlet and Hawes Road Channel HEC-RAS Model

The Oak Street basin outlet storm drain and the Hawes Road channel were modeled with one HEC-RAS model. The basin outlet storm drain was modeled in a similar manner as the Oak Street and Hawes Road storm drains that were mentioned earlier. The benefit of combining the basin outlet and Hawes Road channel into a single HEC-RAS model is that it eliminates the need for downstream (for the basin outlet storm drain) and upstream (for the Hawes Road channel) boundary condition assumptions.

The existing Hawes Road Channel serves as the outfall for the project. In order to determine the amount of flow that can be discharged to the channel, a HEC-RAS model was set up to determine its capacity. The channel was surveyed as part of the Oak Street Basin and Storm Drain project and the HEC-RAS cross-section geometry was obtained from this survey. The channel is located along the east side of Hawes Road between Oak Street and McDowell Road. The channel has 7 drop structures as well as a culvert crossing (2–48 inch pipes) at the Thunder Mountain entrance. There are three locations where storm water flows into the channel. The first inflow is at Oak Street where the basin outlet pipe discharges 183 cfs into the channel. The second inflow is located approximately 800 feet south of Oak Street where runoff from watershed 390A, within Thunder Mountain, discharges to the channel. The combined peak discharge at this location is 185 cfs. The third inflow is located approximately 650 feet south of the Thunder Mountain entrance where runoff from watershed 390B enters from the Thunder Mountain subdivision. The combined peak discharge at this location is 243 cfs which drains into the Thunder Mountain detention basin at the northeast corner of McDowell Road and Hawes Road.

From the HEC-RAS model it was determined that the Hawes Road Channel has sufficient capacity to convey the proposed outflow from the basin. However, even though the channel has drop structures, the longitudinal slope of the channel is steep causing the flow within the channel to be predominantly supercritical. The requirement for freeboard in a supercritical channel is the greater of 2 feet or the results of Equation 6.25 (Maricopa County Hydraulics Manual). The results of the HEC-RAS model indicate that the existing channel does not meet the required freeboard. The lack of freeboard is most predominant at the upstream side of the channel drop structures. Therefore, a floodwater containment curb is proposed at the locations where the existing channel does not have sufficient freeboard capacity. Table B4.3 shows the calculated minimum freeboard required per Equation 6.25. From the table it can be seen that the minimum required freeboard along the existing channel will be 2 feet; except for the upstream segment that is being reconstructed with a flatter channel slope. In this section, which runs about 200 feet

downstream of the basin outlet pipe, the minimum freeboard is only one foot (minimum freeboard requirement for subcritical flow). The table also shows the proposed channel elevation in order to meet the freeboard requirements.

Station	FREEBOARD		
	Existing	Required	Provided
	(ft)	(ft)	(ft)
7+50 - 27+70 (Supercritical Flow)	Varies (0.1 ft - 5.1 ft)	Minimum (2.0 ft)*	Varies (2.2 ft - 5.1 ft)
27+70 - 29+45 (Subcritical Flow)	Varies (1.2 ft - 2.3 ft)	Minimum (1.0 ft)*	Varies (1.2 ft - 2.3 ft)

* Minimum Freeboard: Per Section 6.5.4 *(FCDMC Hydraulics Drainage Design Manual)*

To provide the freeboard in sections where the existing channel does not meet the freeboard requirements as outlined in Table B4.3, a flood containment curb will be built on the west side of the channel. With the flood containment curb in place, the entire channel will conform to the requirements for freeboard in a supercritical channel.

Granite Mountain Channel HEC-RAS Model

The Granite Mountain subdivision is located at the northeast corner of Redberry and Hawes Road. There is a man-made channel along the southern edge of the subdivision that currently drains to a small detention basin just north of Redberry. The detention basin is very small relative to the 100-year inflow from the channel so, under current conditions, larger floods will simply overtop the basin and spill over an existing retaining wall at the southwest corner of the subdivision. To avoid the overflow, the upstream end of the Hawes Road storm drain will capture flow from the channel and convey it to the new Oak Street Basin.

According to the Granite Mountain drainage report, the channel was intended to act as a distribution channel to allow flows to split out to the south along the channel at various locations to replicate the existing conditions prior to development of the subdivision. However, a HEC-RAS analysis of the channel indicates that it has enough capacity to convey the entire 100-year flow of 121 cfs. The results of the HEC-RAS model can be found in sub-section B5.

Oak Street Basin Secondary (Spillway) Outfall

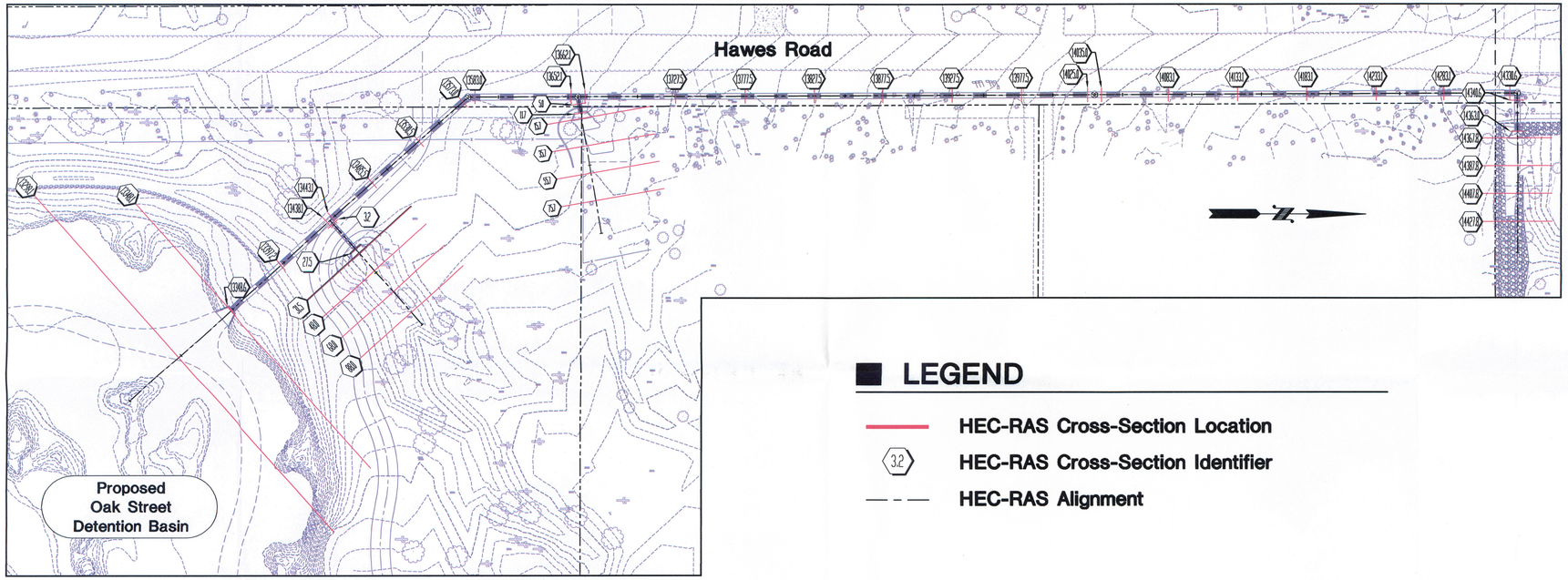
The Oak Street Basin includes a Roller Compacted Concrete (RCC) Dam, along the south and west sides of the embankment. The RCC dam ranges in height from 2 feet to 14 feet and is tied into the cemented material that can be found at relatively shallow depths at the basin site. As aforementioned, the 100-year water surface elevation in the basin was calculated to be at 1809.3 feet. With one foot of freeboard, the emergency spillway was set at an elevation of 1810.3 feet. The length of the spillway was sized in order to discharge the un-attenuated 100-year peak discharge of 830 cfs that was calculated to arrive at the basin with only one foot of head over the spillway. This resulted in a 325-foot long spillway that was roughly centered on the southwest corner of the basin, at the location where historically the existing wash has discharged to Oak

Street and Hawes Road. The depth of flow over the spillway was set at one foot, therefore, the water surface elevation over the spillway is 1811.3 feet. To provide additional freeboard, the top of the RCC dam was set at 1812.3 feet. The top of the dam, which will be buried with loose backfill, will be extended horizontally at a level elevation far enough to tie into the cemented material.

Oak Street Basin Rip-Rap and Scour Design Calculations

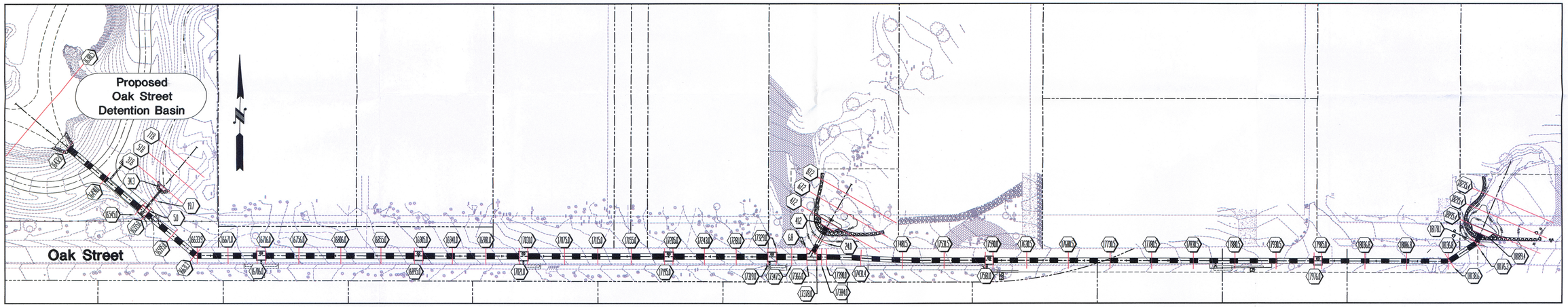
The Oak Street Basin downstream embankment will not be protected against erosion with a rock rip-rap layer. The downstream backfill against the RCC dam will be sacrificial fill and in the event of the spillway being overtopped, the erosion of the downstream embankment will have no impact on the stability of the dam. The design of the RCC Dam ignored the downstream fill in the dam stability analysis. Therefore, the downstream fill can erode away without affecting the stability of the Dam (refer to the RCC Dam Design Report prepared by AMEC).

Sub-Section B1: **Storm Drain Hydraulics**



HAWES ROAD STORM DRAIN

SCALE: 1"=50'



OAK STREET STORM DRAIN

SCALE: 1"=60'

Gavan & Barker Inc.

Gavan & Barker, Inc.
3030 N. Central Ave.
Suite 1530
Phoenix, Arizona 85012
Phone: 602-200-0031
Fax: 602-200-0032

Civil Engineering
Landscape Architecture

Project :

Oak Street Basin and Storm Drain Design

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD - 2009C021

Submittal :	
G&B No.	0912
Issue Date:	09/12
Drawn By:	OK
Checked By:	MTG

Sheet Title :
Exhibit B1.1: Oak Street & Hawes Road SD - HEC RAS Location Map

Page Number:

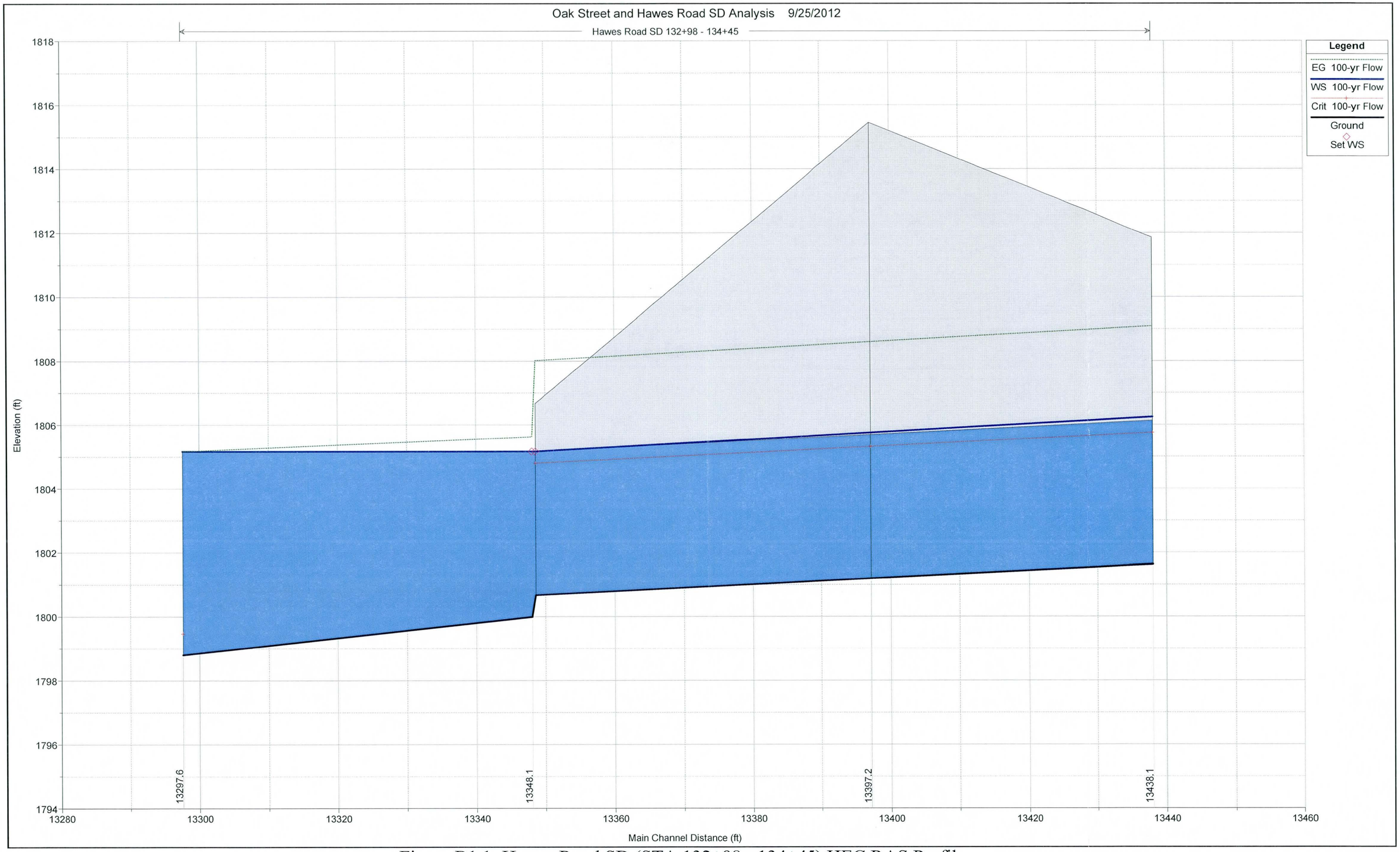


Figure B1.1: Hawes Road SD (STA 132+98 - 134+45) HEC RAS Profile

HEC-RAS Plan: Storm Drain River: Hawes Road SD Reach: 132+98 - 134+45 Profile: 100-yr Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	Flow Area	Vel Total	Top Width	Hydr Radius	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(sq ft)	(ft/s)	(ft)	(ft)	
132+98 - 134+45	13438.1	100-yr Flow	215	1801.63	1806.2	1805.8	1809.1	15.9	13.5		1.12	1.11
132+98 - 134+45	13397.2	100-yr Flow	215	1801.19	1805.8	1805.3	1808.6	15.9	13.5		1.12	1.12
132+98 - 134+45	13348.6	100-yr Flow	215	1800.67	1805.2	1804.8	1808.0	15.9	13.5		1.12	1.13
132+98 - 134+45	13348.1	100-yr Flow	215	1799.99	1805.2		1805.6	41.1	5.2	20.1	1.42	0.44
132+98 - 134+45	13297.6	100-yr Flow	215	1798.80	1805.2	1799.5	1805.2	1256.8	0.2	230.7	5.36	0.01

Table B1.1: Hawes Road SD (STA 132+98 - 134+45) HEC RAS Cross Section Summary

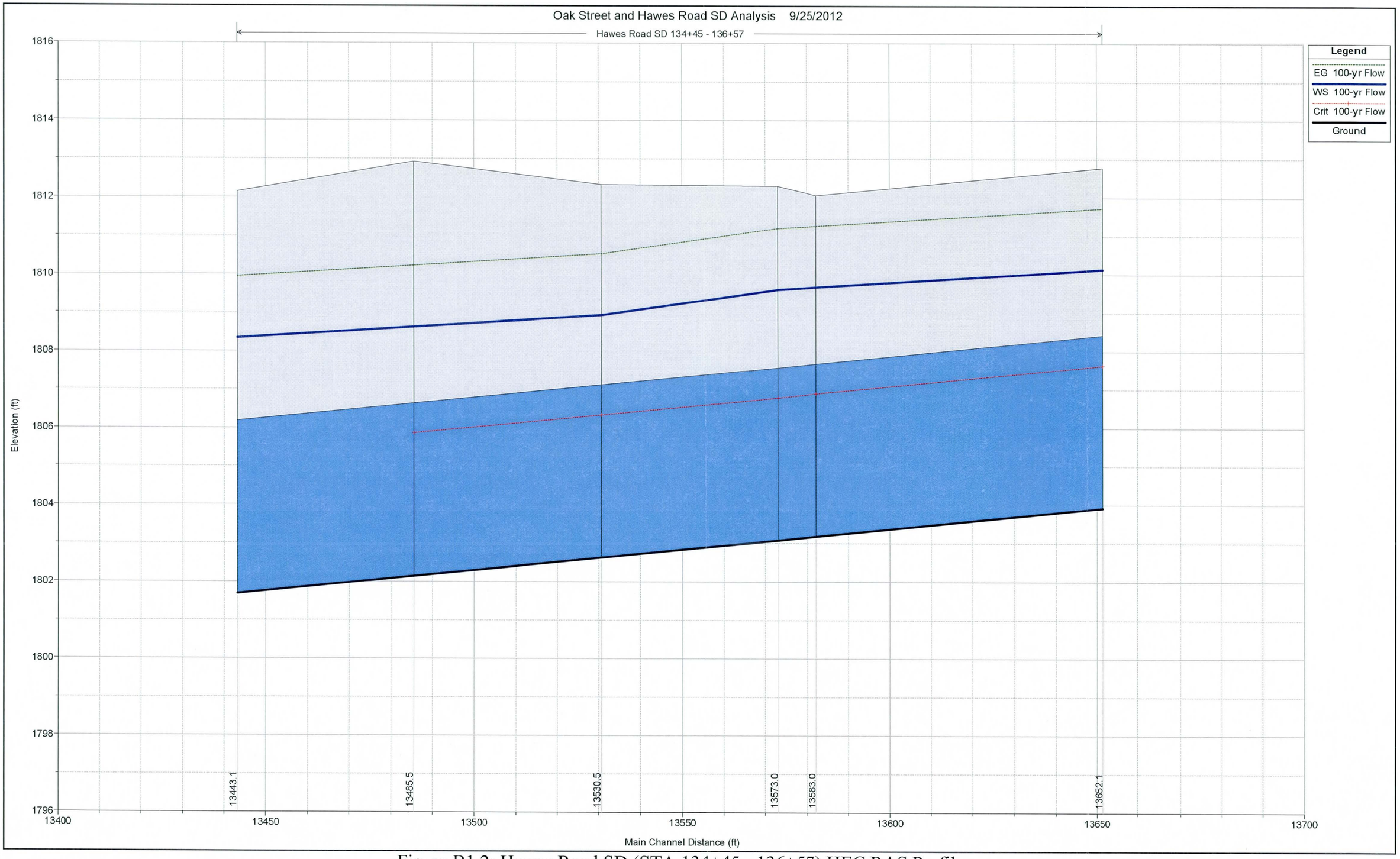


Figure B1.2: Hawes Road SD (STA 134+45 - 136+57) HEC RAS Profile

HEC-RAS Plan: Storm Drain River: Hawes Road SD Reach: 134+45 - 136+57 Profile: 100-yr Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	Flow Area	Vel Total	Top Width	Hydr Radius	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(sq ft)	(ft/s)	(ft)	(ft)	
134+45 - 136+57	13652.1	100-yr Flow	161	1803.92	1810.1	1807.6	1811.7	15.9	10.1		1.12	0.72
134+45 - 136+57	13583.0	100-yr Flow	161	1803.18	1809.7	1806.9	1811.3	15.9	10.1		1.12	0.70
134+45 - 136+57	13573.0	100-yr Flow	161	1803.07	1809.6	1806.8	1811.2	15.9	10.1		1.12	0.70
134+45 - 136+57	13530.5	100-yr Flow	161	1802.62	1808.9	1806.3	1810.5	15.9	10.1		1.12	0.71
134+45 - 136+57	13485.5	100-yr Flow	161	1802.14	1808.6	1805.9	1810.2	15.9	10.1		1.12	0.70
134+45 - 136+57	13443.1	100-yr Flow	161	1801.68	1808.3		1809.9	15.9	10.1		1.12	0.69

Table B1.2: Hawes Road SD (STA 134+45 - 136+57) HEC RAS Cross Section Summary

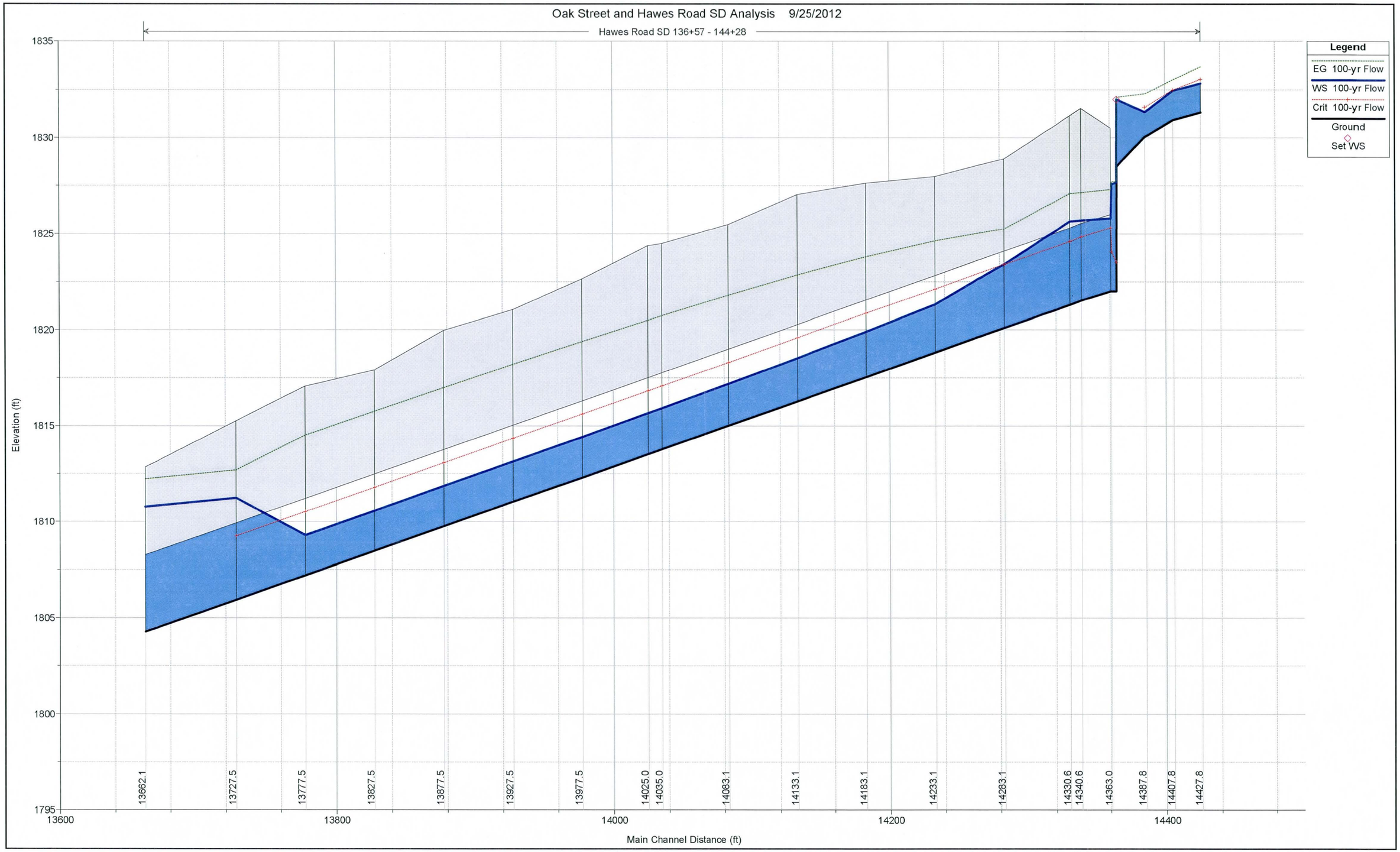


Figure B1.3: Hawes Road SD (STA 134+57 - 144+28) HEC RAS Profile

HEC-RAS Plan: Storm Drain River: Hawes Road SD Reach: 136+57 - 144+28 Profile: 100-yr Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	Flow Area	Vel Total	Top Width	Hydr Radius	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(sq ft)	(ft/s)	(ft)	(ft)	
136+57 - 144+28	14427.8	100-yr Flow	121	1831.31	1832.8	1833.0	1833.7	16.3	7.4	16.7	0.95	1.32
136+57 - 144+28	14407.8	100-yr Flow	121	1830.92	1832.4	1832.5	1833.0	20.0	6.1	19.2	1.02	1.05
136+57 - 144+28	14387.8	100-yr Flow	121	1830.05	1831.3	1831.6	1832.3	15.5	7.8	16.5	0.90	1.42
136+57 - 144+28	14367.8	100-yr Flow	121	1828.50	1832.0		1832.1	81.8	1.5	30.4	2.43	0.25
136+57 - 144+28	14367.3	100-yr Flow	121	1822.00	1827.7	1823.5	1827.7	64.8	1.9	11.4	2.85	0.14
136+57 - 144+28	14363.5	100-yr Flow	121	1822.00	1827.6	1824.1	1827.7	39.5	3.1	7.1	2.17	0.23
136+57 - 144+28	14363.0	100-yr Flow	121	1822.00	1825.8	1825.3	1827.3	12.3	9.8	1.7	1.14	0.89
136+57 - 144+28	14340.6	100-yr Flow	121	1821.53	1825.7	1824.9	1827.2	12.5	9.7		1.00	0.83
136+57 - 144+28	14330.6	100-yr Flow	121	1821.30	1825.6	1824.6	1827.1	12.5	9.7		1.00	0.82
136+57 - 144+28	14283.1	100-yr Flow	121	1820.10	1823.4	1823.4	1825.3	11.1	10.9	3.0	1.21	1.05
136+57 - 144+28	14233.1	100-yr Flow	121	1818.81	1821.3	1822.1	1824.6	8.3	14.6	3.8	1.13	1.62
136+57 - 144+28	14183.1	100-yr Flow	121	1817.55	1819.9	1820.9	1823.8	7.6	15.9	3.9	1.09	1.83
136+57 - 144+28	14133.1	100-yr Flow	121	1816.28	1818.5	1819.6	1822.9	7.3	16.7	3.9	1.07	1.96
136+57 - 144+28	14083.1	100-yr Flow	121	1815.00	1817.2	1818.3	1821.8	7.0	17.3	3.9	1.05	2.05
136+57 - 144+28	14035.0	100-yr Flow	121	1813.77	1815.9	1817.1	1820.7	6.9	17.6	4.0	1.04	2.11
136+57 - 144+28	14025.0	100-yr Flow	121	1813.52	1815.7	1816.8	1820.5	6.9	17.7	4.0	1.04	2.12
136+57 - 144+28	13977.5	100-yr Flow	121	1812.29	1814.4	1815.6	1819.4	6.8	17.9	4.0	1.03	2.17
136+57 - 144+28	13927.5	100-yr Flow	121	1811.03	1813.1	1814.4	1818.2	6.7	18.0	4.0	1.03	2.19
136+57 - 144+28	13877.5	100-yr Flow	121	1809.76	1811.9	1813.1	1817.0	6.7	18.2	4.0	1.03	2.21
136+57 - 144+28	13827.5	100-yr Flow	121	1808.48	1810.6	1811.8	1815.8	6.6	18.3	4.0	1.02	2.22
136+57 - 144+28	13777.5	100-yr Flow	121	1807.21	1809.3	1810.5	1814.5	6.6	18.3	4.0	1.02	2.24
136+57 - 144+28	13727.5	100-yr Flow	121	1805.93	1811.2	1809.3	1812.7	12.5	9.7		1.00	0.74
136+57 - 144+28	13662.1	100-yr Flow	121	1804.27	1810.8		1812.2	12.5	9.7		1.00	0.67

Table B1.3: Hawes Road SD (STA 136+57 - 144+28) HEC RAS Cross Section Summary

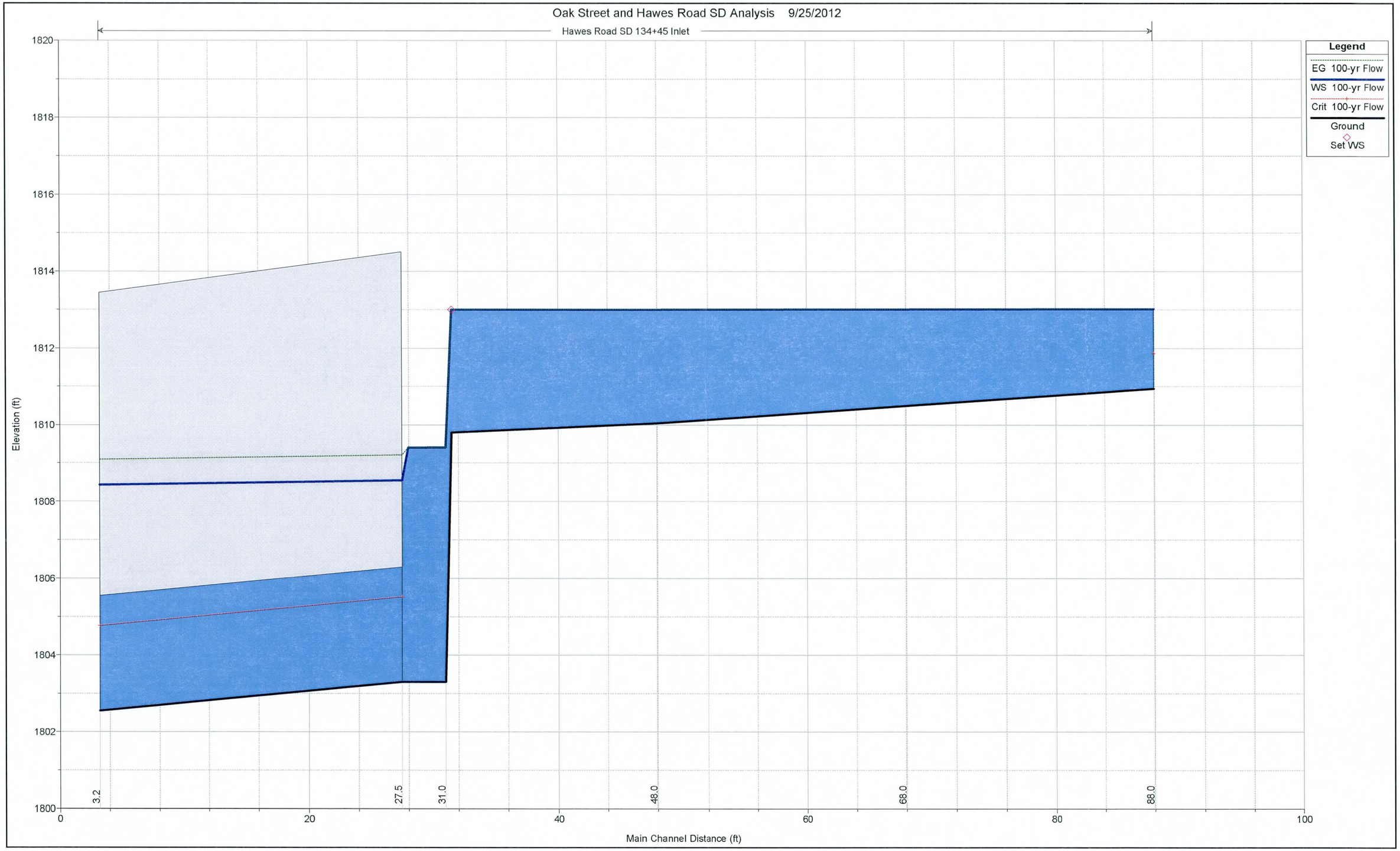


Figure B1.4: Hawes Road SD (STA 134+41 Inlet) HEC RAS Profile

HEC-RAS Plan: Storm Drain River: Hawes Road SD Reach: 134+45 Inlet Profile: 100-yr Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	Flow Area	Vel Total	Top Width	Hydr Radius	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(sq ft)	(ft/s)	(ft)	(ft)	
134+45 Inlet	88.0	100-yr Flow	46	1810.94	1813.0	1811.9	1813.0	43.0	1.1	33.8	1.25	0.17
134+45 Inlet	68.0	100-yr Flow	46	1810.49	1813.0		1813.0	43.8	1.1	28.8	1.49	0.15
134+45 Inlet	48.0	100-yr Flow	46	1810.04	1813.0		1813.0	53.1	0.9	32.6	1.59	0.12
134+45 Inlet	31.5	100-yr Flow	46	1809.80	1813.0		1813.0	79.4	0.6	39.6	1.95	0.10
134+45 Inlet	31.0	100-yr Flow	46	1803.30	1809.4		1809.4	75.6	0.6	12.4	3.08	0.04
134+45 Inlet	28.0	100-yr Flow	46	1803.30	1809.4		1809.4	54.3	0.8	8.9	2.58	0.06
134+45 Inlet	27.5	100-yr Flow	46	1803.30	1808.5	1805.5	1809.2	7.0	6.5		0.75	0.50
134+45 Inlet	3.2	100-yr Flow	46	1802.55	1808.4	1804.8	1809.1	7.0	6.5		0.75	0.48

Table B1.4: Hawes Road SD (STA 134+41 Inlet) HEC RAS Cross Section Summary

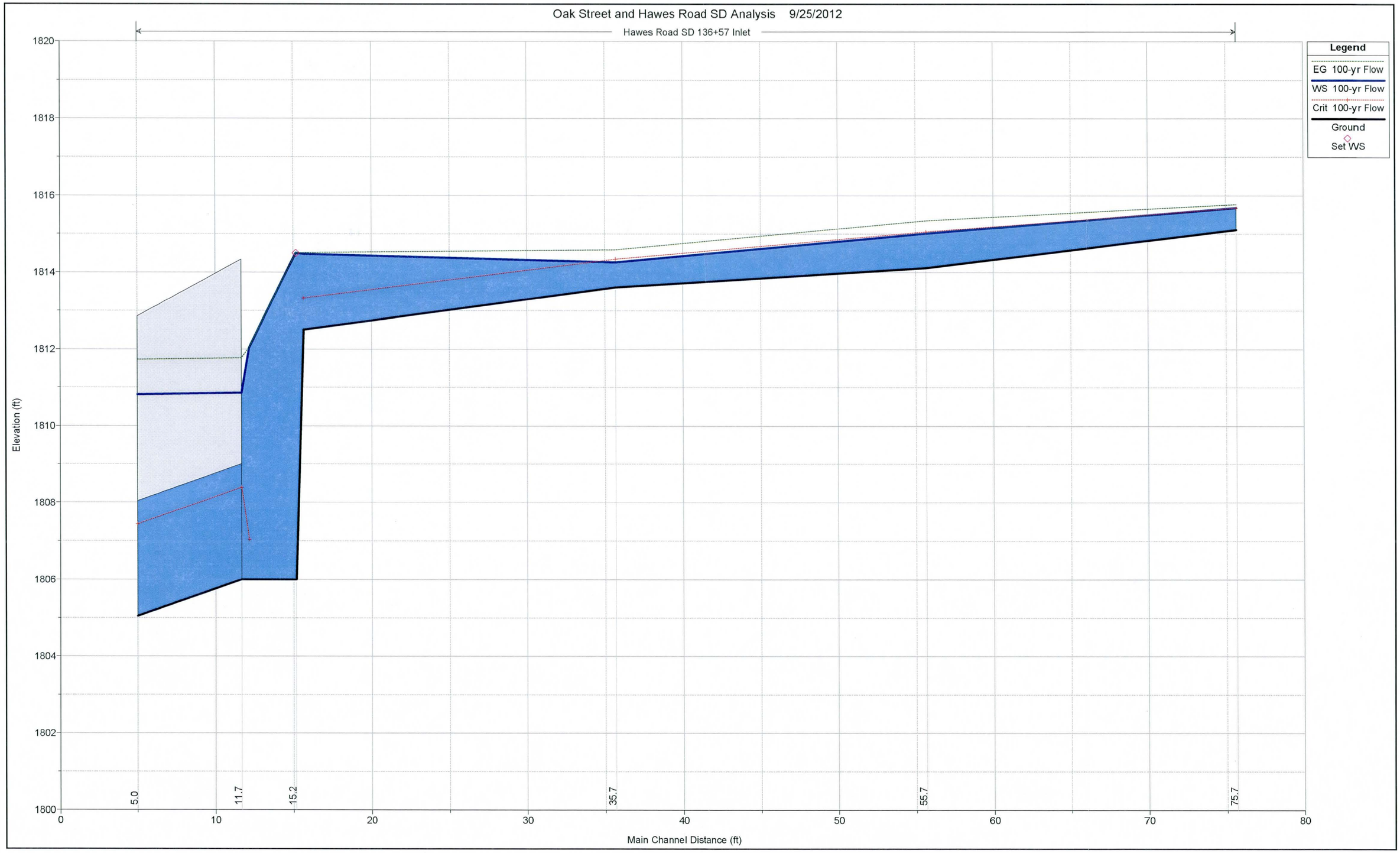


Figure B1.5: Hawes Road SD (STA 136+57 Inlet) HEC RAS Profile

HEC-RAS Plan: Storm Drain River: Hawes Road SD Reach: 136+57 Inlet Profile: 100-yr Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	Flow Area	Vel Total	Top Width	Hydr Radius	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(sq ft)	(ft/s)	(ft)	(ft)	
136+57 Inlet	75.7	100-yr Flow	54	1815.10	1815.7	1815.7	1815.8	22.6	2.4	57.2	0.39	0.72
136+57 Inlet	55.7	100-yr Flow	54	1814.11	1815.0	1815.1	1815.4	11.5	4.7	26.7	0.43	1.27
136+57 Inlet	35.7	100-yr Flow	54	1813.60	1814.3	1814.3	1814.6	12.3	4.4	35.8	0.34	1.26
136+57 Inlet	15.7	100-yr Flow	54	1812.50	1814.5	1813.3	1814.5	60.5	0.9	64.3	0.91	0.21
136+57 Inlet	15.2	100-yr Flow	54	1806.00	1814.5		1814.5	145.1	0.4	62.5	1.87	0.03
136+57 Inlet	12.2	100-yr Flow	54	1806.00	1812.0	1807.0	1812.0	53.7	1.0	8.9	2.56	0.07
136+57 Inlet	11.7	100-yr Flow	54	1806.00	1810.9	1808.4	1811.8	7.0	7.7		0.75	0.61
136+57 Inlet	5.0	100-yr Flow	54	1805.04	1810.8	1807.4	1811.7	7.0	7.7		0.75	0.56

Table B1.5: Hawes Road SD (STA 136+57 Inlet) HEC RAS Cross Section Summary

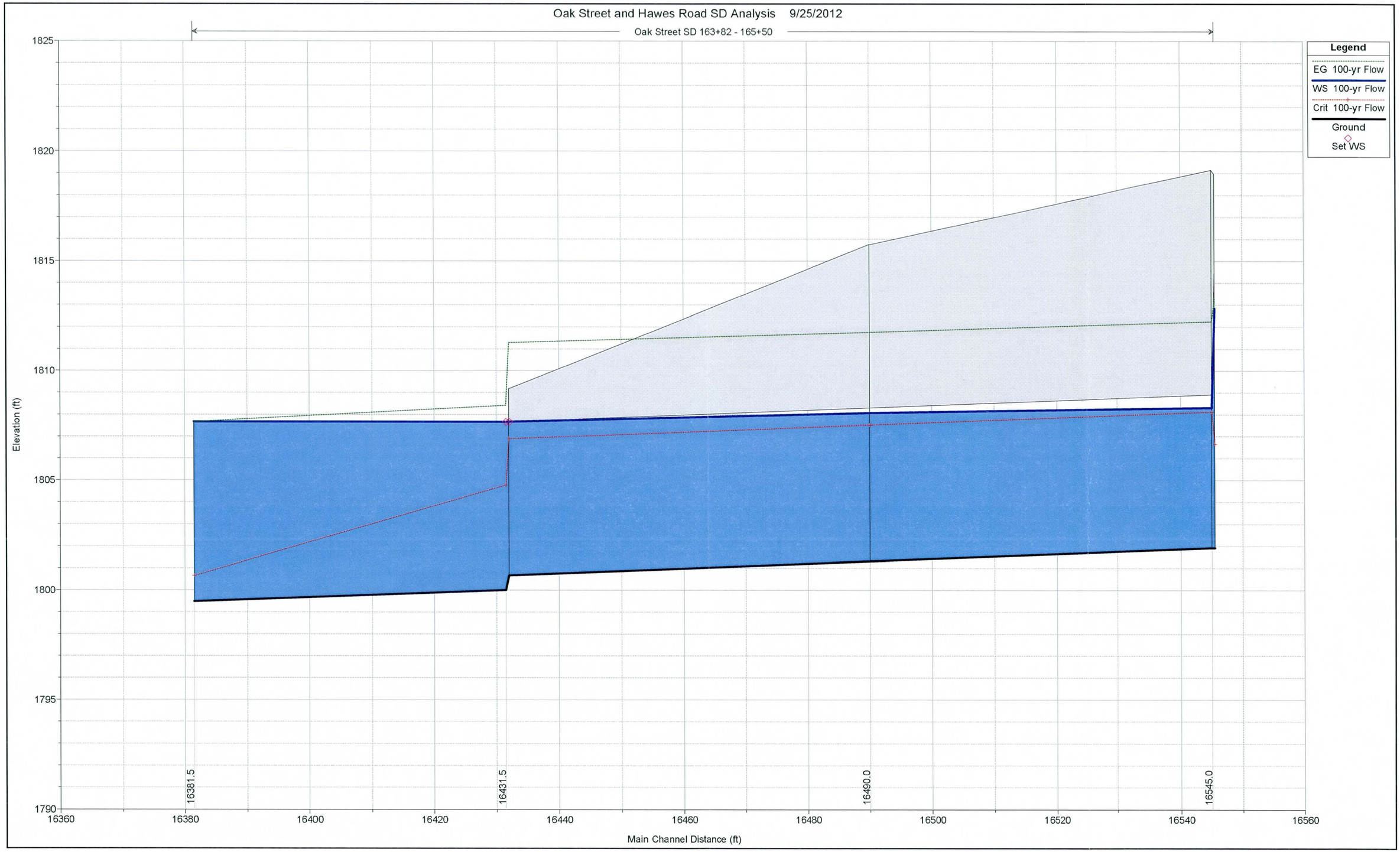


Figure B1.6: Oak Street SD (STA 163+82 - 165+50) HEC RAS Profile

HEC-RAS Plan: Storm Drain River: Oak Street SD Reach: 163+82 - 165+50 Profile: 100-yr Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	Flow Area	Vel Total	Top Width	Hydr Radius	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(sq ft)	(ft/s)	(ft)	(ft)	
163+82 - 165+50	16545.5	100-yr Flow	586	1801.91	1812.8	1806.7	1813.3	109.4	5.4	10.0	3.43	0.29
163+82 - 165+50	16545.0	100-yr Flow	586	1801.91	1808.3	1808.1	1812.2	36.8	15.9	3.9	2.06	1.11
163+82 - 165+50	16490.0	100-yr Flow	586	1801.31	1808.1	1807.5	1811.8	38.0	15.4	2.5	1.96	1.04
163+82 - 165+50	16432.0	100-yr Flow	586	1800.67	1807.7	1806.9	1811.3	38.4	15.3		1.75	1.02
163+82 - 165+50	16431.5	100-yr Flow	586	1799.99	1807.7	1804.8	1808.4	103.5	5.7	61.7	1.36	0.47
163+82 - 165+50	16381.5	100-yr Flow	586	1799.47	1807.7	1800.7	1807.7	975.4	0.6	137.5	6.88	0.04

Table B1.6: Oak Street SD (STA 163+82 - 165+50) HEC RAS Cross Section Summary

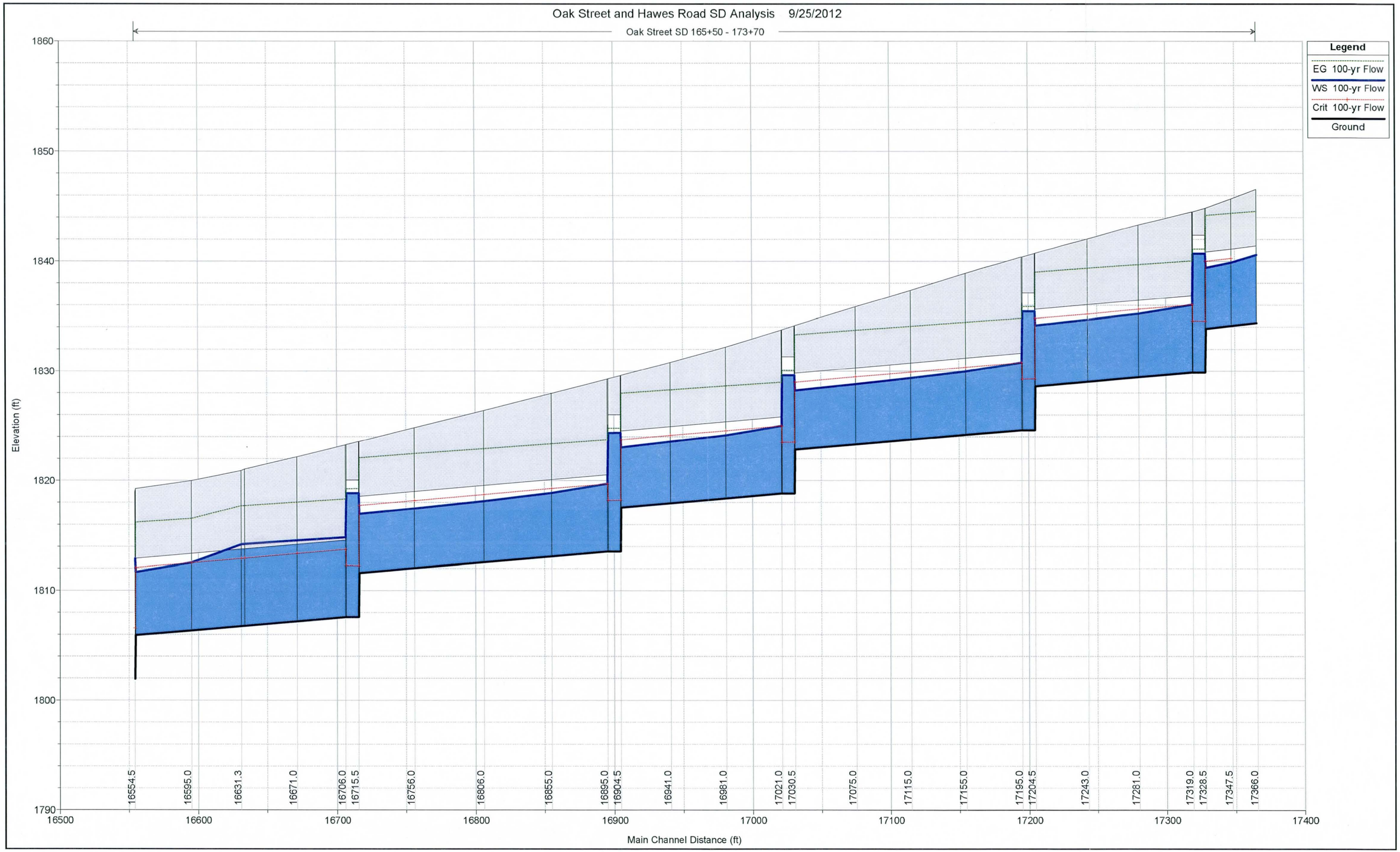


Figure B1.7: Oak Street SD (STA 165+50 - 173+70) HEC RAS Profile

HEC-RAS Plan: Storm Drain River: Oak Street SD Reach: 165+50 - 173+70 Profile: 100-yr Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	Flow Area	Vel Total	Top Width	Hydr Radius	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(sq ft)	(ft/s)	(ft)	(ft)	
165+50 - 173+70	17366.0	100-yr Flow	577	1834.38	1840.6		1844.6	36.0	16.0	4.5	2.10	1.14
165+50 - 173+70	17347.5	100-yr Flow	577	1834.11	1839.9	1840.3	1844.4	33.9	17.0	5.3	2.13	1.25
165+50 - 173+70	17329.0	100-yr Flow	577	1833.83	1839.4	1840.0	1844.2	32.8	17.6	5.6	2.13	1.31
165+50 - 173+70	17328.5	100-yr Flow	577	1829.87	1840.7	1834.6	1841.1	108.3	5.3	10.0	3.42	0.29
165+50 - 173+70	17319.5	100-yr Flow	577	1829.87	1840.7	1834.6	1841.1	108.3	5.3	10.0	3.42	0.29
165+50 - 173+70	17319.0	100-yr Flow	577	1829.87	1836.1	1836.1	1840.1	36.0	16.0	4.5	2.10	1.14
165+50 - 173+70	17281.0	100-yr Flow	577	1829.45	1835.2	1835.6	1839.7	34.0	17.0	5.3	2.13	1.24
165+50 - 173+70	17243.0	100-yr Flow	577	1829.04	1834.7	1835.2	1839.4	33.2	17.4	5.5	2.13	1.29
165+50 - 173+70	17205.0	100-yr Flow	577	1828.62	1834.1	1834.8	1839.0	32.5	17.7	5.7	2.12	1.33
165+50 - 173+70	17204.5	100-yr Flow	577	1824.62	1835.5	1829.3	1835.9	108.4	5.3	10.0	3.42	0.29
165+50 - 173+70	17195.5	100-yr Flow	577	1824.62	1835.4	1829.3	1835.9	108.4	5.3	10.0	3.42	0.29
165+50 - 173+70	17195.0	100-yr Flow	577	1824.62	1830.8	1830.8	1834.8	35.9	16.1	4.5	2.10	1.14
165+50 - 173+70	17155.0	100-yr Flow	577	1824.18	1830.0	1830.4	1834.5	34.0	17.0	5.3	2.13	1.24
165+50 - 173+70	17115.0	100-yr Flow	577	1823.74	1829.4	1829.9	1834.1	33.1	17.4	5.6	2.13	1.30
165+50 - 173+70	17075.0	100-yr Flow	577	1823.30	1828.8	1829.5	1833.7	32.4	17.8	5.7	2.12	1.34
165+50 - 173+70	17031.0	100-yr Flow	577	1822.82	1828.2	1829.0	1833.3	31.9	18.1	5.8	2.12	1.37
165+50 - 173+70	17030.5	100-yr Flow	577	1818.82	1829.6	1823.5	1830.1	108.4	5.3	10.0	3.42	0.29
165+50 - 173+70	17021.5	100-yr Flow	577	1818.82	1829.6	1823.5	1830.1	108.3	5.3	10.0	3.42	0.29
165+50 - 173+70	17021.0	100-yr Flow	577	1818.82	1825.0	1825.0	1829.0	36.0	16.0	4.5	2.10	1.14
165+50 - 173+70	16981.0	100-yr Flow	577	1818.38	1824.1	1824.6	1828.7	33.8	17.1	5.3	2.13	1.25
165+50 - 173+70	16941.0	100-yr Flow	577	1817.94	1823.5	1824.1	1828.3	33.0	17.5	5.6	2.13	1.30
165+50 - 173+70	16905.0	100-yr Flow	577	1817.54	1823.0	1823.7	1828.0	32.4	17.8	5.7	2.12	1.34
165+50 - 173+70	16904.5	100-yr Flow	577	1813.54	1824.4	1818.2	1824.8	108.4	5.3	10.0	3.42	0.29
165+50 - 173+70	16895.5	100-yr Flow	577	1813.54	1824.4	1818.2	1824.8	108.3	5.3	10.0	3.42	0.29
165+50 - 173+70	16895.0	100-yr Flow	577	1813.54	1819.7	1819.7	1823.7	35.9	16.1	4.5	2.10	1.14
165+50 - 173+70	16855.0	100-yr Flow	577	1813.10	1818.9	1819.3	1823.4	34.0	17.0	5.3	2.13	1.24
165+50 - 173+70	16806.0	100-yr Flow	577	1812.56	1818.1	1818.8	1822.9	32.8	17.6	5.6	2.13	1.31
165+50 - 173+70	16756.0	100-yr Flow	577	1812.01	1817.5	1818.2	1822.5	32.2	17.9	5.8	2.12	1.35
165+50 - 173+70	16716.0	100-yr Flow	577	1811.57	1817.0	1817.8	1822.1	31.7	18.2	5.9	2.12	1.38
165+50 - 173+70	16715.5	100-yr Flow	577	1807.57	1818.9	1812.3	1819.3	113.0	5.1	10.0	3.47	0.27
165+50 - 173+70	16706.5	100-yr Flow	577	1807.57	1818.9	1812.3	1819.3	112.9	5.1	10.0	3.47	0.27
165+50 - 173+70	16706.0	100-yr Flow	577	1807.57	1814.8	1813.8	1818.3	38.4	15.0		1.75	0.98
165+50 - 173+70	16671.0	100-yr Flow	577	1807.19	1814.5	1813.4	1818.0	38.4	15.0		1.75	0.98
165+50 - 173+70	16633.9	100-yr Flow	577	1806.77	1814.2	1813.0	1817.7	38.4	15.0		1.75	0.97
165+50 - 173+70	16631.3	100-yr Flow	577	1806.75	1814.2	1812.9	1817.7	38.4	15.0		1.75	0.97
165+50 - 173+70	16595.0	100-yr Flow	577	1806.35	1812.5	1812.5	1816.5	36.0	16.0	4.5	2.10	1.14
165+50 - 173+70	16555.0	100-yr Flow	577	1805.91	1811.7	1812.1	1816.2	33.8	17.1	5.3	2.13	1.25
165+50 - 173+70	16554.5	100-yr Flow	577	1801.91	1812.9	1806.6	1813.3	109.8	5.3	10.0	3.44	0.28

Table B1.7: Oak Street SD (STA 165+50 - 173+70) HEC RAS Cross Section Summary

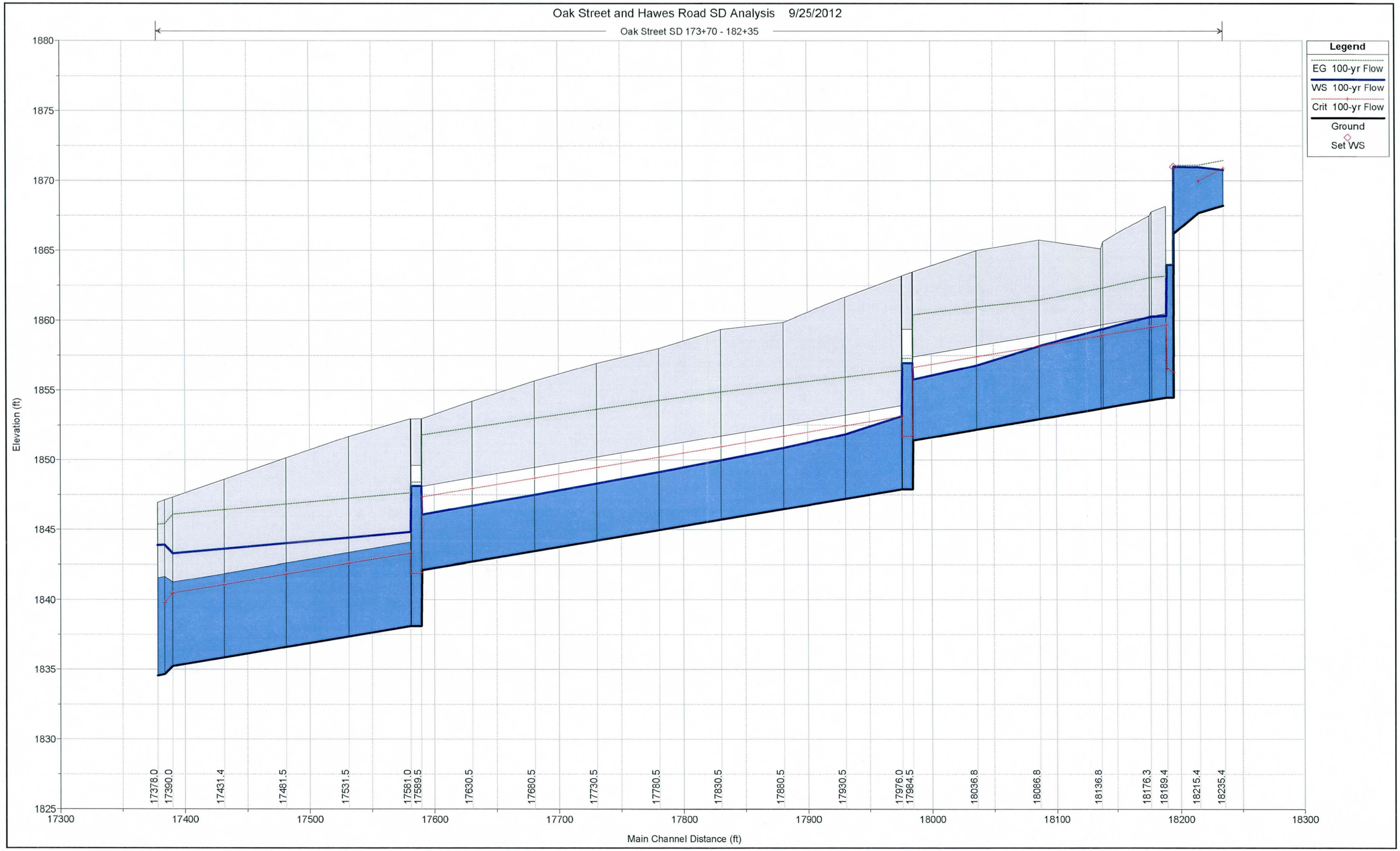


Figure B1.8: Oak Street SD (STA 173+70 - 182+35) HEC RAS Profile

HEC-RAS Plan: Storm Drain River: Oak Street SD Reach: 173+70 - 182+35 Profile: 100-yr Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	Flow Area	Vel Total	Top Width	Hydr Radius	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(sq ft)	(ft/s)	(ft)	(ft)	
173+70 - 182+35	18235.4	100-yr Flow	380	1868.22	1870.8	1870.9	1871.4	68.9	5.5	73.8	0.92	0.90
173+70 - 182+35	18215.4	100-yr Flow	380	1867.70	1871.0	1870.0	1871.1	138.7	2.7	89.5	1.53	0.37
173+70 - 182+35	18195.4	100-yr Flow	380	1866.20	1871.0		1871.1	212.5	1.8	57.8	3.39	0.20
173+70 - 182+35	18194.9	100-yr Flow	380	1854.47	1864.0	1856.3	1864.0	260.9	1.5	27.4	5.62	0.08
173+70 - 182+35	18189.9	100-yr Flow	380	1854.47	1864.0	1856.6	1864.0	205.1	1.9	21.6	5.05	0.11
173+70 - 182+35	18189.4	100-yr Flow	380	1854.47	1860.3	1859.7	1863.2	28.0	13.6	1.8	1.65	0.99
173+70 - 182+35	18178.1	100-yr Flow	380	1854.30	1860.3	1859.6	1863.1	28.2	13.5	0.9	1.57	0.97
173+70 - 182+35	18176.3	100-yr Flow	380	1854.27	1860.3	1859.5	1863.1	28.2	13.5	0.6	1.54	0.97
173+70 - 182+35	18138.6	100-yr Flow	380	1853.71	1859.4	1859.0	1862.3	27.7	13.7	2.6	1.72	1.01
173+70 - 182+35	18136.8	100-yr Flow	380	1853.68	1859.4	1858.9	1862.3	27.7	13.7	2.5	1.71	1.01
173+70 - 182+35	18086.8	100-yr Flow	380	1852.93	1858.2	1858.2	1861.5	26.2	14.5	4.0	1.80	1.12
173+70 - 182+35	18036.8	100-yr Flow	380	1852.18	1856.8	1857.4	1860.9	23.2	16.4	5.1	1.81	1.35
173+70 - 182+35	17985.0	100-yr Flow	380	1851.40	1855.8	1856.7	1860.4	22.0	17.2	5.3	1.80	1.45
173+70 - 182+35	17984.5	100-yr Flow	380	1847.90	1857.0	1851.7	1857.3	81.7	4.6	9.0	3.01	0.27
173+70 - 182+35	17976.5	100-yr Flow	380	1847.90	1857.0	1851.7	1857.3	81.7	4.7	9.0	3.01	0.27
173+70 - 182+35	17976.0	100-yr Flow	380	1847.90	1853.1	1853.1	1856.4	26.2	14.5	4.0	1.81	1.12
173+70 - 182+35	17930.5	100-yr Flow	380	1847.22	1851.8	1852.5	1856.0	23.3	16.3	5.0	1.82	1.33
173+70 - 182+35	17880.5	100-yr Flow	380	1846.47	1850.9	1851.7	1855.4	22.2	17.1	5.3	1.80	1.44
173+70 - 182+35	17830.5	100-yr Flow	380	1845.72	1850.0	1851.0	1854.9	21.4	17.7	5.4	1.78	1.52
173+70 - 182+35	17780.5	100-yr Flow	380	1844.97	1849.1	1850.2	1854.3	20.9	18.2	5.5	1.77	1.57
173+70 - 182+35	17730.5	100-yr Flow	380	1844.22	1848.3	1849.5	1853.7	20.5	18.5	5.6	1.76	1.61
173+70 - 182+35	17680.5	100-yr Flow	380	1843.47	1847.5	1848.7	1853.0	20.2	18.8	5.6	1.75	1.65
173+70 - 182+35	17630.5	100-yr Flow	380	1842.72	1846.7	1848.0	1852.3	20.0	19.0	5.7	1.74	1.68
173+70 - 182+35	17590.0	100-yr Flow	380	1842.11	1846.1	1847.4	1851.8	19.8	19.2	5.7	1.74	1.70
173+70 - 182+35	17589.5	100-yr Flow	380	1838.11	1848.1	1841.9	1848.4	90.4	4.2	9.0	3.11	0.23
173+70 - 182+35	17581.5	100-yr Flow	380	1838.11	1848.1	1841.9	1848.4	90.4	4.2	9.0	3.11	0.23
173+70 - 182+35	17581.0	100-yr Flow	380	1838.11	1844.8	1843.4	1847.7	28.2	13.5		1.50	0.92
173+70 - 182+35	17531.5	100-yr Flow	380	1837.37	1844.4	1842.6	1847.3	28.2	13.5		1.50	0.89
173+70 - 182+35	17481.5	100-yr Flow	380	1836.61	1844.0	1841.9	1846.8	28.2	13.5		1.50	0.87
173+70 - 182+35	17431.4	100-yr Flow	380	1835.86	1843.6	1841.1	1846.4	28.2	13.5		1.50	0.85
173+70 - 182+35	17390.0	100-yr Flow	380	1835.24	1843.3	1840.5	1846.1	28.2	13.5		1.50	0.84
173+70 - 182+35	17384.0	100-yr Flow	380	1834.65	1843.9	1839.8	1845.4	38.4	9.9		1.75	0.57
173+70 - 182+35	17378.0	100-yr Flow	380	1834.56	1843.9		1845.4	38.4	9.9		1.75	0.57

Table B1.8: Oak Street SD (STA 173+70 - 182+35) HEC RAS Cross Section Summary

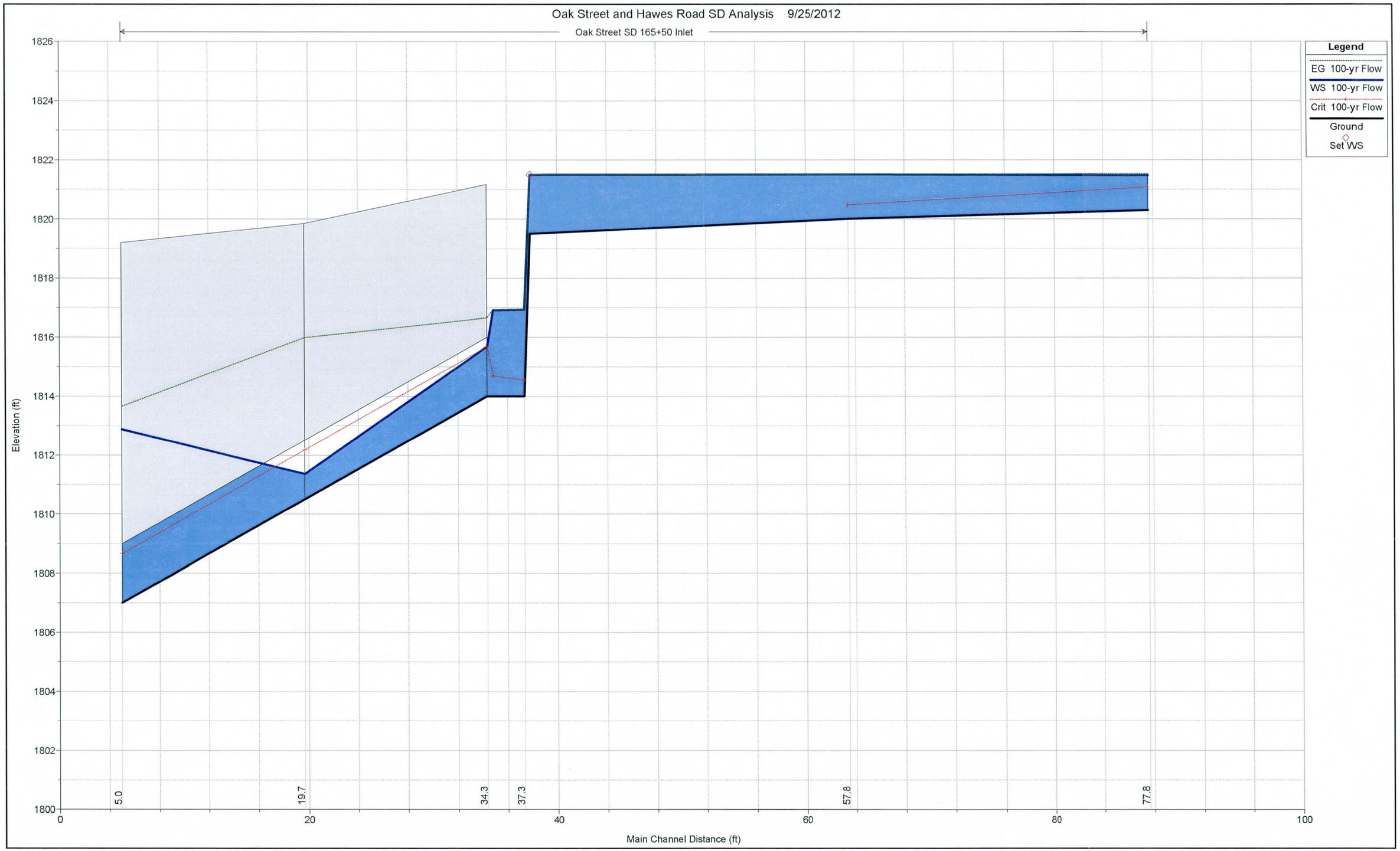


Figure B1.9: Oak Street SD (STA 165+50 Inlet) HEC RAS Profile

HEC-RAS Plan: Storm Drain River: Oak Street SD Reach: 165+50 Inlet Profile: 100-yr Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	Flow Area	Vel Total	Top Width	Hydr Radius	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(sq ft)	(ft/s)	(ft)	(ft)	
165+50 Inlet	77.8	100-yr Flow	22	1820.30	1821.5	1821.1	1821.5	12.1	1.8	25.6	0.47	0.42
165+50 Inlet	57.8	100-yr Flow	22	1820.00	1821.5	1820.5	1821.5	41.5	0.5	42.4	0.97	0.09
165+50 Inlet	37.8	100-yr Flow	22	1819.50	1821.5		1821.5	34.4	0.6	26.4	1.25	0.12
165+50 Inlet	37.3	100-yr Flow	22	1814.00	1816.9	1814.6	1816.9	27.5	0.8	9.4	1.80	0.08
165+50 Inlet	34.8	100-yr Flow	22	1814.00	1816.9	1814.7	1816.9	19.2	1.1	6.6	1.54	0.12
165+50 Inlet	34.3	100-yr Flow	22	1814.00	1815.7	1815.7	1816.7	2.8	7.9	1.4	0.60	1.07
165+50 Inlet	19.7	100-yr Flow	22	1810.50	1811.4	1812.2	1816.0	1.3	17.3	1.9	0.45	3.75
165+50 Inlet	5.0	100-yr Flow	22	1807.00	1812.9	1808.7	1813.7	3.1	7.1		0.50	0.52

Table B1.9: Oak Street SD (STA 165+50 Inlet) HEC RAS Cross Section Summary

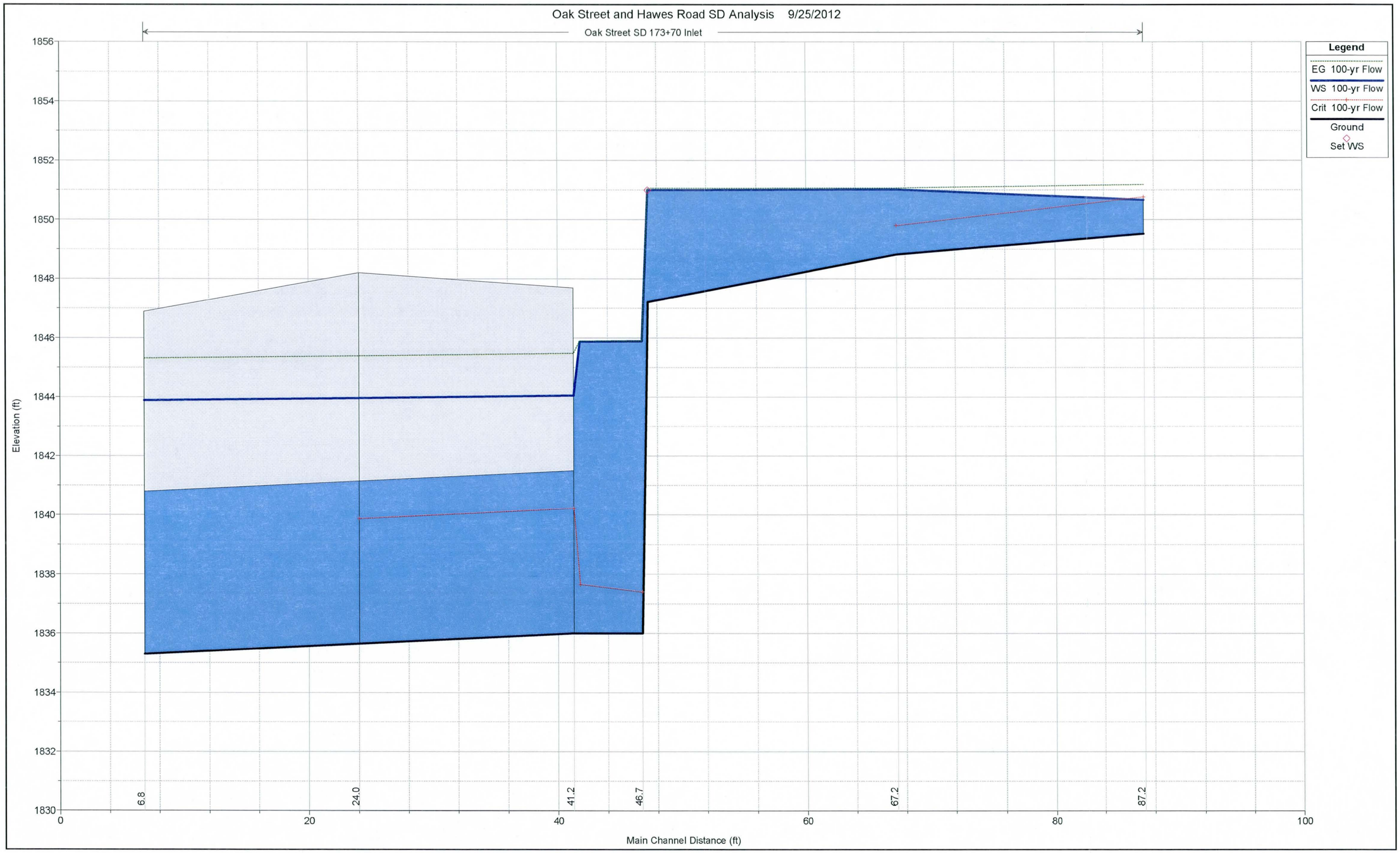


Figure B1.10: Oak Street SD (STA 173+70 Inlet) HEC RAS Profile

HEC-RAS Plan: Storm Drain River: Oak Street SD Reach: 173+70 Inlet Profile: 100-yr Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	Flow Area	Vel Total	Top Width	Hydr Radius	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(sq ft)	(ft/s)	(ft)	(ft)	
173+70 Inlet	87.2	100-yr Flow	228	1849.52	1850.7	1850.8	1851.2	40.5	5.6	66.4	0.61	1.22
173+70 Inlet	67.2	100-yr Flow	228	1848.82	1851.0	1849.8	1851.1	145.9	1.6	89.2	1.60	0.22
173+70 Inlet	47.2	100-yr Flow	228	1847.20	1851.0		1851.1	150.3	1.5	52.1	2.70	0.19
173+70 Inlet	46.7	100-yr Flow	228	1836.00	1845.9	1837.4	1845.9	241.4	0.9	24.4	5.46	0.05
173+70 Inlet	41.7	100-yr Flow	228	1836.00	1845.9	1837.7	1845.9	183.6	1.2	18.6	4.79	0.07
173+70 Inlet	41.2	100-yr Flow	228	1836.00	1844.0	1840.2	1845.5	23.7	9.6		1.37	0.60
173+70 Inlet	24.0	100-yr Flow	228	1835.65	1844.0	1839.9	1845.4	23.7	9.6		1.37	0.59
173+70 Inlet	6.8	100-yr Flow	228	1835.30	1843.9		1845.3	23.7	9.6		1.37	0.58

Table B1.10: Oak Street SD (STA 173+70 Inlet) HEC RAS Cross Section Summary

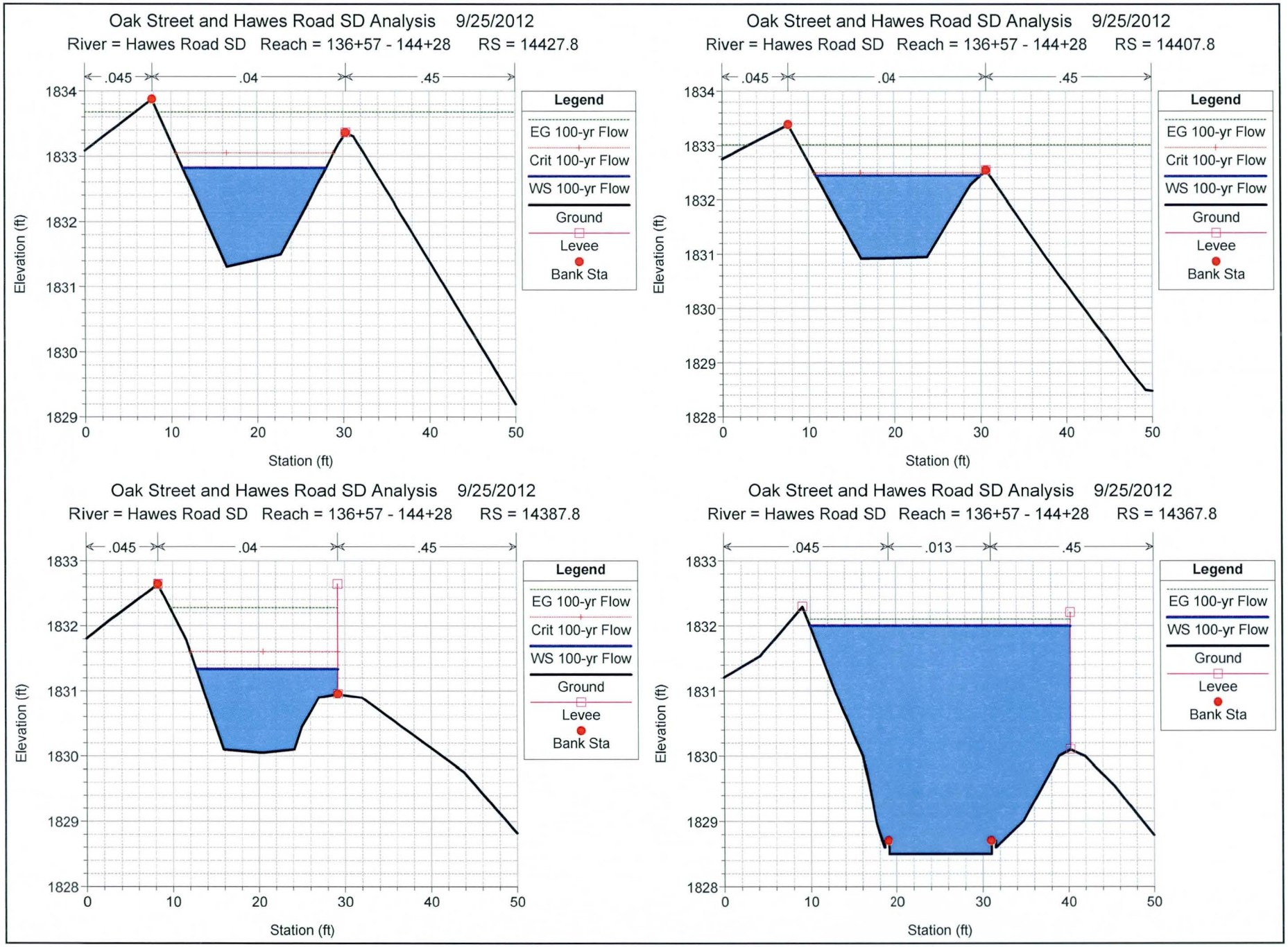
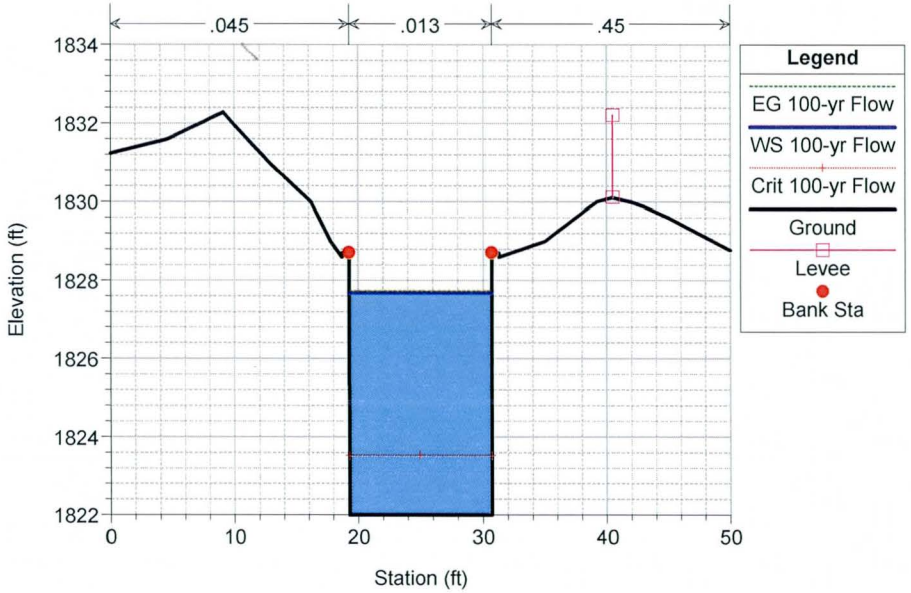


Figure B1.11: Hawes Road SD - HEC RAS Cross Sections

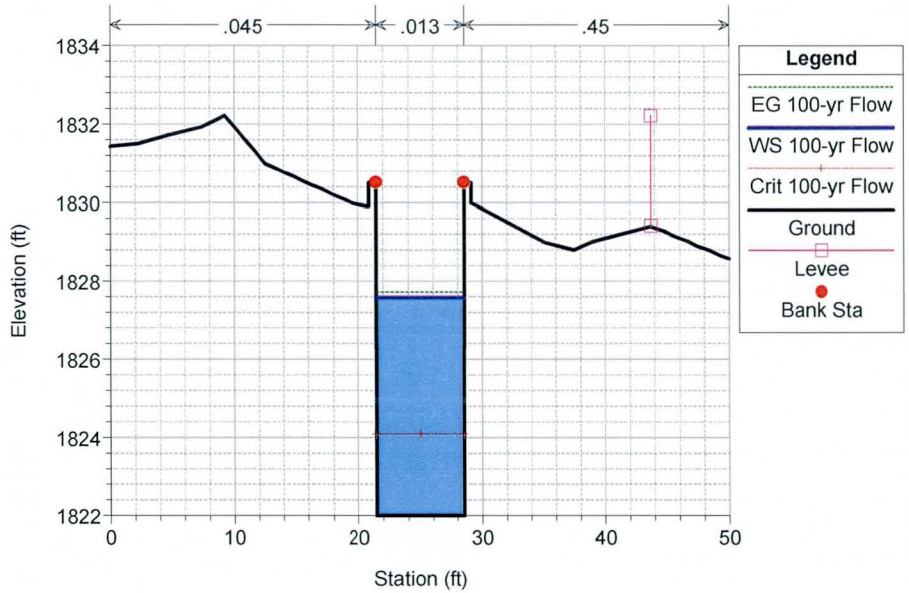
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 14367.3



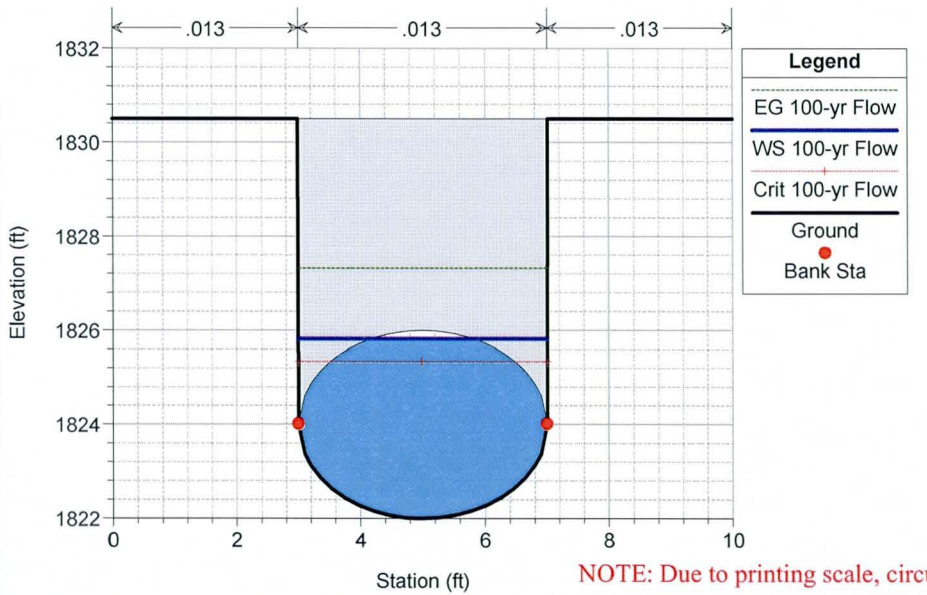
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 14363.5



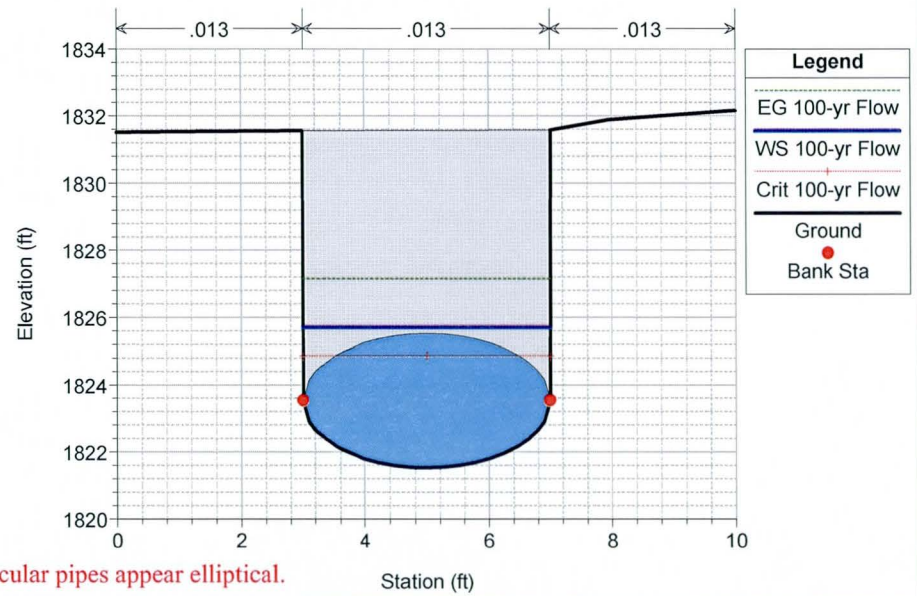
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 14363.0



Oak Street and Hawes Road SD Analysis 9/25/2012

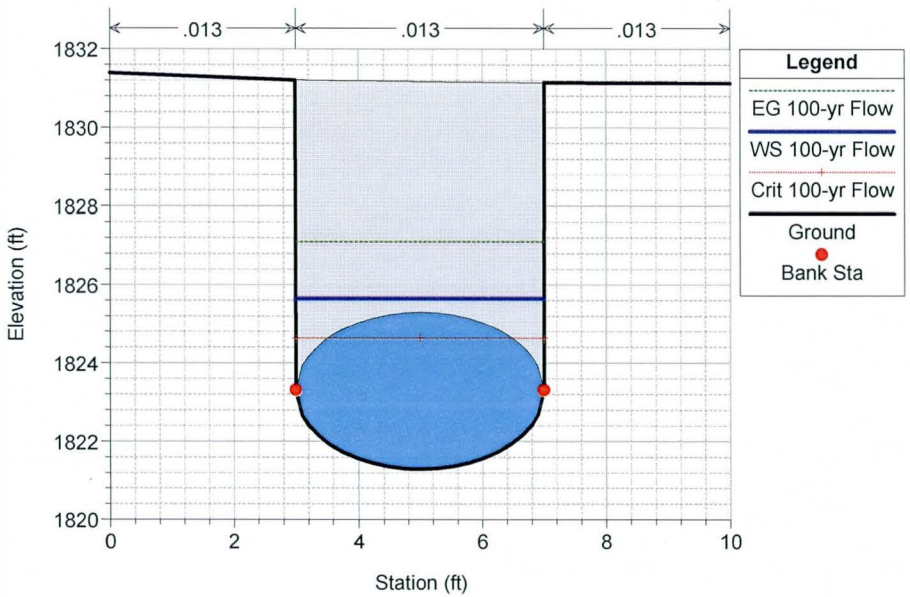
River = Hawes Road SD Reach = 136+57 - 144+28 RS = 14340.6



NOTE: Due to printing scale, circular pipes appear elliptical.

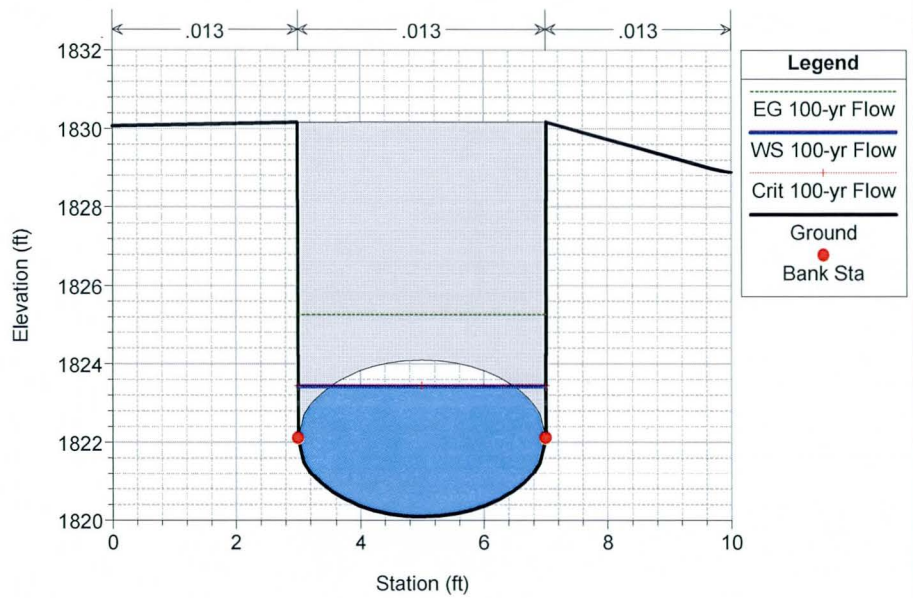
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 14330.6



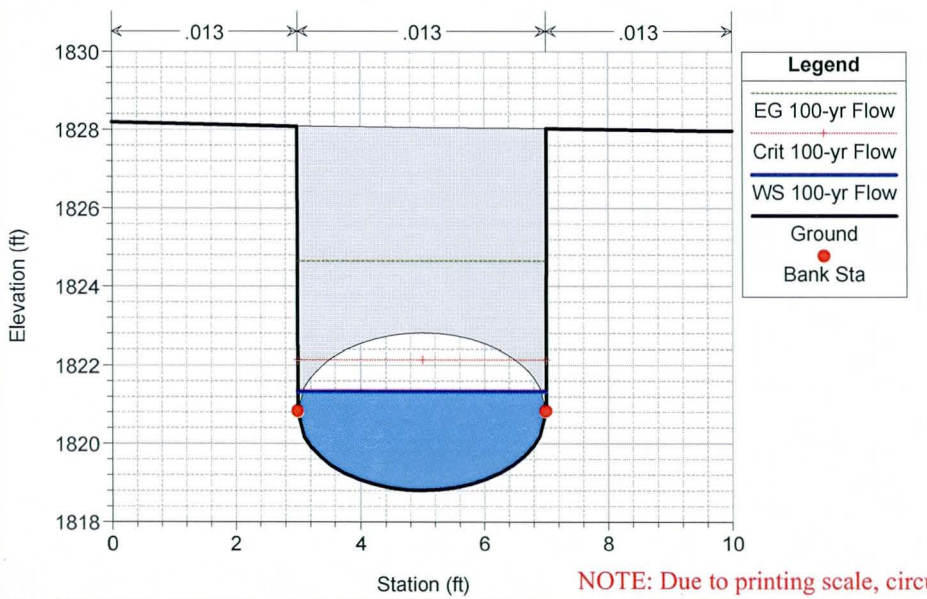
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 14283.1



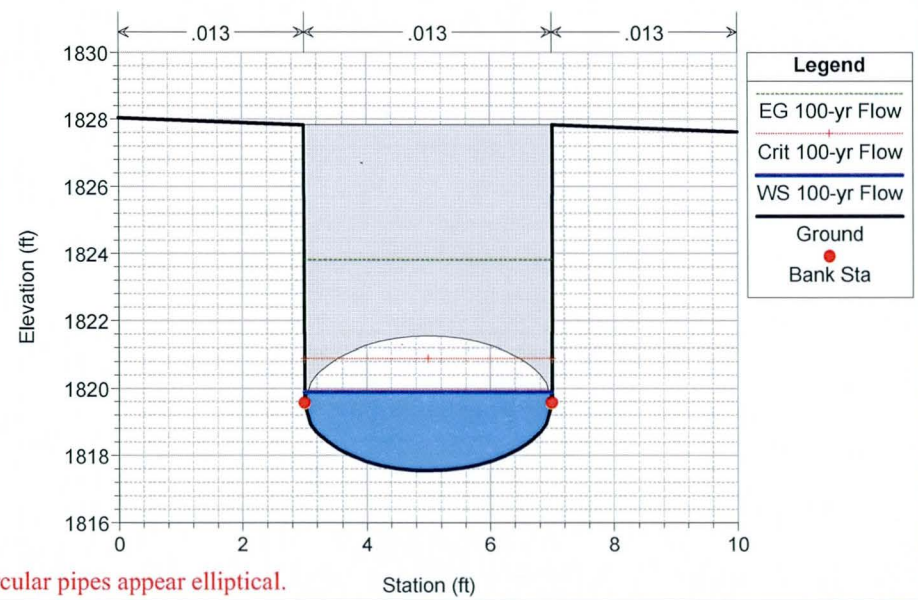
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 14233.1



Oak Street and Hawes Road SD Analysis 9/25/2012

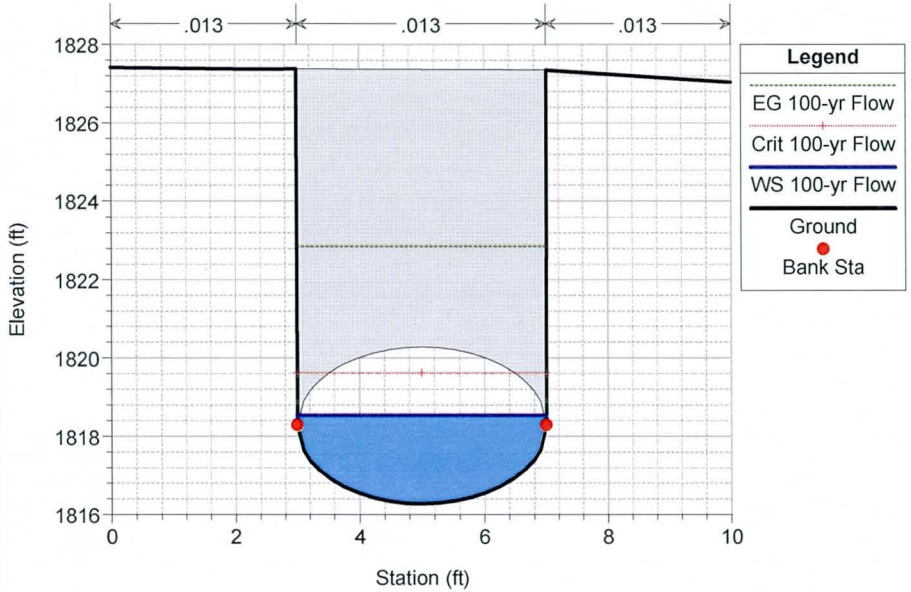
River = Hawes Road SD Reach = 136+57 - 144+28 RS = 14183.1



NOTE: Due to printing scale, circular pipes appear elliptical.

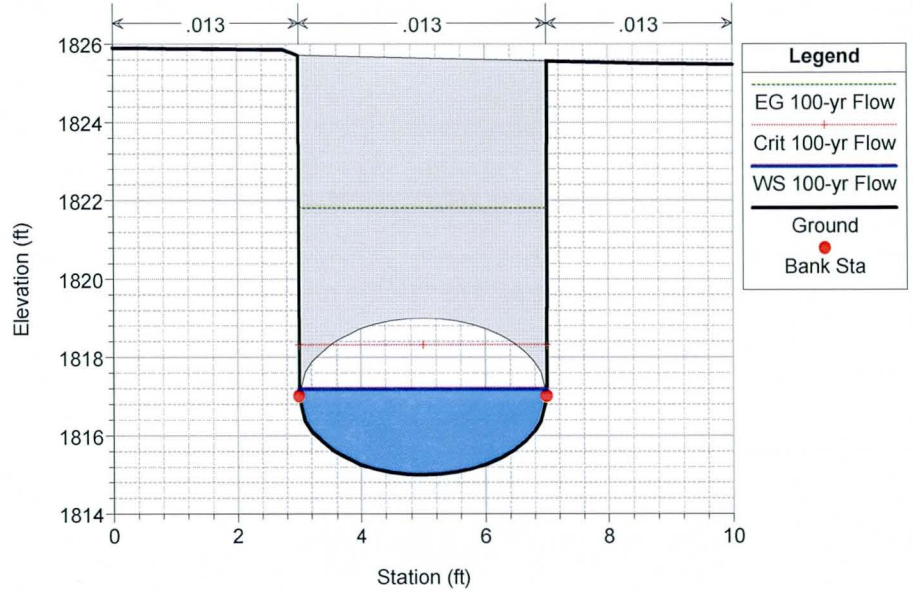
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 14133.1



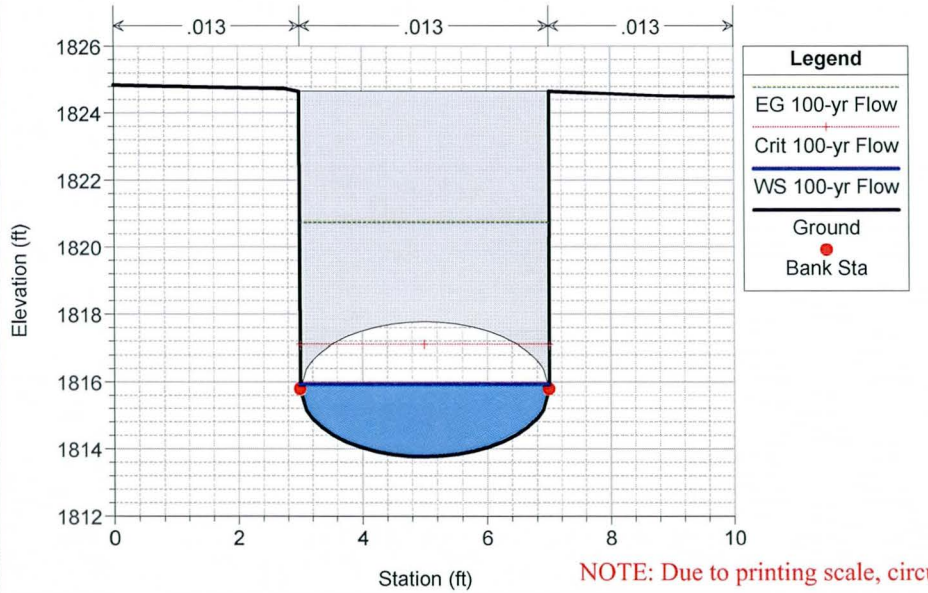
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 14083.1



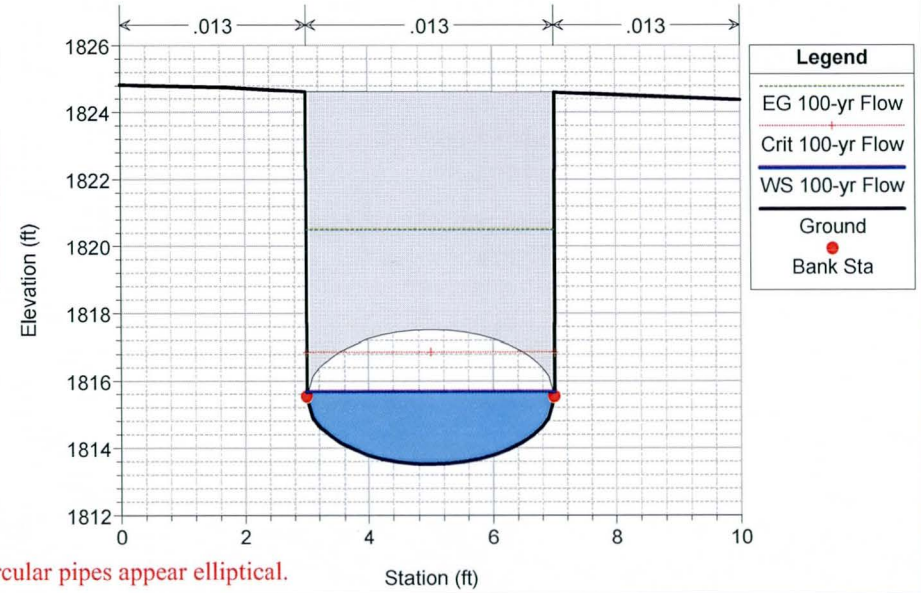
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 14035.0



Oak Street and Hawes Road SD Analysis 9/25/2012

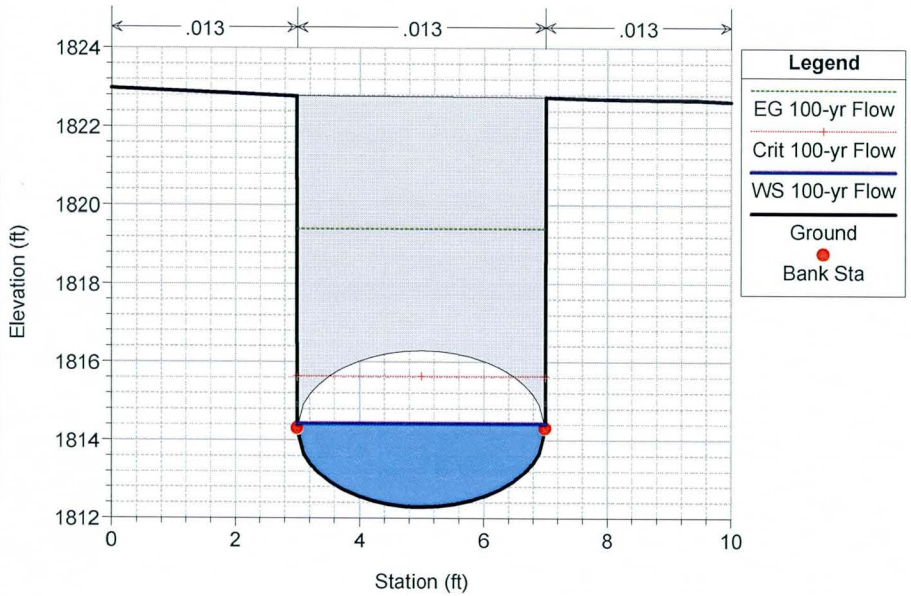
River = Hawes Road SD Reach = 136+57 - 144+28 RS = 14025.0



NOTE: Due to printing scale, circular pipes appear elliptical.

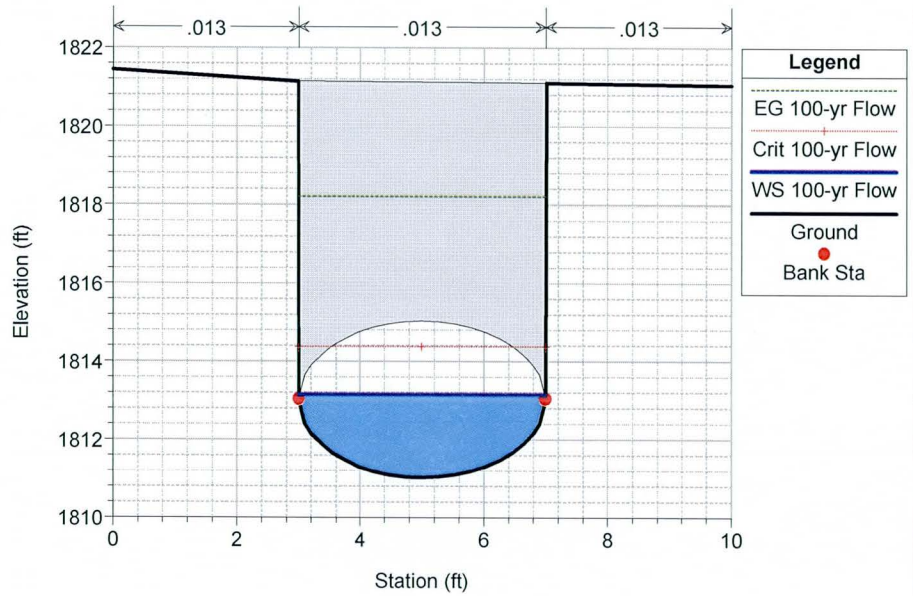
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 13977.5



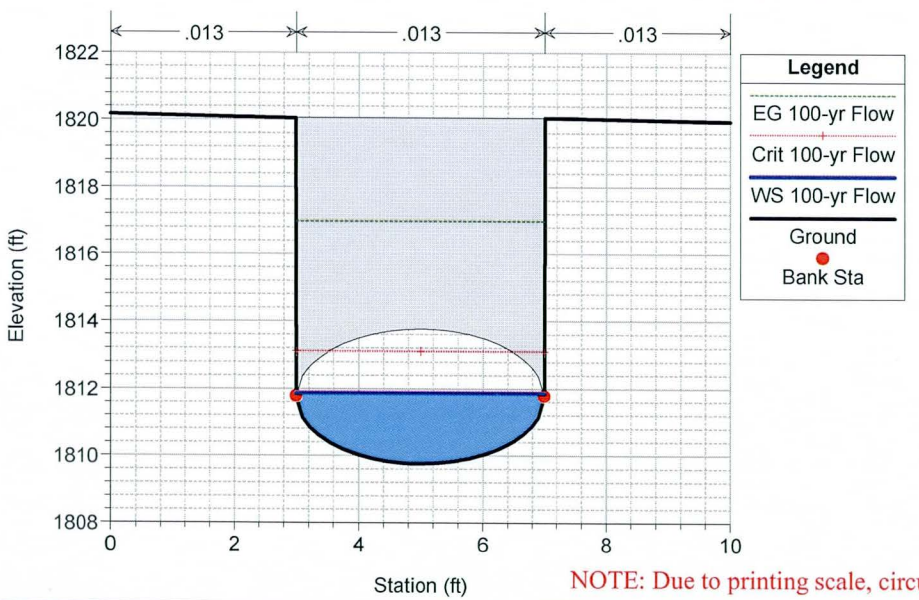
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 13927.5



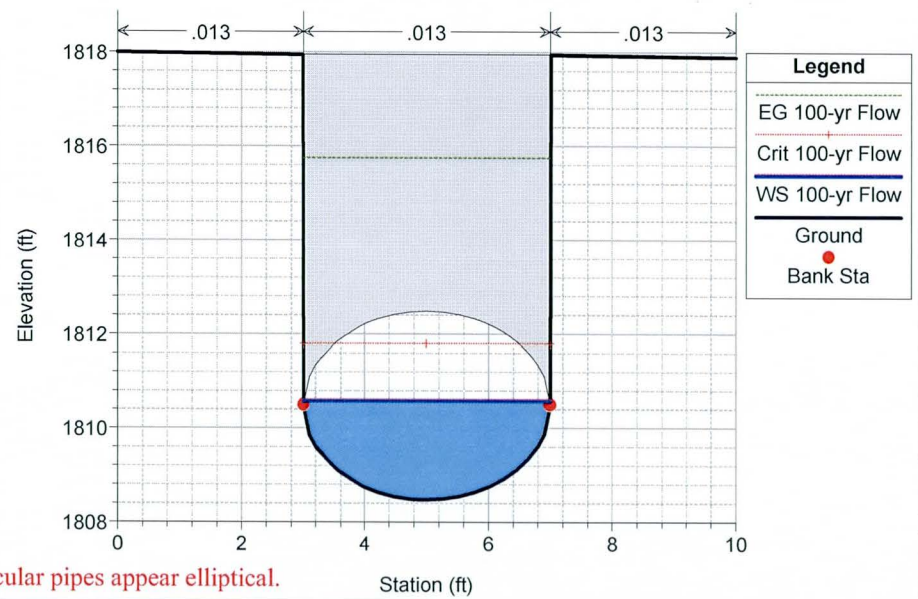
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 13877.5



Oak Street and Hawes Road SD Analysis 9/25/2012

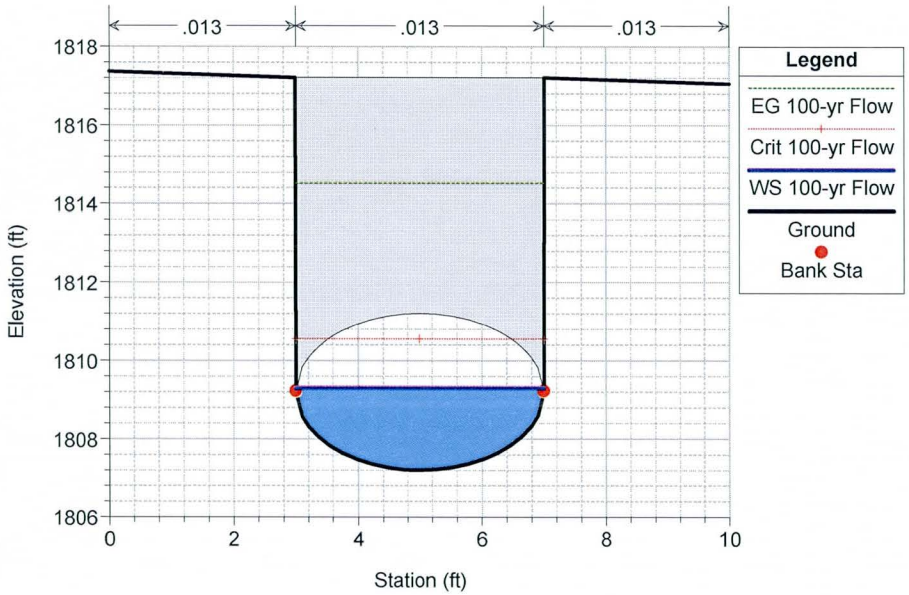
River = Hawes Road SD Reach = 136+57 - 144+28 RS = 13827.5



NOTE: Due to printing scale, circular pipes appear elliptical.

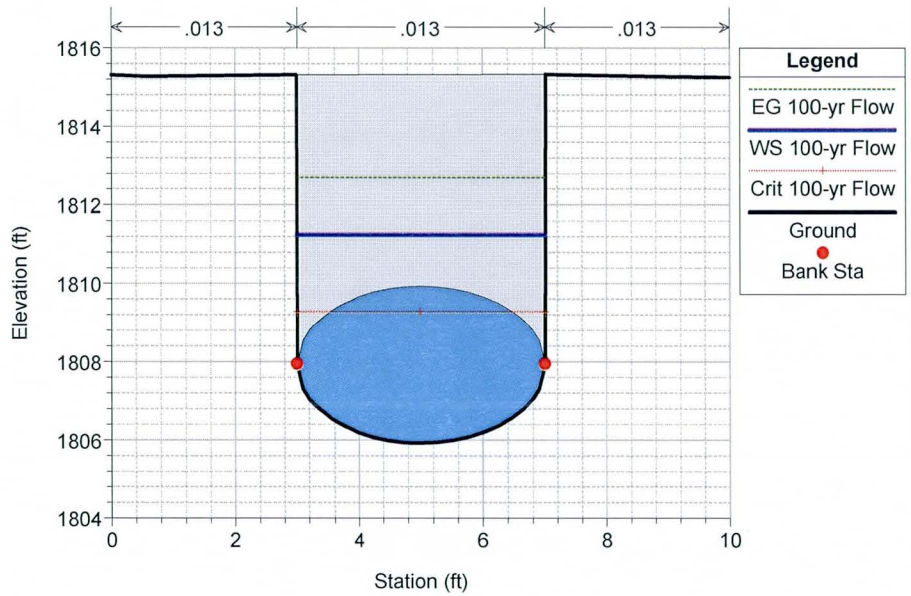
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 13777.5



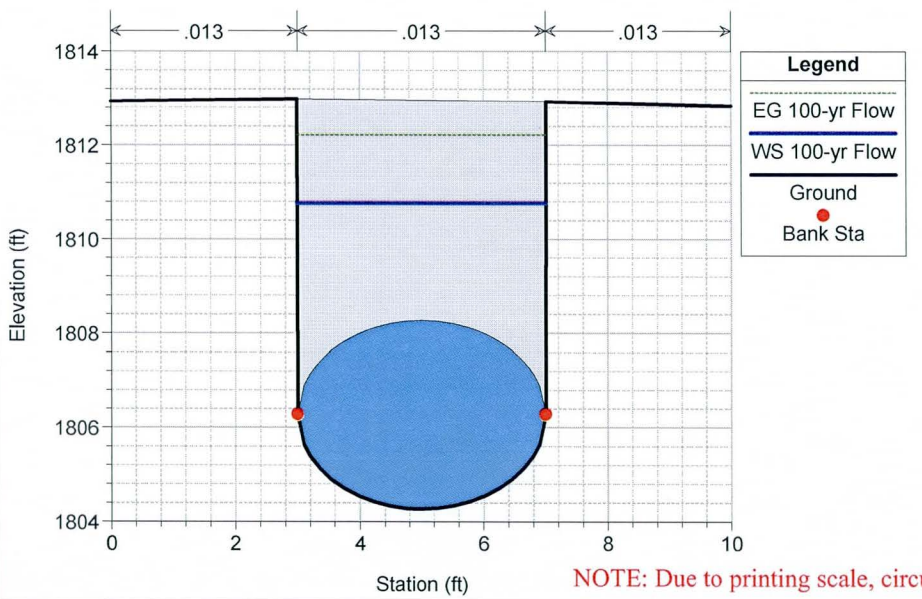
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 13727.5



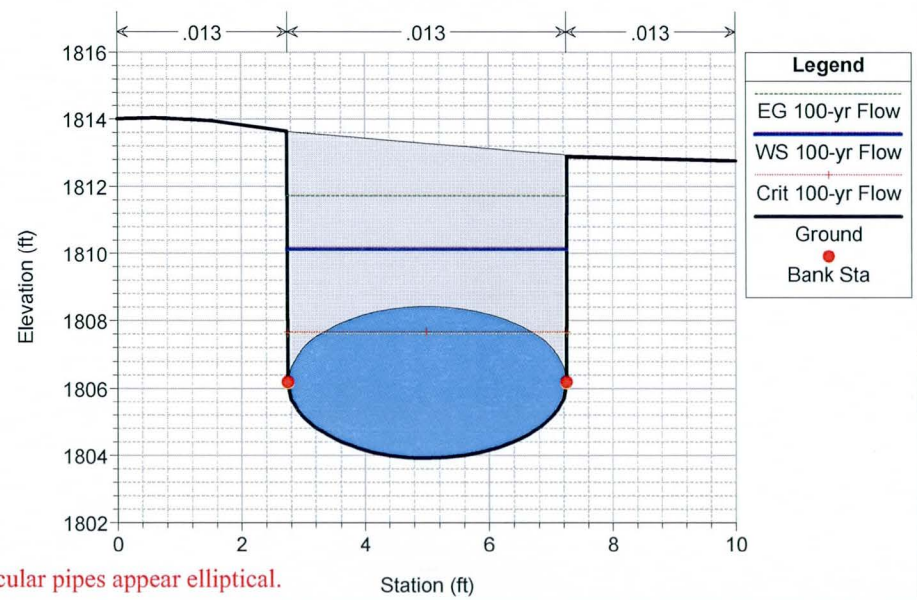
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 - 144+28 RS = 13662.1



Oak Street and Hawes Road SD Analysis 9/25/2012

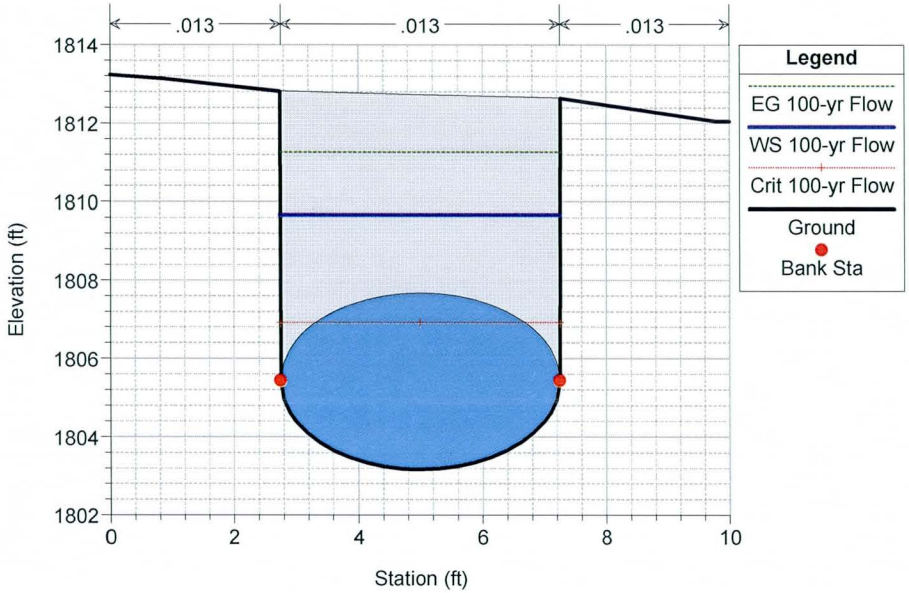
River = Hawes Road SD Reach = 134+45 - 136+57 RS = 13652.1



NOTE: Due to printing scale, circular pipes appear elliptical.

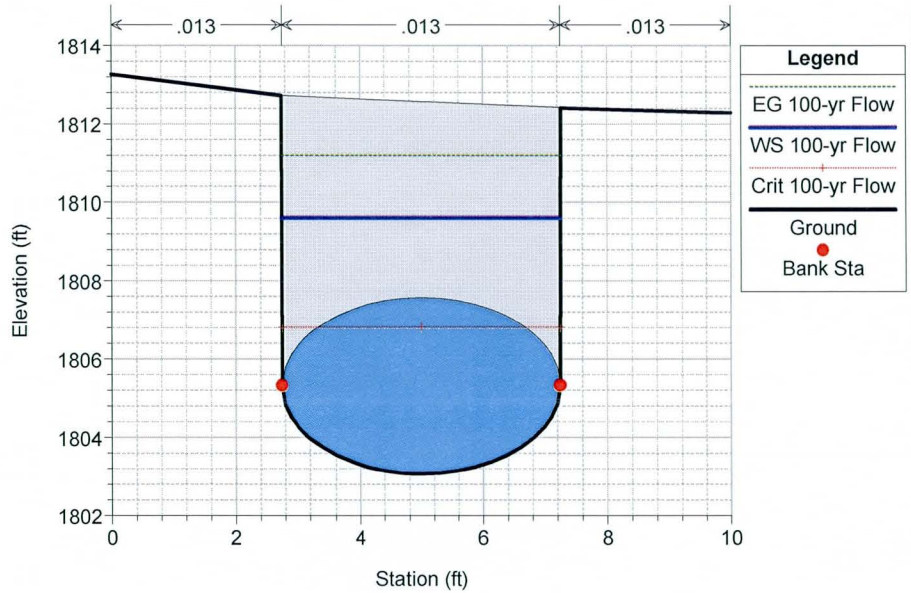
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 134+45 - 136+57 RS = 13583.0



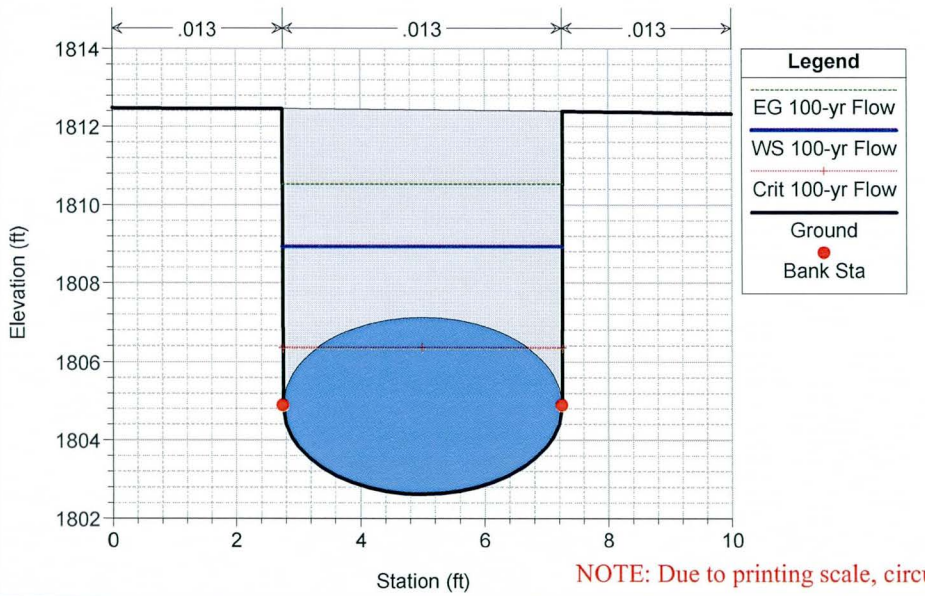
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 134+45 - 136+57 RS = 13573.0



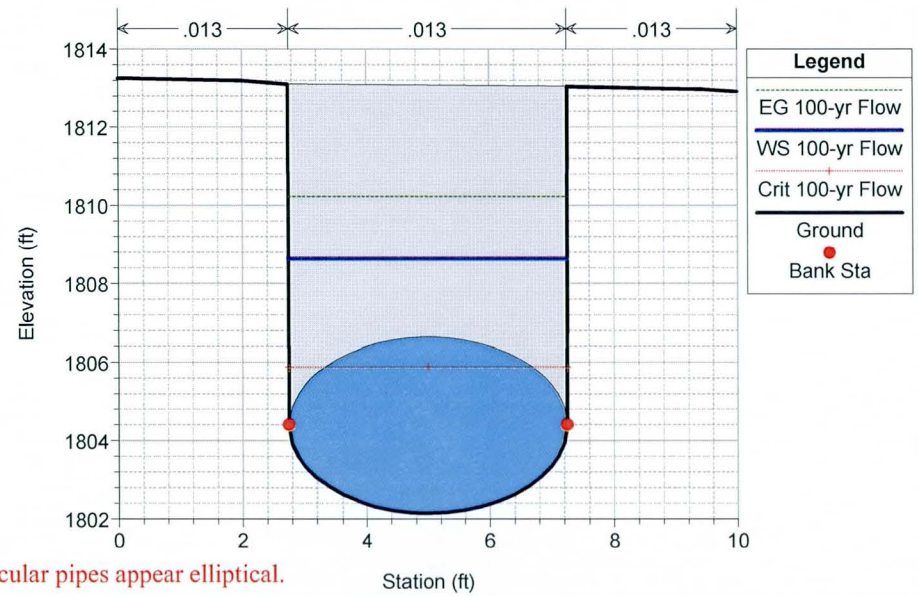
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 134+45 - 136+57 RS = 13530.5



Oak Street and Hawes Road SD Analysis 9/25/2012

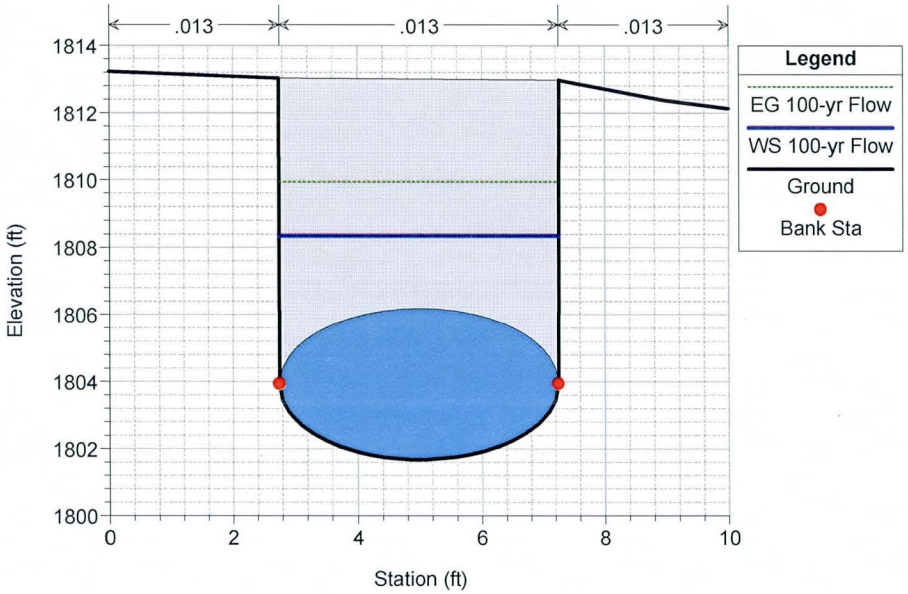
River = Hawes Road SD Reach = 134+45 - 136+57 RS = 13485.5



NOTE: Due to printing scale, circular pipes appear elliptical.

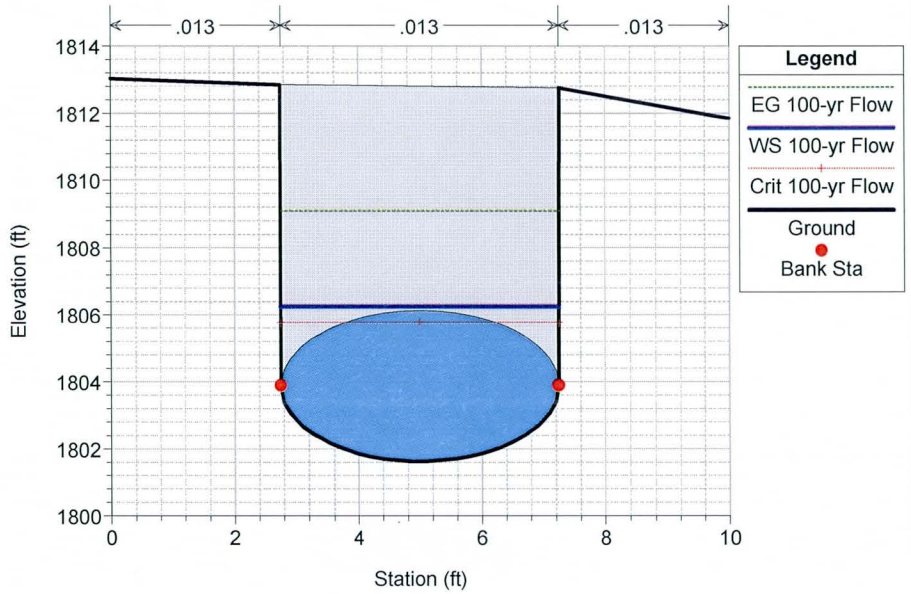
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 134+45 - 136+57 RS = 13443.1



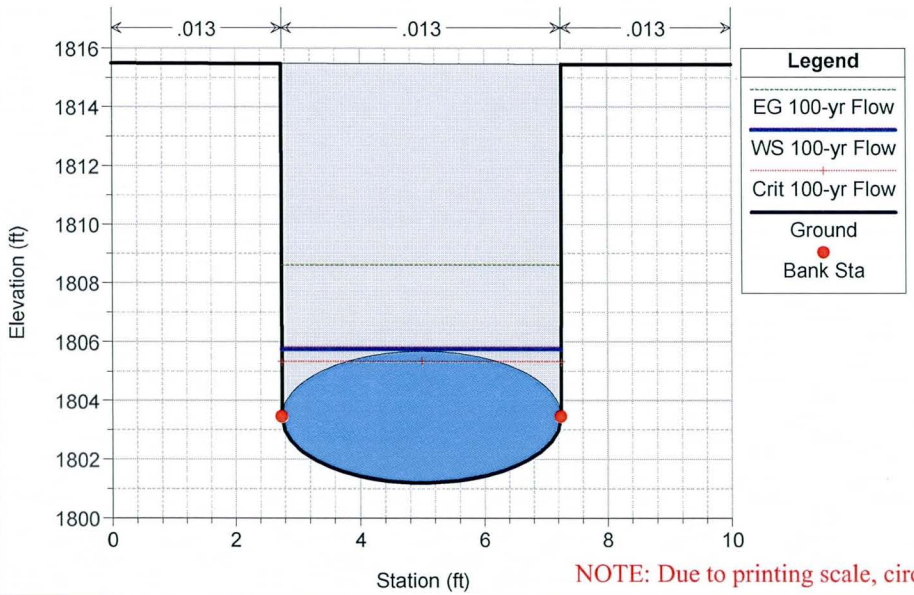
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 132+98 - 134+45 RS = 13438.1



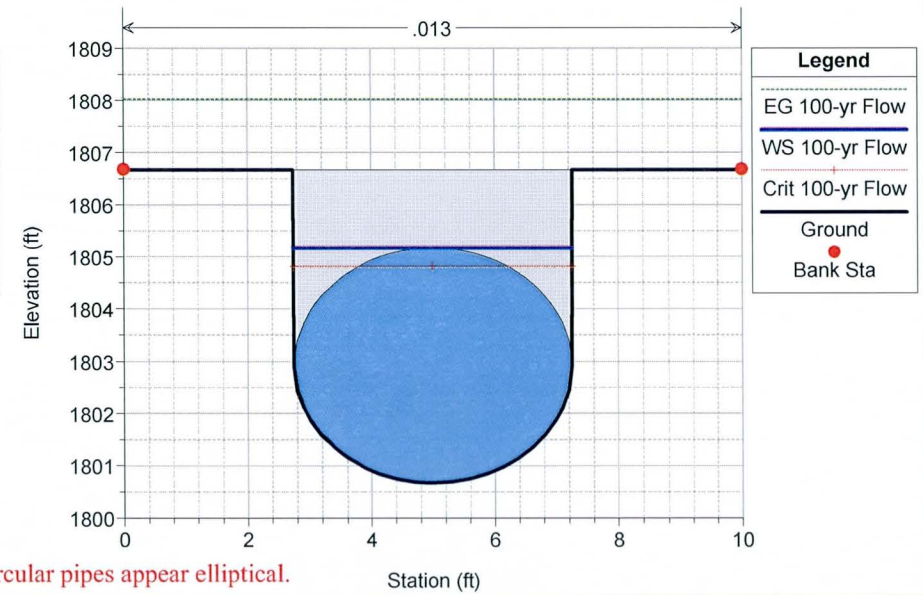
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 132+98 - 134+45 RS = 13397.2



Oak Street and Hawes Road SD Analysis 9/25/2012

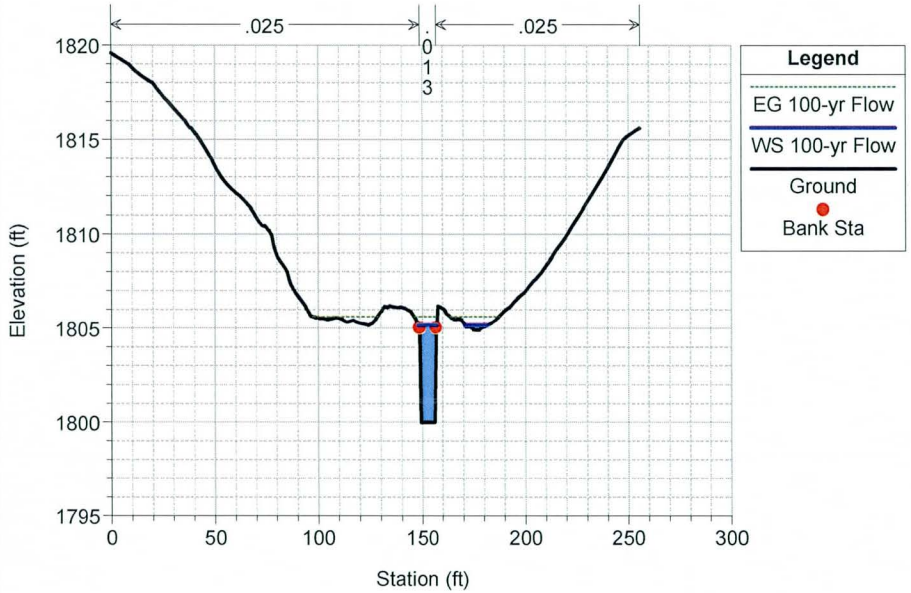
River = Hawes Road SD Reach = 132+98 - 134+45 RS = 13348.6



NOTE: Due to printing scale, circular pipes appear elliptical.

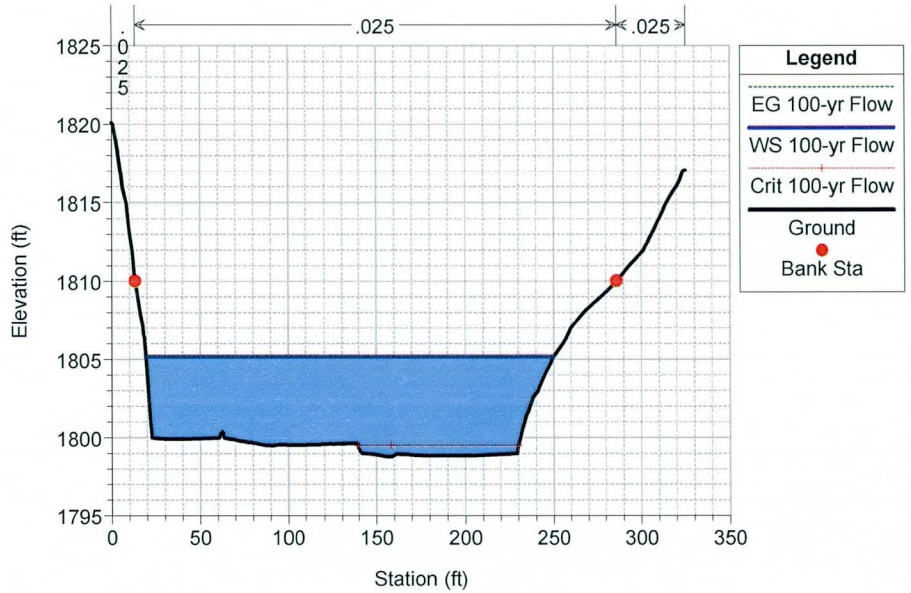
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 132+98 - 134+45 RS = 13348.1



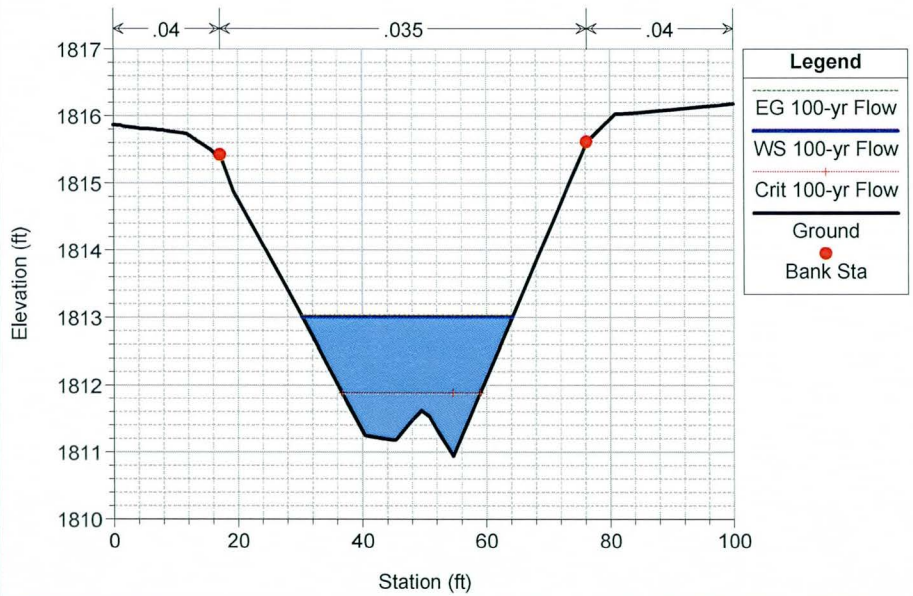
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 132+98 - 134+45 RS = 13297.6



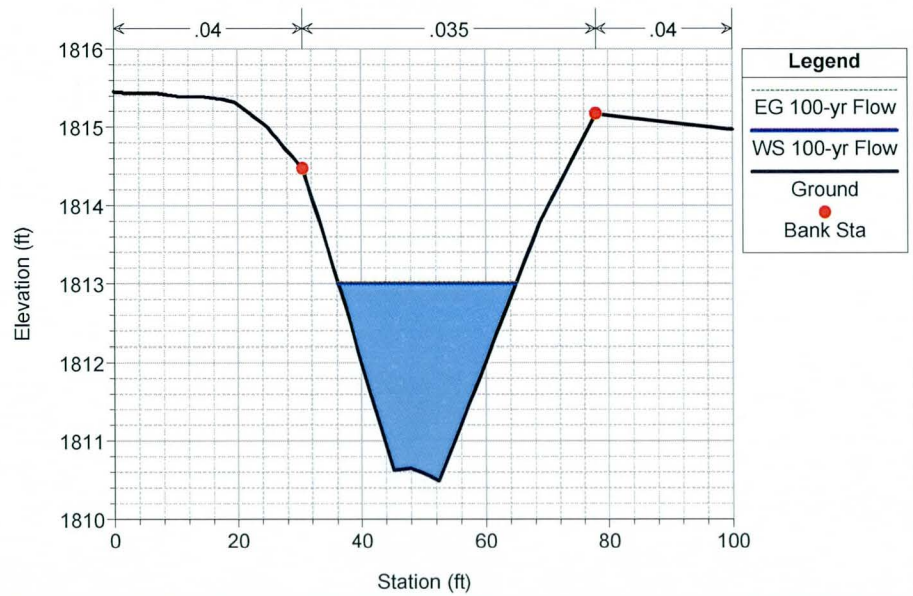
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 134+45 Inlet RS = 88.0

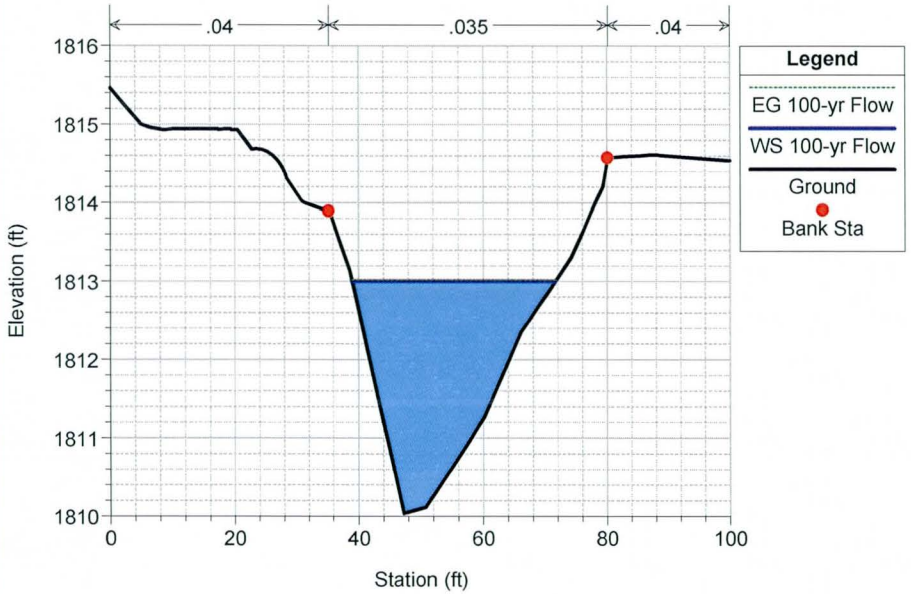


Oak Street and Hawes Road SD Analysis 9/25/2012

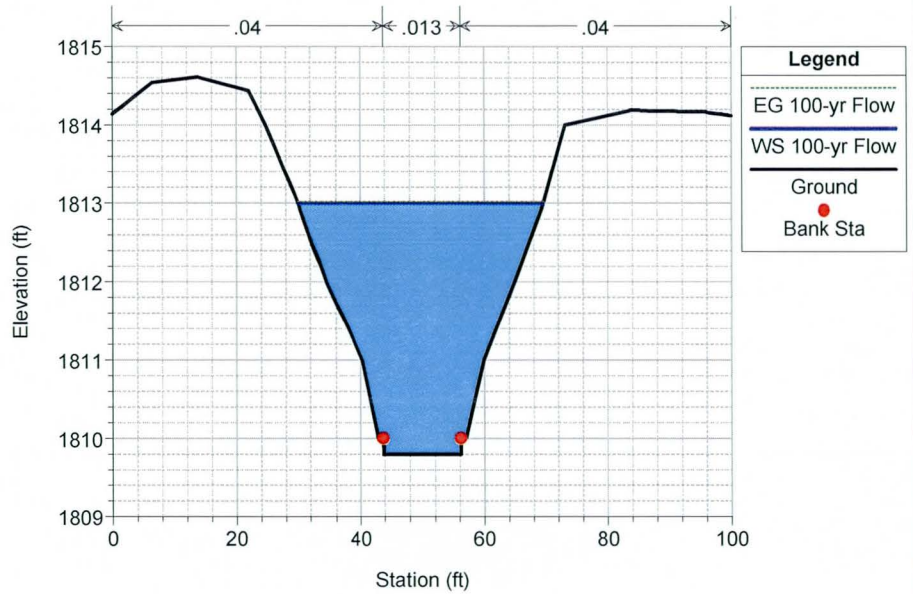
River = Hawes Road SD Reach = 134+45 Inlet RS = 68.0



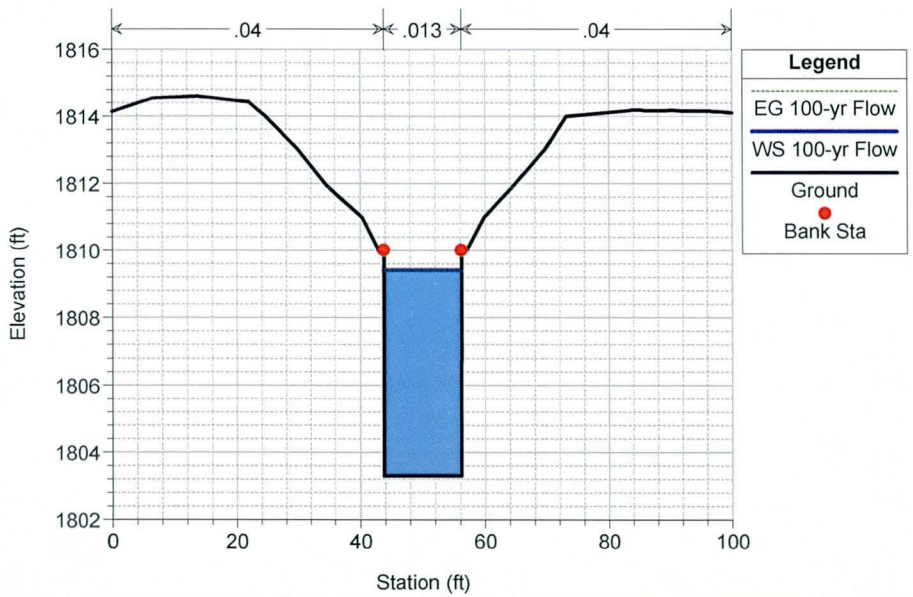
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Hawes Road SD Reach = 134+45 Inlet RS = 48.0



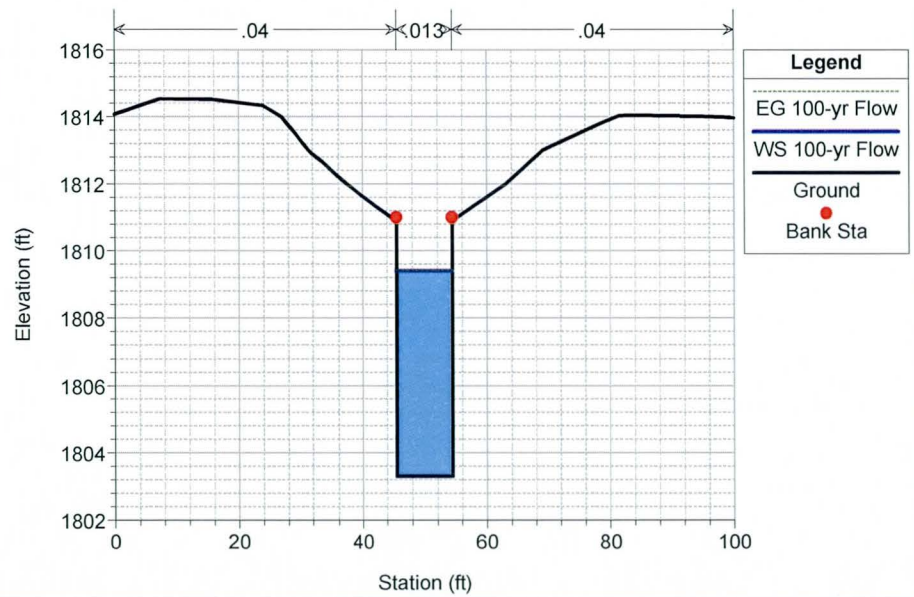
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Hawes Road SD Reach = 134+45 Inlet RS = 31.5



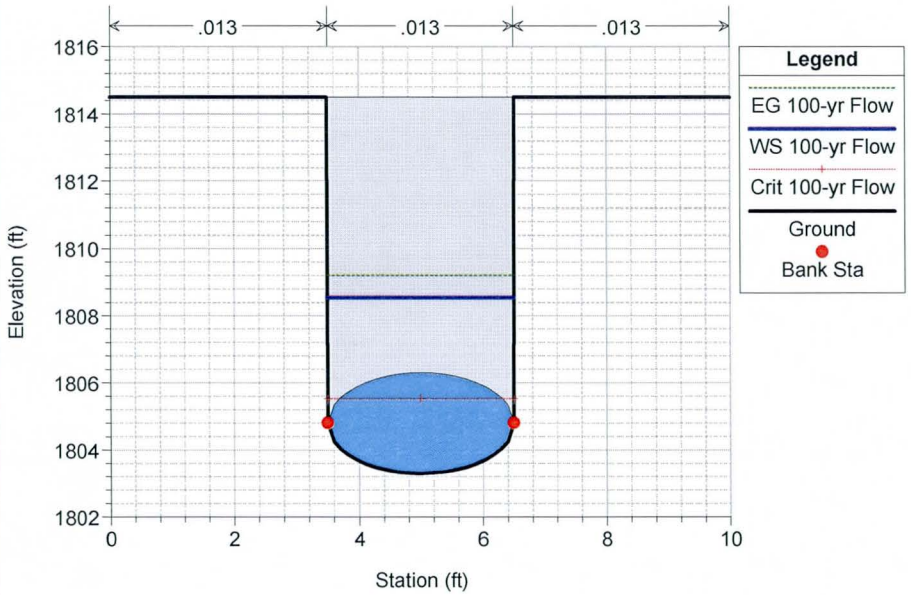
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Hawes Road SD Reach = 134+45 Inlet RS = 31.0



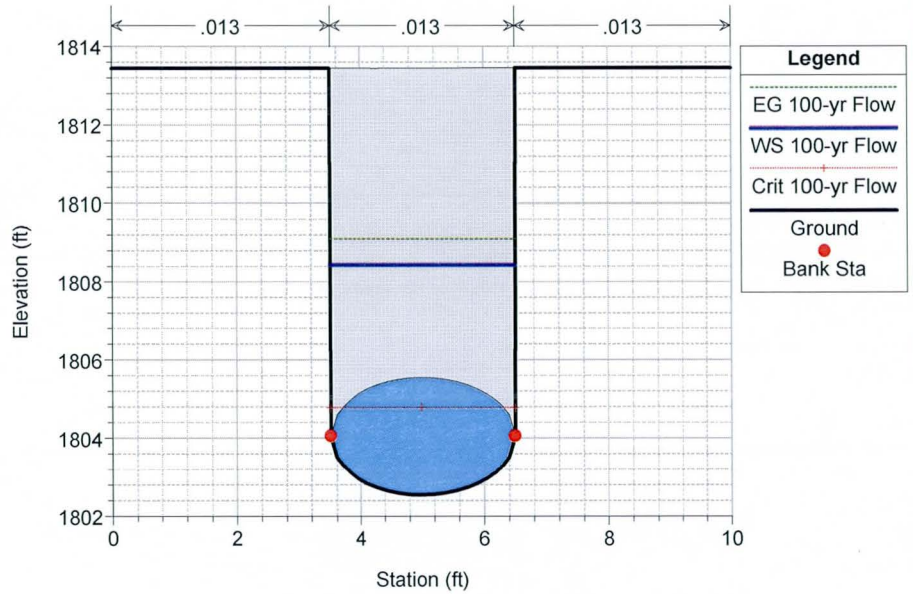
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Hawes Road SD Reach = 134+45 Inlet RS = 28.0



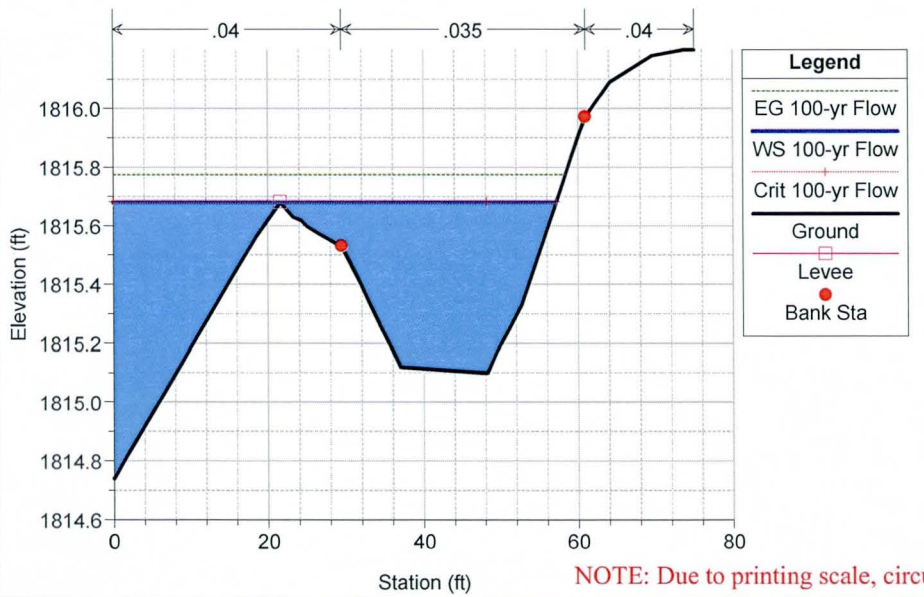
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Hawes Road SD Reach = 134+45 Inlet RS = 27.5



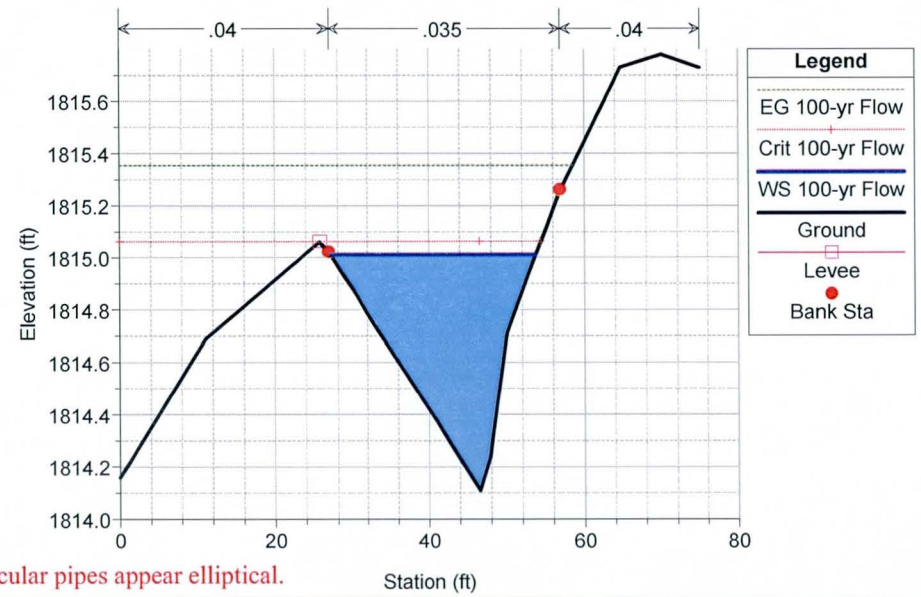
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Hawes Road SD Reach = 134+45 Inlet RS = 3.2



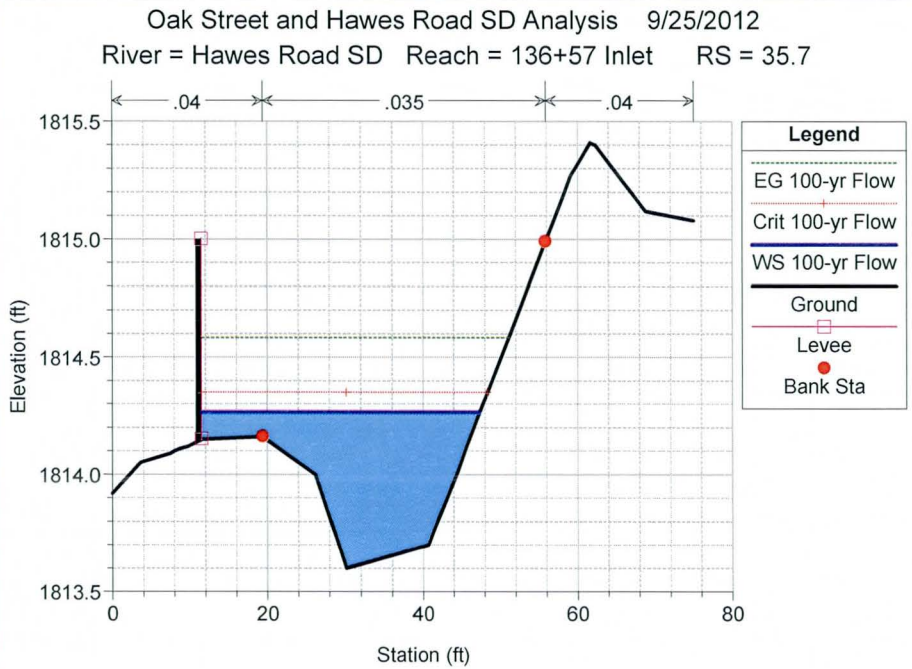
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Hawes Road SD Reach = 136+57 Inlet RS = 75.7

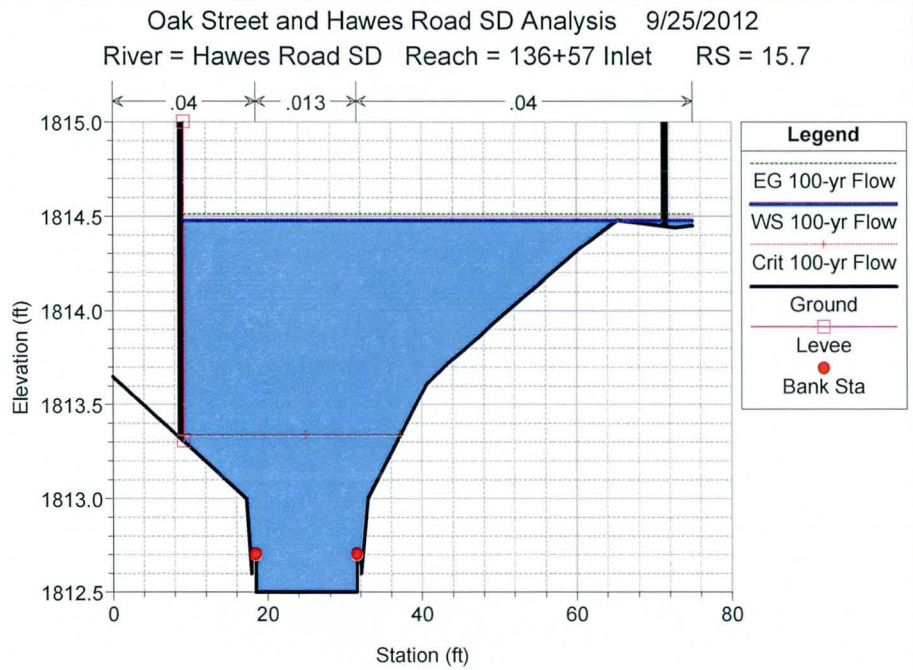


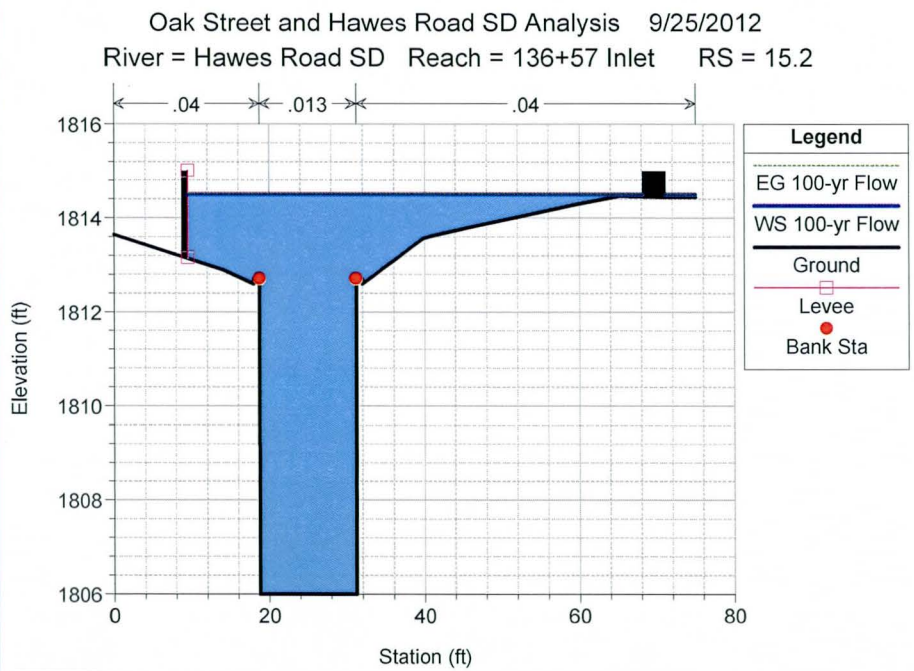
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Hawes Road SD Reach = 136+57 Inlet RS = 55.7

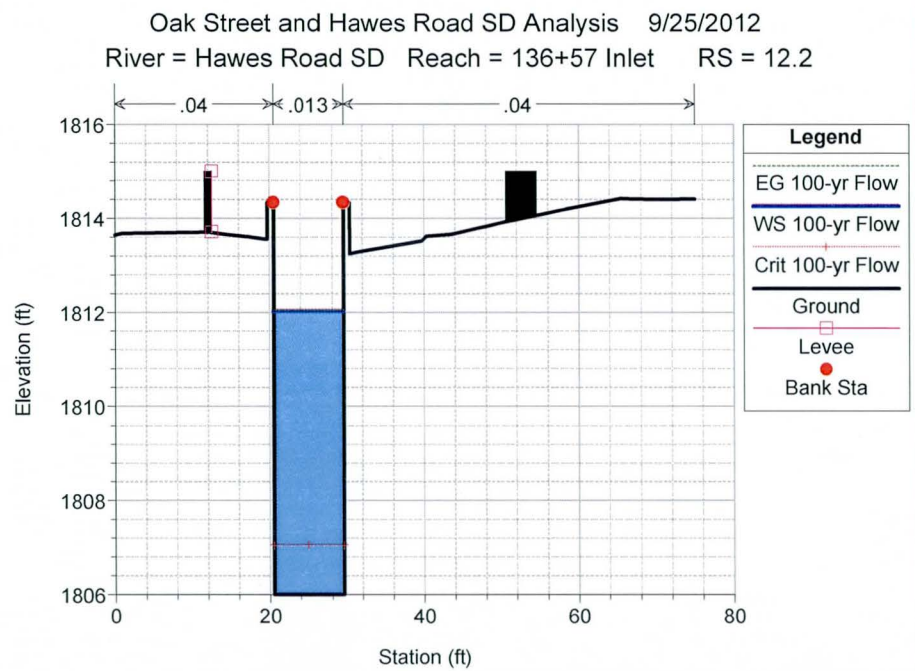


NOTE: Due to printing scale, circular pipes appear elliptical.


Oak Street and Hawes Road SD Analysis 9/25/2012
River = Hawes Road SD Reach = 136+57 Inlet RS = 35.7
.04
.035
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Levee
Bank Sta

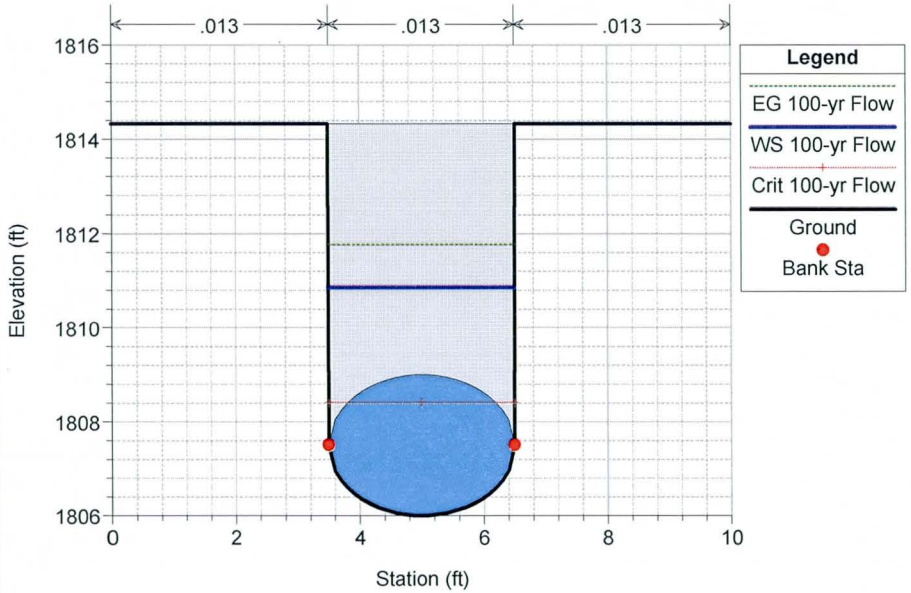

Oak Street and Hawes Road SD Analysis 9/25/2012
River = Hawes Road SD Reach = 136+57 Inlet RS = 15.7
.04
.013
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Levee
Bank Sta


Oak Street and Hawes Road SD Analysis 9/25/2012
River = Hawes Road SD Reach = 136+57 Inlet RS = 15.2
.04
.013
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
WS 100-yr Flow
Ground
Levee
Bank Sta


Oak Street and Hawes Road SD Analysis 9/25/2012
River = Hawes Road SD Reach = 136+57 Inlet RS = 12.2
.04
.013
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Levee
Bank Sta

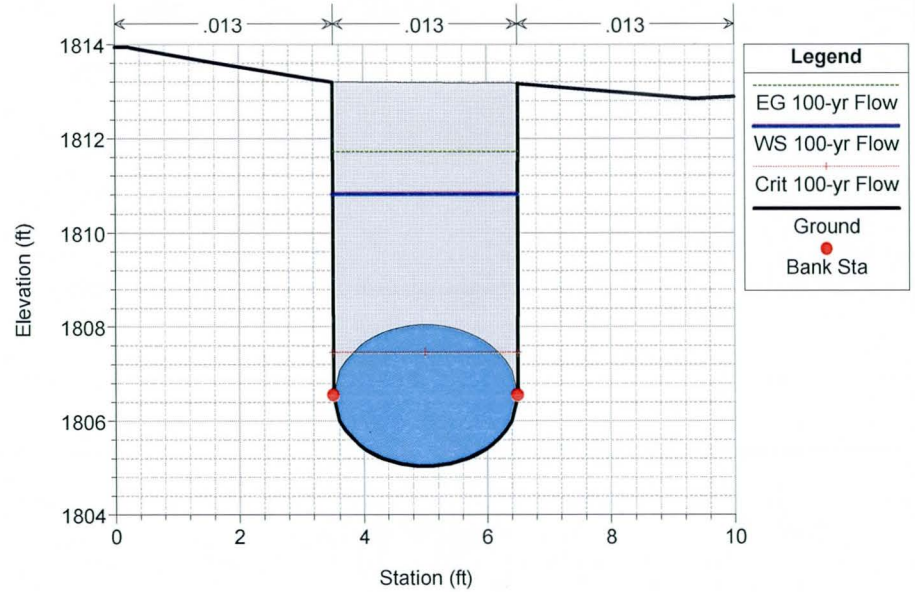
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 Inlet RS = 11.7



Oak Street and Hawes Road SD Analysis 9/25/2012

River = Hawes Road SD Reach = 136+57 Inlet RS = 5.0



NOTE: Due to printing scale, circular pipes appear elliptical.

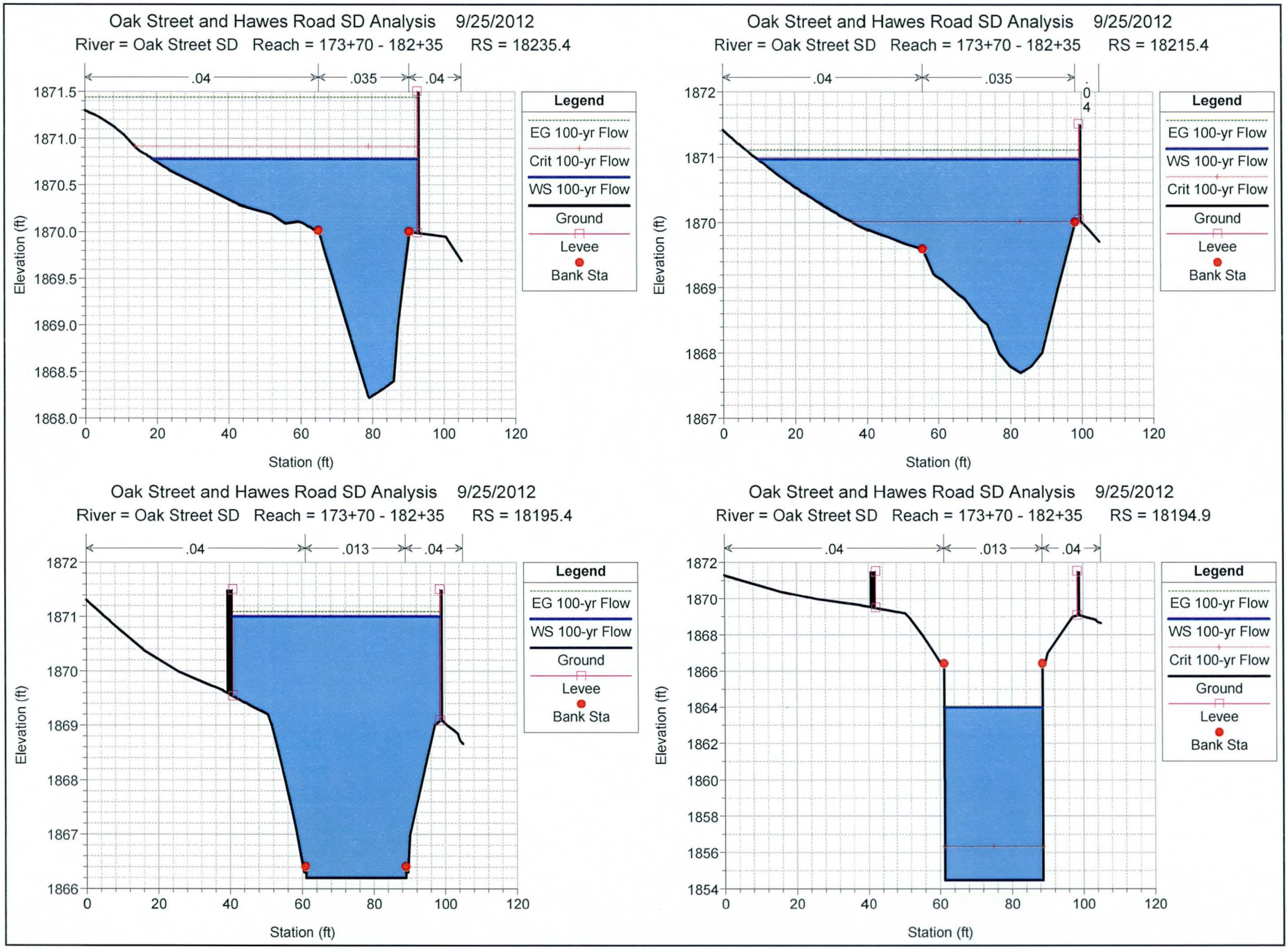
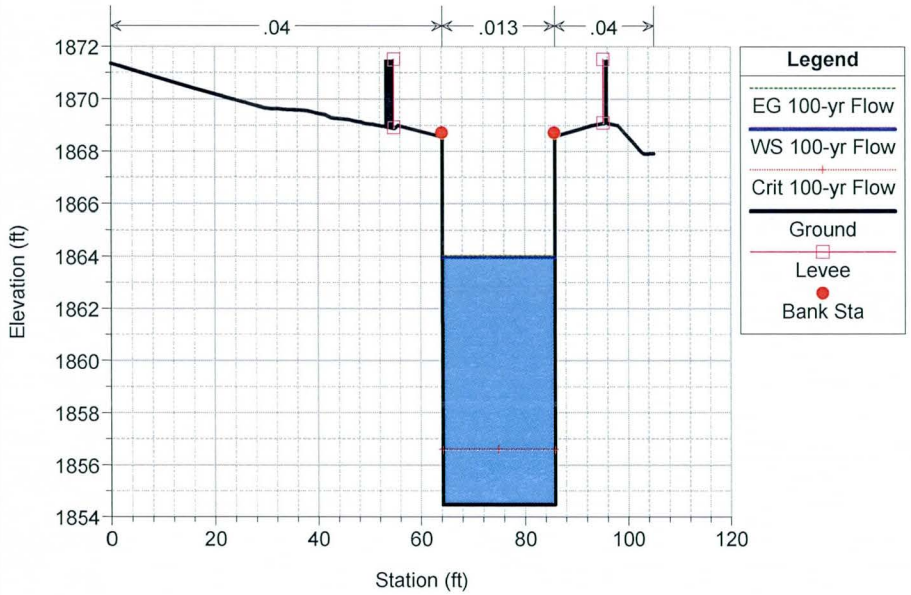


Figure B1.12: Oak Street SD - HEC RAS Cross Sections

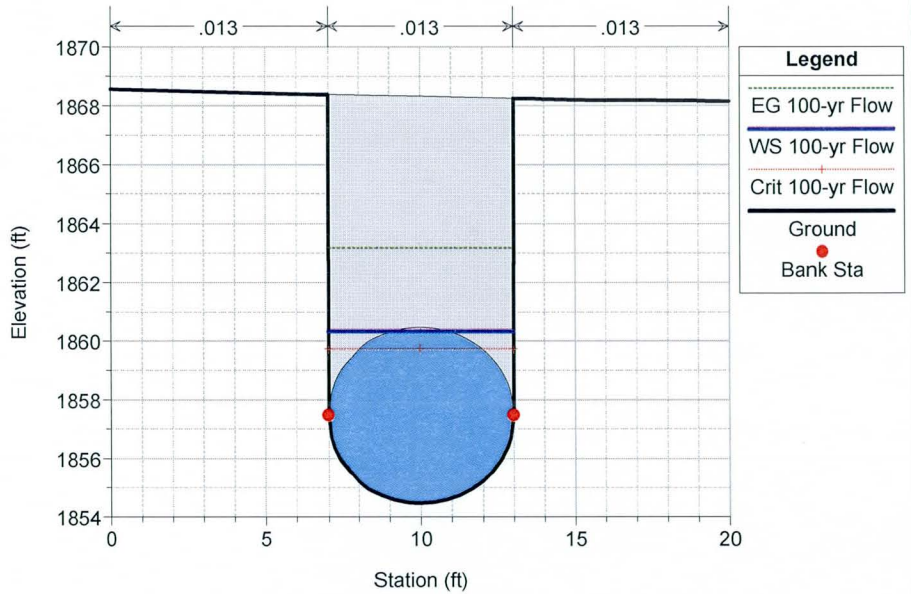
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 18189.9



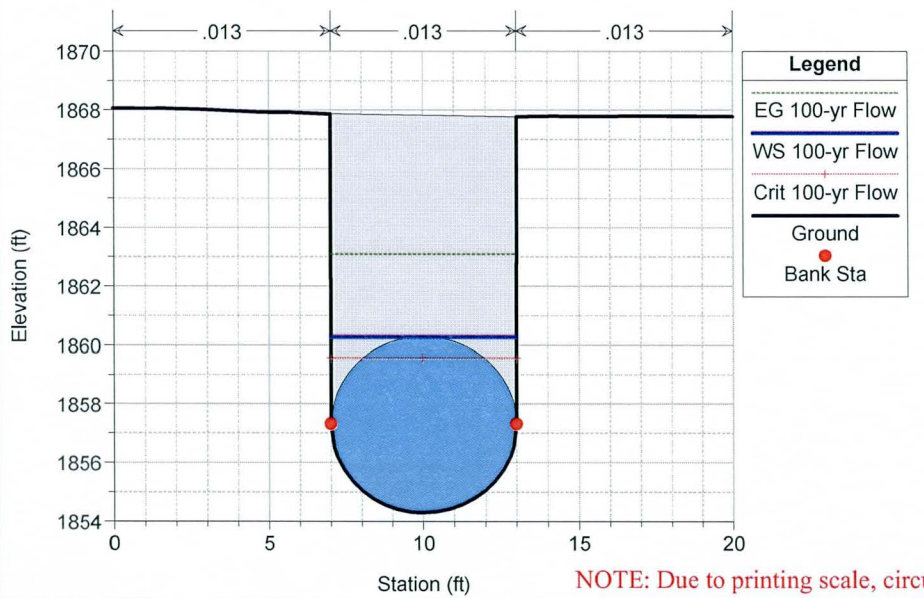
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 18189.4



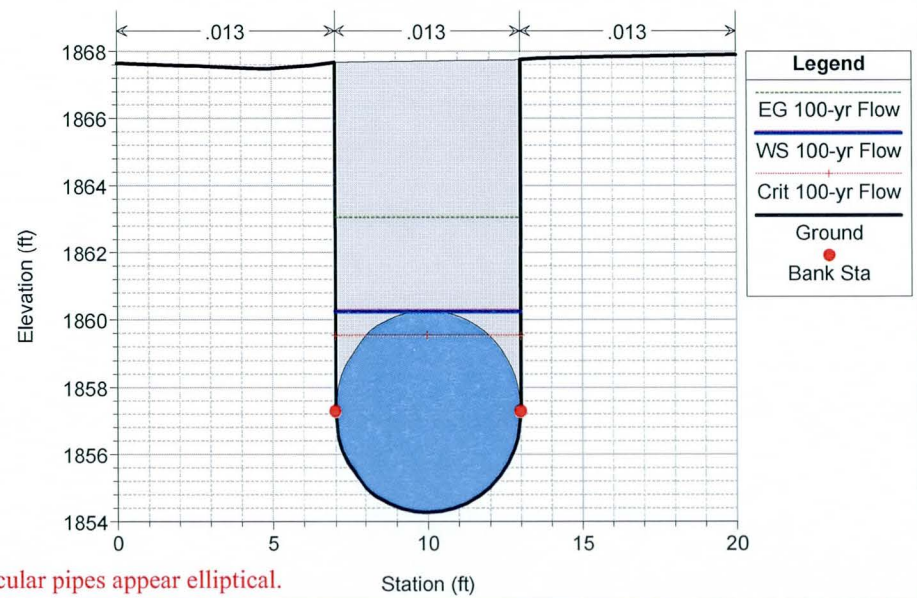
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 18178.1



Oak Street and Hawes Road SD Analysis 9/25/2012

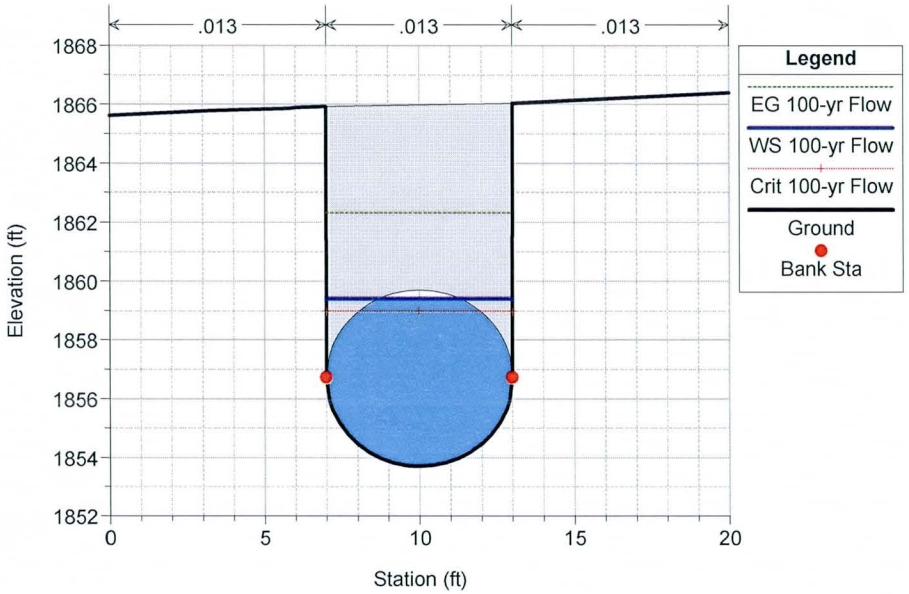
River = Oak Street SD Reach = 173+70 - 182+35 RS = 18176.3



NOTE: Due to printing scale, circular pipes appear elliptical.

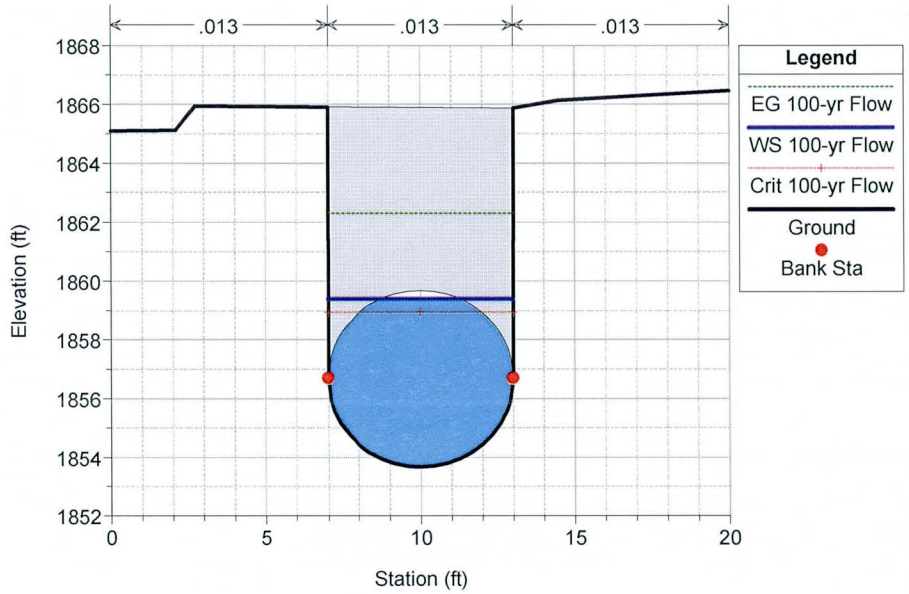
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 18138.6



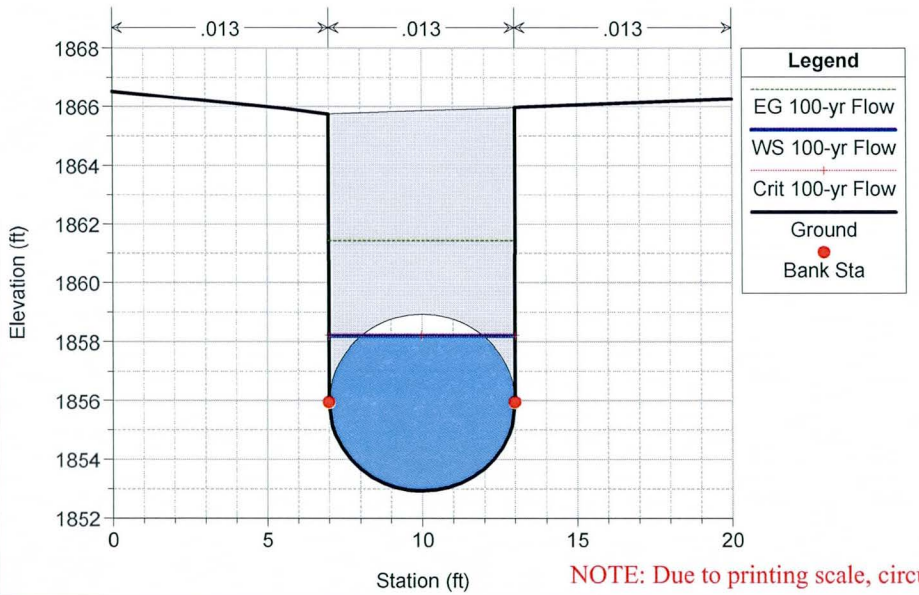
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 18136.8



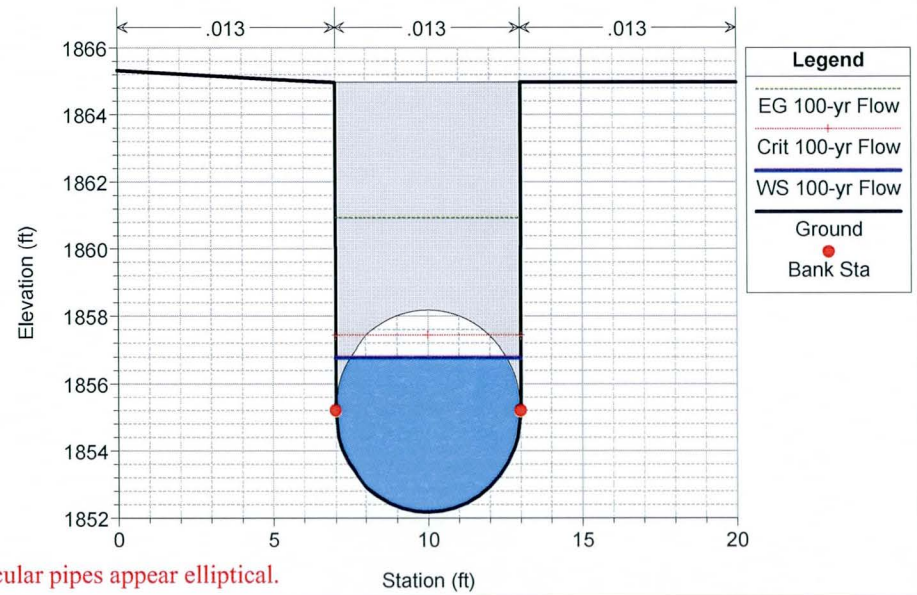
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 18086.8



Oak Street and Hawes Road SD Analysis 9/25/2012

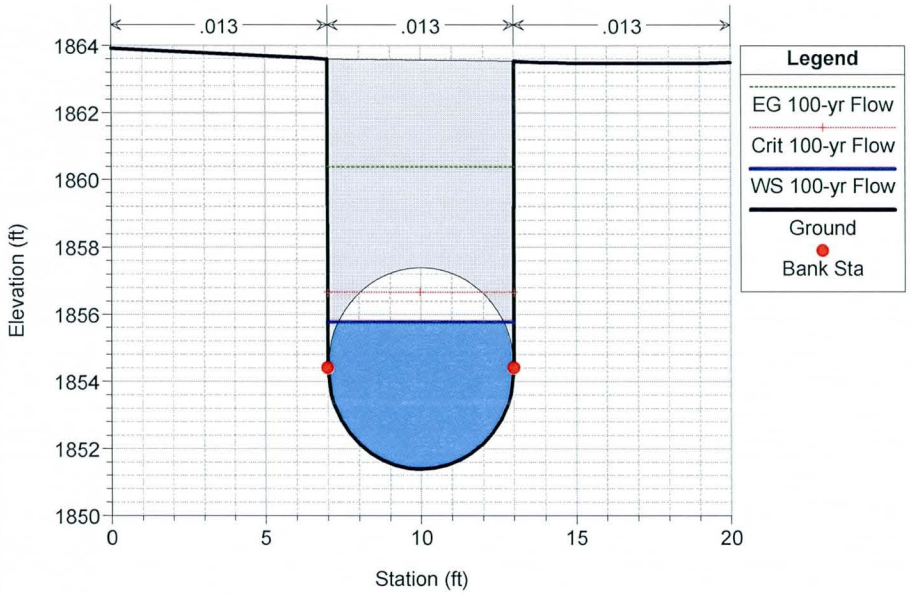
River = Oak Street SD Reach = 173+70 - 182+35 RS = 18036.8



NOTE: Due to printing scale, circular pipes appear elliptical.

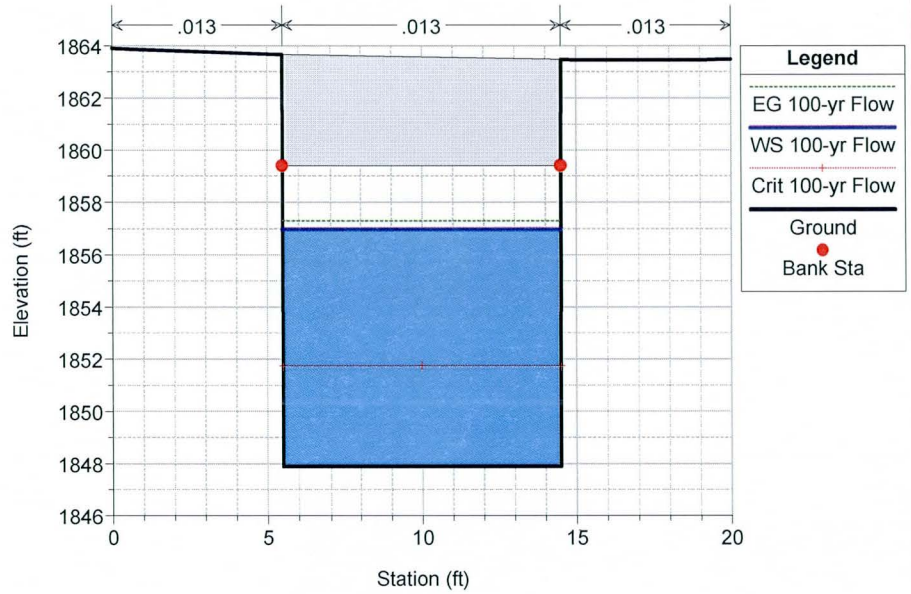
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17985.0



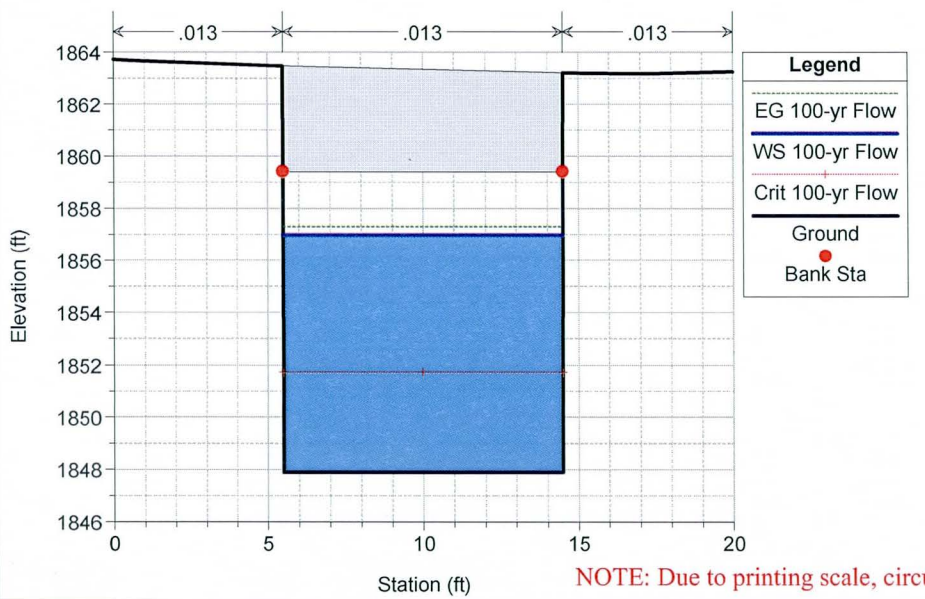
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17984.5



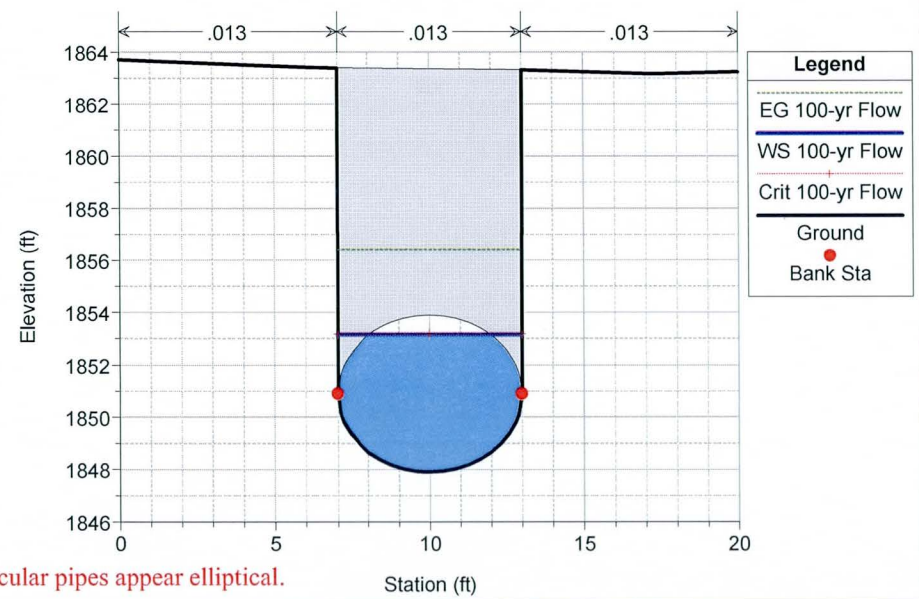
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17976.5



Oak Street and Hawes Road SD Analysis 9/25/2012

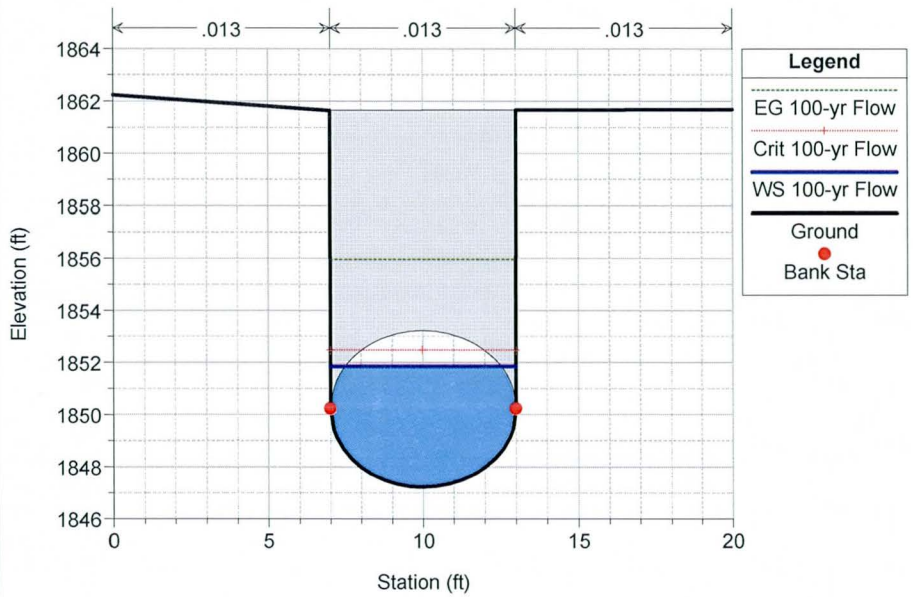
River = Oak Street SD Reach = 173+70 - 182+35 RS = 17976.0



NOTE: Due to printing scale, circular pipes appear elliptical.

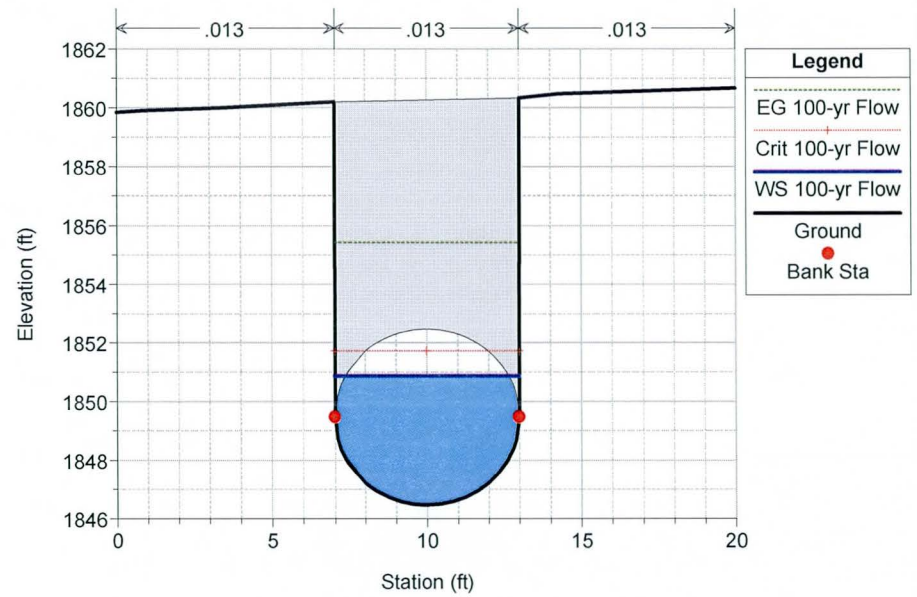
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17930.5



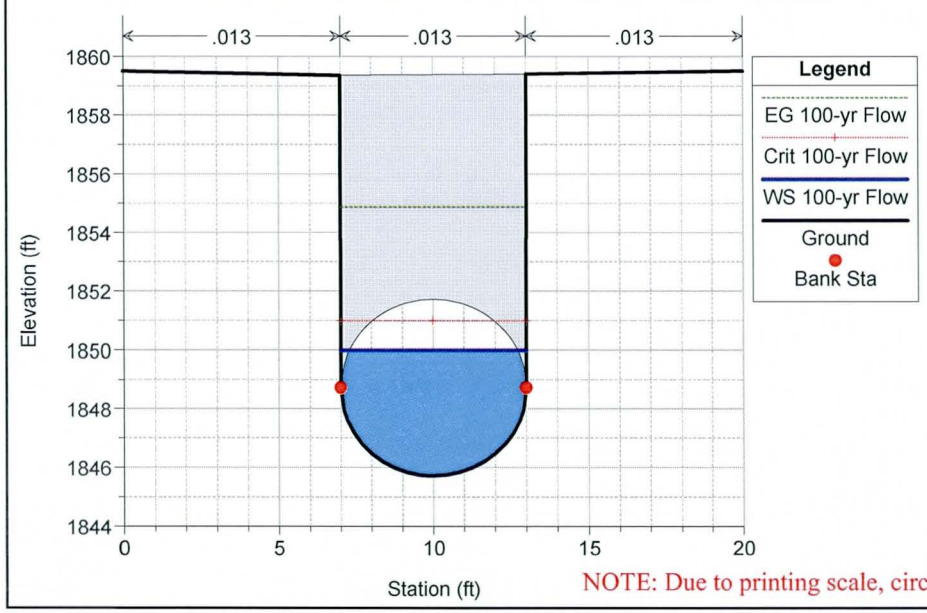
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17880.5



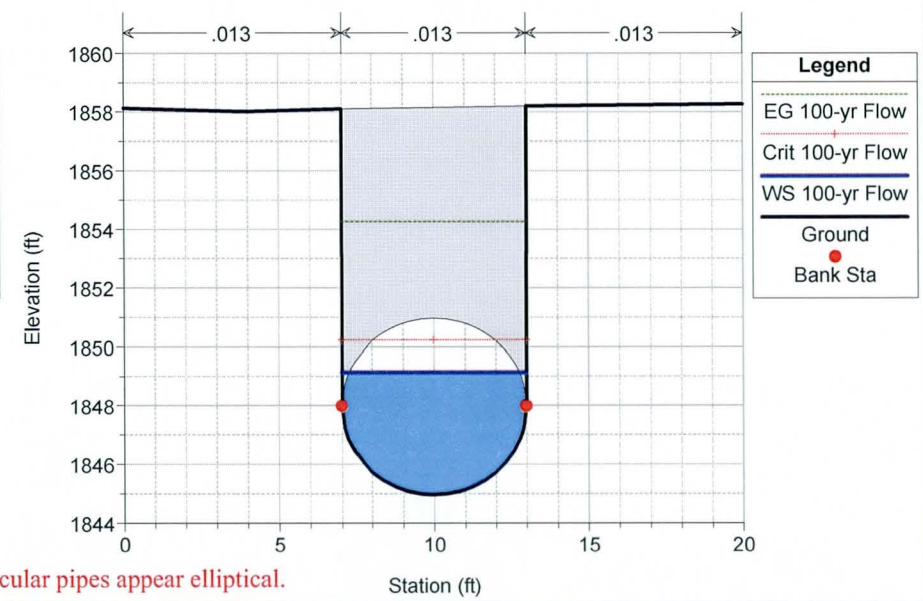
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17830.5



Oak Street and Hawes Road SD Analysis 9/25/2012

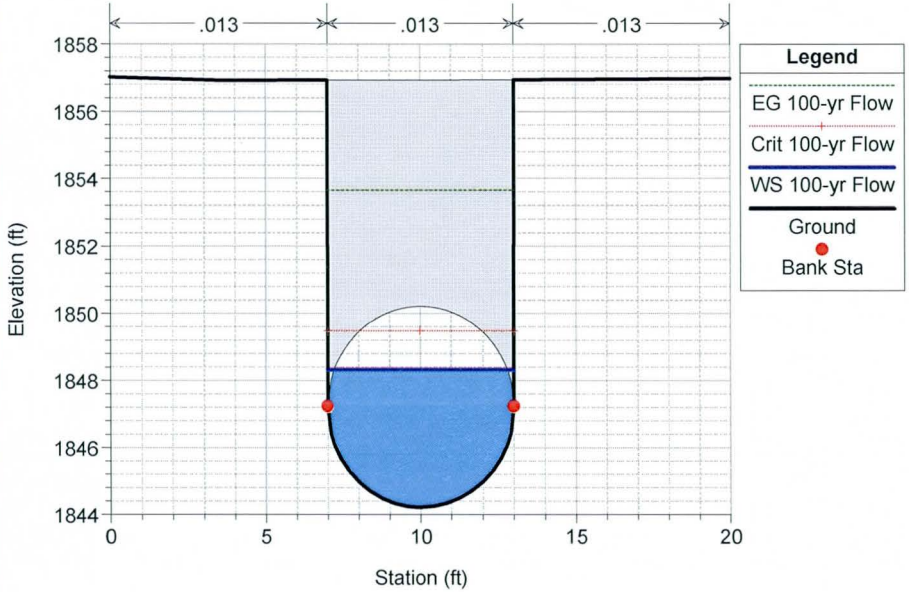
River = Oak Street SD Reach = 173+70 - 182+35 RS = 17780.5



NOTE: Due to printing scale, circular pipes appear elliptical.

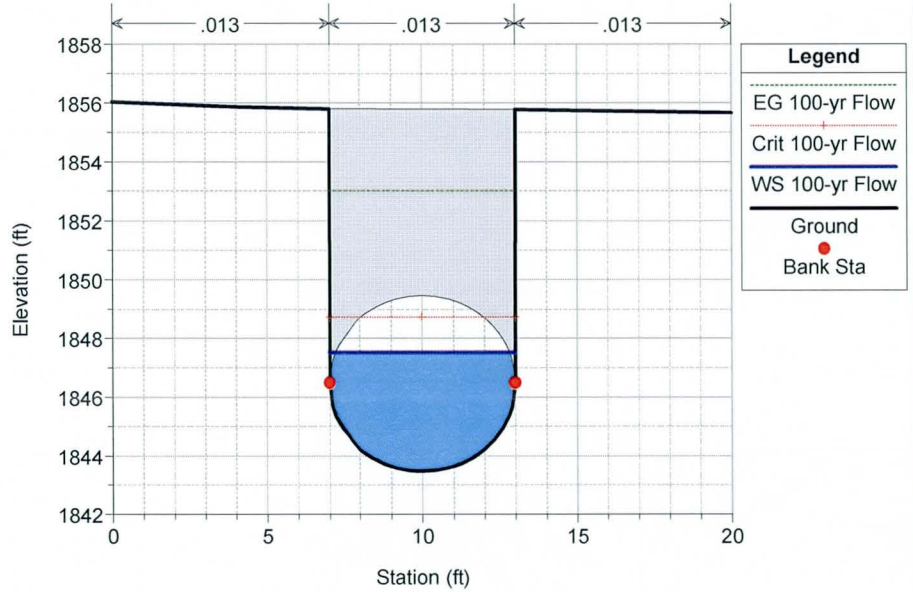
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17730.5



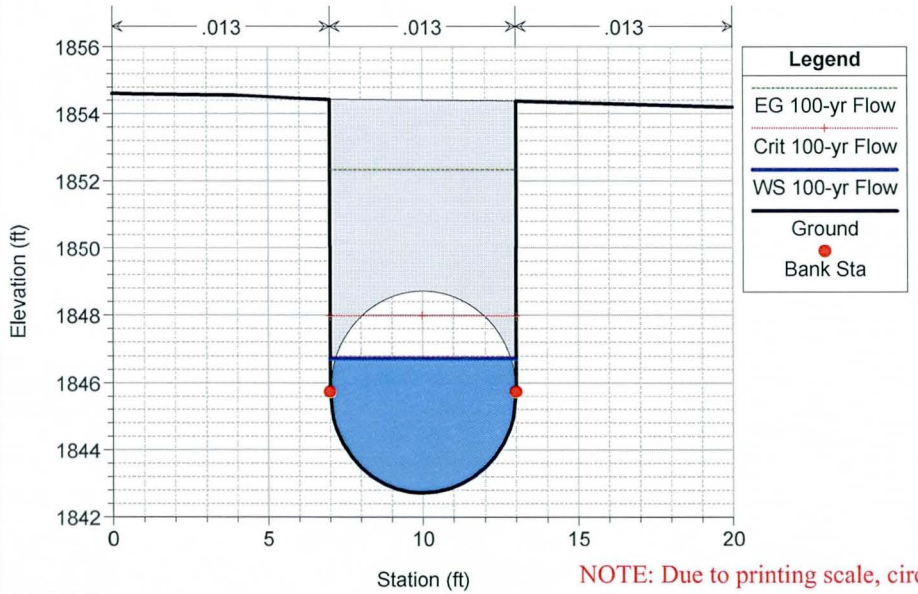
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17680.5



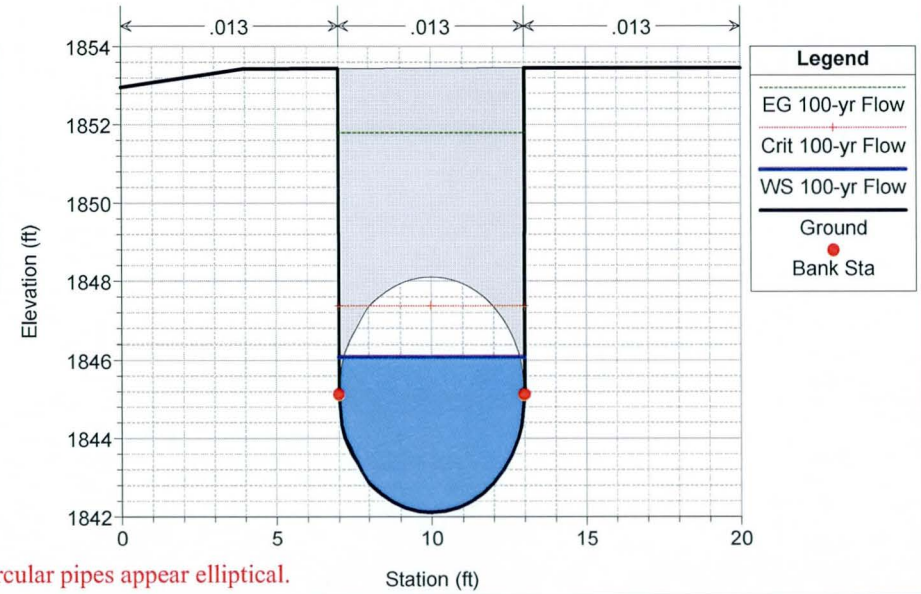
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17630.5



Oak Street and Hawes Road SD Analysis 9/25/2012

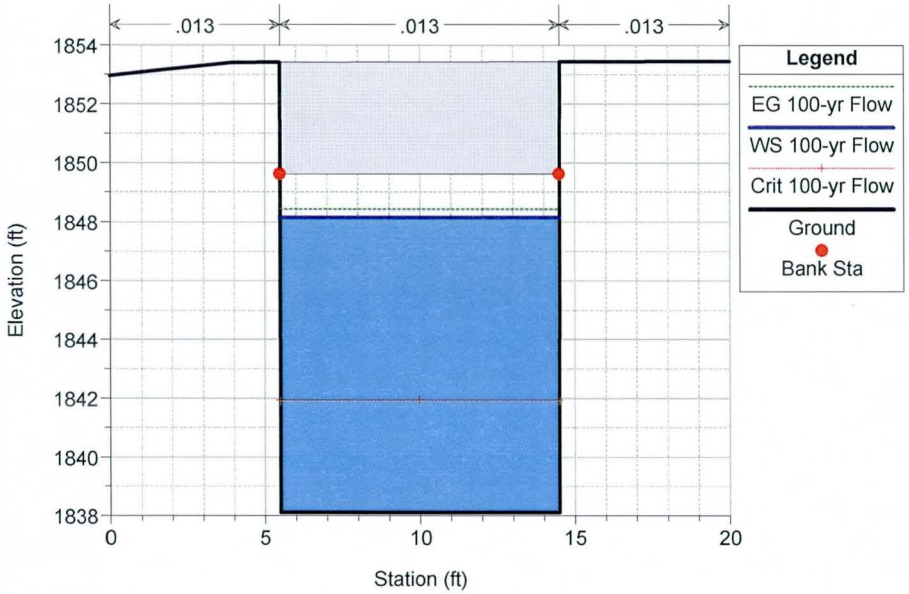
River = Oak Street SD Reach = 173+70 - 182+35 RS = 17590.0



NOTE: Due to printing scale, circular pipes appear elliptical.

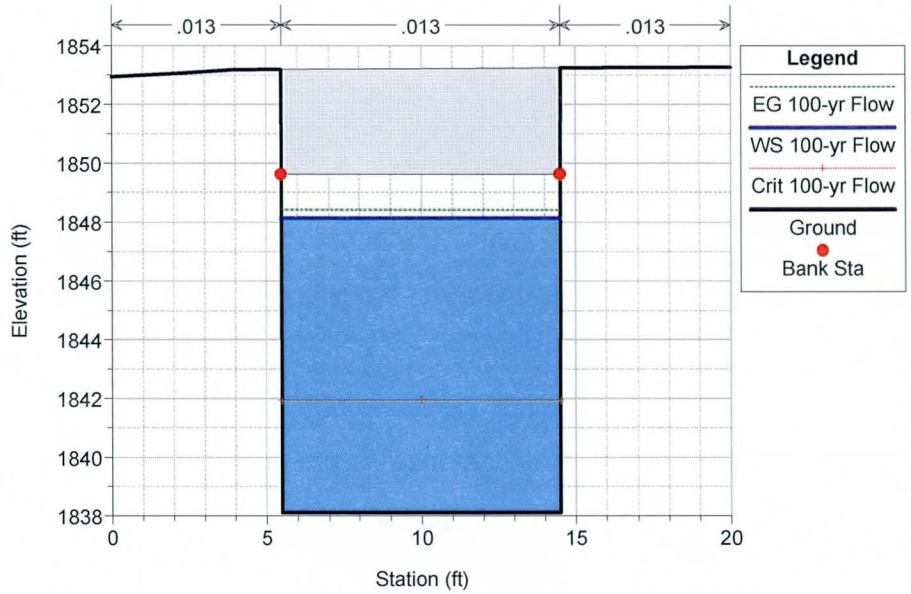
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17589.5



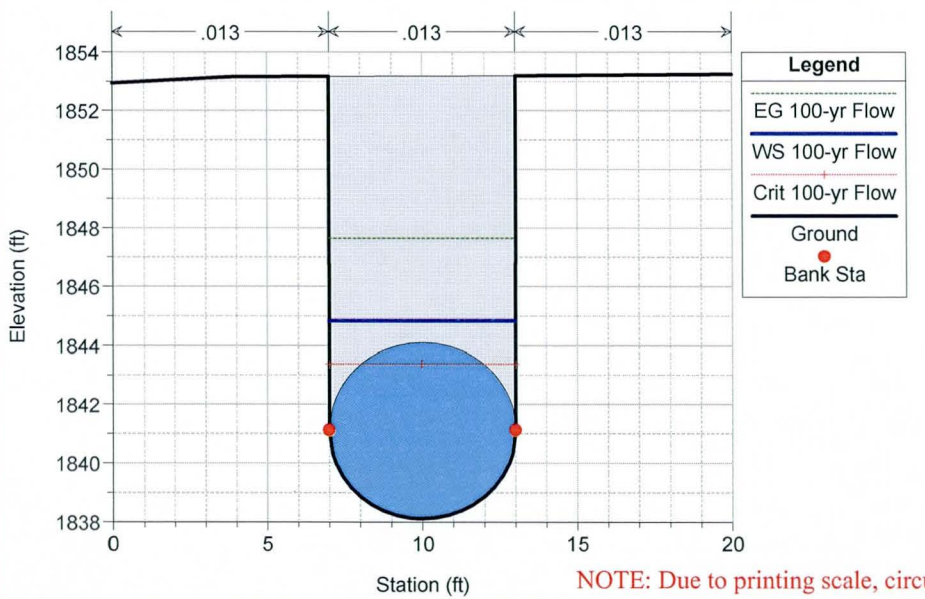
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17581.5



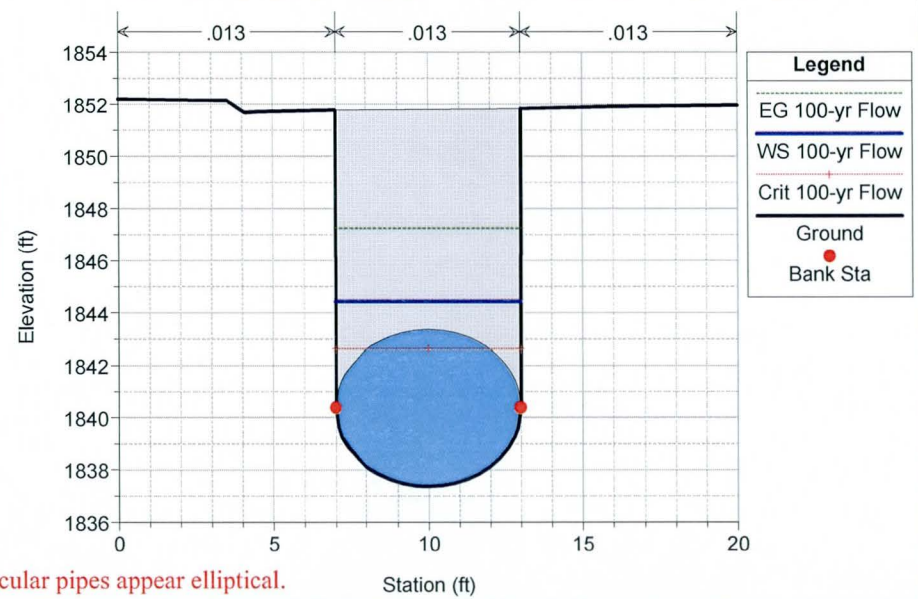
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17581.0



Oak Street and Hawes Road SD Analysis 9/25/2012

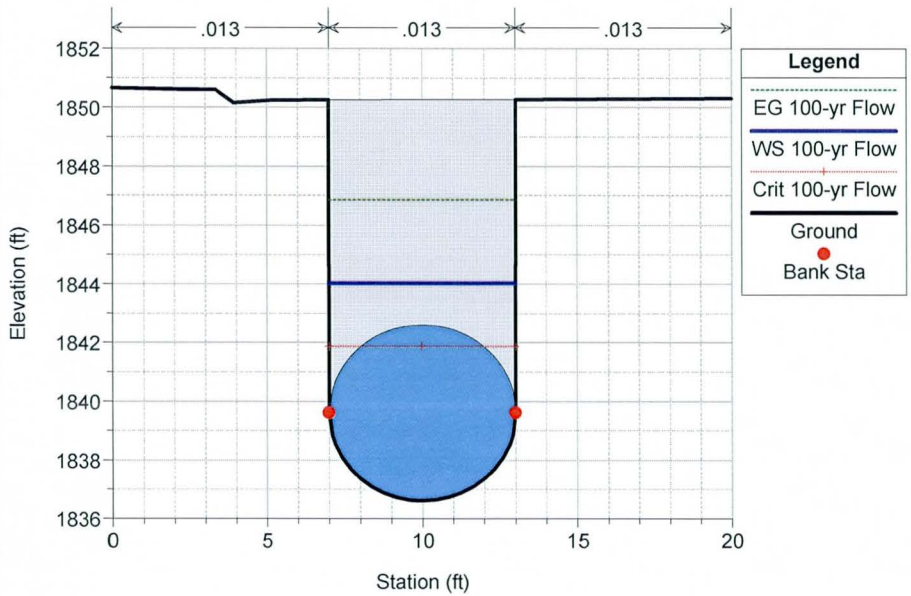
River = Oak Street SD Reach = 173+70 - 182+35 RS = 17531.5



NOTE: Due to printing scale, circular pipes appear elliptical.

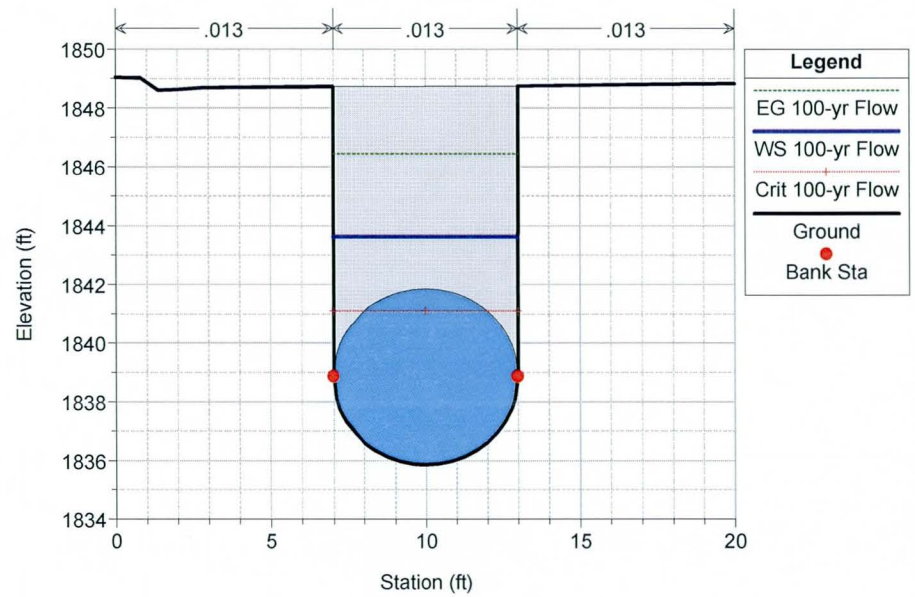
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17481.5



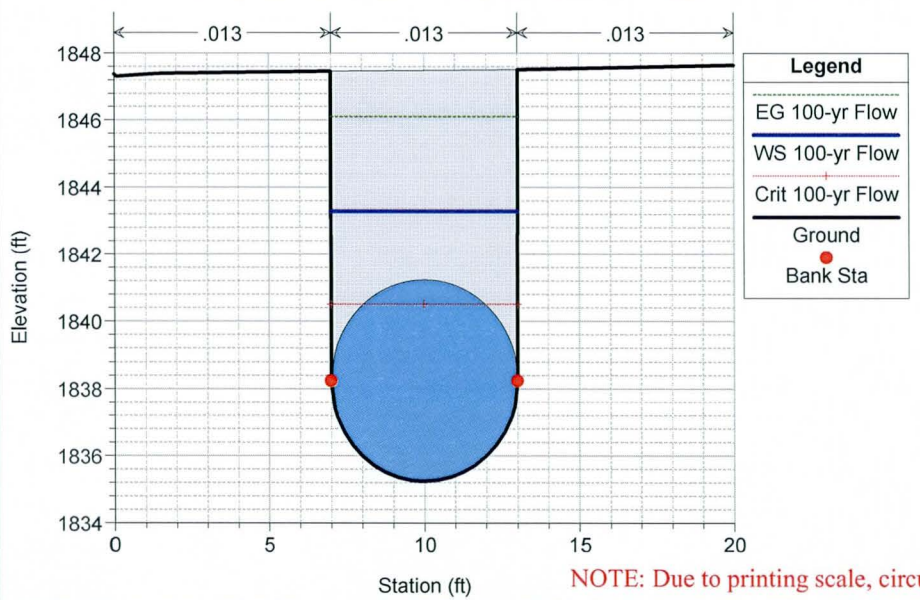
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17431.4



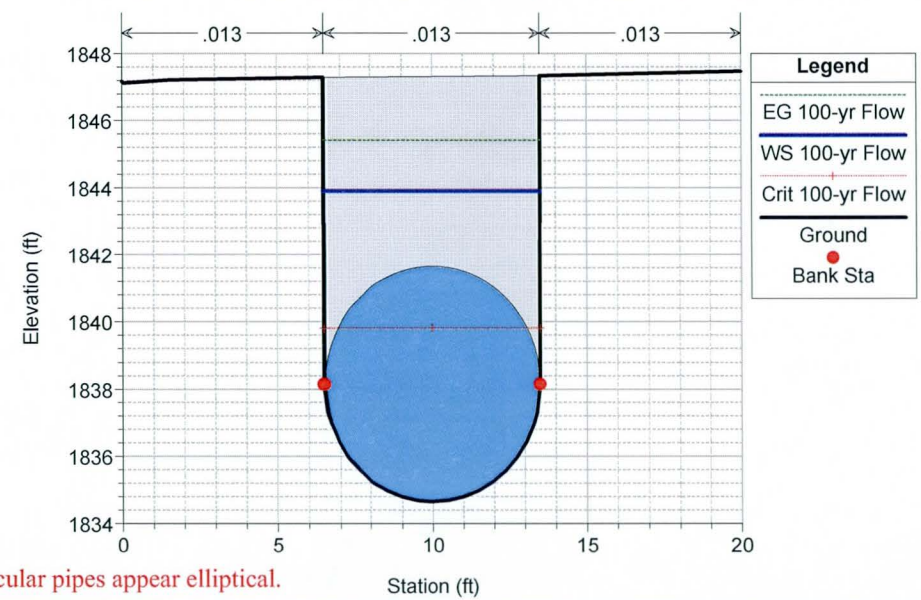
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17390.0



Oak Street and Hawes Road SD Analysis 9/25/2012

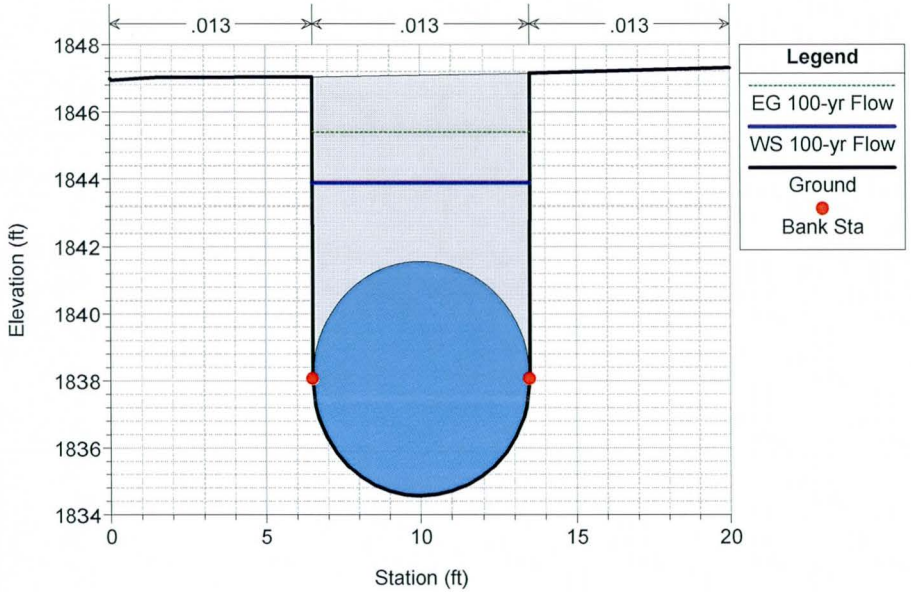
River = Oak Street SD Reach = 173+70 - 182+35 RS = 17384.0



NOTE: Due to printing scale, circular pipes appear elliptical.

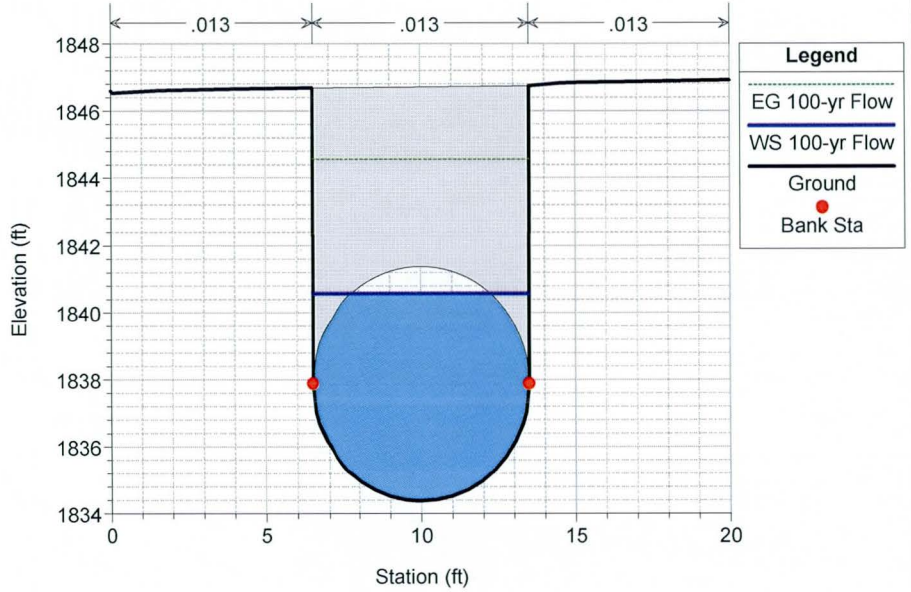
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 - 182+35 RS = 17378.0



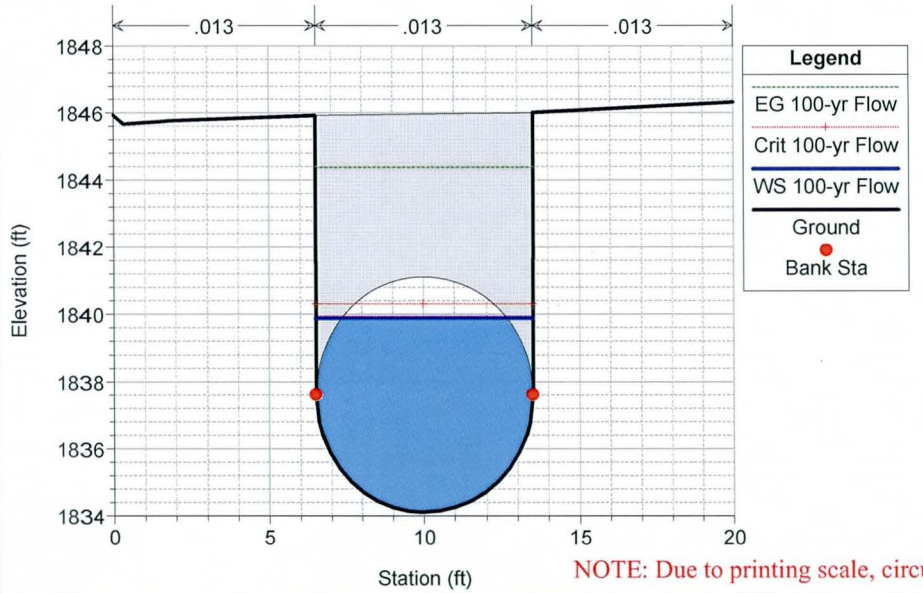
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 17366.0



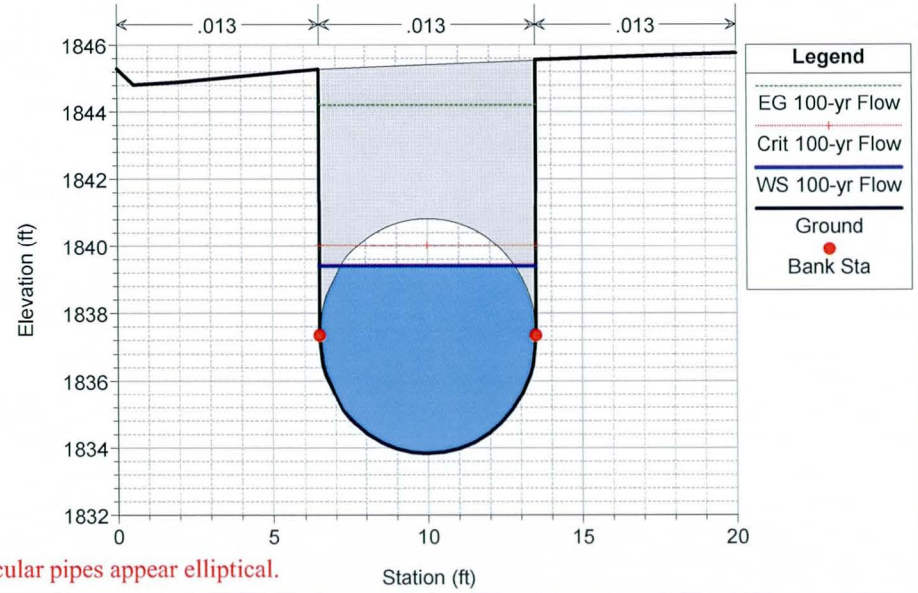
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 17347.5

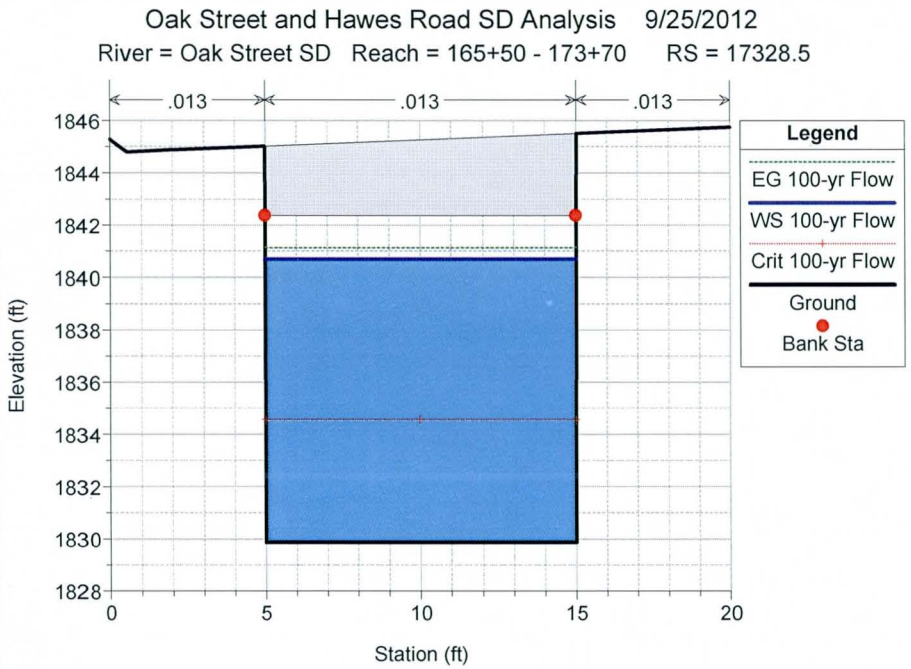


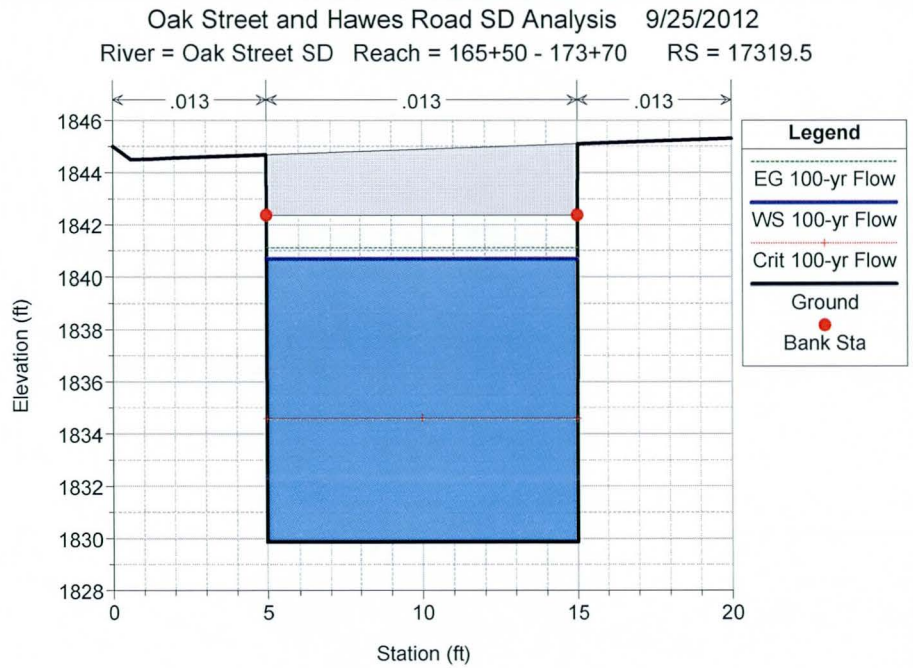
Oak Street and Hawes Road SD Analysis 9/25/2012

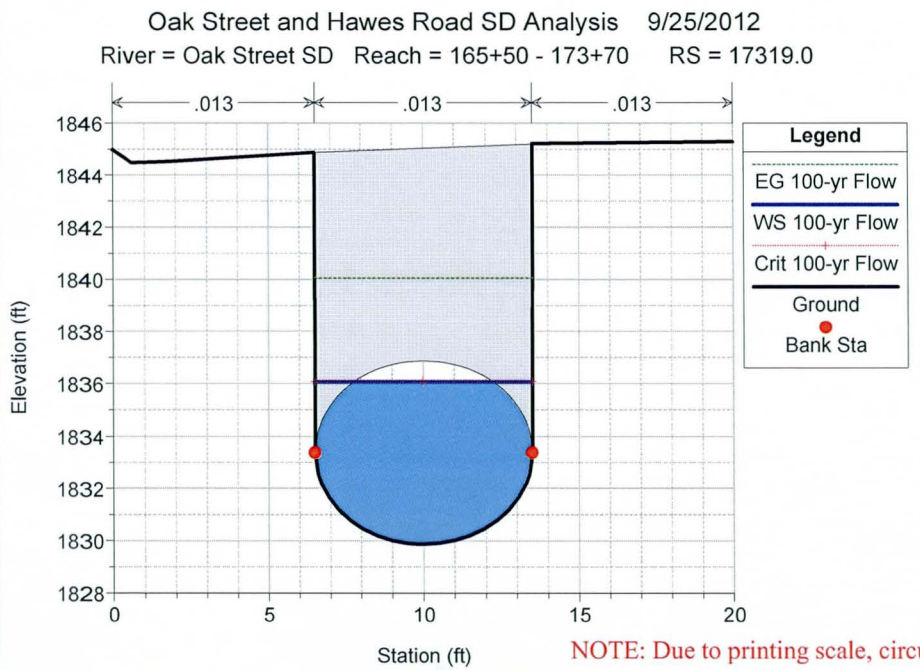
River = Oak Street SD Reach = 165+50 - 173+70 RS = 17329.0

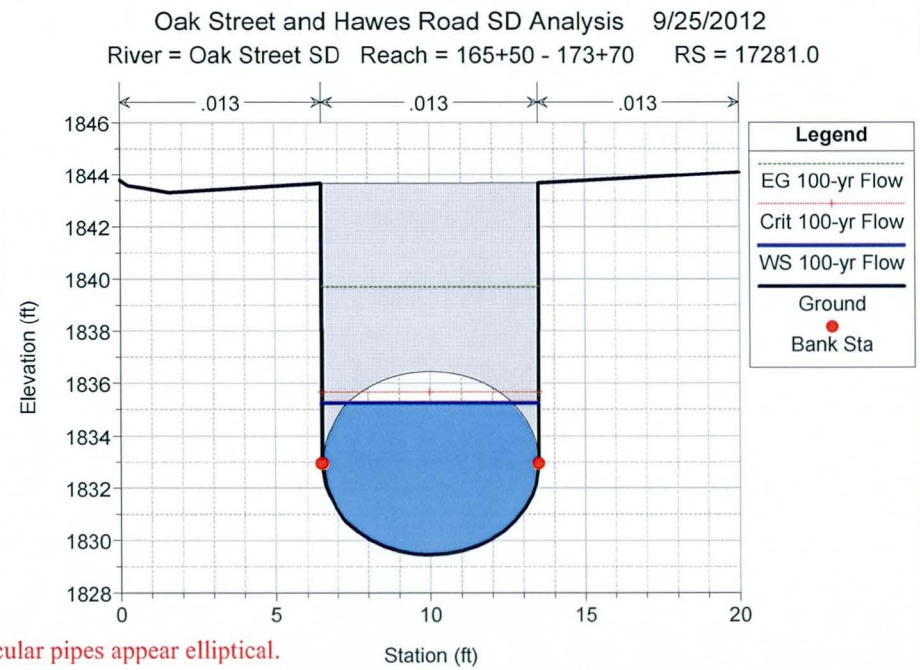


NOTE: Due to printing scale, circular pipes appear elliptical.

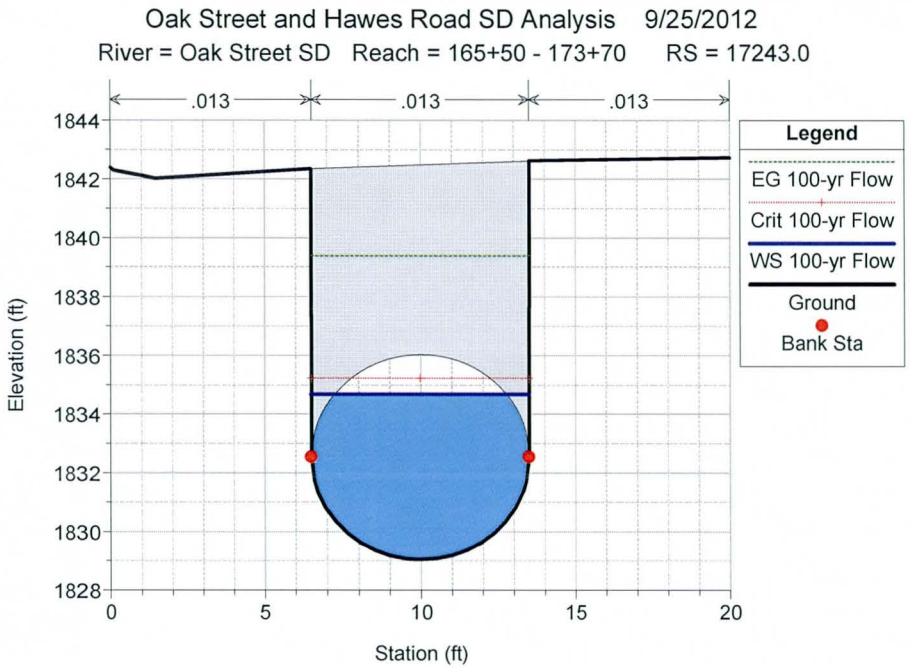


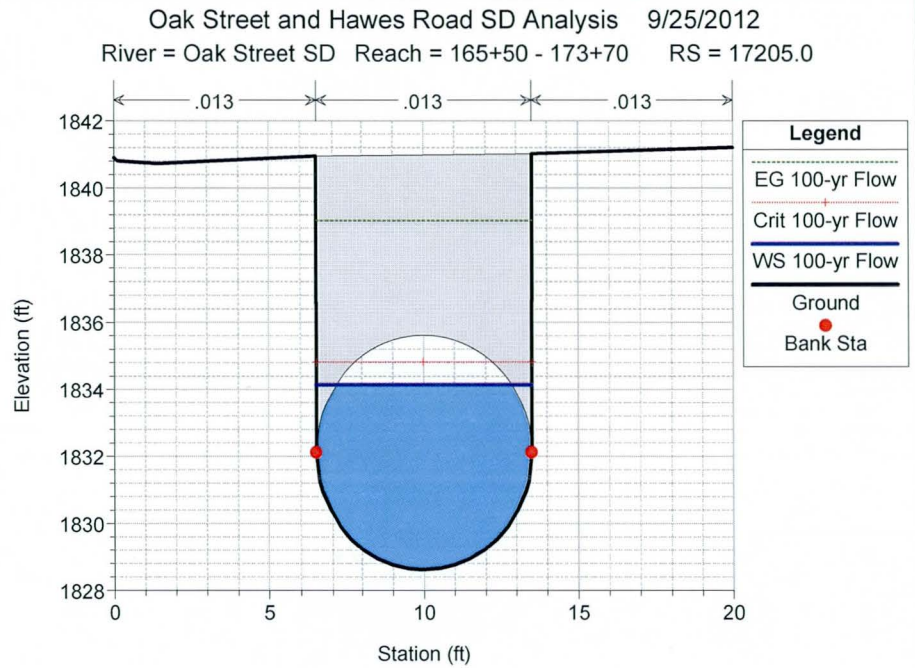


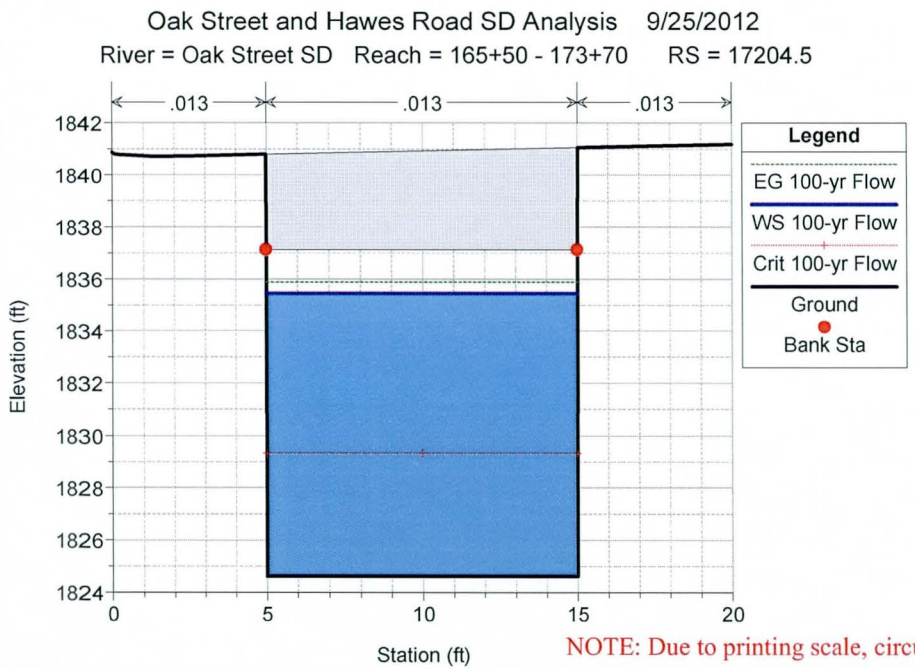


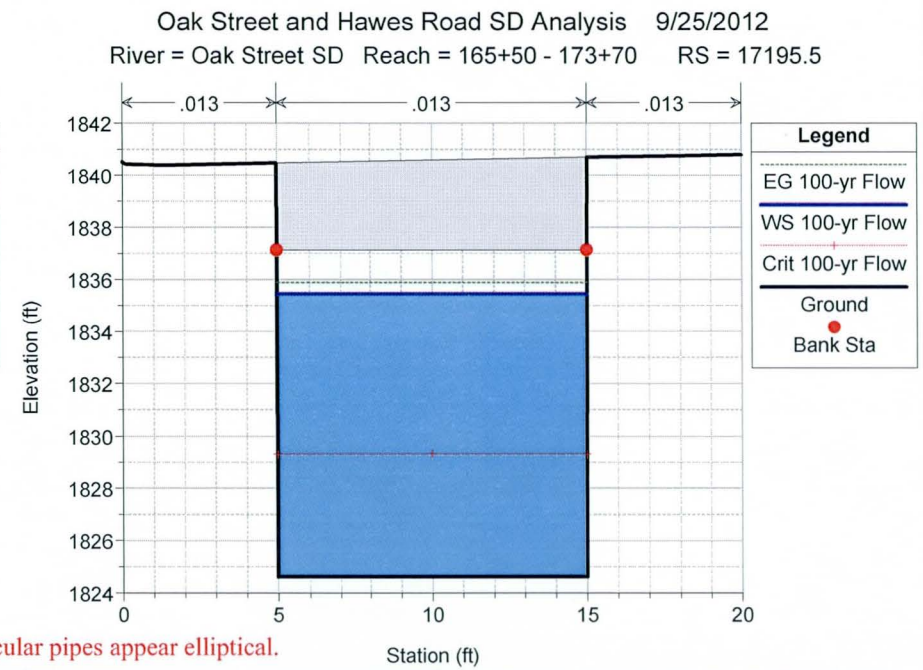


NOTE: Due to printing scale, circular pipes appear elliptical.





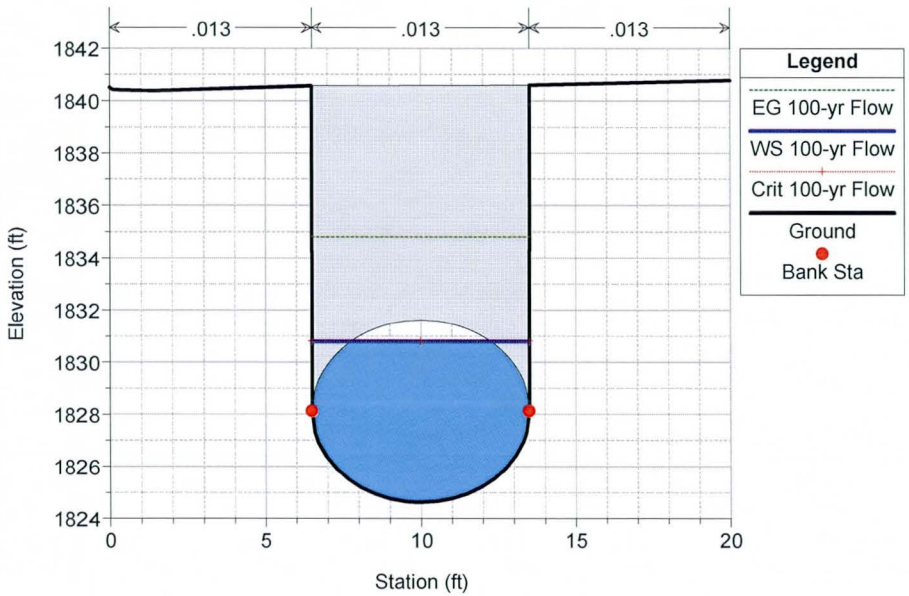




NOTE: Due to printing scale, circular pipes appear elliptical.

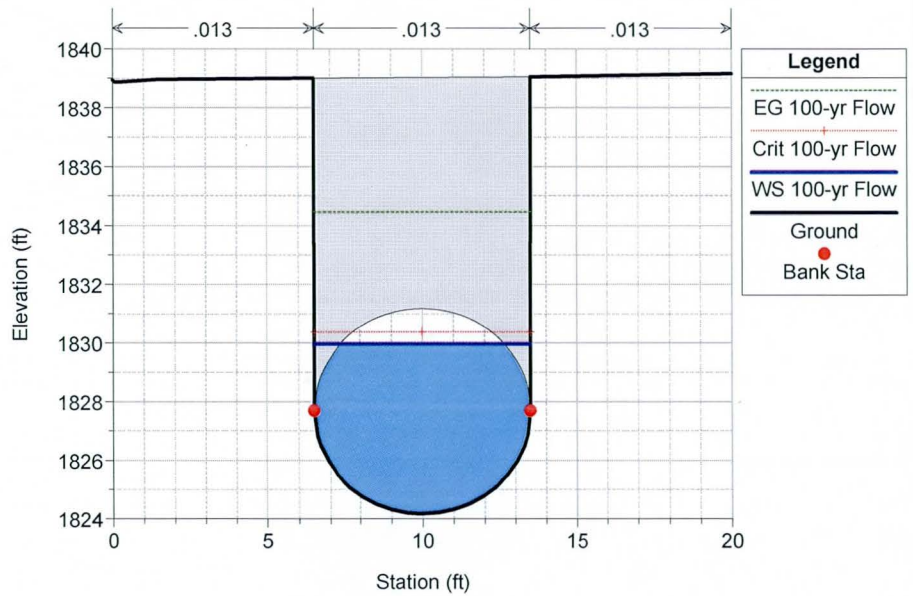
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 17195.0



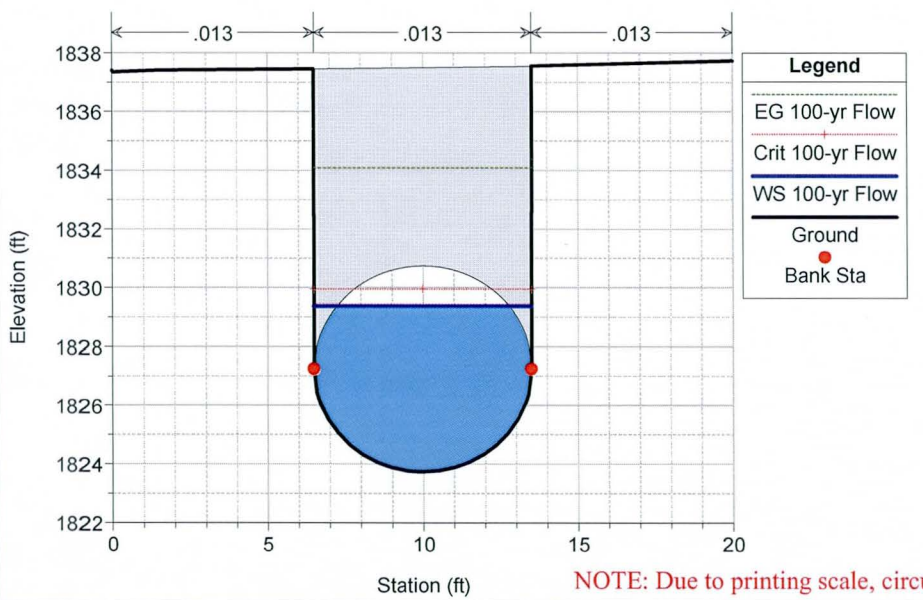
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 17155.0



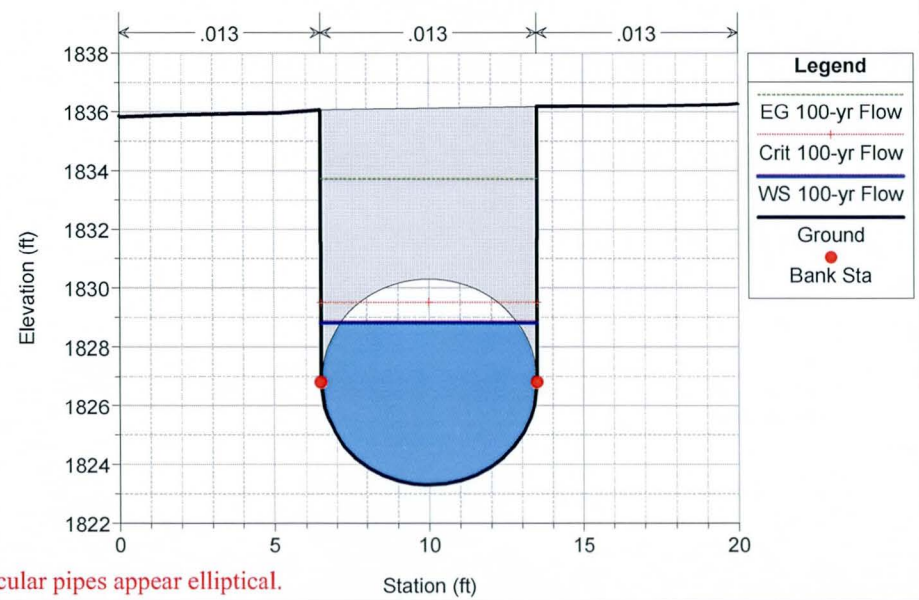
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 17115.0



Oak Street and Hawes Road SD Analysis 9/25/2012

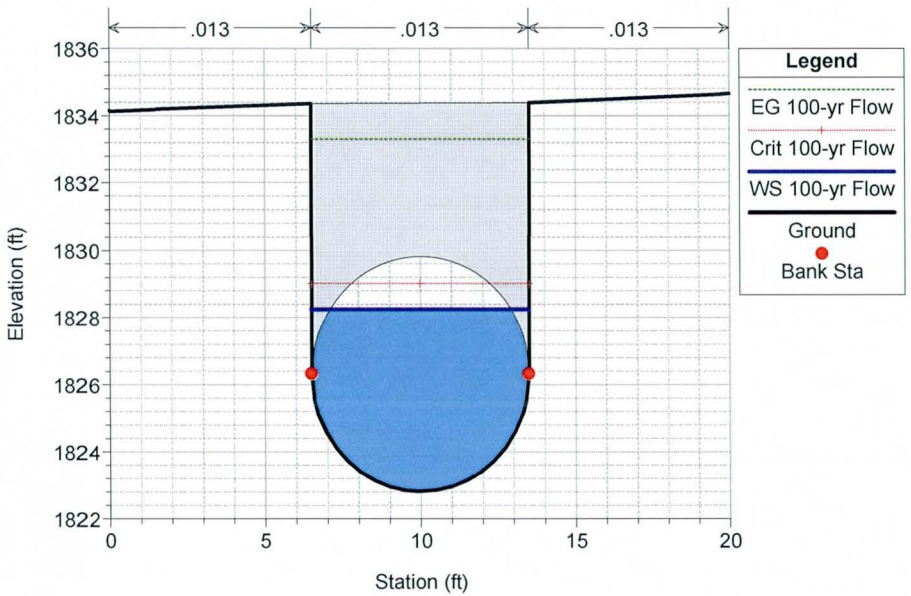
River = Oak Street SD Reach = 165+50 - 173+70 RS = 17075.0



NOTE: Due to printing scale, circular pipes appear elliptical.

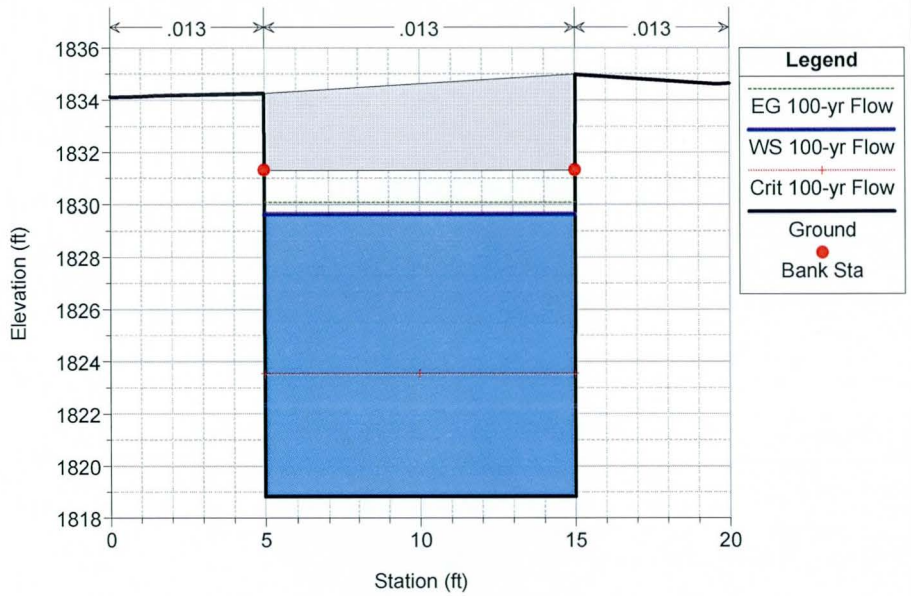
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 17031.0



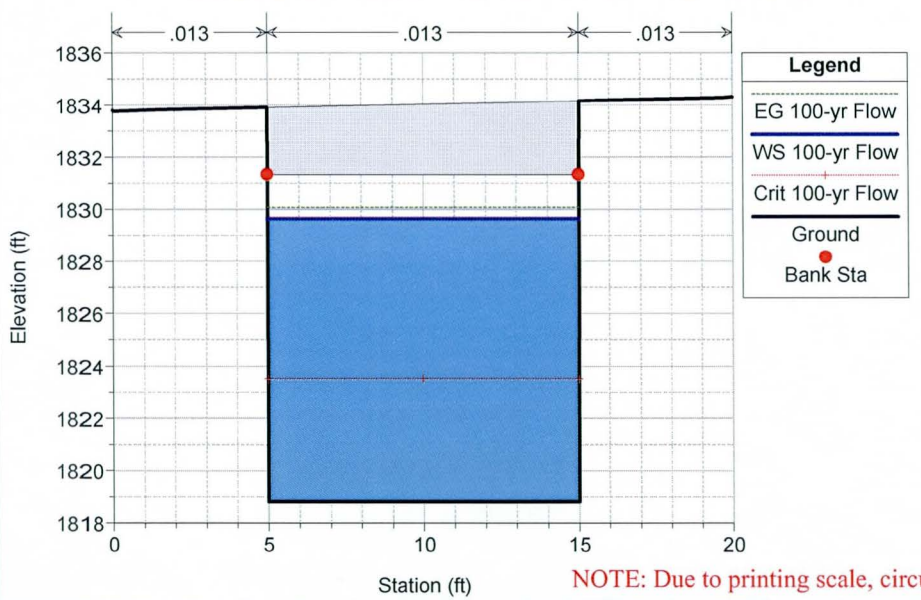
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 17030.5



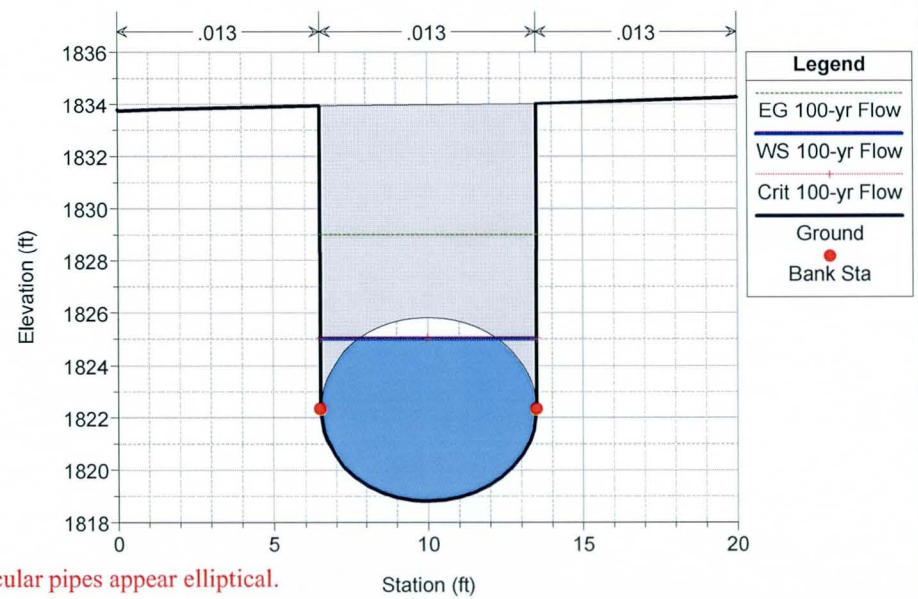
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 17021.5



Oak Street and Hawes Road SD Analysis 9/25/2012

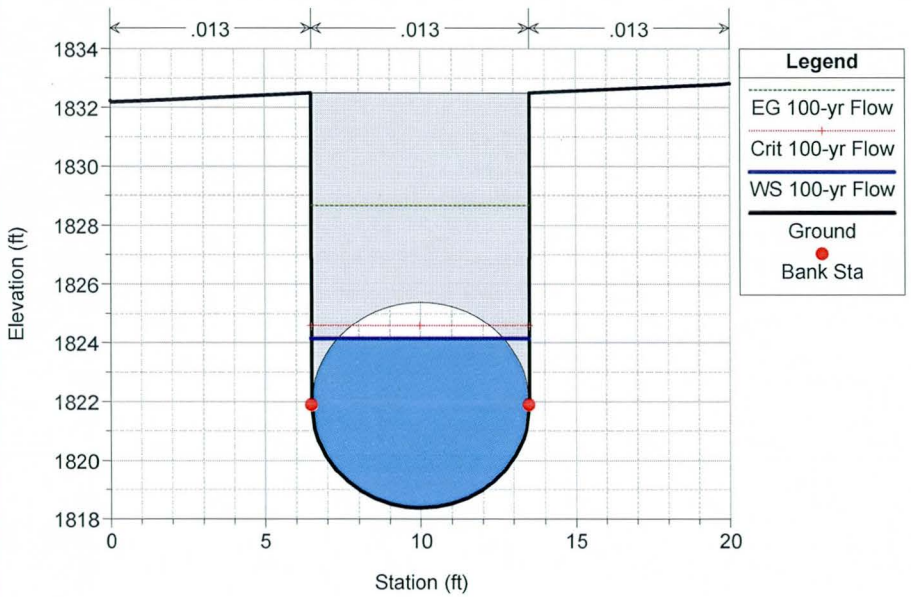
River = Oak Street SD Reach = 165+50 - 173+70 RS = 17021.0



NOTE: Due to printing scale, circular pipes appear elliptical.

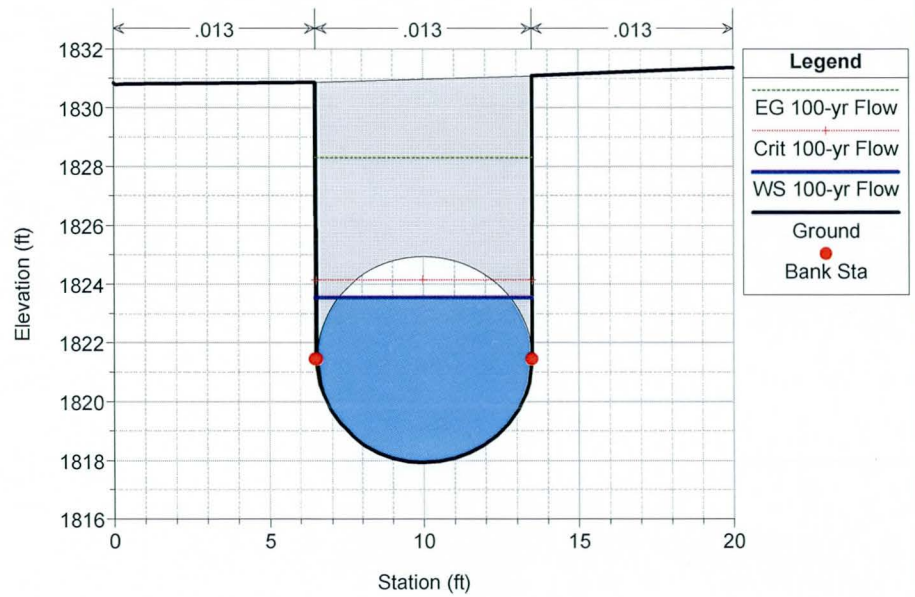
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16981.0



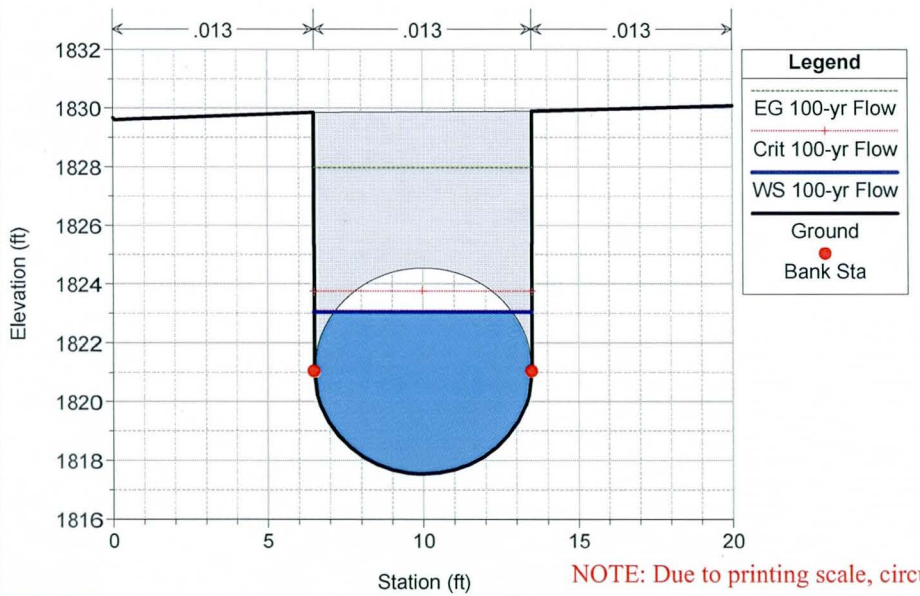
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16941.0



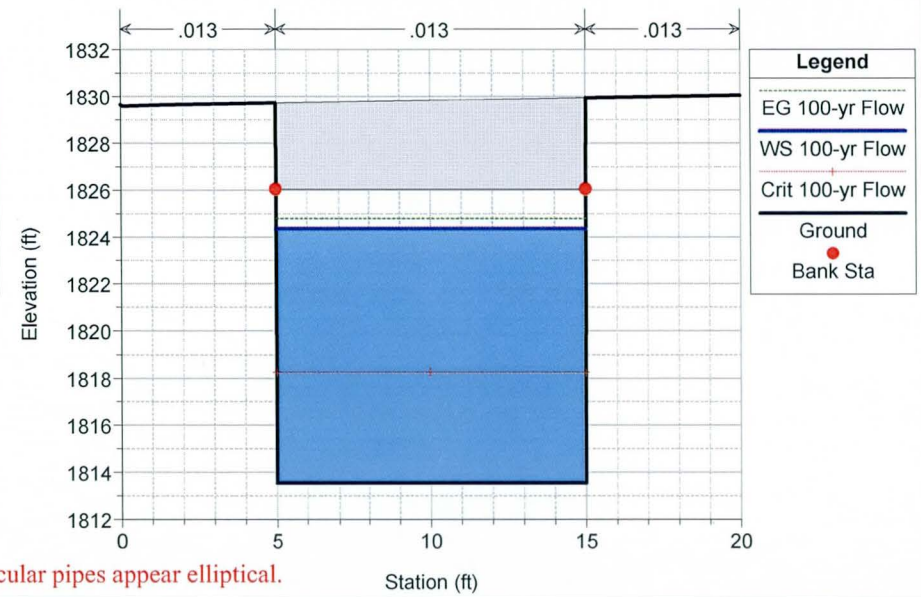
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16905.0



Oak Street and Hawes Road SD Analysis 9/25/2012

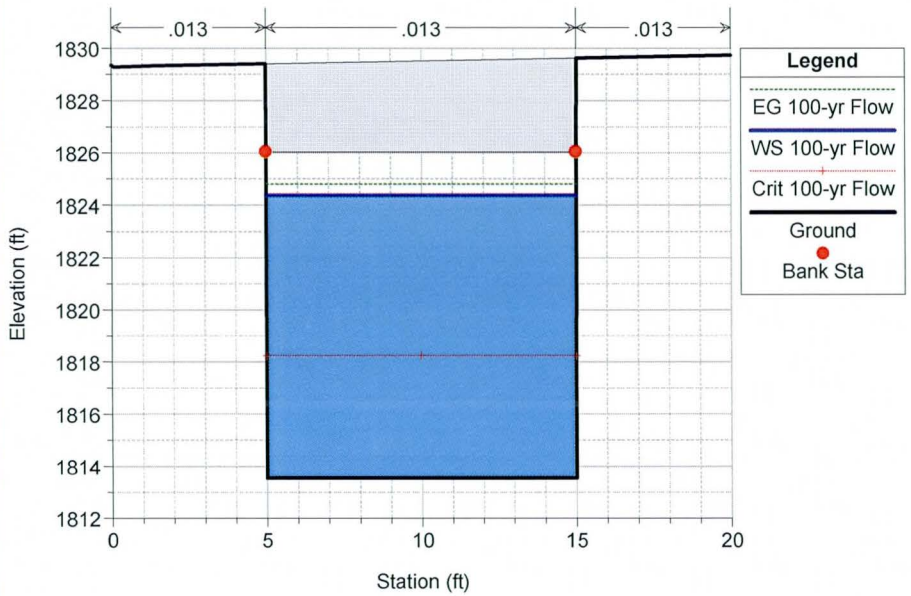
River = Oak Street SD Reach = 165+50 - 173+70 RS = 16904.5



NOTE: Due to printing scale, circular pipes appear elliptical.

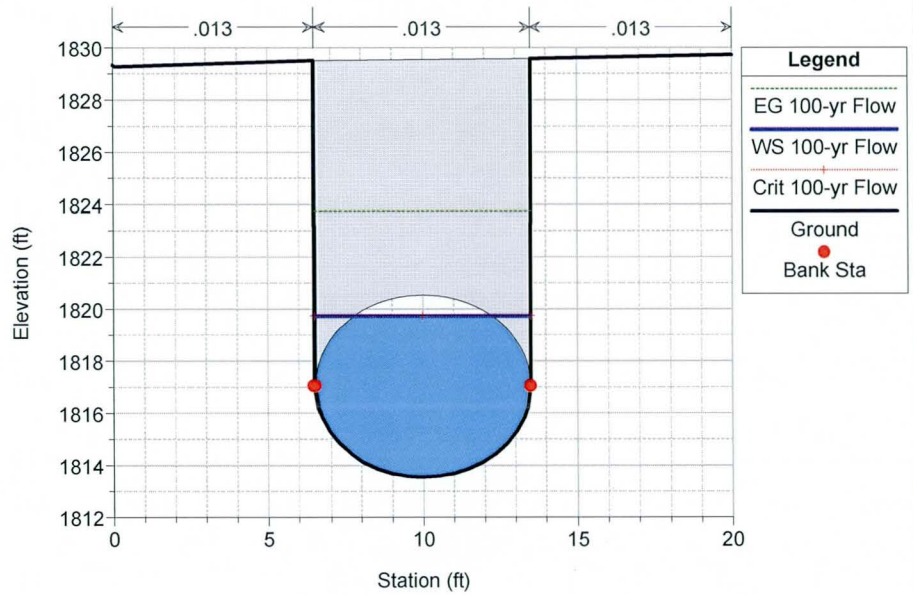
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16895.5



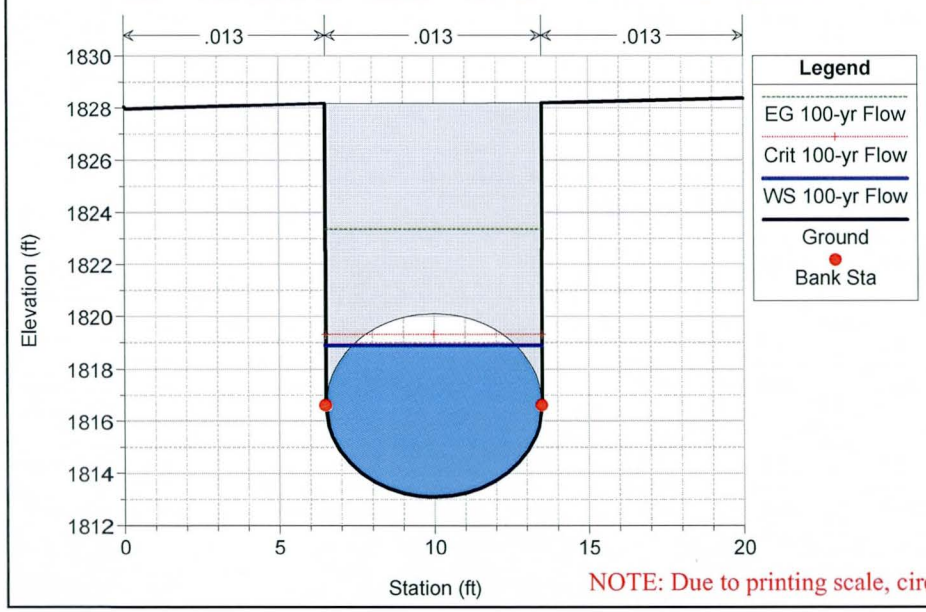
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16895.0



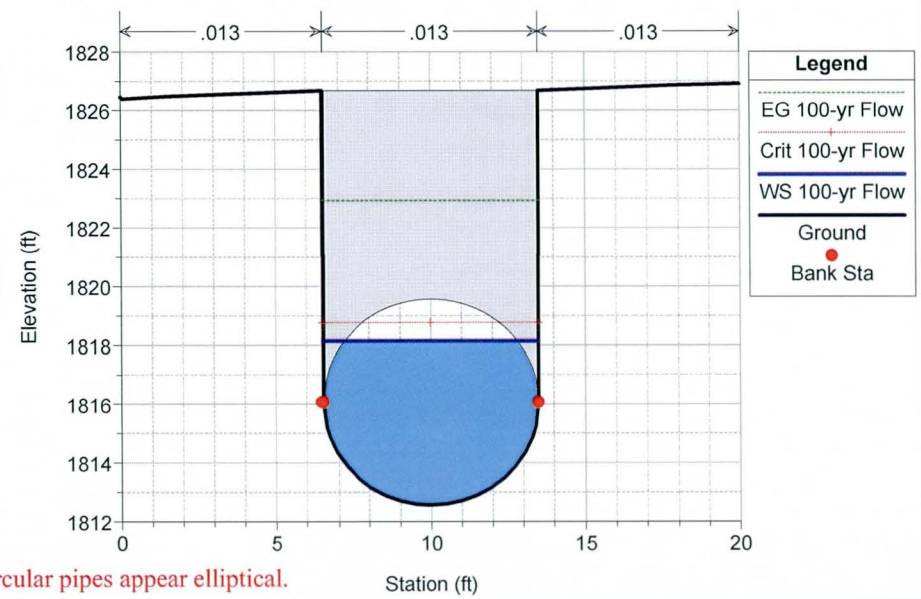
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16855.0



Oak Street and Hawes Road SD Analysis 9/25/2012

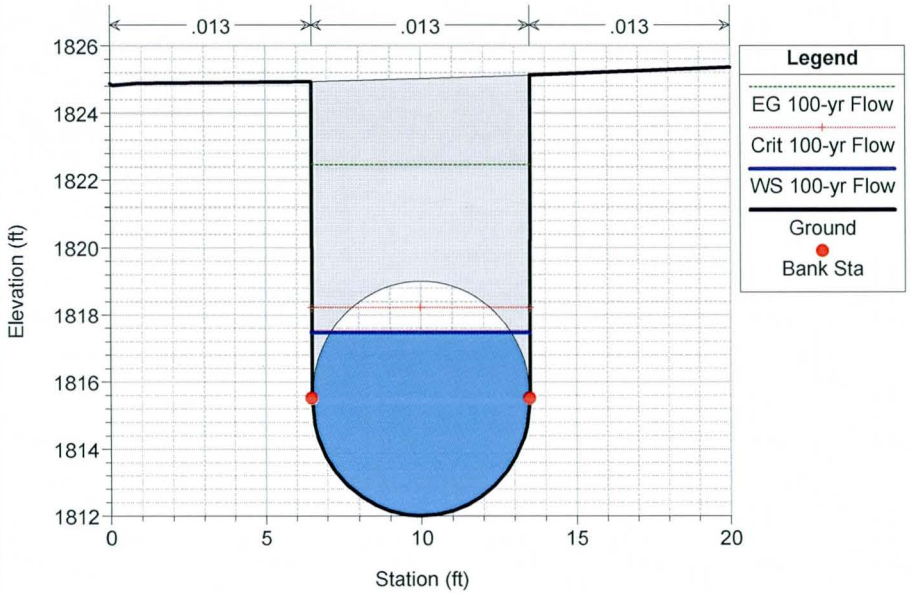
River = Oak Street SD Reach = 165+50 - 173+70 RS = 16806.0



NOTE: Due to printing scale, circular pipes appear elliptical.

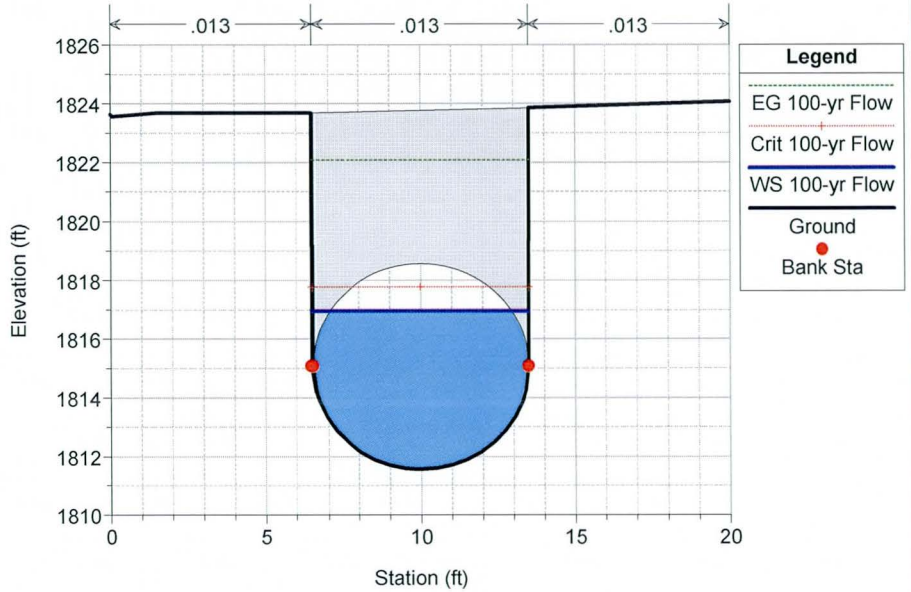
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16756.0



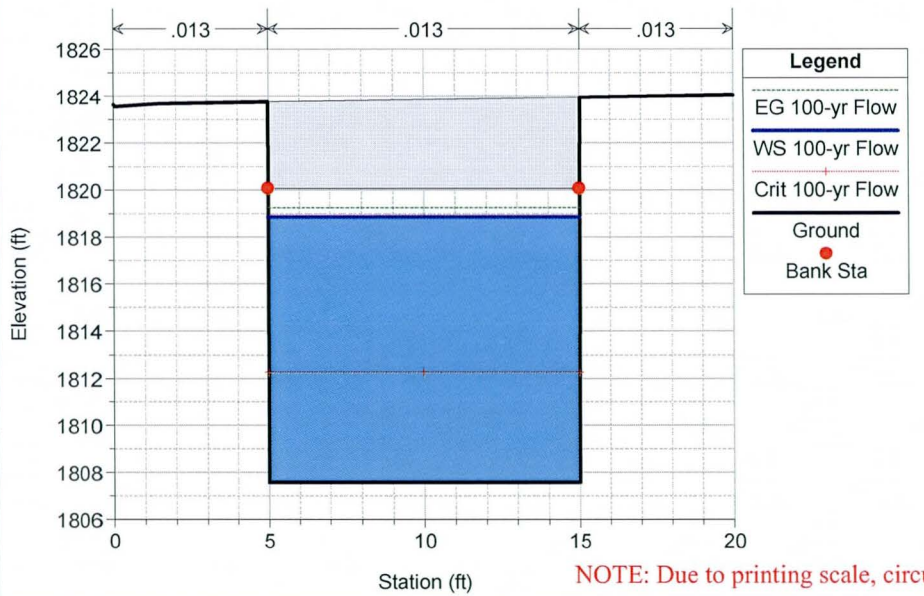
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16716.0



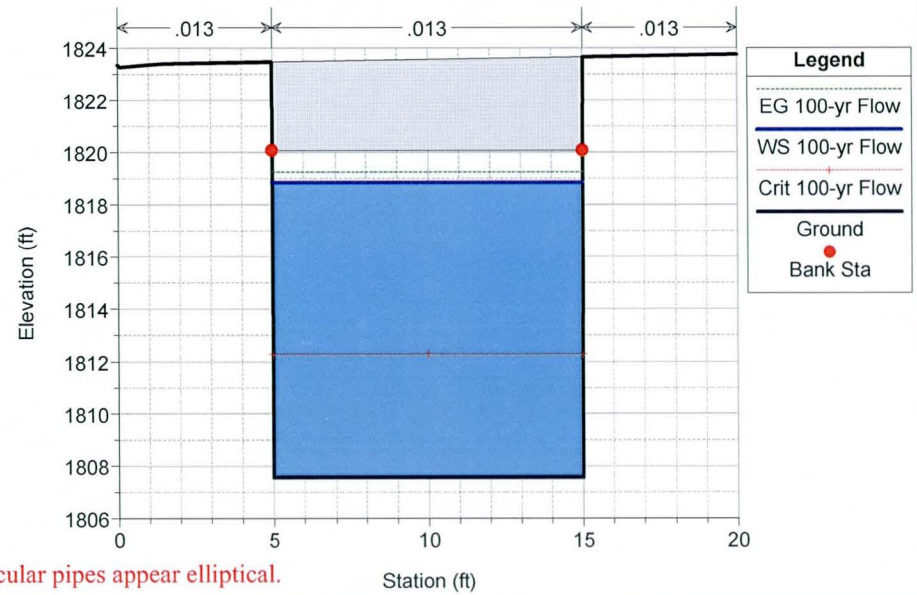
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16715.5



Oak Street and Hawes Road SD Analysis 9/25/2012

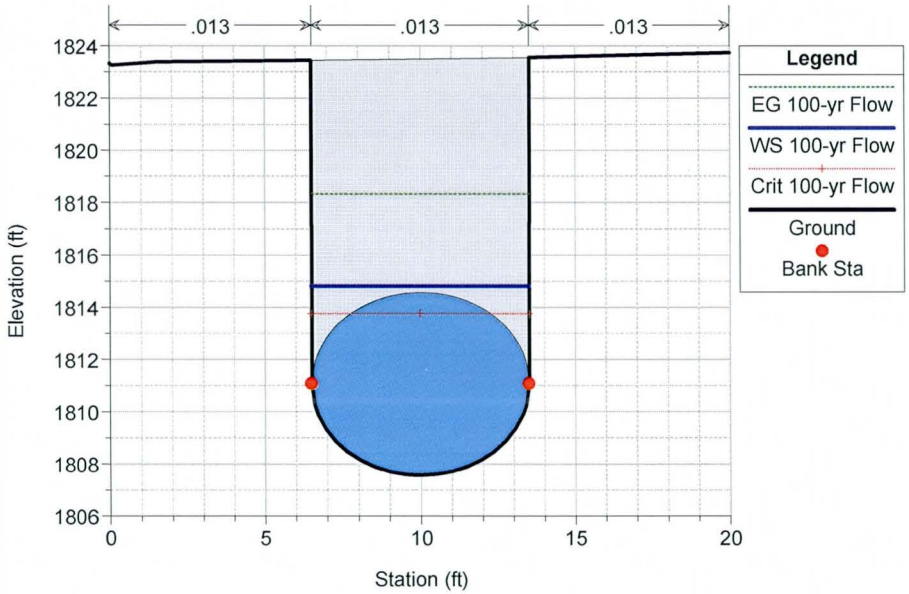
River = Oak Street SD Reach = 165+50 - 173+70 RS = 16706.5



NOTE: Due to printing scale, circular pipes appear elliptical.

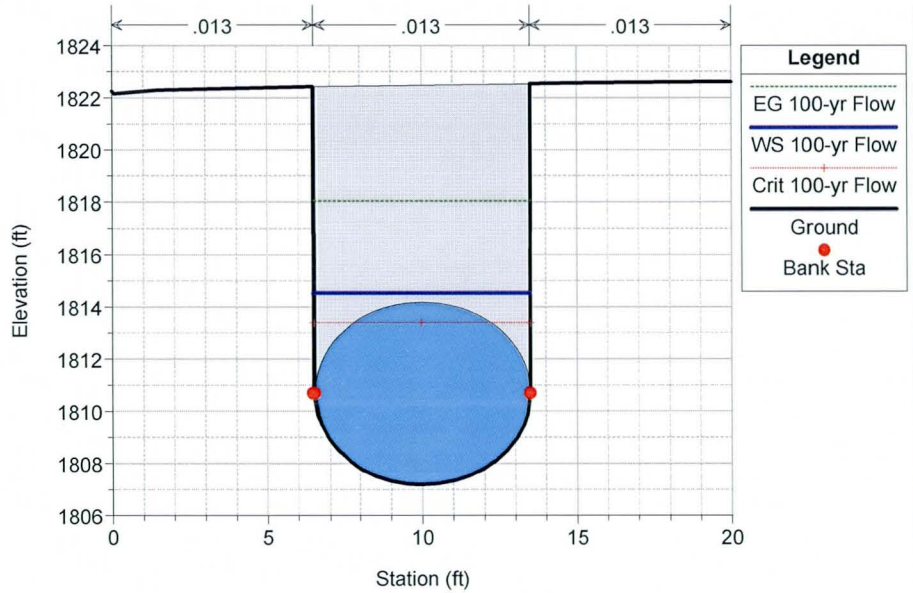
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16706.0



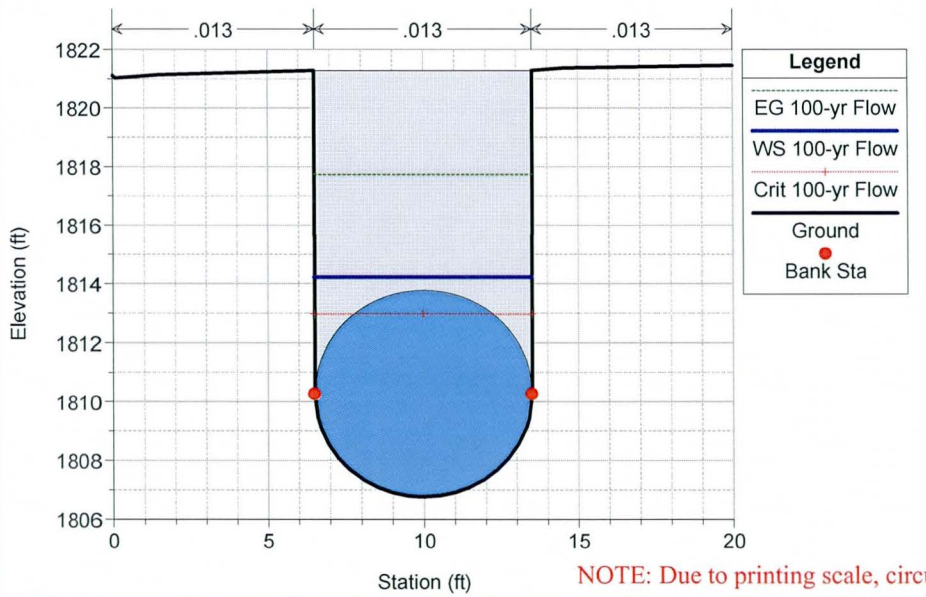
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16671.0



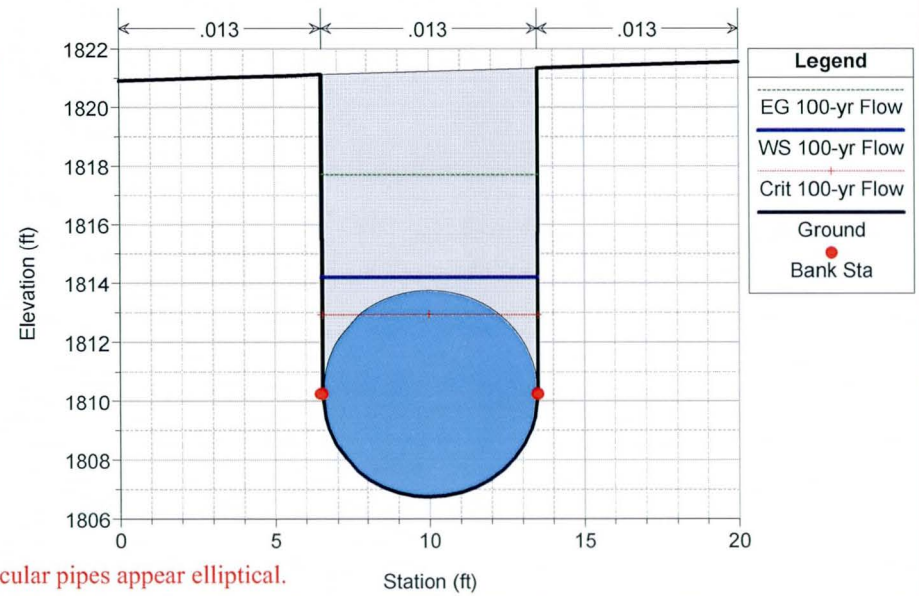
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16633.9



Oak Street and Hawes Road SD Analysis 9/25/2012

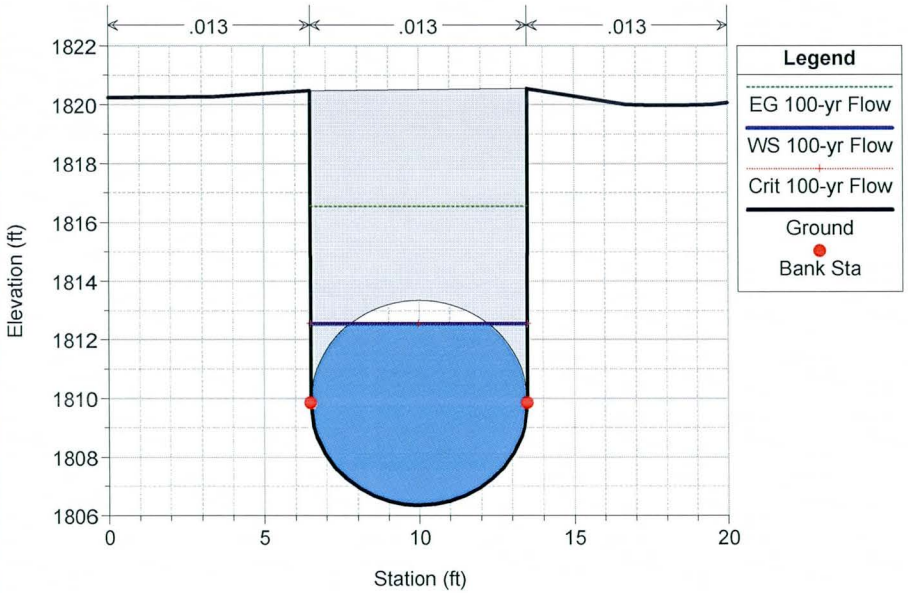
River = Oak Street SD Reach = 165+50 - 173+70 RS = 16631.3



NOTE: Due to printing scale, circular pipes appear elliptical.

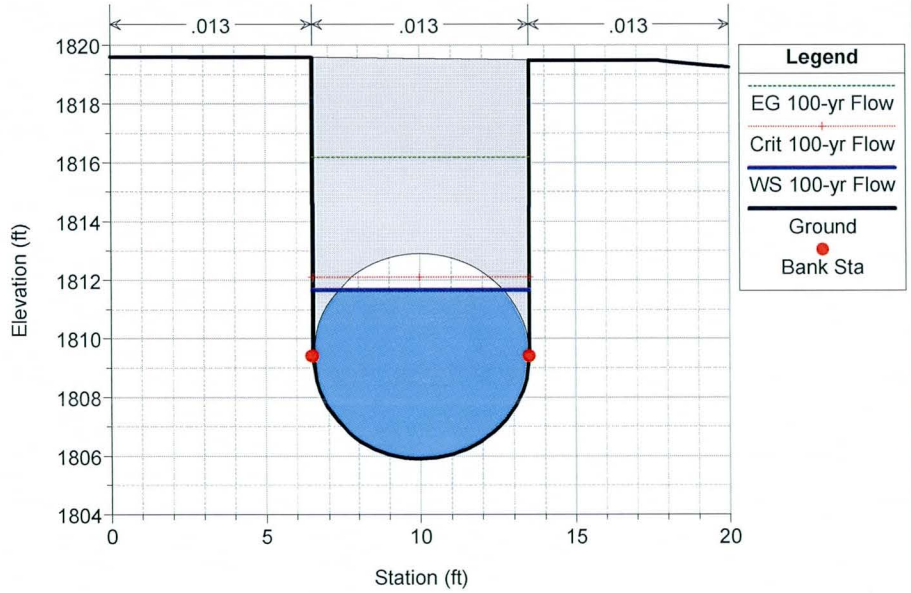
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16595.0



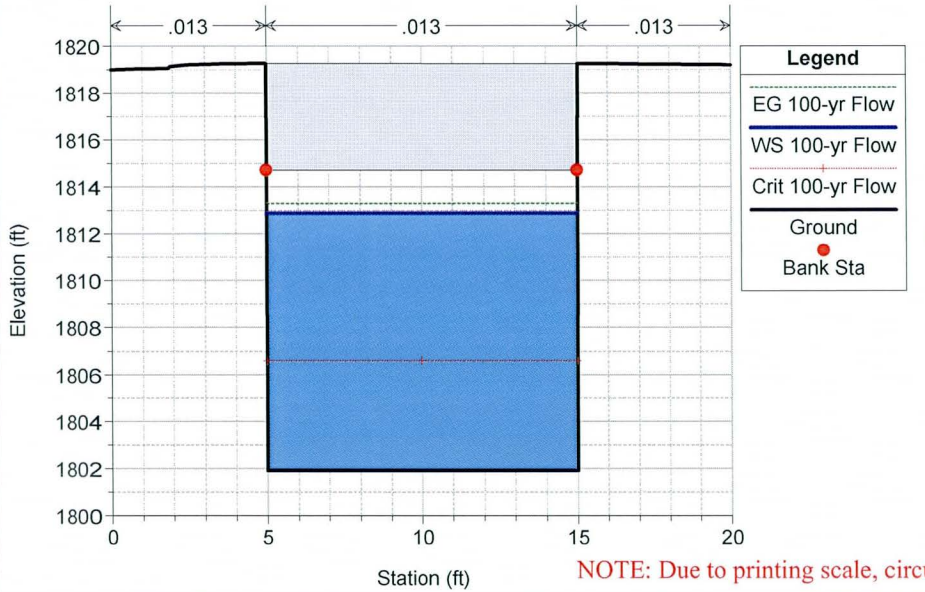
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16555.0



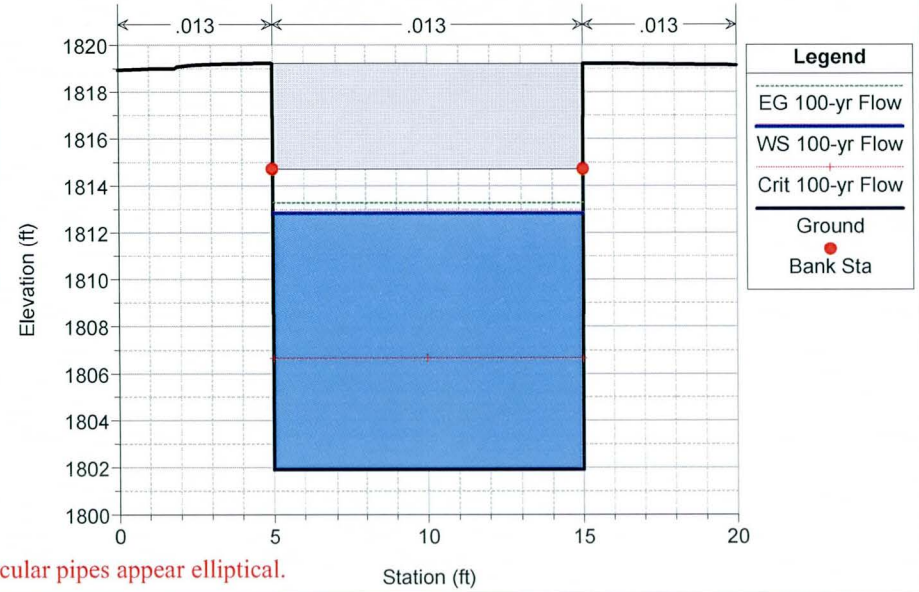
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 - 173+70 RS = 16554.5



Oak Street and Hawes Road SD Analysis 9/25/2012

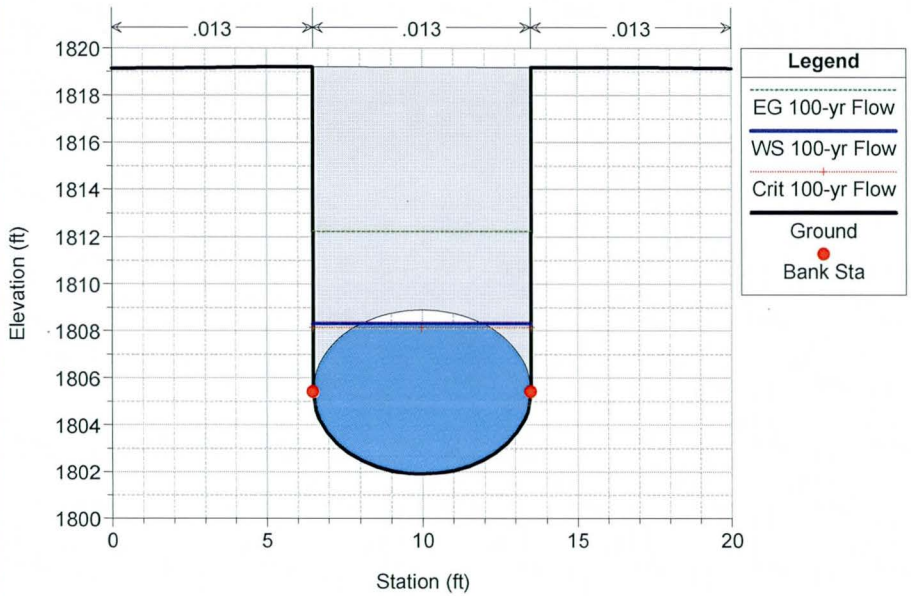
River = Oak Street SD Reach = 163+82 - 165+50 RS = 16545.5



NOTE: Due to printing scale, circular pipes appear elliptical.

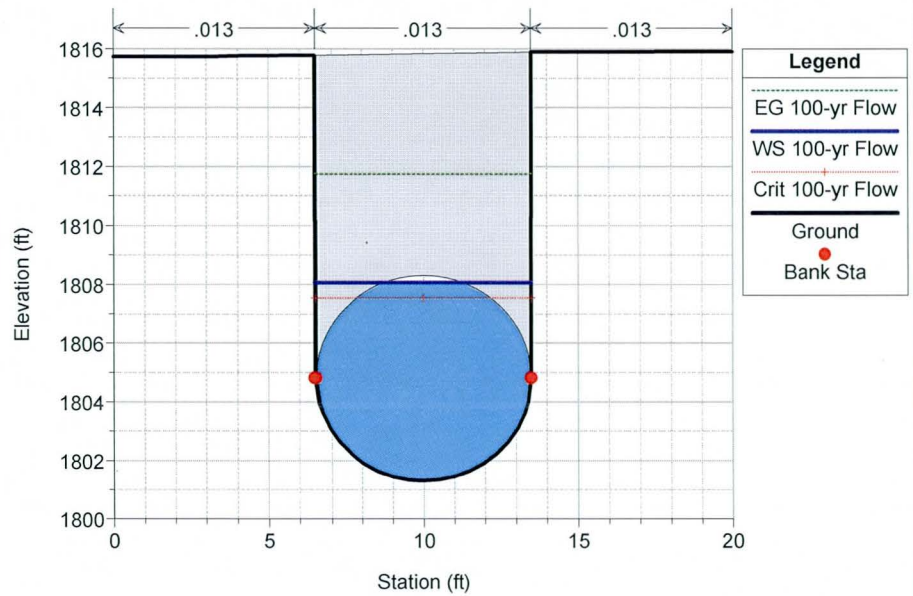
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 163+82 - 165+50 RS = 16545.0



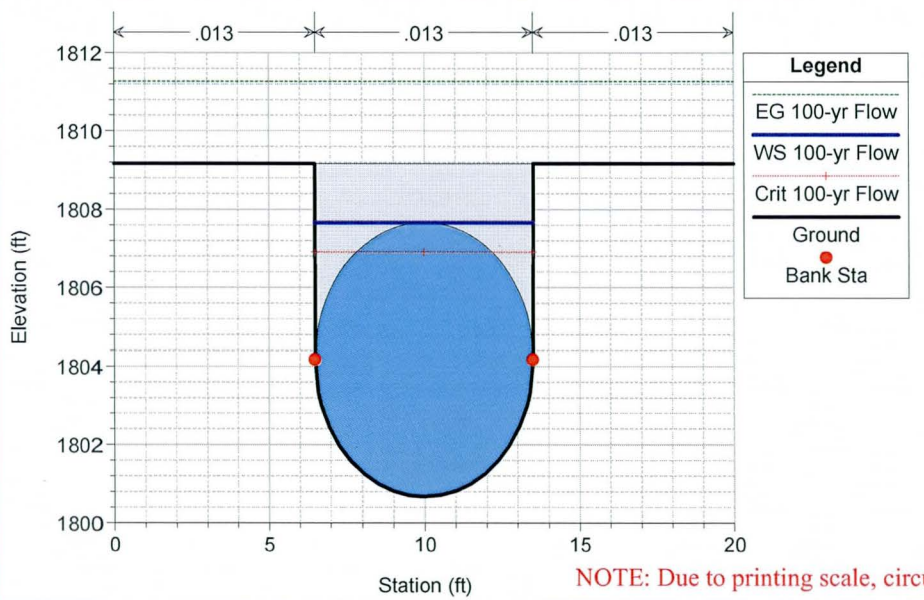
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 163+82 - 165+50 RS = 16490.0



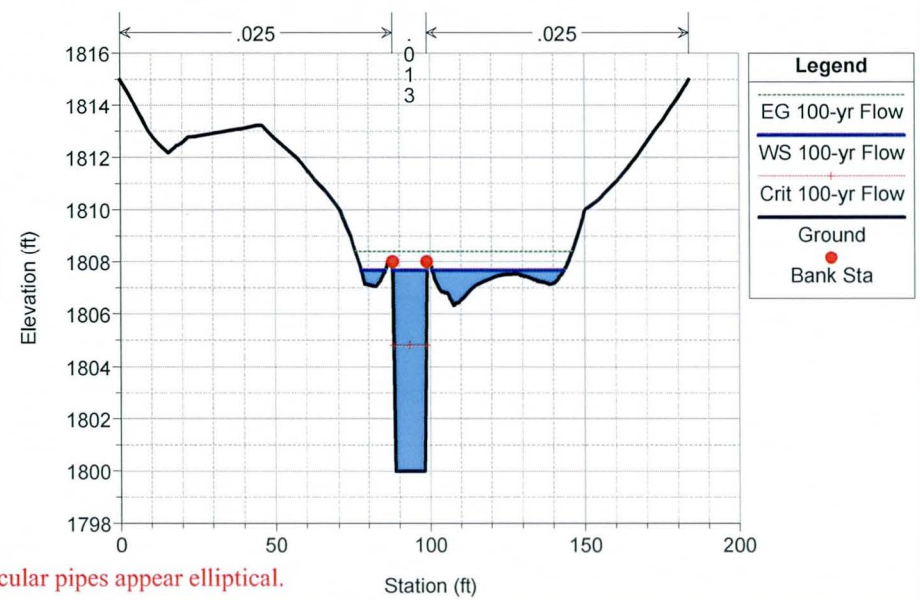
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 163+82 - 165+50 RS = 16432.0



Oak Street and Hawes Road SD Analysis 9/25/2012

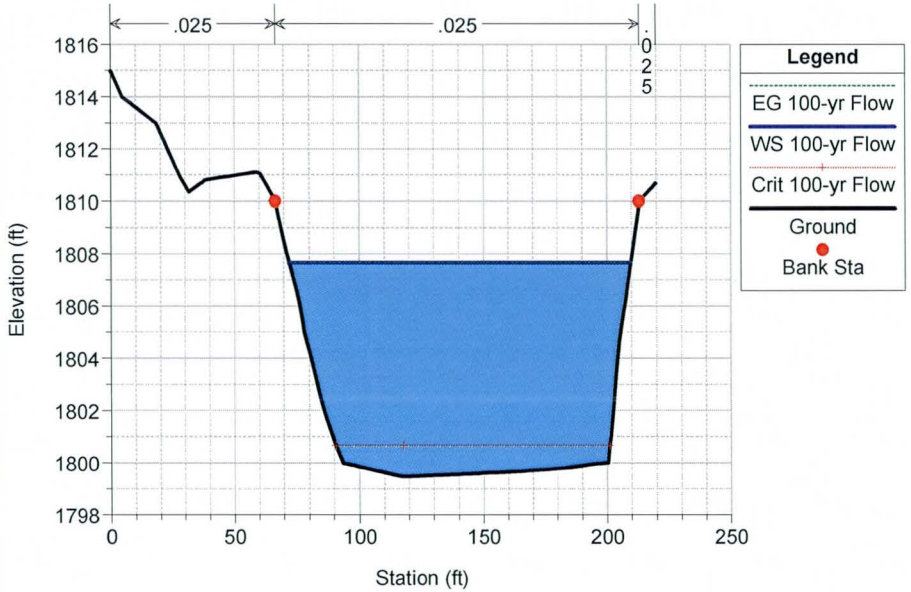
River = Oak Street SD Reach = 163+82 - 165+50 RS = 16431.5



NOTE: Due to printing scale, circular pipes appear elliptical.

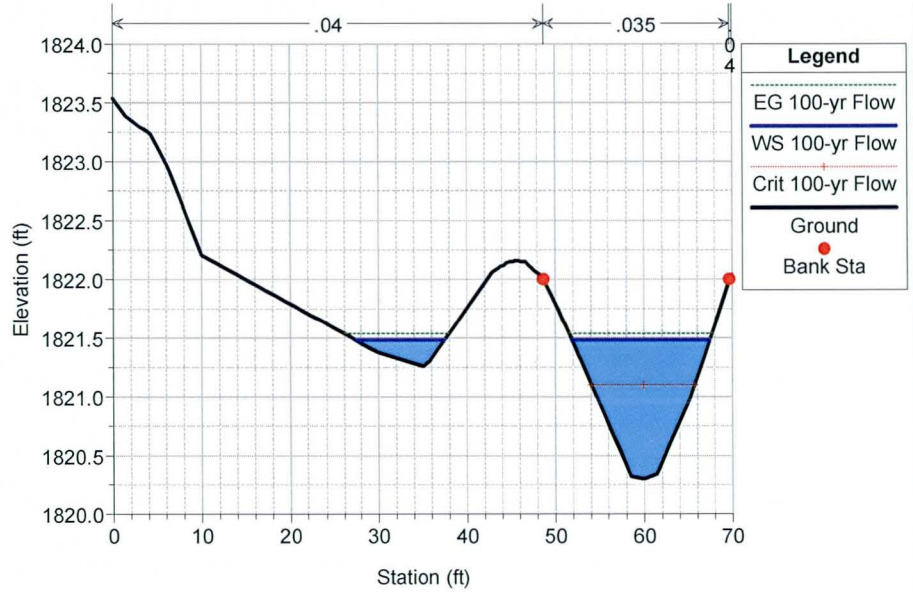
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 163+82 - 165+50 RS = 16381.5



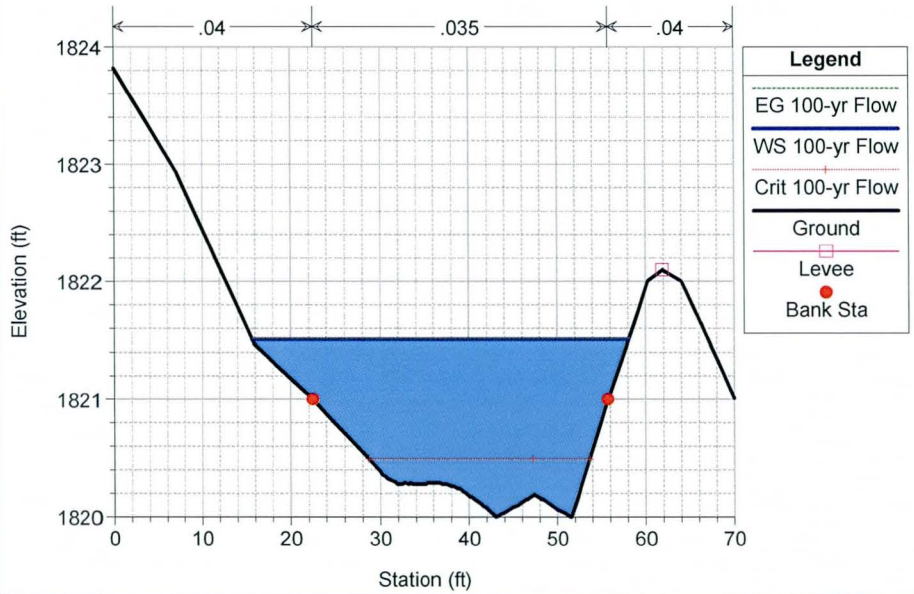
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 Inlet RS = 77.8



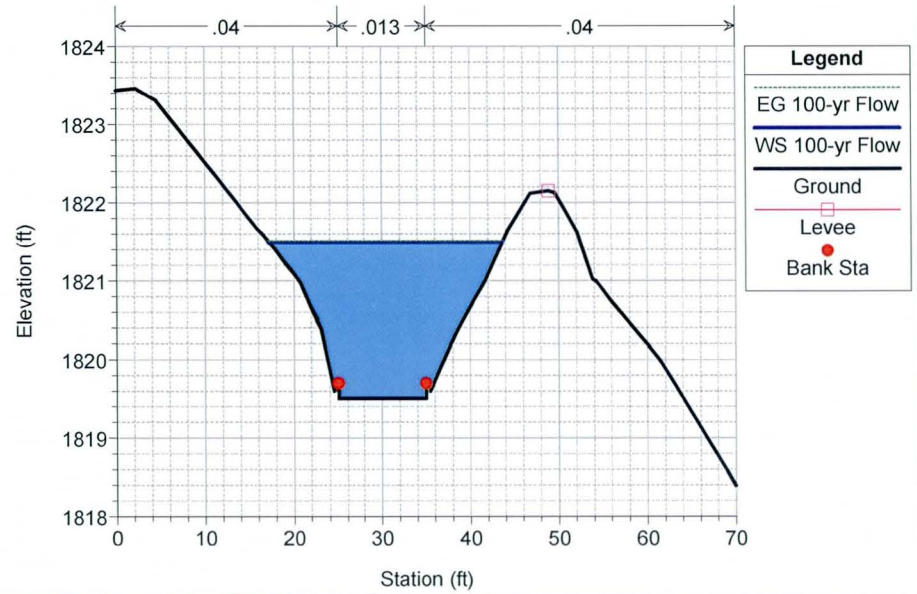
Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 165+50 Inlet RS = 57.8

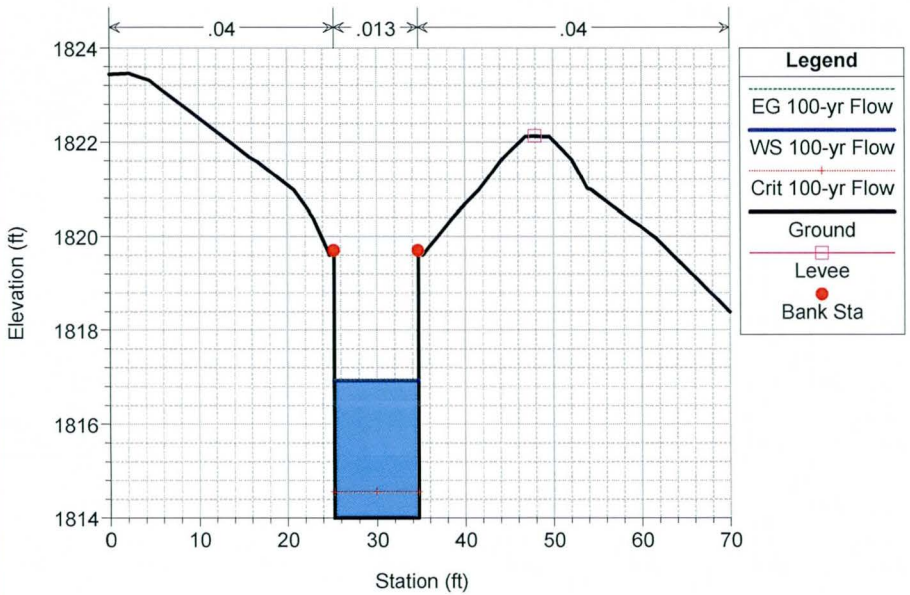


Oak Street and Hawes Road SD Analysis 9/25/2012

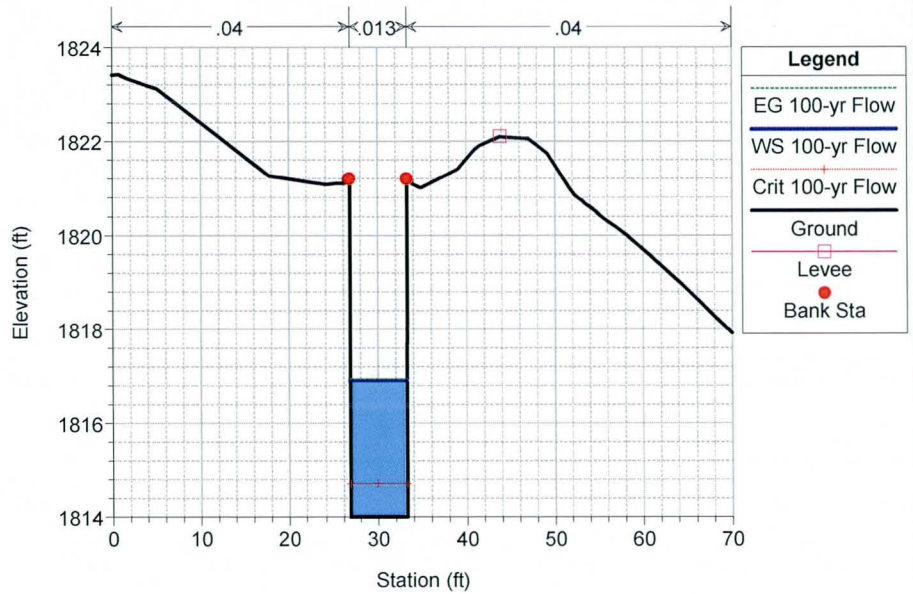
River = Oak Street SD Reach = 165+50 Inlet RS = 37.8



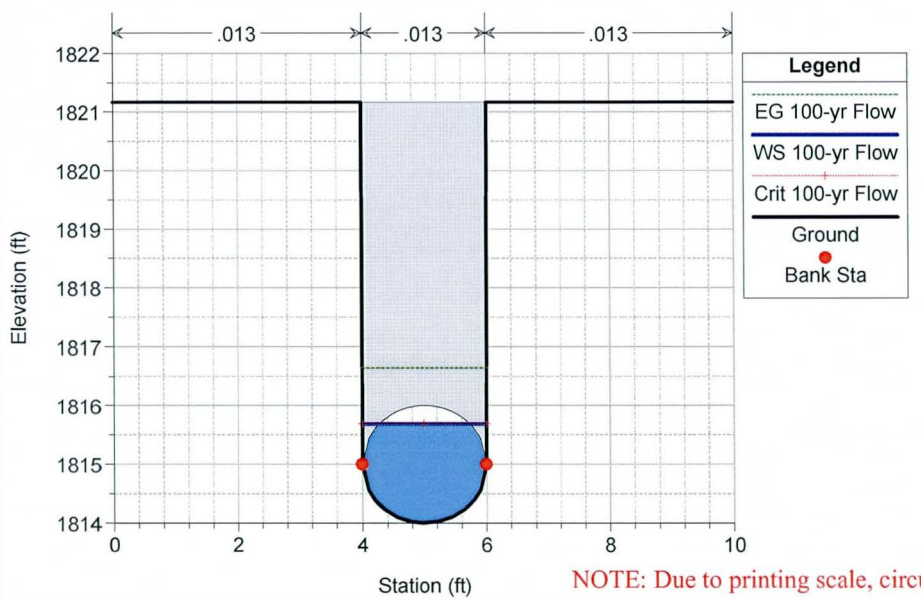
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Oak Street SD Reach = 165+50 Inlet RS = 37.3



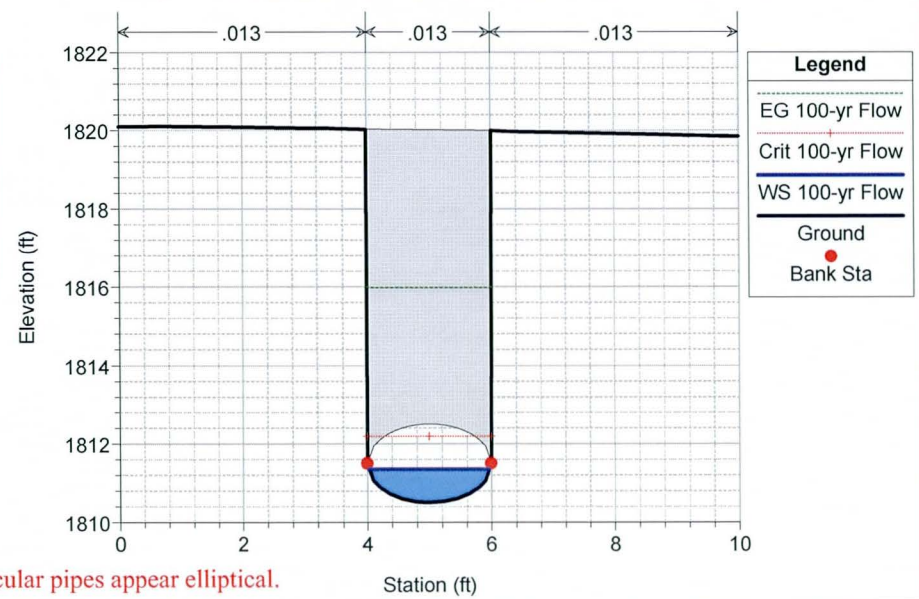
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Oak Street SD Reach = 165+50 Inlet RS = 34.8



Oak Street and Hawes Road SD Analysis 9/25/2012
River = Oak Street SD Reach = 165+50 Inlet RS = 34.3

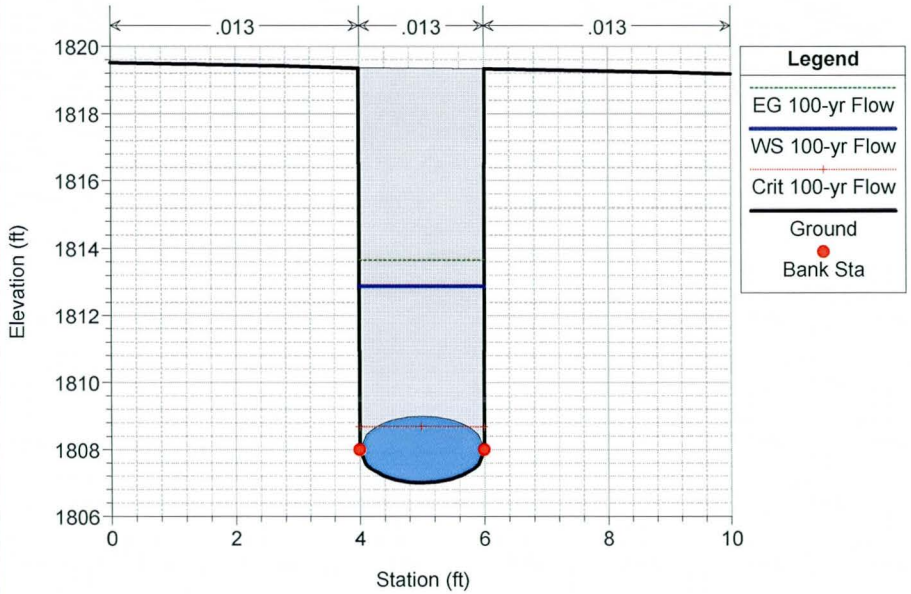


Oak Street and Hawes Road SD Analysis 9/25/2012
River = Oak Street SD Reach = 165+50 Inlet RS = 19.7

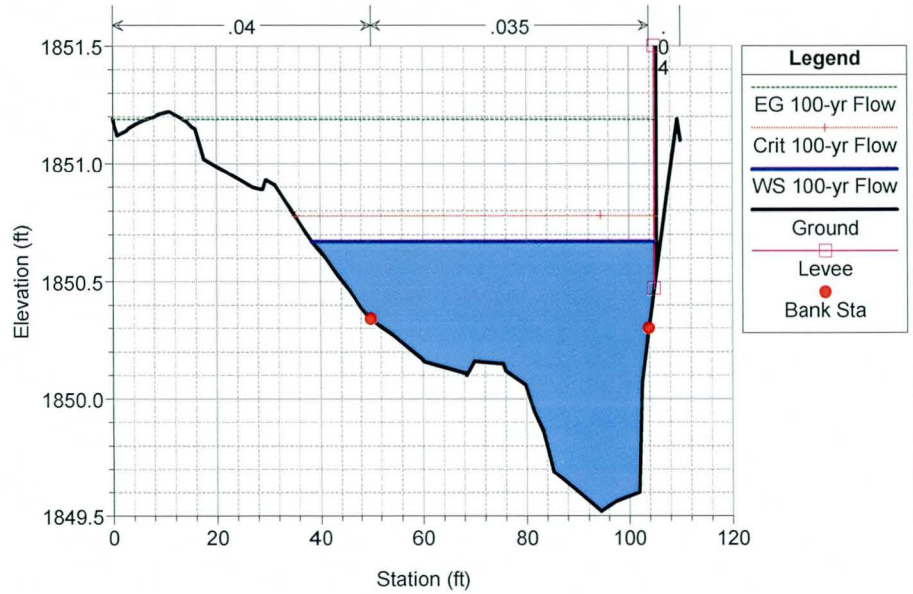


NOTE: Due to printing scale, circular pipes appear elliptical.

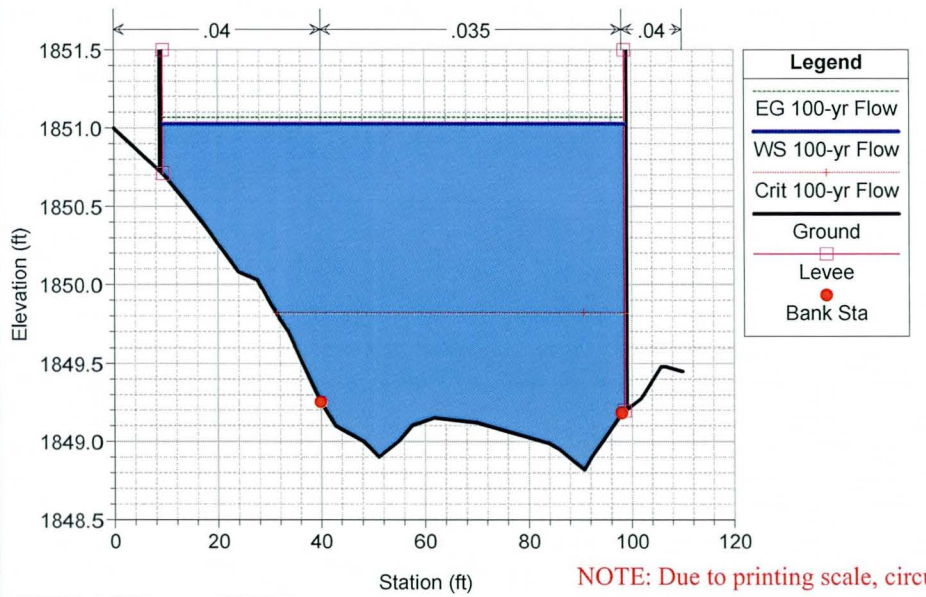
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Oak Street SD Reach = 165+50 Inlet RS = 5.0



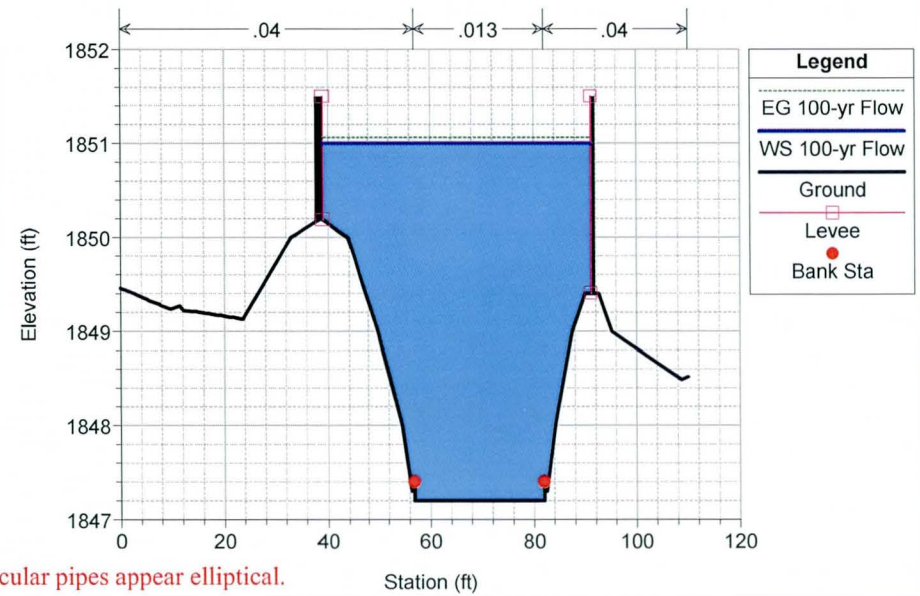
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Oak Street SD Reach = 173+70 Inlet RS = 87.2



Oak Street and Hawes Road SD Analysis 9/25/2012
River = Oak Street SD Reach = 173+70 Inlet RS = 67.2

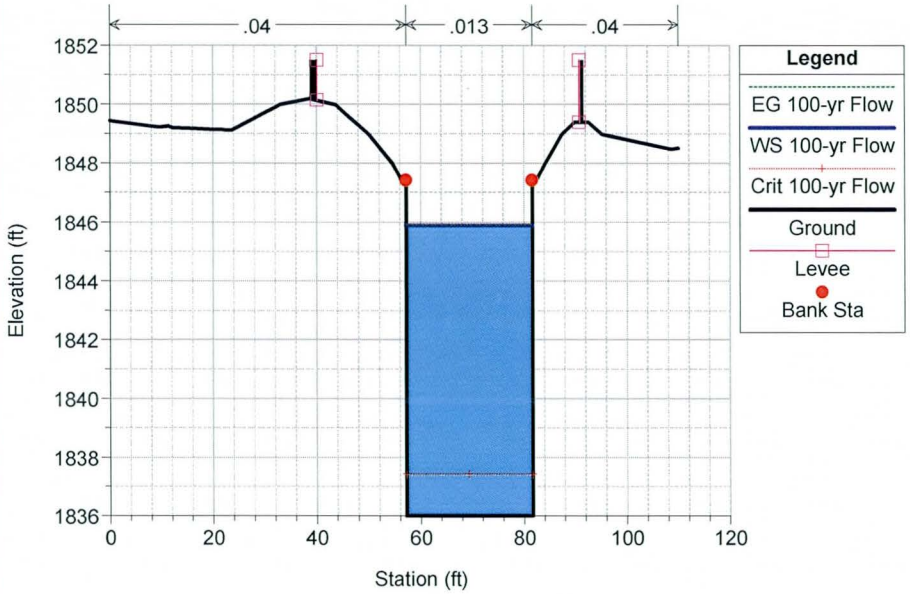


Oak Street and Hawes Road SD Analysis 9/25/2012
River = Oak Street SD Reach = 173+70 Inlet RS = 47.2

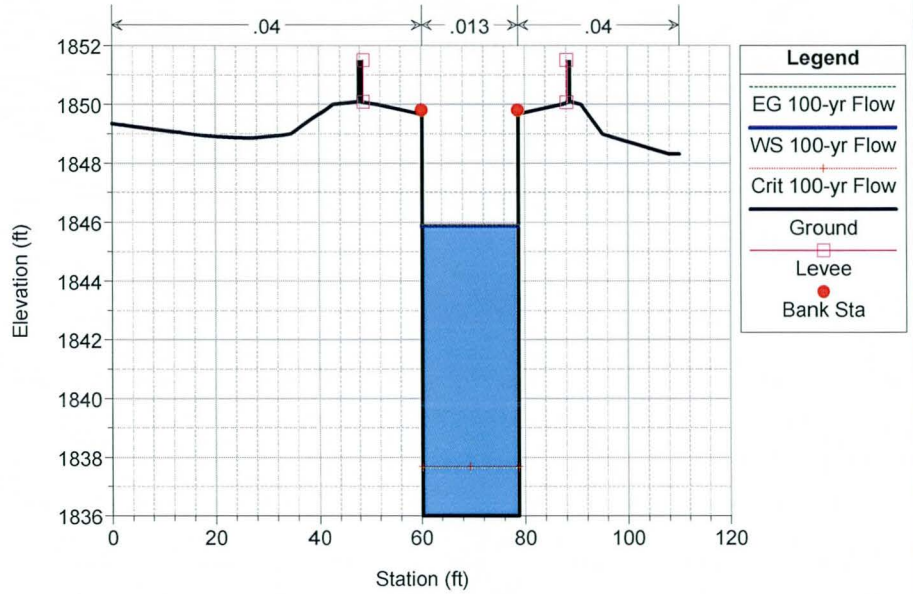


NOTE: Due to printing scale, circular pipes appear elliptical.

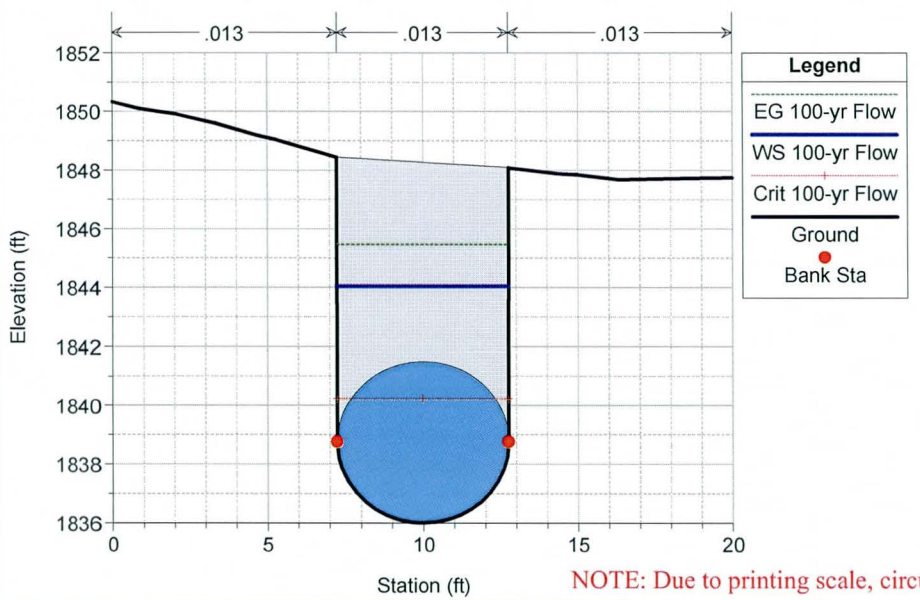
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Oak Street SD Reach = 173+70 Inlet RS = 46.7



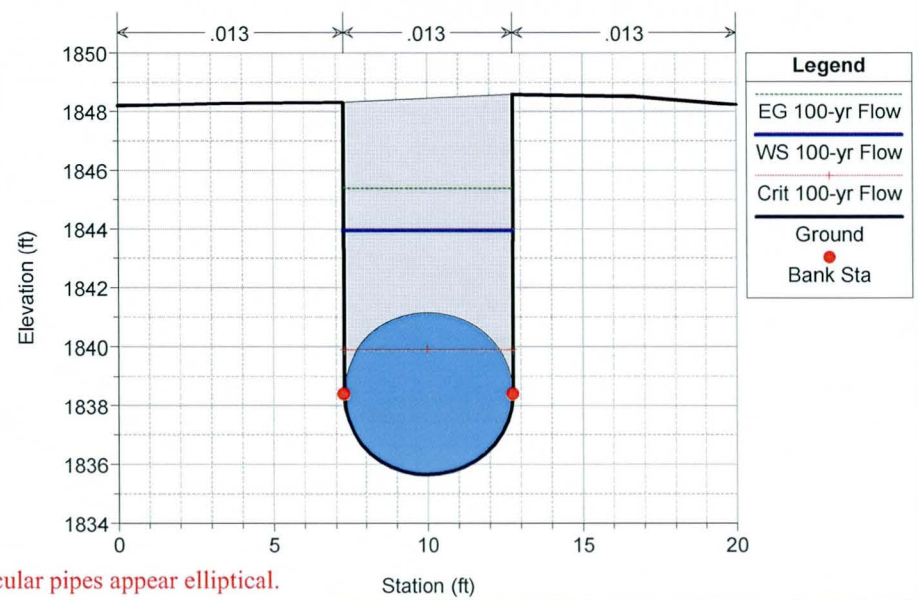
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Oak Street SD Reach = 173+70 Inlet RS = 41.7



Oak Street and Hawes Road SD Analysis 9/25/2012
River = Oak Street SD Reach = 173+70 Inlet RS = 41.2



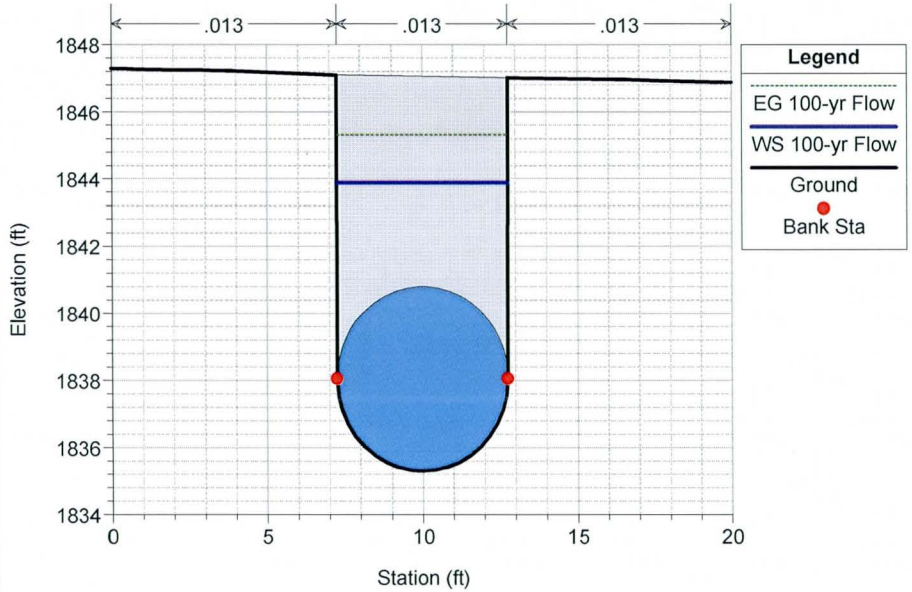
Oak Street and Hawes Road SD Analysis 9/25/2012
River = Oak Street SD Reach = 173+70 Inlet RS = 24.0



NOTE: Due to printing scale, circular pipes appear elliptical.

Oak Street and Hawes Road SD Analysis 9/25/2012

River = Oak Street SD Reach = 173+70 Inlet RS = 6.8



NOTE: Due to printing scale, circular pipes appear elliptical.

Sub-Section B2: **Catch Basin Design**

	Oak St. SD STA. 181+90	Oak St. SD STA. 173+70	Oak St. SD STA. 165+50	Hawes Rd. SD STA 134+45	Hawes Rd. SD STA 136+57	Hawes Rd. SD STA. 143+60
100-year Peak Discharge (cfs)	380	228	22	54**	46	121
Headwater Elevation (ft)	1871.0	1851.0	1821.5	1813.0	1814.5	1832.0
Drop Inlet Lip Elevation (ft)	1866.2	1847.3	1819.5	1809.8	1812.5	1828.5
Total Weir Head (ft)	4.8	3.7	2.0	3.2	2.0	3.5
Clogging Factor (%)	50	50	50	50	50	50
Drop Inlet Length (ft)	28.0	25.0	6.0	13.0	13.0	15.0
Storm Drain Pipe Size (in)	72	72	24	36	36	48
Inlet Control Headwater* (ft)	9.9	6.3	3.0	4.5	3.5	5.6
Storm Drain Invert Elevation (ft)	≤ 1856.3	≤ 1841.0	≤ 1816.0	≤ 1805.3	≤ 1809.0	≤ 1822.9

* Inlet Control Headwater: Per Figure 5.20, *FCDMC Drainage Design Manual; Hydraulics*

** See "*Sub-Section A5*" for 100-year Peak Discharge Calculation

Table B2.1: Drop Inlet Design – Inlet Capacity Summary

Drop Inlet Design: Length of Drop Inlet Calculation - Oak Street Storm Drain STA. 181+90

$Q_W = CLH^{\frac{3}{2}}$ (Weir Equation - Hydraulic Drainage Design Manual: *Equation* 8.28)

where;

$Q_W = Peak\ Discharge\ to\ be\ Captured = 380\ cfs$ (100-yr Peak Discharge)

$C = Weir\ Coefficient = 3.0$ (TYP. for Broad Crested Weirs)

$L = Total\ Unobstructed\ Length$

$H = Total\ Head$

$H_{top} = Maximum\ allowable\ Headwater\ Elevation = 1871.0\,ft$

$H_{bottom} = Drop\ Inlet\ Lip\ Elevation = 1866.2\,ft$

$H = H_{top} - H_{bottom}$

$H = 1871.0 - 1866.2$

$H = 4.8\,ft$

$$Q_W = CLH^{\frac{3}{2}}$$

$$L = \frac{Q_W}{CH^{\frac{3}{2}}}$$

$$L = \frac{380}{3 \times 4.8^{\frac{3}{2}}}$$

$$L = 12.04\,ft$$

Apply a 50% clogging factor to the unobstructed length, hence:

$L = 24.08\,ft$

In order to calculate the total drop inlet length, the width of the trashrack bars has to be accounted for:

A total of 73, 4-in, openings is required to achieve the desired 24.08 ft unobstructed weir length:

$$\frac{24.08\,ft}{0.33\,ft} \approx 73$$

Therefore a total of 72, 0.5-in, trashrack bars are required in order to have 73 openings in the grate.

$L_{Total} = Total\ Drop\ Inlet\ Length$

$L_{Total} = 73 \times 4\ in + 72 \times 0.5\ in$

$L_{Total} = 328.0\ in$

$L_{Total} = 27.33\,ft$

$\therefore$ *The total length of the drop inlet has to be greater or equal to* $27.4\,ft$

$$\boxed{L_{total} = 28\,ft}$$

Drop Inlet Design: Length of Drop Inlet Calculation - Oak Street Storm Drain STA. 173+70

$Q_W = CLH^{\frac{3}{2}}$ (Weir Equation - Hydraulic Drainage Design Manual: *Equation* 8.28)

where;

$Q_W = Peak\ Discharge\ to\ be\ Captured = 228\ cfs$ (100-yr Peak Discharge)

$C = Weir\ Coefficient = 3.0$ (TYP. for Broad Crested Weirs)

$L = Total\ Unobstructed\ Length$

$H = Total\ Head$

$H_{top} = Maximum\ allowable\ Headwater\ Elevation = 1851.0\ ft$

$H_{bottom} = Drop\ Inlet\ Lip\ Elevation = 1847.3\ ft$

$H = H_{top} - H_{bottom}$

$H = 1851.0 - 1847.3$

$H = 3.7\ ft$

$$Q_W = CLH^{\frac{3}{2}}$$

$$L = \frac{Q_W}{CH^{\frac{3}{2}}}$$

$$L = \frac{228}{3 \times 3.7^{\frac{3}{2}}}$$

$$L = 10.68\ ft$$

Apply a 50% clogging factor to the unobstructed length, hence:

$L = 21.36\ ft$

In order to calculate the total drop inlet length, the width of the trashrack bars has to be accounted for:

A total of 65, 4-in, openings is required to achieve the desired 21.36 ft unobstructed weir length:

$$\frac{21.36\ ft}{0.33\ ft} \approx 65$$

Therefore, a total of 64, 0.5-in, trashrack bars are required in order to have 65 openings in the grate.

$L_{Total} = Total\ Drop\ Inlet\ Length$

$L_{Total} = 65 \times 4\ in + 64 \times 0.5\ in$

$L_{Total} = 292.0\ in$

$L_{Total} = 24.33\ ft$

$\therefore$ *The total length of the drop inlet has to be greater or equal to* $24.4\ ft$

$$\boxed{L_{total} = 25\ ft}$$

Drop Inlet Design: Length of Drop Inlet Calculation - Oak Street Storm Drain STA. 165+50

$Q_W = CLH^{\frac{3}{2}}$ (Weir Equation - Hydraulic Drainage Design Manual: *Equation* 8.28)

where;

$Q_W = Peak\ Discharge\ to\ be\ Captured = 22\ cfs$ (100-yr Peak Discharge)

$C = Weir\ Coefficient = 3.0$ (TYP. for Broad Crested Weirs)

$L = Total\ Unobstructed\ Length$

$H = Total\ Head$

$H_{top} = Maximum\ allowable\ Headwater\ Elevation = 1821.5\ ft$

$H_{bottom} = Drop\ Inlet\ Lip\ Elevation = 1819.5\ ft$

$H = H_{top} - H_{bottom}$

$H = 1821.5 - 1819.5$

$H = 2.0\ ft$

$$Q_W = CLH^{\frac{3}{2}}$$

$$L = \frac{Q_W}{CH^{\frac{3}{2}}}$$

$$L = \frac{22}{3 \times 2.0^{\frac{3}{2}}}$$

$$L = 2.59\ ft$$

Apply a 50% clogging factor to the unobstructed length, hence:

$L = 5.18\ ft$

In order to calculate the total drop inlet length, the width of the trashrack bars has to be accounted for:

A total of 16, 4-in, openings is required to achieve the desired 5.18 ft unobstructed weir length:

$$\frac{5.18\ ft}{0.33\ ft} \approx 16$$

Therefore, a total of 15, 0.5-in, trashrack bars are required in order to have 16 openings in the grate.

$L_{Total} = Total\ Drop\ Inlet\ Length$

$L_{Total} = 16 \times 4\ in + 15 \times 0.5\ in$

$L_{Total} = 71.5\ in$

$L_{Total} = 5.96\ ft$

$\therefore$ *The total length of the drop inlet has to be greater or equal to* $6.0\ ft$ ·

$$\boxed{L_{total} = 6\ ft}$$

Drop Inlet Design: Length of Drop Inlet Calculation - Hawes Road Storm Drain STA. 134+45

$Q_W = CLH^{\frac{3}{2}}$ (Weir Equation - Hydraulic Drainage Design Manual: *Equation* 8.28)

where;

$Q_W = Peak\ Discharge\ to\ be\ Captured = 54\ cfs$ (100-yr Peak Discharge, Exhibit A5.1)

$C = Weir\ Coefficient = 3.0$ (TYP. for Broad Crested Weirs)

$L = Total\ Unobstructed\ Length$

$H = Total\ Head$

$H_{top} = Maximum\ allowable\ Headwater\ Elevation = 1813.0\,ft$

$H_{bottom} = Drop\ Inlet\ Lip\ Elevation = 1809.8\,ft$

$H = H_{top} - H_{bottom}$

$H = 1813.0 - 1809.8$

$H = 3.2\,ft$

$$Q_W = CLH^{\frac{3}{2}}$$

$$L = \frac{Q_W}{CH^{\frac{3}{2}}}$$

$$L = \frac{54}{3 \times 3.2^{\frac{3}{2}}}$$

$$L = 3.14\,ft$$

Apply a 50% clogging factor to the unobstructed length, hence:

$L = 6.28\,ft$

In order to calculate the total drop inlet length, the width of the trashrack bars has to be accounted for:

A total of 20, 4-in, openings is required to achieve the desired 6.28 ft unobstructed weir length:

$$\frac{6.28\,ft}{0.33\,ft} \approx 20$$

Therefore, a total of 19, 0.5-in, trashrack bars are required in order to have 20 openings in the grate.

$L_{Total} = Total\ Drop\ Inlet\ Length$

$L_{Total} = 20 \times 4\ in + 19 \times 0.5\ in$

$L_{Total} = 89.5\ in$

$L_{Total} = 7.46\,ft$

$\therefore$ *The total length of the drop inlet has to be greater or equal to* $7.5\,ft$

$$\boxed{L_{total} = 13\,ft}$$

Drop Inlet Design: Length of Drop Inlet Calculation - Hawes Road Storm Drain STA. 136+57

$Q_W = CLH^{\frac{3}{2}}$ (Weir Equation - Hydraulic Drainage Design Manual: *Equation* 8.28)

where;

$Q_W = Peak\ Discharge\ to\ be\ Captured = 46\ cfs$ (100-yr Peak Discharge)

$C = Weir\ Coefficient = 3.0$ (TYP. for Broad Crested Weirs)

$L = Total\ Unobstructed\ Length$

$H = Total\ Head$

$H_{top} = Maximum\ allowable\ Headwater\ Elevation = 1814.5\,ft$

$H_{bottom} = Drop\ Inlet\ Lip\ Elevation = 1812.5\,ft$

$H = H_{top} - H_{bottom}$

$H = 1814.5 - 1812.5$

$H = 2.0\,ft$

$$Q_W = CLH^{\frac{3}{2}}$$

$$L = \frac{Q_W}{CH^{\frac{3}{2}}}$$

$$L = \frac{46}{3 \times 2.0^{\frac{3}{2}}}$$

$$L = 5.42\,ft$$

Apply a 50% clogging factor to the unobstructed length, hence:

$L = 10.84\,ft$

In order to calculate the total drop inlet length, the width of the trashrack bars has to be accounted for:

A total of 33, 4-in, openings is required to achieve the desired 10.84 ft unobstructed weir length:

$$\frac{10.84\,ft}{0.33\,ft} \approx 33$$

Therefore, a total of 32, 0.5-in, trashrack bars are required in order to have 33 openings in the grate.

$L_{Total} = Total\ Drop\ Inlet\ Length$

$L_{Total} = 33 \times 4\ in + 32 \times 0.5\ in$

$L_{Total} = 148\ in$

$L_{Total} = 12.33\,ft$

$\therefore$ *The total length of the drop inlet has to be greater or equal to* $12.3\,ft$

$$\boxed{L_{total} = 13\,ft}$$

Drop Inlet Design: Length of Drop Inlet Calculation - Hawes Road Storm Drain STA. 143+60

$Q_W = CLH^{\frac{3}{2}}$ (Weir Equation - Hydraulic Drainage Design Manual: *Equation* 8.28)

where;

$Q_W = Peak\ Discharge\ to\ be\ Captured = 121\ cfs$ (100-yr Peak Discharge)

$C = Weir\ Coefficient = 3.0$ (TYP. for Broad Crested Weirs)

$L = Total\ Unobstructed\ Length$

$H = Total\ Head$

$H_{top} = Maximum\ allowable\ Headwater\ Elevation = 1832.0\,ft$

$H_{bottom} = Drop\ Inlet\ Lip\ Elevation = 1828.5\,ft$

$H = H_{top} - H_{bottom}$

$H = 1832.0 - 1828.5$

$H = 3.5\,ft$

$$Q_W = CLH^{\frac{3}{2}}$$

$$L = \frac{Q_W}{CH^{\frac{3}{2}}}$$

$$L = \frac{121}{3 \times 3.5^{\frac{3}{2}}}$$

$$L = 6.16\,ft$$

Apply a 50% clogging factor to the unobstructed length, hence:

$L = 12.32\,ft$

In order to calculate the total drop inlet length, the width of the trashrack bars has to be accounted for:

A total of 38, 4-in, openings is required to achieve the desired 12.32 ft unobstructed weir length:

$$\frac{12.32\,ft}{0.33\,ft} \approx 38$$

Therefore, a total of 37, 0.5-in, trashrack bars are required in order to have 38 openings in the grate.

$L_{Total} = Total\ Drop\ Inlet\ Length$

$L_{Total} = 38 \times 4\ in + 37 \times 0.5\ in$

$L_{Total} = 170.5\ in$

$L_{Total} = 14.21\,ft$

$\therefore$ *The total length of the drop inlet has to be greater or equal to* $14.3\,ft$

$$\boxed{L_{total} = 15\,ft}$$

	On Grade - Curb Opening Catch Basin			
	CP @ STA 173+40	CP @ STA 170+25	CP @ STA 167+10	CP @ STA 129+80
100-Year Peak Discharge (cfs)	2.3	5.6	15.9	2.1
Contributing Bypass Flow (cfs)	0.0	0.3	2.1	4.1
Total Flow at Catch Basin (cfs)	2.3	5.9	18.0	6.2
Length for Total Interception (ft)	29.3	44.6	66.8	43.3
Proposed Length (M-1 or M-2, L=17') (ft)	20.0	20.0	37.0	20.0
Proposed Interception Capacity (cfs)	2.0	3.8	13.9	4.2
Bypass Flow (cfs)	0.3	2.1	4.1	2.0
Connector Pipe Size (in)	18.0	18.0	18.0	18.0

Total Flow at Intersection of Oak Street and Hawes Road (cfs):	25.9
Total Flow Intercepted by System of Catch Basins (cfs):	23.9
Total Flow Bypassed to Intersection of Oak Street and Hawes Road (cfs):	2.0

Table B2.2: On Grade Curb Opening Catch Basin Design Summary

	Sump - Curb Opening Catch Basin	
	CP @ STA 175+90	CP @ STA 178+90
100-Year Peak Discharge (cfs)	12.2	14.2
Depth of Sump (in)	6.0	4.0
Height of Curb Opening (in)	5.0	5.0
Length for Total Interception (ft)	10.1	18.8
Proposed Inlet Length (MAG Type-D, L=10' or L=17') (ft)	13.0	20.0
Connector Pipe Size (in)	18.0	18.0

Table B2.3: Sump Curb Opening Catch Basin Design Summary

	Sump - Grated Catch Basins	
	CP @ STA 130+30	CP @ STA 164+95
100-Year Peak Discharge (cfs)	2.2	3.5
Depth of Weir Flow (Height of Raised Grate) (in)	4.0	4.0
Perimeter Length for Total Interception (ft)	7.7	12.3
Proposed Inlet Perimeter (Modified MAG Type-G, Double Grate) (ft)	12.3	12.3
Connector Pipe Size (in)	18.0	18.0

Table B2.4: Sump Grated Catch Basin Design Summary

Oak Street Storm Drain - Catch Basin Design: CP @ STA 173+40

On-Grade Curb Opening Catch Basin Sizing:

$$L = 0.6\,Q_t^{0.42}\,S^{0.3}\left(\frac{1}{nS_e}\right)^{0.6}$$ (Equation 3.10 - Drainage Design Manual for Maricopa County, Hydraulics)

where;

$Q_t = Total\ Gutter\ Flow\ Rate$

$Q_t = (Q_{100}$: CP @ STA 173+40)

(*See* 'Sub-Section A5' *for 100-Year Peak Discharge Calculation*)

$Q_t = 2.3\ cfs$

$L = Length\ of\ Catch\ Basin$

$S = Longitudinal\ Slope = 3.4\,\% = 0.034\ \frac{ft}{ft}$ (Existing Slope @ Inlet Location)

$n = Manning's\ Roughness\ Coefficient = 0.015$ (Typ)

$S_e = S_x + S'_w\,E_0$ (Equation 3.9 - Drainage Design Manual for Maricopa County, Hydraulics)

where;

$S_e = Equivalent\ Cross-Slope$

$S_x = Pavement\ Cross-Slope = 2.2\,\% = 0.022\ \frac{ft}{ft}$ (Existing Slope @ Inlet Location)

$S'_w = Gutter\ Cross-Slope\ at\ the\ Inlet = \frac{a}{W} = \frac{0.167}{1.42} = 0.118\ \frac{ft}{ft}$

$a = Gutter\ Depression\ at\ the\ Inlet = 2\ in = 0.167\,ft$

$W = Depressed\ Gutter\ Width\ at\ the\ Inlet = 1.42\,ft$

$$E_0 = \left[\frac{1}{1 + \dfrac{\frac{S_w}{S_x}}{\left(1 + \frac{\frac{S_w}{S_x}}{\frac{T}{W} - 1}\right)^{2.67} - 1}}\right]$$ (Equation 3.4 - Drainage Design Manual for Maricopa County, Hydraulics)

where;

$E_0 = Ratio\ of\ flow\ in\ depressed\ section\ to\ total\ gutter\ flow$

$S_w = Cross-Slope\ of\ Depressed\ Gutter = S_x + \frac{a}{W} = 0.022 + \frac{0.167}{1.42} = 0.140\ \frac{ft}{ft}$

$T = Width\ of\ Flow,\ Spread \approx 20\,ft$ (Existing Width of Oak @ Inlet Location)

$$E_0 = \left[\frac{1}{1 + \frac{\frac{S_w}{S_x}}{\left(1 + \frac{\frac{S_w}{S_x}}{\frac{T}{W} - 1}\right)^{2.67} - 1}} \right] = \left[\frac{1}{1 + \frac{\frac{0.140}{0.022}}{\left(1 + \frac{\frac{0.140}{0.022}}{\frac{20}{1.42} - 1}\right)^{2.67} - 1}} \right]$$

$$E_0 = \left[\frac{1}{1 + \left(\frac{6.36}{1.88}\right)} \right]$$

$$E_0 = 0.228$$

$$S_e = S_x + S'_w E_0$$

$$S_e = 0.022 + 0.118 \times 0.228$$

$$\left[S_e = 0.049 \frac{ft}{ft} \right]$$

$$L = 0.6 Q_t^{0.42} S^{0.3} \left(\frac{1}{nS_e} \right)^{0.6}$$

$$L = 0.6(2.3)^{0.42}(0.034)^{0.3} \left(\frac{1}{(0.015)(0.049)} \right)^{0.6}$$

$$L = 23.43\, ft$$

Catch Basin Clogging Factor :

$L_f = 1.25 \times L$ (Table 6.8 - FCDMC Drainage Policies and Standards Manual)

$$L_f = 1.25 \times L$$

$$L_f = 1.25 \times 23.43$$

$$L_f = 29.29\, ft$$

$$\boxed{\mathbf{L_f = 29.3\, ft}}$$

Capacity of Proposed On-Grade M-1, L=17' Catch Basin: CP @ STA 173+40

The Efficiency (E) of a curb-opening catch basin shorter than the length required for total interception is:

$$E = 1 - \left(1 - \frac{L}{L_f}\right)^{1.8} \quad \text{(Equation 3.8 - Drainage Design Manual for Maricopa County, Hydraulics)}$$

where;

$L = Length\ of\ proposed\ curb\ opening = 20.0\,ft$ (per COP Std. Det. P1569-1)

$L_f = Curb\ opening\ length\ required\ to\ intercept\ 100\%\ of\ the\ flow\ (includes\ reduction\ factor) = 29.3\,ft$

$$E = 1 - \left(1 - \frac{L}{L_f}\right)^{1.8}$$

$$E = 1 - \left(1 - \frac{20.0}{29.3}\right)^{1.8}$$

$[E = 0.87]$

The capacity of the Proposed M-1, L=17' Catch Basin is:

$Q_i = Q_t \times E$

where;

$Q_i = Partial\ Flow\ Intercepted$

$Q_t = Total\ Flow = 2.3\ cfs$

$Q_i = Q_t \times E$

$Q_i = 2.3 \times 0.87$

$Q_i = 2.00$

$$\boxed{\mathbf{Q_i = 2.0\ cfs}}$$

The capacity of an M-1, L=17' catch basin, at Oak Street Storm Drain Station 173+40, on a continuous grade is approximately 2.0 cfs.

$Q_{Bypass} = Q_t - Q_i = 2.3 - 2.0$

$Q_{Bypass} = 0.30$

$$\boxed{\mathbf{Q_{Bypass} = 0.3\ cfs}}$$

The remaining 0.3 cfs bypasses the catch basin and gets accounted for in the total peak discharge at the next downstream concentration point (CP @ STA 171+25).

Oak Street Storm Drain - Connector Pipe Design: CP @ STA 173+40

Determine the total (friction + inlet) headloss:

$h_f = S_f L$ (Equation 4.6 - Drainage Design Manual for Maricopa County, Hydraulics)

$h_i = (1 + k_{en})\left(\frac{V^2}{2g}\right)$ (Equation 4.17 - Drainage Design Manual for Maricopa County, Hydraulics)

Try a 15 inch Reinforced Concrete Pipe:

Minimum allowable connector pipe size (Table 6.9 - FCDMC Drainage Policies and Standards Manual) *hence*;

$S_f = Pipe\ Friction\ Slope = K\frac{V^2}{2gR^{\frac{4}{3}}}$ (Equation 4.4 - Design Manual for Maricopa County, Hydraulics)

$K = Roughness\ Coefficient = \frac{2gn^2}{2.21}$ (Equation 4.5 - Design Manual for Maricopa County, Hydraulics)

$n = Manning's\ roughness\ coefficient = 0.013$ (Typ)

$g = Acceleration\ due\ to\ Gravity = 32.2\ \frac{ft}{s^2}$

$V = Velocity\ in\ Pipe = \frac{Q}{A}$

$Q = Flow\ Rate\ in\ Pipe = 2.0\ cfs$ (Interception Capacity of Inlet)

$A = Cross-Section\ area\ of\ Pipe = \pi r^2 = \pi(0.625)^2 = 0.391\pi$

$R_h = Hydraulic\ Radius = \frac{A}{W_p} = \frac{A}{2\pi r} = \frac{0.391\pi}{\pi(1.25)} = 0.313$

$L = Length\ of\ Pipe = 8.0\ ft$

$k_{en} = Entrance\ Loss\ Coefficient = 0.2$ (Table 5.1 - Design Manual for Maricopa County, Hydraulics)

$$K = \frac{2gn^2}{2.21}$$

$$K = \frac{2(32.2)(0.013)^2}{2.21}$$

$$[K = 0.0049]$$

$$V = \frac{Q}{A}$$

$$V = \frac{2.0}{0.391\pi}$$

$$\left[V = 1.63\ \frac{ft}{s}\right]$$

$$S_f = K\frac{V^2}{2gR^{\frac{4}{3}}}$$

$$S_f = (0.0049)\frac{1.63^2}{2\,(32.2)(0.313)^{\frac{4}{3}}}$$

$$\left[S_f = 0.0010\right]$$

Friction Headloss:

$$h_f = S_f L$$

$$h_f = (0.0010)\,(8.0)$$

$$\left[h_f = 0.01\,ft\right]$$

Inlet Headloss:

$$h_i = \left(1 + k_{en}\right)\left(\frac{V^2}{2g}\right)$$

$$h_i = (1 + 0.2)\left(\frac{1.63^2}{2\,(32.2)}\right)$$

$$\left[h_i = 0.05\,ft\right]$$

Total Headloss:

$$h_t = h_f + h_i$$

$$h_t = 0.01 + 0.05$$

$$h_t = 0.06$$

$$\boxed{h_f = 0.1\,ft}$$

Available Head: h_a

Upstream HW Elevation: 1843.9 *ft* (14 inches below Top of Curb Elevation at Catch Basin)

14 in = 8 in (Gutter below Top of Curb) + 6 in (HW Elevation below Gutter)

Downstream HW Elevation: 1836.7 *ft* (Soffit of Proposed 84 inch Storm Drain Pipe)

$$h_a = Upstream\ HW - Downstream\ HW$$

$$h_a = 1843.9 - 1836.7$$

$$h_a = 7.2$$

$$\boxed{h_a = 7.2\,ft}$$

The available head is greater than the total headloss in the storm drain system, therefore:

The 15 inch connector pipe has sufficient capacity to convey the inlet discharge

Increase connector pipe one size (18-inch) to help convey sediment

Oak Street Storm Drain - Catch Basin Design: CP @ STA 170+25

On-Grade Curb Opening Catch Basin Sizing:

$$L = 0.6\,Q_t^{0.42}\,S^{0.3}\left(\frac{1}{nS_e}\right)^{0.6}$$ (Equation 3.10 - Drainage Design Manual for Maricopa County, Hydraulics)

where;

$Q_t = Total\ Gutter\ Flow\ Rate$

$Q_t = (Q_{100}$: CP @ STA 170+25 + Q_{Bypass} : CP @ STA 173+40)

(*See* 'Sub-Section A5' *for 100-Year Peak Discharge Calculation*)

(*See* 'CP @ STA 173+40 - Catch Basin Design Calculations' *for Bypass Flow*)

$Q_t = 5.6 + 0.3 = 5.9\ cfs$

$L = Length\ of\ Catch\ Basin$

$S = Longitudinal\ Slope = 3.8\,\% = 0.038\ \frac{ft}{ft}$ (Existing Slope @ Inlet Location)

$n = Manning's\ Roughness\ Coefficient = 0.015$ (Typ)

$S_e = S_x + S'_w\,E_0$ (Equation 3.9 - Drainage Design Manual for Maricopa County, Hydraulics)

where;

$S_e = Equivalent\ Cross-Slope$

$S_x = Pavement\ Cross-Slope = 2.0\,\% = 0.020\ \frac{ft}{ft}$ (Existing Slope @ Inlet Location)

$S'_w = Gutter\ Cross-Slope\ at\ the\ Inlet = \frac{a}{W} = \frac{0.167}{1.42} = 0.118\ \frac{ft}{ft}$

$a = Gutter\ Depression\ at\ the\ Inlet = 2\ in = 0.167\,ft$

$W = Depressed\ Gutter\ Width\ at\ the\ Inlet = 1.42\,ft$

$$E_0 = \left[\frac{1}{1 + \dfrac{\frac{S_w}{S_x}}{\left(1 + \frac{\frac{S_w}{S_x}}{\frac{T}{W} - 1}\right)^{2.67} - 1}}\right]$$ (Equation 3.4 - Drainage Design Manual for Maricopa County, Hydraulics)

where;

$E_0 = Ratio\ of\ flow\ in\ depressed\ section\ to\ total\ gutter\ flow$

$S_w = Cross-Slope\ of\ Depressed\ Gutter = S_x + \frac{a}{W} = 0.020 + \frac{0.167}{1.42} = 0.138\ \frac{ft}{ft}$

$T = Width\ of\ Flow,\ Spread \approx 20\,ft$ (Existing Width of Oak @ Inlet Location)

$$E_0 = \left[\frac{1}{1 + \frac{\frac{S_w}{S_x}}{\left(1 + \frac{\frac{S_w}{S_x}}{\frac{T}{W} - 1}\right)^{2.67} - 1}}\right] = \left[\frac{1}{1 + \frac{\frac{0.138}{0.020}}{\left(1 + \frac{\frac{0.138}{0.020}}{\frac{20}{1.42} - 1}\right)^{2.67} - 1}}\right]$$

$$E_0 = \left[\frac{1}{1 + \left(\frac{6.90}{2.10}\right)}\right]$$

$$E_0 = 0.233$$

$$S_e = S_x + S'_w E_0$$

$$S_e = 0.020 + 0.118 \times 0.233$$

$$\left[S_e = 0.047 \frac{ft}{ft}\right]$$

$$L = 0.6 Q_t^{0.42} S^{0.3} \left(\frac{1}{nS_e}\right)^{0.6}$$

$$L = 0.6(5.9)^{0.42}(0.038)^{0.3}\left(\frac{1}{(0.015)(0.047)}\right)^{0.6}$$

$$L = 36.89 ft$$

Catch Basin Clogging Factor :

$L_f = 1.25 \times L$ (Table 6.8 - FCDMC Drainage Policies and Standards Manual)

$$L_f = 1.25 \times L$$

$$L_f = 1.25 \times 36.89$$

$$L_f = 46.11 ft$$

$$\boxed{\mathbf{L_f = 46.1\, ft}}$$

Capacity of Proposed On-Grade M-1, L=17' Catch Basin: CP @ STA 170+25

The Efficiency (E) of a curb-opening catch basin shorter than the length required for total interception is:

$$E = 1 - \left(1 - \frac{L}{L_f}\right)^{1.8} \quad \text{(Equation 3.8 - Drainage Design Manual for Maricopa County, Hydraulics)}$$

where;

$L = Length\ of\ proposed\ curb\ opening = 20.0\,ft$ (per COP Std. Det. P1569-1)

$L_f = Curb\ opening\ length\ required\ to\ intercept\ 100\%\ of\ the\ flow\ (includes\ reduction\ factor) = 46.1\,ft$

$$E = 1 - \left(1 - \frac{L}{L_f}\right)^{1.8}$$

$$E = 1 - \left(1 - \frac{20.0}{46.1}\right)^{1.8}$$

$[E = 0.64]$

The capacity of the Proposed M-1, L=17' Catch Basin is:

$Q_i = Q_t \times E$

where;

$Q_i = Partial\ Flow\ Intercepted$

$Q_t = Total\ Flow = 5.9\ cfs$

$Q_i = Q_t \times E$

$Q_i = 5.9 \times 0.64$

$Q_i = 3.78$

$$\boxed{\mathbf{Q_i = 3.8\ cfs}}$$

The capacity of an M-1, L=17' catch basin, at Oak Street Storm Drain Station 170+25, on a continuous grade is approximately 3.8 cfs.

$Q_{Bypass} = Q_t - Q_i = 5.9 - 3.8$

$Q_{Bypass} = 2.1$

$$\boxed{\mathbf{Q_{Bypass} = 2.1\ cfs}}$$

The remaining 2.1 cfs bypasses the catch basin and gets accounted for in the total peak discharge at the next downstream concentration point (CP @ STA 167+10).

Oak Street Storm Drain - Connector Pipe Design: CP @ STA 170+25

Determine the total (friction + inlet) headloss:

$h_f = S_f L$ (Equation 4.6 - Drainage Design Manual for Maricopa County, Hydraulics)

$h_i = (1 + k_{en})\left(\frac{V^2}{2g}\right)$ (Equation 4.17 - Drainage Design Manual for Maricopa County, Hydraulics)

Try a 15 inch Reinforced Concrete Pipe:

Minimum allowable connector pipe size (Table 6.9 - FCDMC Drainage Policies and Standards Manual) *hence*;

$S_f = Pipe\ Friction\ Slope = K\frac{V^2}{2gR^{\frac{4}{3}}}$ (Equation 4.4 - Design Manual for Maricopa County, Hydraulics)

$K = Roughness\ Coefficient = \frac{2gn^2}{2.21}$ (Equation 4.5 - Design Manual for Maricopa County, Hydraulics)

$n = Manning's\ roughness\ coefficient = 0.013$ (Typ)

$g = Acceleration\ due\ to\ Gravity = 32.2\ \frac{ft}{s^2}$

$V = Velocity\ in\ Pipe = \frac{Q}{A}$

$Q = Flow\ Rate\ in\ Pipe = 3.8\ cfs$ (Interception Capacity of Inlet)

$A = Cross-Section\ area\ of\ Pipe = \pi r^2 = \pi(0.625)^2 = 0.391\pi$

$R_h = Hydraulic\ Radius = \frac{A}{W_p} = \frac{A}{2\pi r} = \frac{0.391\pi}{\pi(1.25)} = 0.313$

$L = Length\ of\ Pipe = 8.0\ ft$

$k_{en} = Entrance\ Loss\ Coefficient = 0.2$ (Table 5.1 - Design Manual for Maricopa County, Hydraulics)

$$K = \frac{2gn^2}{2.21}$$

$$K = \frac{2(32.2)(0.013)^2}{2.21}$$

$$[K = 0.0049]$$

$$V = \frac{Q}{A}$$

$$V = \frac{3.8}{0.391\pi}$$

$$\left[V = 3.09\ \frac{ft}{s}\right]$$

$$S_f = K\frac{V^2}{2gR^{\frac{4}{3}}}$$

$$S_f = (0.0049)\frac{3.09^2}{2\,(32.2)(0.313)^{\frac{4}{3}}}$$

$$\left[S_f = 0.0034\right]$$

Friction Headloss:

$$h_f = S_f L$$

$$h_f = (0.0034)\,(8.0)$$

$$\left[h_f = 0.03\,ft\right]$$

Inlet Headloss:

$$h_i = \left(1 + k_{en}\right)\left(\frac{V^2}{2g}\right)$$

$$h_i = (1 + 0.2)\left(\frac{3.09^2}{2\,(32.2)}\right)$$

$$\left[h_i = 0.18\,ft\right]$$

Total Headloss:

$$h_t = h_f + h_i$$

$$h_t = 0.03 + 0.18$$

$$h_t = 0.21$$

$$\boxed{h_f = 0.21\,ft}$$

Available Head: h_a

Upstream HW Elevation: 1836.1 *ft* (14 inches below Top of Curb Elevation at Catch Basin)

14 in = 8 in (Gutter below Top of Curb) + 6 in (HW Elevation below Gutter)

Downstream HW Elevation: 1830.4 *ft* (Soffit of Proposed 84 inch Storm Drain Pipe)

$$h_a = \textit{Upstream HW} - \textit{Downstream HW}$$

$$h_a = 1836.1 - 1830.4$$

$$h_a = 5.7$$

$$\boxed{h_a = 5.7\,ft}$$

The available head is greater than the total headloss in the storm drain system, therefore:

The 15 inch connector pipe has sufficient capacity to convey the inlet discharge

Increase connector pipe one size (18-inch) to help convey sediment

Oak Street Storm Drain - Catch Basin Design: CP @ STA 167+10

On-Grade Curb Opening Catch Basin Sizing:

$$L = 0.6\,Q_t^{0.42}\,S^{0.3}\left(\frac{1}{nS_e}\right)^{0.6}$$ (Equation 3.10 - Drainage Design Manual for Maricopa County, Hydraulics)

where;

$Q_t = Total\ Gutter\ Flow\ Rate$

$Q_t = (Q_{100}$: CP @ STA 167+10 + Q_{Bypass} : CP @ STA 170+25)

(*See* 'Sub-Section A5' *for 100-Year Peak Discharge Calculation*)

(*See* 'CP @ STA 170+25 - Catch Basin Design Calculations' *for Bypass Flow*)

$Q_t = 15.9 + 2.1 = 18.0\ cfs$

$L = Length\ of\ Catch\ Basin$

$S = Longitudinal\ Slope = 3.1\ \% = 0.031\ \frac{ft}{ft}$ (Existing Slope @ Inlet Location)

$n = Manning's\ Roughness\ Coefficient = 0.015$ (Typ)

$S_e = S_x + S'_w E_0$ (Equation 3.9 - Drainage Design Manual for Maricopa County, Hydraulics)

where;

$S_e = Equivalent\ Cross-Slope$

$S_x = Pavement\ Cross-Slope = 2.3\ \% = 0.023\ \frac{ft}{ft}$ (Existing Slope @ Inlet Location)

$S'_w = Gutter\ Cross-Slope\ at\ the\ Inlet = \frac{a}{W} = \frac{0.167}{1.42} = 0.118\ \frac{ft}{ft}$

$a = Gutter\ Depression\ at\ the\ Inlet = 2\ in = 0.167\ ft$

$W = Depressed\ Gutter\ Width\ at\ the\ Inlet = 1.42\ ft$

$$E_0 = \left[\frac{1}{1 + \dfrac{\frac{S_w}{S_x}}{\left(1 + \frac{\frac{S_w}{S_x}}{\frac{T}{W} - 1}\right)^{2.67} - 1}}\right]$$ (Equation 3.4 - Drainage Design Manual for Maricopa County, Hydraulics)

where;

$E_0 = Ratio\ of\ flow\ in\ depressed\ section\ to\ total\ gutter\ flow$

$S_w = Cross-Slope\ of\ Depressed\ Gutter = S_x + \frac{a}{W} = 0.023 + \frac{0.167}{1.42} = 0.141\ \frac{ft}{ft}$

$T = Width\ of\ Flow,\ Spread \approx 20\ ft$ (Existing Width of Oak @ Inlet Location)

$$E_0 = \left[\frac{1}{1 + \frac{\frac{S_w}{S_x}}{\left(1 + \frac{\frac{S_w}{S_x}}{\frac{T}{W} - 1}\right)^{2.67} - 1}} \right] = \left[\frac{1}{1 + \frac{\frac{0.141}{0.023}}{\left(1 + \frac{\frac{0.141}{0.023}}{\frac{20}{1.42} - 1}\right)^{2.67} - 1}} \right]$$

$$E_0 = \left[\frac{1}{1 + \left(\frac{6.13}{1.79}\right)} \right]$$

$$E_0 = 0.226$$

$$S_e = S_x + S'_w E_0$$

$$S_e = 0.023 + 0.118 \times 0.226$$

$$\left[S_e = 0.050 \frac{ft}{ft} \right]$$

$$L = 0.6 Q_t^{0.42} S^{0.3} \left(\frac{1}{nS_e} \right)^{0.6}$$

$$L = 0.6(18.0)^{0.42}(0.031)^{0.3} \left(\frac{1}{(0.015)(0.050)} \right)^{0.6}$$

$$L = 53.42 ft$$

Catch Basin Clogging Factor :

$L_f = 1.25 \times L$ (Table 6.8 - FCDMC Drainage Policies and Standards Manual)

$$L_f = 1.25 \times L$$

$$L_f = 1.25 \times 53.42$$

$$L_f = 66.78 ft$$

$$\boxed{\mathbf{L_f = 66.8\, ft}}$$

Capacity of Proposed On-Grade M-2, L=17' Catch Basin: CP @ STA 167+10

The Efficiency (E) of a curb-opening catch basin shorter than the length required for total interception is:

$$E = 1 - \left(1 - \frac{L}{L_f}\right)^{1.8} \quad \text{(Equation 3.8 - Drainage Design Manual for Maricopa County, Hydraulics)}$$

where;

$L = Length\ of\ proposed\ curb\ opening = 34.0\,ft$ (per COP Std. Det. P1569-1)

$L_f = Curb\ opening\ length\ required\ to\ intercept\ 100\%\ of\ the\ flow\ (includes\ reduction\ factor) = 66.8\,ft$

$$E = 1 - \left(1 - \frac{L}{L_f}\right)^{1.8}$$

$$E = 1 - \left(1 - \frac{37.0}{66.8}\right)^{1.8}$$

$[E = 0.77]$

The capacity of the Proposed M-2, L=17' Catch Basin is:

$Q_i = Q_t \times E$

where;

$Q_i = Partial\ Flow\ Intercepted$

$Q_t = Total\ Flow = 18.0\ cfs$

$Q_i = Q_t \times E$

$Q_i = 18.0 \times 0.77$

$Q_i = 13.86$

$$\boxed{\mathbf{Q_i = 13.9\ cfs}}$$

The capacity of an M-2, L=17' catch basin, at Oak Street Storm Drain Station 167+10, on a continuous grade is approximately 13.9 cfs.

$Q_{Bypass} = Q_t - Q_i = 18.0 - 13.9$

$Q_{Bypass} = 4.1$

$$\boxed{\mathbf{Q_{Bypass} = 4.1\ cfs}}$$

The remaining 4.1 cfs bypasses the catch basin and gets accounted for in the total peak discharge at the next downstream concentration point (CP @ STA 129+80).

Oak Street Storm Drain - Connector Pipe Design: CP @ STA 167+10

Determine the total (friction + inlet) headloss:

$h_f = S_f L$ (Equation 4.6 - Drainage Design Manual for Maricopa County, Hydraulics)

$h_i = (1 + k_{en})\left(\frac{V^2}{2g}\right)$ (Equation 4.17 - Drainage Design Manual for Maricopa County, Hydraulics)

Try a 15 inch Reinforced Concrete Pipe:

Minimum allowable connector pipe size (Table 6.9 - FCDMC Drainage Policies and Standards Manual) *hence*;

$S_f = Pipe\ Friction\ Slope = K\frac{V^2}{2gR^{\frac{4}{3}}}$ (Equation 4.4 - Design Manual for Maricopa County, Hydraulics)

$K = Roughness\ Coefficient = \frac{2gn^2}{2.21}$ (Equation 4.5 - Design Manual for Maricopa County, Hydraulics)

$n = Manning's\ roughness\ coefficient = 0.013$ (Typ)

$g = Acceleration\ due\ to\ Gravity = 32.2\ \frac{ft}{s^2}$

$V = Velocity\ in\ Pipe = \frac{Q}{A}$

$Q = Flow\ Rate\ in\ Pipe = 13.9\ cfs$ (Interception Capacity of Inlet)

$A = Cross-Section\ area\ of\ Pipe = \pi r^2 = \pi(0.625)^2 = 0.391\pi$

$R_h = Hydraulic\ Radius = \frac{A}{W_p} = \frac{A}{2\pi r} = \frac{0.391\pi}{\pi(1.25)} = 0.313$

$L = Length\ of\ Pipe = 8.0\ ft$

$k_{en} = Entrance\ Loss\ Coefficient = 0.2$ (Table 5.1 - Design Manual for Maricopa County, Hydraulics)

$$K = \frac{2gn^2}{2.21}$$

$$K = \frac{2(32.2)(0.013)^2}{2.21}$$

$$[K = 0.0049]$$

$$V = \frac{Q}{A}$$

$$V = \frac{13.9}{0.391\pi}$$

$$\left[V = 11.32\ \frac{ft}{s}\right]$$

$$S_f = K\frac{V^2}{2gR^{\frac{4}{3}}}$$

$$S_f = (0.0049)\frac{11.32^2}{2\,(32.2)(0.313)^{\frac{4}{3}}}$$

$$\left[S_f = 0.0459\right]$$

Friction Headloss:

$$h_f = S_f L$$

$$h_f = (0.0459)\,(8.0)$$

$$\left[h_f = 0.37\,ft\right]$$

Inlet Headloss:

$$h_i = \left(1 + k_{en}\right)\left(\frac{V^2}{2g}\right)$$

$$h_i = (1 + 0.2)\left(\frac{11.32^2}{2\,(32.2)}\right)$$

$$\left[h_i = 2.39\,ft\right]$$

Total Headloss:

$$h_t = h_f + h_i$$

$$h_t = 0.37 + 2.39$$

$$h_t = 2.76$$

$$\boxed{h_f = 2.8\,ft}$$

Available Head: h_a

Upstream HW Elevation: 1820.8 *ft* (14 inches below Top of Curb Elevation at Catch Basin)

14 in = 8 in (Gutter below Top of Curb) + 6 in (HW Elevation below Gutter)

Downstream HW Elevation: 1813.9 *ft* (Soffit of Proposed 84 inch Storm Drain Pipe)

$$h_a = Upstream\ HW - Downstream\ HW$$

$$h_a = 1820.8 - 1813.9$$

$$h_a = 6.9$$

$$\boxed{h_a = 6.9\,ft}$$

The available head is greater than the total headloss in the storm drain system, therefore:

The 15 inch connector pipe has sufficient capacity to convey the inlet discharge

Increase connector pipe one size (18-inch) to help convey sediment

Hawes Road Storm Drain - Catch Basin Design: CP @ STA 129+80

On-Grade Curb Opening Catch Basin Sizing:

$$L = 0.6\,Q_t^{0.42}\,S^{0.3}\left(\frac{1}{nS_e}\right)^{0.6} \quad \text{(Equation 3.10 - Drainage Design Manual for Maricopa County, Hydraulics)}$$

where;

$Q_t = Total\ Gutter\ Flow\ Rate$

$Q_t = (Q_{100}: \text{CP @ STA 129+80} + Q_{Bypass}: \text{CP @ STA 167+10})$

(*See* 'Sub-Section A5' *for 100-Year Peak Discharge Calculation*)

(*See* 'CP @ STA 167+10 - Catch Basin Design Calculations' *for Bypass Flow*)

$Q_t = 2.1 + 4.1 = 6.2\ cfs$

$L = Length\ of\ Catch\ Basin$

$S = Longitudinal\ Slope = 3.0\,\% = 0.030\ \frac{ft}{ft}$ (Existing Slope @ Inlet Location)

$n = Manning's\ Roughness\ Coefficient = 0.015$ (Typ)

$S_e = S_x + S'_w E_0$ (Equation 3.9 - Drainage Design Manual for Maricopa County, Hydraulics)

where;

$S_e = Equivalent\ Cross-Slope$

$S_x = Pavement\ Cross-Slope = 2.1\,\% = 0.021\ \frac{ft}{ft}$ (Existing Slope @ Inlet Location)

$S'_w = Gutter\ Cross-Slope\ at\ the\ Inlet = \frac{a}{W} = \frac{0.167}{1.42} = 0.118\ \frac{ft}{ft}$

$a = Gutter\ Depression\ at\ the\ Inlet = 2\ in = 0.167\ ft$

$W = Depressed\ Gutter\ Width\ at\ the\ Inlet = 1.42\ ft$

$$E_0 = \left[\frac{1}{1 + \dfrac{\frac{S_w}{S_x}}{\left(1 + \frac{\frac{S_w}{S_x}}{\frac{T}{W} - 1}\right)^{2.67} - 1}}\right] \quad \text{(Equation 3.4 - Drainage Design Manual for Maricopa County, Hydraulics)}$$

where;

$E_0 = Ratio\ of\ flow\ in\ depressed\ section\ to\ total\ gutter\ flow$

$S_w = Cross-Slope\ of\ Depressed\ Gutter = S_x + \frac{a}{W} = 0.021 + \frac{0.167}{1.42} = 0.139\ \frac{ft}{ft}$

$T = Width\ of\ Flow,\ Spread \approx 20\ ft$ (Existing Width of Oak @ Inlet Location)

$$E_0 = \left[\frac{1}{1 + \frac{\frac{S_w}{S_x}}{\left(1 + \frac{\frac{S_w}{S_x}}{\frac{T}{W} - 1}\right)^{2.67} - 1}} \right] = \left[\frac{1}{1 + \frac{\frac{0.139}{0.021}}{\left(1 + \frac{\frac{0.139}{0.021}}{\frac{20}{1.42} - 1}\right)^{2.67} - 1}} \right]$$

$$E_0 = \left[\frac{1}{1 + \left(\frac{6.62}{1.98}\right)} \right]$$

$$E_0 = 0.231$$

$$S_e = S_x + S'_w E_0$$

$$S_e = 0.021 + 0.118 \times 0.231$$

$$\left[S_e = 0.048 \frac{ft}{ft} \right]$$

$$L = 0.6 Q_t^{0.42} S^{0.3} \left(\frac{1}{n S_e} \right)^{0.6}$$

$$L = 0.6(6.2)^{0.42}(0.030)^{0.3} \left(\frac{1}{(0.015)(0.048)} \right)^{0.6}$$

$$L = 34.65\, ft$$

Catch Basin Clogging Factor :

$L_f = 1.25 \times L$ (Table 6.8 - FCDMC Drainage Policies and Standards Manual)

$$L_f = 1.25 \times L$$

$$L_f = 1.25 \times 34.65$$

$$L_f = 43.31\, ft$$

$$\boxed{\mathbf{L_f = 43.3\, ft}}$$

Capacity of Proposed On-Grade M-1, L=17' Catch Basin: CP @ STA 129+80

The Efficiency (E) of a curb-opening catch basin shorter than the length required for total interception is:

$$E = 1 - \left(1 - \frac{L}{L_f}\right)^{1.8} \quad \text{(Equation 3.8 - Drainage Design Manual for Maricopa County, Hydraulics)}$$

where;

$L = Length\ of\ proposed\ curb\ opening = 20.0\,ft$ (per COP Std. Det. P1569-1)

$L_f = Curb\ opening\ length\ required\ to\ intercept\ 100\%\ of\ the\ flow\ (includes\ reduction\ factor) = 43.3\,ft$

$$E = 1 - \left(1 - \frac{L}{L_f}\right)^{1.8}$$

$$E = 1 - \left(1 - \frac{20.0}{43.3}\right)^{1.8}$$

$[E = 0.67]$

The capacity of the Proposed M-1, L=17' Catch Basin is:

$Q_i = Q_t \times E$

where;

$Q_i = Partial\ Flow\ Intercepted$

$Q_t = Total\ Flow = 6.2\ cfs$

$Q_i = Q_t \times E$

$Q_i = 6.2 \times 0.67$

$Q_i = 4.15$

$$\boxed{\mathbf{Q_i = 4.2\ cfs}}$$

The capacity of an M-1, L=17' catch basin, at Hawes Road Storm Drain Station 129+80, on a continuous grade is approximately 4.2 cfs.

$Q_{Bypass} = Q_t - Q_i = 6.2 - 4.2$

$Q_{Bypass} = 2.0$

$$\boxed{\mathbf{Q_{Bypass} = 2.0\ cfs}}$$

The remaining 2.0 cfs bypasses the catch basin and reaches the intersection of Hawes Road and Oak Street, where it eventually flows south within Hawes Road.

Hawes Road Storm Drain - Connector Pipe Design: CP @ STA 129+80

Determine the total (friction + inlet) headloss:

$h_f = S_f L$ (Equation 4.6 - Drainage Design Manual for Maricopa County, Hydraulics)

$h_i = (1 + k_{en})\left(\frac{V^2}{2g}\right)$ (Equation 4.17 - Drainage Design Manual for Maricopa County, Hydraulics)

Try a 15 inch Reinforced Concrete Pipe:

Minimum allowable connector pipe size (Table 6.9 - FCDMC Drainage Policies and Standards Manual) *hence*;

$S_f = Pipe\ Friction\ Slope = K\frac{V^2}{2gR^{\frac{4}{3}}}$ (Equation 4.4 - Design Manual for Maricopa County, Hydraulics)

$K = Roughness\ Coefficient = \frac{2gn^2}{2.21}$ (Equation 4.5 - Design Manual for Maricopa County, Hydraulics)

$n = Manning's\ roughness\ coefficient = 0.013$ (Typ)

$g = Acceleration\ due\ to\ Gravity = 32.2\ \frac{ft}{s^2}$

$V = Velocity\ in\ Pipe = \frac{Q}{A}$

$Q = Flow\ Rate\ in\ Pipe = 4.2\ cfs$ (Interception Capacity of Inlet)

$A = Cross-Section\ area\ of\ Pipe = \pi r^2 = \pi(0.625)^2 = 0.391\pi$

$R_h = Hydraulic\ Radius = \frac{A}{W_p} = \frac{A}{2\pi r} = \frac{0.391\pi}{\pi(1.25)} = 0.313$

$L = Length\ of\ Pipe = 5.0\ ft$

$k_{en} = Entrance\ Loss\ Coefficient = 0.2$ (Table 5.1 - Design Manual for Maricopa County, Hydraulics)

$$K = \frac{2gn^2}{2.21}$$

$$K = \frac{2(32.2)(0.013)^2}{2.21}$$

$$[K = 0.0049]$$

$$V = \frac{Q}{A}$$

$$V = \frac{4.2}{0.391\pi}$$

$$\left[V = 3.42\ \frac{ft}{s}\right]$$

$$S_f = K\frac{V^2}{2gR^{\frac{4}{3}}}$$

$$S_f = (0.0049)\frac{3.42^2}{2\,(32.2)(0.313)^{\frac{4}{3}}}$$

$$\left[S_f = 0.0042\right]$$

Friction Headloss:

$$h_f = S_f L$$

$$h_f = (0.0042)\,(5.0)$$

$$\left[h_f = 0.02\,ft\right]$$

Inlet Headloss:

$$h_i = \left(1 + k_{en}\right)\left(\frac{V^2}{2g}\right)$$

$$h_i = (1 + 0.2)\left(\frac{3.42^2}{2\,(32.2)}\right)$$

$$\left[h_i = 0.22\,ft\right]$$

Total Headloss:

$$h_t = h_f + h_i$$

$$h_t = 0.02 + 0.22$$

$$h_t = 0.24$$

$$\boxed{h_f = 0.24\,ft}$$

Available Head: h_a

Upstream HW Elevation: 1802.4 *ft* (14 inches below Top of Curb Elevation at Catch Basin)

14 in = 8 in (Gutter below Top of Curb) + 6 in (HW Elevation below Gutter)

Downstream HW Elevation: 1801.5 *ft* (Soffit of Proposed 48 inch Storm Drain Pipe)

$$h_a = \textit{Upstream HW} - \textit{Downstream HW}$$

$$h_a = 1802.4 - 1801.5$$

$$h_a = 0.9$$

$$\boxed{h_a = 0.9\,ft}$$

The available head is greater than the total headloss in the storm drain system, therefore:

The 15 inch connector pipe has sufficient capacity to convey the inlet discharge

Increase connector pipe one size (18-inch) to help convey sediment

Oak Street Storm Drain - Catch Basin Design: CP @ STA 175+90

Determine if Catch Basin operates as a Weir or as an Orifice:

$d \le h \quad \Rightarrow Weir\ Flow$
$h \ge d \ge 1.4h \quad \Rightarrow Transitional\ Flow$
$d \ge 1.4h \quad \Rightarrow Orifice\ Flow$

where;

$d = Depth\ of\ Flow\ at\ the\ Catch\ Basin\ Inlet$
$d = 6\ in\ Sump + 2\ in\ Catch\ Basin\ Depression$
$d = 8\ in$
$h = Height\ of\ Curb\ Opening\ Catch\ Basin$
$h = 5\ in$

$d \ge 1.4h$
$8\ in \ge 1.4\ (5\ in)$
$8\ in \ge 7\ in$

Orifice Flow

Orifice Flow, Sump Condition, Curb Opening Catch Basin Sizing:

$Q_i = C_0\, h\, L \sqrt{2gd_0}$ (Equation 3.14 - Drainage Design Manual for Maricopa County, Hydraulics)

where;

$Q_i = Curb\ Opening\ Catch\ Basin\ Flow\ Interception\ Capacity$
$Q_i = (Q_{100} : \text{CP @ STA 175+90})$
(See 'Sub-Section A5' for 100-Year Peak Discharge Calculation)
$Q_i = 12.2\ cfs$
$C_0 = Orifice\ Coefficient = 0.67$
$h = Height\ of\ Curb\ Opening\ Catch\ Basin = 5\ in = 0.417\ ft$
$L = Length\ of\ Catch\ Basin$
$g = Gravity = 32.2\ \frac{ft}{s^2}$
$d_0 = Effective\ Depth\ at\ Center\ of\ Curb\ Opening = d - \frac{h}{2} = 8 - \frac{5}{2} = 5.5\ in = 0.458\ ft$
$d = Depth\ of\ Flow\ at\ the\ Catch\ Basin\ Inlet = 6\ in\ Curb + 2\ in\ Catch\ Basin\ Depression = 8\ in$

$$Q_i = C_0 h L \sqrt{2gd_0}$$

$$L = \frac{Q_i}{C_0 h \sqrt{2gd_0}}$$

$$L = \frac{12.2}{0.67 \times 0.417 \sqrt{2 \times 32.2 \times 0.458}}$$

$$L = 8.04 ft$$

Catch Basin Clogging Factor :

$L_f = 1.25 \times L$ (Table 6.8 - FCDMC Drainage Policies and Standards Manual)

$$L_f = 1.25 \times L$$

$$L_f = 1.25 \times 8.04$$

$$L_f = 10.05 ft$$

$$\boxed{L_f = 10.1 ft}$$

The length of the curb opening catch basin at CP @ STA 175+90 has to be greater than 10.1 feet to capture the entire 100-year peak discharge.

Oak Street Storm Drain - Connector Pipe Design: CP @ STA 175+90

Determine the total (friction + inlet) headloss:

$h_f = S_f L$ (Equation 4.6 - Drainage Design Manual for Maricopa County, Hydraulics)

$h_i = (1 + k_{en})\left(\frac{V^2}{2g}\right)$ (Equation 4.17 - Drainage Design Manual for Maricopa County, Hydraulics)

Try a 15 inch Reinforced Concrete Pipe:

Minimum allowable connector pipe size (Table 6.9 - FCDMC Drainage Policies and Standards Manual) *hence*;

$S_f = Pipe\ Friction\ Slope = K\frac{V^2}{2gR^{\frac{4}{3}}}$ (Equation 4.4 - Design Manual for Maricopa County, Hydraulics)

$K = Roughness\ Coefficient = \frac{2gn^2}{2.21}$ (Equation 4.5 - Design Manual for Maricopa County, Hydraulics)

$n = Manning's\ roughness\ coefficient = 0.013$ (Typ)

$g = Acceleration\ due\ to\ Gravity = 32.2\ \frac{ft}{s^2}$

$V = Velocity\ in\ Pipe = \frac{Q}{A}$

$Q = Flow\ Rate\ in\ Pipe = 12.2\ cfs$ (Interception Capacity of Inlet)

$A = Cross-Section\ area\ of\ Pipe = \pi r^2 = \pi(0.625)^2 = 0.391\pi$

$R_h = Hydraulic\ Radius = \frac{A}{W_p} = \frac{A}{2\pi r} = \frac{0.391\pi}{\pi(1.25)} = 0.313$

$L = Length\ of\ Pipe = 7.0\ ft$

$k_{en} = Entrance\ Loss\ Coefficient = 0.2$ (Table 5.1 - Design Manual for Maricopa County, Hydraulics)

$$K = \frac{2gn^2}{2.21}$$

$$K = \frac{2(32.2)(0.013)^2}{2.21}$$

$$[K = 0.0049]$$

$$V = \frac{Q}{A}$$

$$V = \frac{12.2}{0.391\pi}$$

$$\left[V = 9.93\ \frac{ft}{s}\right]$$

$$S_f = K\frac{V^2}{2gR^{\frac{4}{3}}}$$

$$S_f = (0.0049)\frac{9.93^2}{2\,(32.2)(0.313)^{\frac{4}{3}}}$$

$$\left[S_f = 0.0353\right]$$

Friction Headloss:

$$h_f = S_f L$$

$$h_f = (0.0353)\,(7.0)$$

$$\left[h_f = 0.25\,ft\right]$$

Inlet Headloss:

$$h_i = \left(1 + k_{en}\right)\left(\frac{V^2}{2g}\right)$$

$$h_i = (1 + 0.2)\left(\frac{9.93^2}{2\,(32.2)}\right)$$

$$\left[h_i = 1.84\,ft\right]$$

Total Headloss:

$$h_t = h_f + h_i$$

$$h_t = 0.25 + 1.84$$

$$h_t = 2.09$$

$$\boxed{h_f = 2.1\,ft}$$

Available Head: h_a

Upstream HW Elevation: 1851.7 *ft* (14 inches below Top of Curb Elevation at Catch Basin)

14 in = 8 in (Gutter below Top of Curb) + 6 in (HW Elevation below Gutter)

Downstream HW Elevation: 1844.3 *ft* (Soffit of Proposed 72 inch Storm Drain Pipe)

$$h_a = \textit{Upstream HW} - \textit{Downstream HW}$$

$$h_a = 1851.7 - 1844.3$$

$$h_a = 7.4$$

$$\boxed{h_a = 7.4\,ft}$$

The available head is greater than the total headloss in the storm drain system, therefore:

The 15 inch connector pipe has sufficient capacity to convey the inlet discharge

Increase connector pipe one size (18-inch) to help convey sediment

Oak Street Storm Drain - Catch Basin Design: CP @ STA 178+90

Determine if Catch Basin operates as a Weir or as an Orifice:

$d \le h \quad \Rightarrow Weir\ Flow$
$h \ge d \ge 1.4h \quad \Rightarrow Transitional\ Flow$
$d \ge 1.4h \quad \Rightarrow Orifice\ Flow$

where;

$d = Depth\ of\ Flow\ at\ the\ Catch\ Basin\ Inlet$
$d = 4\ in\ Sump + 2\ in\ Catch\ Basin\ Depression$
$d = 6\ in$
$h = Height\ of\ Curb\ Opening\ Catch\ Basin$
$h = 5\ in$

$h \ge d \ge 1.4h$
$5\ in \ge 6\ in \ge 1.4\ (5\ in)$
$5\ in \ge 6\ in \ge 7\ in$

Transitional Flow

Transitional Flow, Sump Condition, Curb Opening Catch Basin Sizing:

Use **Figure 3.12** from the *Maricopa County Hydraulics Design Manual* to determine the required length of the curb opening catch basin.

where;

$d = Depth\ of\ Flow\ at\ the\ Catch\ Basin\ Inlet$
$d = 4\ in\ Sump + 2\ in\ Catch\ Basin\ Depression$
$d = 6\ in = 0.5\ ft$
$Q_i = Curb\ Opening\ Catch\ Basin\ Flow\ Interception\ Capacity$
$Q_i = (Q_{100} : \text{CP @ STA 175+90})$
(See 'Sub-Section A5' for 100-Year Peak Discharge Calculation)
$Q_i = 14.2\ cfs$

From **Figure 3.12**, for a depth of flow of 0.5 feet and a discharge of 14.2 cfs, the length of curb opening catch basin needs to be:

$$L = 15.0\ ft$$

Catch Basin Clogging Factor :

$L_f = 1.25 \times L$ (Table 6.8 - FCDMC Drainage Policies and Standards Manual)

$L_f = 1.25 \times L$

$L_f = 1.25 \times 15.0$

$L_f = 18.75\,ft$

$$\boxed{L_f = 18.8\,ft}$$

The length of the curb opening catch basin at CP @ STA 178+90 has to be greater than 18.8 feet to capture the entire 100-year peak discharge.

Oak Street Storm Drain - Connector Pipe Design: CP @ STA 178+90

Determine the total (friction + inlet) headloss:

$h_f = S_f L$ (Equation 4.6 - Drainage Design Manual for Maricopa County, Hydraulics)

$h_i = (1 + k_{en})\left(\frac{V^2}{2g}\right)$ (Equation 4.17 - Drainage Design Manual for Maricopa County, Hydraulics)

Try a 15 inch Reinforced Concrete Pipe:

Minimum allowable connector pipe size (Table 6.9 - FCDMC Drainage Policies and Standards Manual)

hence;

$S_f = Pipe\ Friction\ Slope = K\frac{V^2}{2gR^{\frac{4}{3}}}$ (Equation 4.4 - Design Manual for Maricopa County, Hydraulics)

$K = Roughness\ Coefficient = \frac{2gn^2}{2.21}$ (Equation 4.5 - Design Manual for Maricopa County, Hydraulics)

$n = Manning's\ roughness\ coefficient = 0.013$ (Typ)

$g = Acceleration\ due\ to\ Gravity = 32.2\ \frac{ft}{s^2}$

$V = Velocity\ in\ Pipe = \frac{Q}{A}$

$Q = Flow\ Rate\ in\ Pipe = 14.2\ cfs$ (Interception Capacity of Inlet)

$A = Cross - Section\ area\ of\ Pipe = \pi r^2 = \pi(0.625)^2 = 0.391\pi$

$R_h = Hydraulic\ Radius = \frac{A}{W_p} = \frac{A}{2\pi r} = \frac{0.391\pi}{\pi(1.25)} = 0.313$

$L = Length\ of\ Pipe = 7.0\ ft$

$k_{en} = Entrance\ Loss\ Coefficient = 0.2$ (Table 5.1 - Design Manual for Maricopa County, Hydraulics)

$$K = \frac{2gn^2}{2.21}$$

$$K = \frac{2(32.2)(0.013)^2}{2.21}$$

$$[K = 0.0049]$$

$$V = \frac{Q}{A}$$

$$V = \frac{14.2}{0.391\pi}$$

$$\left[V = 11.56\ \frac{ft}{s}\right]$$

$$S_f = K\frac{V^2}{2gR^{\frac{4}{3}}}$$

$$S_f = (0.0049)\frac{11.56^2}{2\,(32.2)(0.313)^{\frac{4}{3}}}$$

$$\left[S_f = 0.0478\right]$$

Friction Headloss:

$$h_f = S_f L$$

$$h_f = (0.0478)\,(7.0)$$

$$\left[h_f = 0.33\,ft\right]$$

Inlet Headloss:

$$h_i = \left(1 + k_{en}\right)\left(\frac{V^2}{2g}\right)$$

$$h_i = (1 + 0.2)\left(\frac{11.56^2}{2\,(32.2)}\right)$$

$$\left[h_i = 2.49\,ft\right]$$

Total Headloss:

$$h_t = h_f + h_i$$

$$h_t = 0.33 + 2.49$$

$$h_t = 2.82$$

$$\boxed{h_f = 2.8\,ft}$$

Available Head: h_a

Upstream HW Elevation: 1859.1 *ft* (14 inches below Top of Curb Elevation at Catch Basin)

14 in = 8 in (Gutter below Top of Curb) + 6 in (HW Elevation below Gutter)

Downstream HW Elevation: 1852.9 *ft* (Soffit of Proposed 72 inch Storm Drain Pipe)

$$h_a = \textit{Upstream HW} - \textit{Downstream HW}$$

$$h_a = 1859.1 - 1852.9$$

$$h_a = 6.2$$

$$\boxed{h_a = 6.2\,ft}$$

The available head is greater than the total headloss in the storm drain system, therefore:

The 15 inch connector pipe has sufficient capacity to convey the inlet discharge

Increase connector pipe one size (18-inch) to help convey sediment

Hawes Road Storm Drain - Catch Basin Design: CP @ STA 130+30

Sump Grate Catch Basin Sizing:

$Q_i = C_w\, P\, d^{1.5}$ (Equation 3.21 - Drainage Design Manual for Maricopa County, Hydraulics)

where;

$Q_i = Grate\ Catch\ Basin\ Flow\ Interception\ Capacity$

$Q_i = (Q_{100} : \text{CP @ STA 130+30})$

(*See* 'Sub-Section A5' *for 100-Year Peak Discharge Calculation*)

$Q_i = 2.2\ cfs$

$C_w = Weir\ Coefficient = 3.0$

$P = Perimeter\ of\ the\ Grate$

$d = Depth\ of\ Flow\ at\ Inlet = Height\ of\ Raised\ Grate = 4.0\ in = 0.33\ ft$

$$Q_i = C_w\, P\, d^{1.5}$$

$$P = \frac{Q_i}{C_w\, d^{1.5}}$$

$$P = \frac{2.2}{3.0 \times 0.33^{1.5}}$$

$$P = 3.87\ ft$$

Catch Basin Clogging Factor :

$P_f = 2.0 \times P$ (Table 6.8 - FCDMC Drainage Policies and Standards Manual)

$$P_f = 2.0 \times L$$

$$P_f = 2.0 \times 3.87$$

$$P_f = 7.74\ ft$$

$$\boxed{\mathbf{P_f = 7.7\ ft}}$$

The perimeter of the grated catch basin at CP @ STA 130+30 has to be longer than 7.7 feet to capture the entire 100-year peak discharge.

Hawes Road Storm Drain - Connector Pipe Design: CP @ STA 130+30

Determine the total (friction + inlet) headloss:

$h_f = S_f L$ (Equation 4.6 - Drainage Design Manual for Maricopa County, Hydraulics)

$h_i = (1 + k_{en})\left(\frac{V^2}{2g}\right)$ (Equation 4.17 - Drainage Design Manual for Maricopa County, Hydraulics)

Try a 15 inch Reinforced Concrete Pipe:

Minimum allowable connector pipe size (Table 6.9 - FCDMC Drainage Policies and Standards Manual)

hence;

$S_f = Pipe\ Friction\ Slope = K\frac{V^2}{2gR^{\frac{4}{3}}}$ (Equation 4.4 - Design Manual for Maricopa County, Hydraulics)

$K = Roughness\ Coefficient = \frac{2gn^2}{2.21}$ (Equation 4.5 - Design Manual for Maricopa County, Hydraulics)

$n = Manning's\ roughness\ coefficient = 0.013$ (Typ)

$g = Acceleration\ due\ to\ Gravity = 32.2\ \frac{ft}{s^2}$

$V = Velocity\ in\ Pipe = \frac{Q}{A}$

$Q = Flow\ Rate\ in\ Pipe = 2.2\ cfs$ (Interception Capacity of Inlet)

$A = Cross - Section\ area\ of\ Pipe = \pi r^2 = \pi(0.625)^2 = 0.391\pi$

$R_h = Hydraulic\ Radius = \frac{A}{W_p} = \frac{A}{2\pi r} = \frac{0.391\pi}{\pi(1.25)} = 0.313$

$L = Length\ of\ Pipe = 7.0\ ft$

$k_{en} = Entrance\ Loss\ Coefficient = 0.2$ (Table 5.1 - Design Manual for Maricopa County, Hydraulics)

$$K = \frac{2gn^2}{2.21}$$

$$K = \frac{2(32.2)(0.013)^2}{2.21}$$

$$[K = 0.0049]$$

$$V = \frac{Q}{A}$$

$$V = \frac{2.2}{0.391\pi}$$

$$\left[V = 1.79\ \frac{ft}{s}\right]$$

$$S_f = K\frac{V^2}{2gR^{\frac{4}{3}}}$$

$$S_f = (0.0049)\frac{1.79^2}{2\,(32.2)(0.313)^{\frac{4}{3}}}$$

$$\left[S_f = 0.0011\right]$$

Friction Headloss:

$$h_f = S_f L$$

$$h_f = (0.0011)(7.0)$$

$$\left[h_f = 0.01\,ft\right]$$

Inlet Headloss:

$$h_i = \left(1 + k_{en}\right)\left(\frac{V^2}{2g}\right)$$

$$h_i = (1 + 0.2)\left(\frac{1.79^2}{2\,(32.2)}\right)$$

$$\left[h_i = 0.06\,ft\right]$$

Total Headloss:

$$h_t = h_f + h_i$$

$$h_t = 0.01 + 0.06$$

$$h_t = 0.07$$

$$\boxed{h_f = 0.07\,ft}$$

Available Head: h_a

Upstream HW Elevation: 1803.0 *ft* (6 inches below Concrete Apron Elevation)

Downstream HW Elevation: 1801.6 *ft* (Soffit of Proposed 48 inch Storm Drain Pipe)

$$h_a = \textit{Upstream HW} - \textit{Downstream HW}$$

$$h_a = 1803.0 - 1801.6$$

$$h_a = 1.4$$

$$\boxed{h_a = 1.4\,ft}$$

The available head is greater than the total headloss in the storm drain system, therefore:

The 15 inch connector pipe has sufficient capacity to convey the inlet discharge

Increase connector pipe one size (18-inch) to help convey sediment

Oak Street Storm Drain - Catch Basin Design: CP @ STA 164+95

Sump Grate Catch Basin Sizing:

$Q_i = C_w P d^{1.5}$ (Equation 3.21 - Drainage Design Manual for Maricopa County, Hydraulics)

where;

$Q_i = Grate\ Catch\ Basin\ Flow\ Interception\ Capacity$

$Q_i = (Q_{100} : \text{CP @ STA 164+95})$

(*See* 'Sub-Section A5' *for 100-Year Peak Discharge Calculation*)

$Q_i = 3.5\ cfs$

$C_w = Weir\ Coefficient = 3.0$

$P = Perimeter\ of\ the\ Grate$

$d = Depth\ of\ Flow\ at\ Inlet = Height\ of\ Raised\ Grate = 4.0\ in = 0.33\ ft$

$$Q_i = C_w P d^{1.5}$$

$$P = \frac{Q_i}{C_w d^{1.5}}$$

$$P = \frac{3.5}{3.0 \times 0.33^{1.5}}$$

$$P = \frac{3.5}{3.0 \times 0.33^{1.5}}$$

$$P = 6.15\ ft$$

Catch Basin Clogging Factor :

$P_f = 2.0 \times P$ (Table 6.8 - FCDMC Drainage Policies and Standards Manual)

$$P_f = 2.0 \times L$$

$$P_f = 2.0 \times 6.15$$

$$P_f = 12.3\ ft$$

$$\boxed{\mathbf{P_f = 12.3\ ft}}$$

The perimeter of the grated catch basin at CP @ STA 164+95 has to be longer than 12.3 feet to capture the entire 100-year peak discharge.

Oak Street Storm Drain - Connector Pipe Design: CP @ STA 164+95

Determine the total (friction + inlet) headloss:

$h_f = S_f L$ (Equation 4.6 - Drainage Design Manual for Maricopa County, Hydraulics)

$h_i = (1 + k_{en})\left(\frac{V^2}{2g}\right)$ (Equation 4.17 - Drainage Design Manual for Maricopa County, Hydraulics)

Try a 15 inch Reinforced Concrete Pipe:

Minimum allowable connector pipe size (Table 6.9 - FCDMC Drainage Policies and Standards Manual)

hence;

$S_f = Pipe\ Friction\ Slope = K\frac{V^2}{2gR^{\frac{4}{3}}}$ (Equation 4.4 - Design Manual for Maricopa County, Hydraulics)

$K = Roughness\ Coefficient = \frac{2gn^2}{2.21}$ (Equation 4.5 - Design Manual for Maricopa County, Hydraulics)

$n = Manning's\ roughness\ coefficient = 0.013$ (Typ)

$g = Acceleration\ due\ to\ Gravity = 32.2\ \frac{ft}{s^2}$

$V = Velocity\ in\ Pipe = \frac{Q}{A}$

$Q = Flow\ Rate\ in\ Pipe = 3.5\ cfs$ (Interception Capacity of Inlet)

$A = Cross - Section\ area\ of\ Pipe = \pi r^2 = \pi(0.625)^2 = 0.391\pi$

$R_h = Hydraulic\ Radius = \frac{A}{W_p} = \frac{A}{2\pi r} = \frac{0.391\pi}{\pi(1.25)} = 0.313$

$L = Length\ of\ Pipe = 25.0\ ft$

$k_{en} = Entrance\ Loss\ Coefficient = 0.2$ (Table 5.1 - Design Manual for Maricopa County, Hydraulics)

$$K = \frac{2gn^2}{2.21}$$

$$K = \frac{2(32.2)(0.013)^2}{2.21}$$

$$[K = 0.0049]$$

$$V = \frac{Q}{A}$$

$$V = \frac{3.5}{0.391\pi}$$

$$\left[V = 2.85\ \frac{ft}{s}\right]$$

$$S_f = K\frac{V^2}{2gR^{\frac{4}{3}}}$$

$$S_f = (0.0049)\frac{2.85^2}{2\,(32.2)(0.313)^{\frac{4}{3}}}$$

$$\left[S_f = 0.0026\right]$$

Friction Headloss:

$$h_f = S_f L$$

$$h_f = (0.0026)(25.0)$$

$$\left[h_f = 0.07\,ft\right]$$

Inlet Headloss:

$$h_i = \left(1 + k_{en}\right)\left(\frac{V^2}{2g}\right)$$

$$h_i = (1 + 0.2)\left(\frac{2.85^2}{2\,(32.2)}\right)$$

$$\left[h_i = 0.15ft\right]$$

Total Headloss:

$$h_t = h_f + h_i$$

$$h_t = 0.07 + 0.15$$

$$h_t = 0.22$$

$$\boxed{h_f = 0.22\,ft}$$

Available Head: h_a

Upstream HW Elevation: 1815.0 *ft* (6 inches below Top of Grate Elevation)

Downstream HW Elevation: 1808.3 *ft* (Soffit of Proposed 84 inch Storm Drain Pipe)

$$h_a = Upstream\ HW - Downstream\ HW$$

$$h_a = 1815.0 - 1808.3$$

$$h_a = 6.7$$

$$\boxed{h_a = 6.7\,ft}$$

The available head is greater than the total headloss in the storm drain system, therefore:

The 15 inch connector pipe has sufficient capacity to convey the inlet discharge

Increase connector pipe one size (18-inch) to help convey sediment

Sub-Section B3: **Sediment Analysis**

Grain Size Distribution Curves

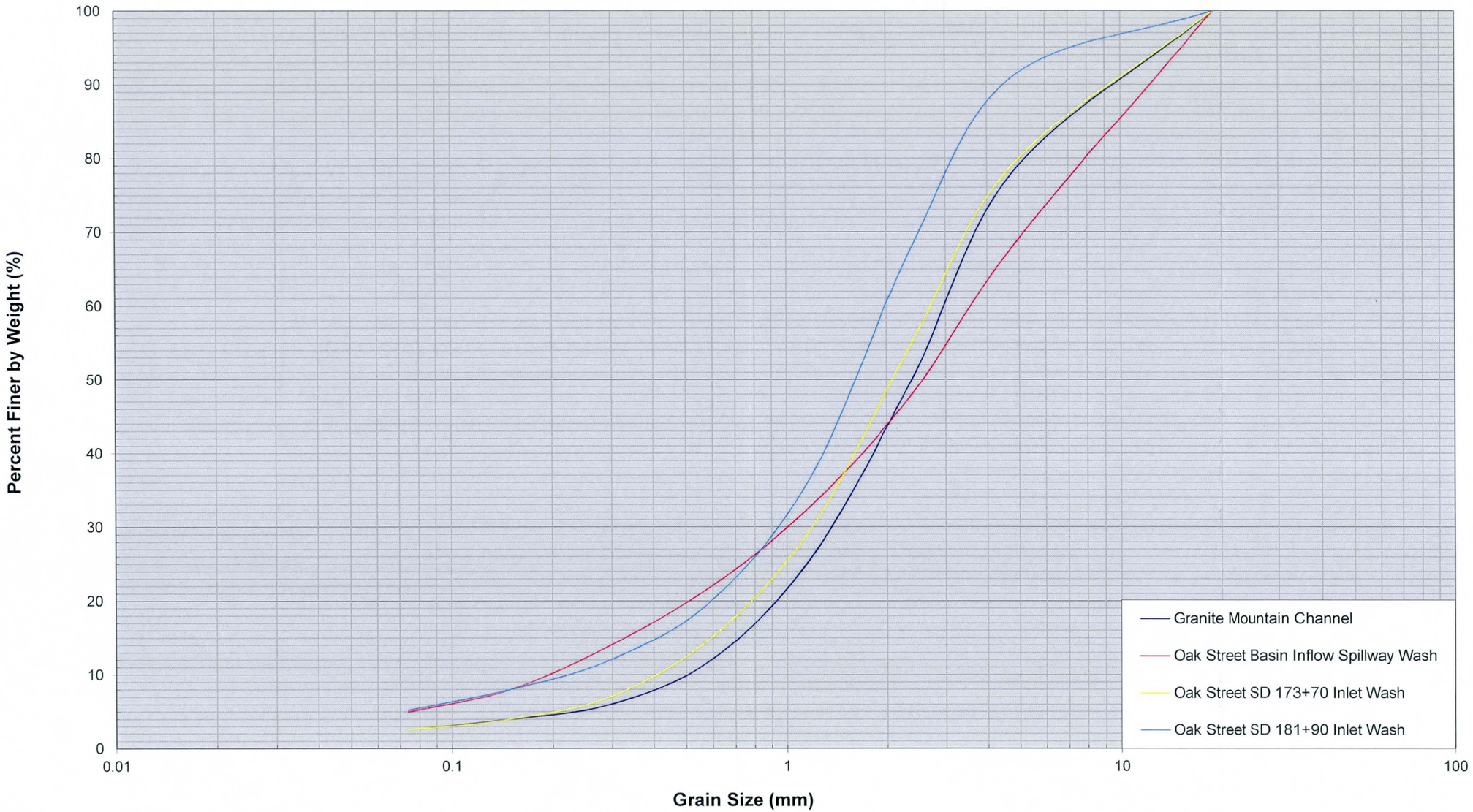


Figure B3.1: Grain Size Distribution Curves

Granite Mountain Channel: Contributing Bed Material Discharge

$Q_s = q_s W$ (Zeller-Fullerton Equation - Hydraulic Drainage Design Manual: *Equation* 11.43)

where;

$$q_s = 0.0064\left(\frac{n^{1.77} V_a^{4.32} G^{0.45}}{Y_h^{0.3} D_{50}^{0.61}}\right)$$

$Q_s = Total\ bed\ material\ discharge$

$q_s = Total\ unit\ bed\ material\ discharge$

$n = Manning's\ roughness\ coefficient = 0.035$

Note: The following channel hydraulic parameters were taken from the *Granite Mountain Channel* HEC-RAS model (River Station: 14). The model and the pertinent information can be found in Sub-Section B5 and Table B5.1

$V_a = Average\ channel\ velocity = 8.0\ \frac{ft}{s}$

$Y_h = Channel\ hydraulic\ depth = 0.9\ \frac{ft}{s}$

$W = Flow\ average\ width = 15.5\ ft$

Note: The following soil parameters were taken from the grain size distribution curve for the Granite Mountain Channel in Figure B3.1

$D_{50} = Median\ diameter \approx 2.24\ mm$

$$G = Gradation\ coefficient = \frac{1}{2}\left(\frac{D_{84.1}}{D_{50}} + \frac{D_{50}}{D_{15.9}}\right) = \frac{1}{2}\left(\frac{6.26}{2.24} + \frac{2.24}{0.78}\right) = 2.83$$

$D_{15.9} \approx 0.78\ mm$

$D_{84.1} \approx 6.26\ mm$

$Q_s = q_s W$

$$Q_s = 0.0064\left(\frac{n^{1.77} V_a^{4.32} G^{0.45}}{Y_h^{0.3} D_{50}^{0.61}}\right) \times W$$

$$Q_s = 0.0064\left(\frac{0.035^{1.77} \times 8.0^{4.32} \times 2.83^{0.45}}{0.9^{0.3} \times 2.24^{0.61}}\right) \times 15.5$$

$Q_s = 0.136 \times 15.5$

$Q_s = 2.11$

$$\boxed{Q_s = 2.1\ cfs}$$

Granite Mountain Channel: Hawes Road SD (STA 136+57 - 144+28) Sediment Discharge Rate

$$Q_{max} = 21.44\, d_s^{-1.02}\, S^{2.52}\, R^{1.52}\, A \quad (Equation\ 7.62)$$

(Graf and Acaroglu Equation - Engineering Analysis of Fluvial Systems, by Simons, Li & Associates)

where;

$Q_{max} = Maximum\ sediment\ discharge\ rate\ conveyed\ by\ a\ closed\ conduit$

$d_s = Mean\ grain\ size \approx 2.24\ mm \times \frac{1\ ft}{304.8\ mm} = 0.0073\ ft$

$S = Storm\ Drain\ Slope = 0.0254\ \frac{ft}{ft}$ (Per Design Plans)

Note: The following storm drain hydraulic parameters were taken from the *Hawes Road SD* (*STA 136+57-144+28*) HEC-RAS model. The pertinent information can be obtained from Table B1.3 at the location where the flow area and hydraulic radius are at its lowest (worst case).

$A = Flow\ Area = 6.6\ ft^2$

$R = Hydraulic\ Radius = 1.02\ ft$

$$Q_{max} = 21.44(0.0073)^{-1.02}(0.0254)^{2.52}(1.02)^{1.52}(6.6)$$

$$Q_{max} = 2.11$$

$$\boxed{Q_{max} = 2.1\ cfs}$$

This shows that the 48-inch Hawes Road storm drain segment has a sufficient sediment discharge rate (2.1 cfs) to pass the contributing bed material discharge (2.1 cfs) from the Granite Mountain Channel.

Oak Street SD 181+90 Inlet Wash: Contributing Bed Material Discharge

$Q_s = q_s W$ (Zeller-Fullerton Equation - Hydraulic Drainage Design Manual: *Equation* 11.43)

where;

$$q_s = 0.0064\left(\frac{n^{1.77} V_a^{4.32} G^{0.45}}{Y_h^{0.3} D_{50}^{0.61}}\right)$$

$Q_s = Total\ bed\ material\ discharge$

$q_s = Total\ unit\ bed\ material\ discharge$

$n = Manning's\ roughness\ coefficient = 0.035$

Note: The following channel hydraulic parameters were taken from the *Oak Street SD 181+90 Inlet Wash* HEC-RAS model, (River Station: 73). The model and the pertinent information can be found at the end of this section (Sub-Section B3).

$V_a = Average\ channel\ velocity = 7.9\ \frac{ft}{s}$

$Y_h = Channel\ hydraulic\ depth = 2.1\ \frac{ft}{s}$

$W = Flow\ average\ width = 20.0\ ft$

Note: The following soil parameters were taken from the grain size distribution curve for the Oak Street SD 181+90 Inlet Wash in Figure B3.1

$D_{50} = Median\ diameter \approx 1.60\ mm$

$$G = Gradation\ coefficient = \frac{1}{2}\left(\frac{D_{84.1}}{D_{50}} + \frac{D_{50}}{D_{15.9}}\right) = \frac{1}{2}\left(\frac{3.54}{1.60} + \frac{1.60}{0.46}\right) = 2.85$$

$D_{15.9} \approx 0.46\ mm$

$D_{84.1} \approx 3.54\ mm$

$Q_s = q_s W$

$$Q_s = 0.0064\left(\frac{n^{1.77} V_a^{4.32} G^{0.45}}{Y_h^{0.3} D_{50}^{0.61}}\right) \times W$$

$$Q_s = 0.0064\left(\frac{0.035^{1.77} \times 7.9^{4.32} \times 2.85^{0.45}}{2.1^{0.3} \times 1.60^{0.61}}\right) \times 20.0$$

$Q_s = 0.123 \times 20.0$

$Q_s = 2.46$

$$\boxed{Q_s = 2.5\ cfs}$$

Oak Street SD 181+90 Inlet Wash: Oak Street SD (STA 173+70 - 182+35) Sediment Discharge Rate

$$Q_{max} = 21.44\, d_s^{-1.02}\, S^{2.52}\, R^{1.52}\, A \quad (Equation\ 7.62)$$

(Graf and Acaroglu Equation - Engineering Analysis of Fluvial Systems, by Simons, Li & Associates)

where;

$Q_{max} = Maximum\ sediment\ discharge\ rate\ conveyed\ by\ a\ closed\ conduit$

$d_s = Mean\ grain\ size \approx 1.60\ mm \times \frac{1\ ft}{304.8\ mm} = 0.0052\ ft$

$S = Storm\ Drain\ Slope = 0.0150\ \frac{ft}{ft}$ (Per Design Plans)

Note: The following storm drain hydraulic parameters were taken from the *Oak Street SD (STA 173+70 - 182+35)* HEC-RAS model. The pertinent information can be obtained from Table B1.8 at the location where the flow area and hydraulic radius are at its lowest (worst case).

$A = Flow\ Area = 19.8\ ft^2$

$R = Hydraulic\ Radius = 1.74\ ft$

$$Q_{max} = 21.44(0.0052)^{-1.02}(0.0150)^{2.52}(1.74)^{1.52}(19.8)$$

$$Q_{max} = 5.33$$

$$\boxed{Q_{max} = 5.3\ cfs}$$

This shows that the 72-inch Oak Street storm drain segment has a sufficient sediment discharge rate (5.3 cfs) to pass the contributing bed material discharge (2.5 cfs) from the Oak Street SD 181+90 Inlet Wash.

Oak Street SD 173+70 Inlet Wash: Contributing Bed Material Discharge

$Q_s = q_s W$ (Zeller-Fullerton Equation - Hydraulic Drainage Design Manual: *Equation* 11.43)

where;

$$q_s = 0.0064\left(\frac{n^{1.77} V_a^{4.32} G^{0.45}}{Y_h^{0.3} D_{50}^{0.61}}\right)$$

$Q_s = Total\ bed\ material\ discharge$

$q_s = Total\ unit\ bed\ material\ discharge$

$n = Manning's\ roughness\ coefficient = 0.035$

Note: The following channel hydraulic parameters were taken from the *Oak Street SD 173+70 Inlet Wash* HEC-RAS model, (River Station: 89). The model and the pertinent information can be found at the end of this section (Sub-Section B3).

$V_a = Average\ channel\ velocity = 6.6\ \frac{ft}{s}$

$Y_h = Channel\ hydraulic\ depth = 1.0\ \frac{ft}{s}$

$W = Flow\ average\ width = 19.0\ ft$

Note: The following soil parameters were taken from the grain size distribution curve for the Oak Street SD 173+70 Inlet Wash in Figure B3.1

$D_{50} = Median\ diameter \approx 2.06\ mm$

$$G = Gradation\ coefficient = \frac{1}{2}\left(\frac{D_{84.1}}{D_{50}} + \frac{D_{50}}{D_{15.9}}\right) = \frac{1}{2}\left(\frac{6.18}{2.06} + \frac{2.06}{0.63}\right) = 3.13$$

$D_{15.9} \approx 0.63\ mm$

$D_{84.1} \approx 6.18\ mm$

$$Q_s = q_s W$$

$$Q_s = 0.0064\left(\frac{n^{1.77} V_a^{4.32} G^{0.45}}{Y_h^{0.3} D_{50}^{0.61}}\right) \times W$$

$$Q_s = 0.0064\left(\frac{0.035^{1.77} \times 6.6^{4.32} \times 3.13^{0.45}}{1.0^{0.3} \times 2.06^{0.61}}\right) \times 19.0$$

$$Q_s = 0.063 \times 19.0$$

$$Q_s = 1.20$$

$$\boxed{Q_s = 1.2\ cfs}$$

Oak Street SD 173+70 Inlet Wash: Oak Street SD (STA 173+70 Inlet) Sediment Discharge Rate

$$Q_{max} = 21.44\, d_s^{-1.02}\, S^{2.52}\, R^{1.52}\, A \quad (Equation\ 7.62)$$

(Graf and Acaroglu Equation - Engineering Analysis of Fluvial Systems, by Simons, Li & Associates)

where;

$Q_{max} = Maximum\ sediment\ discharge\ rate\ conveyed\ by\ a\ closed\ conduit$

$d_s = Mean\ grain\ size \approx 2.06\ mm \times \frac{1\ ft}{304.8\ mm} = 0.0068\ ft$

$S = Storm\ Drain\ Slope = 0.0235\ \frac{ft}{ft}$ (Per Design Plans)

Note: The following storm drain hydraulic parameters were taken from the *Oak Street SD* (STA 173+70 *Inlet*) HEC-RAS model. The pertinent information can be obtained from Table B1.10 at the location where the flow area and hydraulic radius are at its lowest (worst case).

$A = Flow\ Area = 23.8\ ft^2$

$R = Hydraulic\ Radius = 1.38\ ft$

$$Q_{max} = 21.44(0.0068)^{-1.02}(0.0235)^{2.52}(1.38)^{1.52}(23.8)$$

$$Q_{max} = 10.63$$

$$\boxed{Q_{max} = 10.6\ cfs}$$

This shows that the 66-inch Oak Street storm drain segment has a sufficient sediment discharge rate (10.6 cfs) to pass the contributing bed material discharge (1.2 cfs) from the Oak Street SD 173+70 Inlet Wash.

Oak Street SD (STA 163+82 - 165+50 & STA 165+50 - 173+70) Sediment Discharge Rate

$$Q_{max} = 21.44\, d_s^{-1.02}\, S^{2.52}\, R^{1.52}\, A \quad (Equation\ 7.62)$$

(Graf and Acaroglu Equation - Engineering Analysis of Fluvial Systems, by Simons, Li & Associates)

where;

$Q_{max} = Maximum\ sediment\ discharge\ rate\ conveyed\ by\ a\ closed\ conduit$

$d_s = Mean\ grain\ size \approx 2.06\ mm \times \frac{1\ ft}{304.8\ mm} = 0.0068\ ft$

Note: There are two washes contributing sediment to this storm drain segment. As is evident from the above equation (Equation 7.62), the wash with the coarser mean grain size will produce a smaller sediment discharge rate through the storm drain. Therefore, the soil parameters from the grain size distribution curve for the Oak Street SD 173+70 Inlet Wash in Figure B3.1 will be used in this calculation to show the smallest capacity (worst case) of the storm drain section.

$S = Storm\ Drain\ Slope = 0.011\ \frac{ft}{ft}$ (Per Design Plans)

Note: The following storm drain hydraulic parameters were taken from the *Oak Street SD (STA 163+82 - 165+50 & STA 165+50 - 173+70)* HEC-RAS models. The pertinent information can be obtained from Table B1.6 and Table B1.7 at the location where the flow area and hydraulic radius are at its lowest (worst case).

$A = Flow\ Area = 31.4\ ft^2$

$R = Hydraulic\ Radius = 2.11\ ft$

$$Q_{max} = 21.44(0.0068)^{-1.02}(0.011)^{2.52}(2.11)^{1.52}(31.4)$$

$$Q_{max} = 3.95$$

$$\boxed{Q_{max} = 4.0\ cfs}$$

This shows that the 84-inch Oak Street storm drain segment, downstream of the two major drop inlets, has a sufficient sediment discharge rate (4.0 cfs) to pass the contributing bed material discharge (1.2 + 2.5 = 3.7 cfs) from the Oak Street SD 181+90 Inlet Wash and the Oak Street SD 173+70 Inlet Wash.

Oak Street Basin Inflow Spillway Wash: Contributing Bed Material Discharge

$Q_s = q_s W$ (Zeller-Fullerton Equation - Hydraulic Drainage Design Manual: *Equation* 11.43)

where;

$$q_s = 0.0064\left(\frac{n^{1.77} V_a^{4.32} G^{0.45}}{Y_h^{0.3} D_{50}^{0.61}}\right)$$

$Q_s = Total\ bed\ material\ discharge$

$q_s = Total\ unit\ bed\ material\ discharge$

$n = Manning's\ roughness\ coefficient = 0.035$

Note: The following channel hydraulic parameters were taken from the *Oak Street Basin Inflow Analysis* HEC-RAS model (River Station: 317.6). The model can be found in Sub-Section B7 and the pertinent information can be obtained from Table B7.1

$V_a = Average\ channel\ velocity = 3.8\ \frac{ft}{s}$

$Y_h = Channel\ hydraulic\ depth = 0.4\ \frac{ft}{s}$

$W = Flow\ average\ width = 63.3\ ft$

Note: The following soil parameters were taken from the grain size distribution curve for the Oak Street Basin Inflow Spillway Wash in Figure B3.1

$D_{50} = Median\ diameter \approx 2.52\ mm$

$$G = Gradation\ coefficient = \frac{1}{2}\left(\frac{D_{84.1}}{D_{50}} + \frac{D_{50}}{D_{15.9}}\right) = \frac{1}{2}\left(\frac{9.39}{2.52} + \frac{2.52}{0.36}\right) = 5.36$$

$D_{15.9} \approx 0.36\ mm$

$D_{84.1} \approx 9.39\ mm$

$$Q_s = q_s W$$

$$Q_s = 0.0064\left(\frac{n^{1.77} V_a^{4.32} G^{0.45}}{Y_h^{0.3} D_{50}^{0.61}}\right) \times W$$

$$Q_s = 0.0064\left(\frac{0.035^{1.77} \times 3.8^{4.32} \times 5.36^{0.45}}{0.4^{0.3} \times 2.52^{0.61}}\right) \times 63.3$$

$$Q_s = 0.0086 \times 63.3$$

$$Q_s = 0.55$$

$$\boxed{Q_s = 0.6\ cfs}$$

Sediment Calculations: Total Wash Load at the Basin

$$Y_s = \alpha \left(V q_p\right)^{\beta} K\, LS\, C\, P$$

(Modified Universal Soil Loss Equation - Hydraulic Drainage Design Manual: *Equation* 11.37)

where;

$Y_s = Watershed\ soil\ erosion\ for\ a\ particular\ return\ period$

$V = Runoff\ volume\ for\ a\ particular\ return\ period = 31\ ac-ft$

Peak Volume at the Oak Street Detention Basin (See Exhibit A4.2)

$q_p = Peak\ flow\ rate\ for\ a\ particular\ return\ period = 830\ cfs$

Peak Inflow at the Oak Street Detention Basin (See Exhibit A4.2)

$\alpha = 95$

$\beta = 0.56$

$K = Soil\ erodibility\ factor = 0.11$

Area weighted from the soil erodibility factors found in the NRCS Soil Resources Report.

$$LS = Topographic\ factor = \left(\frac{\lambda}{72.6}\right)^{n} \left(0.065 + 0.0454\,S + 0.0065\,S^2\right) \left(Equation\ 11.38\right)$$

$\lambda = Slope\ Length = 2250\ ft$ (Obtained from a representative Sub-Basin: 385F)

$S = Percent\ Slope = 4.3\ \%$ (Obtained from a representative Sub-Basin: 385F)

$n = Slope\ Exponent = 0.4$

$$LS = \left(\frac{\lambda}{72.6}\right)^{n} \left(0.065 + 0.0454\,S + 0.0065\,S^2\right)$$

$$LS = \left(\frac{2250}{72.6}\right)^{0.4} \left(0.065 + 0.0454\,(4.3) + 0.0065(4.3)^2\right)$$

$$LS = 1.50$$

$$C = Cover\ and\ management\ factor = C_1\, C_2\, C_3 \quad \left(Equation\ 11.39\right)$$

$C_1 = Type\ I - Effects\ of\ canopy\ cover = 0.9$

From Figure 11.24, for 20% ground covered with average fall height of 2 meters (6 feet)

$C_2 = Type\ II - Effects\ of\ close - growing\ ground\ vegetation = 0.6$

From Figure 11.25, for 20% ground covered with close-growing ground vegetation

$C_3 = Type\ III - Residual\ effects\ of\ the\ land\ use = 0.45$

From Figure 11.26, for no (0%) root network in topsoil

$$C = C_1\, C_2\, C_3$$

$$C = 0.9 \times 0.6 \times 0.45$$

$$C = 0.24$$

$P = Erosion\ control\ practice\ factor = 1.0$ (Typically 1.0 in wild land areas)

$$Y_s = \alpha \left(V q_p\right)^{\beta} K\,LS\,C\,P$$

$$Y_s = 95(31 \times 830)^{0.56}(0.11)(1.5)(0.24)(1.0)$$

$$Y_s = 1109.9\,tons$$

$$\boxed{Y_s = \mathbf{1110}\,\boldsymbol{tons}}$$

Sediment Calculations: Sediment Deliver Ration Calculation

Table 11.8 in the Flood Control District Hydraulics Manual shows that for a drainage area of 1.0 square miles, the recommended Sediment Delivery Ration (SDR) is 0.61 (61%).

Total Bed Material Load at the Oak Street Basin

$Q_s = 2.1\ cfs$ (Bed Material Discharge from Hawes Road Storm Drain)
$Q_s = 3.7\ cfs$ (Bed Material Discharge from the Oak Street Storm Drain)
$Q_s = 0.6\ cfs$ (Bed Material Discharge from the Oak Street Basin Inflow Spillway)

$Q_S = \sum Q_s$
$Q_S = 2.1 + 3.7 + 0.6$
$Q_S = 6.4\ cfs$

$$\boxed{Q_S = 6.4\ cfs}$$

Total Bed Material Volume at the Oak Street Basin

$V_s = V_w \left(\frac{Q_S}{Q}\right)$ (Total Bed Material Volume Equation – *Hydraulic Drainage Design Manual*: *Equation* 11.32)

where;

$V_s = Bed\ material\ sediment\ volume$
$V_w = Total\ volume\ of\ water = 31\ ac - ft$ (See Exhibit A4.2)
$Q_S = Total\ bed\ material\ discharge = 6.4\ cfs$
$Q = Peak\ discharge\ into\ the\ Basin = 830\ cfs$ (See Exhibit A4.2)

$V_s = V_w \left(\frac{Q_S}{Q}\right)$

$V_s = 31 \left(\frac{6.4}{830}\right)$

$V_s = 0.24$

$$\boxed{V_s = 0.24\ ac - ft}$$

Total Wash Load Volume at the Oak Street Basin

$Y_s = 1110\ tons$

Convert to volume in order to add to the total bed material load. To convert the weight into a volume, the bulk specific weight for the sediment deposits needs to be calculated.

$$\gamma = 100.5 + 20.44 \log_{10}\left(D_{50}\right)$$

where;

$\gamma = Bulk\ specific\ weight\ for\ sediment\ deposit$

$D_{50} = Median\ sediment\ size\ (Use\ coarsest\ median\ sediment\ size) = 2.52\ mm$

$$\gamma = 100.5 + 20.44 \log_{10}(2.52)$$

$$\gamma = 108.7\ \frac{lb}{ft^3}$$

$$Y_s = 1110\ tons \times \frac{2000\ lb}{1\ ton} \times \frac{1\ ft^3}{108.7\ lb} \times \frac{1\ ac}{43560\ ft^2}$$

$$Y_s = 0.47$$

$$\boxed{Y_s = 0.47\ ac - ft}$$

Total Sediment Yield for the 100-yr Return Period at the Oak Street Basin

$$V_{SY} = V_s + (SDR)\,Y_s$$

where;

$V_{SY} = Total\ Sediment\ Yield\ Volume$

$V_s = Total\ bed\ material\ volume\ at\ the\ Basin = 0.24\ ac - ft$

$Y_s = Total\ wash\ load\ volume\ at\ the\ Basin = 0.47\ ac - ft$

$SDR = Sediment\ Deliver\ Ratio = 61\ \% = 0.61$

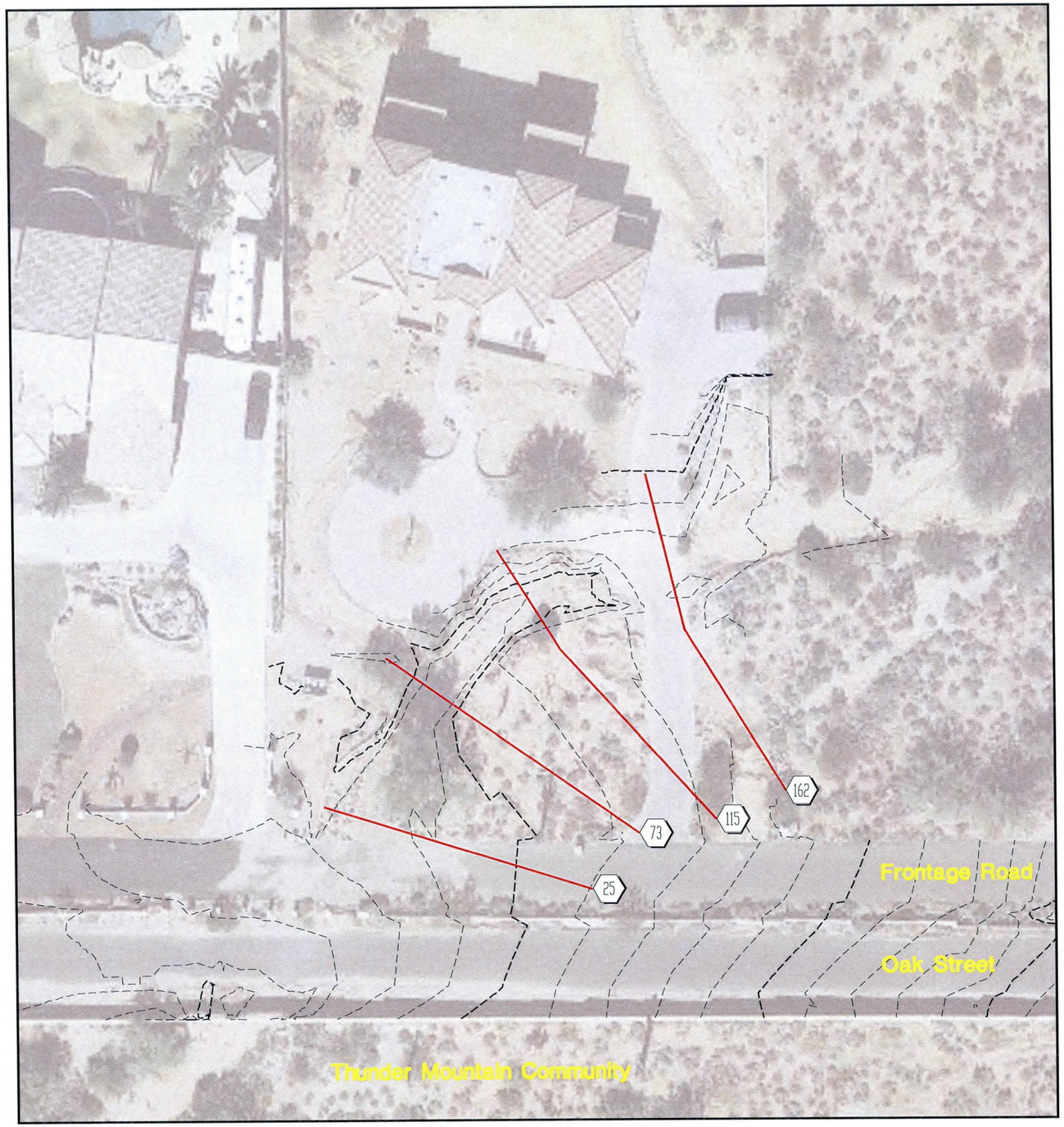
$$V_{SY} = V_s + (SDR)\,Y_s$$

$$V_{SY} = 0.24 + (0.61)\,0.47$$

$$V_{SY} = 0.527$$

$$\boxed{V_{SY} = 0.53\ ac - ft}$$

The provided one foot of freeboard in the Oak Street Basin has a volume of approximately 3.7 ac-ft, which is sufficient to accommodate the total sediment yield for the 100-yr flood.



LEGEND

HEC-RAS Cross-Section Location

435 HEC-RAS Cross-Section Identifier

GRAPHIC SCALE

20 0 10 20 40

SCALE: 1"=20 FT.

Gavan & Barker Inc.

Gavan & Barker, Inc.
3030 N. Central Ave.
Suite 1530
Phoenix, Arizona 85012
Phone: 602-200-0031
Fax: 602-200-0032

Civil Engineering
Landscape Architecture

Project:

Oak Street Basin and Storm Drain Design

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CONTRACT FCD - 2009C021

Submittal:

G&B No.	0912
Issue Date:	04/11
Drawn By:	OK
Checked By:	MTG

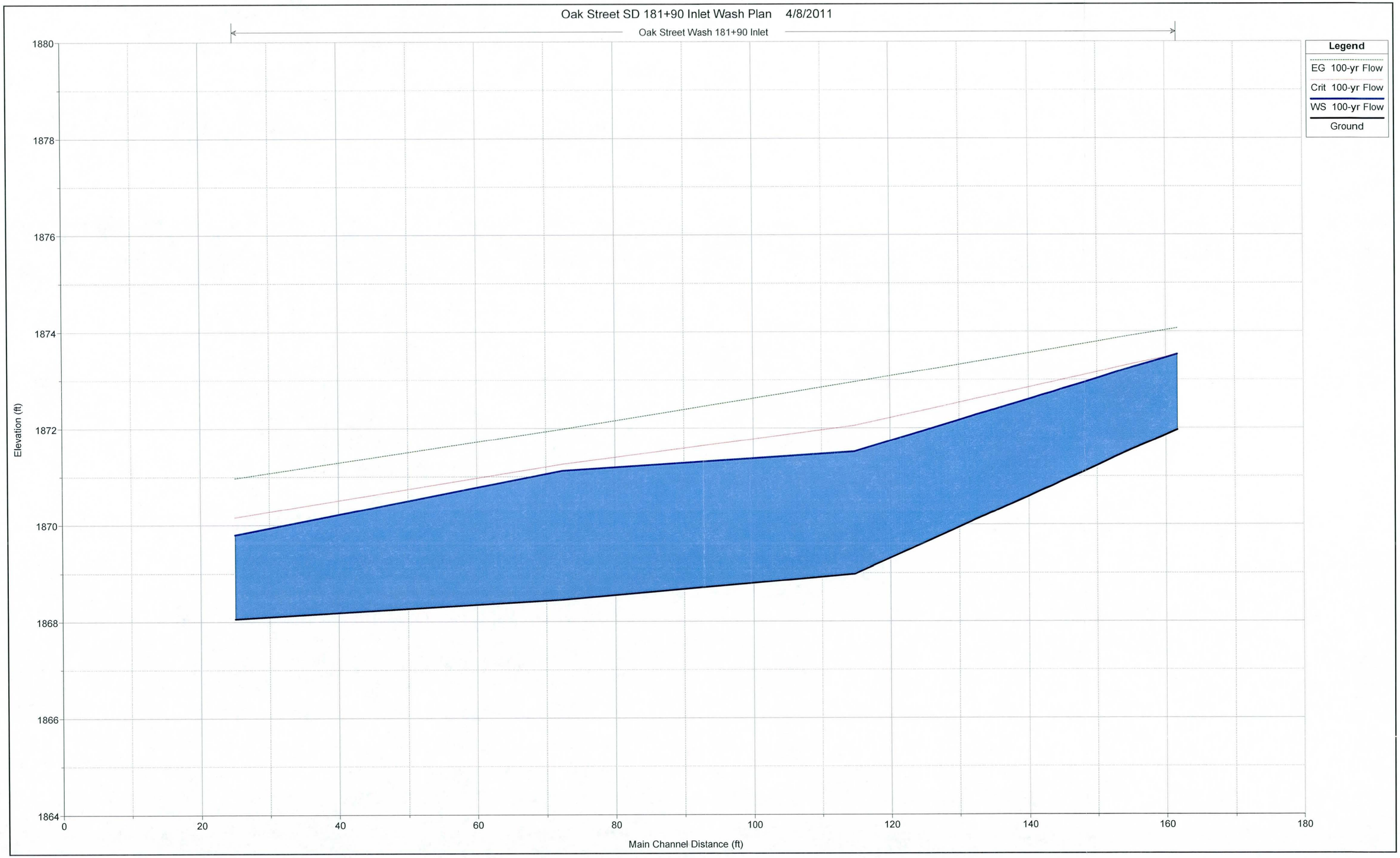
Sheet Title:

Oak Street SD 181+90 Inlet Wash Location Map

Page Number:

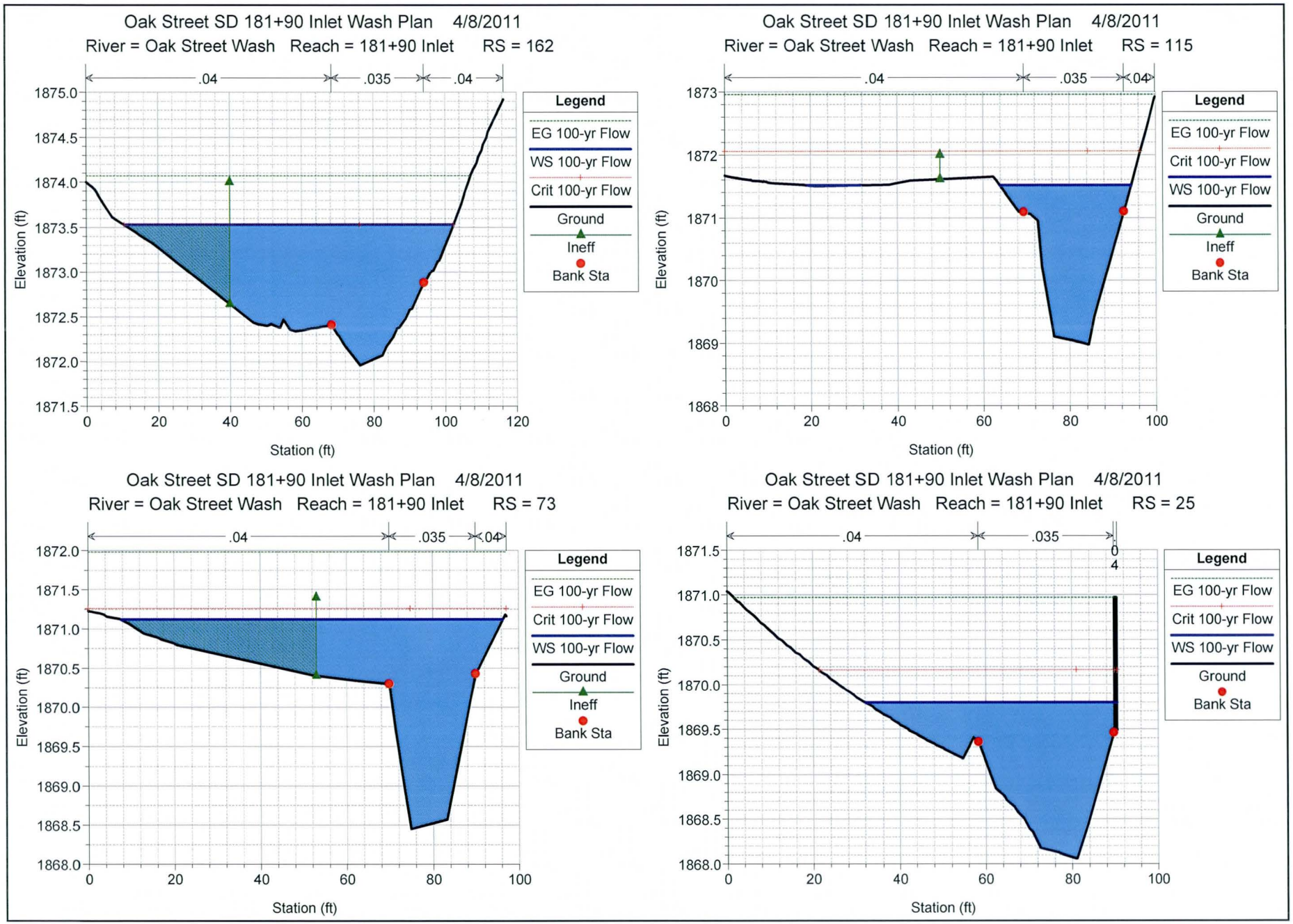
-343-

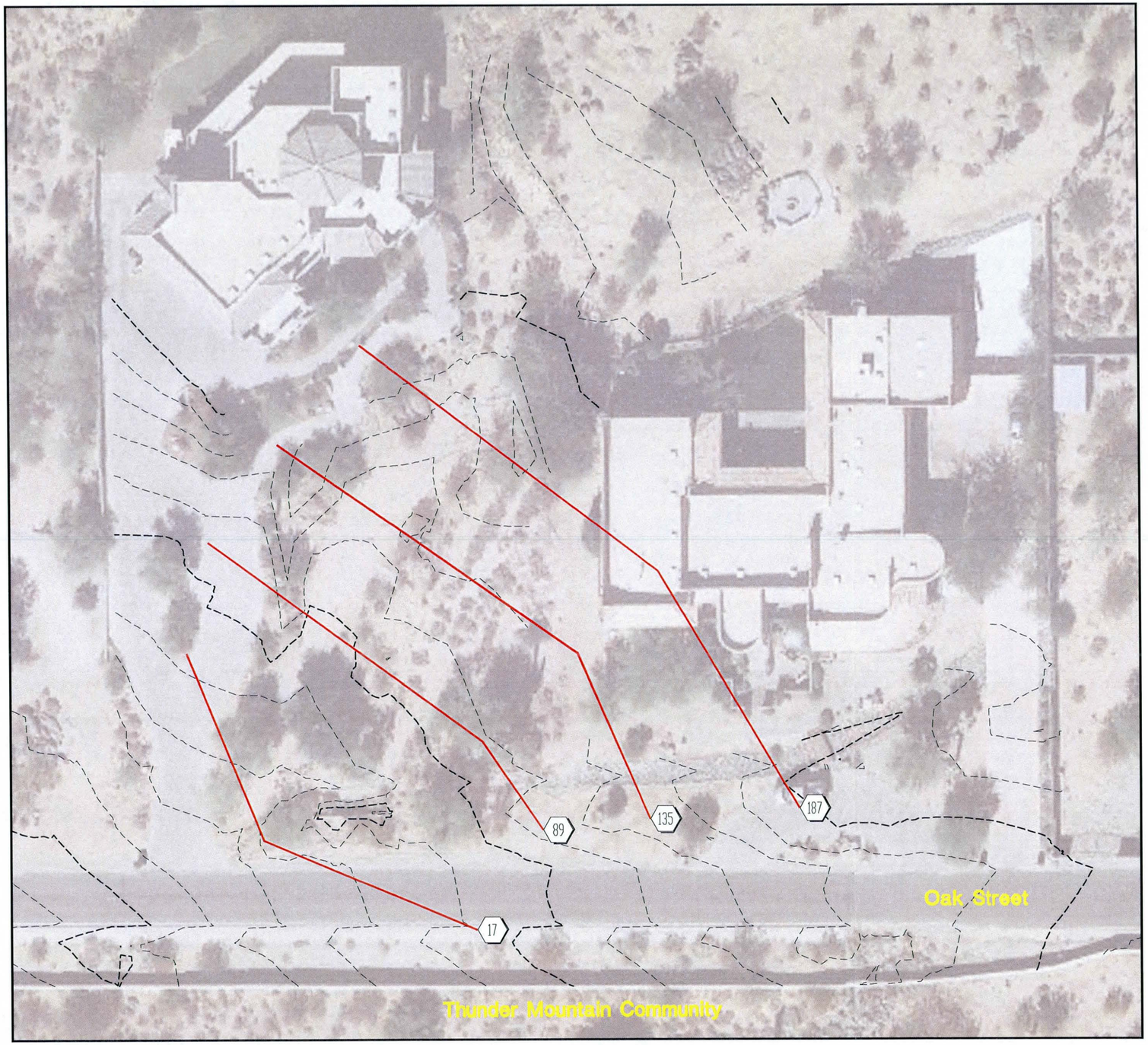
Exhibit B3.1: Oak Street SD 181+90 Inlet Wash HEC-RAS Model


Oak Street SD 181+90 Inlet Wash Plan 4/8/2011
Oak Street Wash 181+90 Inlet
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Elevation (ft)
1880
1878
1876
1874
1872
1870
1868
1866
1864
0
20
40
60
80
100
120
140
160
180
Main Channel Distance (ft)

HEC-RAS Plan: 18190 River: Oak Street Wash Reach: 181+90 Inlet Profile: 100-yr Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	Flow Area	Vel Chnl	Top W Chnl	Hydr Depth C	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(sq ft)	(ft/s)	(ft)	(ft)	
181+90 Inlet	162	100-yr Flow	380	1871.96	1873.5	1873.5	1874.1	66.8	6.5	25.8	1.3	1.01
181+90 Inlet	115	100-yr Flow	380	1868.98	1871.5	1872.1	1873.0	40.5	9.7	23.1	1.7	1.32
181+90 Inlet	73	100-yr Flow	380	1868.45	1871.1	1871.3	1872.0	56.7	7.9	20.0	2.1	0.97
181+90 Inlet	25	100-yr Flow	380	1868.06	1869.8	1870.2	1871.0	47.9	9.0	31.4	1.2	1.43


Oak Street SD 181+90 Inlet Wash Plan 4/8/2011
River = Oak Street Wash Reach = 181+90 Inlet RS = 162
.04
.035
.04
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Oak Street SD 181+90 Inlet Wash Plan 4/8/2011
River = Oak Street Wash Reach = 181+90 Inlet RS = 115
.04
.035
.04
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Oak Street SD 181+90 Inlet Wash Plan 4/8/2011
River = Oak Street Wash Reach = 181+90 Inlet RS = 73
.04
.035
.04
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Oak Street SD 181+90 Inlet Wash Plan 4/8/2011
River = Oak Street Wash Reach = 181+90 Inlet RS = 25
.04
.035
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)



LEGEND

HEC-RAS Cross-Section Location

435 HEC-RAS Cross-Section Identifier

GRAPHIC SCALE

20 0 10 20 40

SCALE: 1"=20 FT.

Gavan & Barker Inc.

Gavan & Barker, Inc.
3030 N. Central Ave.
Suite 1530
Phoenix, Arizona 85012
Phone: 602-200-0031
Fax: 602-200-0032

Civil Engineering
Landscape Architecture

Project :

Oak Street Basin and Storm Drain Design

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD - 2009C021

Submittal :

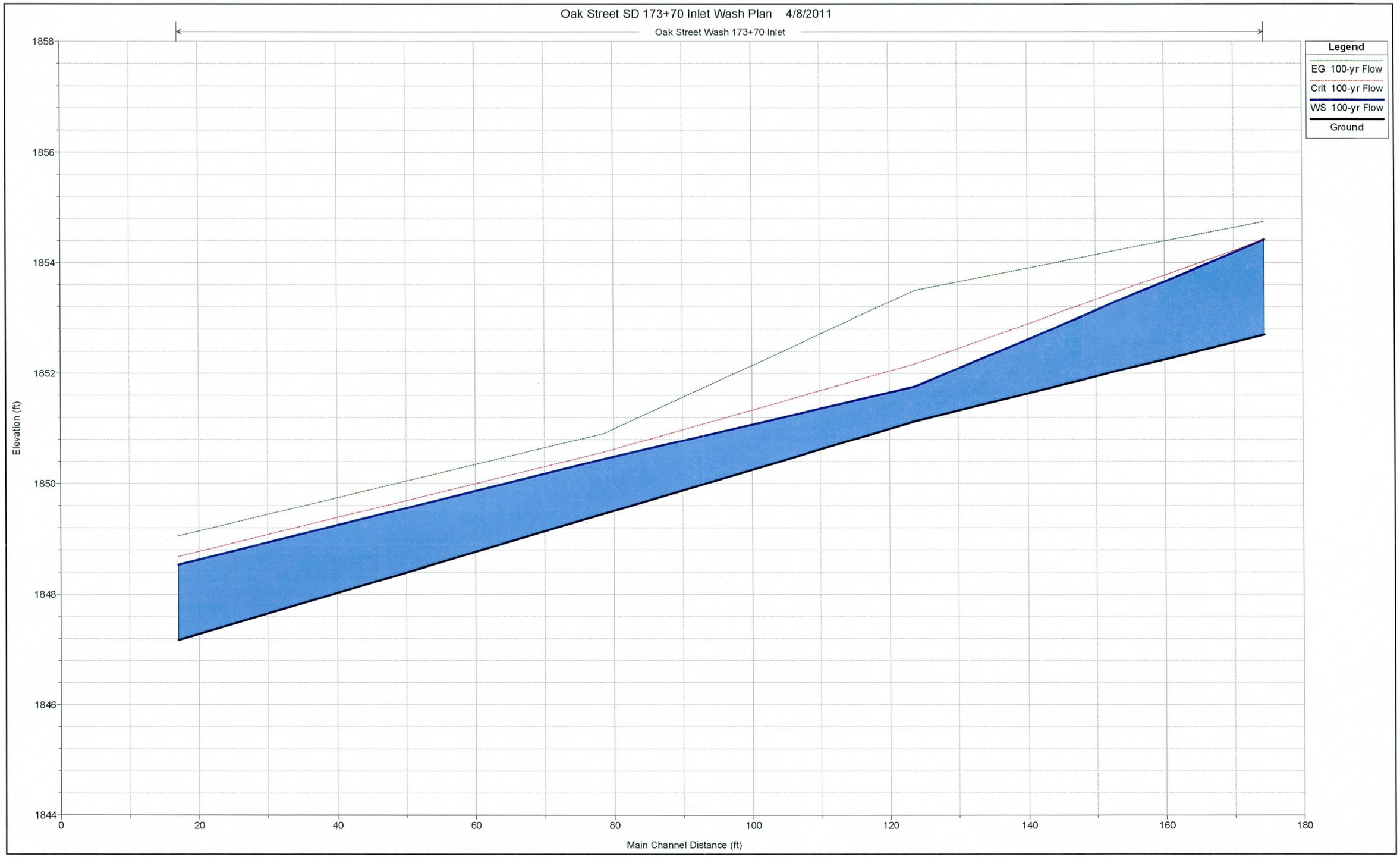
G&B No.	0912
Issue Date:	04/11
Drawn By:	OK
Checked By:	MTG

Sheet Title :

Exhibit B3.2: Oak Street SD 173+70 Inlet Wash HEC-RAS Model

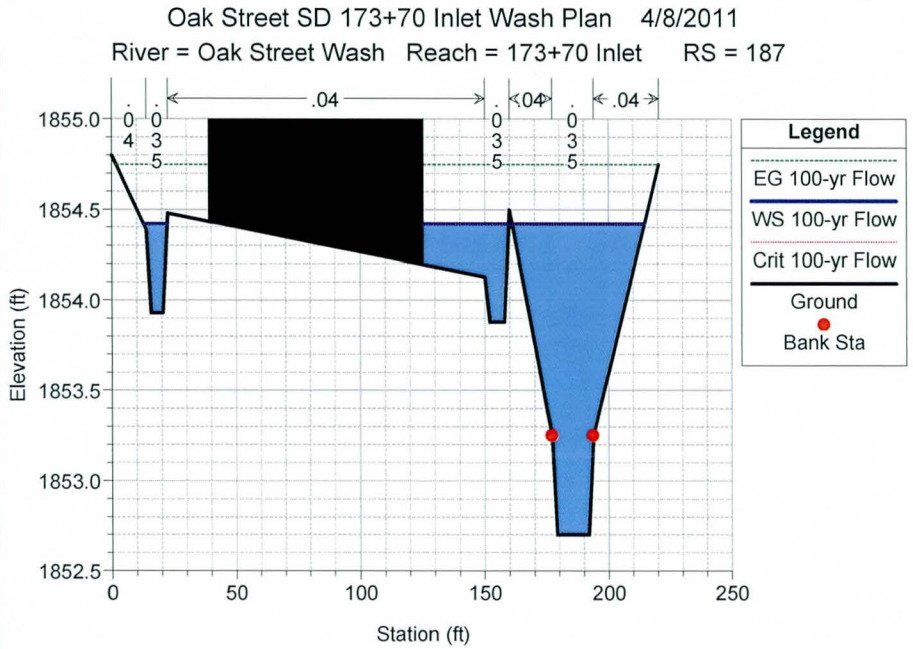
Page Number:

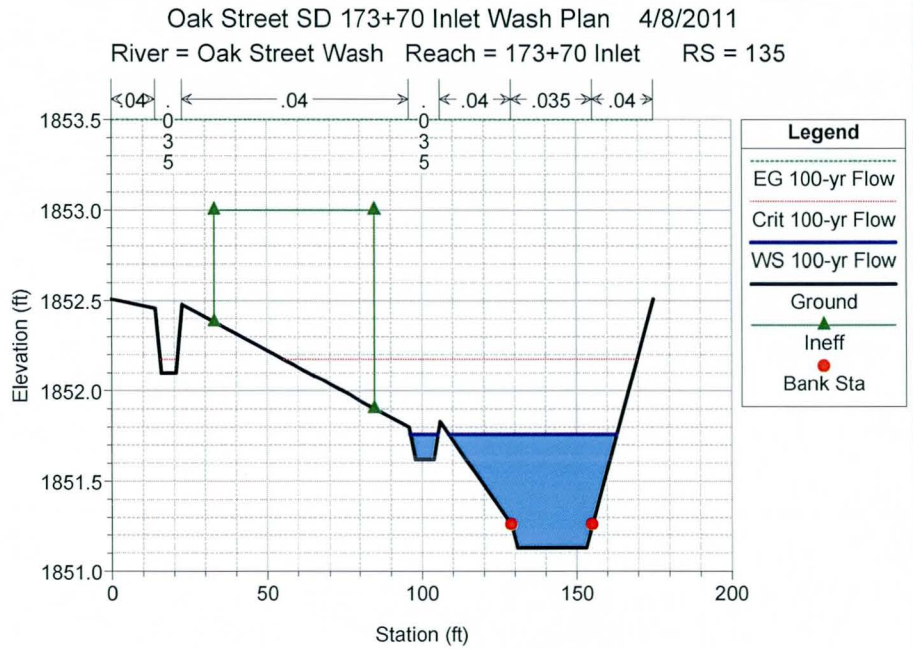
Exhibit B3.2: Oak Street SD 173+70 Inlet Wash HEC-RAS Model

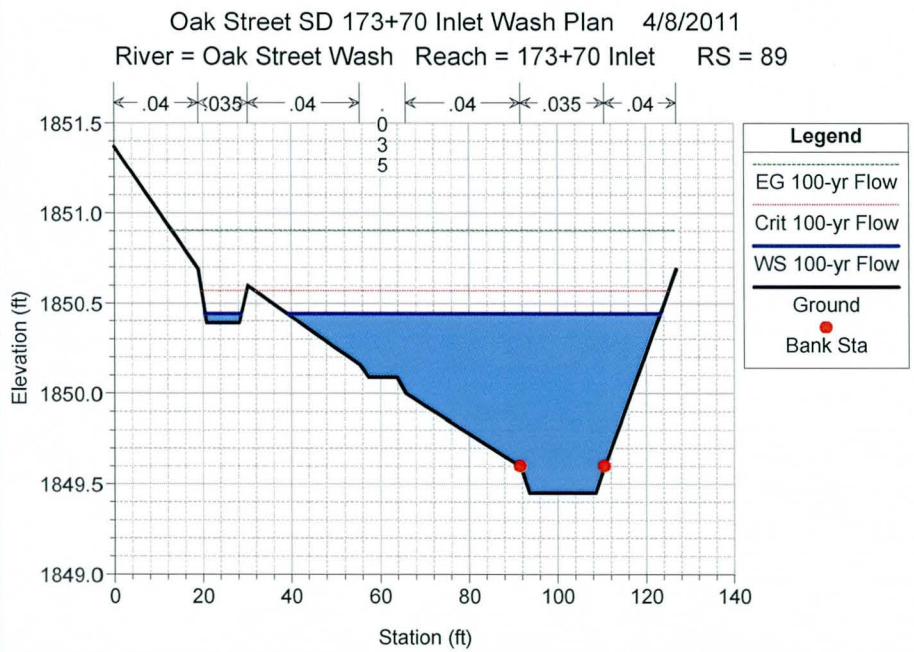

Oak Street SD 173+70 Inlet Wash Plan 4/8/2011
Oak Street Wash 173+70 Inlet
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Elevation (ft)
1858
1856
1854
1852
1850
1848
1846
1844
0
20
40
60
80
100
120
140
160
180
Main Channel Distance (ft)

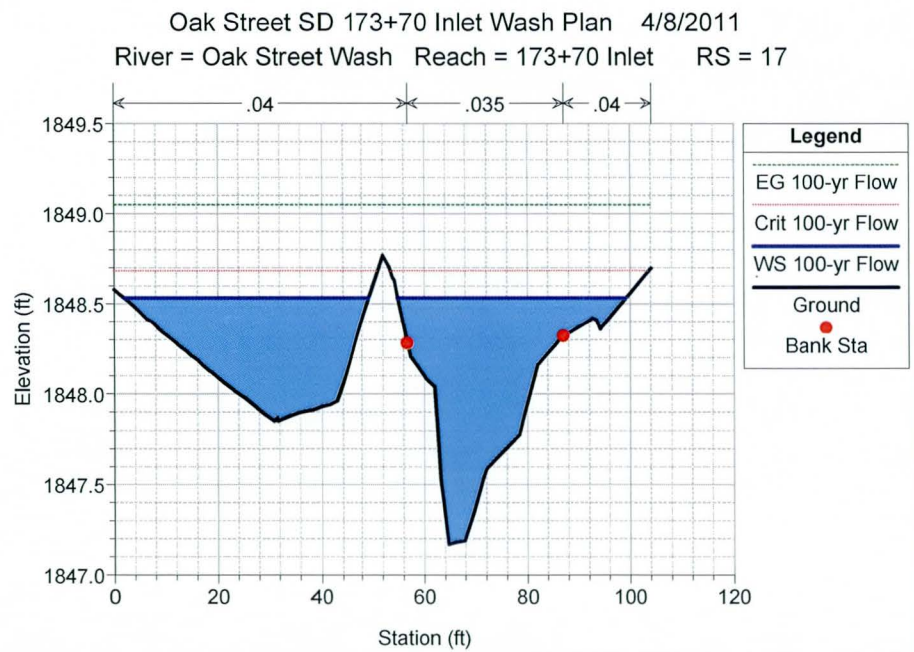
HEC-RAS Plan: 17370 River: Oak Street Wash Reach: 173+70 Inlet Profile: 100-yr Flow

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	Flow Area	Vel Chnl	Top W Chnl	Hydr Depth C	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(sq ft)	(ft/s)	(ft)	(ft)	
173+70 Inlet	187	100-yr Flow	228	1852.70	1854.4	1854.4	1854.8	63.2	5.5	16.7	1.7	0.75
173+70 Inlet	135	100-yr Flow	228	1851.13	1851.8	1852.2	1853.5	24.3	11.5	26.2	0.6	2.57
173+70 Inlet	89	100-yr Flow	228	1849.45	1850.4	1850.6	1850.9	46.8	6.6	19.0	1.0	1.17
173+70 Inlet	17	100-yr Flow	228	1847.17	1848.5	1848.7	1849.0	43.9	6.6	30.3	0.7	1.34

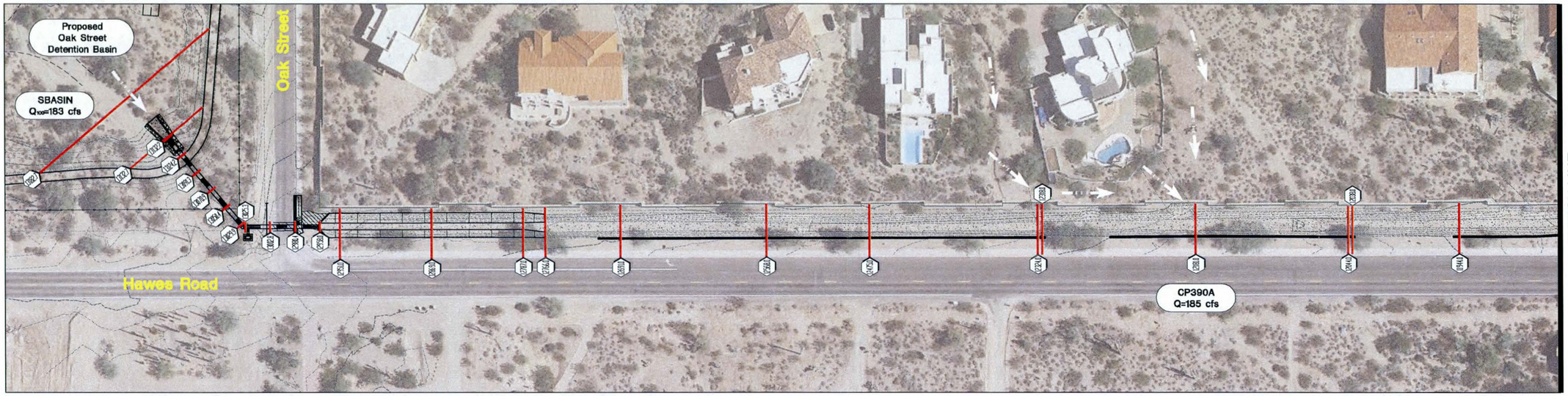

Oak Street SD 173+70 Inlet Wash Plan 4/8/2011
River = Oak Street Wash Reach = 173+70 Inlet RS = 187
.04
.04
.04
.04
.035
.035
.035
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

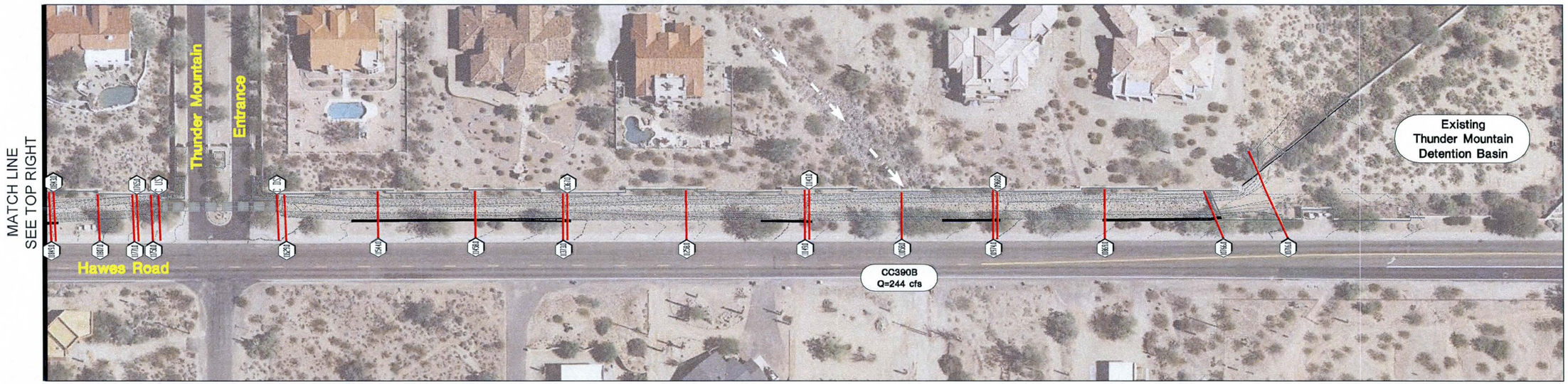

Oak Street SD 173+70 Inlet Wash Plan 4/8/2011
River = Oak Street Wash Reach = 173+70 Inlet RS = 135
.04
.04
.04
.035
.04
.035
.035
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Oak Street SD 173+70 Inlet Wash Plan 4/8/2011
River = Oak Street Wash Reach = 173+70 Inlet RS = 89
.04
.035
.04
.04
.035
.04
.035
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)


Oak Street SD 173+70 Inlet Wash Plan 4/8/2011
River = Oak Street Wash Reach = 173+70 Inlet RS = 17
.04
.035
.04
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

Sub-Section B4: **Basin Outlet and Hawes Road Channel Analysis**





LEGEND

- HEC-RAS Cross-Section Location
- 979 — HEC-RAS Cross-Section Identifier
- Incoming Channel Flows
- CC390B Q=244 cfs — Flow Change Locations

GRAPHIC SCALE

50 0 25 50 100

SCALE: 1"=50 FT.

Gavan & Barker Inc.

Gavan & Barker, Inc.
3030 N. Central Ave.
Suite 1530
Phoenix, Arizona 85012
Phone: 602-200-0031
Fax: 602-200-0032

Civil Engineering
Landscape Architecture

Project :

Oak Street Basin and Storm Drain Design

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD - 2009C021

Submittal :	
G&B No.	0912
Issue Date:	07/12
Drawn By:	OK
Checked By:	MTG

Sheet Title :

Exhibit B4.1: Hawes Road - HEC RAS Location Map

Page Number:

HEC-RAS Plan: BO River: Basin Outflow Reach: Hawes Rd Channel Profile: 100-yr Flow

Reach	River Sta	Profile	Q Total	Q Channel	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Flow Area Ch	Vel Chnl	Top W Chnl	Hydr Depth C	Hydr Radius C	Froude # Chl
			(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(sq ft)	(ft/s)	(ft)	(ft)	(ft)	
Hawes Rd Channel	13182.7	100-yr Flow	183	166	1798.29	1809.30	1799.1	1809.3	0.000229	1570.2	0.1	150.8	10.4	10.24	0.01
Hawes Rd Channel	13132.7	100-yr Flow	183	28	1798.01	1809.30		1809.3	0.007405	81.1	0.3	7.4	11.0	4.44	0.02
Hawes Rd Channel	13132.2	100-yr Flow	183	183	1798.00	1806.01	1801.8	1809.3	0.016449	12.5	14.6			1.00	0.91
Hawes Rd Channel	13124.2	100-yr Flow	183	183	1797.97	1805.18	1801.8	1808.5	0.016448	12.5	14.6			1.00	0.96
Hawes Rd Channel	13111.8	100-yr Flow	183	183	1797.93	1804.97	1801.7	1808.3	0.016448	12.5	14.6			1.00	0.97
Hawes Rd Channel	13091.3	100-yr Flow	183	183	1797.86	1804.64	1801.7	1808.0	0.016448	12.5	14.6			1.00	0.99
Hawes Rd Channel	13070.9	100-yr Flow	183	183	1797.79	1804.30	1801.6	1807.6	0.016448	12.5	14.6			1.00	1.01
Hawes Rd Channel	13050.4	100-yr Flow	183	183	1797.72	1803.96	1801.5	1807.3	0.016448	12.5	14.6			1.00	1.03
Hawes Rd Channel	13029.9	100-yr Flow	183	183	1797.65	1803.63	1801.5	1807.0	0.016448	12.5	14.6			1.00	1.05
Hawes Rd Channel	13025.3	100-yr Flow	183	183	1797.63	1802.42	1801.4	1805.7	0.016448	12.5	14.6			1.00	1.18
Hawes Rd Channel	13002.8	100-yr Flow	183	183	1797.56	1802.05	1801.4	1805.4	0.016448	12.5	14.6			1.00	1.22
Hawes Rd Channel	12980.4	100-yr Flow	183	183	1797.48	1801.68	1801.3	1805.0	0.016448	12.5	14.6			1.00	1.26
Hawes Rd Channel	12958.0	100-yr Flow	183	183	1797.40	1801.20	1801.2	1804.7	0.014241	12.3	14.9	1.7	7.1	1.14	1.35
Hawes Rd Channel	12951.0	100-yr Flow	183	183	1797.36	1798.58	1799.8	1803.9	0.110116	9.9	18.5	10.2	1.0	0.91	3.32
Hawes Rd Channel	12869.0	100-yr Flow	183	183	1797.25	1800.39	1799.7	1800.8	0.003145	35.4	5.2	16.5	2.1	1.94	0.62
Hawes Rd Channel	12787.0	100-yr Flow	183	183	1797.04	1799.49	1799.5	1800.4	0.008449	24.5	7.5	13.9	1.8	1.60	0.99
Hawes Rd Channel	12766.0	100-yr Flow	183	183	1796.91	1798.79	1799.1	1800.1	0.015621	20.0	9.2	13.2	1.5	1.37	1.31
Hawes Rd Channel	12691.0	100-yr Flow	183	183	1796.44	1798.56	1798.6	1799.4	0.008690	25.0	7.3	15.1	1.6	1.52	1.01
Hawes Rd Channel	12568.0	100-yr Flow	183	183	1795.20	1798.03	1797.4	1798.4	0.003233	35.9	5.1	17.9	2.0	1.86	0.63
Hawes Rd Channel	12475.0	100-yr Flow	183	183	1794.92	1797.14	1797.1	1797.9	0.008395	25.4	7.2	15.6	1.6	1.52	0.99
Hawes Rd Channel	12324.0	100-yr Flow	183	183	1793.21	1794.94	1795.3	1796.2	0.016255	20.6	8.9	15.4	1.3	1.27	1.35
Hawes Rd Channel	12318.0	100-yr Flow	183	183	1791.78	1793.20	1794.0	1795.9	0.043797	14.0	13.1	12.1	1.2	1.08	2.15
Hawes Rd Channel	12181.0	100-yr Flow	185	185	1790.74	1792.66	1792.7	1793.4	0.008640	26.1	7.1	17.0	1.5	1.45	1.01
Hawes Rd Channel	12044.0	100-yr Flow	185	185	1789.46	1791.31	1791.4	1792.1	0.010796	25.7	7.2	19.8	1.3	1.26	1.11
Hawes Rd Channel	12038.0	100-yr Flow	185	185	1786.59	1787.90	1788.9	1791.7	0.068841	11.9	15.6	11.0	1.1	1.00	2.66
Hawes Rd Channel	11944.0	100-yr Flow	185	185	1785.71	1787.79	1787.9	1788.8	0.010799	23.5	7.9	15.4	1.5	1.43	1.12
Hawes Rd Channel	11849.0	100-yr Flow	185	185	1784.91	1786.71	1786.9	1787.6	0.012583	24.0	7.7	18.9	1.3	1.24	1.20
Hawes Rd Channel	11843.0	100-yr Flow	185	185	1781.56	1783.26	1784.4	1787.2	0.062906	11.6	15.9	9.6	1.2	1.10	2.54
Hawes Rd Channel	11807.0	100-yr Flow	185	185	1780.94	1782.78	1783.5	1785.1	0.032321	15.0	12.3	11.0	1.4	1.24	1.86
Hawes Rd Channel	11771.0	100-yr Flow	185	185	1780.25	1781.94	1782.6	1784.0	0.028014	16.2	11.4	12.2	1.3	1.23	1.74
Hawes Rd Channel	11765.0	100-yr Flow	185	185	1777.27	1778.78	1780.0	1783.4	0.077637	10.7	17.3	8.9	1.2	1.07	2.78
Hawes Rd Channel	11750.0	100-yr Flow	185	185	1776.63	1780.69	1779.0	1780.9	0.001130	48.0	3.9	16.0	3.2	2.68	0.38
Hawes Rd Channel	11690.0		Culvert												
Hawes Rd Channel	11629.0	100-yr Flow	185	185	1775.09	1776.82	1777.3	1778.5	0.021310	17.7	10.5	11.9	1.5	1.32	1.51
Hawes Rd Channel	11544.0	100-yr Flow	185	185	1774.42	1777.00	1777.0	1777.9	0.008040	24.8	7.4	13.5	1.8	1.65	0.97
Hawes Rd Channel	11458.0	100-yr Flow	185	185	1773.74	1776.27	1776.3	1777.2	0.008458	24.5	7.5	13.7	1.8	1.62	0.99
Hawes Rd Channel	11373.0	100-yr Flow	185	185	1773.01	1774.87	1775.2	1776.1	0.016979	20.6	9.0	15.8	1.3	1.25	1.39
Hawes Rd Channel	11367.0	100-yr Flow	185	185	1768.55	1770.29	1771.6	1775.5	0.085583	10.1	18.4	8.1	1.2	1.09	2.91
Hawes Rd Channel	11258.0	100-yr Flow	185	185	1767.05	1768.91	1769.4	1770.5	0.019738	18.2	10.2	12.4	1.5	1.34	1.48
Hawes Rd Channel	11149.0	100-yr Flow	185	185	1766.55	1768.52	1768.5	1769.3	0.008438	26.6	7.0	17.6	1.5	1.44	1.00
Hawes Rd Channel	11143.0	100-yr Flow	185	185	1762.68	1763.87	1765.0	1768.7	0.095816	10.5	17.7	10.2	1.0	0.94	3.09
Hawes Rd Channel	11058.0	100-yr Flow	244	244	1761.79	1764.90	1764.3	1765.4	0.003681	41.0	6.0	17.2	2.4	2.12	0.68
Hawes Rd Channel	10974.0	100-yr Flow	244	244	1761.75	1764.06	1764.1	1765.0	0.008156	31.9	7.6	17.4	1.8	1.70	1.00
Hawes Rd Channel	10968.0	100-yr Flow	244	244	1760.06	1761.77	1762.7	1764.7	0.037647	17.9	13.7	12.7	1.4	1.29	2.03
Hawes Rd Channel	10869.0	100-yr Flow	244	244	1758.21	1761.38	1760.7	1761.9	0.003434	42.3	5.8	17.9	2.4	2.13	0.66
Hawes Rd Channel	10766.0	100-yr Flow	244	244	1758.13	1760.41	1760.4	1761.3	0.008273	31.7	7.7	17.0	1.9	1.70	0.90
Hawes Rd Channel	10716.0	100-yr Flow	244	244	1756.89	1758.00	1758.7	1760.3	0.052729	19.9	12.3	23.0	0.9	0.85	2.33

Table B4.1: Hawes Road Channel - HEC RAS Cross Section Summary

HEC-RAS Plan: BO River: Basin Outflow Reach: Hawes Rd Channel Profile: 100-yr Flow

Reach	River Sta	Profile	E.G. US.	W.S. US.	E.G. IC	E.G. OC	Min El Weir Flow	Q Culv Group	Q Weir	Delta WS	Culv Vel US	Culv Vel DS
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(ft)	(ft/s)	(ft/s)
Hawes Rd Channel	11690.0 48" Culverts	100-yr Flow	1780.92	1780.69	1780.92	1780.69	1782.01	185.00		2.79	9.43	12.90

Table B4.2: Hawes Road Channel - HEC RAS Culvert Summary

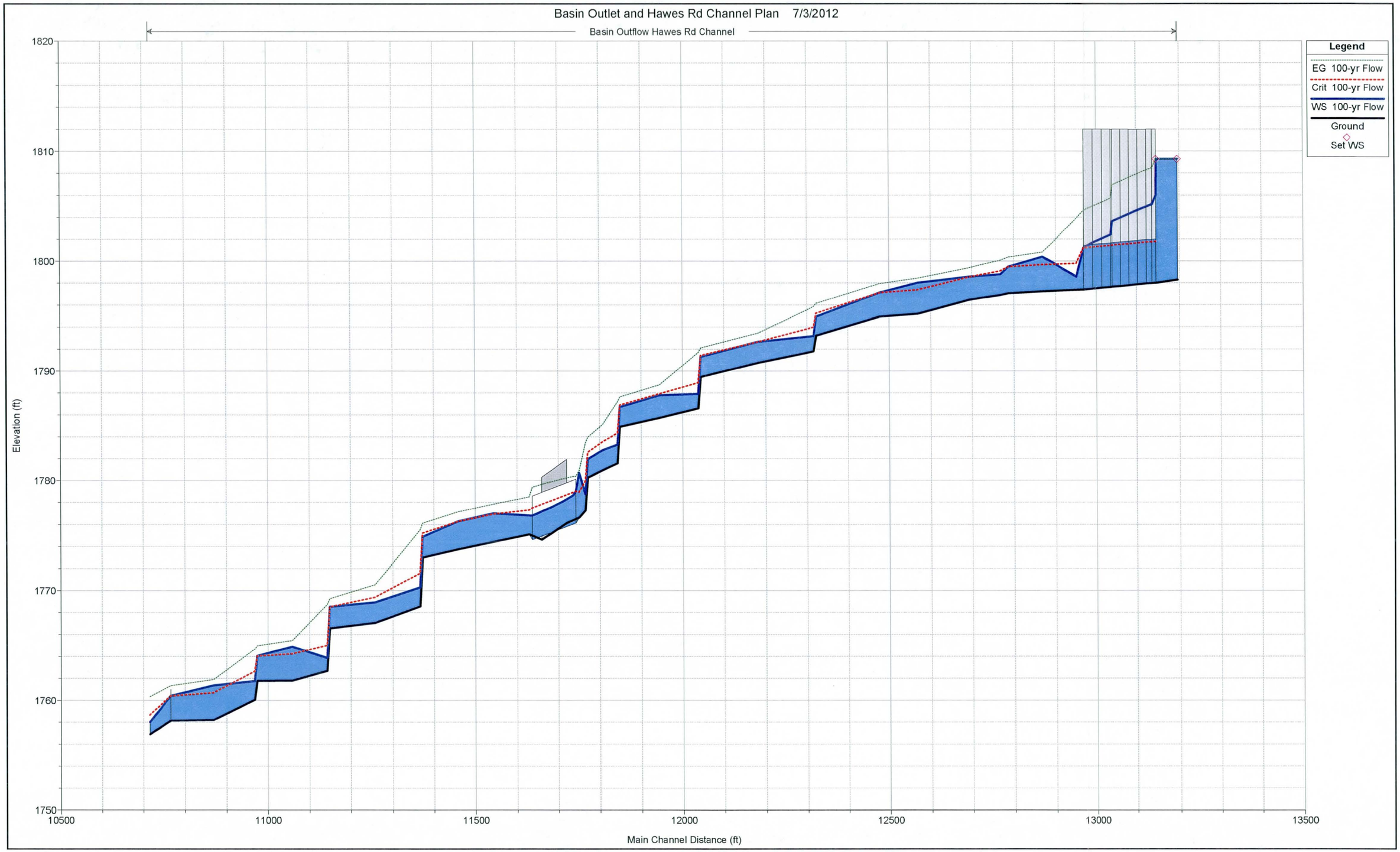


Figure B4.1: Hawes Road Channel - HEC RAS Profile

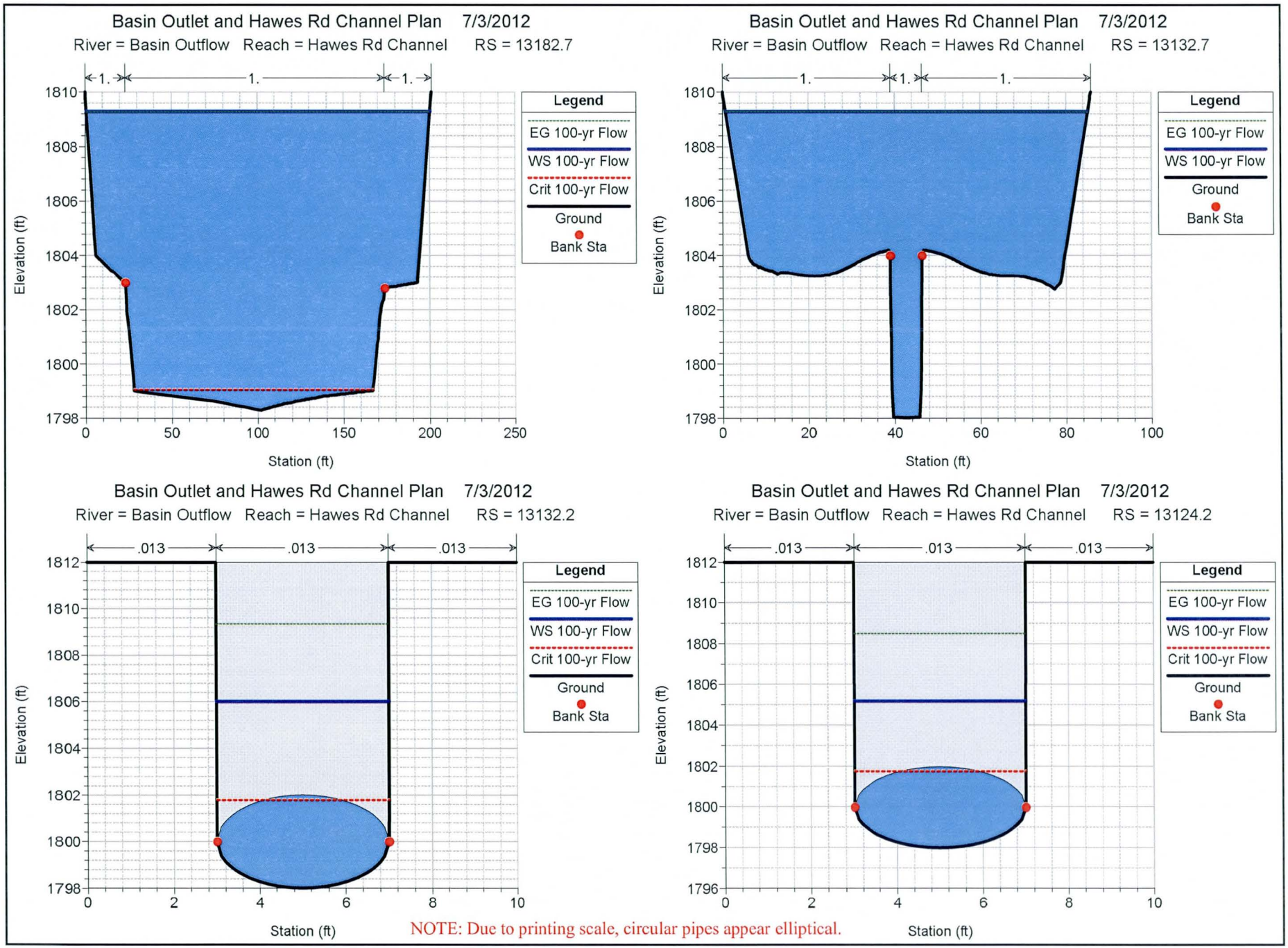
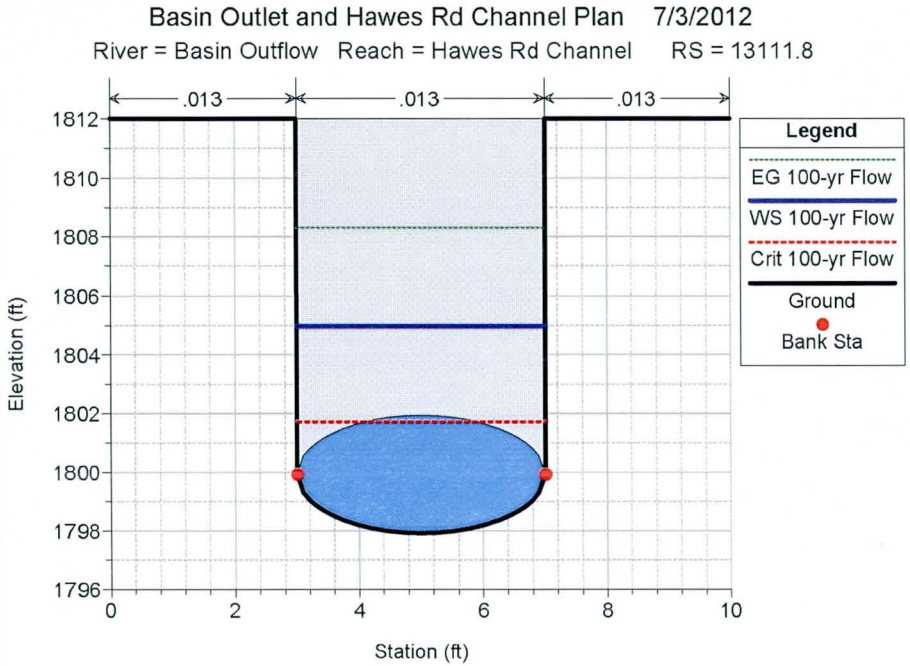
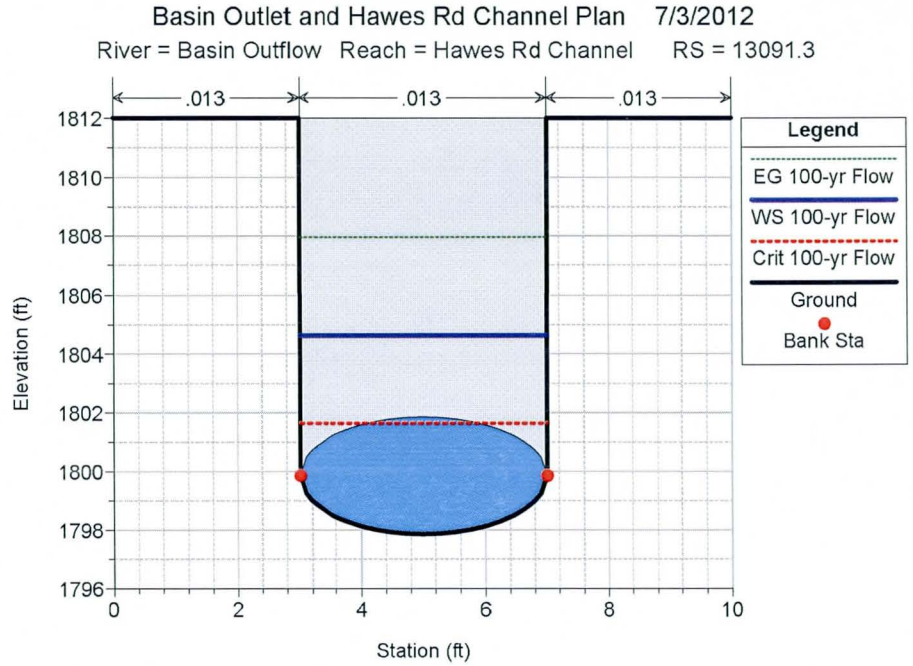
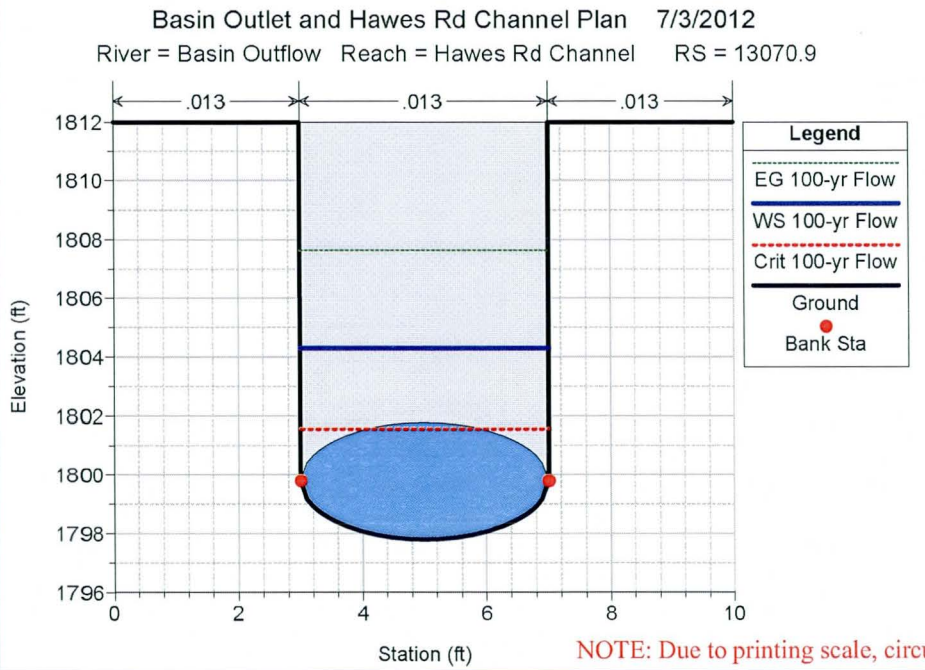
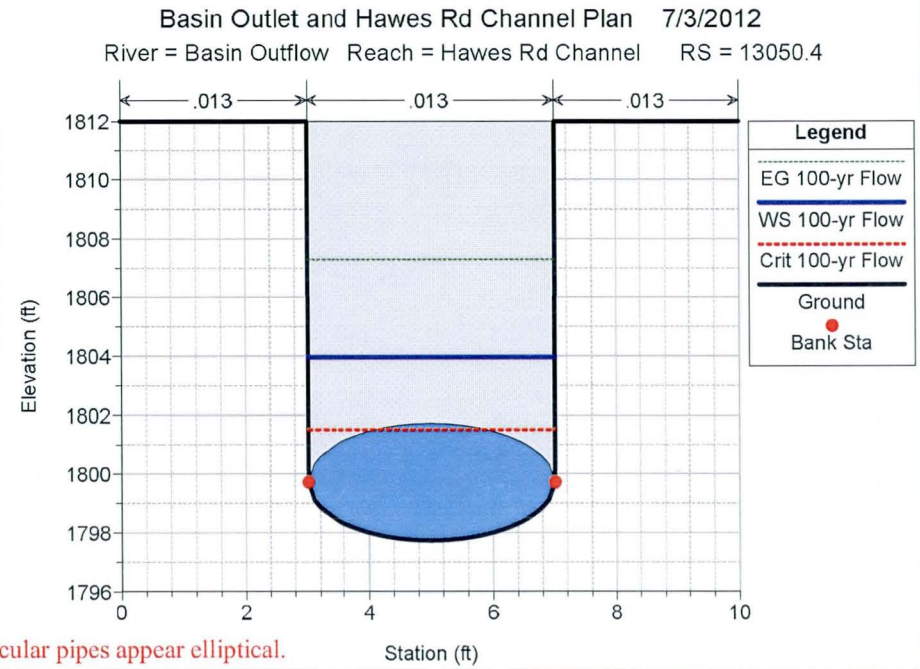


Figure B4.2: Hawes Road Channel - HEC RAS Cross Sections

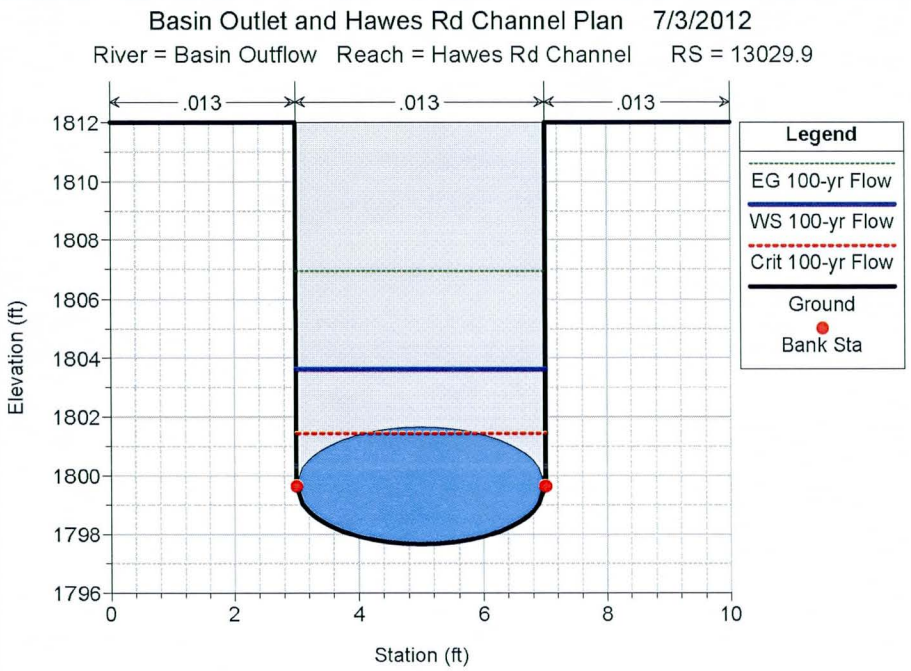


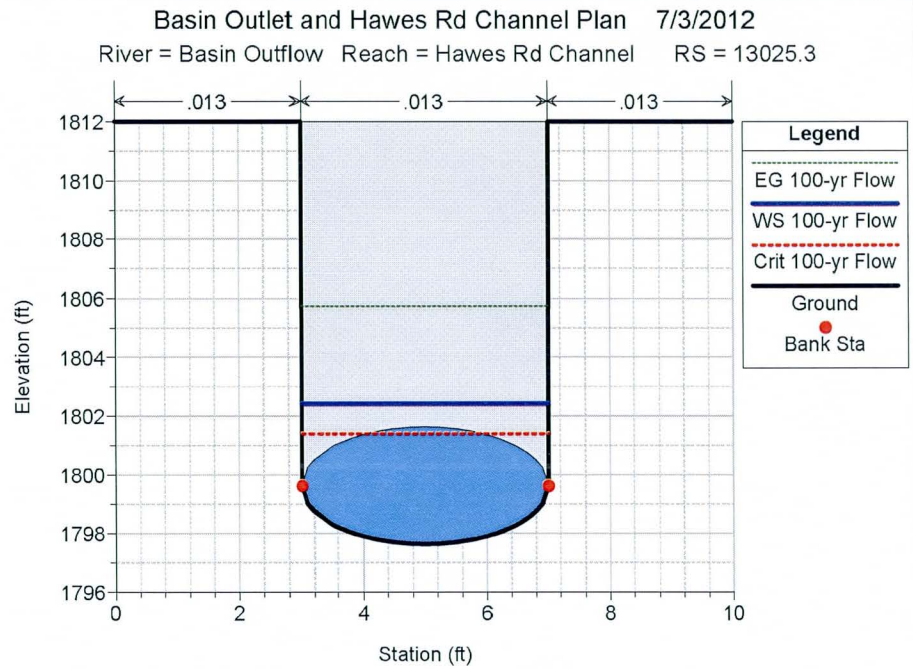


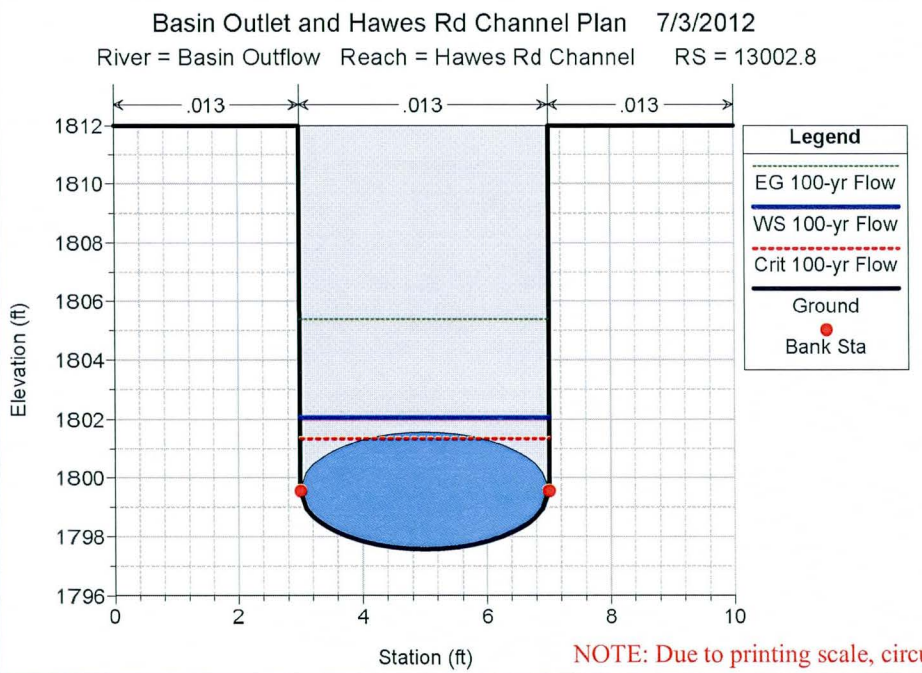


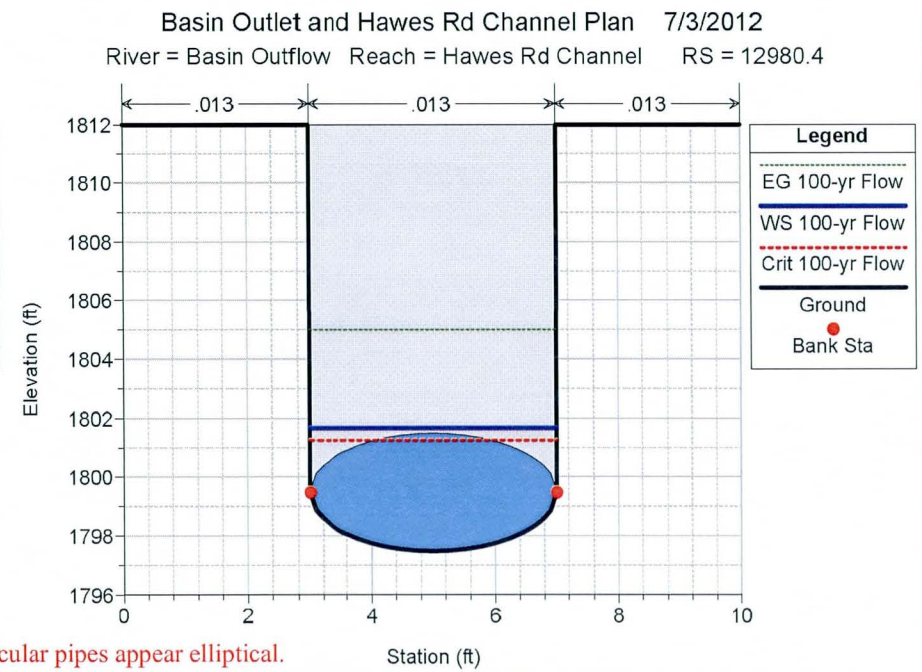


NOTE: Due to printing scale, circular pipes appear elliptical.

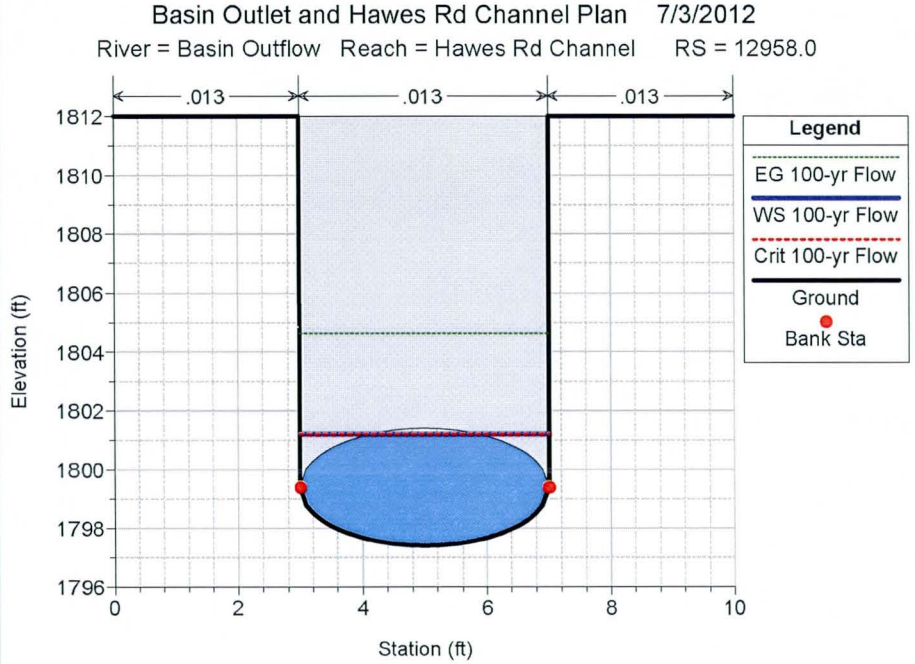


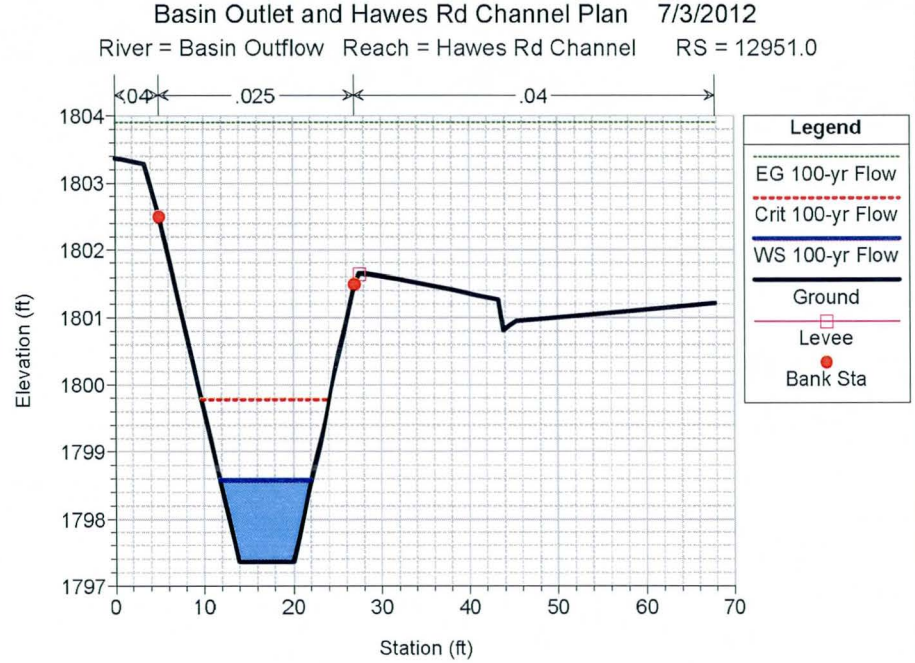


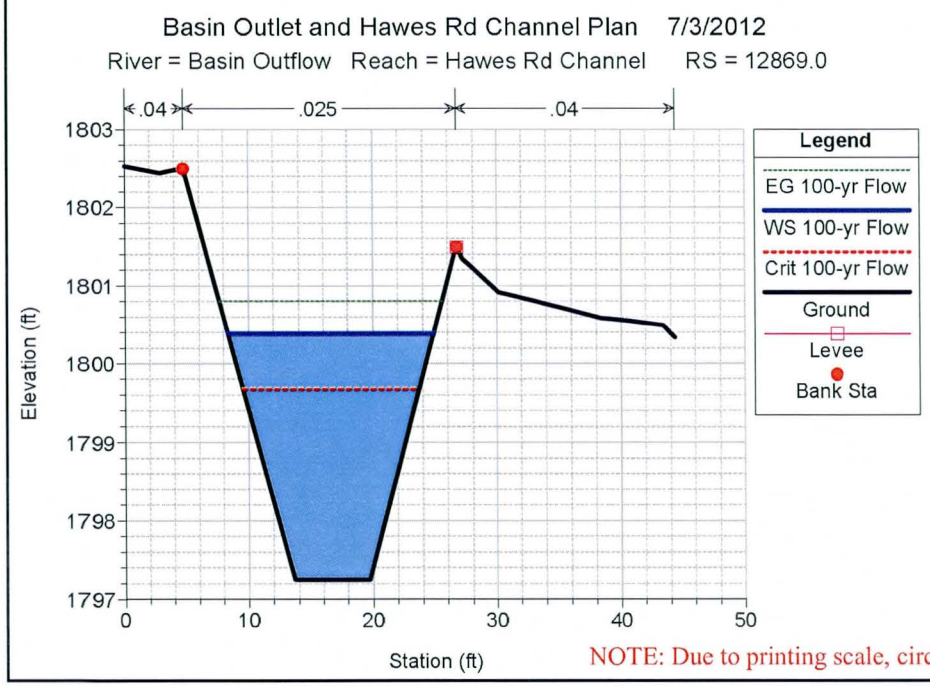


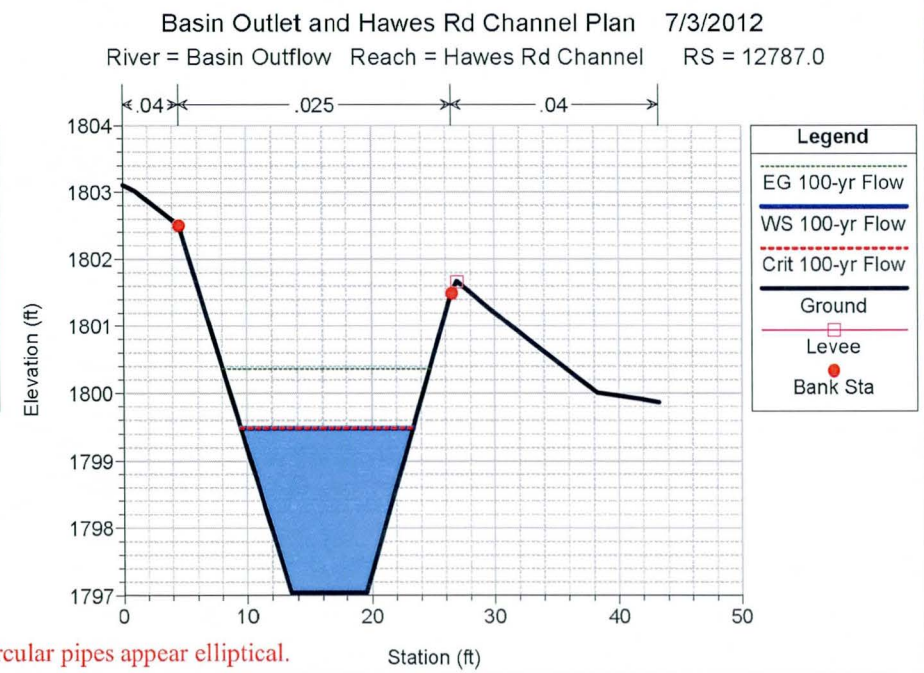


NOTE: Due to printing scale, circular pipes appear elliptical.

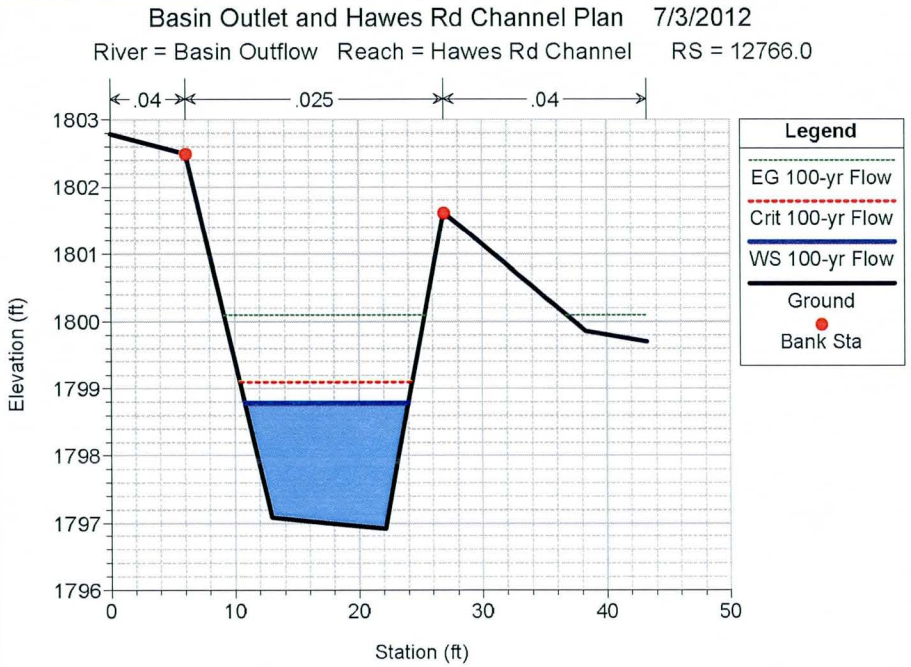


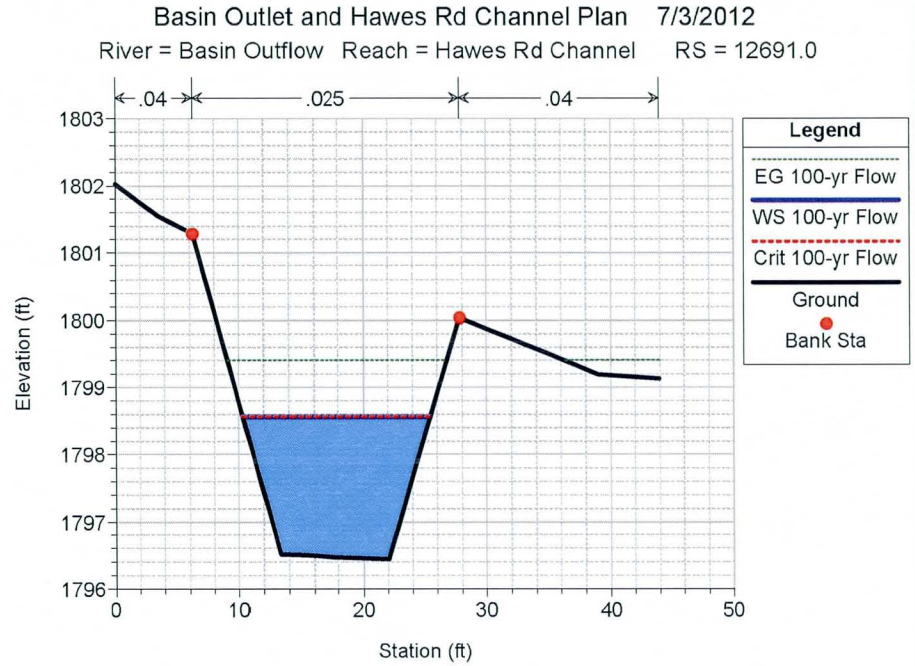


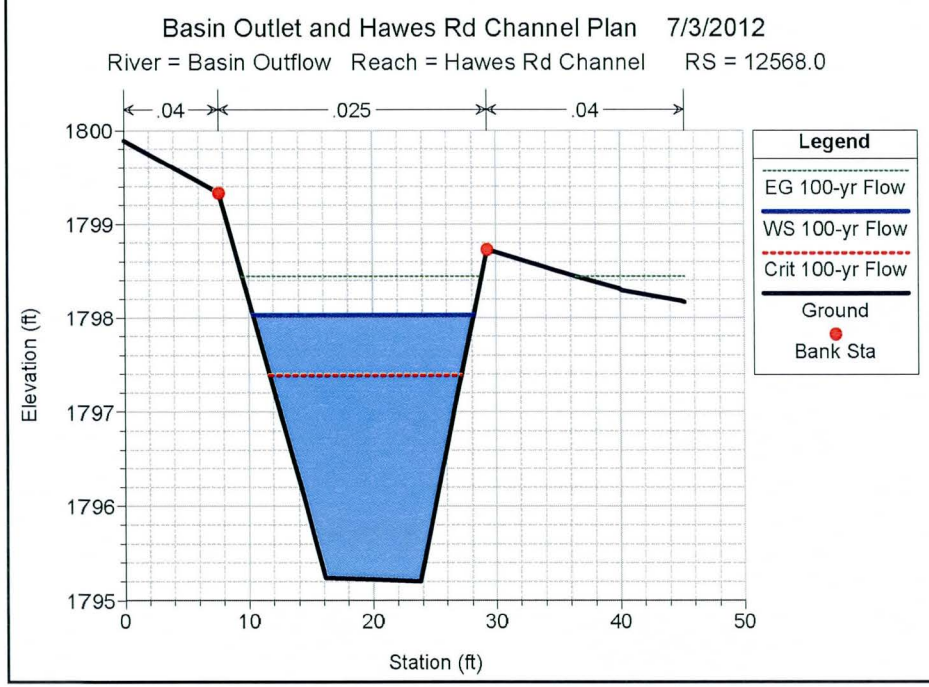


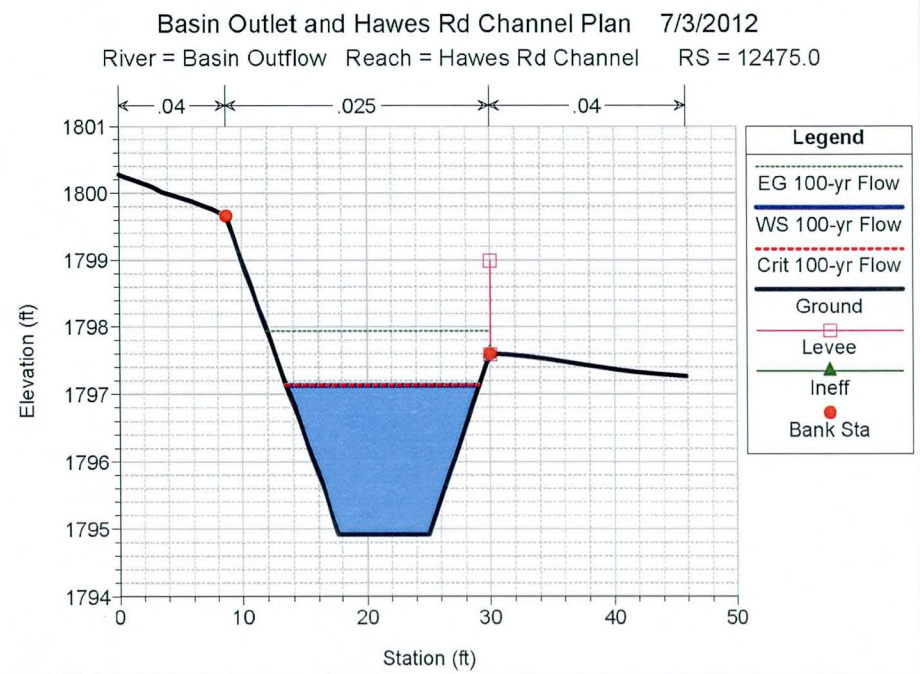


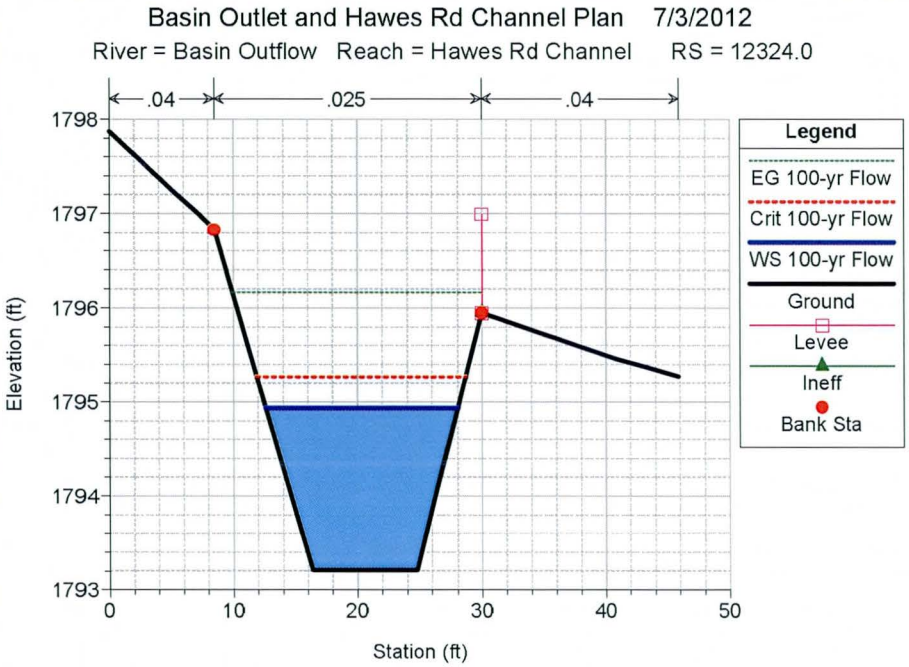
NOTE: Due to printing scale, circular pipes appear elliptical.

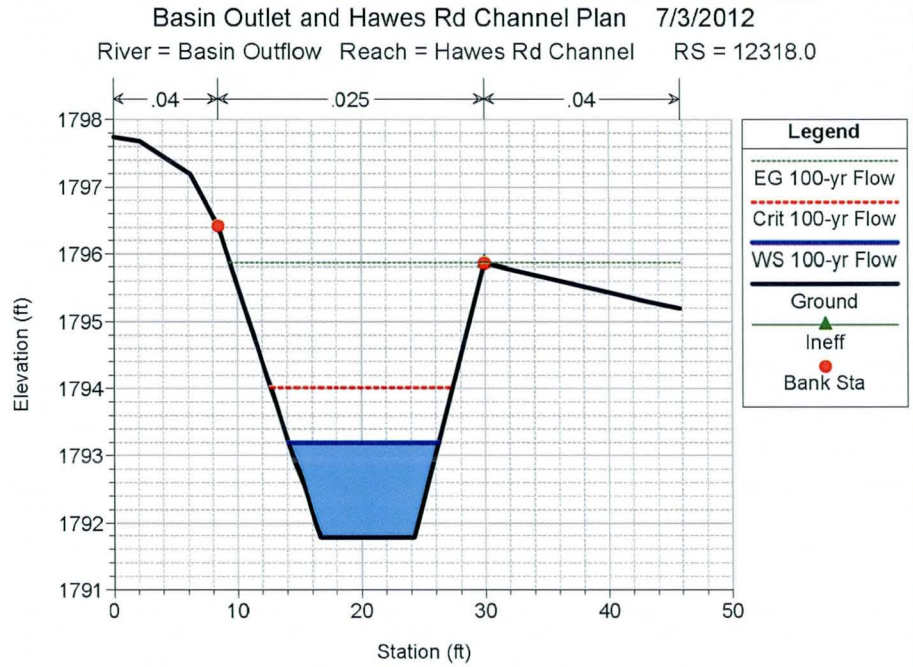

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 12766.0
.04
.025
.04
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

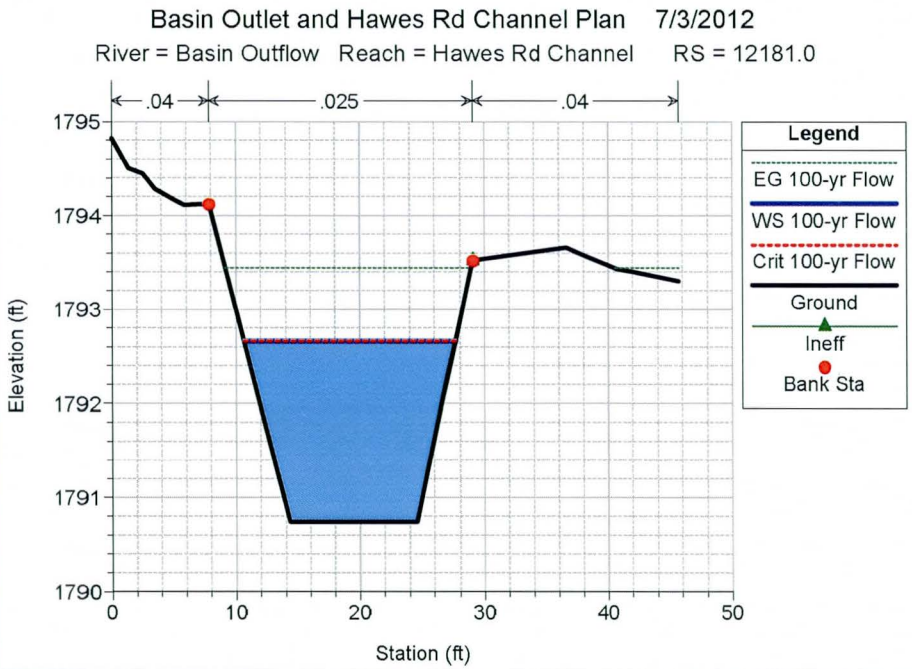

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 12691.0
.04
.025
.04
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

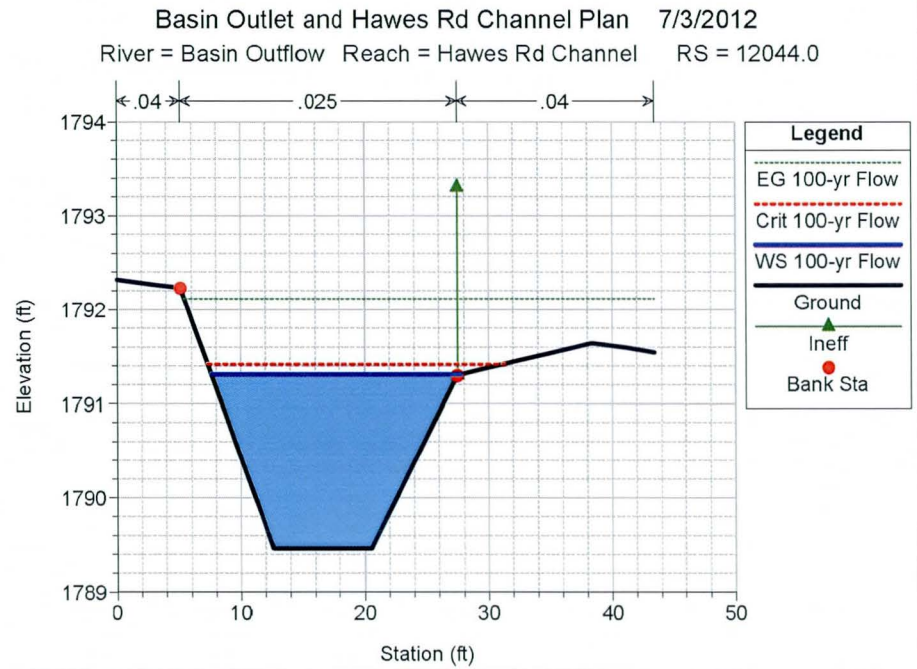

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 12568.0
.04
.025
.04
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Bank Sta
Elevation (ft)
Station (ft)

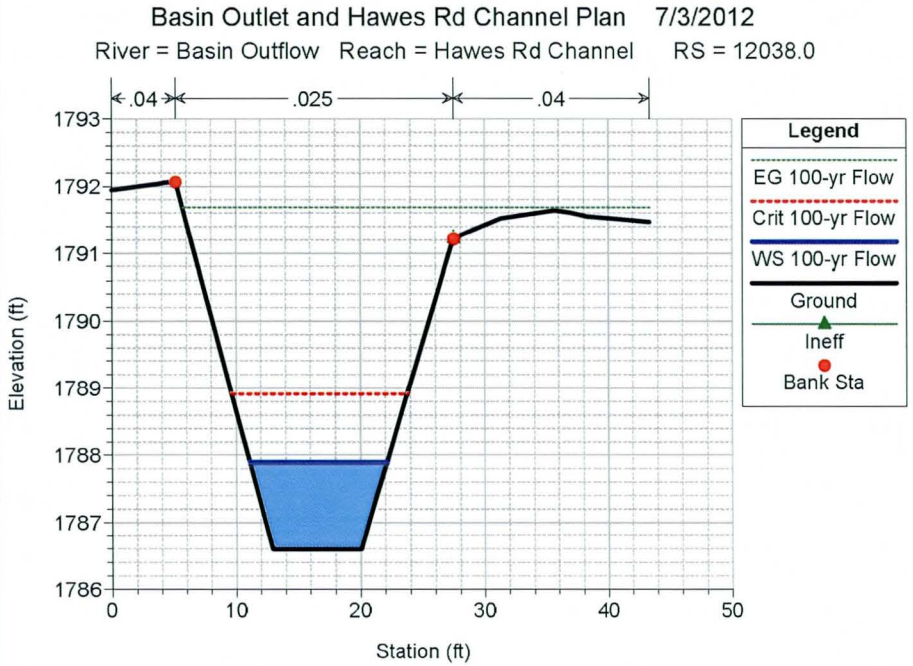

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 12475.0
.04
.025
.04
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
Station (ft)

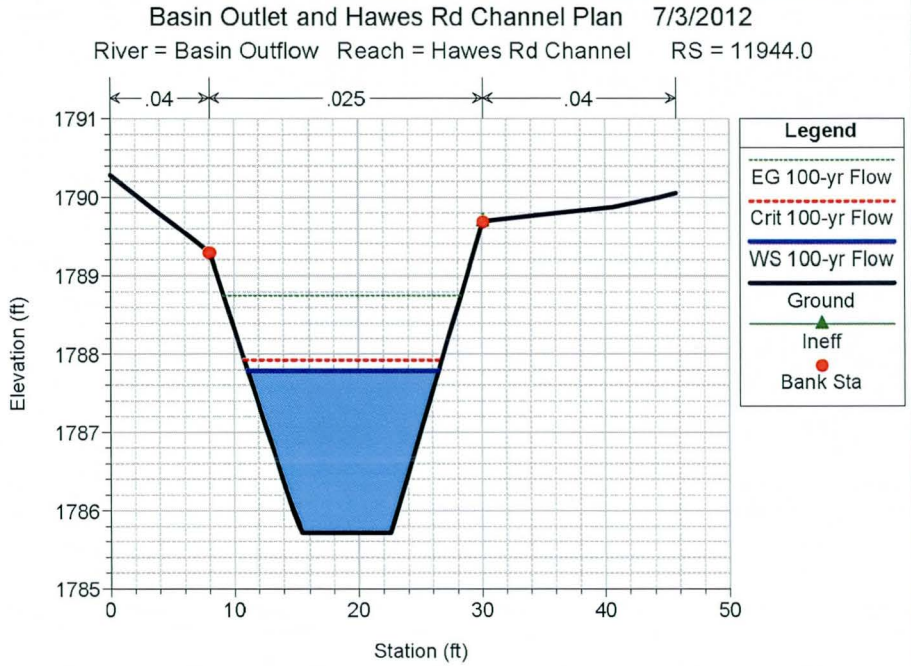

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 12324.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Levee
Ineff
Bank Sta

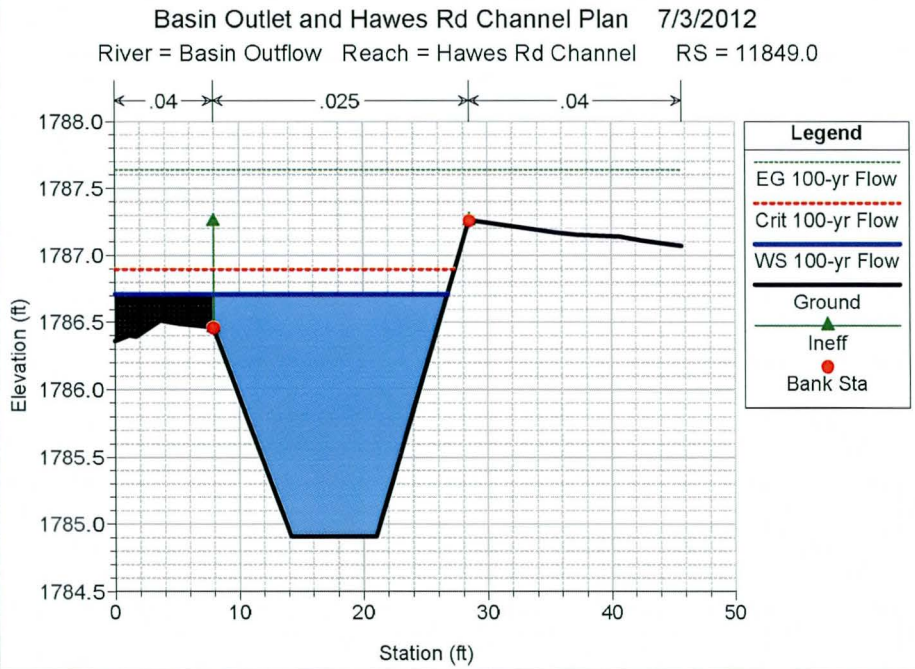

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 12318.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta

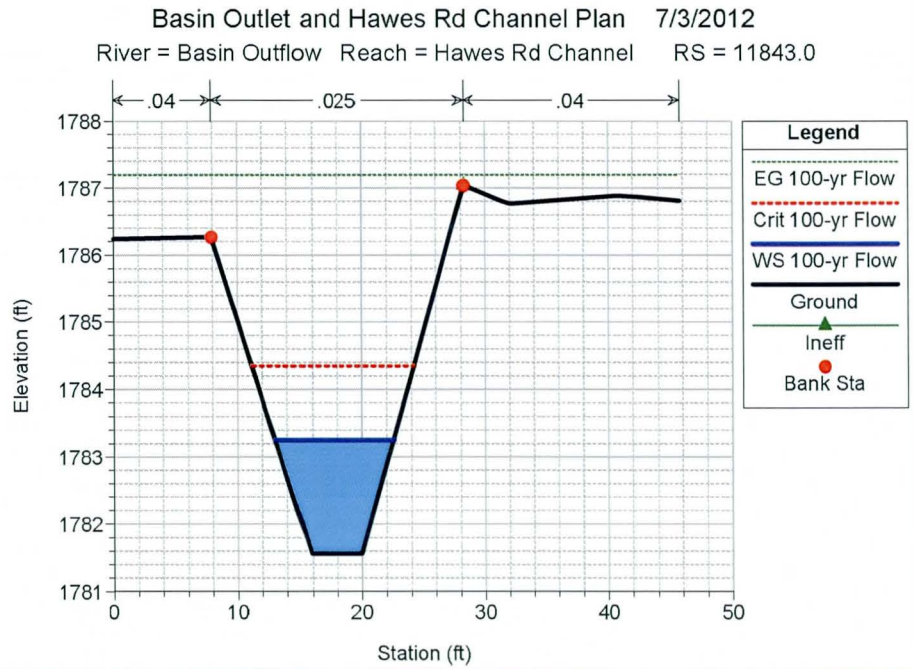

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 12181.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Ineff
Bank Sta

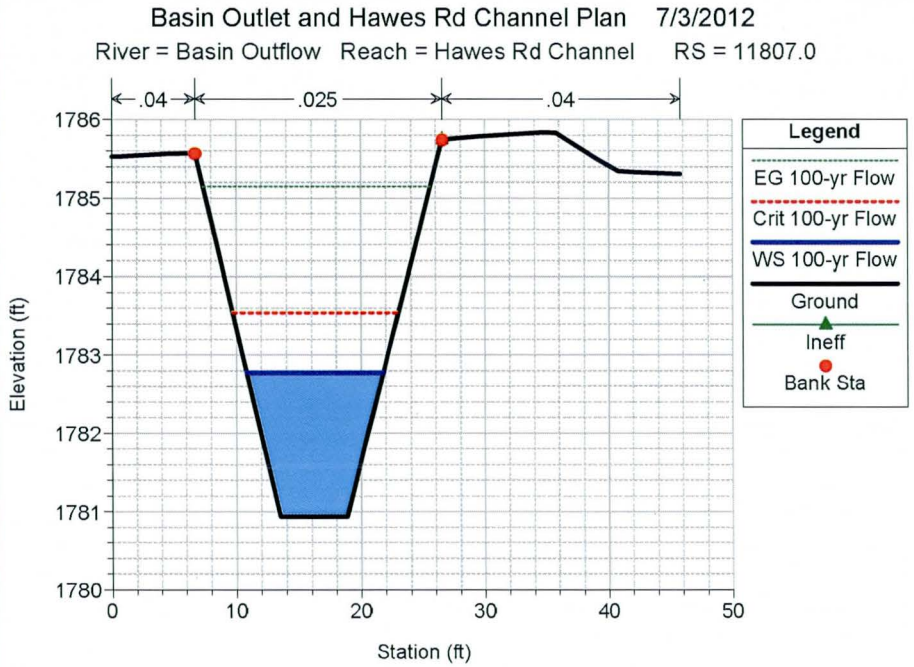

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 12044.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta

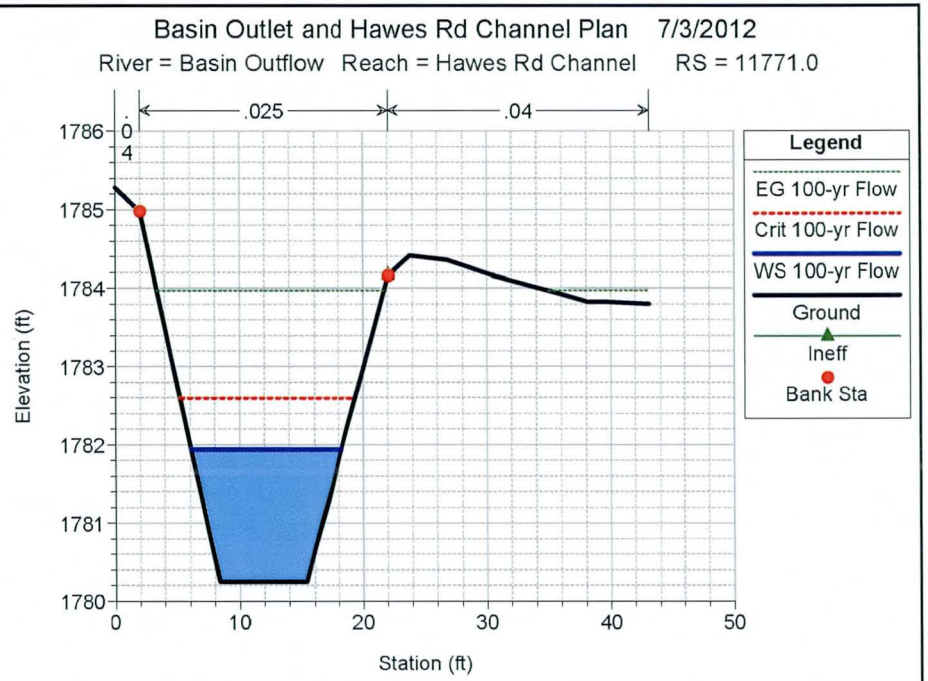

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 12038.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta

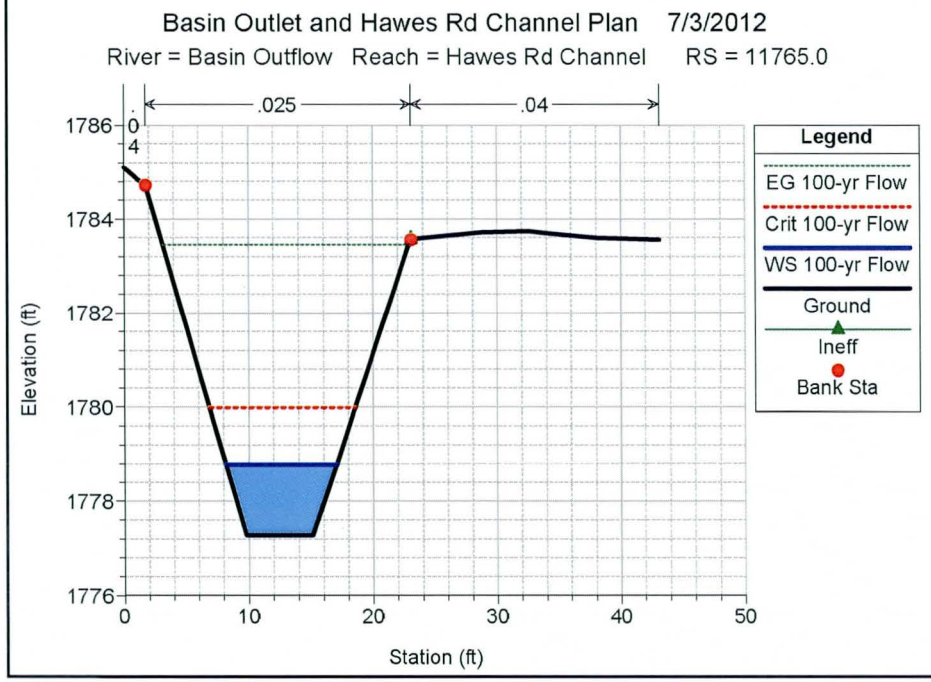

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 11944.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta

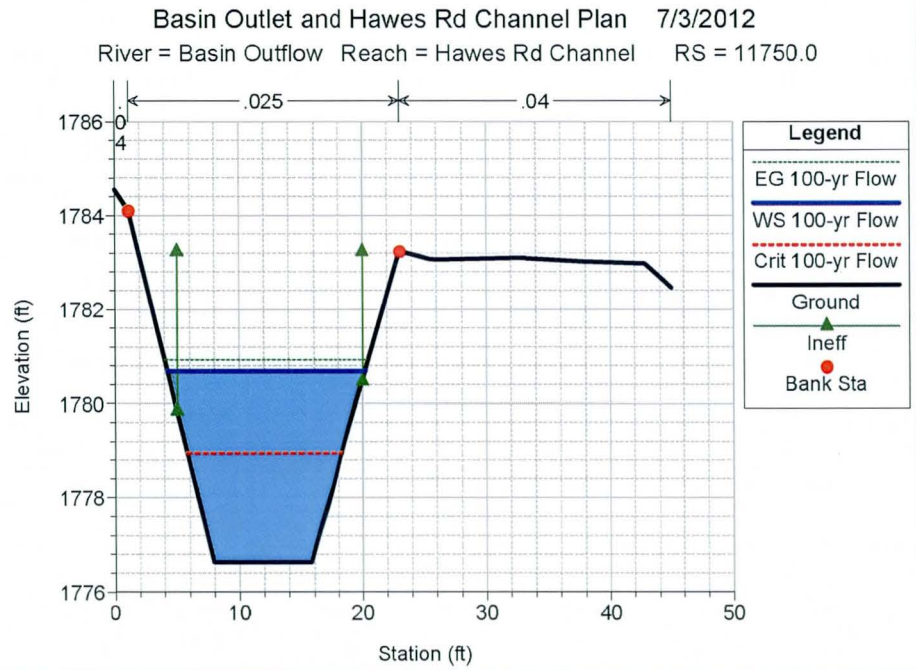

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 11849.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta

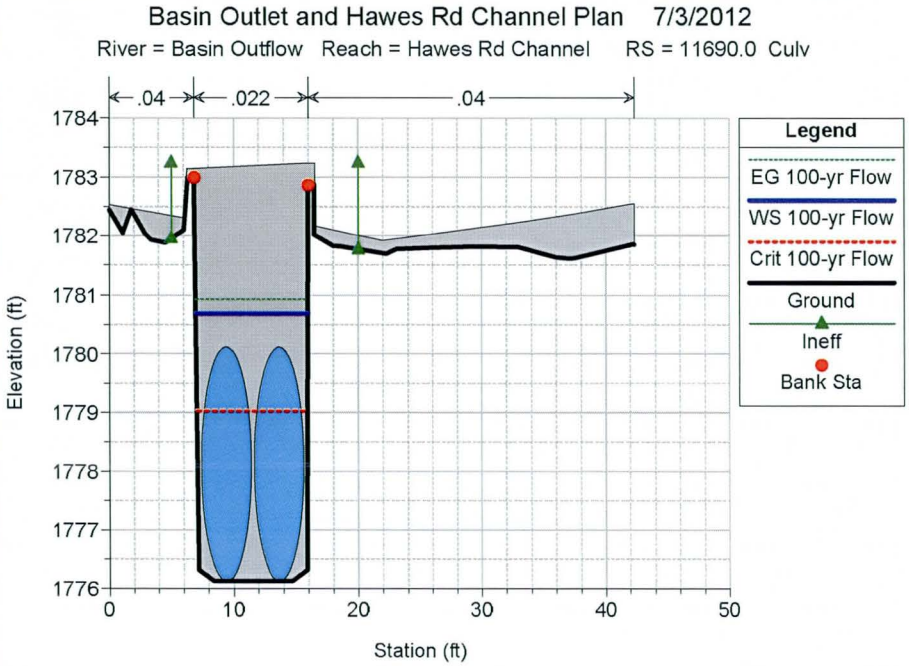

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 11843.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta

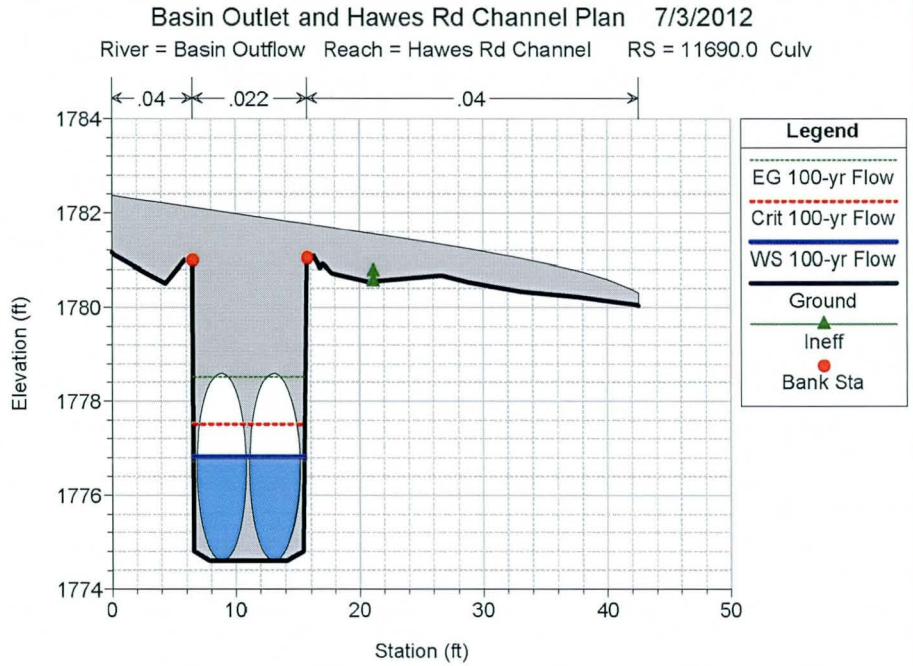

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 11807.0
.04
.025
.04
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

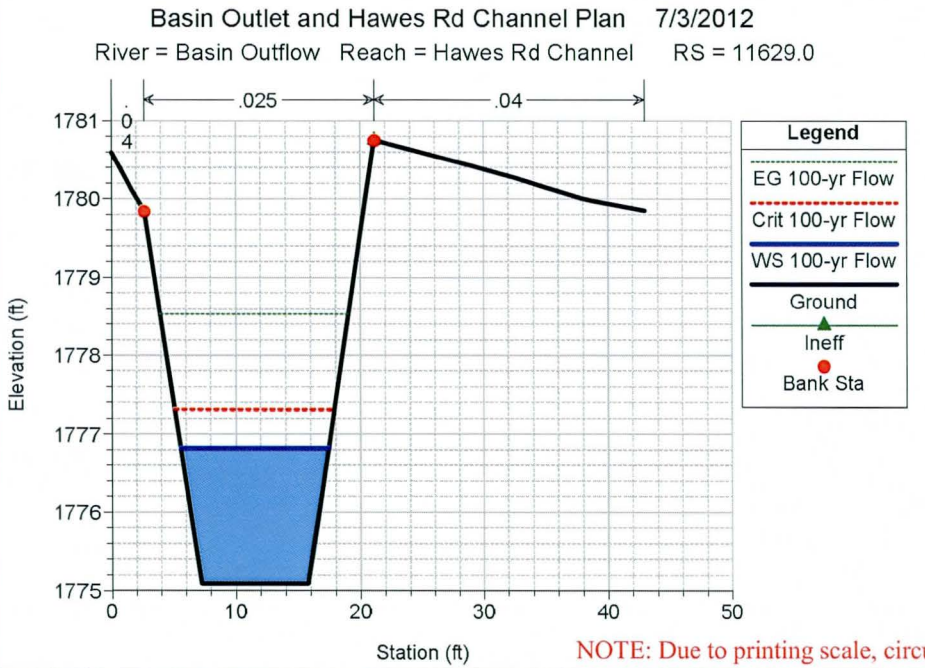

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 11771.0
.025
.04
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

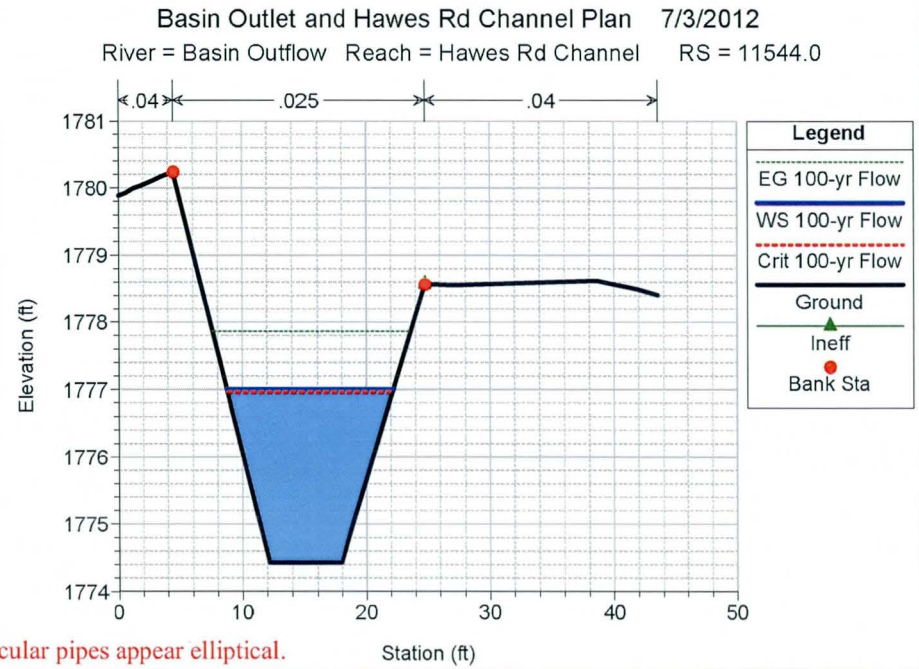

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 11765.0
.025
.04
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 11750.0
.025
.04
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

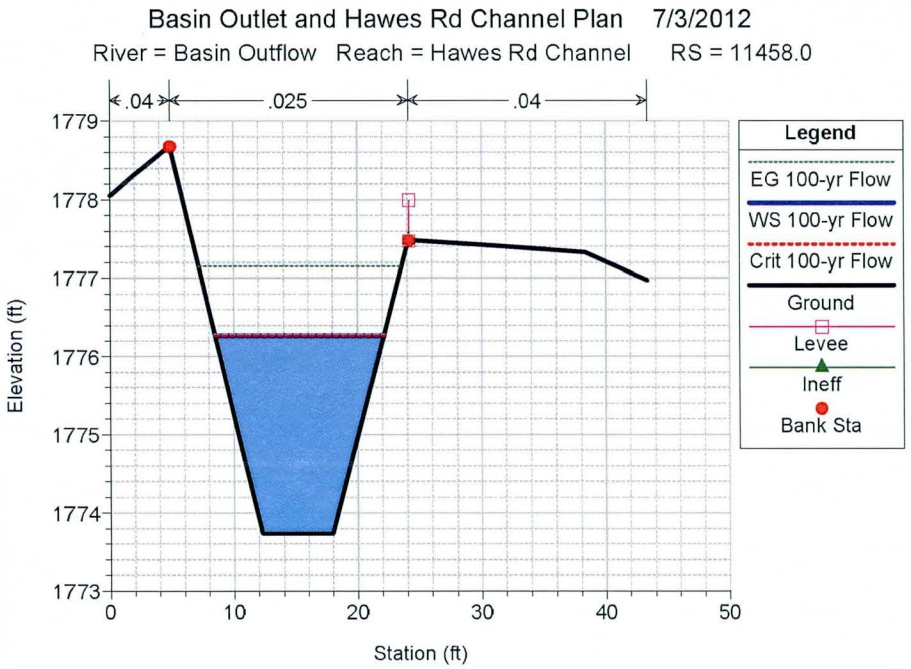


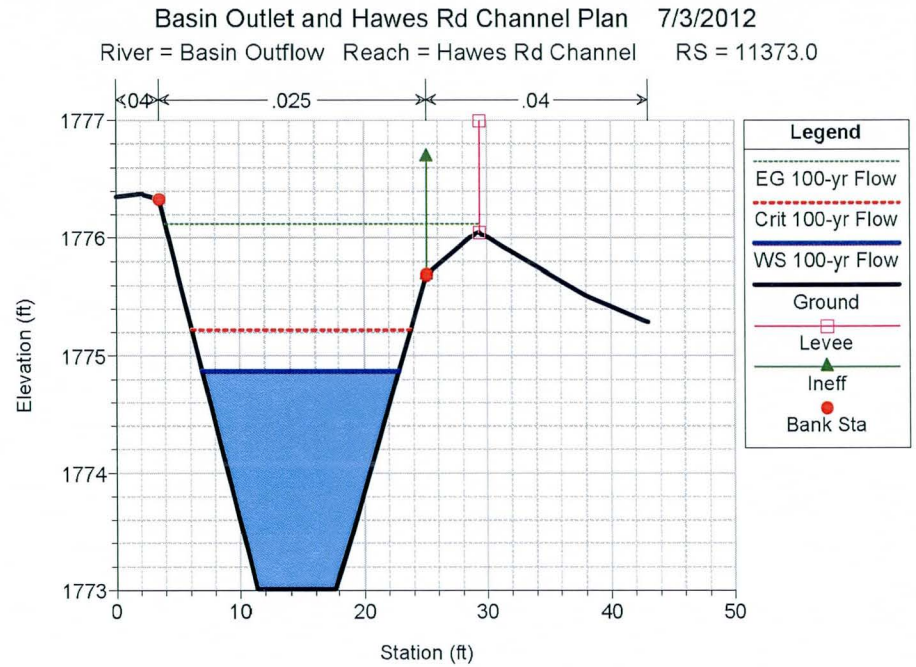


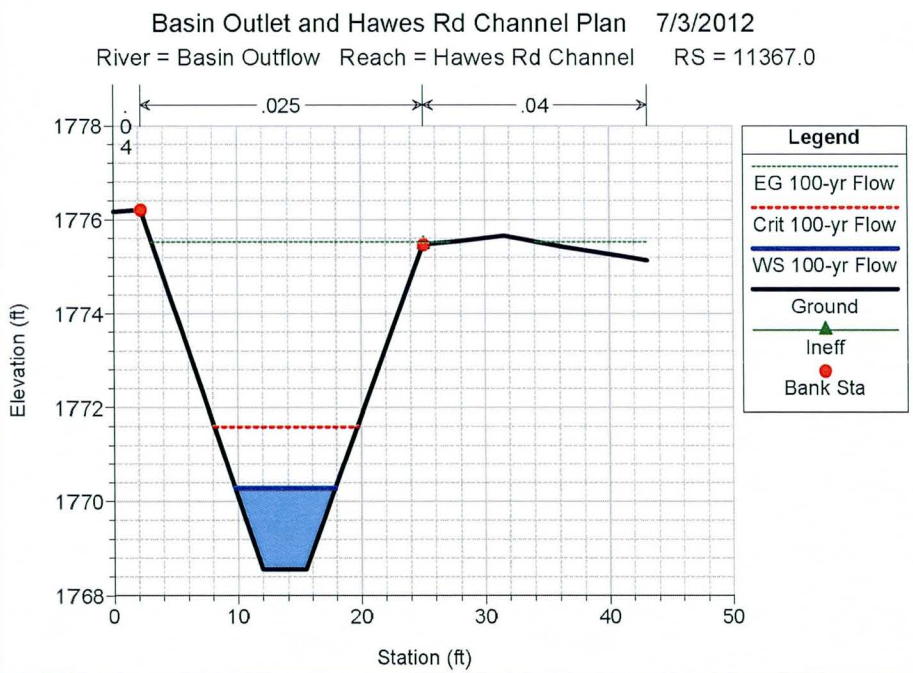


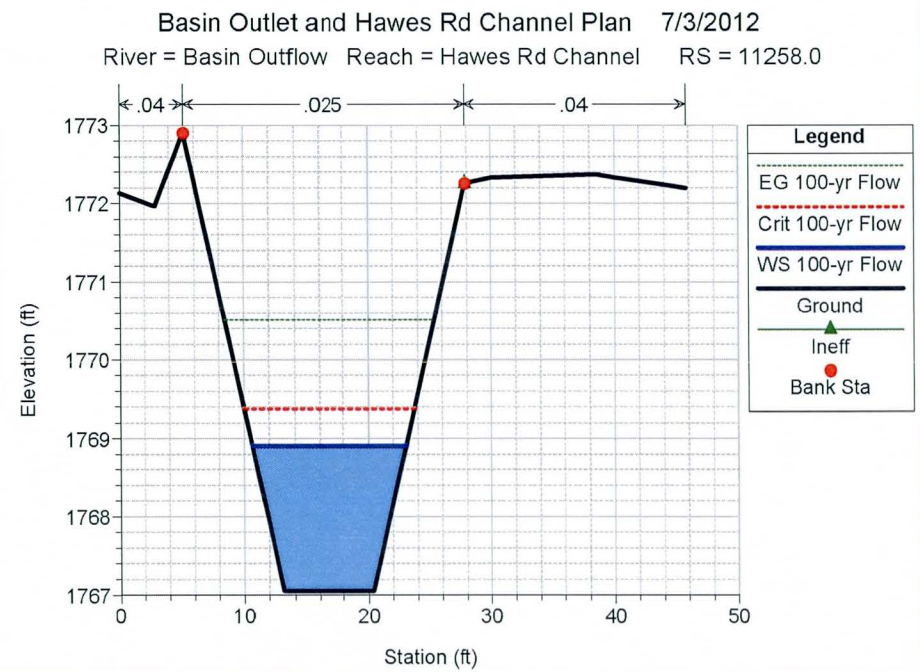


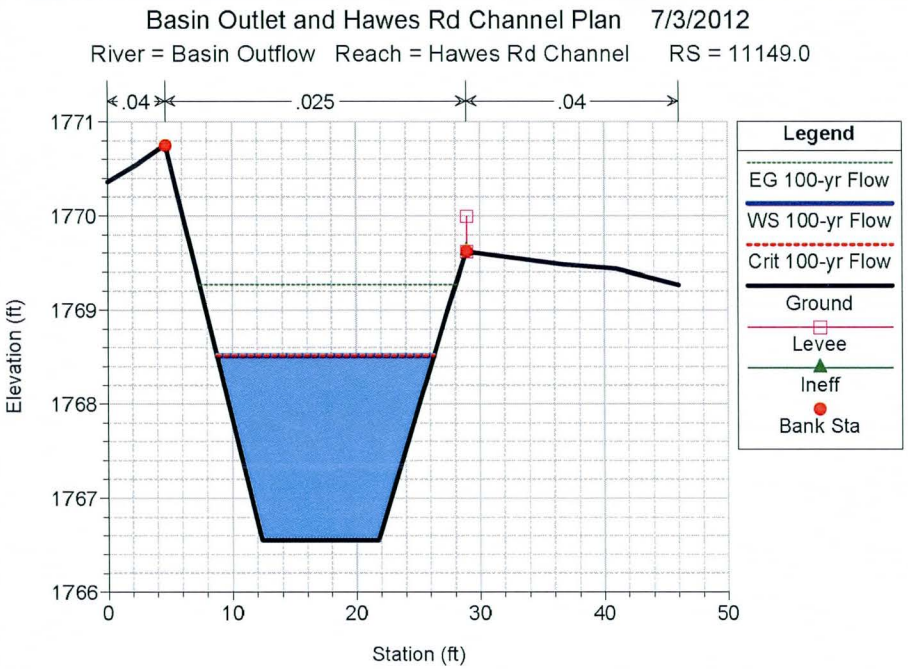
NOTE: Due to printing scale, circular pipes appear elliptical.

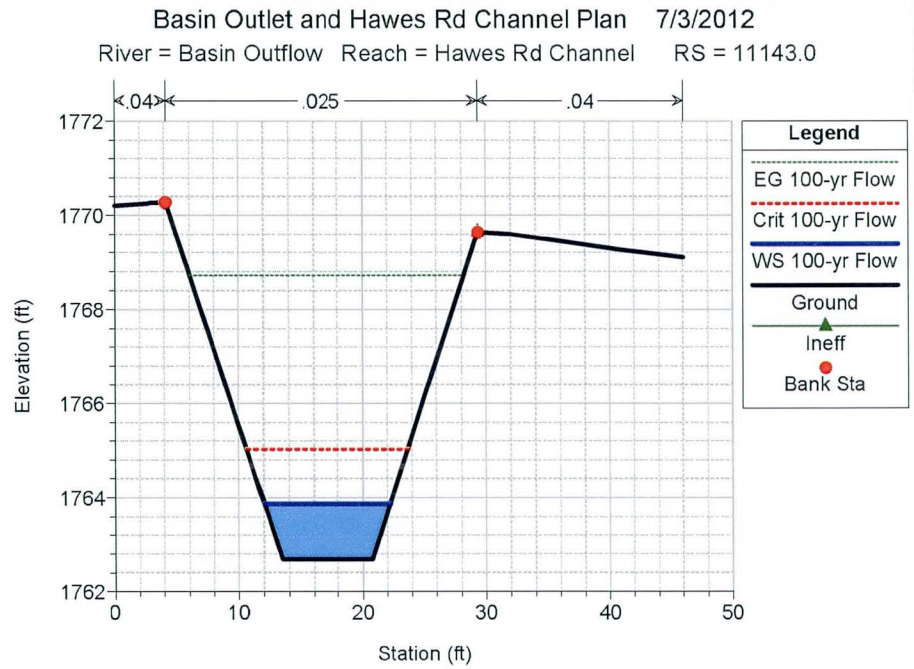

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 11458.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Levee
Ineff
Bank Sta

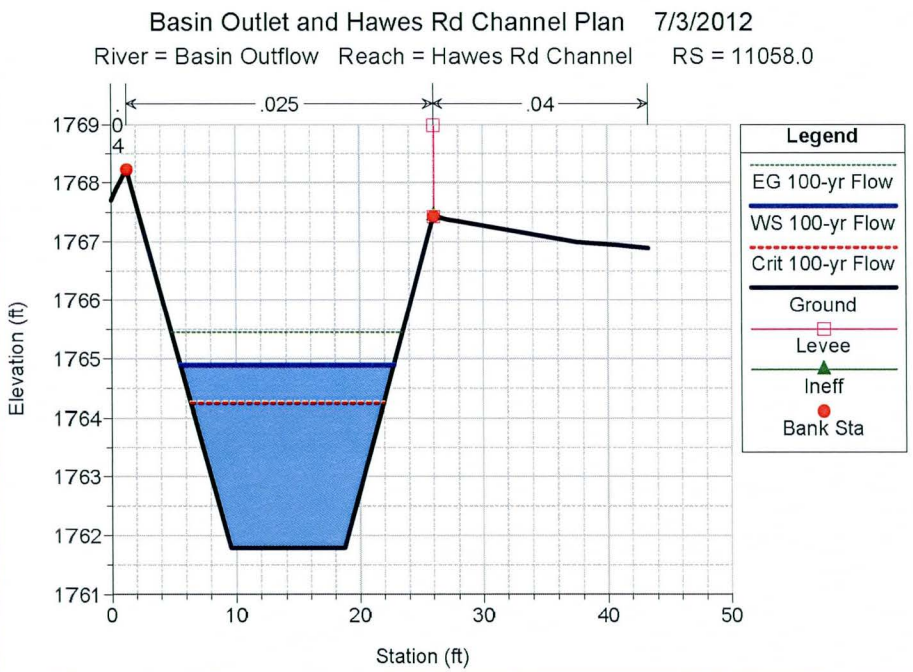

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 11373.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Levee
Ineff
Bank Sta

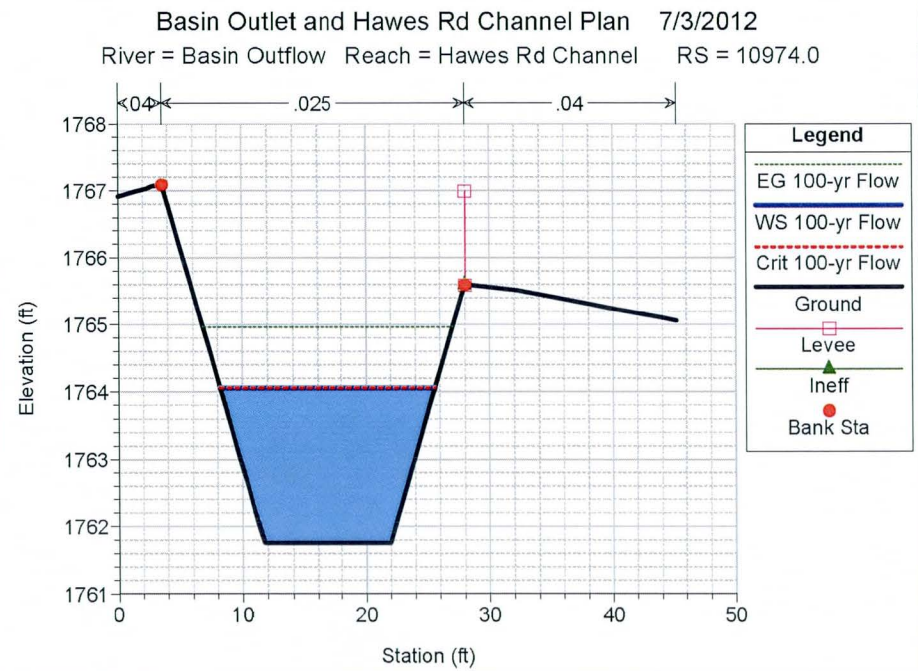

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 11367.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta

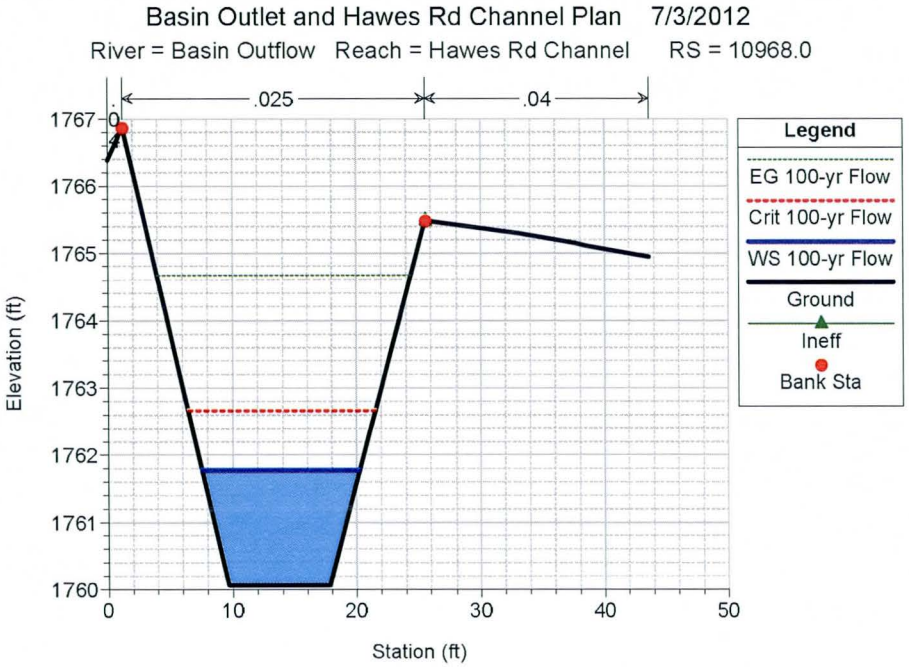

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 11258.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta

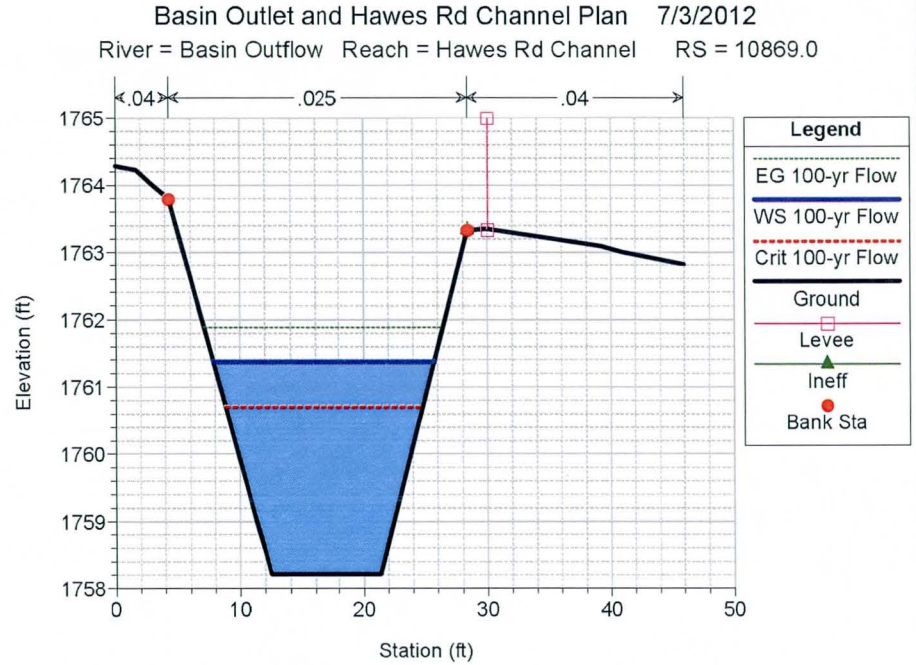

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 11149.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Levee
Ineff
Bank Sta

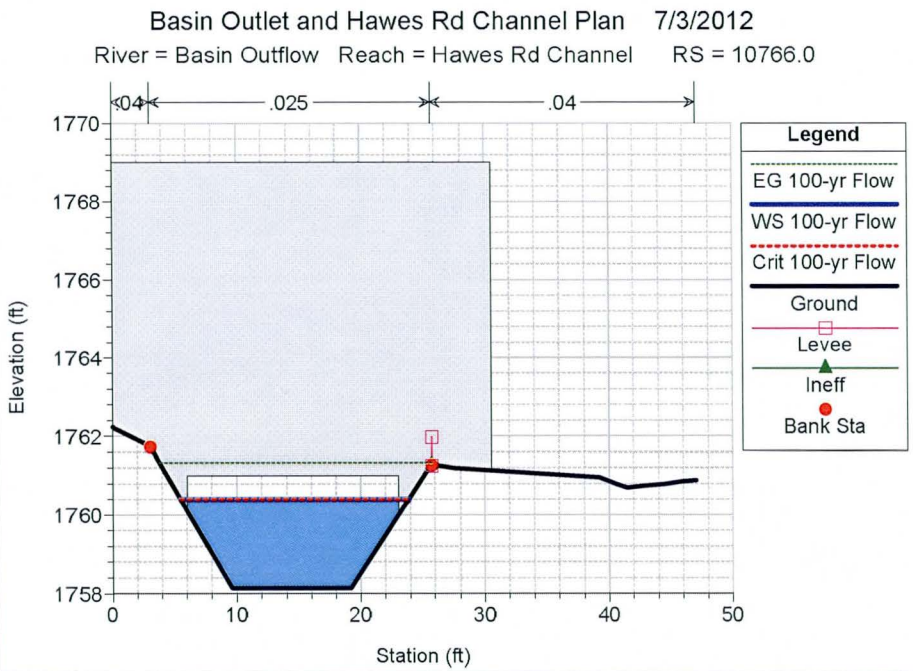

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 11143.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta

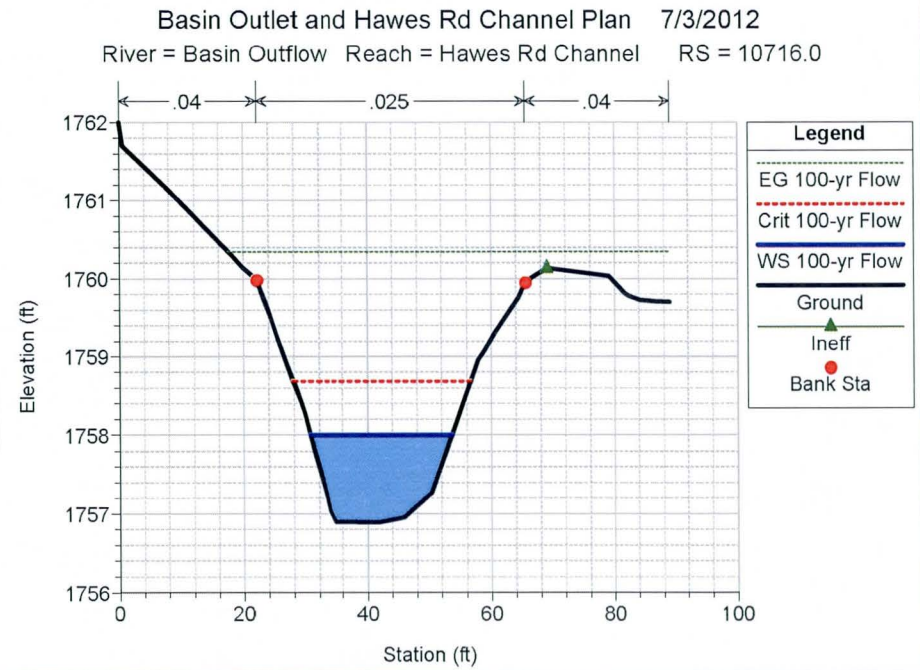

Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 11058.0
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Levee
Ineff
Bank Sta


Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 10974.0
.04
.025
.04
Elevation (ft)
Station (ft)
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Levee
Ineff
Bank Sta


Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 10968.0
.025
.04
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 10869.0
.04
.025
.04
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 10766.0
.04
.025
.04
Legend
EG 100-yr Flow
WS 100-yr Flow
Crit 100-yr Flow
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Basin Outlet and Hawes Rd Channel Plan 7/3/2012
River = Basin Outflow Reach = Hawes Rd Channel RS = 10716.0
.04
.025
.04
Legend
EG 100-yr Flow
Crit 100-yr Flow
WS 100-yr Flow
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

Hawes Road Station	HEC-RAS Cross-Section	Froude Number	Water Surface Elevation	Depth	Velocity	Minimum Freeboard Required*	Design Freeboard**	Proposed Channel Top Elevation
			(ft)	(ft)	(ft/s)	(ft)	(ft)	(ft)
29+40.00	12951.0	3.32	1798.6	1.0	18.5	1.58	2.0	1800.6
28+58.00	12869.0	0.62	1800.4	2.1	5.2	0.63	1.0	1801.4
27+76.00	12787.0	0.99	1799.5	1.8	7.5	0.67	2.0	1801.5
27+56.00	12766.0	1.31	1798.8	1.5	9.2	0.70	2.0	1800.8
26+80.00	12691.0	1.01	1798.6	1.6	7.3	0.61	2.0	1800.6
25+68.00	12568.0	0.63	1798.0	2.0	5.1	0.60	2.0	1800.0
24+65.00	12475.0	0.99	1797.1	1.6	7.2	0.60	2.0	1799.1
23+11.00	12324.0	1.35	1794.9	1.3	8.9	0.64	2.0	1796.9
23+08.00	12318.0	2.15	1793.2	1.2	13.1	0.95	2.0	1795.2
21+70.00	12181.0	1.01	1792.7	1.5	7.1	0.58	2.0	1794.7
20+31.00	12044.0	1.11	1791.3	1.3	7.2	0.52	2.0	1793.3
20+28.00	12038.0	2.66	1787.9	1.1	15.6	1.21	2.0	1789.9
19+33.00	11944.0	1.12	1787.8	1.5	7.9	0.62	2.0	1789.8
18+35.00	11849.0	1.20	1786.7	1.3	7.7	0.54	2.0	1788.7
18+32.00	11843.0	2.54	1783.3	1.2	15.9	1.28	2.0	1785.3
Thunder Mountain Culvert								
15+34.00	11544.0	0.97	1777.0	1.8	7.4	0.67	2.0	1779.0
14+48.00	11458.0	0.99	1776.3	1.8	7.5	0.67	2.0	1778.3
13+60.00	11373.0	1.39	1774.9	1.3	9.0	0.64	2.0	1776.9
13+57.00	11367.0	2.91	1770.3	1.2	18.4	1.61	2.0	1772.3
11+36.00	11149.0	1.00	1768.5	1.5	7.0	0.57	2.0	1770.5
11+33.00	11143.0	3.09	1763.9	1.0	17.7	1.47	2.0	1765.9
9+61.00	10974.0	1.00	1764.1	1.8	7.6	0.68	2.0	1766.1
9+61.00	10968.0	2.03	1761.8	1.4	13.7	1.09	2.0	1763.8
8+58.00	10869.0	0.66	1761.4	2.4	5.8	0.73	2.0	1763.4
7+51.00	10766.0	0.90	1760.4	1.9	7.7	0.70	2.0	1762.4

Refer to Table B4.1 for Channel *Froude Number*, *Water Surface Elevation*, *Depth* and *Velocity*

* Minimum Freeboard Required: *Per Equation 6.25 - FCDMC Hydraulics Manual*

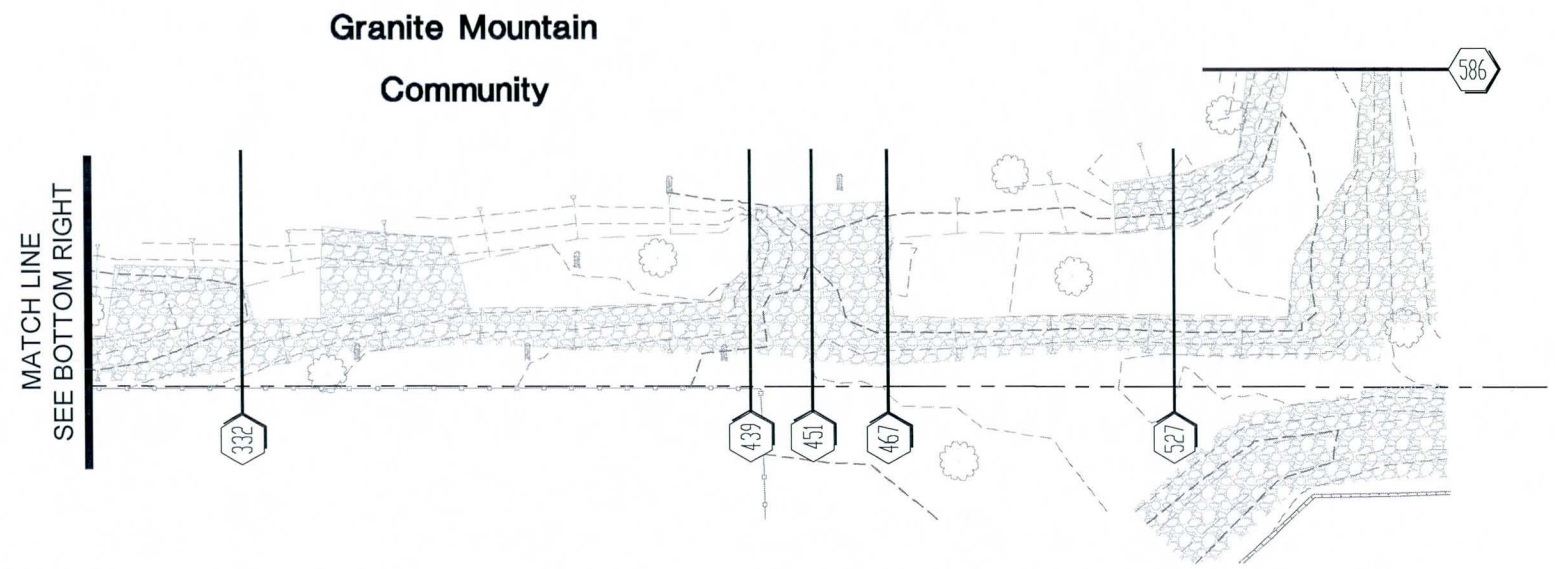
** Design Freeboard: *Per Section 6.5.4 - FCDMC Hydraulics Manual, 2' Minimum Freeboard for supercritical flow and 1' for subcritical flow*

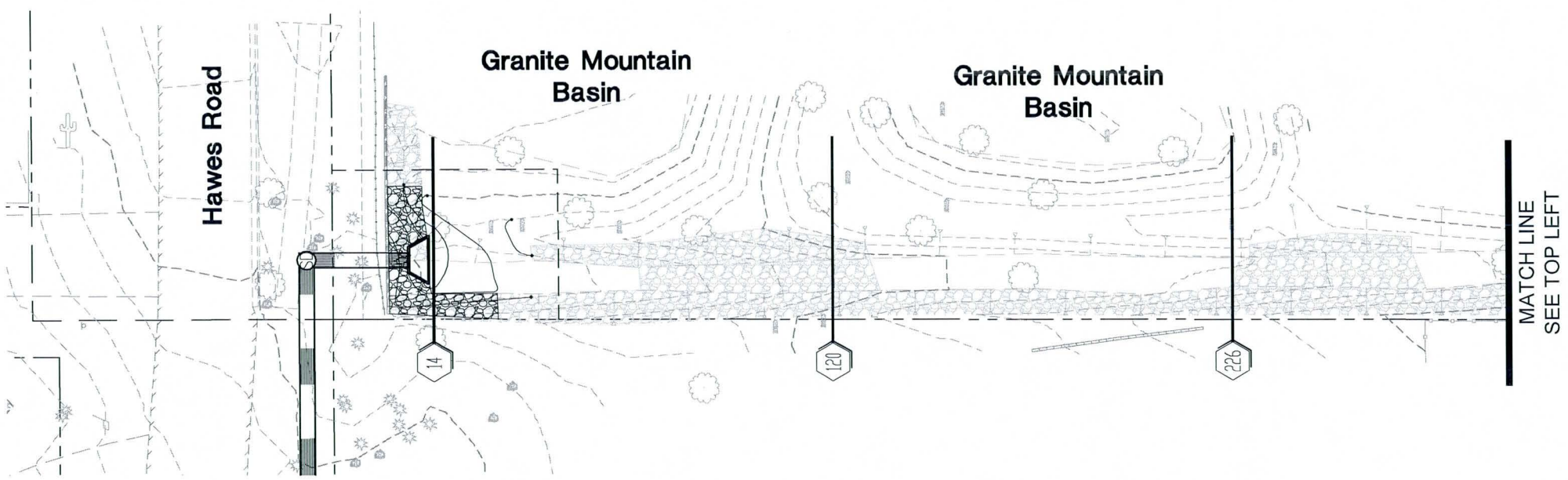
Table B4.3: Hawes Road Channel Freeboard Requirements

Sub-Section B5: **Granite Mountain Channel Analysis**

LEGEND

- HEC-RAS Cross-Section Location
- (435) HEC-RAS Cross-Section Identifier
- HEC-RAS Alignment





GRAPHIC SCALE

20 0 20 40

SCALE: 1"=40 FT.

Gavan & Barker Inc.

Gavan & Barker, Inc.
3030 N. Central Ave.
Suite 1530
Phoenix, Arizona 85012
Phone: 602-200-0031
Fax: 602-200-0032

Civil Engineering
Landscape Architecture

Project:

Oak Street Basin and Storm Drain Design

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD - 2009C021

Submittal:

G&B No.	0912
Issue Date:	04/11
Drawn By:	OK
Checked By:	MTG

Sheet Title:

Exhibit B5.1: Granite Mountain - HEC RAS Location Map

Page Number:

HEC-RAS Plan: GMC River: Granite Mountain Reach: Granite Mountain Profile: GMC

Reach	River Sta	Profile	Q Total	Q Channel	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	Flow Area	Flow Area Ch	Vel Total	Vel Chnl	Top Width	Top W Chnl	Hydr Depth	Hydr Depth C	Froude # Chl
			(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(sq ft)	(sq ft)	(ft/s)	(ft/s)	(ft)	(ft)	(ft)	(ft)	
Granite Mountain	586	GMC	121	121	1845.60	1847.0	1847.0	1847.5	22.2	22.2	5.4	5.4	24.7	24.7	0.9	0.9	1.01
Granite Mountain	527	GMC	121	121	1843.56	1846.6	1844.8	1846.6	73.4	73.4	1.6	1.6	32.8	32.8	2.2	2.2	0.19
Granite Mountain	467	GMC	121	119	1843.85	1846.5	1845.1	1846.6	67.8	64.8	1.8	1.8	38.7	33.2	1.7	2.0	0.23
Granite Mountain	453		Inl Struct														
Granite Mountain	439	GMC	121	121	1842.11	1843.7	1843.6	1844.1	23.1	23.1	5.2	5.2	20.8	20.8	1.1	1.1	0.88
Granite Mountain	332	GMC	121	121	1839.91	1841.4	1841.4	1841.9	21.4	21.4	5.7	5.7	21.9	21.9	1.0	1.0	1.01
Granite Mountain	226	GMC	121	121	1835.89	1837.4	1837.7	1838.4	15.4	15.4	7.9	7.9	14.9	14.9	1.0	1.0	1.36
Granite Mountain	120	GMC	121	121	1833.96	1835.5	1835.5	1836.0	20.5	20.5	5.9	5.9	19.3	19.3	1.1	1.1	1.01
Granite Mountain	14	GMC	121	117	1830.20	1831.4	1831.7	1832.3	16.0	14.5	7.6	8.0	20.7	15.5	0.8	0.9	1.46

Table B5.1: Granite Mountain Channel - HEC RAS Cross Section Summary

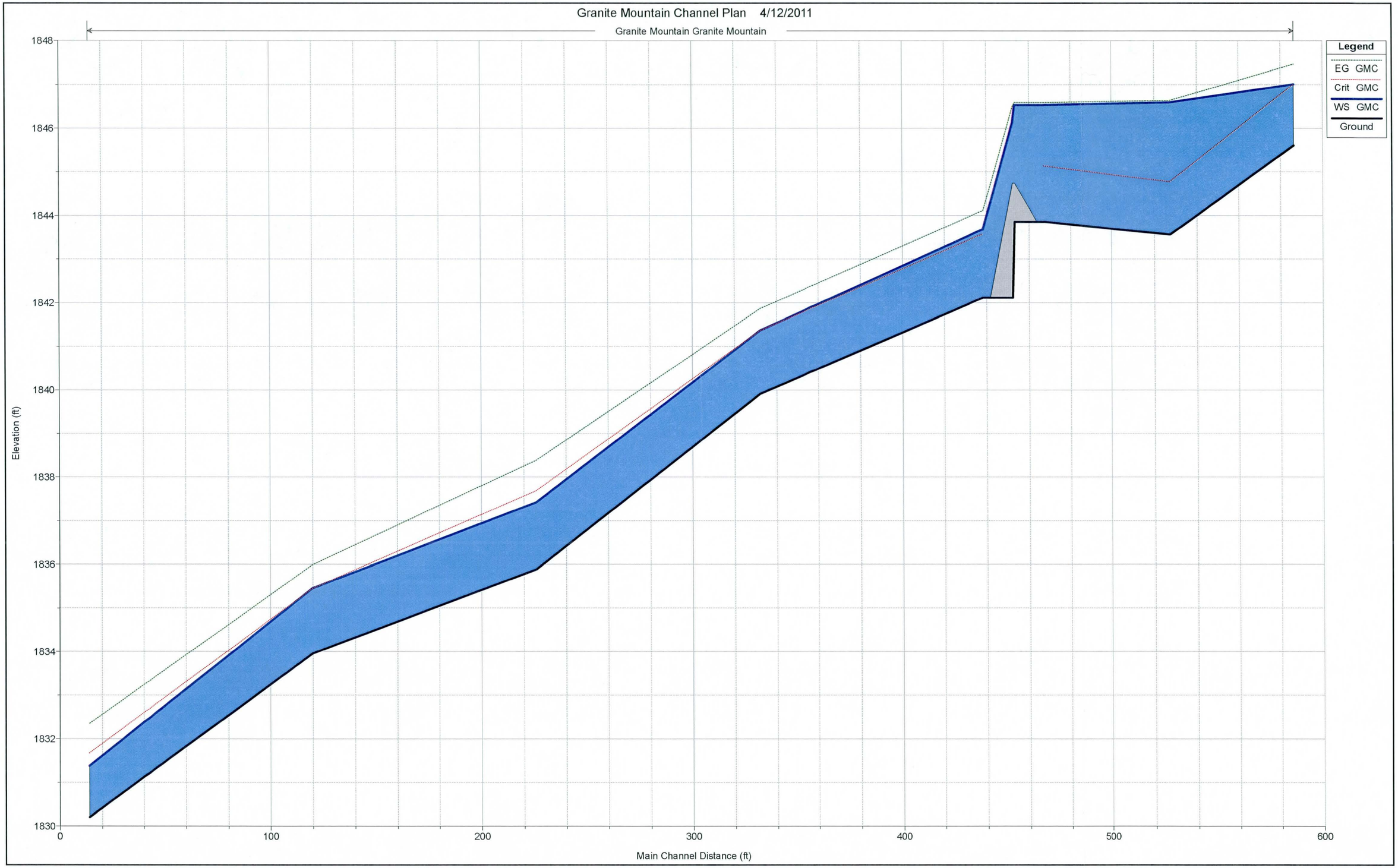


Figure B5.1: Granite Mountain Channel - HEC RAS Profile

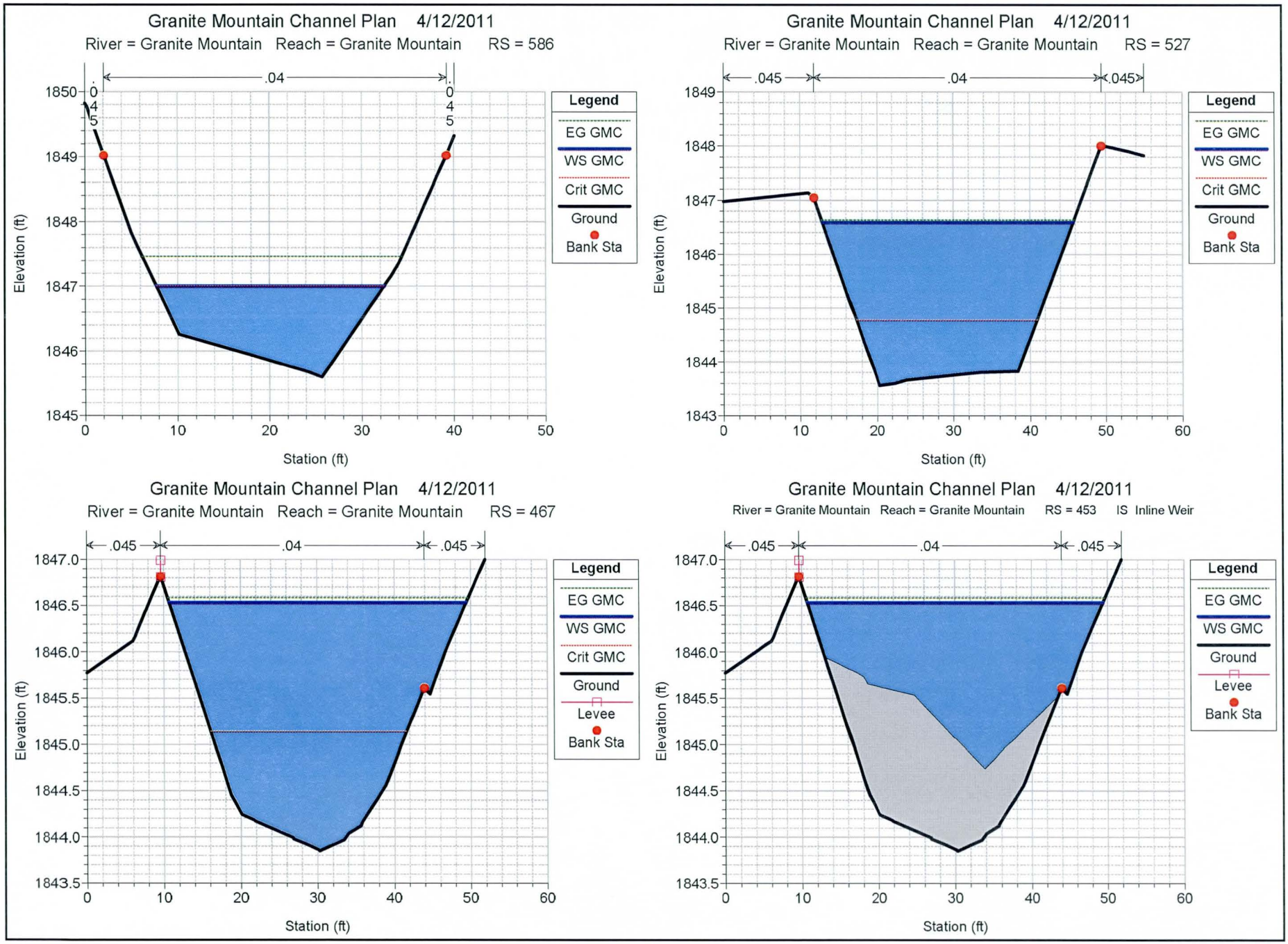
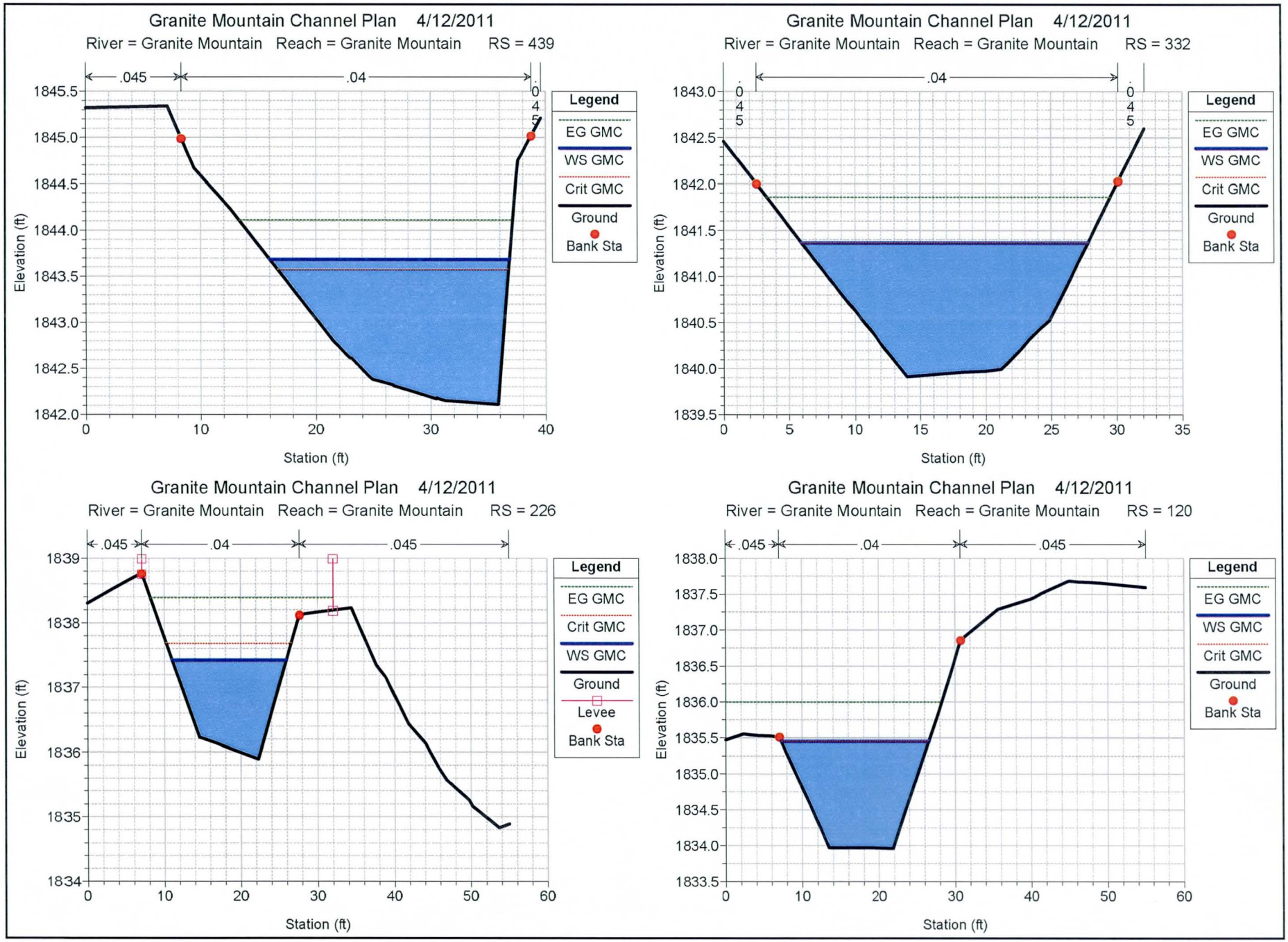
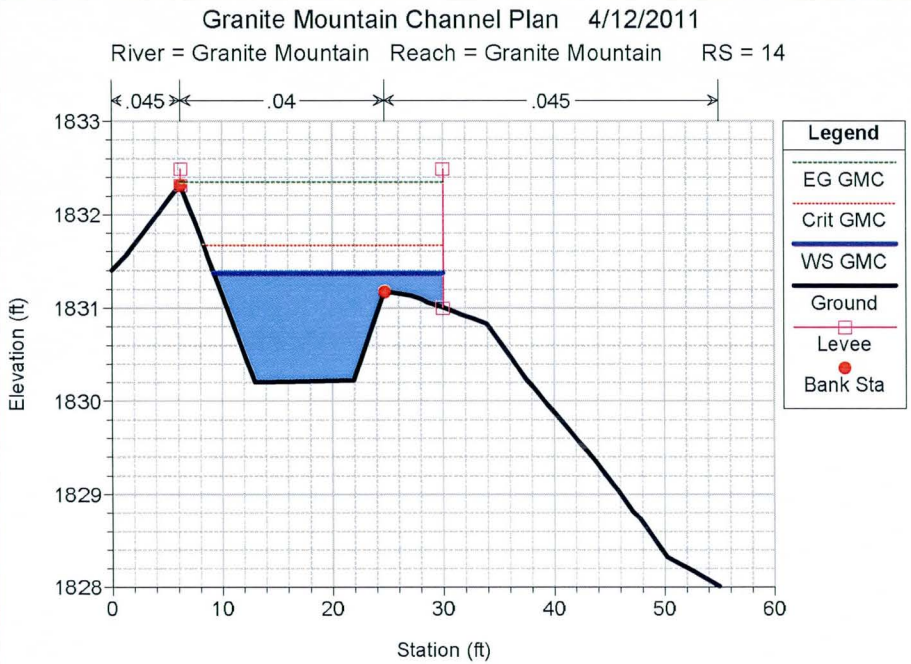


Figure B5.2: Granite Mountain Channel - HEC RAS Cross Sections


Granite Mountain Channel Plan 4/12/2011
River = Granite Mountain Reach = Granite Mountain RS = 439
.045
.04
.045
Elevation (ft)
Station (ft)
Legend
EG GMC
WS GMC
Crit GMC
Ground
Bank Sta
Granite Mountain Channel Plan 4/12/2011
River = Granite Mountain Reach = Granite Mountain RS = 332
.045
.04
.045
Elevation (ft)
Station (ft)
Legend
EG GMC
WS GMC
Crit GMC
Ground
Bank Sta
Granite Mountain Channel Plan 4/12/2011
River = Granite Mountain Reach = Granite Mountain RS = 226
.045
.04
.045
Elevation (ft)
Station (ft)
Legend
EG GMC
Crit GMC
WS GMC
Ground
Levee
Bank Sta
Granite Mountain Channel Plan 4/12/2011
River = Granite Mountain Reach = Granite Mountain RS = 120
.045
.04
.045
Elevation (ft)
Station (ft)
Legend
EG GMC
WS GMC
Crit GMC
Ground
Bank Sta


Granite Mountain Channel Plan 4/12/2011
River = Granite Mountain Reach = Granite Mountain RS = 14
.045
.04
.045
1833
1832
1831
1830
1829
1828
Elevation (ft)
0
10
20
30
40
50
60
Station (ft)
Legend
EG GMC
Crit GMC
WS GMC
Ground
Levee
Bank Sta

Sub-Section B6: **Oak Street Basin Secondary (Spillway) Outfall Analysis**

Weir Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. Monday, Jul 2 2012

Oak Street Basin Secondary (Spillway) Outfall Sizing

Rectangular Weir

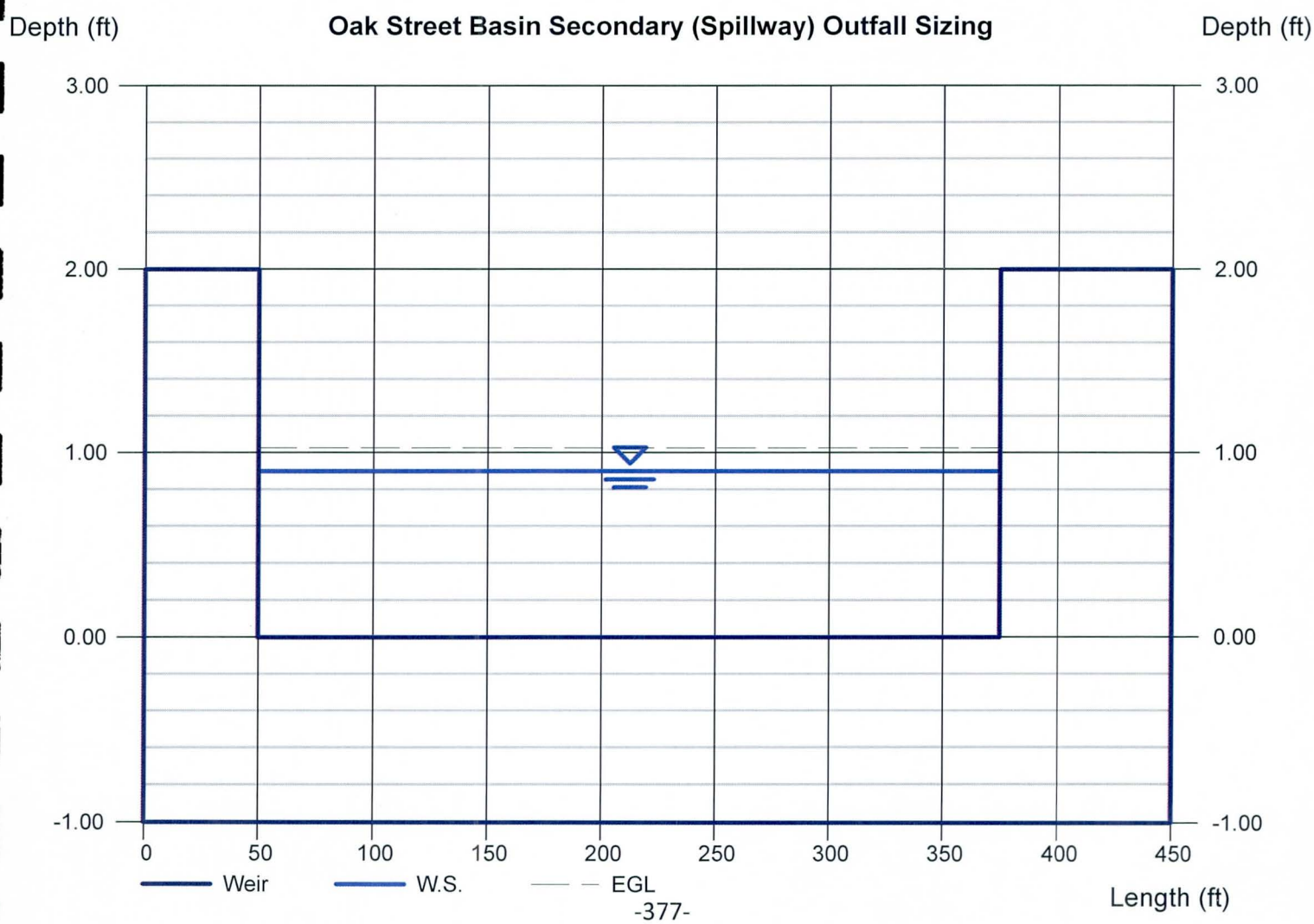
Crest	= Sharp
Bottom Length (ft)	= 325.00
Total Depth (ft)	= 2.00

Calculations

Weir Coeff. Cw	= 3.00
Compute by:	Known Q
Known Q (cfs)	= 830.00

Highlighted

Depth (ft)	= 0.90
Q (cfs)	= 830.00
Area (sqft)	= 291.91
Velocity (ft/s)	= 2.84
Top Width (ft)	= 325.00



Oak Street Basin Secondary (Spillway) Outfall - Critical Velocity Calculation

Find Critical Depth over Secondary (Spillway) Outlet:

$$y_c = \left(\frac{q^2}{g}\right)^{\frac{1}{3}} \quad \text{(Equation 5.2.14 - Water Resources Engineering, Mays, L.W. (2010))}$$

where;

$y_c = Critical\ depth\ of\ flow\ over\ spillway$

$q = Flow\ rate\ per\ unit\ width = \frac{Q}{T}$

$Q = 100 - year\ unattenuated\ Oak\ Street\ Basin\ peak\ inflow\ discharge = 830\ cfs$

(See 'Exhibit A4.2: Flow Summary Map' for the Oak Street Basin peak inflow)

$T = Top\ width\ of\ proposed\ secondary\ (spillway)\ outfall = 325\ ft$

(See 'Figure B6.1: Oak Street Basin Secondary (Spillway) Outfall Weir Calculation' for top width)

$$q = \frac{Q}{T} = \frac{830}{325} = 2.55\ \frac{cfs}{ft}$$

$$g = Gravity = 32.2\ \frac{ft}{s^2}$$

$$y_c = \left(\frac{q^2}{g}\right)^{\frac{1}{3}} = \left(\frac{2.55^2}{32.2}\right)^{\frac{1}{3}}$$

$$y_c = 0.59\ ft$$

Find Critical Velocity over Secondary (Spillway) Outlet:

$$v_c = \frac{q}{y_c}$$

where;

$v_c = Critical\ velocity\ over\ the\ spillway$

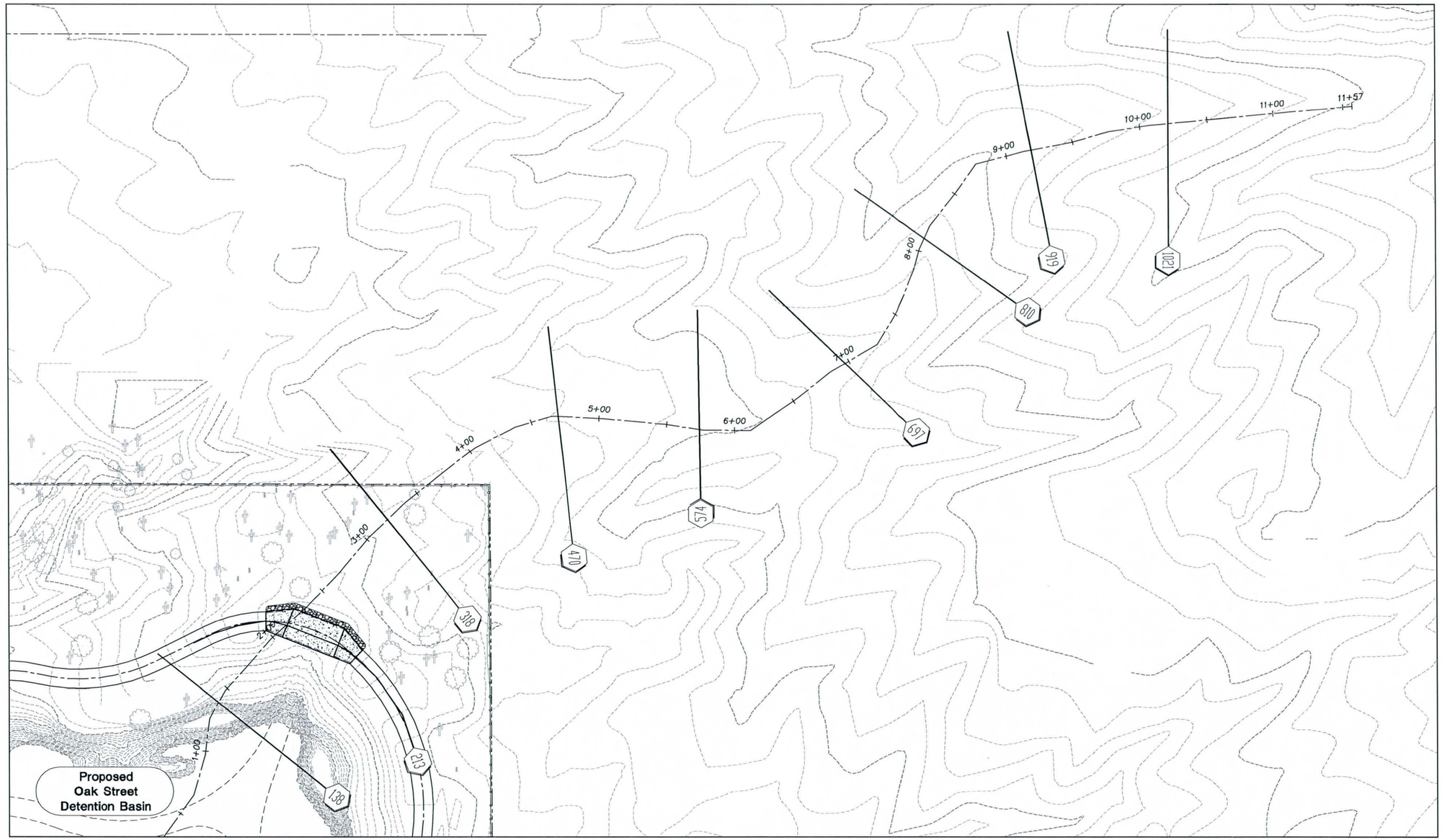
$$v_c = \frac{q}{y_c} = \frac{2.55}{0.59}$$

$$v_c = 4.32\ \frac{ft}{s}$$

$$\boxed{v_c = \mathbf{4.3}\ \frac{ft}{s}}$$

The velocity over the Oak Street Basin secondary (spillway) outfall is 4.3 ft/s

Sub-Section B7: **Oak Street Basin Inflow Analysis**



LEGEND

- HEC-RAS Cross-Section Location
- (435) HEC-RAS Cross-Section Identifier
- HEC-RAS Alignment

N

GRAPHIC SCALE

40 0 40 80

SCALE: 1"=80 FT.

Gavan & Barker Inc.

Gavan & Barker, Inc.
3030 N. Central Ave.
Suite 1530
Phoenix, Arizona 85012
Phone: 602-200-0031
Fax: 602-200-0032

Civil Engineering
Landscape Architecture

Project :

Oak Street Basin and Storm Drain Design

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD - 2009C021

Submittal :

G&B No.	0912
Issue Date:	04/11
Drawn By:	OK
Checked By:	MTG

Sheet Title :

Exhibit B7.1: Oak Street Basin Inflow - HEC RAS Location Map

Page Number:

HEC-RAS Plan: Inflow River: Oak Street Basin Reach: Inflow Profile: 100-Year

Reach	River Sta	Profile	Q Total	Q Channel	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Flow Area Ch	Vel Chnl	Top W Chnl	Hydr Depth C	Hydr Radius C	Froude # Chl
			(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(sq ft)	(ft/s)	(ft)	(ft)	(ft)	
Inflow	1020.91	100-Year	94	94	1854.45	1855.49	1855.7	1856.2	0.075149	14.3	6.6	27.6	0.5	0.52	1.61
Inflow	918.83	100-Year	94	94	1851.11	1852.17	1852.2	1852.5	0.029174	21.6	4.4	37.8	0.6	0.57	1.02
Inflow	810.02	100-Year	94	94	1847.41	1848.34	1848.4	1848.7	0.040816	18.9	5.0	34.9	0.5	0.54	1.19
Inflow	696.88	100-Year	94	94	1843.27	1844.35	1844.4	1844.7	0.031338	20.4	4.6	34.6	0.6	0.59	1.06
Inflow	574.31	100-Year	94	94	1838.79	1839.67	1839.7	1840.0	0.048229	21.7	4.3	56.4	0.4	0.39	1.23
Inflow	470.48	100-Year	94	94	1835.45	1836.28	1836.3	1836.5	0.030846	25.8	3.6	61.9	0.4	0.42	0.99
Inflow	317.94	100-Year	94	94	1830.35	1831.04	1831.1	1831.3	0.038118	24.5	3.8	63.3	0.4	0.39	1.09
Inflow	213.28	100-Year	94	94	1827.00	1827.57	1827.6	1827.8	0.029817	23.3	4.0	46.4	0.5	0.50	1.01
Inflow	137.6	100-Year	94	94	1800.00	1806.00	1800.5	1806.0	0.000008	316.5	0.3	58.5	5.4	4.97	0.02

Table B7.1: Oak Street Basin Inflow - HEC RAS Cross Section Summary

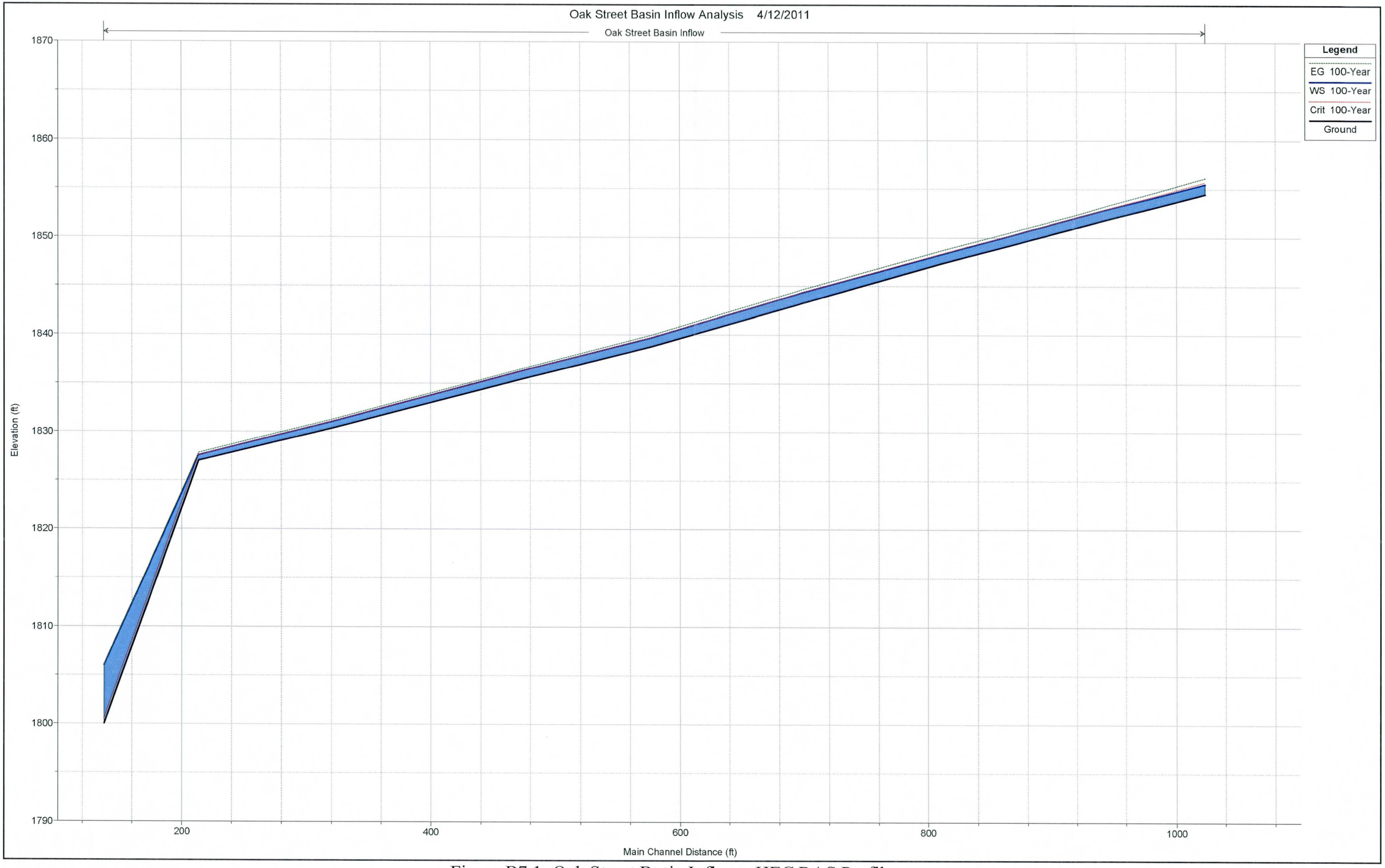


Figure B7.1: Oak Street Basin Inflow - HEC RAS Profile

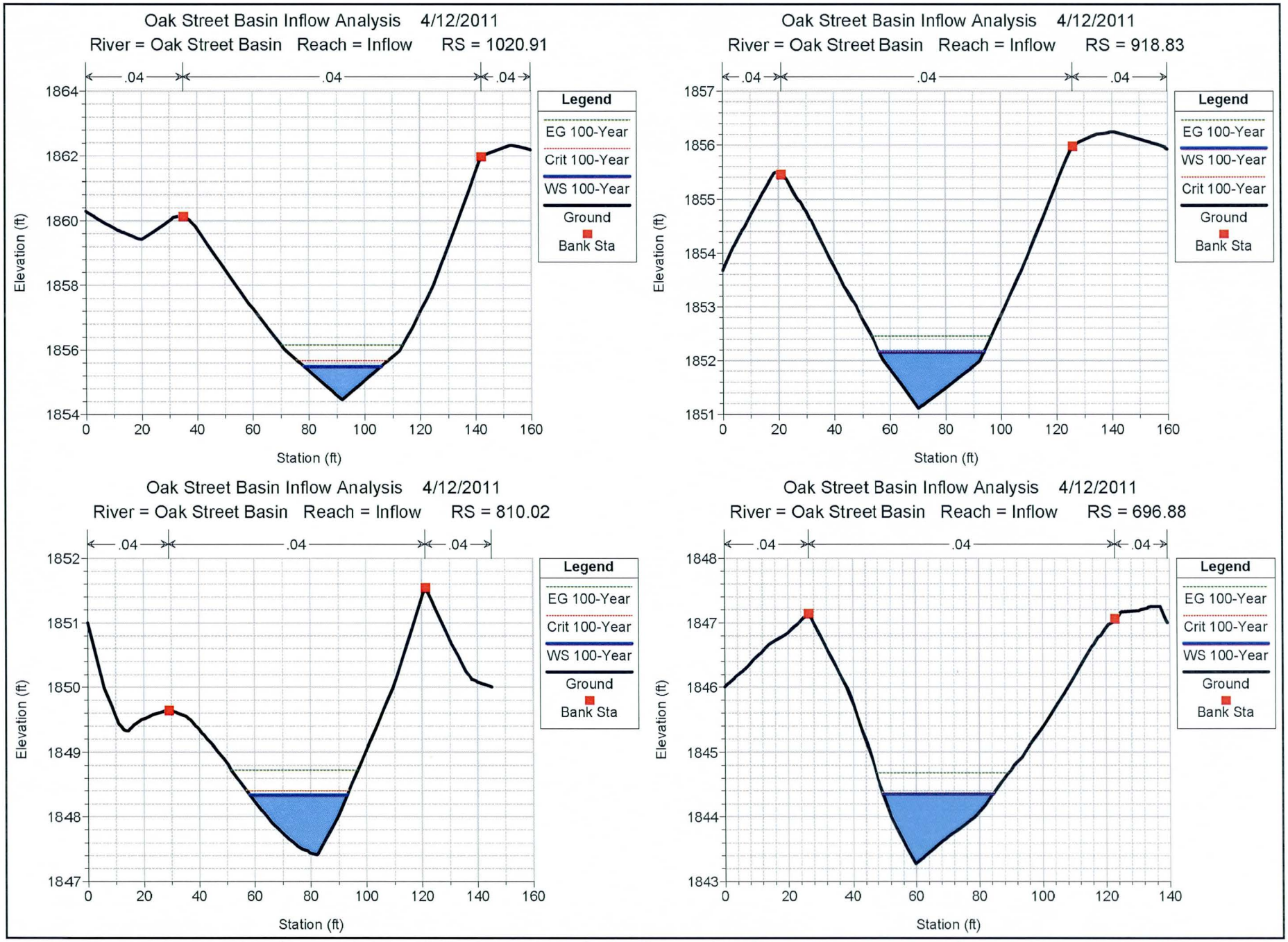
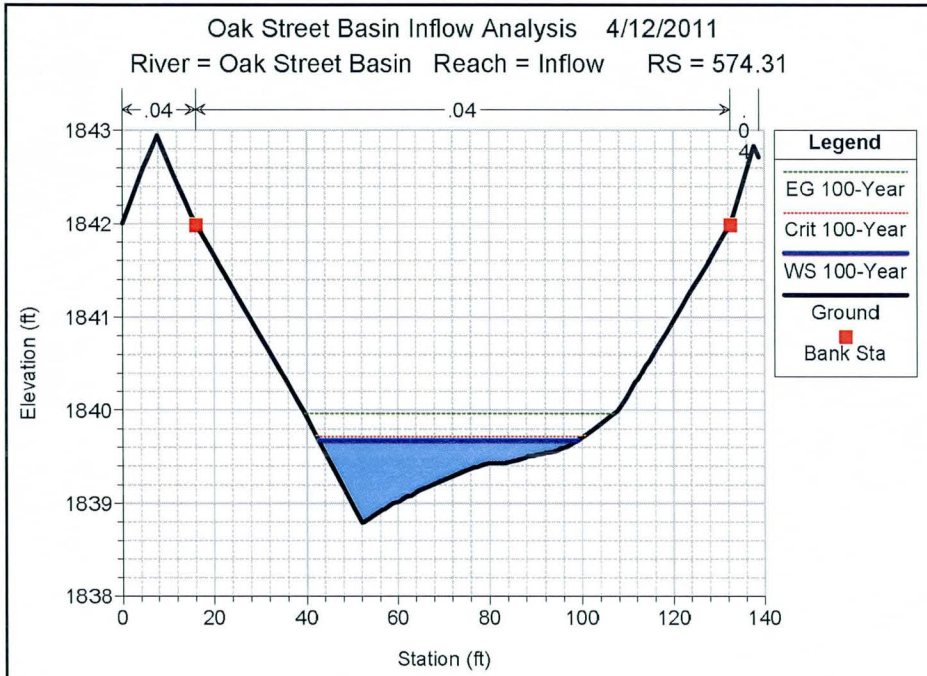
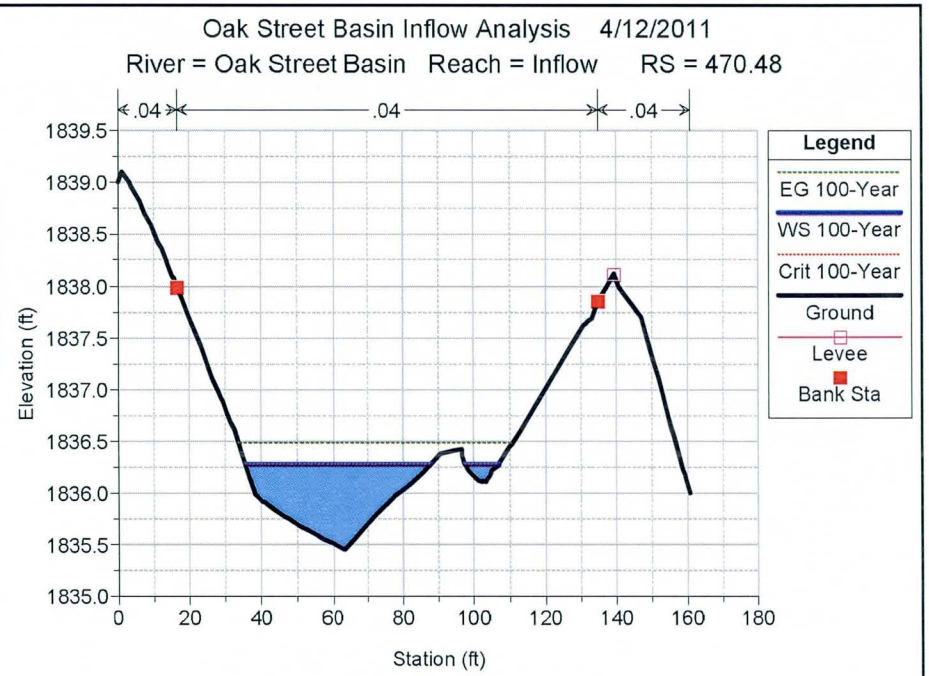
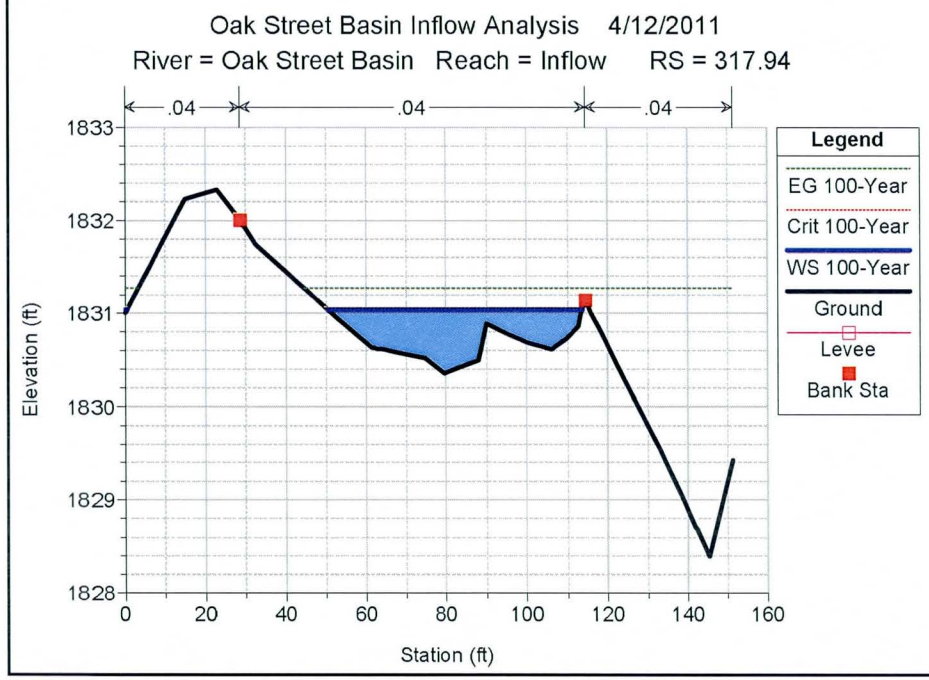
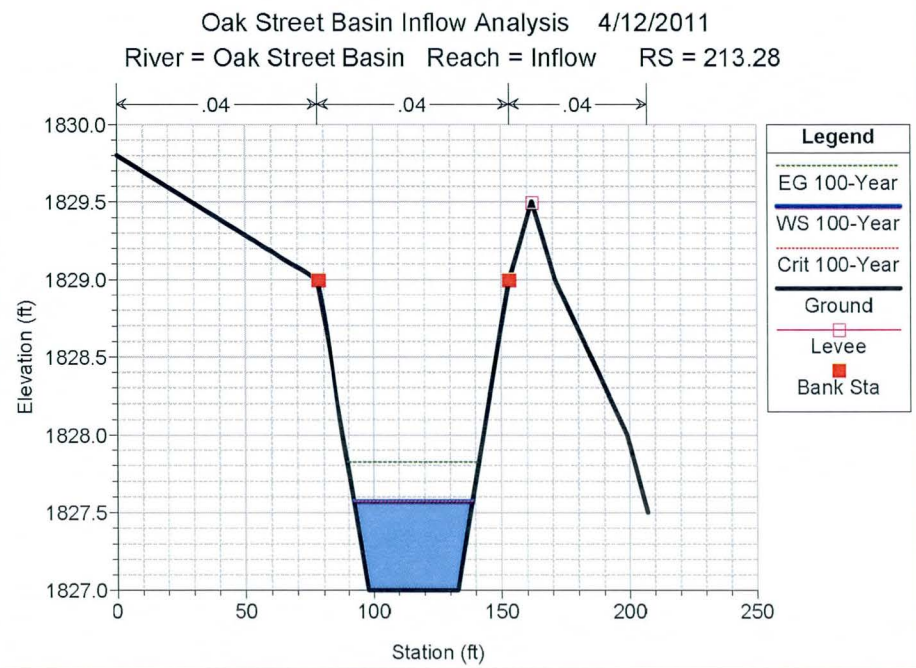


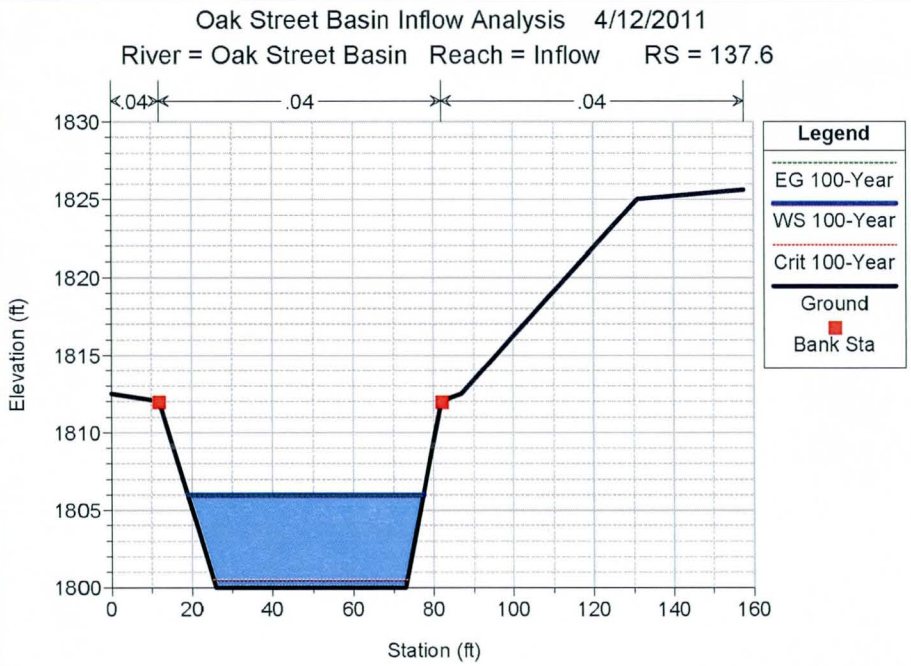
Figure B7.2: Oak Street Basin Inflow - HEC RAS Cross Sections


Oak Street Basin Inflow Analysis 4/12/2011
River = Oak Street Basin Reach = Inflow RS = 574.31
.04
.04
.04
Legend
EG 100-Year
Crit 100-Year
WS 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Oak Street Basin Inflow Analysis 4/12/2011
River = Oak Street Basin Reach = Inflow RS = 470.48
.04
.04
.04
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)


Oak Street Basin Inflow Analysis 4/12/2011
River = Oak Street Basin Reach = Inflow RS = 317.94
.04
.04
.04
Legend
EG 100-Year
Crit 100-Year
WS 100-Year
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)


Oak Street Basin Inflow Analysis 4/12/2011
River = Oak Street Basin Reach = Inflow RS = 213.28
.04
.04
.04
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)


Oak Street Basin Inflow Analysis 4/12/2011
River = Oak Street Basin Reach = Inflow RS = 137.6
.04
.04
.04
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Bank Sta
Elevation (ft)
1830
1825
1820
1815
1810
1805
1800
0
20
40
60
80
100
120
140
160
Station (ft)

DIGITAL DATA